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ANTENNAS, ROTATABLE LOG - PERIODIC RACAL TYPES LPH SERIES

GENERAL AND TECHNICAL INFORMATION

BY COMMAND OF THE DEFENCE COUNCIL

Ministry of Defence

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Each leaf bears the date of issue and, except for the initial issue, the amendment number with which it was issued. New or amended material will be indicated by black triangles positioned in the text in this manner ▶-----◀ to show the extent of the amended text. When a chapter is reissued in a completely revised form the triangles will not appear.

Chapter 1

INTRODUCTION AND DATA SUMMARY

Completely Revised

CONTENTS

INTRODUCTION (fig. 2)

1 The LPH series of antennas are rotatable, horizontally polarized directional log periodic types which are used for transmitting and receiving. Three types are explained in this publication, namely the LPH73, LPH72 and LPH72 (modified) Gibraltar. They have slightly different characteristics, as detailed in Table 1.

2 The orientation of the antenna is controlled in one of three ways, as detailed below.

2.1 One method of control employs a three position CW/OFF/CCW switch giving continuous directional control (LPH73, fig. 4 and LPH72, figs 4&8).

2.2 An alternative method has a twelve position switch which causes the antenna to rotate in 30 degree steps to positions which correspond to the setting of the switch (LPH73, fig. 5).

2.3 A version of the above exists which has a twelve position switch in the remote control unit, but a three position CW/OFF/CCW switch in the local control at the antenna (LPH73, fig. 6).

2.4 The third method, known as computer controlled, uses a different remote control unit, which places the antenna and its associated transmitter (or receiver) under the control of a pre-programmed computer. At selected times the transmitter is shut down, the antenna is rotated to a different bearing and the transmitter power is then restored. The bearings can be preselected in one degree intervals (fig. 7 and 9).

3 The general construction consists of twin steel lattice masts with a remote controlled rotator mounted between them at the base. A torque tube mounted on the rotator passes vertically between the twin lattice masts. An aluminium horizontal boom is mounted at the head of the torque tube, arranged along which are twenty antenna elements, varying in length from 3m to 37.8m in the case of the LPH73 antenna and sixteen antenna elements, varying in length from 3m to 23.2m in the case of the LPH72 antenna. Each element is supported by glass fibre insulators mounted on each side of the boom, thus insulating the elements from the boom. The elements are constructed of aluminium tubing and rod, insulated at the centre by a round glass fibre tube.

TABLE 1 ANTENNA PARAMETERS

Parameters	LPH73	LPH72	LPH72 (modified) Gibraltar
Lattice mast height	24.4m	24.4m	7.5m (tower)
Horizontal boom length	36m	20.13m	20.13m
Twin lattice masts weight	1247kg	1247kg	No twin masts
Antenna array weight	1324kg	499kg	499kg
Torque tube weight	1805kg	1028kg	251kg
Rotator weight	545kg	345kg	345kg
Ancillary items weight	635kg	145kg	3.18kg
Total weight	5556kg	3264kg	1104kg
Power	25kW(50kW PEP)	25kW(50kW PEP)	25kW(50kW PEP)
Frequency	4-30 MHz	6.5-32 MHz	6.5-32 MHz
Standing wave ratio	2:1	2:1	2:1
Input impedance	50 ohm	50 ohm	50 ohm
Gain (over isotropic)	12dB	14dB	14dB
Azimuth beam width	65 average	65 average	65 average
Front-to-back ratio	18dB average 14dB min.	20dB average 14dB min.	20dB average 14dB min.
Shortest element length	3m	3m	3m
Longest element length	37.8m	23.18m	23.18m
Turning radius	22.1m	14.6m	14.6m
Number of elements	20	16	16

Note ...

The antenna installed at the RAF site at Middle Hill Gibraltar has been referred to as an LPH9 antenna. It will henceforth be known as LPH72 (modified) Gibraltar. Only the support structure is different (see Chapter 4); the boom assembly, elements and rotator are all standard LPH72 parts.

4 The twin lattice masts are mounted on a hinged base bolted to a concrete pier. Bearing assemblies at the 18.3m and 24.4m (top) levels provide lateral support for the torque tube.

5 The twin lattice masts are held by two sets of four guys. The guys are attached at the 19.3m and 24.4m (top) levels. The lower ends of the guys are terminated in steel anchors embedded in concrete blocks. A site approximately 72m x 40m is required for the LPH73 antenna and 68m x 40m for the LPH72 antenna.

6 The rotator, which consists of a bearing assembly, a motor and a gear reducer, is carried on a framework between the twin lattice masts. Also carried on the framework is a junction box containing circuitry for control of the electric motor.

PRINCIPLES OF OPERATION

7 The antenna array consists of twenty dipole elements for the LPH73 (sixteen elements for the LPH72), each being of different length. The elements are connected to a balanced transmission line ascending by order of length from the feedpoint. The elements are designed and arranged so that each is equal to 88% in length of the next larger element. The space between any two elements on the transmission line is equal to 88% of the next larger space. Considering the foregoing, any portion of the antenna is a scale model of any other portion. Optimum operation of the antenna requires that each element is resonant only once as the frequency is varied through the designed range; the elements operate in the half-wave mode.

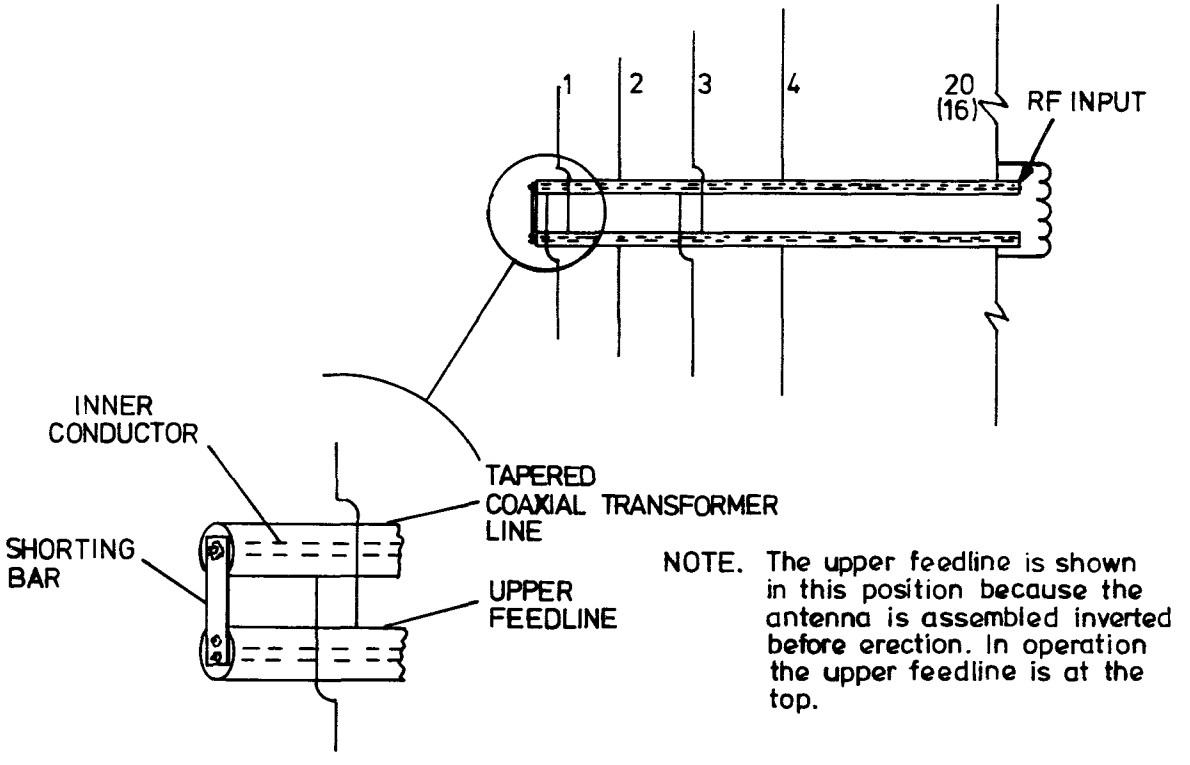


Fig. 1 Element Connections

8 A tapered coaxial transformer (fig. 1) is used to match the balanced feedpoint impedance of 80 ohms to the desired 50 ohms input impedance. This transformer is formed by a tapered centre conductor inserted in the coaxial line extending from the rear of the antenna to the feed point. Its design provides an impedance match over the entire frequency range of the antenna.

9 The flow of rf energy through the antenna is such that the energy is contained in the coaxial line until it reaches the front of the antenna. At this point, the coaxial centre conductor is connected to the outer conductor of the upper feed line. The total current on the inside of the lower feed line outer conductor folds over and flows back down the outside of the outer conductor. Thus an unbalanced-to-balanced transformation takes place, which is not frequency-sensitive.

10 Energy is transmitted from the front of the antenna to the radiating elements by the balanced line. Because the phase is reversed between each element pair (by criss-cross connection) the direction of radiation is directed toward the front of the antenna. Typical elevation and azimuth radiation patterns and a VSWR/Frequency plot over the full frequency band are shown in fig. 3.

INSTALLATION

11 The assembly and erection of the LPH73 is contained in Chap. 2.1, the LPH72 in Chap. 3.1 and the modified LPH72 for Middle Hill Gibraltar in Chap. 4.

MAINTENANCE

12 Corrosion resistant materials and joints of similar metals minimise potential corrosion and provide high reliability for this antenna in extreme corrosive atmospheres. Preventative maintenance actions are specified in AP 116E-1737-45.

Antenna

13 The antenna boom and element assemblies should be inspected for corrosion and tightness of all connections. Particular attention should be paid to the tightness of all bolts making electrical connection between the coaxial line, the dummy line and the element assemblies. The insulators, such as glass fibre element mounts and the glass fibre tubes in the centre of the element assemblies, should be inspected for accumulation of conductive debris such as soot, dirt or salt.

14 Corrosion must be corrected by cleaning and coating with a suitable preservative as appropriate. Paint materials and paint application instructions are detailed on RAFSEE drawing SEE 116319, to which reference should be made.

15 Accumulation of conductive debris must be corrected by cleaning. If possible, this debris should be removed with clean water. If this will not loosen, solvents may be used which are in themselves non-conductive. Conductive cleaners, such as soap or compounds containing acids or alkalis, will become an electrolyte when wet and therefore must be avoided.

Pedestal (rotator)

16 Although the pedestal is serviced with the proper lubricant when shipped, the oil level should be checked prior to operation. New units, after 240 hours of operation or six months, should have the oil completely drained, flushed with a light flushing oil and refilled with the appropriate grade oil. Under normal circumstances, the oil should be changed annually; however, under abnormal operating conditions, such as extreme temperature changes, exceptionally humid or dusty conditions, or in a chemical fume environment, the oil change interval should be decreased depending on the severity of the condition. Grease fittings are provided for bearing lubrication; a six-month lubrication interval is recommended.

LPH73 gear drive

17 The antenna drive gears should be cleaned and greased annually. Remove the hose clamp securing the boot and slide the boot up the torque tube. Remove the screws holding the cover and support the cover at a sufficient height to allow access to the gears. Clean and grease the gears as required to remove any rust and apply sufficient grease where the gears mesh. Grease the bearing external gear through four grease fittings located at 90 degree intervals around the bearing. An access hole is provided in the bearing flange; rotate the antenna until the access hole is over each grease fitting. Check the tightness of the set screws securing the motor flywheel and the spur gear. Refit the cover and boot. Apply silicone grease where the boot contacts the torque tube and cover and refit the hose clamp.

LPH72 chain drive

18 The set screws in the motor flywheel small sprocket and the bolts holding the large sprocket should be periodically checked for tightness. If the drive chain has excessive slack (greater than 3/8 in. sideways movement), loosen the gear reducer mount bolts, tighten the tensioning bolt against the gear reducer and retighten the mounting bolts.

CAUTION

If the gear reducer mounting bolts are too loose when tensioning the chain, retightening the mounting bolts will put excessive tension in the chain.

REMOTE CONTROL EQUIPMENT

19 The LPH antennas can be rotated by a continuous rotation control system, a stepped rotation control system and a computer controlled system. A brief description of each method of rotation is given in the following paragraphs, with wiring diagrams in fig. 4, 5, 6, 7, 8 and 9.

Continuous rotation control system (LPH73, fig. 4 and LPH72, fig. 8)

20 The continuous rotation control uses a toggle switch and a synchro-operated indicator. The pedestal contains a transmitting synchro which is connected directly to the receiving synchro in the control. To position the antenna to a desired azimuth heading, the operator activates the toggle switch and the antenna will immediately rotate in a clockwise or counter-clockwise direction, depending on the switch position selected (CW or CCW) until the switch is returned to the centre off position. A complete 360 degree rotation takes about four minutes.

21 Provision is also made for local control of the antennas. In the LPH73 antenna and later LPH72 antennas delivered after 1990 a 'CW-CCW' toggle switch and a LOCAL/REMOTE selector switch are housed in the junction box at the base of the antenna. The selector switch is normally set to REMOTE. In the early LPH72 antennas delivered prior to 1990, these switches are not fitted. Local control is possible by opening the junction box and operating the contactor by pressing the push buttons located below it.

22 When the drive motor is not activated, the only power transmitted from the pedestal is 110V ac to operate the synchro. Therefore, as long as power is applied to the pedestal, the antenna azimuth will be indicated.

The indicator light will be on only when the toggle switch is activated and the antenna is rotating.

CAUTION

Do not rotate the antenna when transmitting. Transmitting power with the rotary joint turning will cause arcing at the contacts and decrease the life of the rotary joint.

Stepped control (LPH73, fig. 5 and 6)

23 Two versions of stepped control exist. In normal operation, the rotation of the antenna is controlled by a remotely located 12-position rotary switch. Operation of this switch, which moves in 30 degree steps, causes the antenna to rotate until it reaches the selected position, when it stops. Indication of the antenna heading at any time is therefore given by the position of the switch. Both versions are similar in this respect.

24 In the version shown in fig. 5 the local control switch is also a 12-position rotary switch. This is brought into operation by moving the Local/Remote switch to LOCAL. Operation is then similar to the remote operation and the antenna can only be brought to rest in 30 degree increments.

25 In the version shown in fig. 6, the local control switch is a centre off three way toggle switch which allows clockwise or counter-clockwise rotation of the antenna to be selected. The CW/CCW switch is activated by moving the Local/Remote switch to LOCAL. With this system the antenna can easily be brought to rest on any desired heading. With both versions the remote control is disabled when LOCAL is selected and vice-versa.

Computer controlled rotation system (LPH73, fig. 7 and LPH72, fig. 9)

26 The pedestal contains a transmitting synchro which is used to indicate the antenna heading. The three phase signal from the synchro is decoded by the electronics and used to operate a three digit l.e.d. display, and is capable of indicating the heading from 000 degrees to 359 degrees in one degree increments. A keypad allows manual operation of the antenna from the remote unit and CW and CCW indicator lights show when the antenna is in motion.

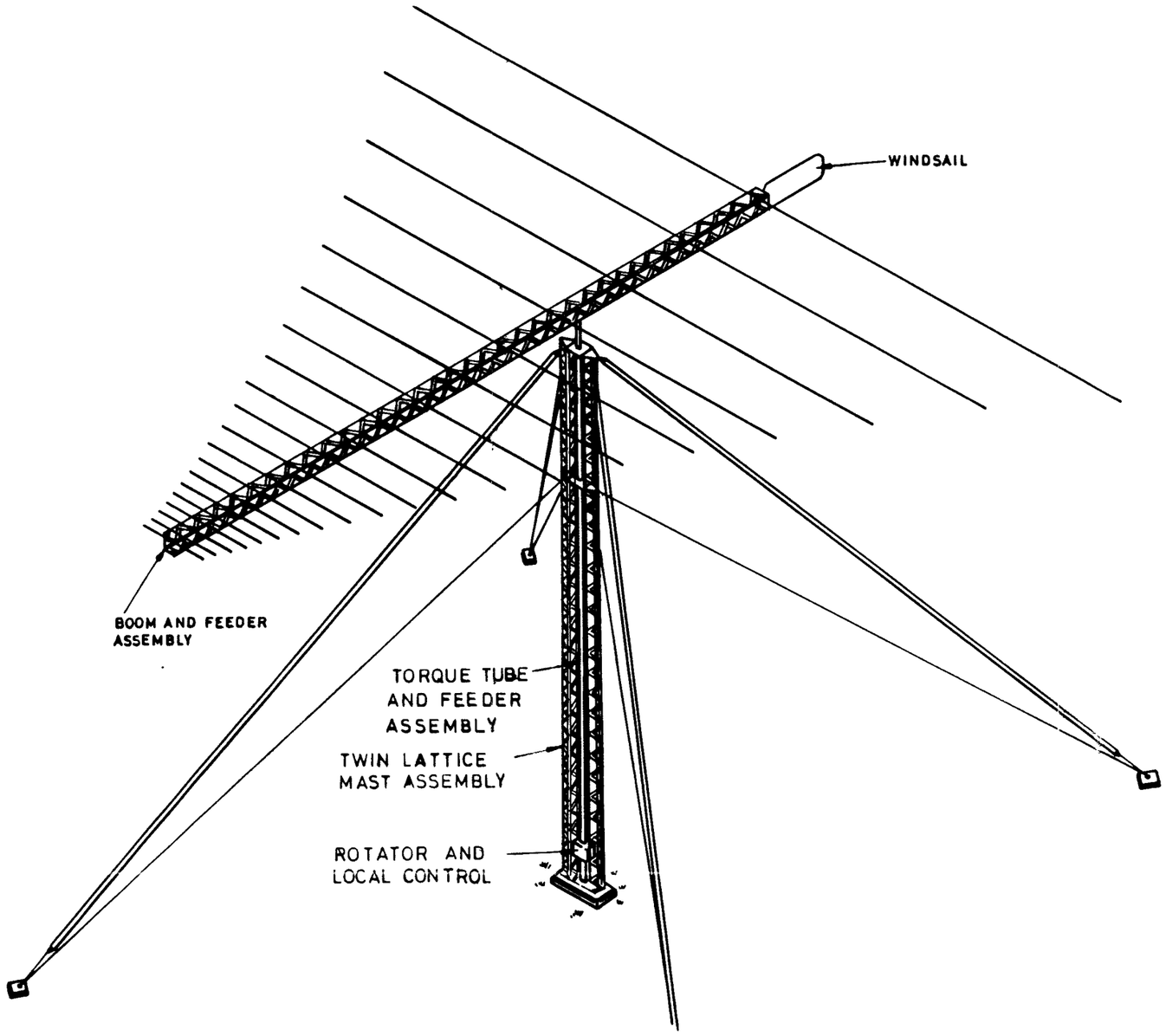
27 When switched from REMOTE to COMPUTER the various functions are controlled by the computer. A status request from the computer results in the antenna heading, as displayed, being transmitted to the computer. A rotate request from the computer results in rotation to the requested heading.

28 Up to sixteen controllers may be connected in parallel on a common line and, by means of a selectable address, only the controller addressed will respond. A facility is provided to allow the displayed heading to be adjusted to the true heading of the antenna. Ten switches are used to add an azimuth correction in various sized increments of degrees. No mechanical adjustment is necessary.

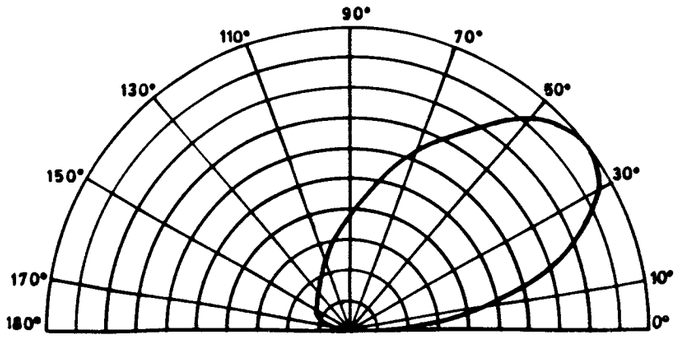
29 Local control of the antenna from the pedestal is carried out in the same way as the continuous rotation control system described in para. 21 above. When switched to LOCAL, the remote unit is disabled but continues to

indicate the antenna heading and the CW and CCW rotation lights still indicate.

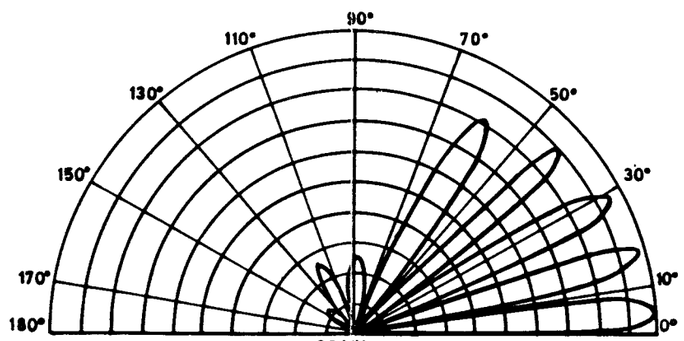
30 Power for the remote control unit is obtained from the 110V ac supply in the pedestal. This is provided by a double-wound transformer whose primary is connected between one of the three-phase lines and neutral. One side of the 110V ac supply is earthed in the pedestal and also in the remote control unit. This must be isolated from the mains neutral and this system differs in this respect from the two earlier control systems.



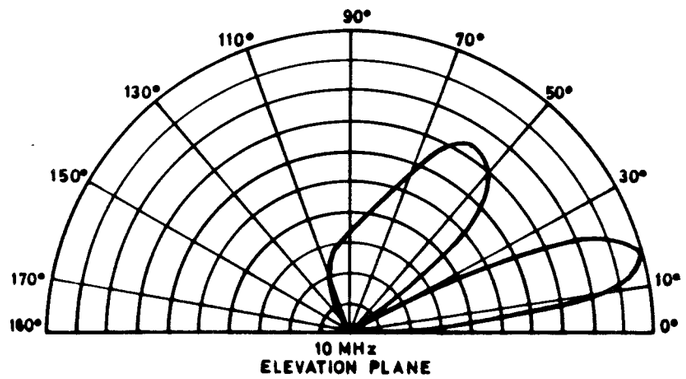
LPH antenna:general view (L P H 73)



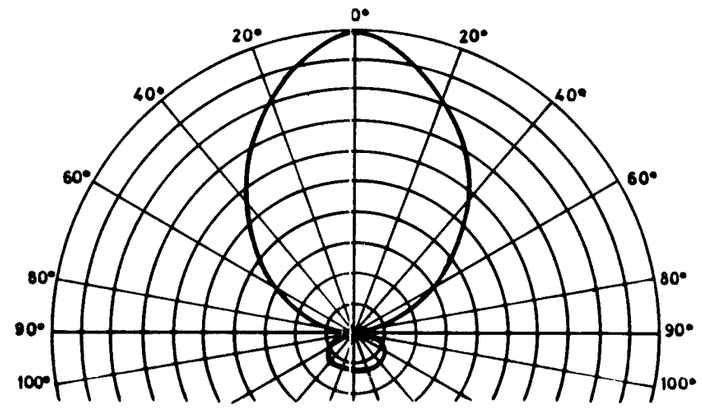
4 MHz
ELEVATION PLANE



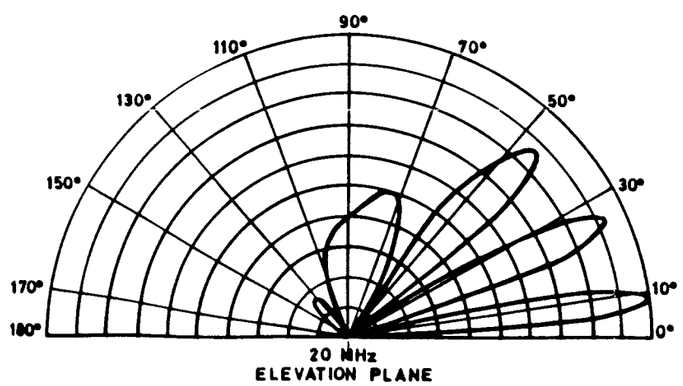
30 MHz
ELEVATION PLANE



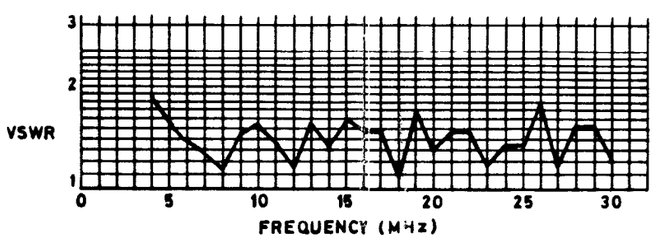
10 MHz
ELEVATION PLANE



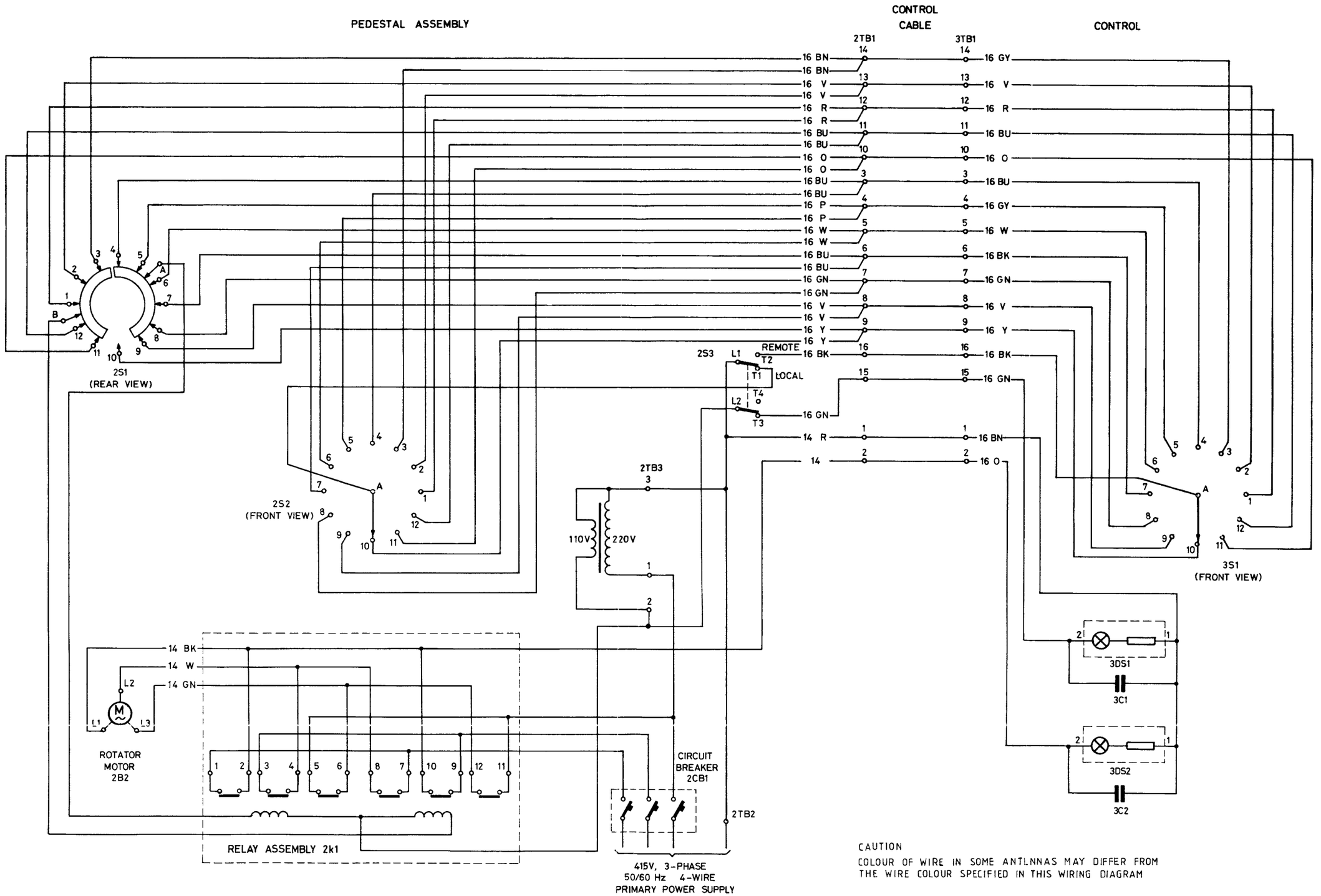
TYPICAL AZIMUTH PLANE



20 MHz
ELEVATION PLANE



Typical radiation patterns and VSWR / frequency plot (LPH73)

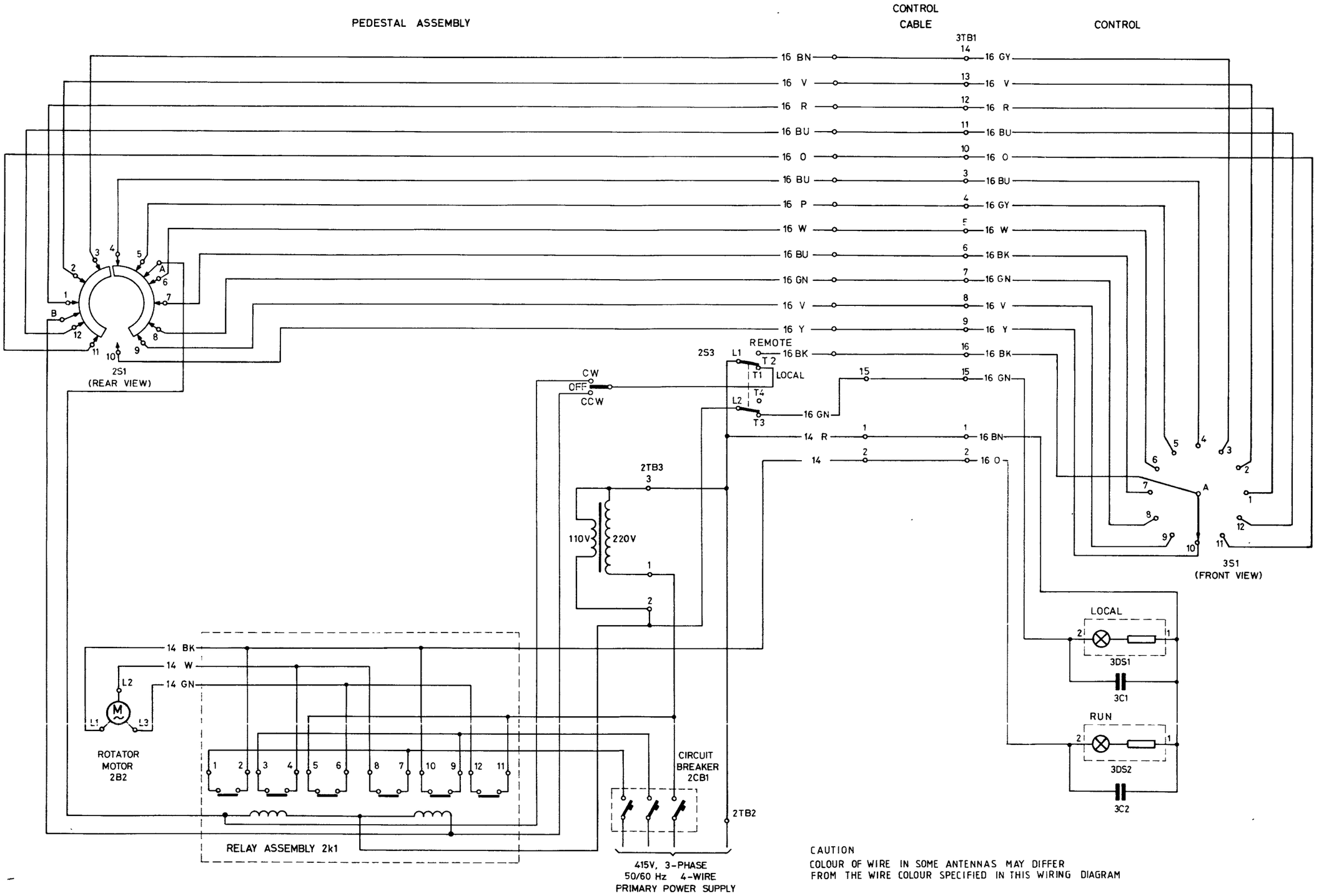


CAUTION

COLOUR OF WIRE IN SOME ANTENNAS MAY DIFFER FROM THE WIRE COLOUR SPECIFIED IN THIS WIRING DIAGRAM

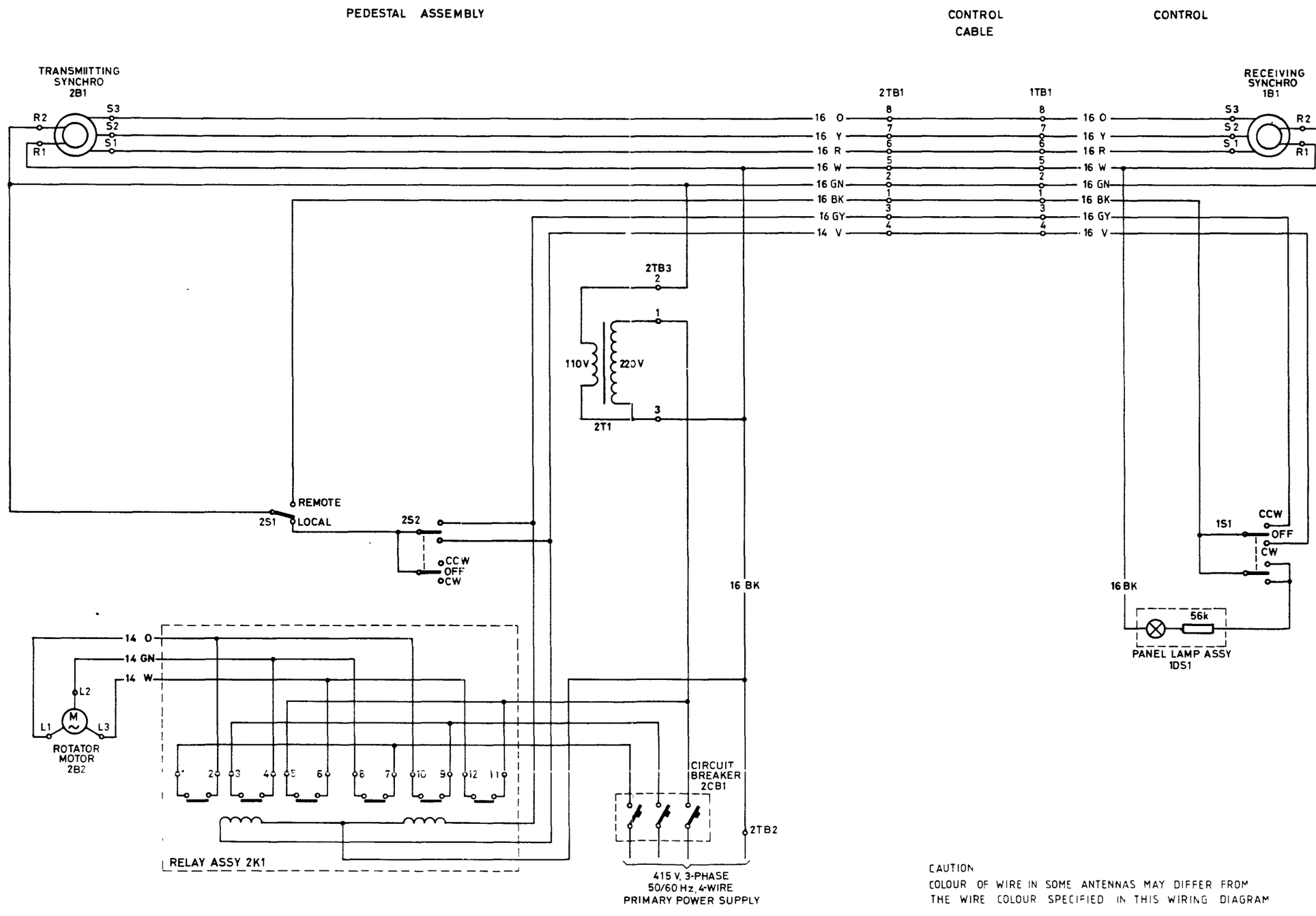
Stepped rotation control system : wiring diagram
LPH 73 Antenna

Fig 5



Stepped rotation control system : wiring diagram
LPH 73 Antenna

Fig 6



CAUTION
COLOUR OF WIRE IN SOME ANTENNAS MAY DIFFER FROM THE WIRE COLOUR SPECIFIED IN THIS WIRING DIAGRAM

Continuous rotation control system : wiring diagram
LPH 72 & LPH 73 Antenna

Fig 4

REMOTE CONTROL

PEDESTAL ASSEMBLY

TRANSMITTING SYNCHRO 2B1

ROTATOR MOTOR 2B2

2TB1 CONTROL CABLE

P4

J2 P3

INTERFACE BOARD A1

A2 MICRO COMPUTER BOARD

RS-232 INTERFACE

POWER SUPPLY

A12

2TB3

2S1

2S2

S2

2CB1 CIRCUIT BREAKER

2TB2 N TERMINAL

2F1 FUSE

RELAY ASSY 2K1

415 V 3-PHASE 50/60 Hz 4-WIRE PRIMARY POWER SUPPLY

SAFETY GROUND

DS3 POWER

DS5 CCW

DS6 CW

DS1 COMPUTER CONTROL

DS2 REMOTE CONTROL

S1

KEYBOARD A11

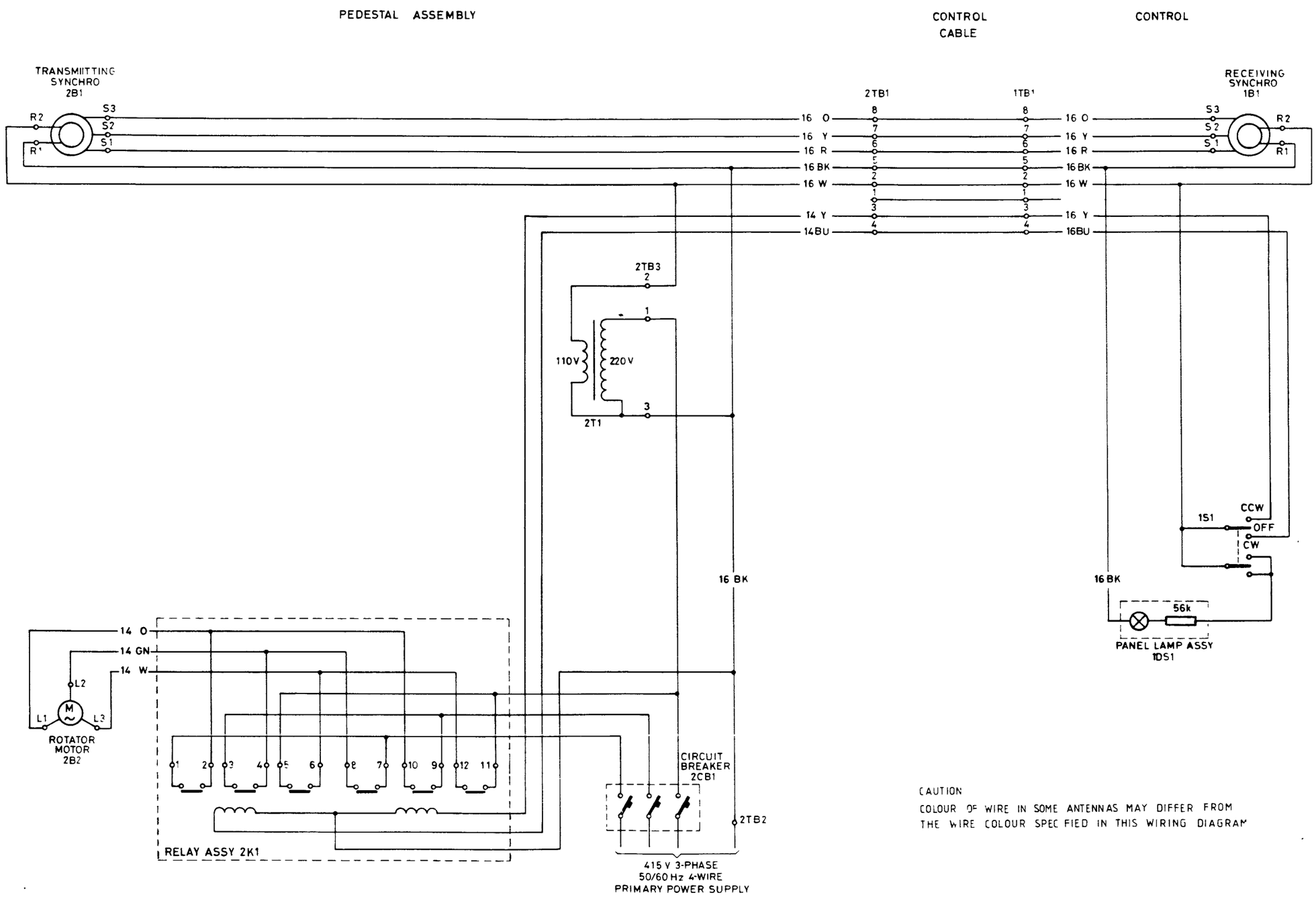
UNITS DISPLAY A10

TENS DISPLAY RB1

HUNDREDS DISPLAY RB0 RB1

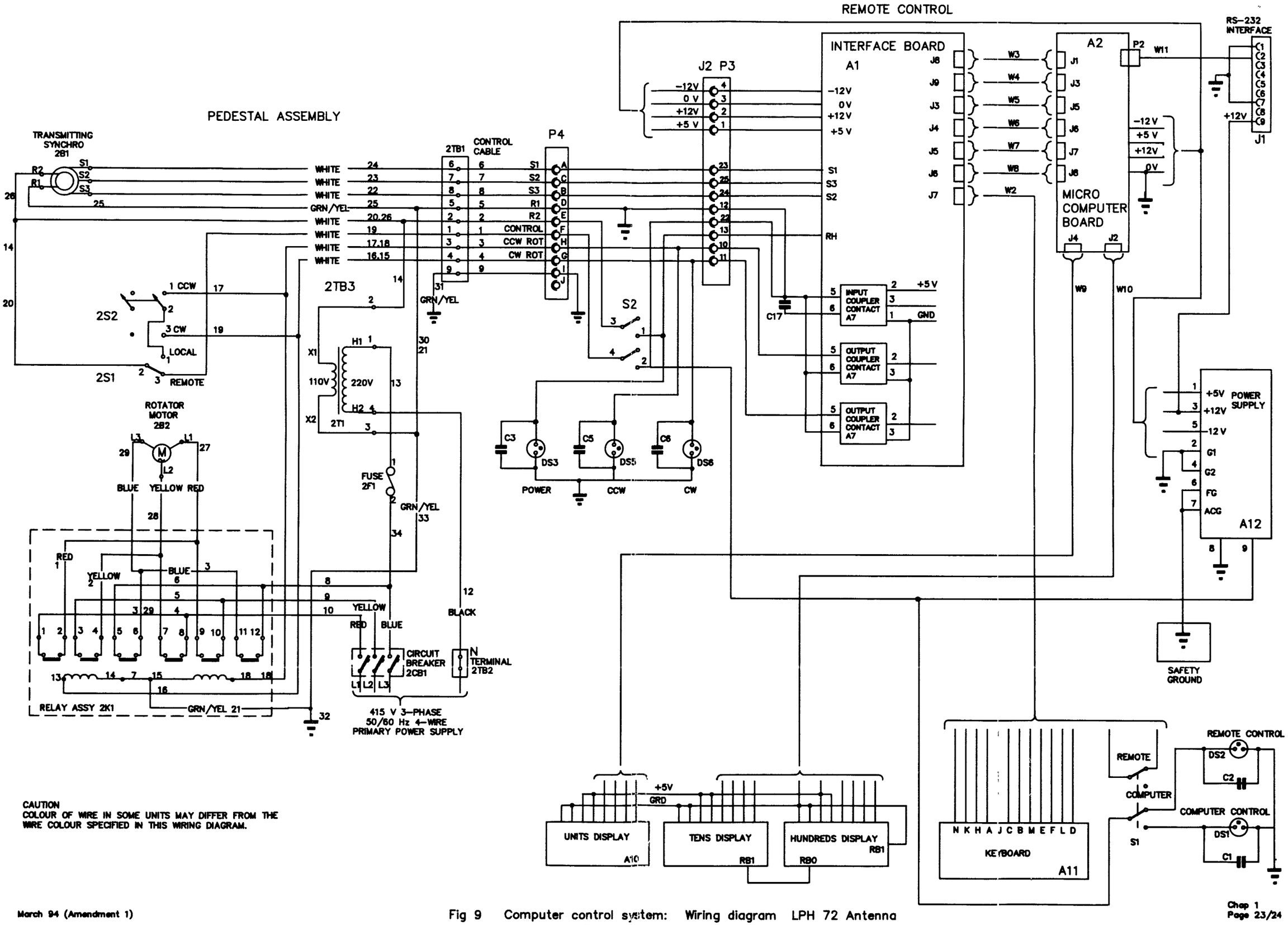
CAUTION
COLOUR OF WIRE IN SOME UNITS MAY DIFFER FROM THE WIRE COLOUR SPECIFIED IN THIS WIRING DIAGRAM.

Fig 7 Computer control system: Wiring diagram LPH 73 Antenna



Continuous rotation control system : wiring diagram
LPH 72 Antenna

Fig 8



CAUTION
COLOUR OF WIRE IN SOME UNITS MAY DIFFER FROM THE WIRE COLOUR SPECIFIED IN THIS WIRING DIAGRAM.

Fig 9 Computer control system: Wiring diagram LPH 72 Antenna

Chapter 2.0

INSTALLATION, ERECTION AND LOWERING OF LPH73 ANTENNA

Completely Revised

CONTENTS

1 Chapter 2.1 covers installation and erection of the antenna. Chapter 2.2 covers lowering of the boom assembly and Chapter 2.3 covers lowering of the twin lattice mast.

Safety precautions

SAFETY WARNING ...

PRIOR TO RAISING OR LOWERING THE TWIN LATTICE MASTS OR THE ANTENNA, THE TEAM LEADER IS TO ENSURE THAT THE SITE IS ADEQUATELY CLEARED OF OBSTACLES AND HAZARDS, AND THAT THE APPROPRIATE WARNING SIGNS ARE DISPLAYED

2 All safety precautions are to be taken during the erection and must not be compromised in any way. The twin lattice mast structure is not to be climbed by more than two persons at any time. Only two persons are to climb the boom when partly erected and no-one is to traverse the boom when fully erected. Safety harnesses are to be worn and fall arrest equipment is to be used at all times when climbing.

PSA responsibilities

3 The twin lattice mast and guys of the antenna are the responsibility of PSA and are not to be adjusted after handover. The PSA is to be informed in writing, a minimum of seven days in advance, the dates of erection, so that an observer may be present if the PSA wishes.

Pre-erection details

4 Six Aerial Erectors and an Aerial Erector Supervisor are required to erect and lower the twin lattice mast, and seven Aerial Erectors and an Aerial Erector Supervisor are required to erect and lower the antenna. It is advisable to make a check of local weather conditions for the time period of antenna work, in case of high wind forecast or thunderstorm states/risks.

5 The prefixes 90G, SC, SCSHQ and SEE, where used, are to be considered synonymous. The words 'guy' and 'stay' in relation to the antenna twin mast assemblies are also synonymous, but in this publication the word 'guy' is used to denote a permanent member which supports the twin lattice masts. 'Sling' is used to denote an item of the erection equipment which is used for lifting and 'stay' is used for an item of erection equipment which is used only for steadying.

Notes ...

(1) Three grades of fastener are used in this installation - high strength galvanised, standard strength galvanised and stainless steel. In general, the galvanised fasteners are used to assemble the galvanised steel parts of the twin lattice mast, with the high strength fasteners used in the more critical positions. The use of the high strength fasteners is indicated in the tables of listed parts by the abbreviation 'Hi. St.' The boom assembly, the elements and transmission lines are assembled with stainless steel fasteners. Torque values, which are different for each grade of fastener, are given in the text and are summarised in Fig. 52 in Chapter 2.1. Stainless steel fasteners which assemble fibreglass parts are torqued to a lower value than those assembling all-metal parts. All fasteners shall have their threads coated with lubricant on assembly.

(2) In the text the hydraulically operated Tirfor winch type TU32H is referred to. The instructions shall be construed as applying equally to the hand operated Tirfor winch type T35, which may be used in lieu of the type TU32H. However, when the T35 winch is used, care must be taken to operate it smoothly, to avoid introducing bounce into the lifting system due to the 'to and fro' action of the winch handle.

Weights

6 The weights of various parts of the antenna are as follows:-

Lattice mast section	159 kg	(350 lb)
Twin lattice mast and guys (total)	1324 kg	(2920 lb)
Torque tube section (each)	451 kg	(995 lb)
Boom assembly complete	1324 kg	(2920 lb)
Pedestal unit	545 kg	(1195 lb)

List of tools

7 The following tools are required for installing, erecting and lowering the LPH73 antenna.

Item No.	Sect/Ref.	Nomenclature	Qty
1	6E/4466210	Binoculars 7 x 50	1
2	6C/9542399	Compass, prismatic	1
3	6C/9542398	Tripod (used with item 2)	1
4		Theodolite	2
5		Tripod (used with item 4)	2
6	1C/1202797	Wrench, torque, 1/2" sq. dr., 200-1200 lbf./in. (16.6-100 lbf.ft.)	1
7	1C/1278258	Wrench, torque, 1/2" sq. dr., 400-2000 lbf./in. (33.3-166.6 lbf.ft)	1
8	1C/1389076	Wrench, torque, 3/8" sq. dr., 5-60 lbf.ft	1
9	1C/1275791	Wrench, torque, 3/4" sq. dr., 1200-5000 lbf.in. (100-416 lbf.ft.)	1
10	1A/1255009	Paint brush 1 in.	2
11	1A/1275341	Paint brush 3 in.	2
12	1A/1202537	Wire brush	1
13		Spanner 7/16 in. across flats	A/R
14		" 1/2 in. " "	"
15		" 9/16 in. " "	"
16		" 5/8 in. " "	"
17		" 11/16 in. " "	"
18		" 3/4 in. " "	"
19		" 7/8 in. " "	"
20		" 15/16 in. " "	"
21		" 1 1/16 in. " "	"
22		" 1 1/8 in. " "	"
23		" 1 1/4 in. " "	"
24		" 1 1/2 in. " "	"
		Note ... Both open ended and socket spanners will be required.	
25		Screwdriver, 4mm blade	1
26		Screwdriver, 6mm blade	1
27		Screwdriver, 8mm blade	1
28		Tension Meter type 05C	1
29		Hammer, 4 lb.	1

Chapter 2.1

INSTALLATION AND ERECTION OF LPH73 ANTENNA

Completely Revised

CONTENTS

General

Note ...

The following paragraphs give, in the correct sequence, the method of erecting the remotely controlled rotatable log periodic antenna type LPH73, fitted with either synchro, stepped or computer control.

1 A site plan appears in Fig.1. The antenna is assembled in the space between block 'B' and the boundary remote from the winch block 'D'.

Base assembly

2 Assemble as follows (Fig.2 and Table 2).

2.1 Remove the nuts and washers (items 6, 10 and 11) from the 12 studs protruding from the centre concrete foundation block; store in a safe place for refitting later. Clean the threads with a wire brush and lightly oil.

2.2 Clean the top surface of the centre foundation block and check that no protrusions are present in the area on which the lattice mast base fits.

2.3 Locate the base assembly (item 3) on the foundation block using the clamp base hinge (item 4), clamp the hinge down using four of the nuts and washers previously removed (items 6, 10 and 11). Torque nuts to 150 lbf.ft. Ensure that, when clamped down, the base is free to hinge about the pivot point (Fig.2). Check that the base is a snug fit on the surface of the block. If necessary, grout must be used when the twin lattice mast is erected (see sub-para.10.8).

Twin lattice mast assembly

3 Assemble as follows (Fig.2 and Table 2).

3.1 Attach mast section bottom RH (item 2) to the base assembly (item 3) with the mast section lying out along the ground, using bolts 3/4 x 2 3/4 (item 5), washers (item 8), lock washers (item 6) and nuts (item 7). The washers (item 8) should be fitted in the highest and lowest positions where the bolts pass through the bevelled webs of the steel base members. Torque to 234 lbf.ft. Note that the pedestal pivot mounts should be close to the base assembly and towards the ground. Support the masts with suitable blocks as assembly proceeds.

3.2 Attach mast section bottom LH (item 1) in a similar manner opposite the bottom RH as fitted in sub-para.7.1.

3.3 The six similar mast sections are shipped without the diagonal and horizontal braces fitted in position. These must now be assembled (refer to Fig.3 and Table 3). Fit the diagonal and horizontal braces (items 4 and 5) in the positions shown using 3/8 inch x 1 1/2 inch long bolts (item 6), 3/8 inch lock washers (item 8) and 3/8 inch nuts (item 7). Torque to 19 lbf.ft.

3.4 Refer to Fig.3 and Table 3. Attach two mast sections (item 1), one after the other, to each of the bottom mast sections using 1/2 inch x 1 1/2 inch long bolts (item 9), 1/2 inch lock washers (item 11) and 1/2 inch nuts (item 10). These sections should be installed with the bolted cross-bracing facing inwards, ie towards the centre line of the mast. Torque to 69 lbf.ft.

3.5 To the left-hand mast sections, looking from the top down the sections, attach a further mast section (item 1), positioning intermediate guy bracket RH (item 13) between the section being installed and the section already installed. The bracket should be orientated as shown in Fig.4. Note that the holes in the edge of the bracket are not symmetrical. Although the holes are equally spaced, the group is closer to the top (the LH side of the Fig.4 view). Attach the section using 1/2 inch by 2 inch long bolts (item 12), 1/2 inch lock washers (item 11) and 1/2 inch nuts (item 10). Torque to 69 lbf.ft.

3.6 To the left-hand mast sections attach, in a similar manner, the remaining mast section and the LH intermediate guy bracket (item 14).

3.7 Refer to Fig.5 and Table 5. Between the left and right-hand intermediate guy brackets (items 2 and 3), attach bearing plate assembly (item 1) and erection brackets (items 4 and 5), using 5/8 inch by 2 1/2 inch long bolts (item 7) to bolt through the erection brackets, bearing plate assembly and intermediate guy brackets. Where the bolts do not pass through the erection brackets, use the 5/8 inch by 1 3/4 inch long bolts (item 6). Secure the bolts using the 5/8 inch lock washer (item 8) and the 5/8 inch nut (item 9). Torque to 145 lbf.ft. The gate (item 10) in the bearing (item 1) should be removed, leaving the resulting opening in the bearing facing towards the ground. Safeguard the gate and its fastenings for later use.

3.8 Refer to Fig. 9A and Table 9A . Attach pulley and bracket assembly (item 1) using clamps (item 2), 3/8 inch by 1 1/2 inch bolts (item 3), 3/8 inch lock washers (item 4) and 3/8 inch nuts (item 5). Torque to 19 lbf.ft. Fit this assembly close to the intermediate bearing assembly between the two uppermost mast section members.

3.9 Refer to Fig.6 and Table 6. To the top of both mast legs attach a guy bracket (item 1) using 1/2 inch by 1 1/2 inch long bolts (item 9), 1/2 inch lock washers (item 10) and 1/2 inch nuts (item 11). Torque to 69 lbf.ft.

3.10 Between the two top guy brackets, fit a bearing plate (item 2) and erection brackets (items 3 and 4), in a similar manner to that in sub-para.7.6. In this case, however, the top guy brackets are symmetrical and the erection brackets should be attached on the side closest to the ground. Remove and safeguard the gate (item 12) and its fastenings as in sub-para.3.7.

3.11 Assemble the bearing halves (item 13) into the bearing plate assemblies (item 2) and the outer welded assemblies (item 12) using No.10-24 screw (item 14), No.10 lock washer (item 15) and No.10-24 nut (item 16). These fastenings should not be torqued.

Attachment of safety line

4 Set up the safety line as follows (Fig.6 and Table 6).

4.1 To the RH erection bracket fitted at the top of the twin lattice mast attach a block, tackle (item 19) using a 5/8 inch shackle (item 20).

4.2 Reeve 6mm diameter polyester rope (item 21) through the block, tackle, take up the slack and attach both ends to the bottom of the mast. Spare polyester rope is to be left coiled at the base of the twin lattice mast.

CAUTION

Before fitting item 19, check that the manufacturer's test certificates for items 19 and 20 have been received.

Attachment to anchor block

5 Refer to Fig.9 and Table 9. Offer the fishplate (item 1) up to the steel plates fixed to the four anchor blocks 'A' and 'E' (see Fig.1). If the concrete interferes with the free fitting of the fishplates, chip away some of the concrete with a hammer and chisel to provide clearance.

6 Attach two fishplates either side of the anchor plate using M24 x 70mm long bolts (item 2), lock washers (item 3) and M24 nuts (item 2). Ensure that the holes for the guy bolt are in alignment. Torque to 822 Nm.

Fitting of guys

7 The attachment of top and intermediate guys is carried out as follows (Fig.4 to 8 and Table 4 to 8).

7.1 Using two 2.5 ton small dee shackles (Fig.8, item 3, supplied with guy), attach a guy (Fig.4, item 7) to the intermediate guy attachment point on the mast and lay it out along the ground at the side of the tower sections towards the base.

7.2 Fit a further three intermediate guys in a similar manner to their respective attachment points.

7.3 Take the two rear (nearest the ground) intermediate guys and attach the rigging screws (Fig.8, item 2, supplied with guy) to the middle of the chains (Fig.8, item 4) using a shackle (Fig.8, item 3). Undo the nut and bolt (supplied with guy) and attach the rigging screw to the second hole up the plates at the respective guy anchorage blocks 'A'.

7.4 Attach each top guy (Fig.7) to the top guy bracket, attaching the top chain by means of the shackle (Fig.7, item 5, supplied with the guy).

7.5 Make off the two rear (nearest the ground) top guys to their respective guy anchor blocks 'A'. Remove the nut and bolt in the end of the rigging screw (Fig.7, item 6) and attach the rigging screw to the top hole in the twin fishplates (Fig.9, item 1). Tighten the nut and bolt firmly but do not overtighten or the fork end of the rigging screw may be distorted. The rigging screw is attached to the lower chain with a shackle (Fig.7, item 5). If necessary, reposition the rigging screw in the centre of the chain.

Note ...

Set all the rigging screws to the centre of their adjustment range.

Twin lattice mast erector gear

8 Assemble and fit the twin lattice mast erector gear as follows (Fig.10 and Table 10).

8.1 Position the cross tube of the erection derrick (item 1) on the two housings provided on the mast base assembly (Fig.2, item 3) and secure with the 'U' bolts provided (Fig.2, item 9). Leave the 'U' bolts slack. Ensure that the small shackle attachment lug at the derrick head is pointing towards the ground when the derrick is laid out above the twin lattice masts, supported with a piece of wood at the derrick head.

8.2 To the small attachment lug mentioned above, attach the two erection slings (items 8 and 9) using one shackle (item 10) and two shackles (item 17).

8.3 Attach the other ends of the slings, one to each of the erection brackets at the intermediate guy level, ie 18.3m (60ft) from the twin lattice mast base. Attach the slings using shackles (item 12).

8.4 Attach the snatch block (item 2), using a shackle (item 3), to the large shackle attachment lug at the head of the derrick opposite the erection slings.

8.5 Reeve the erection sling (item 13) through the snatch block (item 2) at the derrick head and attach one end to the hairpin nearest the twin lattice mast base on the downhaul block 'C' on Fig.1 using a shackle (item 10).

8.6 Shackle a second snatch block (item 2) to the remaining hairpin on the downhaul block 'C' using shackle (item 10). Reeve the free end of the erection sling (item 13) through this snatch block. Attach a T35 Tirfor rope (item 16) to this free end using two shackles (item 10) back to back.

8.7 Shackle the TU32H Tirfor winch (item 14) to the winch-block 'D' using two shackles (item 10) back to back. Feed the Tirfor rope through the Tirfor winch but leave slack.

8.8 Attach two Tirfor ropes (item 11), one to each side of the derrick head, using shackles (items 10 and 12), back to back.

8.9 Attach two Tirfor winches (item 6) to block 'F' on each side of the derrick, using shackle (item 12). Reeve the Tirfor ropes (item 11) through the Tirfor winches (item 6) and take up the slack to centralise the derrick.

8.10 Two men now lift the derrick head and walk slowly towards the twin lattice mast base, pushing the derrick up towards the vertical position until it is approximately 80 degrees to the horizontal (Fig.10). A further man is positioned on the Tirfor winch at 'D' to take up the slack.

8.11 Take up the slack and apply a light tension to the derrick, to maintain it in the erected position. Check the tension of side stays and adjust if necessary.

8.12 Adjust the rigging screw on item 9 so that there is equal tension in the two slings (items 8 and 9). Tighten the 'U' bolts holding the derrick to the twin lattice mast.

8.13 Refer to Fig.11 and Table 11. Attach the wire rope assembly (item 2) one to each mast leg as shown. To each of these attach a rope assembly (item 1) using a shackle (item 5). Shackle a Tirfor winch (item 3) to each block 'F' at each side of the mast base using a shackle (item 5). Attach a Tirfor rope (item 4) to the rope assembly (item 1) using a shackle (item 5). Feed the ropes (item 4) through the winches (item 3) and take up the slack.

Erection of twin lattice masts

9 Proceed with mast erection as follows:

9.1 Position two men on the winch at block 'D', two men, one at each side, by the stay anchor blocks 'F' and one man at each rear guy anchor block.

9.2 Raise the twin lattice masts slowly using the winch at block 'D'.

9.3 The men on the side stays are to check them continually to ensure they are not overtight or slack. The supervisor is to watch carefully the whole erection operation, to see that the twin lattice masts rise smoothly.

9.4 During the final stage of erection, the two men positioned at the rear guy positions are to resist the erection by pulling down on the rear guys, and if necessary adjust them. When adjusting guys, the erection is to be stopped and only one guy is to be adjusted at any time.

9.5 When the lattice masts are vertical, clamp the base down with the angle tie down (Fig.13, item 1) and the channel tie down (Fig.13, item 2), using the nuts and washers removed from the foundation bolts in sub-para.2.1. Torque to 150 lbf.ft.

9.6 Attach the two remaining intermediate guys as described in para.7.3 to their respective guy anchor blocks 'E'.

9.7 Make off two remaining top guys as described in para.7.5 to their respective guy anchor blocks 'E'.

Tensioning Parafil guys

10 Two conditions have to be achieved simultaneously, that the masts are plumbed vertically and that the prescribed erection tensions are applied to the guys. The two conditions are interactive and are complicated by the fact that, when Parafil is initially tensioned, some relaxation always occurs due to bedding-in effects of the fibres in the end fittings. The following tensioning procedure shall be followed:

Note ...

When tensioning guys and straightening the twin lattice mast, the Tirfor winches used during erection shall be slackened off, but the erection equipment shall be left in position until the tensioning operation is completed.

10.1 Check the masts are vertical using two theodolites at right angles. Check the guy tensions using a Tension Meter type 05C.

10.2 Set the guys to the following 'erection tensions':
Top guy - 15kN in each rope of the pair
Intermediate guy - 12kN.

10.3 Apply tension to the 'erection tension' values and then wait one hour.

10.4 Re-apply the 'erection tension' values and then wait for a second hour.

10.5 After the second hour has elapsed, re-apply the 'erection tension' values.

10.6 During the tensioning, check the verticality of the masts and adjust the tensions appropriately.

10.7 Dismantle the erection equipment. Remove from the site the items no longer required and pack ready for transit.

10.8 Grout the base assembly to ensure good surface contact with the foundation block.

Pedestal assembly

11 Assemble and fit as follows (Fig.6 and 12 and Table 6 and 12).

11.1 Climb to the top of the twin lattice mast. Undo the 5/8 inch shackle (Fig.6, item 20) which secures the block and rope (Fig.6, item 19 and 21) to the erection bracket (Fig.6, item 3) and transfer them to one of the cross braces at the top of the mast. The line, when so attached, may still be used for hauling up tools and equipment, but the load should not exceed about 100kg.

11.2 Refer to Fig.12. Attach a shackle (item 1) to each of the erection brackets. To each of these shackles attach a shackle (item 2). To these shackles attach the two hooks of a two leg sling (item 3).

11.3 To the centre ring of the two leg sling attach a snatch block (item 4) using a shackle (item 2).

11.4 Attach a TU32 Tirfor winch (item 5) to the anchor block 'C' (see Fig.1) using a shackle (item 2).

11.5 Reeve a Tirfor rope (item 6) up the mast, through the snatch block and down through the Tirfor winch (item 5).

11.6 Attach two chains (item 7) to the captive shackle at the end of the Tirfor rope (item 6).

11.7 Attach the two chains to the lifting eyes of the pedestal using two shackles (item 1).

11.8 Take up the slack in the lifting system by operating the Tirfor winch.

11.9 Lift the pedestal and guide it carefully into position between the two lattice masts. Turn the pedestal so that the torque tube mounting face points away from the anchor block 'C'. Align the holes in the pedestal with the holes in the mast mounting brackets.

11.10 Grease the pivot shaft and insert it through the mounting holes. Retain the pivot shaft with the 3/8-16 x 3 1/2 inch bolt, lock washer and nut supplied with the shaft (Fig.13, Table 13, items 3, 4 and 5).

11.11 Block the pedestal with suitable wooden packing blocks, so that the torque tube mounting face is vertical.

11.12 Dismantle the lifting equipment. Restore the block and safety line, which was moved in sub-para.11.1, to its normal position.

ALTERNATIVELY - if a HIAB is available:-

11.13 Omit operations detailed in sub-para.11.1 to 11.5. Position the vehicle to which the HIAB is fitted in a convenient position. Note that the pedestal, which weighs 0.54 tonne, is well within the safe lifting capacity of the HIAB at full extension.

11.14 Attach the two chains as in sub-para.11.6 above. Link the ends of the two chains with a shackle (item 8) and put this shackle over the hook of the HIAB. The HIAB is only to be operated by an operator trained in its use and he is to be satisfied that all the necessary safety procedures are followed.

11.15 Use the HIAB to carry out the procedures detailed in sub-para.11.9 to 11.11.

Torque Tube and Transmission Line Assembly

12 If the rotary joint is not already fitted, it should be fitted now, as shown in Fig.14 and Table 14, using 1/4-20 x 1 inch long stainless steel hex bolts, nuts and lock washers supplied as part of the assembly (item 1). Torque to 6.5 lbf.ft.

CAUTION ...

The rotary joint must be fitted before assembling the transmission line and checked to see that it will revolve. This joint must not be taken apart on site.

13 Lubricate the 'O' ring (item 6) with silicone grease and position it on the flange of the rotary joint, then fit the short transmission line (item 5) to the pedestal assembly as shown in Fig.14. Ensure that the centre conductor is located in the transmission line and is pushed fully over the rotary joint bullet. Fix in position using 5/16 inch bolt (item 7) and 5/16 inch washer (item 8) into tapped holes. Torque to 11.5 lbf.ft.

14 Refer to Fig.15. Take a torque tube section (item 1) and support it on trestles at an equal height to mate with the flange on the pedestal. Position it so that the spring attachment points are at the end remote from the pedestal.

15 Slide a section of transmission line (item 2) into the torque tube section, with the spring attachment tabs towards the top. Ensure that the

centre conductor is located in the transmission line.

16 Stretch the rubber boot (item 3) over the torque tube flange nearest the pedestal and fit the hose clamp (item 4) (Fig.15 and Table 15). Do not tighten the hose clamp at this stage. Remove the top cover from the pedestal by taking out the 16 1/4-20 x 1/2 bolts and lock washers. Place the cover over the end of the torque tube and safeguard the bolts and washers for re-use later.

17 Attach the four springs (Fig.16, item 4) to their respective positions, one end to the transmission line, the other to the torque tube, so suspending the transmission line in the torque tube (Fig.16 and 17).

18 Insert the connector (part of item 12) into the transmission line section previously installed in the pedestal (para.16).

19 Lubricate the 'O' ring (part of item 12) with silicone grease and position it in the recess in the transmission line flange.

20 Pull the inner conductor from the transmission line and slide it into position on the connector previously installed (para.21).

21 Slide the outer conductor of the transmission line against the short transmission line previously installed (para.16). Carefully position the 'O' ring in its proper groove and secure with the 5/16 inch diameter bolts, nuts and lock washers (item 7, 8 and 9 - Fig.15 and Table 15). Torque to 11.5 lbf.ft.

22 Slide the torque tube section (item 1) against the pedestal and bolt the flange to the pedestal flange using washers (item 10) and bolts, hex hd 3/4-10 x 2 1/4 (item 11). Torque to 150 lbf.ft.

23 Refer to Fig.16 and Table 16. Install a further three sections and feeder in a similar manner to that detailed in para.17 to 25, using items 5 to 9 to join the centre conductors, and bolts, nuts and washers (item 10, 11 and 12) to join the torque tube sections. Torque to 234 lbf.ft. Carry out ► electrical and pressurization checks on the torque tube transmission line assembly (see Appendix 1 and 2). Cover the open ends of the transmission ◄ line to prevent the ingress of moisture. Safeguard items 5 to 9 for later use.

Note ...

The top torque tube section is item 3, the section with a large head plate, whereas the others are item 1. This top torque tube section must be fitted as shown in Fig.17, with the head plate pivot holes at the lower end. At this time, carry out the deployment of the erection equipment described in para.29 below and use this to support and position the torque tube whilst the boom members are assembled beneath it. It may be necessary to rotate the pedestal slightly to achieve the correct orientation of the head plate. This can be done by turning the drive motor by hand.

Boom Assembly

24 The boom half-sections are assembled first and these are then combined to form complete sections. The boom is assembled upside-down on the ground beneath the torque tube sections, so that the front of the antenna (ie, the end with the smallest elements) is facing away from the pedestal. The boom

centre section is attached to the top torque tube section and the remaining boom sections are then attached to this. This procedure avoids the need to lift the completed boom assembly into position for erection. As the assembly proceeds, insert wooden packing pieces to support the boom clear o the ground. All the figures show the boom in the attitude in which it will be when assembly takes place.

Note ...

Refer to Chapter 6 for details of production variations which affect the boom assembly. The instructions given here relate to currently produced items.

24.1 Assemble the half sections of the boom as shown in Fig.18 to 25. Two identical assemblies are required of half sections 1, 2, 3, 4, 6 and 7, and one each of half sections 5A and 5B. When the half sections 5A and 5B are assembled, the bolts and reinforcing plates (items 15 and 24 of Fig.38, Table 38) must be fitted prior to the attachment of the channels (items 5). Do not tighten the fasteners on the half sections until the boom is completely assembled.

24.2 Assemble the half sections into complete sections, as shown in Fig.26 to 29.

24.3 Position boom section 5 below the top torque tube section, so that the pivot holes are aligned (see Fig.40). Insert the hinge bolt and secure it loosely with the washer and nut.

24.4 Attach boom section 6 to section 5 below the torque tube and towards the pedestal using items 1 to 8 (Fig.30 and Table 30).

24.5 Attach boom section 7 to section 6 using items 1 to 8 (Fig.31 and Table 31).

24.6 Attach boom section 4 to section 5 using items 1 to 8 (Fig.32 and Table 32).

24.7 Attach boom section 3 to section 4 using items 1 to 8 (Fig.33 and Table 33).

24.8 Attach boom section 2 to section 3 using items 1 to 7 (Fig.34 and Table 34).

24.9 Attach boom section 1 to section 2 using items 1 to 7 (Fig.35 and Table 35).

24.10 At the front end of boom section 1 fit four gusset plates (item 7 fixed with items 8, 9 and 10, Fig.42 and Table 42).

24.11 At the rear end of boom section 7 fit the cross braces using item 1, 2, 3 and 4 (Fig.36 and Table 36).

24.12 Check that the assembly of the boom is complete and correct, and that the sections are square before tightening the bolts. Torque all the fasteners in the boom assembly in accordance with the tables in Fig.52. Note that assemblies which contain fibreglass parts must be torqued to the lower values stated in the lower table.

24.13 Assemble the windsail using items 1 to 7 (Fig.37 and Table 37). Do not fit the windsail to the boom at this time, but put it aside safely for later use.

Element Assembly

25 Assemble and fit centre braces to the boom (Figs/Tables 38-41) and also the outer elements (Figs/Tables 44-46. At the outer element joints, prior to assembly, clean surfaces and grease with XG 264 (34D 2201049).

Note ...

Elements 1 to 6 are complete assemblies, elements 7 to 20 are built up sections.

25.1 Attach the centre sections of elements 1 to 20 to the boom on the rectangular fibreglass element mounts using the bolts, reinforcing plates, saddles, lock washers and nuts. See Fig.38 and Table 38 for assembly and items used. Position each element section with the drain holes facing up so that they will face down when the antenna is erected. Protect the drain holes against the entry of moisture. Do not tighten the nuts and bolts at this stage.

Note ...

Elements 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 15, 16, 17 and 20 are mounted in front of the fibreglass element mounts. Elements 3, 13, 14, 18 and 19 are mounted behind the element mounts.

Transmission line assembly

26 Assemble the transmission line, transformer line and feed line in accordance with the following instructions (Fig.39 to 43 and Table 39 to 43).

26.1 Refer to Fig.40 and Table 40. Position the transmission line adaptor (item 1) as shown in Fig.40, from the centre towards the rear of the boom, with the elbow and flange facing up and positioned 24 5/16 inches from the pivot bolt to transmission line centre.

Note ...

From this point the transmission line runs in a corner of the boom to the rear, through two elbows towards the centre of the boom. The transmission line then runs from the rear right to the front of the boom. At this point the inner conductor is connected to a feed line positioned below the transmission line, which runs to the rear of the boom.

26.2 Refer to Fig.41 and Table 41. Connect the transmission line (item 2) to the transmission line adaptor (item 1), using the connector kit (item 15), taking care to lubricate the 'O' ring with silicone grease and to locate it correctly. Torque to 11.5 lbf.ft. Connect an elbow (item 3) to the transmission line, as shown in Fig.39 and 41, using the connector kit (item 15) and ensure that the 'O' ring, fitted between the elbow and the transmission line, is correctly lubricated and positioned. Torque to 11.5 lbf.ft.

26.3 Fix the length of transmission line to the corner of the boom using the seven spacers and clamps (items 4, 5 and 6 of Fig.39 and Table 39), equally spaced. The two larger clamps (item 6) are required on the larger boom legs. Check that the 24 5/16 inches dimension (Fig.40) is still correct and adjust if necessary.

26.4 Attach a further elbow (item 4) to elbow (item 3), as shown in Fig.41, using the connector kit (item 15), and ensure that the 'O' ring is lubricated and correctly positioned. Torque to 11.5 lbf.ft.

26.5 Attach a transmission line (item 2) to the elbow previously fitted, using the connector kit (item 15). Ensure that the 'O' ring is lubricated and correctly positioned. Torque to 11.5 lbf.ft.

26.6 Attach a feed strap assembly (item 33 of Fig.38 and Table 38), as shown generally in Fig.38 and in more detail in Fig.39, so as to connect element 20 centre section to the transmission lines just fitted. Centralise the centre section but leave the mounting bolts and feed strap bolts loose at this stage. Do not fit the coil (item 3 of Fig.39, Table 39) at this time.

26.7 Attach the transformer assembly section 5 (item 9) to the transmission line using the connector kit (item 15), ensuring that the 'O' ring is lubricated and correctly positioned. Torque to 11.5 lbf.ft.

26.8 Attach a feed strap assembly so as to connect element 19 centre section to the transformer line, but with the connections reversed compared with those for element 20. Refer to Fig.39 - the left-hand side of element 20 is connected to the upper line (item 4) and the right-hand side to the other line (not yet fitted). The right-hand side of element 19 must be connected to the transformer line which is the extension of item 4. Centralise the centre section but leave the bolts loose.

Note ...

> As the assembly proceeds, ensure that the connections to each succeeding element are transposed, so that the elements are connected as shown in Fig.1 of Chapter 1.

26.9 Attach the remaining transformer line assemblies (items 8, 7, 6 and 5) in a similar manner, using the connector kits (items 16, 17, 18 and 19) respectively, ensuring that the 'O' rings are lubricated with silicone grease and are correctly positioned. Similarly, fit feed strap assemblies to each element.

26.10 Feed line upper (item 11) and strap, jumper, (item 10) are pre-assembled. Attach the strap, jumper, to the transformer line (item 5) using items 20 and 21 as shown in Fig.41 and 42. Torque to 6.5 lbf.ft. The feed line upper is now assembled on a line directly beneath the transformer line and below the elements.

26.11 Connect to the feed line upper (item 11) the feed line (item 12) using the feed line coupling (items 14 and 22), as shown in Fig.43 and Table 43. Attach feed strap assemblies between each element and the feed line as assembly proceeds, but leave the bolts loose.

26.12 Connect a further feed line (item 12) and feed strap assemblies in a similar way to the preceding description.

26.13 A 15m (50 ft) rope vibration damper (item 3 of Fig.44), fixed using items 4 to 8 of Fig.44, Table 44, is used inside the last three sections of the feed line. Assemble the last three sections of the feed line away from the boom, inserting the vibration damper, as shown in Fig.44. Install the complete assembly into the boom below the elements and connect to the rest of the feed line previously installed, using the connector (item 14) and hose clamp (item 22). Attach the element feed strap assemblies in a similar way, leaving the bolts loose.

26.14 Position all the element centre sections so that the transformer line and feed line are straight. Tighten all the element clamp bolts and feed strap assembly bolts. Torque the bolts to the following values.

TABLE 1 TORQUE VALUES, ELEMENT CLAMPS AND FEED STRAPS

Element Clamp Bolts					Feed Strap Assemblies
1 - 8	9 - 13	14 - 16	17, 18	19, 20	
5.8lbf.ft.	9lbf.ft.	23lbf.ft.	32lbf.ft.	65lbf.ft.	6.5lbf.ft.

► 26.15 Carry out electrical and pressurization checks on the boom transmission line assembly (see Appendix 1 and 2). Cover the end of the ◄ transmission line adaptor (item (1) to prevent the ingress of moisture.

26.16 Fit vibration dampers between the lines, (see Fig.39, items 7, 8, 9 and 10). Nine dampers are to be fitted, approximately equally spaced between elements 14 and 20, one between elements 14 and 15, one between elements 15 and 16, one between elements 16 and 17, two between elements 17 and 18, two between elements 18 and 19 and two between elements 19 and 20. The precise positioning of these dampers is not critical.

Remaining element assembly

27 Complete the element assembly as follows (Fig.45, 46 and 47 and Tables ► 45, 46 and 47). Grease outer elements with XG 264 and carry out electrical checks, (see Appendix 2 Para 11-3). ◄

CAUTION ...

All elements must be assembled with the drain holes facing up so that after erection they face down. Protect against ingress of moisture.

27.1 Refer to Fig.45 and Table 45. Starting with elements 7 and 8, attach short element section (item 13) using the pinch bolt and nut (item 17 and 20), and through bolt and nut (item 15 and 19). Torque items 17 and 20 to 21 lbf.ft. Torque items 15 and 19 to 6.5 lbf.ft.

27.2 Attach the remaining element sections in a similar manner. Do not, at this stage, connect up the outer elements (items 5 and 6 of Fig.47 and Table 47) on element 20, as these would foul the guys when being erected. Torque the fixing bolts to the following values -

1/4 inch diameter to 6.5 lbf.ft.
3/8 inch diameter to 21 lbf.ft.
1/2 inch diameter to 45 lbf.ft.

28 If the erection site is left after any elements have been installed on the boom, suitable fencing must be provided to prevent damage from animals or personnel. This temporary fencing is to be so installed as not to imped later erection of the antenna.

Antenna pre-erection

29 Prepare for antenna erection as follows (Fig.48 and 49, and Tables 48 and 49).

29.1 Attach the leather covered sling (item 1) to the torque tube immediately above the third joint, making two complete turns as shown in Fig.48.

29.2 To each end of the leather covered sling, attach a 30.5m (100 ft) T13 Tirfor rope (item 2) using 1 3/4 ton shackle (item 3).

29.3 Attach a Tirfor winch type T13 (item 4) to chain (item 5) and shackle the chain to guy anchor block A (see Fig.1) using a 1 3/4 ton shackle (item 3). Similarly, shackle a second winch and chain to the other guy block A.

29.4 Feed the Tirfor ropes (item 2) through the Tirfor winches and take up the slack.

29.5 Attach the sling (item 6) to the torque tube at the lifting point, using a 3 ton shackle (item 7) as shown in Fig.49.

29.6 Attach the 5 ton snatch block (item 8) to one end of the sling (item 11) using a 5 ton shackle (item 9).

29.7 Reeve the T35 Tirfor rope (item 10) through the snatch block and lay it out on the ground so that it is free of kinks and twists.

29.8 Feed the free end of the sling (item 11) up and over the pulley mounted between the twin lattice masts at the 18.3m (60 ft) level. Brir the free end down and attach it to the two ends of sling (item 6) using 5 ton shackle (item 9).

Note ...

The following instructions, paragraphs 32.9 to 32.10, are to prever rotation of the 5 ton snatch block and twisting of the Tirfor rope.

29.9 Thread a length of polyester rope (item 12) through the holes in the side of the 5 ton snatch block and tie it to form a loop.

29.10 Attach a T13 Tirfor rope (item 2) to the loop of polyester rope and reeve the free end through a T13 Tirfor winch (item 4). Attach the T13 Tirfor winch to the anchor block C using a 1 3/4 ton shackle (item 3

29.11 At the main winch anchor block D attach the spreader plate (item 13) using a 5 ton shackle (item 9).

29.12 Attach a TU32H Tirfor winch (item 14) to the upper hole in the spreader plate using the pin supplied with the winch.

29.13 Attach the hard eye end of the T35 Tirfor rope (item 10) to the lower hole in the spreader plate using a 3 ton shackle (item 7).

29.14 Reeve the free end of the T35 Tirfor rope through the TU32H Tirfor winch.

29.15 Take up the slack in the ropes by taking in on the three T13 Tirfor winches and TU32 Tirfor winch. Check all the connections and the lay of the gear. The antenna is now ready for erection.

Note ...

The gates at the 60 and 80 ft (18.3 and 24.4m) levels will be open, ready to receive the torque tube, as they were removed in sub-paras.3.7 and 3.11 above.

Erecting the antenna

30 Position the men as follows:

One man on each of the side T13 Tirfor winches
Two men on the TU32H Tirfor winch
One man on the T13 Tirfor winch attached to the snatch block
Two men at the end of the antenna boom nearest the base

Note ...

The supervisor is to control the erection of the antenna and should move about the site so as to view the operation to the best advantage.

CAUTIONS

(1) During erection no personnel should be allowed to pass beneath the antenna.

(2) The TU32H Tirfor winch must be operated smoothly so as to avoid exciting undue oscillation into the torque tube and antenna assembly.

(3) To prevent siezure of the TU32H Tirfor winch, lubricate the moving parts frequently during the erection operation, using oil OMD75.

(4) When sideways adjustment is necessary using the side stay T13 Tirfor winches, cease operating the TU32H Tirfor winch whilst this is carried out.

(5) As erection proceeds it will be necessary to maintain some tension on the T13 Tirfor winch attached to the snatch block. Initially this will need to be taken in but later it will need to be paid out.

30.1 Remove the pedestal packing positioned in para.11.11.

30.2 Apply an upward lift to the boom and torque tube by operating the TU32H Tirfor winch. Raise the assembly just clear of the ground and the supporting packing.

30.3 Check that the assembly of the antenna and the deployment of the erector gear are in agreement with the relevant figures contained in this chapter.

30.4 Remove all obstructions and spare equipment from the site.

30.5 Operate the TU32H Tirfor winch so as to raise the boom and torque tube assembly. As the erection proceeds, the two men on the end of the boom must walk forward, steadying the boom all the time. Check that the elements are not likely to collide with any temporary stays. Check from time to time whether adjustment of the side stays is necessary.

30.6 Continue the erection until the boom will swing clear of the ground and make an angle of 90 degrees with the torque tube.

30.7 Now lower the boom assembly so that the end is close to the ground. Place wooden blocks under the end of the boom to protect it. Lower the boom on to the blocks but do not allow the whole weight to be taken by the blocks, as this could damage the boom.

30.8 Approximately 1.5m (5 ft) from the end of the boom, in the direction away from the pedestal, drive a picket into the ground and secure the boom to it with a length of 10mm diameter polyester rope.

30.9 Refer to Fig.50 and Table 50. Climb the boom, wearing safety harness complete with two safety lines. Refer to Fig.53 for use of the safety equipment. Secure the boom to the top torque tube using two reinforcing plates and sixteen 1/2 inch bolts, nuts and lock washers (items 1 to 4). Torque to 45 lbf.ft. Fit eight 3/8 inch bolts, nuts, lock washers and plain washers (items 5 to 8) through the channel members, with the plain washers under the heads of the bolts where they pass through the slotted holes in the channel members. Torque to 19 lbf.ft.

30.10 Tighten the 1 inch nut (item 12) at the end of the hinge bolt (item 10). Do not torque this nut to the value stated in Fig.52, as this might cause distortion of the assembled parts.

30.11 In order to connect the transmission line at the boom to torque tube joint, loosen the hose clamps holding the adaptor to the side of the boom. Pull the flanges of the transmission line apart and remove the temporary covers. Locate the 'O' ring (part of connector kit item 13, Fig.16 and Table 16), lubricating it with silicone grease. Insert the connector (part of item 13) into each inner conductor. (These are the items safeguarded in para.23 above.)

30.12 Push the flanges of the outer conductor together, ensuring the 'O' ring is correctly positioned, and attach using the bolts, nuts and washers (part of item 13, Fig.16 and Table 16), items safeguarded in para.23 above. Torque to 11.5 lbf.ft.

30.13 Re-secure the transmission line with the hose clamps. Climb down from the boom.

30.14 Fit the remaining parts of element No.20 (Fig.47 and Table 47). Torque the 1/4 inch diameter bolts to 6.5 lbf.ft. and the 3/8 inch diameter bolts to 21 lbf.ft.

30.15 Remove the short restraining guy from the end of the boom. Raise the boom assembly a short distance from the ground. Fit the shorting coil (item 3, Fig.39 and Table 39) to the centre section of element 20 using the nuts and bolts which already secure the feed strap assembly. Torque to 6.5 lbf.ft.

30.16 Attach the windsail to the end of the boom using 3/8 inch nuts and bolts (items 6 and 7 in Table 37). Some of these nuts and bolts also attach the windsail mount to the boom (item 1 in Table 29). Torque to 21 lbf.ft.

30.17 Continue raising the boom assembly until the torque tube comes to rest in the bearings.

30.18 Climb the twin lattice mast and secure the torque tube with the two outer bearing halves (item 10 on Fig.5 and item 12 on Fig.6) using 5/8 inch x 1 3/4 inch bolts, nuts and washers (items 11, 8 and 12 on Fig.5 and items 17, 7 and 18 on Fig.6), items safeguarded in sub-para.3.7 and 3.10 above. Torque to 93 lbf.ft.

30.19 Secure the pedestal to its supporting members by fitting ten 5/8 inch x 2 inch bolts, nuts and washers (items 6, 7 and 8 of Fig.13 and Table 13). Torque to 145 lbf.ft. Carry out electrical and ► pressurization checks on the torque tube/boom transmission line assemblies (see Appendix 1 and 2). ◄

30.20 Disconnect all the erection equipment.

30.21 Slide the rubber boot down onto the pedestal and apply silicone grease liberally where the boot makes contact with the mast pedestal cover. Clamp the boot to the torque tube using the hose clamp.

Feeder connection

31 Carry out electrical checks and (if appropriate) pressurization checks on the coaxial feeder cable between the transmitter/receiver building and ► the antenna (see Appendix 1 and 2). Connect the coaxial feeder to the antenna and repeat the relevant electrical and pressurization checks. ◄

Earthing of twin lattice mast

32 Earth the twin lattice mast structure as follows (Fig.51 and Table 51).

32.1 Attach the earth wire (item 1) to the earthing rod (item 2) using the clamp (item 3).

32.2 Position the earthing rod several feet from the twin lattice mast and drive it a minimum of six inches below ground level.

32.3 Connect the earth wire to the twin lattice mast using the cable connector (item 4) and the 1/4 inch bolt, nut and washer (item 5, 6 and 7).

Site clearance

33 After completing the erection of the antenna, clear the site of all erection equipment. Grease all the shackles and rigging screws. Lock all the rigging screws with siezing wire. Finally, examine the guy anchorages for damage.

Painting

34 Carry out paint treatment to the twin lattice mast in accordance with RAFSEE Drawing No. SEE116319.

Power connection

35 WARNING ...

ENSURE ALL POWER IS SWITCHED OFF AND ISOLATED FROM THE TRANSMITTER/RECEIVER BUILDING BEFORE PROCEEDING WITH THE FOLLOWING.

Terminating the control cable

35.1 The control cable is to be terminated in accordance with the appropriate antenna pedestal circuit diagram. All wires are to be continuity checked to the remote control inside the transmitter/receiver hall by a competent Jun. Tech. Fitter Grade (or above) before applying mains power to the antenna.

35.2 The mains power cable carrying the three phase 415V and neutral ac supply into the antenna pedestal is to be installed by a Trade Group 5 Electrician or by PSA. The person carrying out the installation is to ensure that the antenna rotates in the correct direction in accordance with the following paragraph.

35.3 Set the LOCAL/REMOTE switch to LOCAL. Switch on the power to the antenna. Depending upon the type of control system, the antenna may rotate when power is applied. If rotation occurs, allow the antenna to rotate until it eventually stops.

Rotate the antenna using the local control switch. Depending upon the particular control system used, the local control switch will be either:-

a. A three position toggle switch; in this case select CW rotation, or
b. A twelve position rotary switch; in this case, rotate the switch 30 degrees in a clockwise direction.

Both of the above actions will cause the antenna to rotate, but the direction of the rotation depends on the connection of the line wires. If the rotation is not clockwise (as viewed from above), switch off the power to the pedestal and interchange any two of the three line wires connected to the circuit breaker 2CB1. Restore the power and check that clockwise rotation is achieved.

Antenna alignment

36 When the antenna is first placed into service, or after replacement of parts, it is necessary to align the pointing system. The method of adjustment depends upon the control system used.

Continuous control

37 At the antenna, set the LOCAL/REMOTE switch to LOCAL. Rotate the antenna until it points to true north by operating the CW/CCW switch. Switch off power at the antenna. At the remote control, remove the back cover from the unit and slacken the three screws on the receiving synchro clamp. Apply power temporarily at the antenna and rotate the receiving

synchro until the pointer indicates 0 degrees, corresponding to true north. Tighten the clamp screws.

WARNING ...

115V supply is present between terminals within the remote control and care must be taken to avoid accidental contact.

Stepped control - 12 position local control switch

38 At the remote control, set the bearing selector switch to north. At the antenna, set the local bearing selector switch to north. Set the LOCAL/REMOTE switch to LOCAL. Switch on the power. The antenna will rotate until it finds the open switch segment and will then stop. If it is not pointing to true north, carry out the following adjustment.

39 Switch off the power. At the local control, loosen the panel fixing screws and open the panel. Locate the gear driven switch 2S1 in the upper left corner. Disconnect the switch from the gear drive. The method used depends upon the actual construction of the unit. The preferred method is to slacken the three nuts securing the mounting plate and slide the plate sideways. Be careful not to alter the rotary position of the switch. Switch on the power.

WARNING ...

415V and 115V supplies are present between terminals within the unit and care must be taken to avoid accidental contact.

Manually rotate the antenna by firmly pressing upward one of the two buttons on the underside of relay assembly 2K1. Stop when the antenna reaches true north. Switch off the power.

40 Reconnect switch 2S1 to the gear drive, without altering its rotational position, and tighten the three nuts. Switch on the power. Rotate switch 2S2 clockwise 30 degrees. The antenna should rotate clockwise 30 degrees from north towards north-east.

41 If component replacement has taken place, it is possible that the antenna may rotate counter-clockwise. In this case, switch off the power and interchange the two black wires which go from switch 2S1 to the relay assembly 2K1. These two wires are not identified and there is no other way to ensure correct connection.

42 Switch on the power. Check that the antenna now turns in the correct direction and also points to true north when switch 2S2 is set to north.

43 Switch to REMOTE and check the operation of the switch in the remote control.

Stepped control - 3 position toggle local control switch

44 At remote control, set the bearing selector switch to north. At the antenna, set the LOCAL/REMOTE switch to REMOTE. Switch on the power. The antenna will rotate until it finds the open switch segment and will then stop. If it is not pointing to true north, carry out the following adjustment.

45 Switch off the power. At the local control, loosen the panel fixing screws and open the panel. Locate the gear driven switch 2S1 in the upper left corner. Disconnect the switch from the gear drive. The method used depends upon the actual construction of the unit. The preferred method is to slacken the three nuts securing the mounting plate and slide the plate sideways. Be careful not to alter the rotary position of the switch.

46 Set the LOCAL/REMOTE switch to LOCAL. Switch on the power.

WARNING ...

415V and 115V supplies are present between terminals within the unit and care must be taken to avoid accidental contact.

Using the CW/CCW switch, rotate the antenna until it points to true north. Switch off the power. Reconnect switch 2S1 to the gear drive and tighten the three nuts. Switch on the power. Using the CW/CCW switch, rotate the antenna about 30 degrees away from north. Set the LOCAL/REMOTE switch to REMOTE. The antenna should rotate directly to true north and stop.

47 The antenna should always take the shortest route when the bearing is changed. If component replacement has taken place, it is possible that the antenna may rotate in the wrong direction. In this case, switch off the power and interchange the two black wires which go from switch 2S1 to the relay assembly 2K1. These two wires are not identified and there is no other way to ensure correct connection.

48 Switch on the power and check correct rotation in accordance with the operation of both the local and remote switches.

Continuous control - computer controlled remote unit

49 When the remote Control 1520-900( ) is fitted, proceed as follows. At the antenna, set the LOCAL/REMOTE switch to LOCAL. Switch on the power. Using the CW/CCW switch, rotate the antenna until it points to true north. At the remote control, note the antenna bearing shown on the display. Refer to Chapter 6.3 for information relating to azimuth correction. Switch off power to the unit and remove the top cover. Operate the azimuth correction switches to correct the displayed bearing. Switch on the power and check that the correct bearing is displayed, ie, '000'. If necessary, readjust the azimuth correction switches. Switch off the power and refit the top cover to the unit.

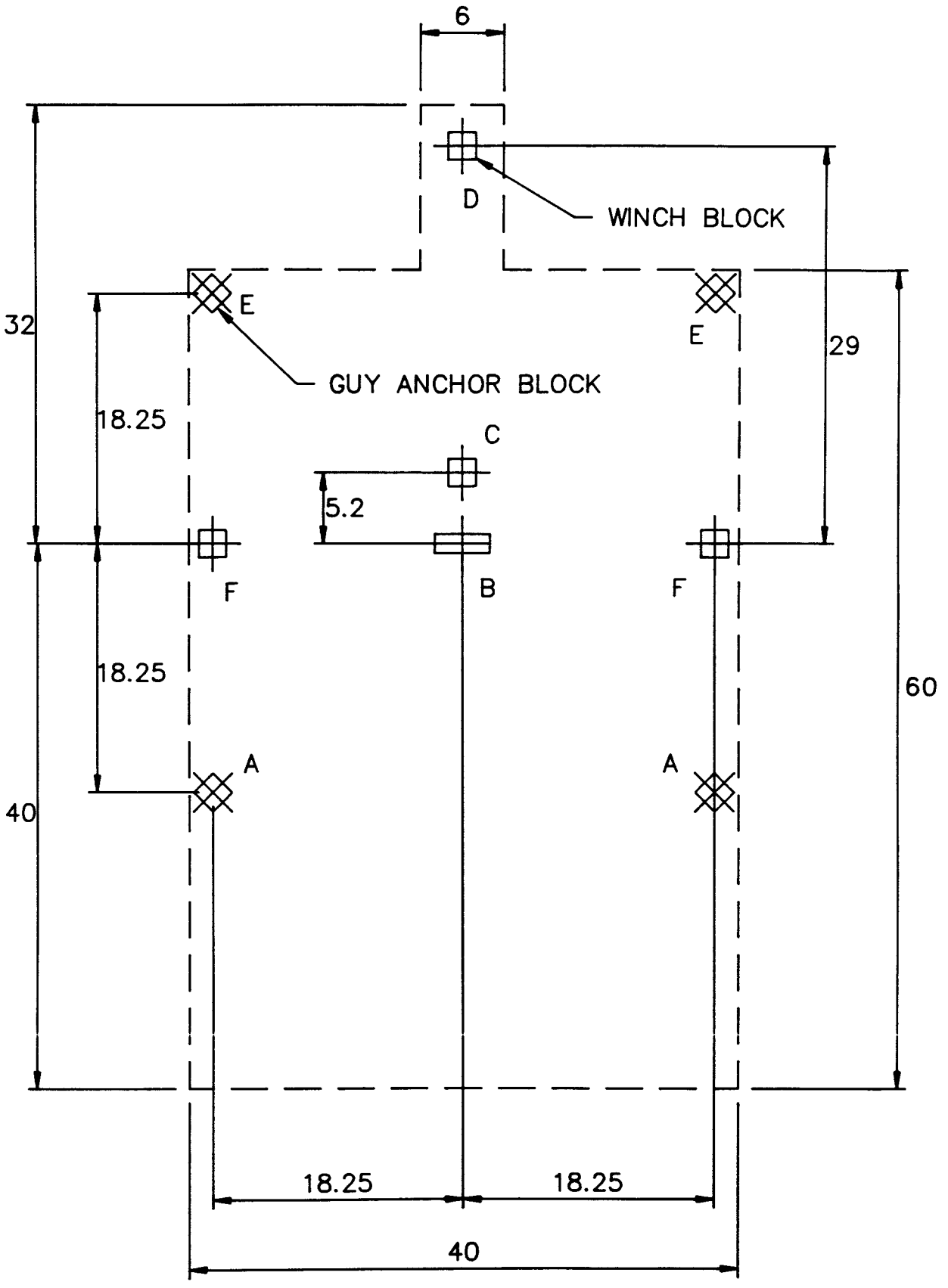


Fig 1 Site Plan– dimensions in metres
(Details in accordance with 90G110166)

TABLE 2 ITEMS LIST FOR FIG.2

Item	Ref./Part No.	Description	Qty.
1	5445-99-627-2481	Mast section, bottom LH	1
2	5445-99-627-2479	Mast section, bottom RH	1
3	0001-7934-002	Base assembly	1
4	0001-7933-001	Clamp, base hinge	2
5	2076-4374-001	Bolt, hex hd, $^3/_4$-10x2$^3/_4$, galv, Hi.St.	18
6	5310-99-627-2412	Washer, lock $^3/_4$, galv.	30
7	2100-0878-001	Nut, hex, $^3/_4$-10, galv. Hi.St.	18
8	2349-0092-001	Washer, square, bevelled, $^3/_4$ galv.	4
9	2450-0191-001	U-Bolt, with nuts	2
10	2310-0153-001	Washer, plain $^3/_4$, galv.	12
11	2100-0133-001	Nut, hex, $^3/_4$-10, galv.	12

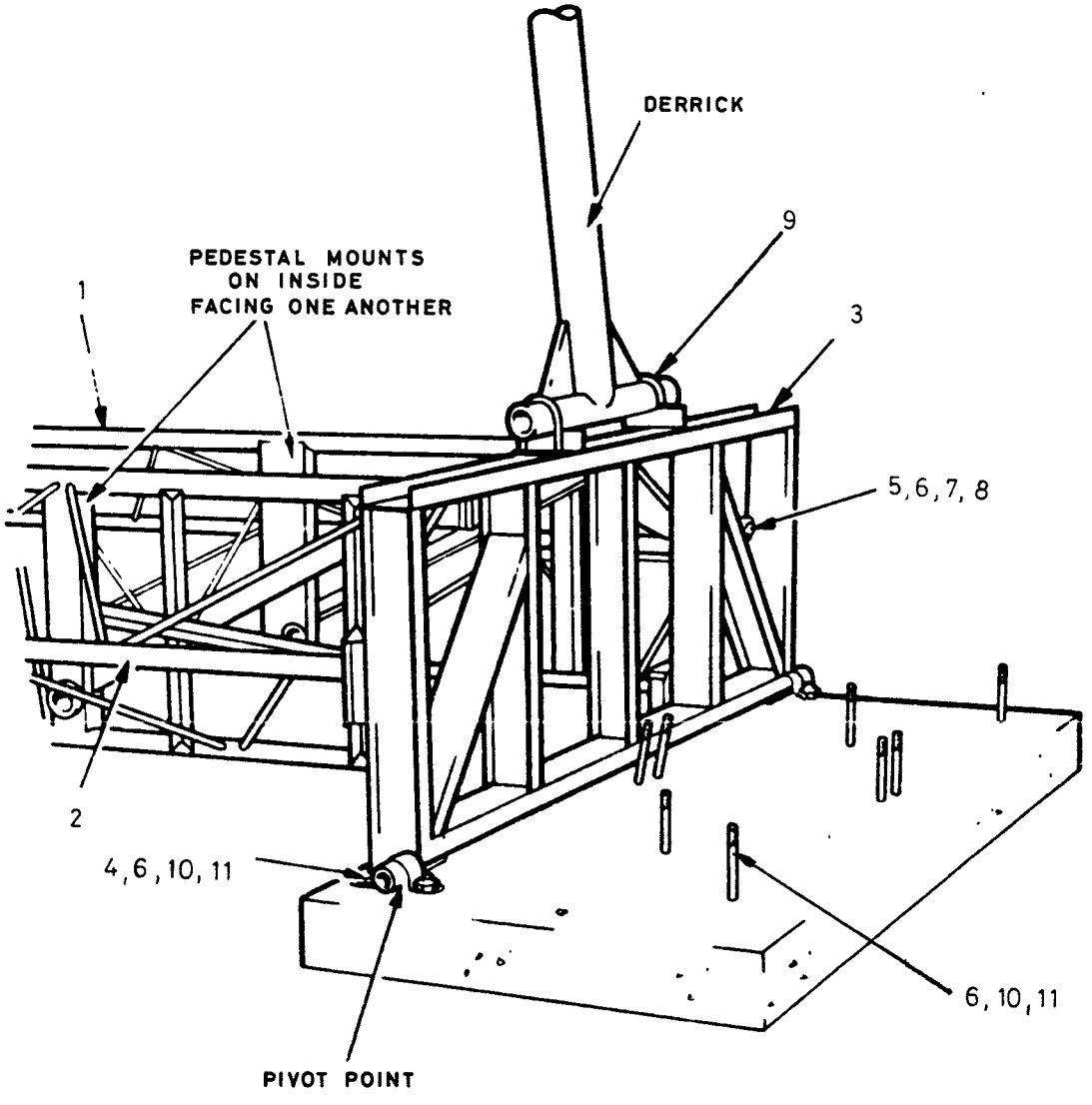


Fig. 2 Base and derrick installation

TABLE 3 ITEMS LIST FOR FIG.3

Item	Ref./Part No.	Description	Qty.
1	0001-7920-001	Mast section	6
2	5445-99-627-2481	Mast section, bottom LH	1
3	5445-99-627-2479	Mast section, bottom RH	1
4	0001-7922-001	Brace, diagonal	84
5	0001-7921-001	Brace, horizontal	12
6	2077-6810-001	Bolt, hex hd, $^3/_8$-16x1$^1/_2$, galv.	102
7	5310-99-627-2425	Nut, hex, $^3/_8$-16 galv.	102
8	5985-99-626-9325	Washer, lock, $^3/_8$, galv.	102
9	2076-4316-001	Bolt, hex hd, $^1/_2$-13x1$^1/_2$, galv, Hi.St.	54
10	2100-0876-001	Nut, hex, $^1/_2$-13, galv, Hi.St.	72
11	2300-0155-001	Washer, lock, $^1/_2$, galv.	72
12	2076-4320-001	Bolt, hex hd, $^1/_2$-13x2, galv, Hi.St.	18
13	0002-1604-407	Intermediate guy bracket, RH	1
14	0002-1604-401	Intermediate guy bracket, LH	1

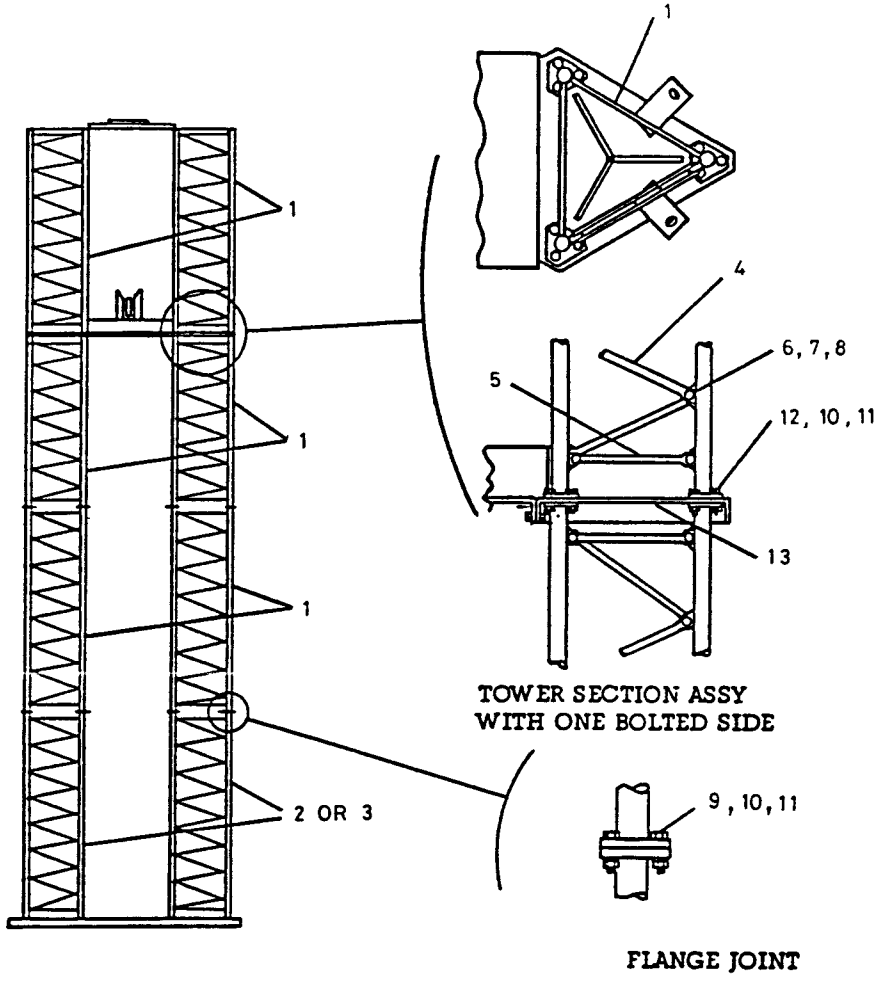


Fig.3 Twin lattice mast assembly

TABLE 4 ITEMS LIST FOR FIG.4

Item	Ref./Part No.	Description	Qty.
1	0001-7920-001	Mast section	6
2	0002-1604-407	Intermediate guy bracket, RH	1
3	0002-1604-401	Intermediate guy bracket, LH (not shown)	1
4	2076-4320-001	Bolt, hex hd, $^1/_2$-13x2, galv, Hi.St.	18
5	2300-0155-001	Washer, lock, $^1/_2$, galv.	18
6	2100-0876-001	Nut, hex, $^1/_2$-13, galv, Hi.St.	18
7	SEE206171	Intermediate guy	4

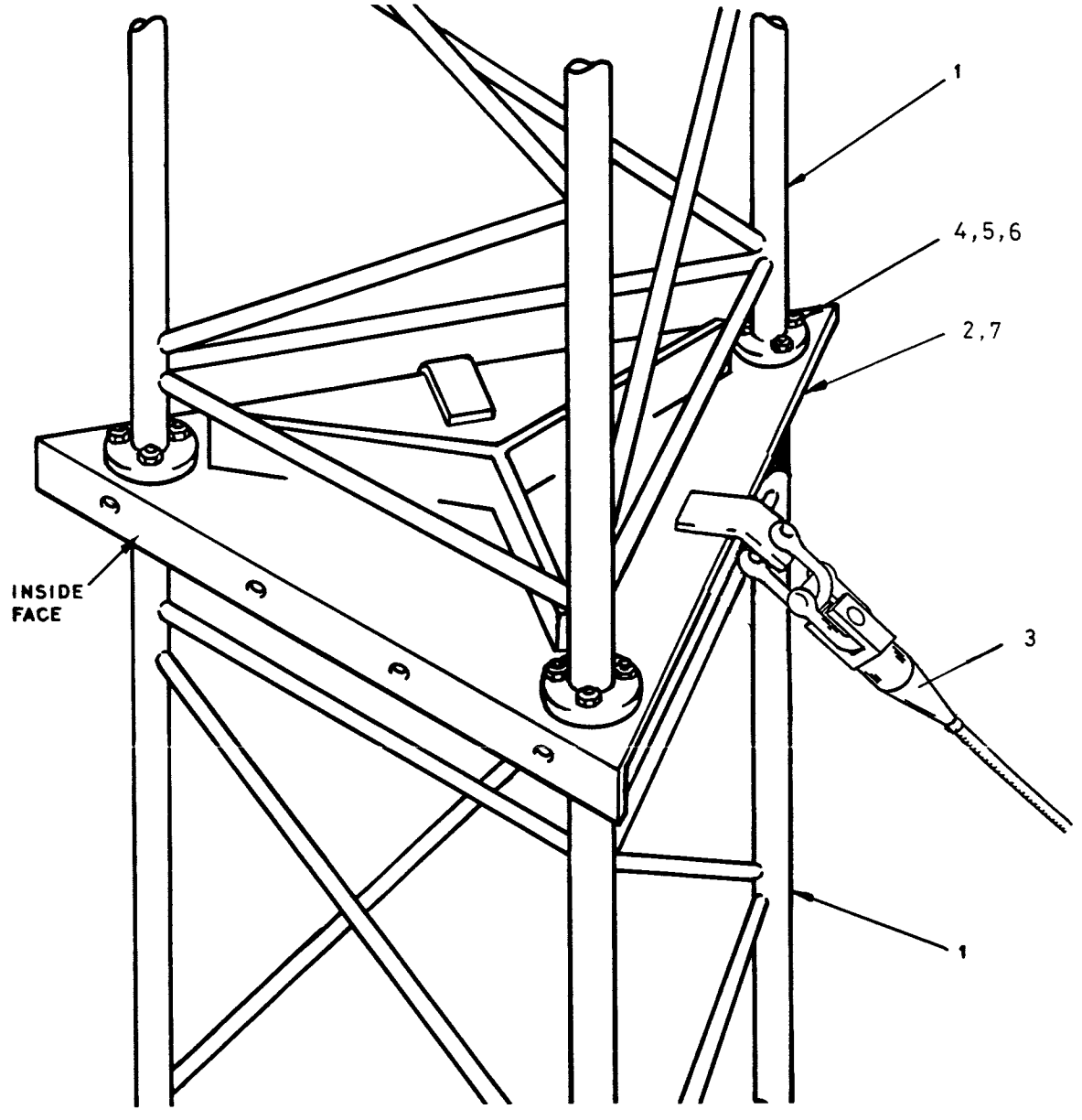


Fig.4 Intermediate guy attachment (viewed in erected position)

TABLE 5 ITEMS LIST FOR FIG.5

Item	Ref./Part No.	Description	Qty.
1	0001-7926-001	Bearing plate assembly	1
2	0002-1604-401	Intermediate guy bracket, LH	1
3	0002-1604-407	Intermediate guy bracket, RH	1
4	0002-8866-302	Erection bracket	1
5	0002-8866-301	Erection bracket	1
6	2076-4341-001	Bolt, hex hd, $^5/_8$-11x1$^3/_4$,galv,Hi.St.	4
7	2076-4344-001	Bolt, hex hd, $^5/_8$-11x2$^1/_2$,galv,Hi.St.	4
8	5310-99-722-4631	Washer, lock, $^5/_8$, galv.	12
9	2100-0877-001	Nut, nex, $^5/_8$-11, galv, Hi.St.	8
10	0001-4250-001	Outer welded assembly	1
11	2077-7907-001	Bolt, hex hd, $^5/_8$-11x1$^3/_4$, galv.	4
12	2100-0131-001	Nut, hex, $^5/_8$-11, galv.	4

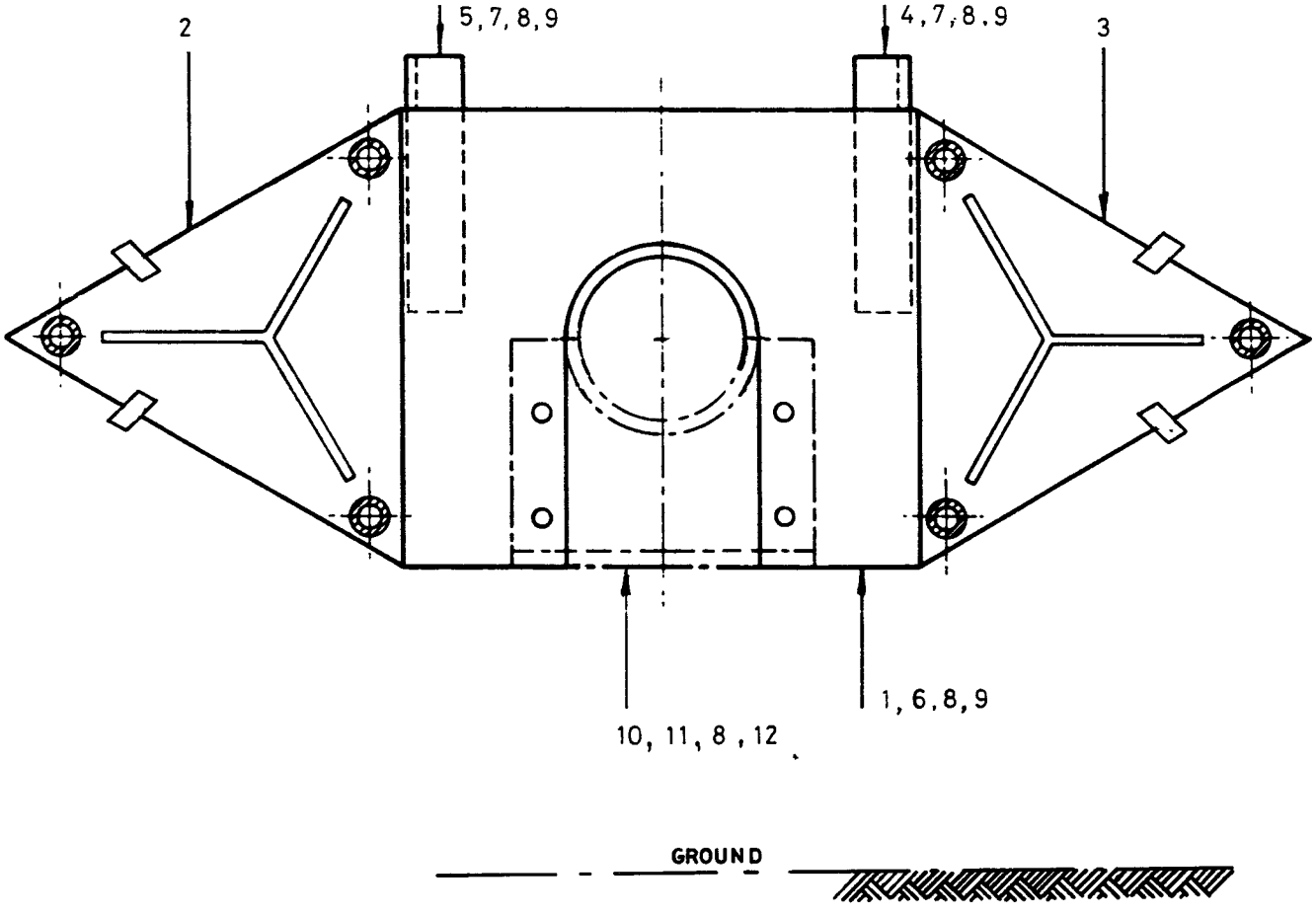


Fig. 5 Intermediate guy attachment and bearing assembly viewed from top of twin lattice mast.

TABLE 6 ITEMS LIST FOR FIG.6

Item	Ref./Part No.	Description	Qty.
1	0001-7913-001	Guy bracket	2
2	0001-7926-001	Bearing plate assembly	1
3	0002-8866-302	Erection bracket LH	1
4	0002-8866-301	Erection bracket RH	1
5	2076-4341-001	Bolt,hex hd, $^5/_8$-11x1$^3/_4$, galv,Hi.St.	4
6	2076-4344-001	Bolt,hex hd, $^5/_8$-11x2$^1/_2$, galv,Hi.St.	4
7	5310-99-722-4631	Washer, lock, $^5/_8$, galv.	12
8	2100-0877-001	Nut, hex, $^5/_8$-11, galv, Hi.St.	8
9	2076-4316-001	Bolt,hex hd, $^1/_2$-13x1$^1/_2$, galv,Hi.St.	18
10	2300-0155-001	Washer, lock, $^1/_2$, galv.	18
11	2100-0876-001	Nut, hex, $^1/_2$-13, galv, Hi.St.	18
12	0001-4250-001	Outer welded assembly	1
13	5820-00-105-5027	Bearing half, sleeve	2
14	5305-99-627-2453	Screw, pan hd slt, No.10-24x$^7/_8$, SST	12
15	5310-99-624-4058	Washer, lock, No.10, SST	12
16	5310-99-120-6257	Nut, hex, No.10-24 SST	12
17	2077-7907-001	Bolt, hex hd, $^5/_8$-11x1$^3/_4$, galv.	4
18	2100-0131-001	Nut, hex, $^5/_8$-11, galv.	4
19	3940-99-519-7422	Block, tackle	1
20	4030-99-960-4348	Large D shackle, $^5/_8$ pin,SWL 0.75ton	1
21	4020-99-933-1559	Rope, polyester 6mm	61m

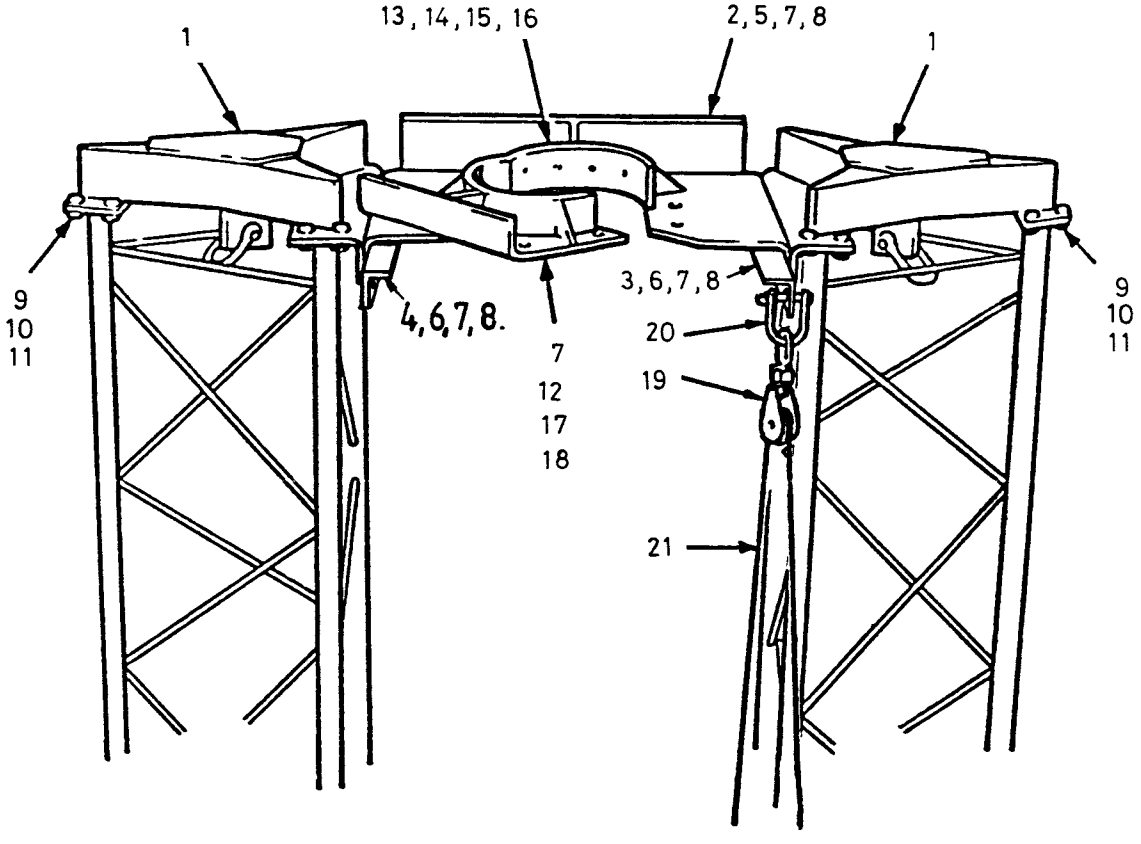


Fig. 6 Top guy attachment and bearing assembly

TABLE 7 ITEMS LIST FOR FIG.7

Item	Ref./Part No.	Description	Qty.
1	SEE 188282	Guy	2
2	SEE 206203	Spreader plate	2
3		Long link chain 1in.dia.x1ft.6in.lg.	1
4		Long link chain 1in.dia.x6ft.lg.	1
5		Shackle small D, 1in.pin	4
6		Rigging screw, Pattern 26, $1\frac{1}{4}$in.dia.	1

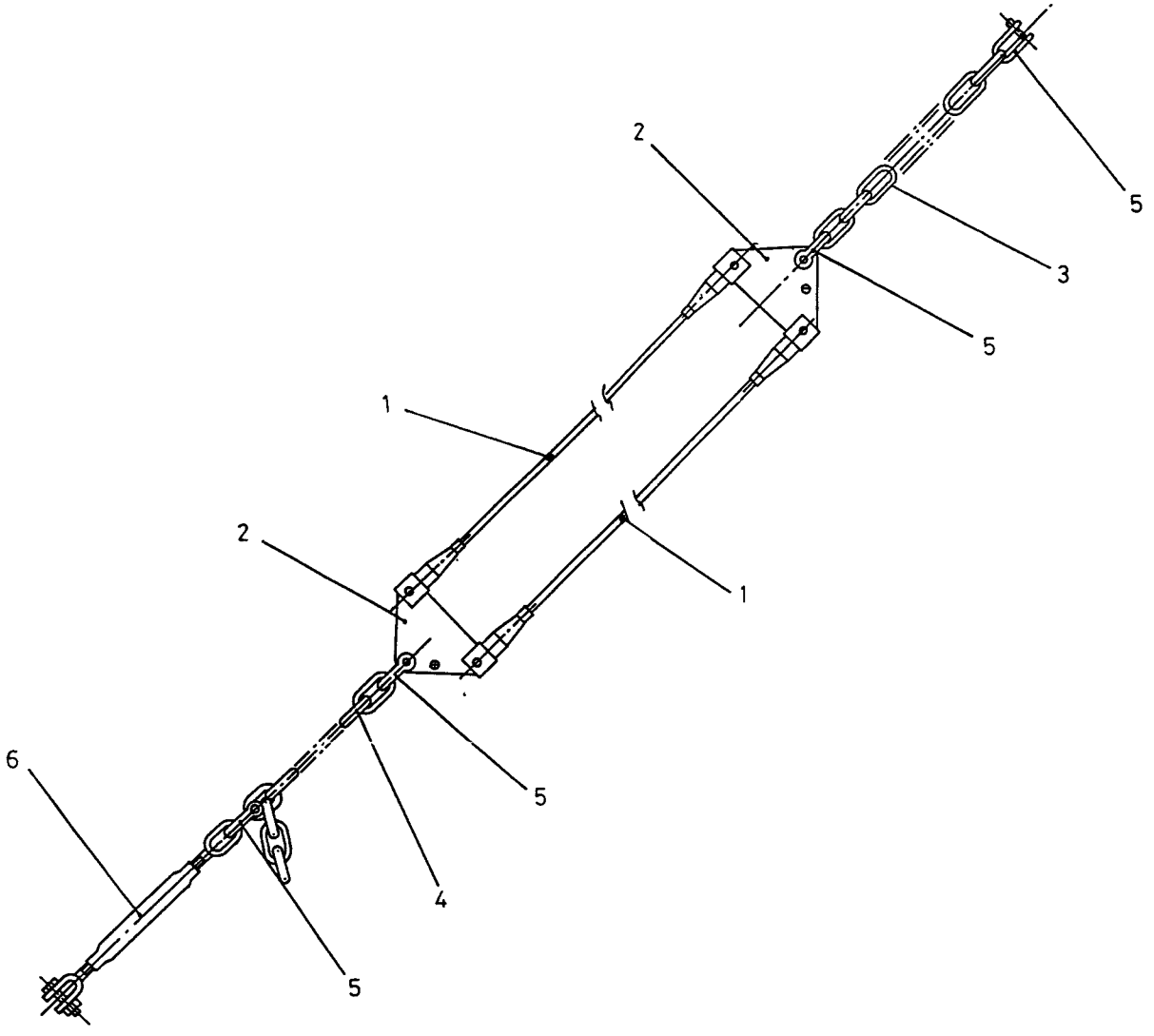


Fig.7 Top guy assembly

TABLE 8 ITEMS LIST FOR FIG.8

Item	Ref./Part No.	Description	Qty.
1	SEE 188281	Mast intermediate guy	1
2		Rigging screw, Pattern 26, 1in. dia.	1
3		Shackle small D, $^{7}/_{8}$in. pin	3
4		Long link chain $^{3}/_{4}$in. dia.x6ft.lg.	1

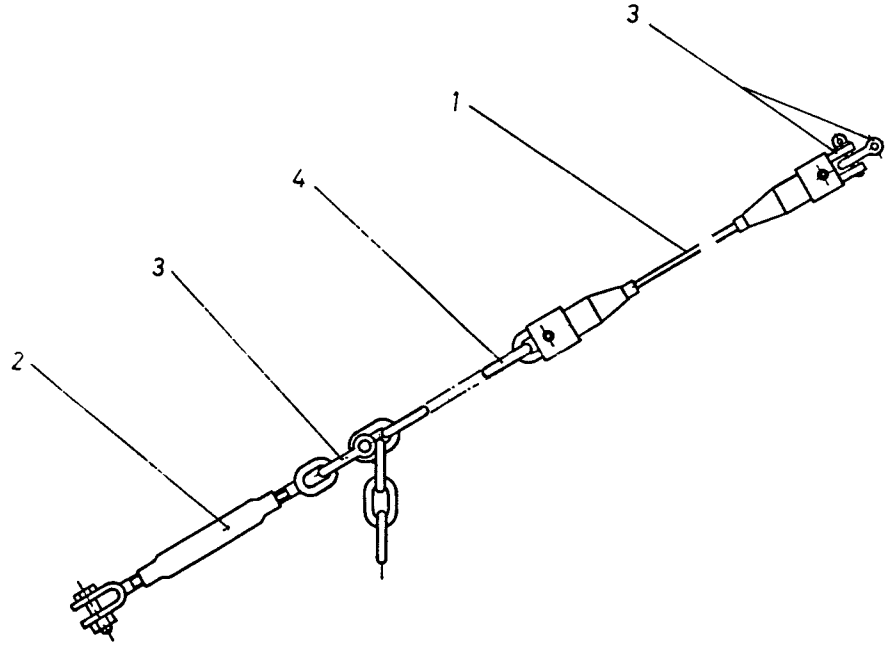


Fig.8 Intermediate guy assembly

TABLE 9A ITEMS LIST FOR FIG.9A

Item	Ref./Part No.	Description	Qty.
1	0002-1616-301	Pulley bracket assy	1
2	0002-1608-001	Clamp	2
3	2077-6453-001	Bolt, hex hd, $^3/_8$ - 16x$1^1/_2$ galv.	8
4	5935-99-626-9325	Washer, lock $^3/_8$ galv.	8
5	5310-99-627-2425	Nut, hex $^3/_8$ - 16 galv.	8

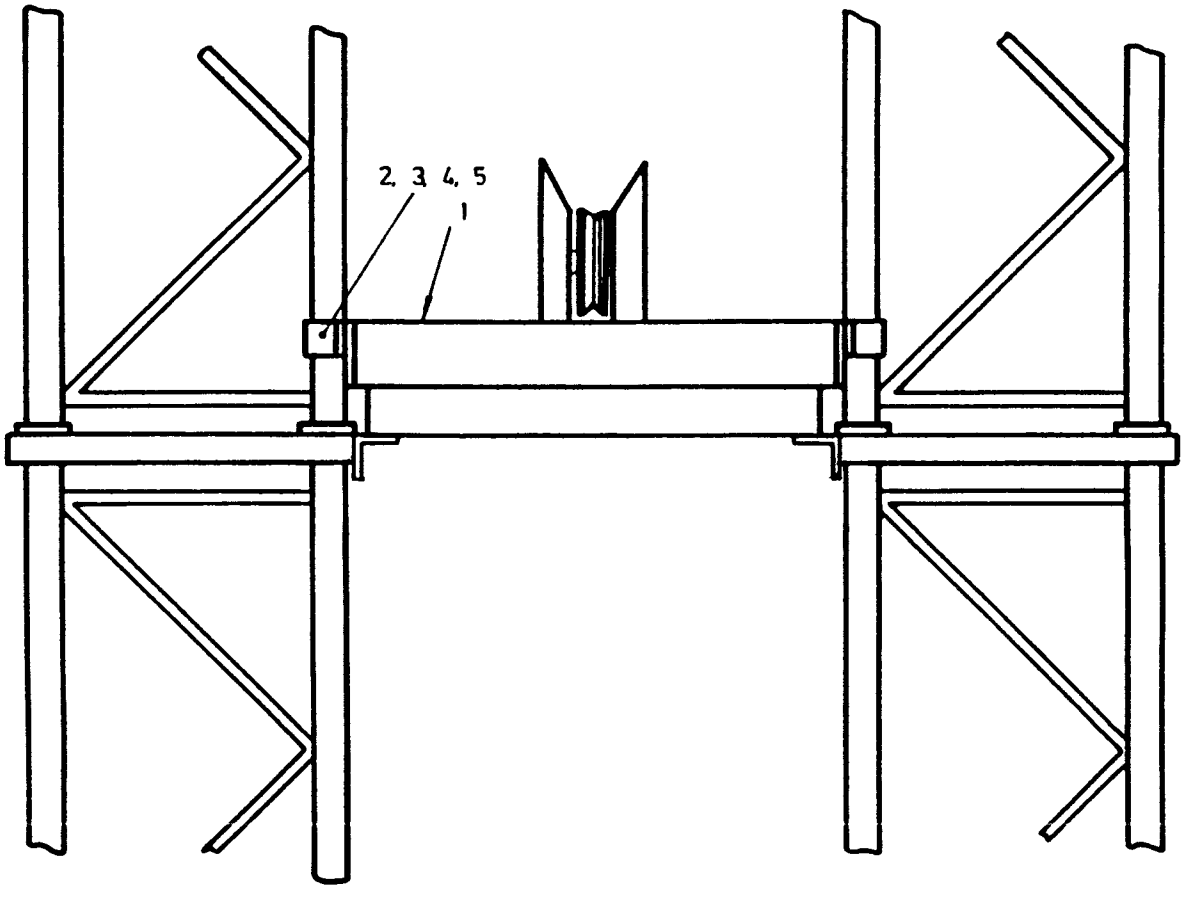


Fig. 9A Pulley bracket assembly

TABLE 9 ITEMS LIST FOR FIG.9

Item	Ref./Part No.	Description	Qty.
1	SEE 188122	Fishplate	8
2		Bolt, hex hd, M24x70mm lg, 8.8st, galv.	8
3		Nut, hex, M24, 8st, galv.	8
4		Washer, Lock, M24 bolt size, galv.	8
5	SEE 206169	LPH73 Top guy assembly	4

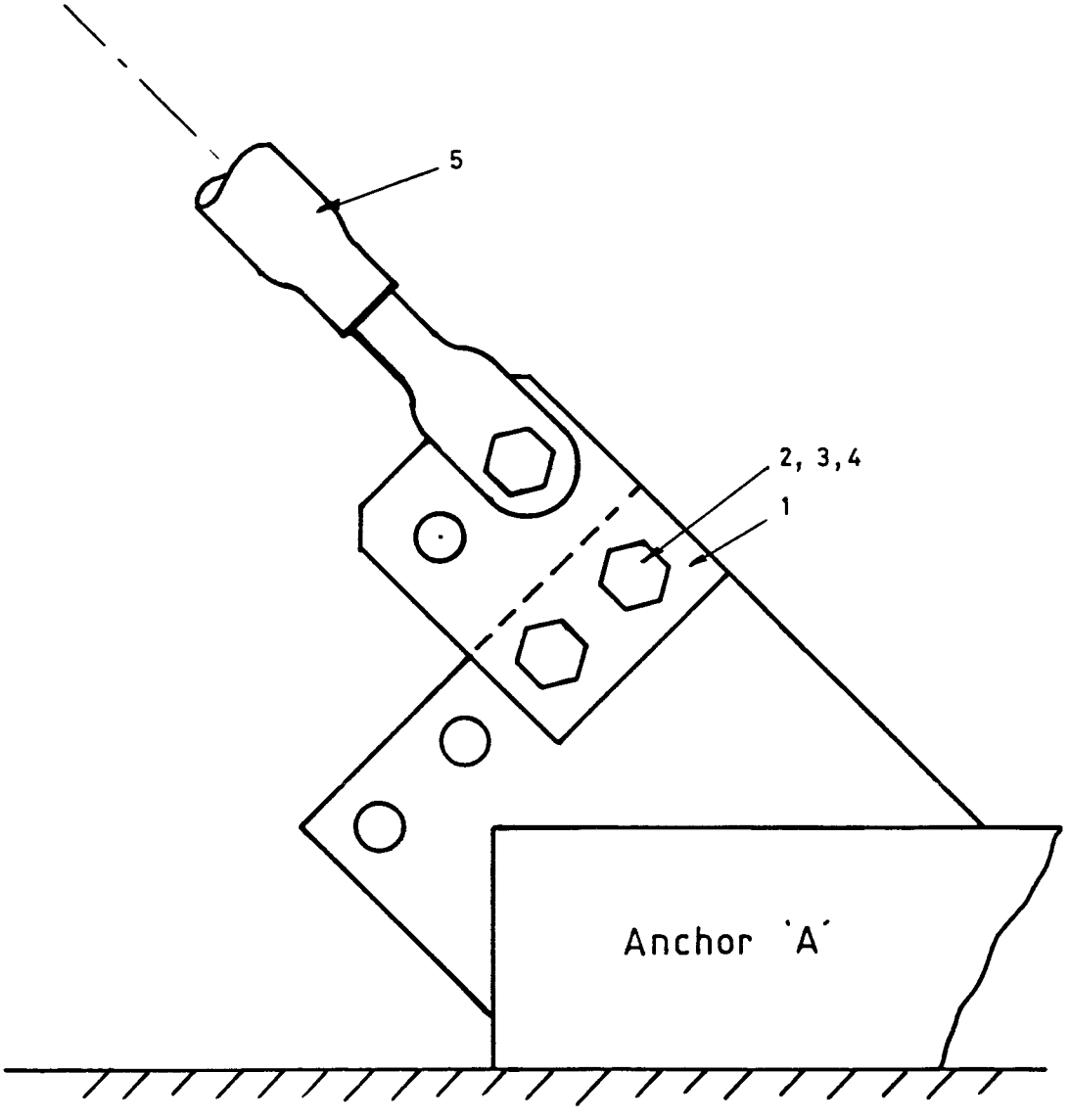


Fig. 9 Anchor block details

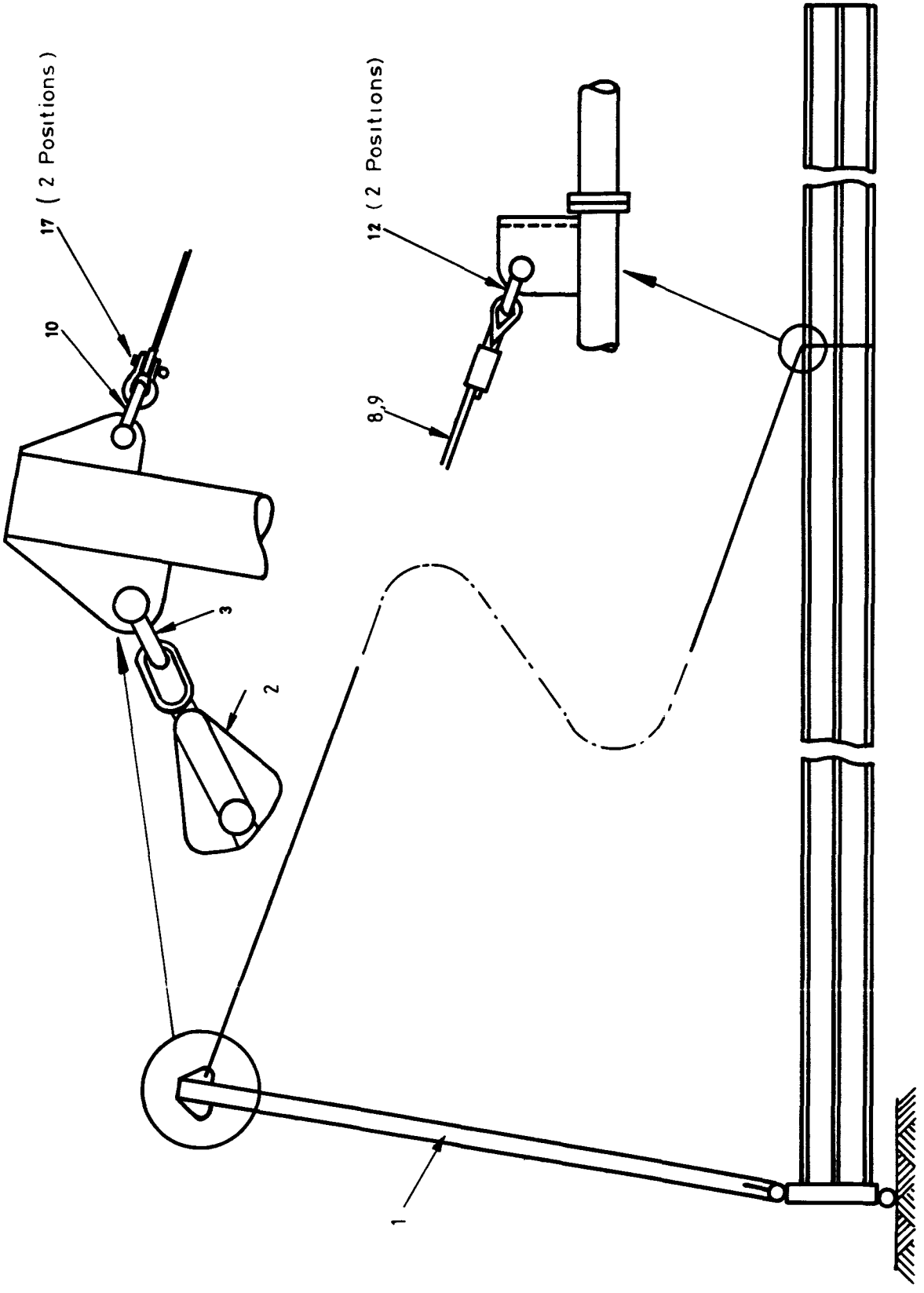


Fig. 10 Derrick attachment

TABLE 10 ITEMS LIST FOR FIG.10

Item	Ref./Part No.	Description	Qty.
1	90G 110723	Derrick assembly, tower	1
2	3940-99-425-3457	Snatch block, 12in.sheave SWL 5t	2
3	4030-99-638-8199	Shackle, large Dee, $1^1/_4$in.dia. pin, SWL 5t.	1
4	4010-99-638-9347	Guy	2
5	5985-99-933-3888	Guy	2
6	3950-99-201-3244	Tirfor Winch T7	2
7	3950-99-204-6346	Tirfor winch T13	2
8	4010-99-638-8200	Sling	1
9	4010-99-638-8409	Sling	1
10	4030-99-638-8201	Shackle, large Dee, $1^1/_8$in.dia. pin, SWL $3^3/_4$t	9
11	4010-99-202-9032	Tirfor rope T7x60 ft. lg	2
12	4030-99-960-4349	Shackle, large Dee, $^3/_4$in.dia. pin, SWL $1^1/_2$t	4
13	4010-99-638-8202	Guy	1
14	4L/4013	Tirfor winch type TU32H	1
15		Longlink chain, $^5/_8$in.dia.x6ft.lg	4
16	4010-99-523-8376	Tirfor rope T35x100ft.lg	1
17	4030-99-638-8203	Shackle, large Dee, 1in.dia. pin, SWL 3t	2
18	4010-99-523-8374	Tirfor rope T13x100ft.lg	2

TABLE 11 ITEMS LIST FOR FIG.11

Item	Ref./Part No.	Description	Qty.
1	5985-99-933-3888	Wire rope assembly, 15.2m (50ft)	2
2	4010-99-638-9347	Wire rope assembly, 10ft.	2
3	3950-99-204-6346	Tirfor winch type T13	2
4	4010-99-523-8374	Tirfor rope T13x30.5m (100ft)	2
5	4030-99-960-4349	Shackle, large Dee, $^3/_4$in.dia. pin, SWL $1^1/_2$t	6

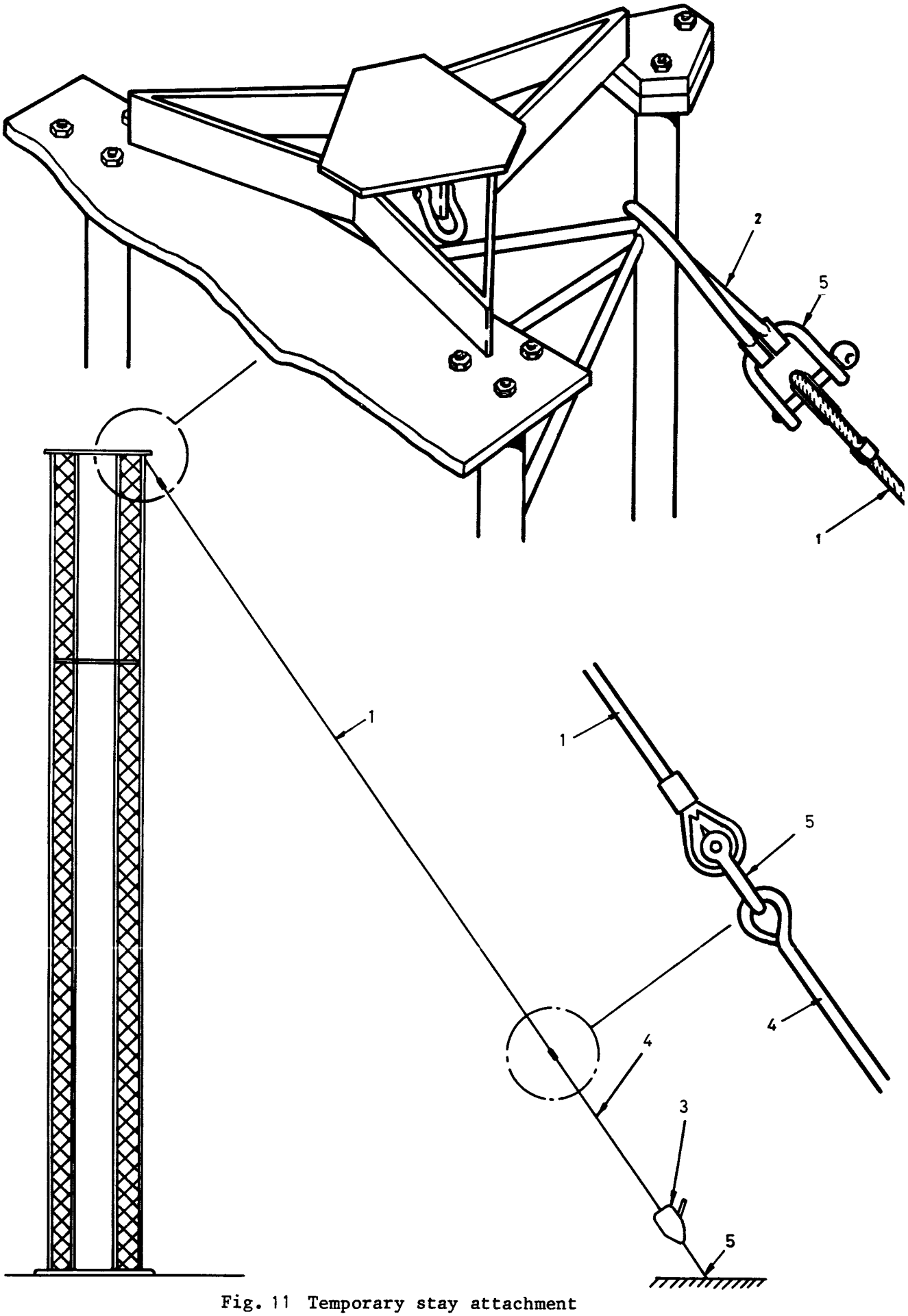


Fig. 11 Temporary stay attachment

TABLE 12 ITEMS LIST FOR FIG.12

Item	Ref./Part No.	Description	Qty.
1	4030-99-960-4349	Shackle, large Dee, $^{3}/_{4}$in.dia. pin SWL $1^{1}/_{2}$t	4
2	4030-99-638-8199	Shackle, large Dee, $1^{1}/_{4}$in. dia. pin SWL 5t	4
3	3940-99-425-3432	Two leg sling	1
4	3940-99-425-3457	Snatch block, 12in. sheave, SWL.5t	1
5	4L/4013	Tirfor winch type TU32H	1
6	4010-99-798-2590	Tirfor rope T35 x 70m	1
7		Chain $^{5}/_{8}$in.dia, long link x 6ft	2

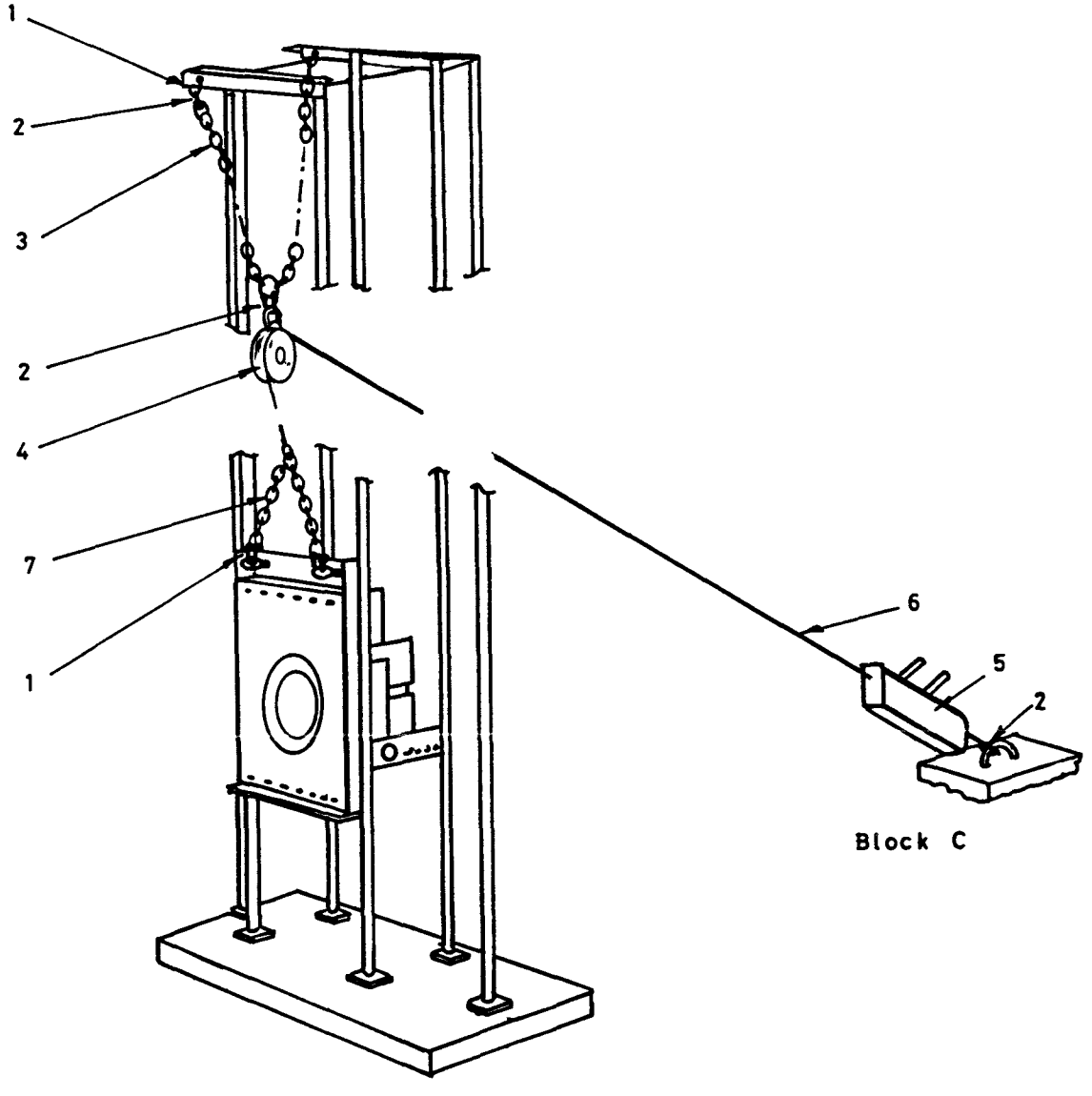


Fig.12 Lifting of pedestal

TABLE 13 ITEMS LIST FOR FIG.13

Item	Ref./Part No.	Description	Qty.
1	0001-7935-001	Angle, tie down	4
2	0001-7945-001	Channel, tie down	2
3	2078-2826-001	Bolt, hex hd, $^{3}/_{8}$-16x3$^{1}/_{2}$,	1
4	5310-99-450-6703	Washer, lock, $^{3}/_{8}$,	1
5	5310-99-944-2935	Nut, hex, $^{3}/_{8}$-16,	1
6	2076-4342-001	Bolt, hex hd, $^{5}/_{8}$-11x2, Hi. St, galvanised	10
7	5310-99-627-2413	Washer, lock, $^{5}/_{8}$, galvanised	10
8	2100-0877-001	Nut, hex, $^{5}/_{8}$-11, Hi.St, galvanised	10

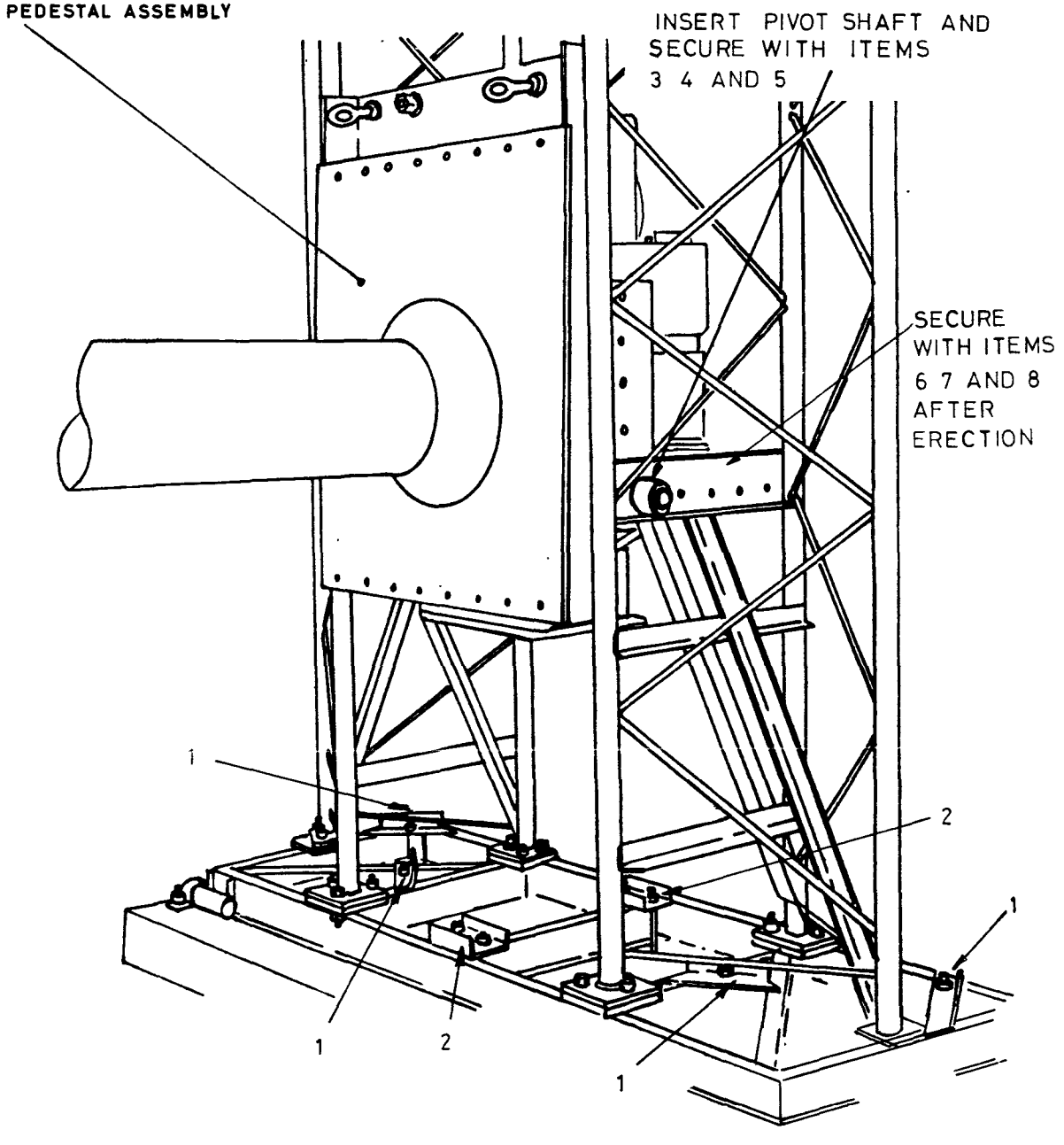


Fig. 13 Pedestal mounting

TABLE 14 ITEMS LIST FOR FIG.14

Item	Ref./Part No.	Description	Qty.
1	5985-99-116-9468	Rotary joint	1
2	5305-99-134-0505	Bolt, hex hd, $^{1}/_{4}$-20x1, SST	4
3	5310-99-111-1293	Lock washer, $^{1}/_{4}$, SST	4
4	5310-99-944-2936	Nut, hex, $^{1}/_{4}$-20, SST	4
5	5985-99-627-2472	Transmission line, short	1
6	5330-99-627-2182	O ring	1
7	5306-99-946-9818	Bolt, hex hd, $^{5}/_{16}$ -18x1, SST	4
8	5310-99-120-9059	Lock washer, $^{5}/_{16}$ SST	4

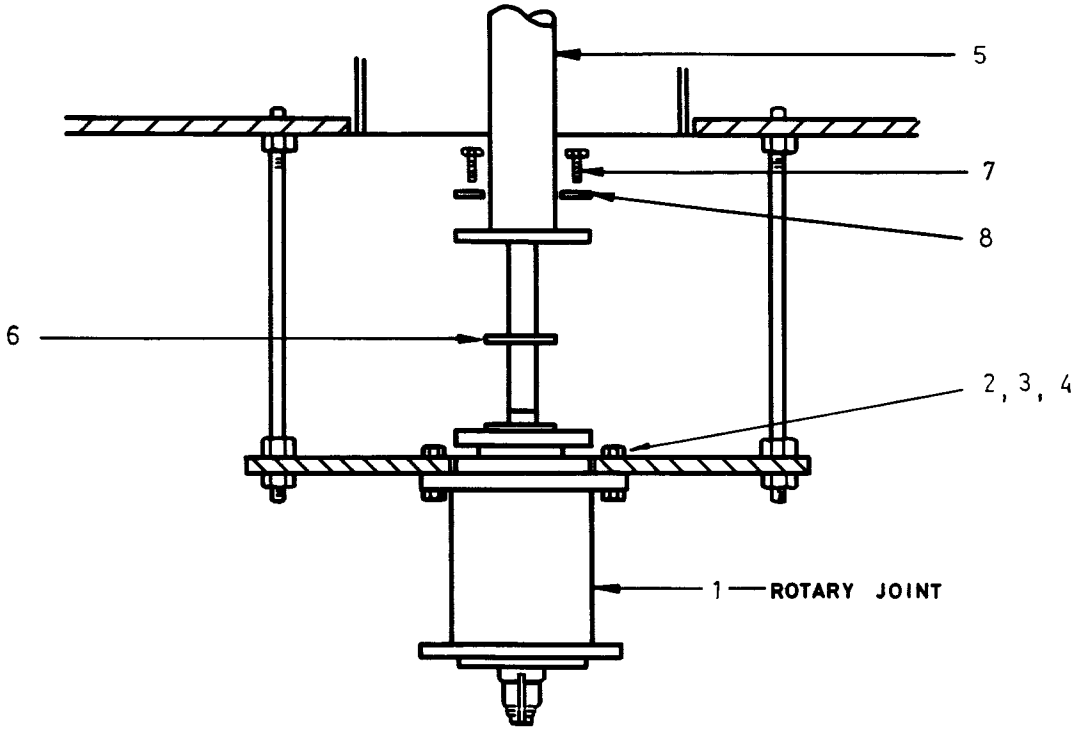


Fig. 14 Pedestal detail

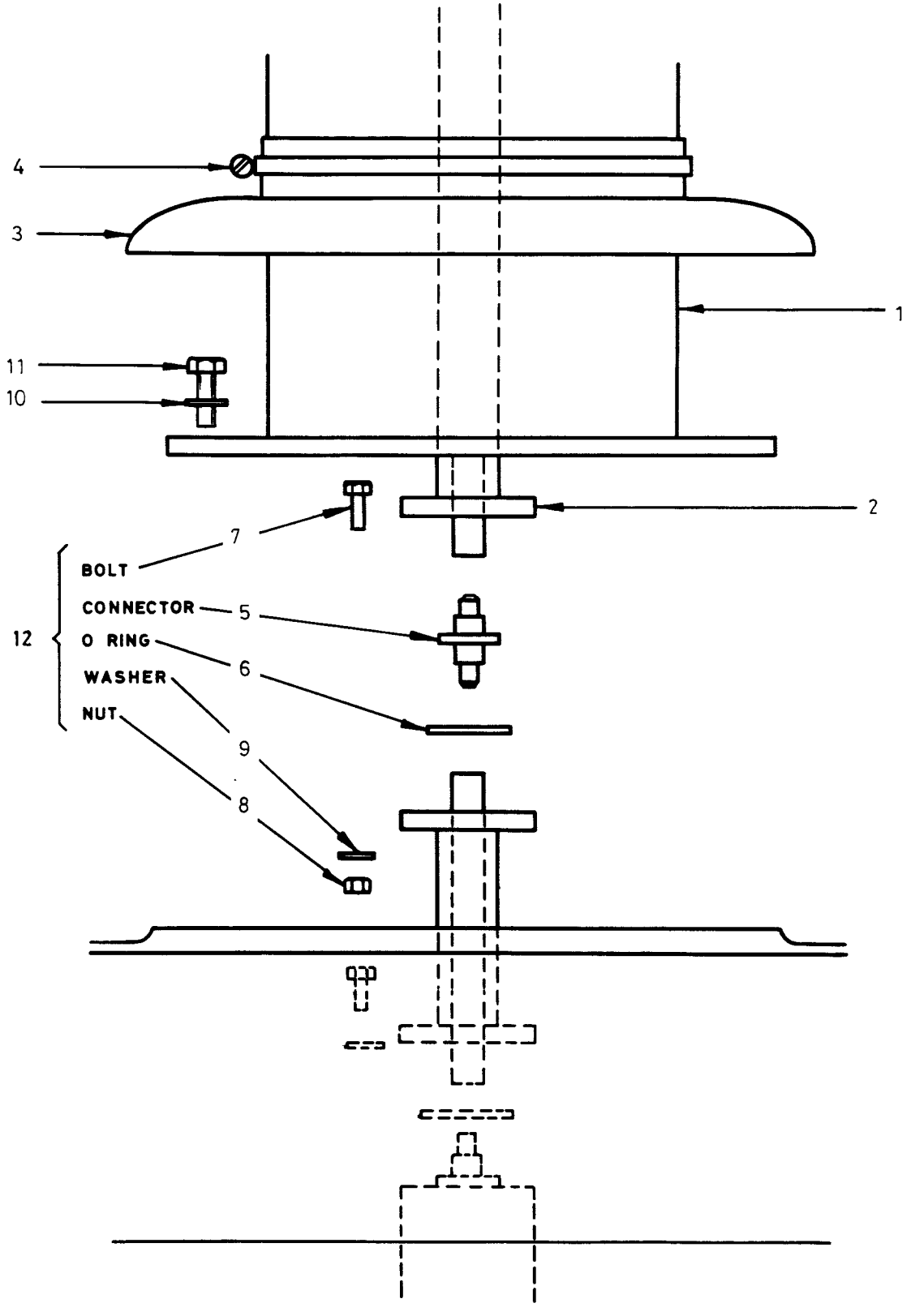


Fig. 15 Torque tube to pedestal joint

TABLE 15 ITEMS LIST FOR FIG.15

Item	Ref./Part No.	Description	Qty.
1	0001-7866-001	Torque tube intermediate	1
2	5985-00-050-4688	Transmission line	1
3	5985-00-409-5604	Boot, dust and moisture seal	1
4	4730-00-910-0289	Clamp, hose	1
5	5985-00-909-3868	Connector	1
6	5330-99-627-2182	O ring	1
7	5306-99-947-3788	Bolt, hex hd, $^{5}/_{16}$-18x$^{1}/_{4}$, SST	4
8	5310-99-139-0551	Nut, hex, $^{5}/_{16}$-18, SST	4
9	5310-99-120-9059	Washer, lock, $^{5}/_{16}$ SST	4
10	5310-99-627-2412	Washer, lock, $^{3}/_{4}$, st, galv.	12
11	5306-99-647-9959	Bolt, hex hd, $^{3}/_{4}$-10x2$^{1}/_{2}$, st, galv.	12
12	0001-4007-001	Transmission line HW kit (comprising items 5 to 9)	1

TABLE 16 ITEMS LIST FOR FIG.16

Item	Ref./Part No.	Description	Qty.
1	0001-7866-001	Torque tube, intermediate	2
2	5985-00-050-4688	Transmission line	2
3	0001-7865-001	Torque tube, top	1
4	5360-99-627-2409	Spring, helical, extension	16
5	5985-00-909-3868	Connector	4
6	5330-99-627-2182	O ring	4
7	5306-99-947-3788	Bolt, hex hd, $^{5}/_{16}$-18x1$^{1}/_{4}$, SST	12
8	5310-99-139-0551	Nut, hex, $^{5}/_{16}$-18, SST	12
9	5310-99-120-9059	Washer, lock, $^{5}/_{16}$, SST	12
10	2076-4374-001	Bolt, hex hd, $^{3}/_{4}$-10x2$^{3}/_{4}$,Hi.st,galv.	36
11	5310-99-627-2412	Washer, lock, st, galv.	36
12	2100-0878-001	Nut, hex, $^{3}/_{4}$-10, Hi. st, galv.	36
13	0001-4006-001	Transmission line spring loaded HW kit (comprising items 4 to 9)	4

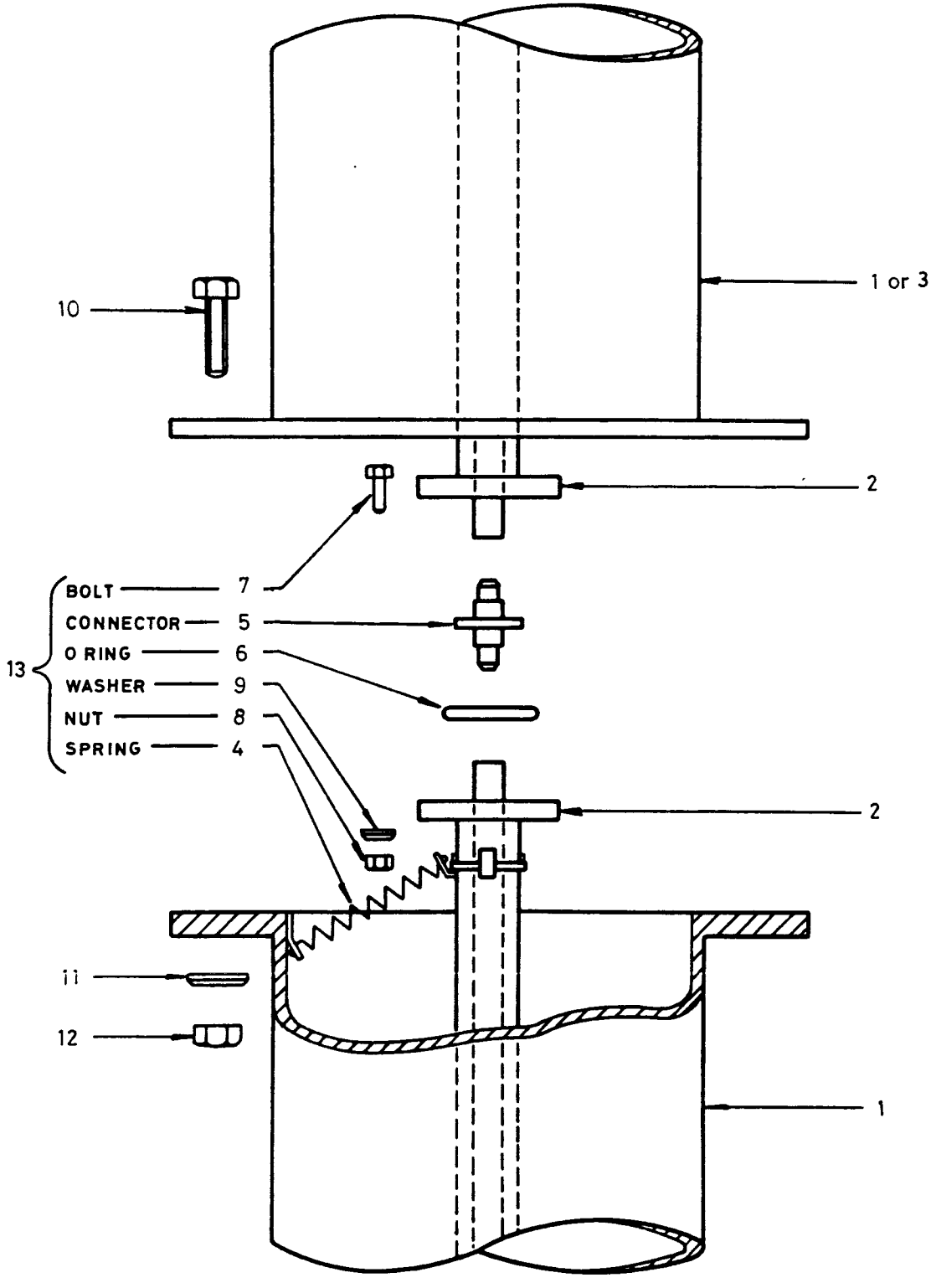


Fig. 16 Intermediate torque tube joints

TABLE 17 ITEMS LIST FOR FIG.17

Item	Ref./Part No.	Description	Qty.
1	0001-7865-001	Torque tube, top	1
2	5985-00-050-4688	Transmission line	1

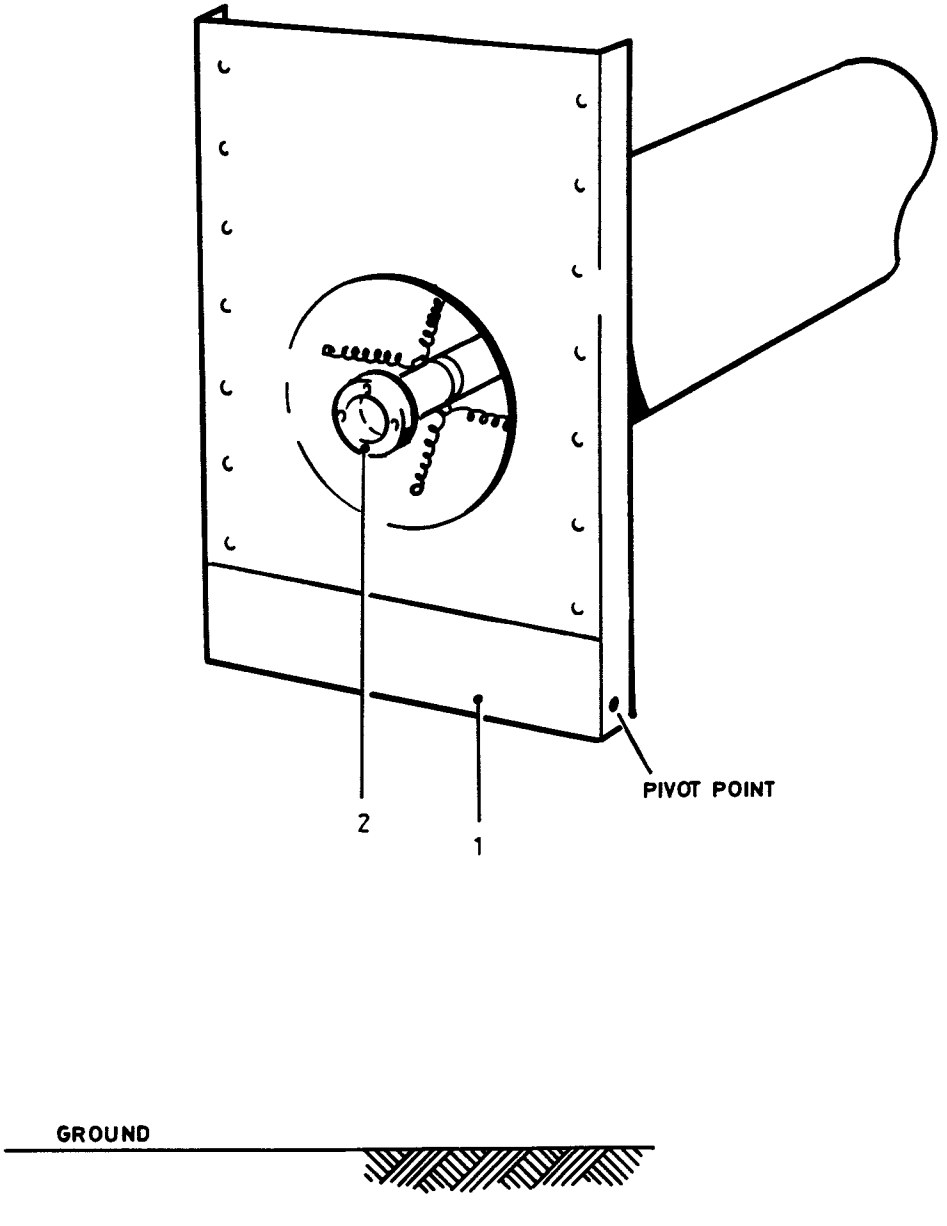


Fig. 17 Torque tube top section installation

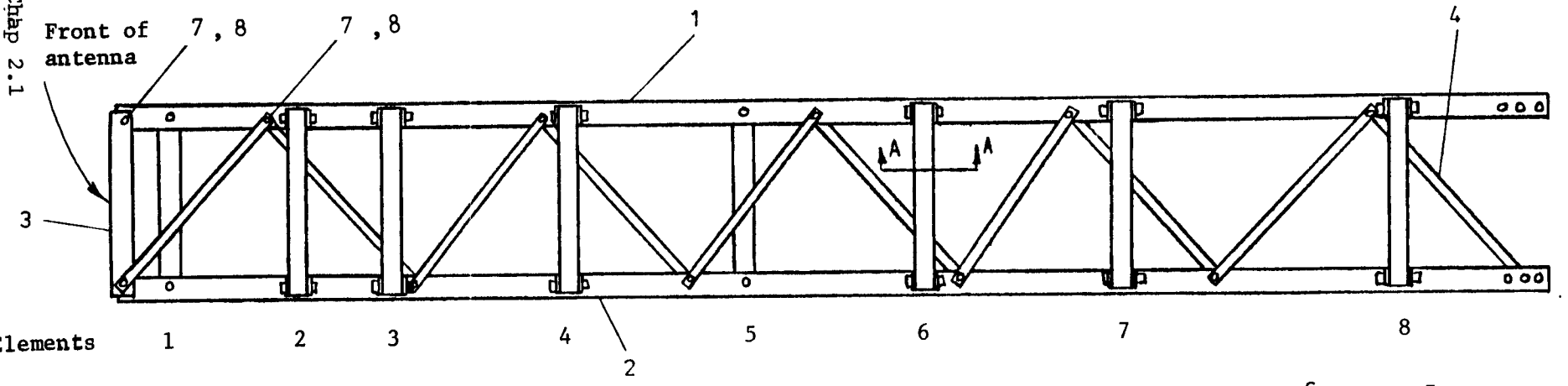
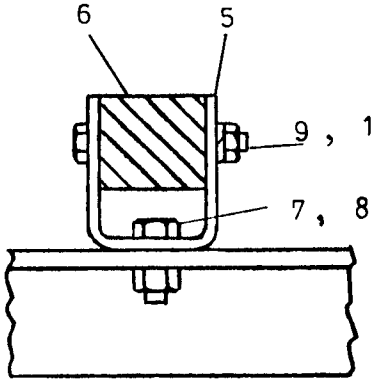


TABLE 18 ITEMS LIST FOR FIG.18

Item	Ref./Part No.	Description	Qty.
1	0001-7726-001	Leg 'A', section 1	1
2	0001-7727-001	Leg 'B', section 1	1
3	0001-8180-001	Brace, angle	1
4	0001-7722-001	Brace, No.1 & 2	10
5	5985-01-156-6905	Mount Bracket No.1 to 8	16
6	5999-01-174-5497	Element Mount No.1 to 8	8
7	5305-99-947-4211	Bolt, hex hd, $^{3}/_{8}$-16x1, SST	27
8	5310-99-944-2456	Nut, hex, lock, $^{3}/_{8}$-16, SST	27
9	5306-99-764-8689	Bolt, hex hd, $^{5}/_{16}$-18x1$^{3}/_{4}$, SST	16
10	5310-99-120-9059	Washer, lock, $^{5}/_{16}$, SST	16
11	5310-99-139-0551	Nut, hex, $^{5}/_{16}$-18, SST	16



Section A-A

Note that the mounts for elements Nos 1 & 5 are mounted inside the angles.

Fig 18 Boom Assembly, Section No. 1 (two required)

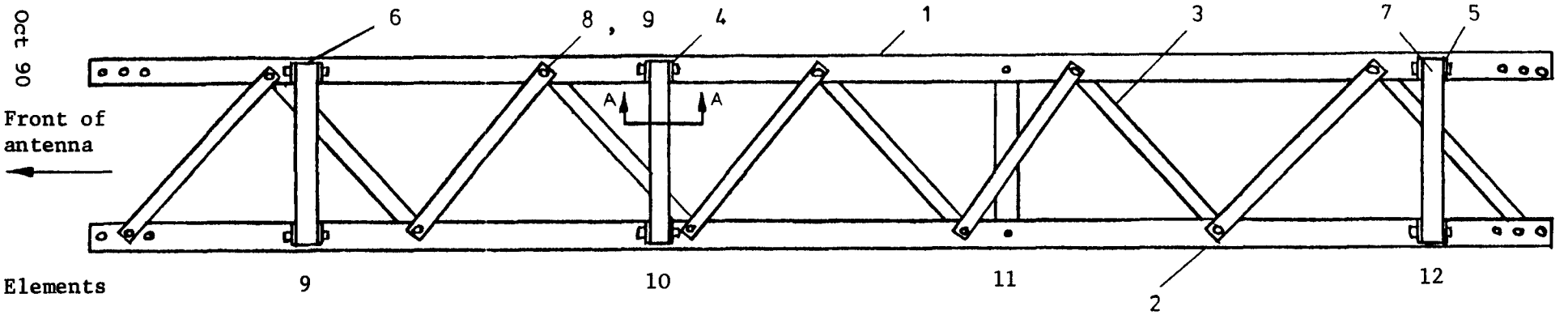
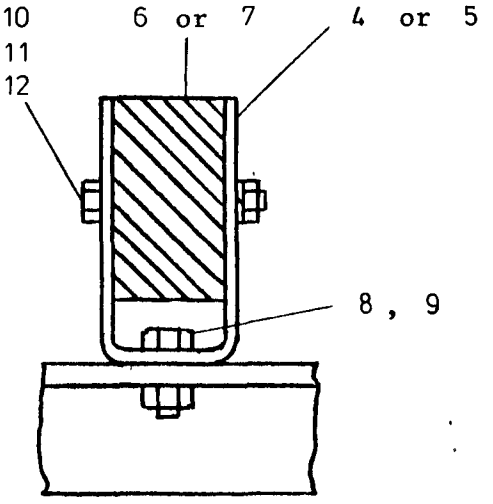


TABLE 19 ITEMS LIST FOR FIG.19

Item	Ref./Part No.	Description	Qty.
1	0001-7806-001	Leg A, section No.2	1
2	0001-7808-001	Leg B, section No.2	1
3	0001-7722-001	Brace No.1 & 2	10
4	5985-01-156-6902	Mount Bracket No.9-11	6
5	5985-01-156-6903	Mount Bracket No.12-13	2
6	5999-01-174-5498	Element Mount No.9-11	3
7	5365-01-230-0002	Element Mount No.12-13	1
8	5305-99-947-4211	Bolt, hex hd, $^{3}/_{8}$-16x1, SST	17
9	5310-99-944-2456	Nut, hex, lock, $^{3}/_{8}$-16, SST	17
10	5306-99-764-8689	Bolt, hex hd, $^{5}/_{16}$-18x1$^{3}/_{4}$, SST	8
11	5310-99-120-9059	Washer, lock, $^{5}/_{16}$, SST	8
12	5310-99-139-0551	Nut, hex, $^{5}/_{16}$-18 SST	8



Section A-A

Note that the mount for element No 11 is mounted inside the angles.

Fig 19 Boom Assembly, Section No. 2 (two required)

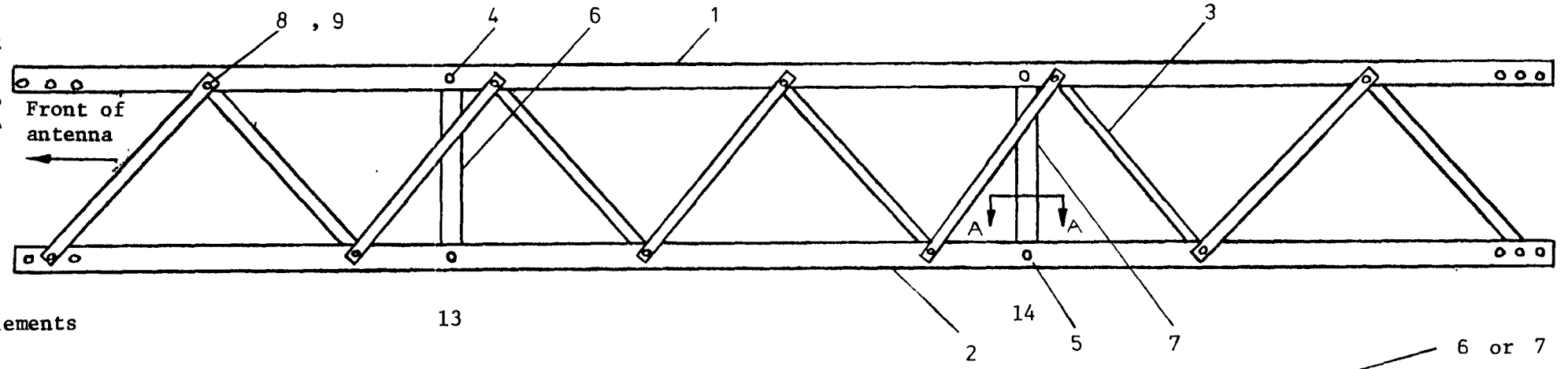
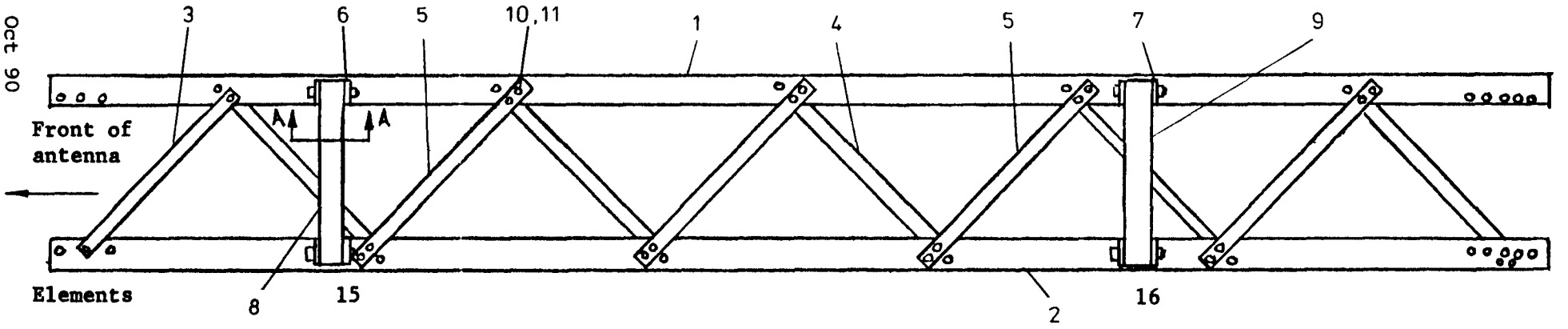


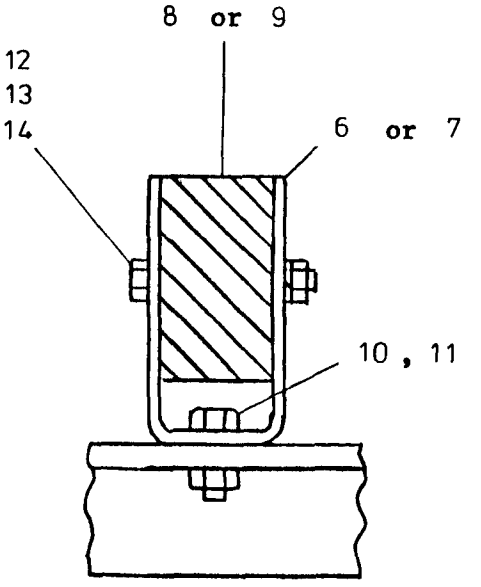
TABLE 20 ITEMS LIST FOR FIG.20

Item	Ref./Part No.	Description	Qty.
1	0001-7807-001	Leg A, section No.3	1
2	0001-7805-001	Leg B, section No.3	1
3	0001-7723-001	Brace No.3	10
4	5985-01-156-6903	Mount Bracket No.12-13	2
5	5985-01-156-6904	Mount Bracket No.14-15	2
6	5365-01-230-0002	Element Mount No.12-13	1
7	5999-01-174-5499	Element Mount No.14-15	1
8	5306-99-781-2204	Bolt, hex hd, $^{3}/_{8}$-16x$1^{1}/_{4}$, SST	13
9	5310-99-944-2456	Nut, hex, lock, $^{3}/_{8}$-16, SST	13
10	5306-99-764-8689	Bolt, hex hd, $^{5}/_{16}$-18x$1^{3}/_{4}$, SST	2
11	5310-99-120-9059	Washer, lock $^{5}/_{16}$, SST	2
12	5310-99-139-0551	Nut, hex, lock, $^{5}/_{16}$, SST	2
13	5306-99-124-7247	Bolt, hex hd, $^{7}/_{16}$-14x2, SST	2
14	5310-99-137-7202	Washer, lock $^{7}/_{16}$, SST	2
15	5310-99-134-3782	Nut, hex, $^{7}/_{16}$-14 SST	2

Note that the mounts for elements Nos. 13 & 14 are mounted inside the angles.

Fig 20 Boom Assembly, Section No. 3 (two required)





Section A-A

TABLE 21 ITEMS LIST FOR FIG.21

Item	Ref./Part No.	Description	Qty.
1	0001-7812-001	Leg A, section No.4	1
2	0001-7813-001	Leg B, section No.4	1
3	0001-7723-001	Brace, No.3	1
4	0001-7725-001	Brace, No.4, 5, 6	7
5	0001-7725-002	Brace, No.4, 5, 6	2
6	5985-01-156-6904	Mount bracket No.14-15	2
7	5985-01-156-6906	Mount bracket No.16	2
8	5999-01-174-5499	Element mount No.14-15	1
9	5999-01-174-6834	Element mount No.16	1
10	5306-99-781-2204	Bolt, hex hd, $^{3}/_{8}$-16x$1^{1}/_{4}$, SST	30
11	5310-99-944-2456	Nut, hex, lock, $^{3}/_{8}$-16, SST	30
12	5306-99-124-7247	Bolt, hex hd, $^{7}/_{16}$-14x2, SST	4
13	5310-99-137-7202	Washer, lock, $^{7}/_{16}$ SST	4
14	5310-99-134-3782	Nut, hex, $^{7}/_{16}$ SST	4

Fig 21 Boom Assembly, Section No. 4 (two required)

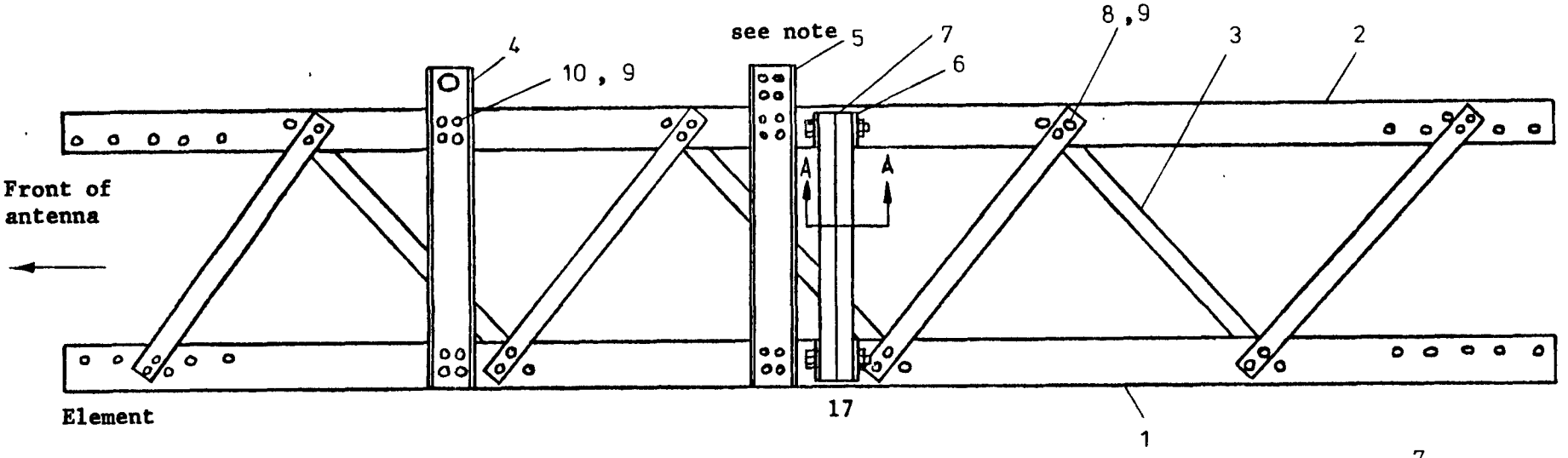
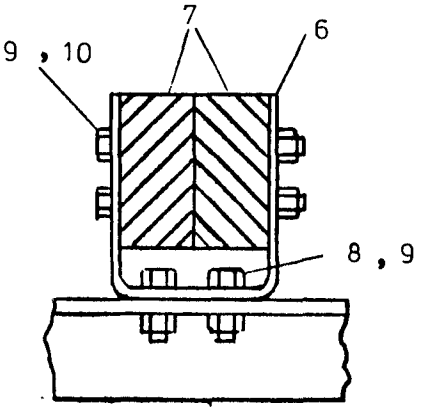


TABLE 22 ITEMS LIST FOR FIG.22

Item	Ref./Part No.	Description	Qty.
1	0001-7815-001	Leg A, section No.5	1
2	0001-7829-001	Leg B, section No.5	1
3	0001-7725-001	Brace, No.4,5,6	7
4	0001-7828-001	Channel, pivot	1
5	0002-5638-201	Channel	1
6	5985-01-216-6847	Mount bracket No.17,18	2
7	5999-01-174-5500	Element mount No.17	2
8	5306-99-781-2204	Bolt, hex hd, $^3/_8$-16x1$^1/_4$, SST	22
9	5310-99-944-2456	Nut, hex, lock, $^3/_8$-16, SST	42
10	5306-99-791-3150	Bolt, hex hd, $^3/_8$-16x1$^3/_4$, SST	16
11	5306-99-124-7261	Bolt, hex hd, $^3/_8$-16x3, SST	4

Fig 22 Boom Assembly, Section No. 5A



Section A-A

NOTE: Before the channel item 5 is attached, the bolts and reinforcing plate used to attach element No. 17 (see Fig 38) must first be positioned through the element mount.

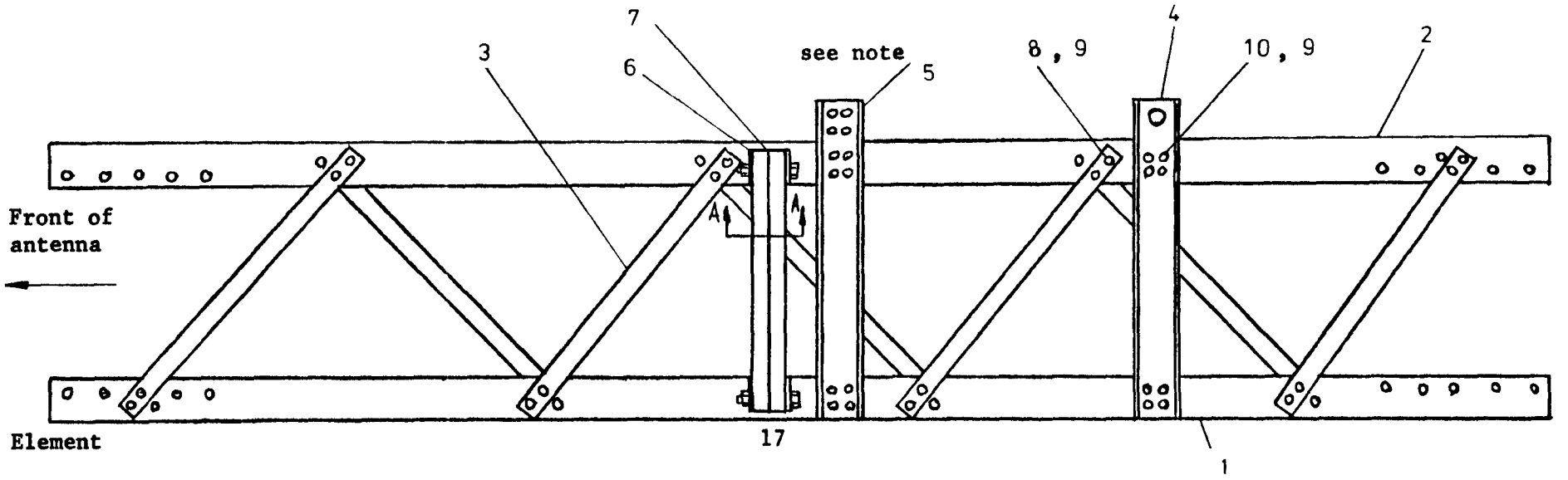
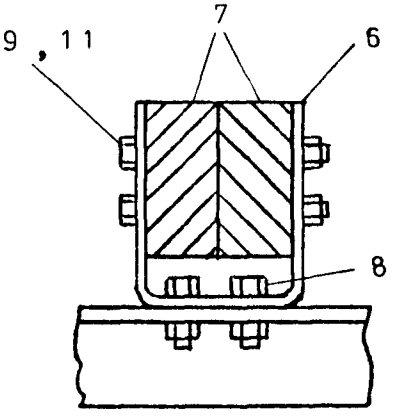


TABLE 23 ITEMS LIST FOR FIG.23

Item	Ref./Part No.	Description	Qty.
1	0001-7817-001	Leg C, section No.5	1
2	0001-7834-001	Leg D, section No.5	1
3	0001-7725-001	Brace, No.4,5,6	7
4	0001-7828-001	Channel, pivot	1
5	0002-5638-201	Channel	1
6	5985-01-216-6847	Mount bracket No.17-18	2
7	5999-01-174-5500	Element mount No.17	2
8	5306-99-781-2204	Bolt, hex hd, $^3/_8$-16x$1^1/_4$, SST	22
9	5310-99-944-2456	Nut, hex, lock, $^3/_8$-16, SST	42
10	5306-99-791-3150	Bolt, hex hd, $^3/_8$-16x$1^3/_4$, SST	16
11	5306-99-124-7261	Bolt, hex hd, $^3/_8$-16x3, SST	4

Fig 23 Boom Assembly, Section No 5B



Section A-A

NOTE: Before the channel item 5 is attached, the bolts and reinforcing plate used to attach element No 17 (see Fig 38) must first be positioned through the element mount

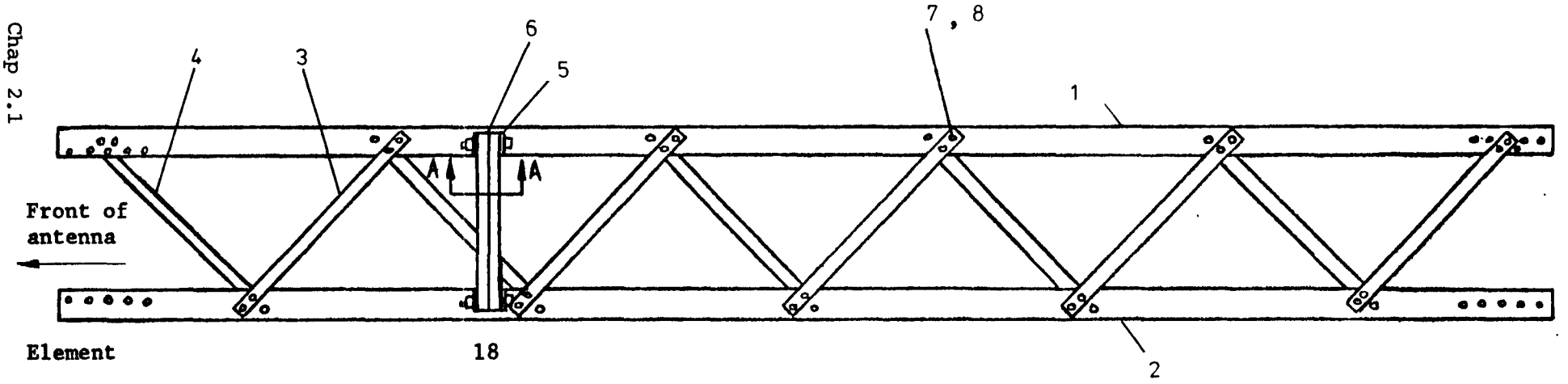
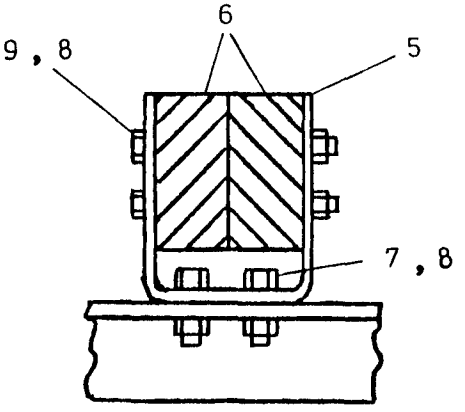


TABLE 24 ITEMS LIST FOR FIG.24

Item	Ref./Part No.	Description	Qty.
1	0001-7816-001	Leg A, section No.6	1
2	0001-7818-001	Leg B, section No.6	1
3	0001-7725-001	Brace, No.4, 5, 6	9
4	0001-7824-001	Brace, No.7	1
5	5985-01-216-6847	Mount bracket, No.17-18	2
6	5999-01-174-5501	Element mount, No.18	2
7	5306-99-781-2204	Bolt, hex hd, $^{3}/_{8}$-16x$1^{1}/_{4}$, SST	31
8	5310-99-944-2456	Nut, hex, lock, $^{3}/_{8}$-16, SST	35
9	5306-99-124-7261	Bolt, hex hd, $^{3}/_{8}$-16x3, SST	4



Section A-A

Fig 24 Boom Assembly, Section No.6 (two required)

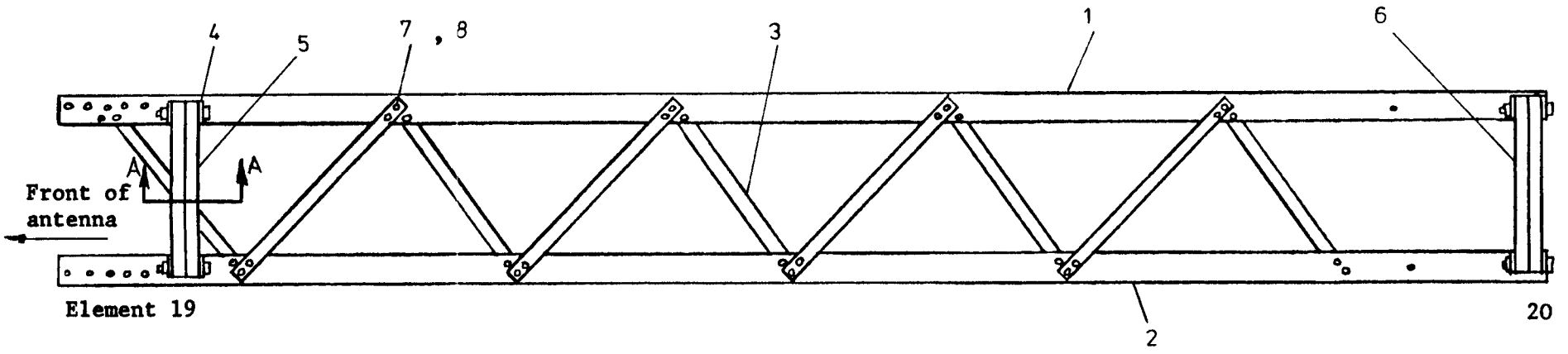


TABLE 25 ITEMS LIST FOR FIG.25

Item	Ref./Part No.	Description	Qty.
1	0001-7820-001	Leg A, section No.7	1
2	0001-7821-001	Leg B, section No.7	1
3	0001-7824-001	Brace No.7	9
4	5985-01-156-6905	Mount bracket No.19, 20	4
5	5999-01-174-5502	Element mount No.19	2
6	5999-01-174-5503	Element mount No.20	2
7	5306-99-781-2204	Bolt, hex hd, $^{3}/_{8}$-16x$1^{1}/_{4}$, SST	34
8	5310-99-944-2456	Nut, hex, lock, $^{3}/_{8}$-16, SST	42
9	5306-99-124-7261	Bolt, hex hd, $^{3}/_{8}$-16x3, SST	8

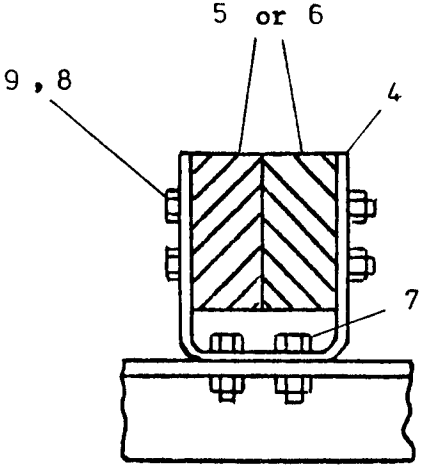
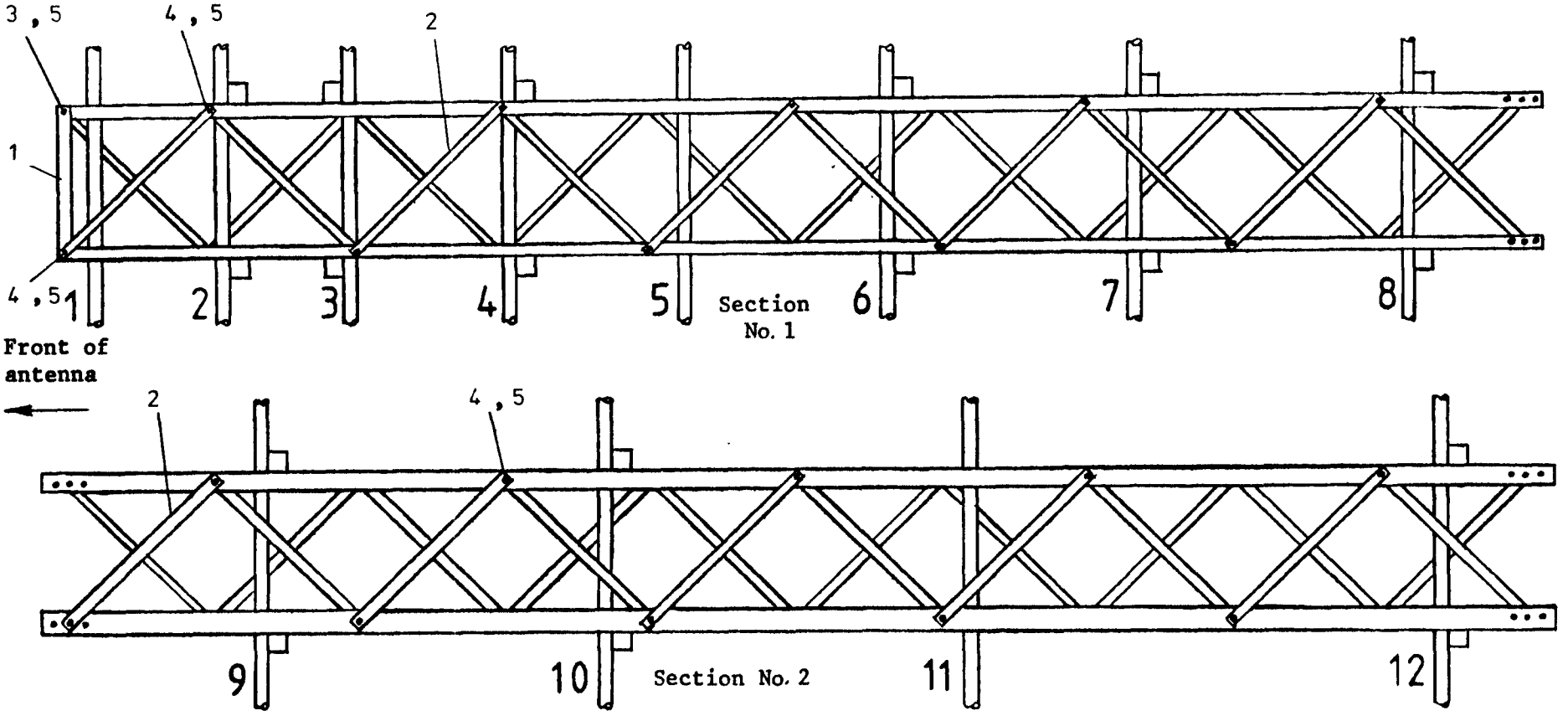


Fig 25 Boom Assembly, Section No. 7 (two required)



NOTE: Do not fit screws and nuts to secure braces at unattached ends of sections

TABLE 26 ITEMS LIST FOR FIG.26

Item	Ref./Part No.	Description	Qty.
1	0001-7724-001	Brace, angle, section No.1	2
2	0001-7722-001	Brace, section No.1 and 2	40
3	5305-99-947-4211	Bolt, hex hd, $^3/_8$-16x1, SST	2
4	5306-99-781-2204	Bolt, hex hd, $^3/_8$-16x$1^1/_4$, SST	38
5	5310-99-944-2456	Nut, hex, lock, $^3/_8$-16, SST	40

Fig 26 Assembly of boom half-sections 1 and 2

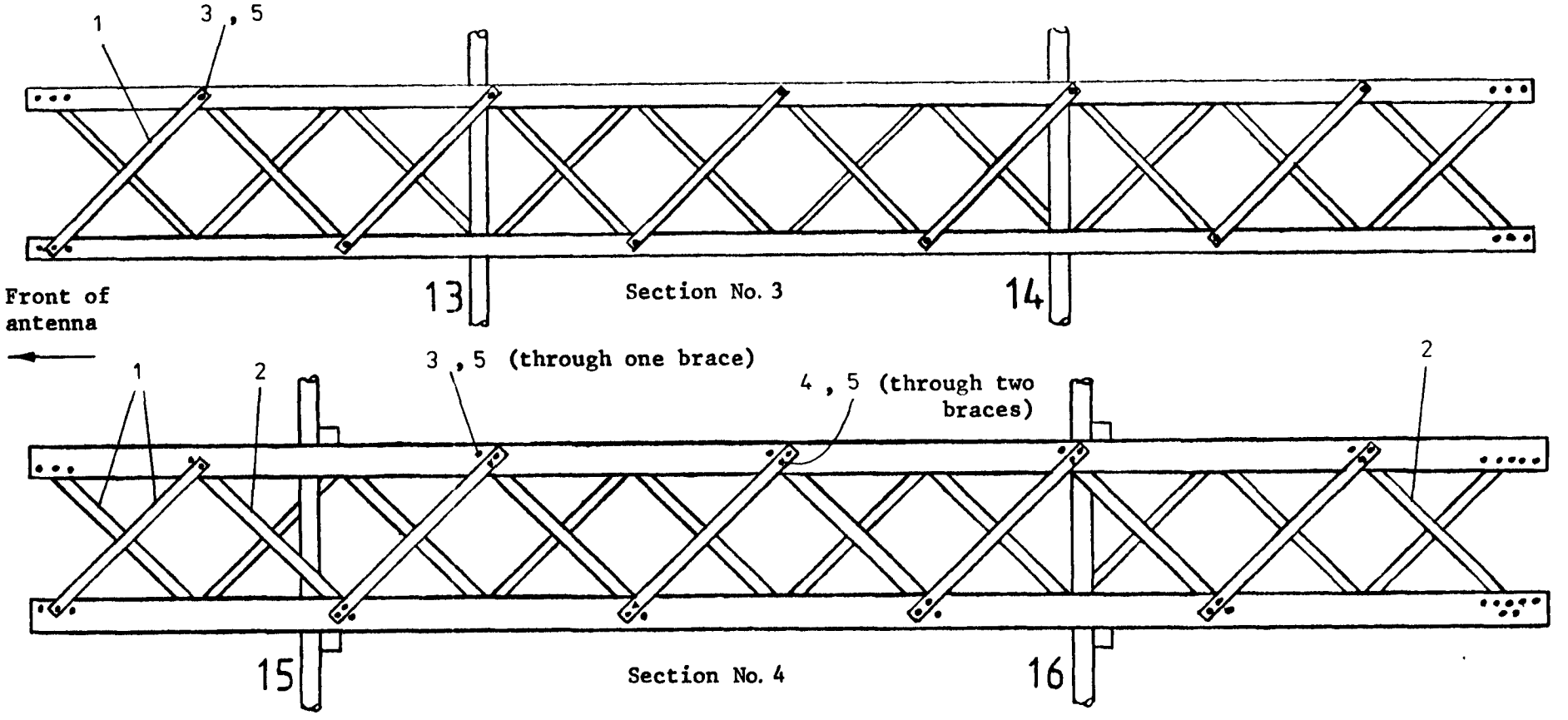


TABLE 27 ITEMS LIST FOR FIG.27

Item	Ref./Part No.	Description	Qty.
1	0001-7723-001	Brace No.3	22
2	0001-7725-001	Brace No.4, 5, 6	18
3	5306-99-781-2204	Bolt, hex hd, $^{3}/_{8}$-16x$1^{1}/_{4}$, SST	52
4	5306-99-791-3150	Bolt, hex hd, $^{3}/_{8}$-16x$1^{3}/_{4}$, SST	18
5	5310-99-944-2456	Nut, hex, lock, $^{3}/_{8}$-16, SST	70

Fig 27 Assembly of boom half-sections 3 and 4

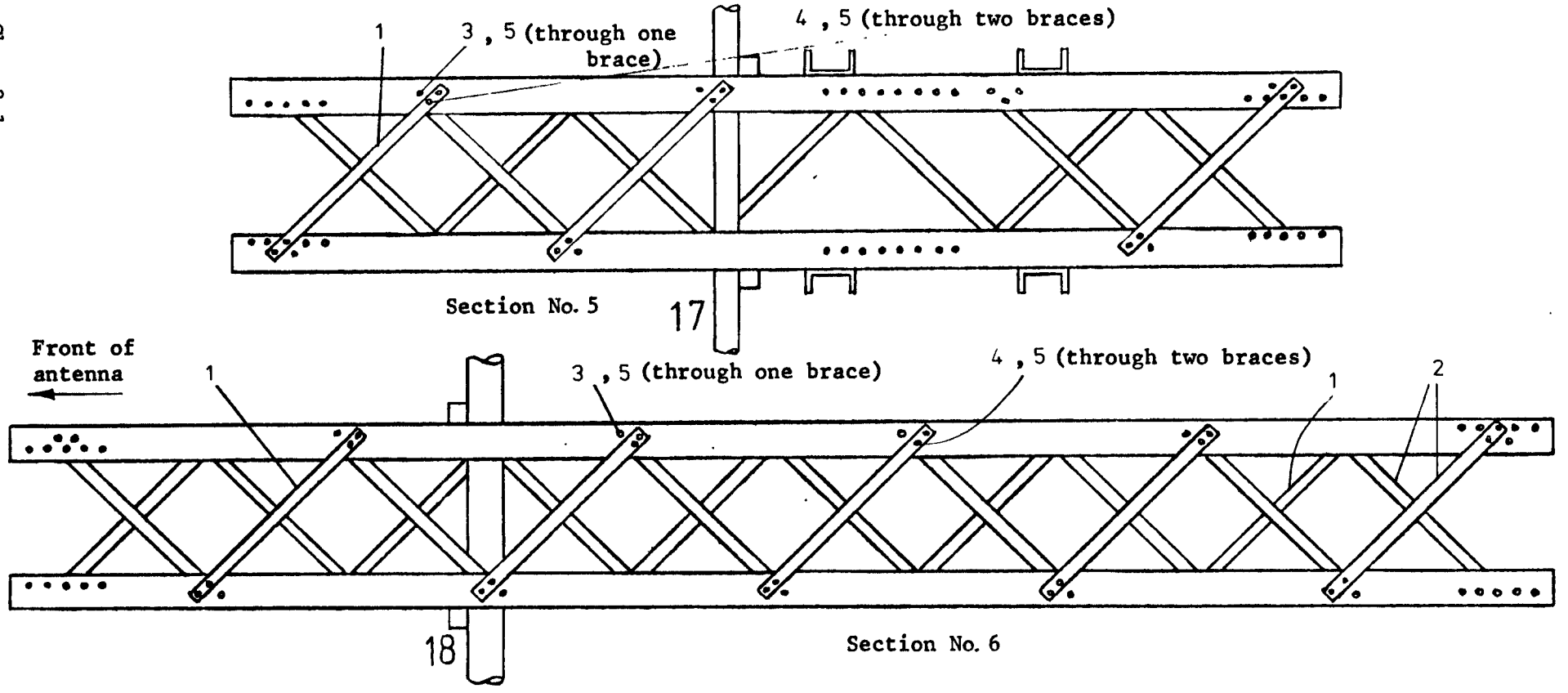


TABLE 28 ITEMS LIST FOR FIG.28

Item	Ref./Part No.	Description	Qty.
1	0001-7725-001	Brace No.4,5,6	30
2	0001-7824-001	Brace No.7	2
3	5306-99-781-2204	Bolt, hex hd, $^3/_8$-16x$1^1/_4$, SST	58
4	5306-99-791-3150	Bolt, hex hd, $^3/_8$-16x$1^3/_4$, SST	27
5	5310-99-944-2456	Nut, hex, lock, $^3/_8$-16, SST	85

Fig 28 Assembly of boom half-sections 5 and 6

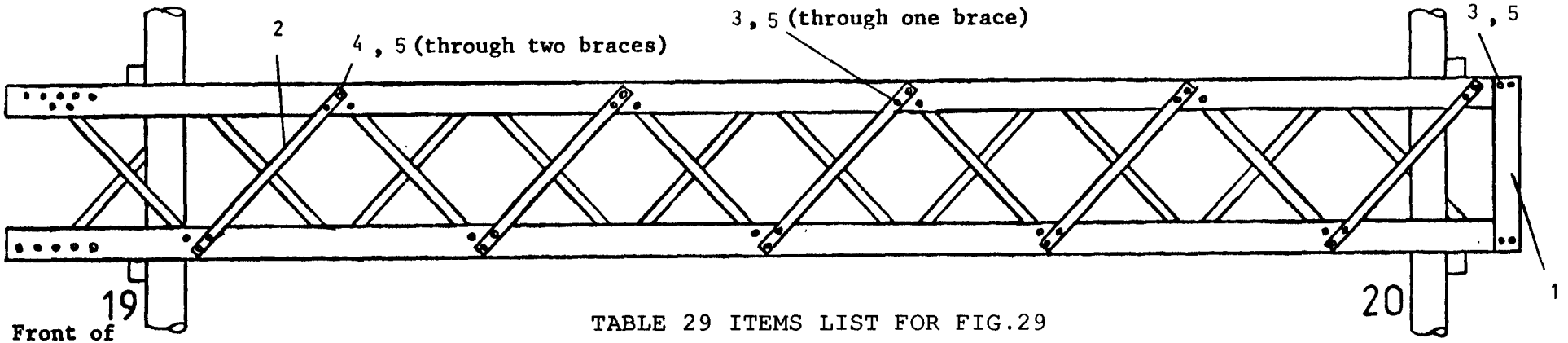


TABLE 29 ITEMS LIST FOR FIG.29

Item	Ref./Part No.	Description	Qty.
1	0001-7832-001	Wind sail mount	2
2	0001-7824-001	Brace No.7	20
3	5306-99-781-2204	Bolt, hex hd, $^3/_8$-16x$1^1/_4$, SST	48
4	5306-99-791-3150	Bolt, hex hd, $^3/_8$-16x$1^3/_4$, SST	18
5	5310-99-944-2456	Nut, hex, lock, $^3/_8$-16, SST	66

Fig 29 Assembly of boom half-sections 7

TABLE 30 ITEMS LIST FOR FIG.30

Item	Ref./Part No.	Description	Qty.
1	0001-7850-001	Long spacer	4
2	0001-7849-001	Short spacer	4
3	0001-7838-001	Centre brace	2
4	0001-7848-001	Angle spacer	4
5	5306-99-781-2204	Bolt, hex hd, $^{3}/_{8}$-16x$1^{1}/_{4}$, SST	8
6	5306-99-791-3150	Bolt, hex hd, $^{3}/_{8}$-16x$1^{3}/_{4}$, SST	36
7	5306-99-772-5162	Bolt, hex hd, $^{3}/_{8}$-16x$2^{1}/_{4}$, SST	12
8	5310-99-944-2456	Nut, hex, lock, $^{3}/_{8}$-16, SST	56

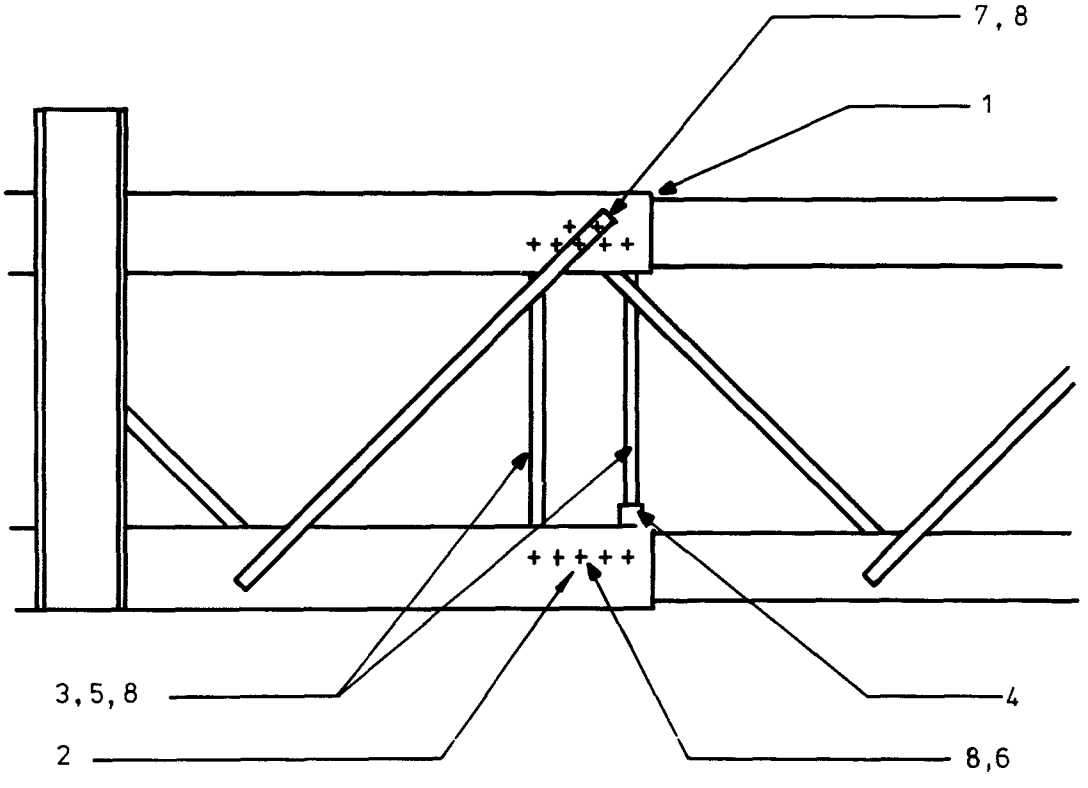


Fig. 30 Boom section joint 5-6

TABLE 31 ITEMS LIST FOR FIG.31

Item	Ref./Part No.	Description	Qty.
1	0001-7853-001	Long spacer	4
2	0001-7852-001	Short spacer	4
3	0001-7838-001	Centre brace	2
4	0001-7851-001	Angle spacer	4
5	5306-99-781-2204	Bolt, hex hd, $^3/_8$-16x1$^1/_4$, SST	12
6	5306-99-791-3150	Bolt, hex hd, $^3/_8$-16x1$^3/_4$, SST	36
7	5306-99-772-5162	Bolt, hex hd, $^3/_8$-16x2$^1/_4$, SST	12
8	5310-99-944-2456	Nut, hex, lock, $^3/_8$-16, SST	56

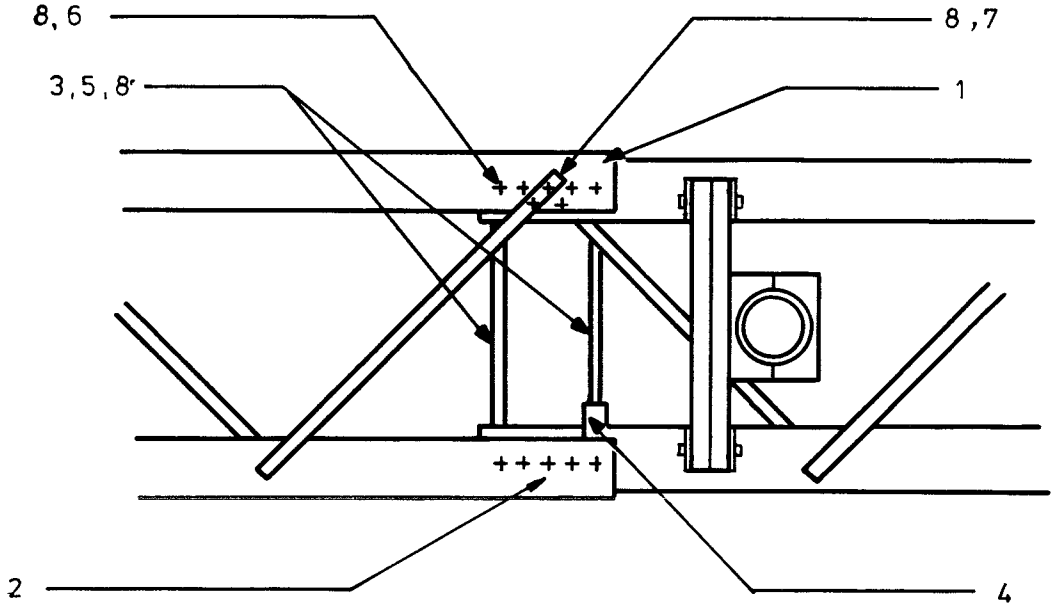


Fig. 31 Boom section joint 6-7

TABLE 32 ITEMS LIST FOR FIG.32

Item	Ref./Part No.	Description	Qty.
1	0001-7850-001	Long spacer	4
2	0001-7849-001	Short spacer	4
3	0001-7838-001	Centre brace	2
4	0001-7848-001	Angle spacer	4
5	5306-99-781-2204	Bolt, hex hd, $^{3}/_{8}$-16x1$^{1}/_{4}$, SST	8
6	5306-99-791-3150	Bolt, hex hd, $^{3}/_{8}$-16x1$^{3}/_{4}$, SST	36
7	5306-99-772-5162	Bolt, hex hd, $^{3}/_{8}$-16x2$^{1}/_{4}$, SST	12
8	5310-99-944-2456	Nut, hex, lock, $^{3}/_{8}$-16, SST	56

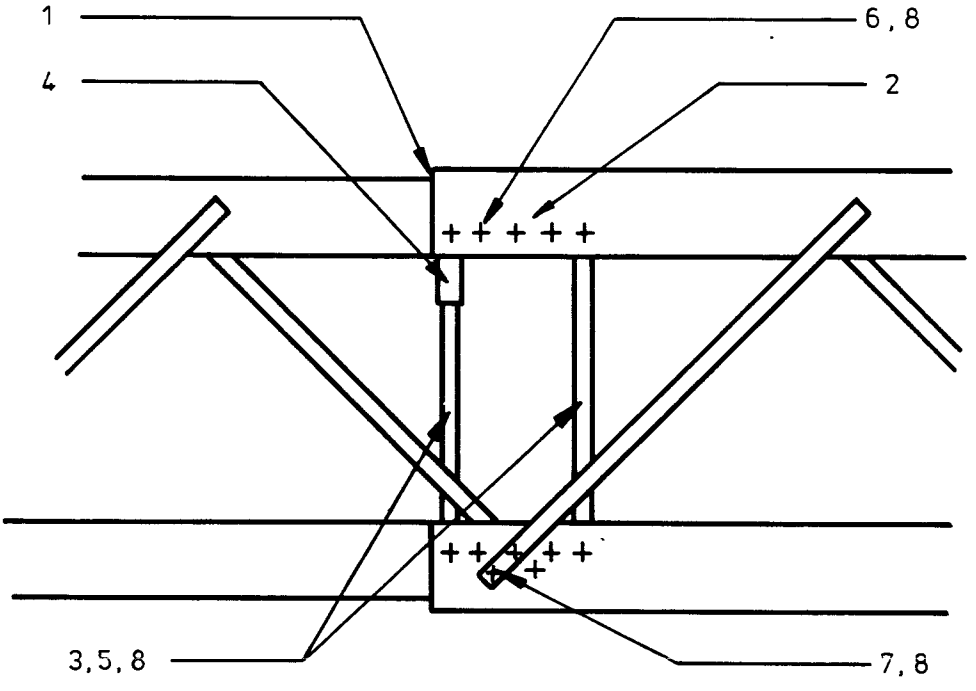


Fig. 32 Boom section joint 4-5

TABLE 33 ITEMS LIST FOR FIG.33

Item	Ref./Part No.	Description	Qty.
1	0001-7847-001	Long spacer	4
2	0001-7846-001	Short spacer	4
3	0001-7838-001	Centre brace	2
4	0001-7845-001	Angle spacer	4
5	5306-99-781-2204	Bolt, hex hd, $^3/_8$-16x$1^1/_4$, SST	8
6	5306-99-791-3150	Bolt, hex hd, $^3/_8$-16x$1^3/_4$, SST	20
7	5306-99-772-5162	Bolt, hex hd, $^3/_8$-16x$2^1/_4$, SST	4
8	5310-99-944-2456	Nut, hex, lock, $^3/_8$-16, SST	32

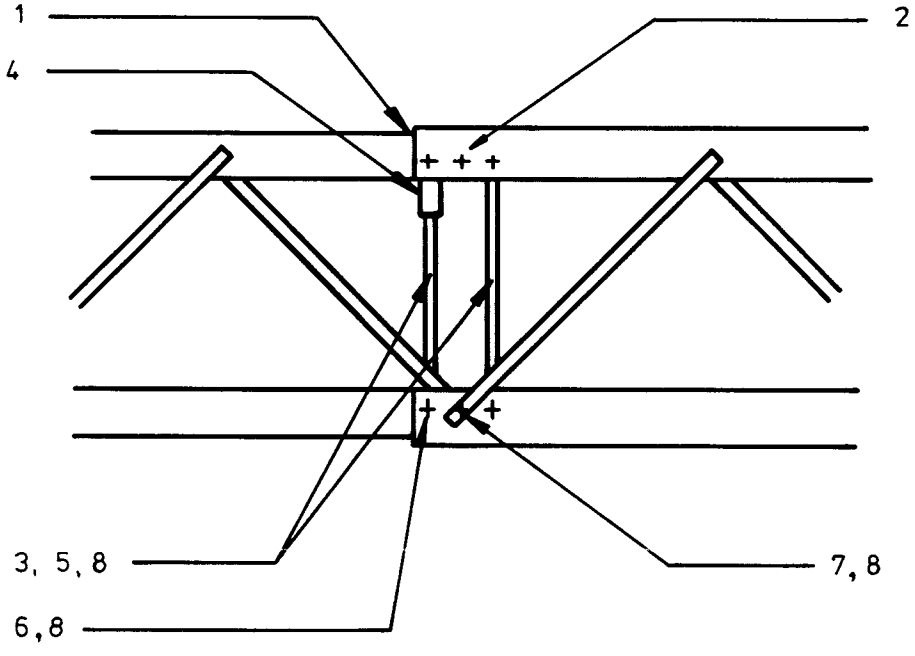


Fig. 33 Boom section joint 3-4

TABLE 34 ITEMS LIST FOR FIG.34

Item	Ref./Part No.	Description	Qty.
1	0001-7844-001	Long spacer	4
2	0001-7843-001	Short spacer	4
3	0002-1192-301	Centre brace	2
4	0001-7842-001	Angle spacer	4
5	5306-99-781-2204	Bolt, hex hd, $^{3}/_{8}$-16x1$^{1}/_{4}$, SST	28
6	5306-99-791-3150	Bolt, hex hd, $^{3}/_{8}$-16x1$^{3}/_{4}$, SST	4
7	5310-99-944-2456	Nut, hex, lock, $^{3}/_{8}$-16, SST	32

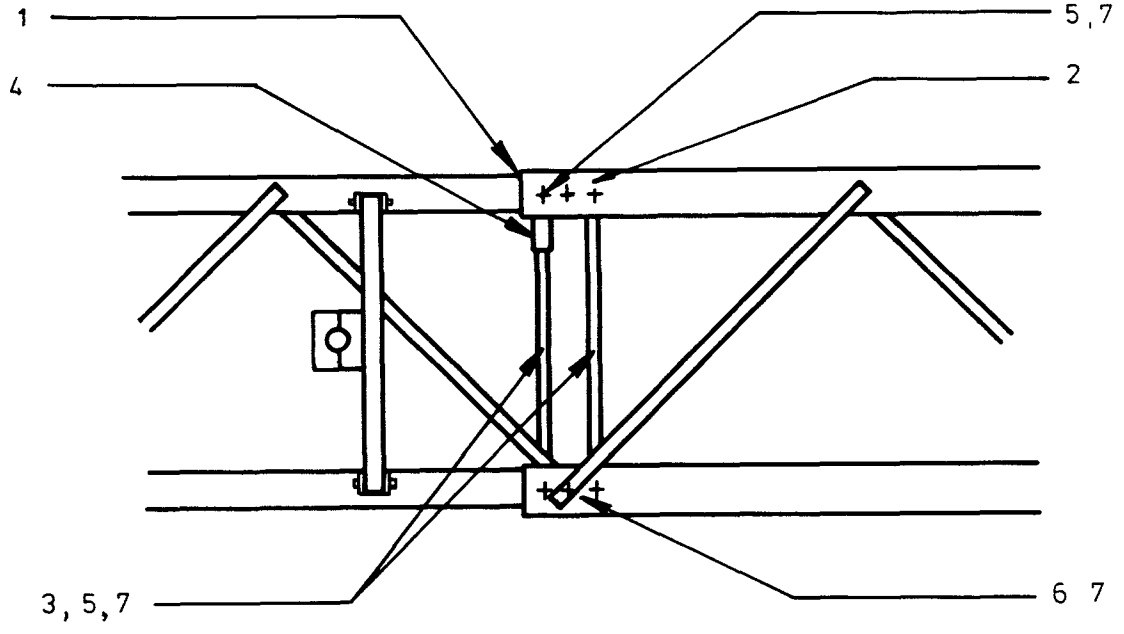


Fig.34 Boom section joint 2-3

TABLE 35 ITEMS LIST FOR FIG.35

Item	Ref./Part No.	Description	Qty.
1	0001-7841-001	Long spacer	4
2	0001-7840-001	Short spacer	4
3	0002-1192-301	Centre brace	2
4	0001-7839-001	Angle spacer	4
5	5306-99-781-2204	Bolt, hex hd, $^{3}/_{8}$-16x1$^{1}/_{4}$, SST	28
6	5306-99-791-3150	Bolt, hex hd, $^{3}/_{8}$-16x1$^{3}/_{4}$, SST	4
7	5310-99-944-2456	Nut, hex, lock, $^{3}/_{8}$-16, SST	32

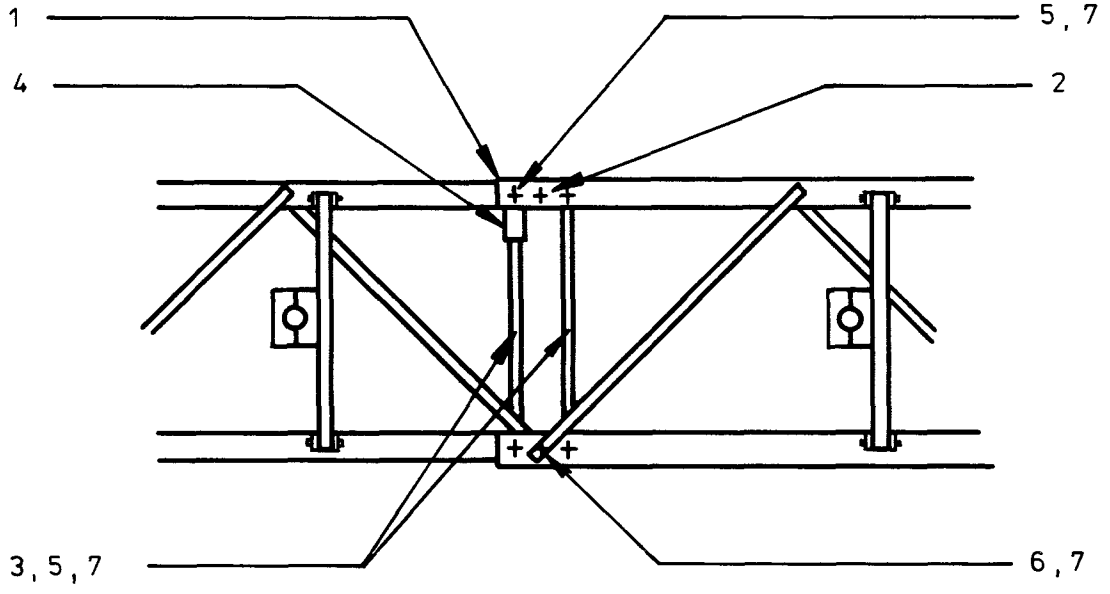


Fig. 35 Boom section joint 1-2

TABLE 36 ITEMS LIST FOR FIG.36

Item	Ref./Part No.	Description	Qty.
1	0001-7838-001	Centre brace	2
2	0001-7859-001	Angle spacer	4
3	5306-99-781-2204	Bolt, hex hd, $^{3}/_{8}$-16x$1^{1}/_{4}$, SST	12
4	5310-99-944-2456	Nut, hex, lock, $^{3}/_{8}$-16, SST	12

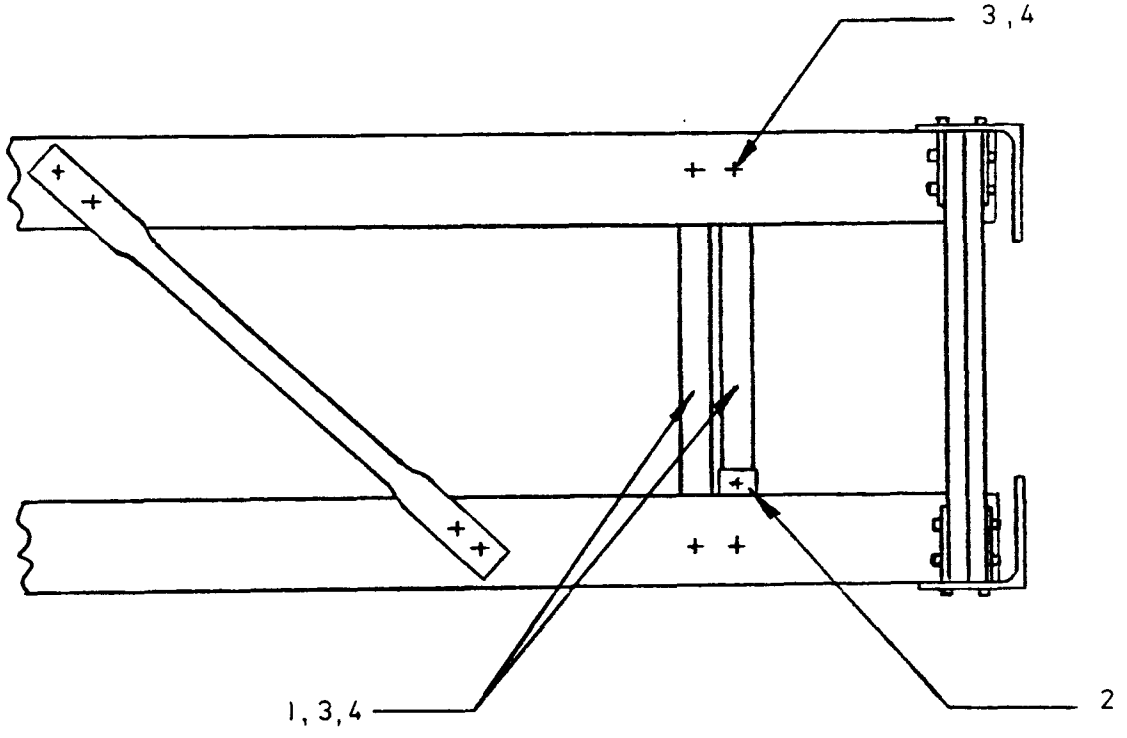


Fig 36 Cross Braces, Section 7

TABLE 37 ITEMS LIST FOR FIG.37

Item	Ref./Part No.	Description	Qty.
1	0003-3726-201	Windsail	1
2	0001-7830-001	Windsail support RH	2
3	0001-7830-002	Windsail support LH	2
4	0003-3727-301	Brace, windsail RH	2
5	0003-3727-302	Brace, windsail LH	2
6	5306-99-781-2204	Bolt, hex hd, $^3/_8$-16x$1^1/_4$, SST	22
7	5310-99-944-2456	Nut, hex, lock, $^3/_8$-16, SST	22
8	5310-99-803-8588	Washer, flat	44

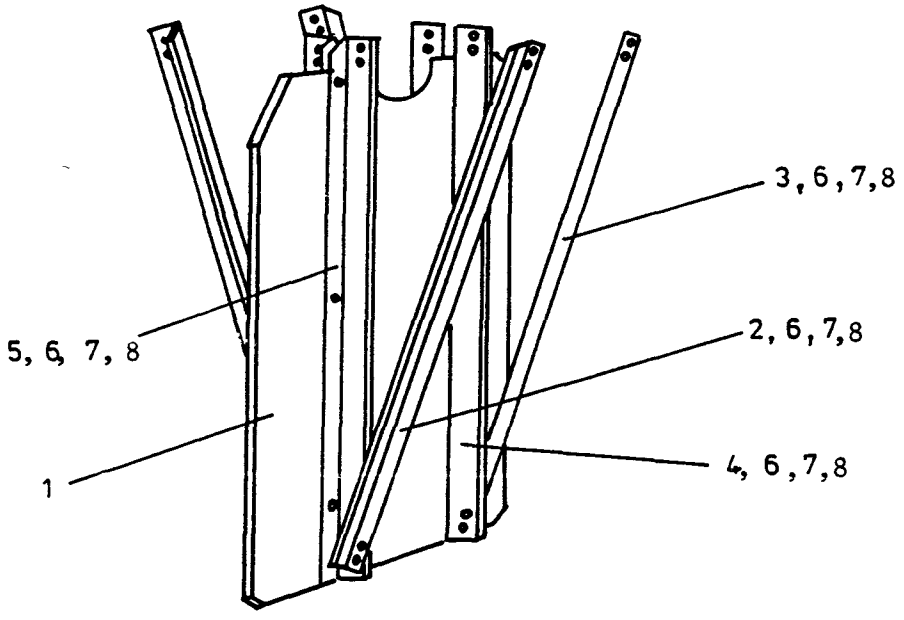
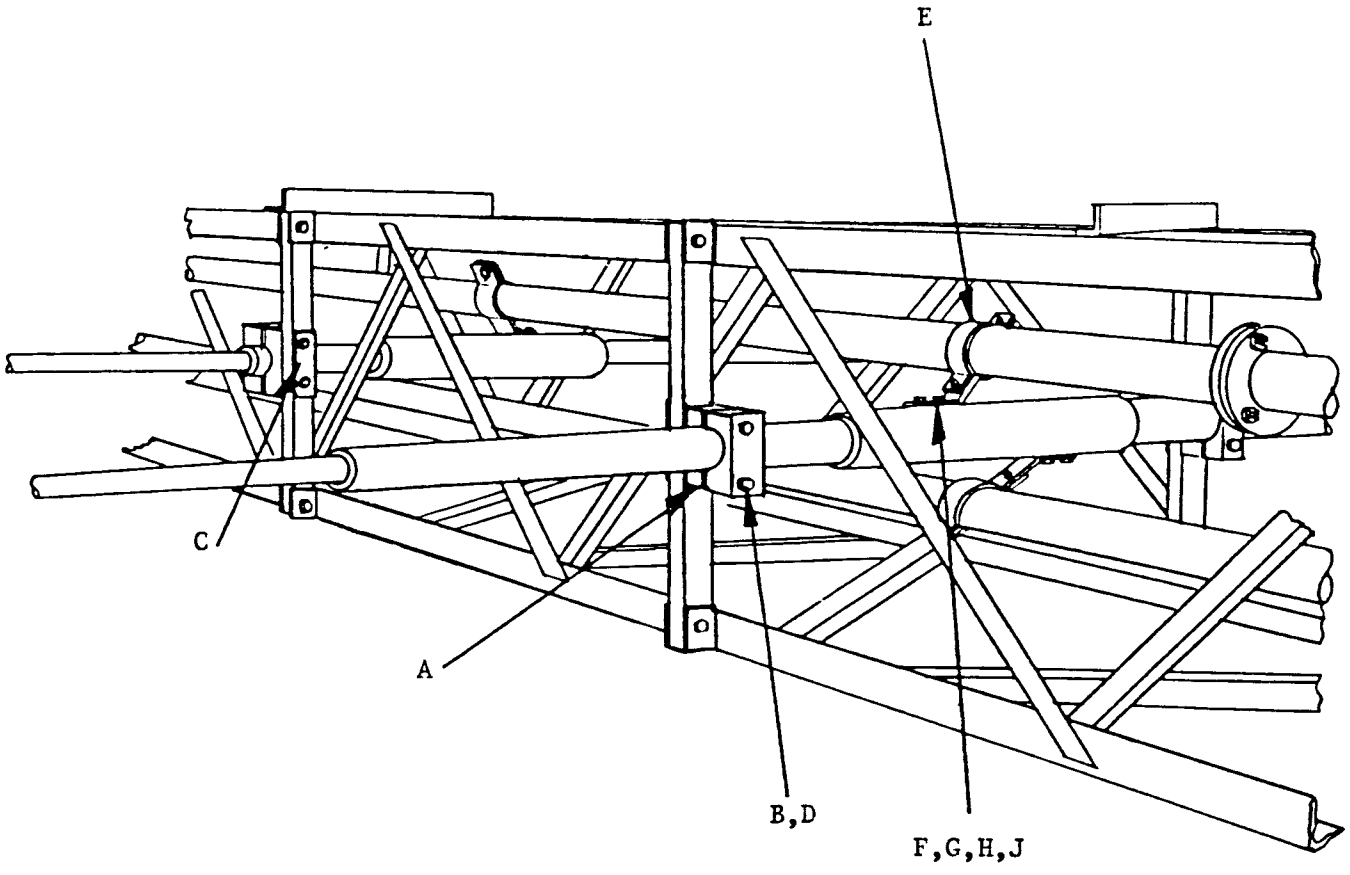


Fig 37 Windsail Assembly



Item	Part Name	1–8	9–11	12,13	14,15
A	Saddle	1	2	3	4
B	Bolt	10	11	12	13
C	Reinforcing Plate	18	19	20	21
D	Nut	27	28	28	29
E	Feed Strap Assy	32	32	32	32
F	Spacer	33	33	33	33
G	Screw	34	35	36	37
H	Lock Washer	43	43	43	43
J	Nut	44	44	44	44

Item	Part Name	16	17	18	19	20
A	Saddle	5	6	7	8	9
B	Bolt	14	15	15	16	17
C	Reinforcing Plate	22	23	24	25	26
D	Nut	29	30	30	31	31
E	Feed Strap Assy	32	32	32	32	32
F	Spacer	33	33	33	33	33
G	Screw	38	39	40	41	42
H	Lock Washer	43	43	43	43	43
J	Nut	44	44	44	44	44

Fig. 38 Typical element installation

TABLE 38 ITEMS LIST FOR FIG.38

Item	Ref./Part No.	Description	Qty.
1	5985-01-156-6892	Saddle casting 1-8	32
2	5985-01-156-6893	Saddle casting 9-11	12
3	5985-01-156-6894	Saddle casting 12,13	8
4	5985-01-156-6895	Saddle casting 14,15	8
5	5985-01-156-6896	Saddle casting 16	4
6	5985-01-156-6897	Saddle casting 17	4
7	5985-01-156-6898	Saddle casting 18	4
8	5985-01-156-6899	Saddle casting 19	4
9	5985-01-156-6900	Saddle casting 20	4
10	5306-99-138-2965	Bolt, hex hd, 1/4-20x3 1/2, SST	32
11	5306-99-764-8690	Bolt, hex hd, 5/16-18x4 1/2,SST	12
12	5306-99-764-8691	Bolt, hex hd, 5/16-18x5 1/2,SST	8
13	0002-4144-202	Threaded rod, 7/16-14x6 1/2,SST	8
14	0002-4144-204	Threaded rod, 7/16-14x7 1/2,SST	4
15	5306-99-764-8695	Bolt, hex hd, 1/2-13x9, SST	8
16	5306-99-764-8697	Bolt, hex hd, 5/8-11x11 1/2,galv.	4
17	5306-99-764-8698	Bolt, hex hd, 5/8-11x12 1/2,galv.	4
18	5985-00-534-8727	Plate, reinforcing 1-8	16
19	5985-00-534-8781	Plate, reinforcing 9-11	6
20	5985-00-534-8820	Plate, reinforcing 12,13	4
21	5985-00-534-8866	Plate, reinforcing 14,15	4
22	5985-00-534-8904	Plate, reinforcing 16	2
23	5985-00-534-8913	Plate, reinforcing 17	2
24	5985-00-534-8917	Plate, reinforcing 18	2
25	5985-00-534-8968	Plate, reinforcing 19	2
26	5985-00-534-9078	Plate, reinforcing 20	2
27	5310-99-944-2457	Nut, hex, lock, 1/4-20, SST	32
28	5310-99-944-2453	Nut, hex, lock, 5/16-18, SST	20
29	5310-99-780-7499	Nut, hex, lock, 7/16-14, SST	24
30	5310-99-944-2548	Nut, hex, lock, 1/2-20, SST	8
31	5310-99-627-2424	Nut, hex, 5/8-11, galv.	8
32	5985-01-180-9230	Feed strap assembly	40
33	5985-99-627-2484	Spacer, feed strap	80
34	5305-99-627-2459	Screw, rd hd slotted, 1/4-20x2, SST	32
35	5305-99-738-3681	Screw, rd hd slotted,1/4-20x2 3/4, SST	12
36	5305-99-771-1993	Screw, rd hd slotted,1/4-20x3 1/4, SST	8
37	5305-99-772-4451	Screw, rd hd slotted,1/4-20x3 3/4, SST	8
38	5305-99-627-2455	Screw, rd hd slotted,1/4-20x4 1/4, SST	4
39	5305-99-627-2465	Screw, rd hd slotted,1/4-20x4 3/4, SST	4
40	5305-99-627-2464	Screw, rd hd slotted,1/4-20x5 1/4, SST	4
41	5305-99-723-4532	Screw, rd hd slotted,1/4-20x6 1/2, SST	4
42	5305-99-627-2462	Screw, rd hd slotted,1/4-20x7 1/4, SST	4
43	5310-99-111-1293	Washer, lock, 1/4 , SST	80
44	5310-99-944-2936	Nut, hex, 1/4-20, SST	80

TABLE 39 ITEMS LIST FOR FIG.39

Item	Ref./Part No.	Description	Qty.
1	5985-00-534-9620	Elbow, transformer line	1
2	5985-00-536-0421	Elbow, transformer line	1
3	5950-00-412-0920	Shorting coil	1
4	5985-99-627-2524	Spacer block	7
5	4730-00-359-9487	Clamp, hose	5
6	4730-99-627-2408	Clamp, hose	2
7	0002-1393-201	Strap, damper	18
8	0002-1395-201	Spacer, dielectric	9
9	0002-1394-201	Stud, dielectric, $^{3}/_{8}$-16	9
10	2199-0015-001	Nut, hex, $^{3}/_{8}$-16, nylon	18

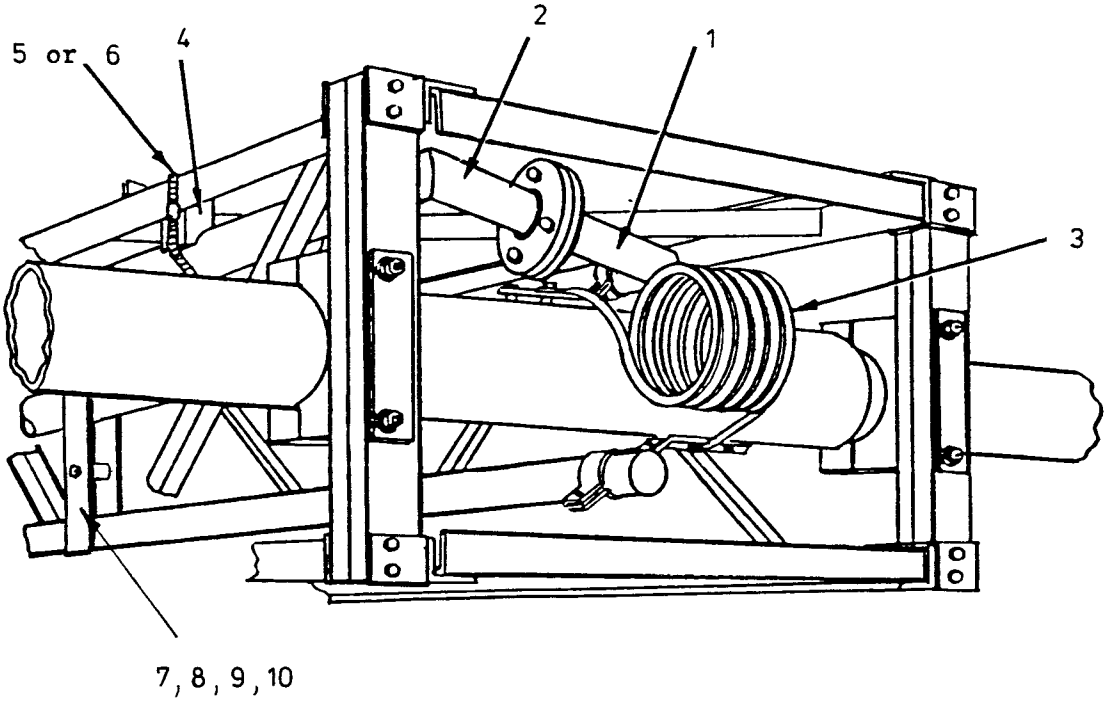


Fig. 39 Rear boom installation

TABLE 40 ITEMS LIST FOR FIG.40

Item	Ref./Part No.	Description	Qty.
1	5985-99-627-2467	Adaptor, transmission Line	1
2	5306-99-627-2480	Hinge bolt	1
3	5310-99-627-2411	Washer, lock, 1in. galvanised	1
4	5310-99-627-2422	Nut, hex, 1-8, galvanised	1

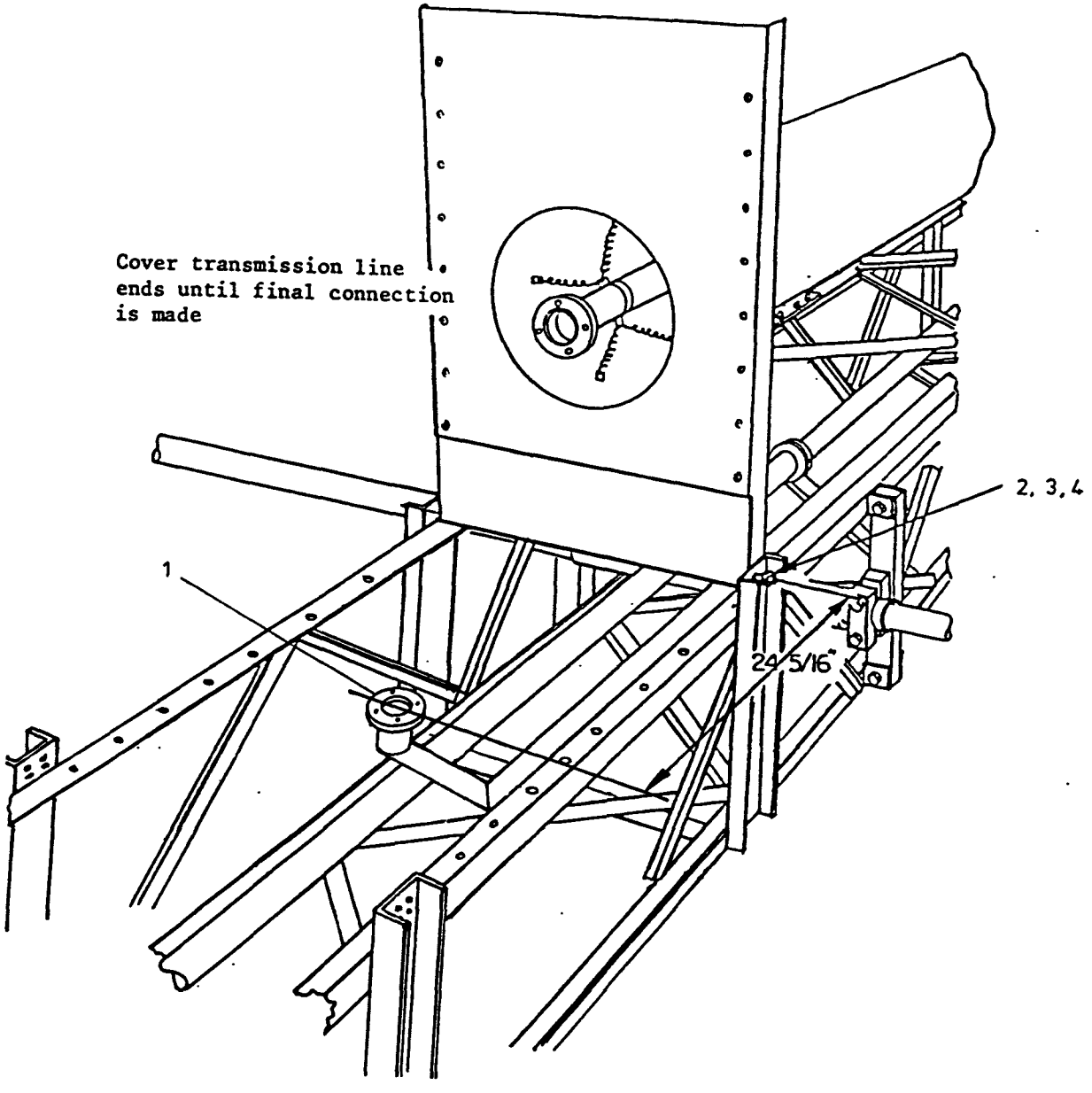


Fig. 40 Torque tube to boom installation

TABLE 41 ITEMS LIST FOR FIG.41

Item	Ref./Part No.	Description	Qty.
1	5985-99-627-2467	Adaptor, transmission line	1
2	5985-00-050-4921	Transmission line, 20ft	2
3	5985-00-536-0421	Elbow, transmission line	1
4	5985-00-534-9620	Elbow transformer line	1
5	5985-99-627-2527	Transformer line, section 1	1
6	5985-99-627-2470	Transformer line, section 2	1
7	5985-99-627-2469	Transformer line, section 3	1
8	5985-99-627-2468	Transformer line, section 4	1
9	5985-00-539-3301	Transformer line, section 5	1
10	5985-99-627-2482	Strap, jumper	1
11	5985-99-627-2483	Feed line, upper	1
12	5985-99-627-2494	Feed line	4
13	5985-99-627-2493	Feed line	1
14	5985-99-627-2495	Coupling, feed line	5
15	0001-4007-001	Connector Kit	5
16	0001-9689-204	Connector Kit	1
17	0001-9689-203	Connector Kit	1
18	0001-9689-202	Connector Kit	1
19	0001-9689-201	Connector Kit	1
20	5305-99-947-3794	Screw, hex hd, $^1/_4$-20x$^1/_2$, SST	1
21	5310-99-111-1293	Washer, lock, $^1/_4$ SST	1
22	4730-00-917-7689	Clamp, hose	10

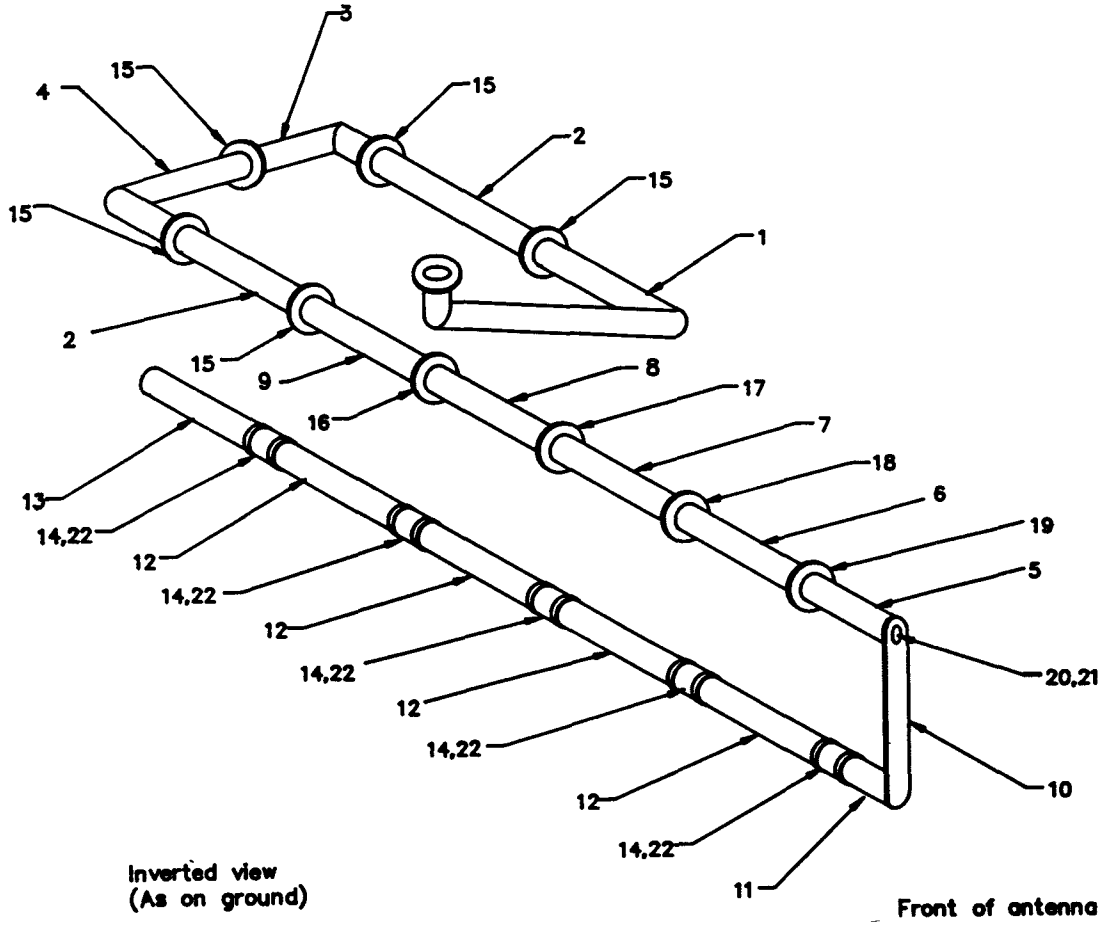


Fig.41 Feedline assembly

TABLE 42 ITEMS LIST FOR FIG.42

Item	Ref./Part No.	Description	Qty.
1	5985-99-627-2483	Feed line, upper	1
2	5985-99-627-2527	Transformer assembly, No.1	1
3	4820-99-620-3013	Valve, pressure relief	1
4	5985-99-627-2482	Strap, jumper	1
5	5305-99-947-3794	Screw, hex hd, $^1/_4$-20x$^1/_2$, SST	1
6	5310-99-111-1293	Washer, lock, $^1/_4$ SST	1
7	0001-8161-001	Gusset, section No.1	4
8	5305-99-945-9487	Screw, hex hd, $^1/_4$-20x$^3/_4$, SST	16
9	5310-99-111-1293	Washer, lock, $^1/_4$ SST	16
10	5310-99-944-2936	Nut, hex, $^1/_4$ SST	16

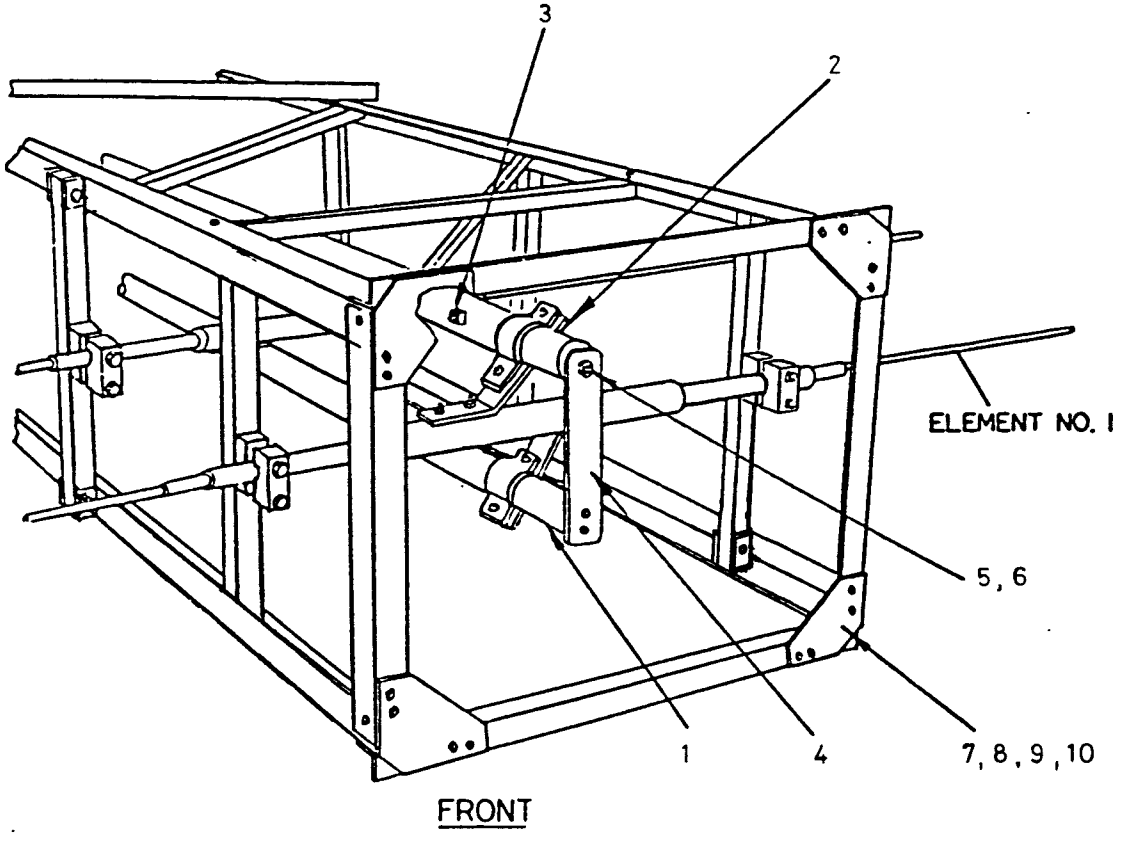


Fig. 42 Front boom installation

TABLE 43 ITEMS LIST FOR FIG.43

Item	Ref./Part No.	Description	Qty.
1	5985-99-627-2494	Feed line	4
2	5985-99-627-2493	Feed line	1
3	5985-99-627-2483	Feed line, upper	1
4	5985-99-627-2495	Coupling, feed line	5
5	4730-00-917-7689	Clamp, hose	10

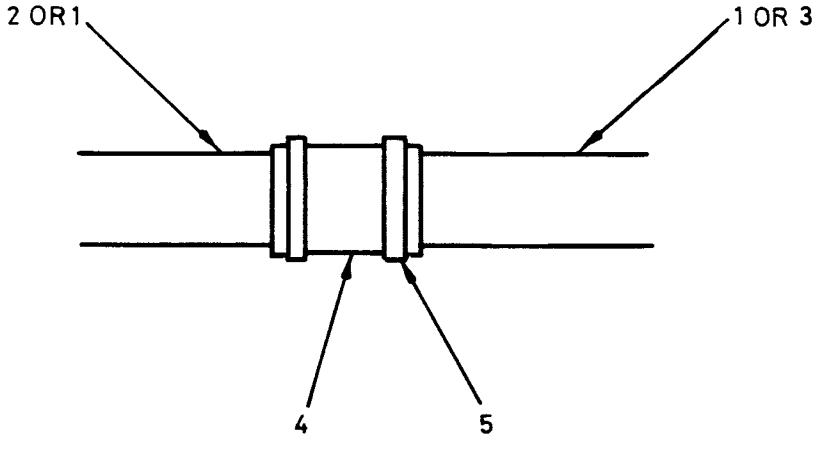


Fig. 43 Feed line joint

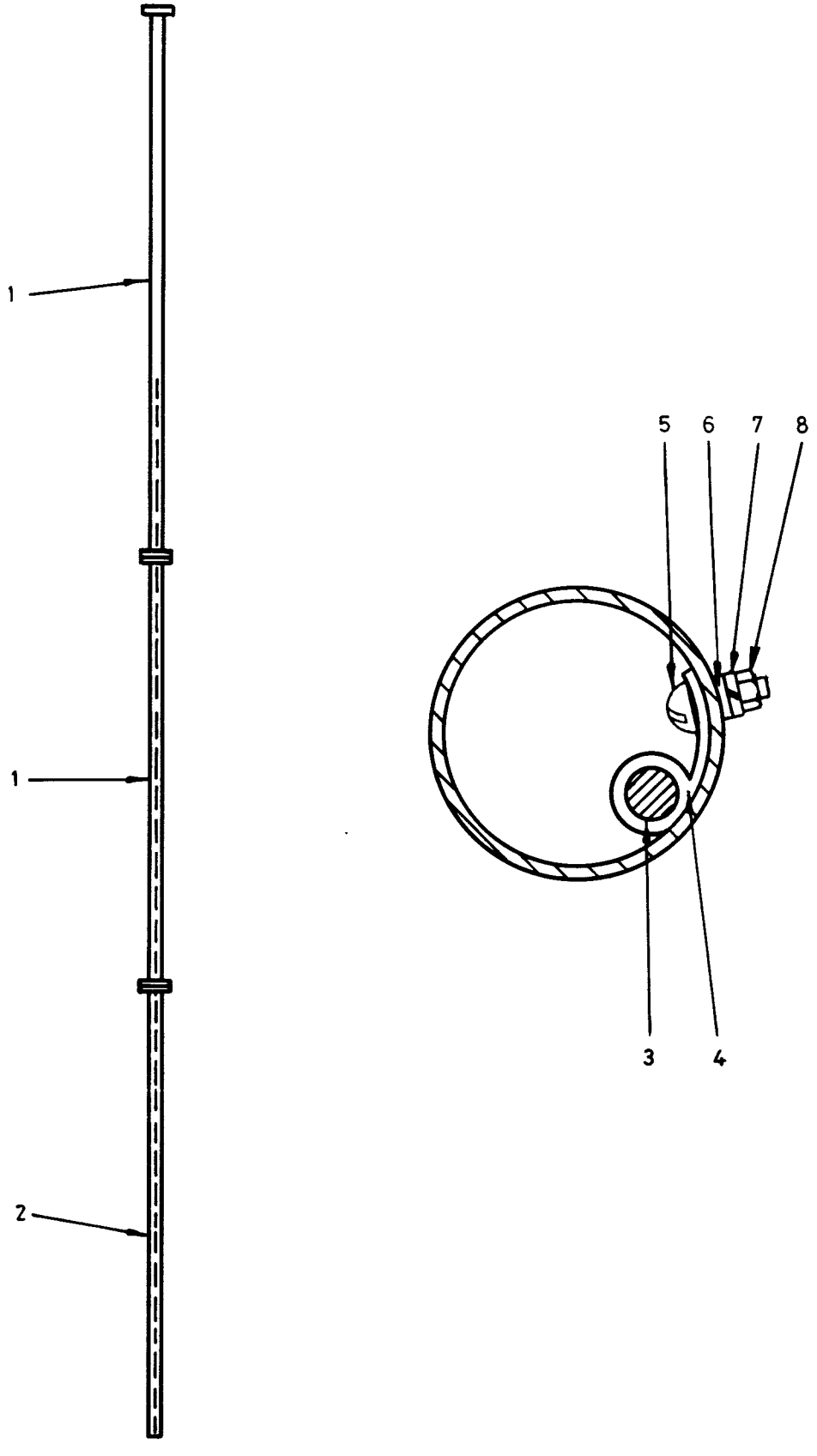


Fig. 44 Vibration damper installation

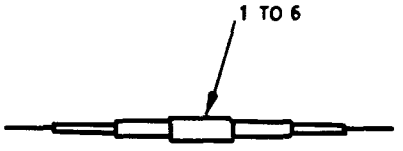
TABLE 44 ITEMS LIST FOR FIG.44

Item	Ref./Part No.	Description	Qty.
1	5985-99-627-2494	Feed line	2
2	5985-99-627-2493	Feed line	1
3	5985-99-627-2471	Vibration damper rope	1
4	5340-99-627-2396	Clamp cable	1
5	5305-99-627-2445	Screw, pan hd, No.10x$^3/_4$, SST	1
6	5310-99-639-0695	Washer, No.10, SST	1
7	5310-99-624-4058	Washer, lock, No.10, SST	1
8	5310-99-134-3463	Nut, hex, No.10, SST	1

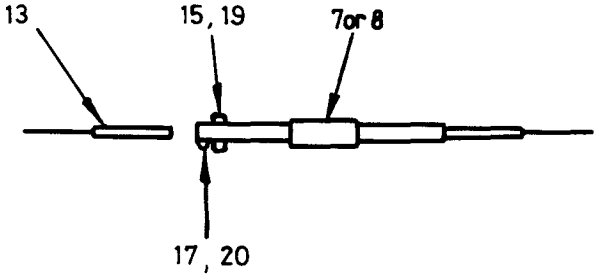
TABLE 45 ITEMS LIST FOR FIG.45

Item	Ref./Part No.	Description	Qty.
1	5985-99-627-2523	Antenna element No.1	1
2	5985-99-627-2522	Antenna element No.2	2
3	5985-99-627-2521	Antenna element No.3	1
4	5985-99-627-2520	Antenna element No.4	1
5	5985-99-627-2519	Antenna element No.5	1
6	5985-99-627-2518	Antenna element No.6	1
7	5985-99-627-2517	Antenna element No.7 centre	1
8	5985-99-627-2516	Antenna element No.8 centre	1
9	5985-99-627-2515	Antenna element No.9 centre	1
10	5985-99-627-2514	Antenna element No.10 centre	1
11	5985-99-627-2513	Antenna element No.11 centre	1
12	5985-99-627-2512	Antenna element No.12 centre	1
13	5985-99-627-2503	Antenna element No.7&8 short section	2
14	5985-99-627-2502	Antenna element No.9&20 short section	7
15	5306-99-947-3798	Bolt, hex hd, $^1/_4$-20x1$^1/_2$, SST	2
16	5306-99-957-3825	Bolt, hex hd, $^1/_4$-20x2, SST	7
17	5306-99-134-5878	Bolt, hex hd, $^3/_8$-16x1$^1/_2$, SST	2
18	5306-99-738-3684	Bolt, hex hd, $^3/_8$-16x2$^3/_4$, SST	7
19	5310-99-944-2457	Nut, hex, lock,$^1/_4$-20, SST	9
20	5310-99-944-2456	Nut, hex hd, $^3/_8$-16, SST	9

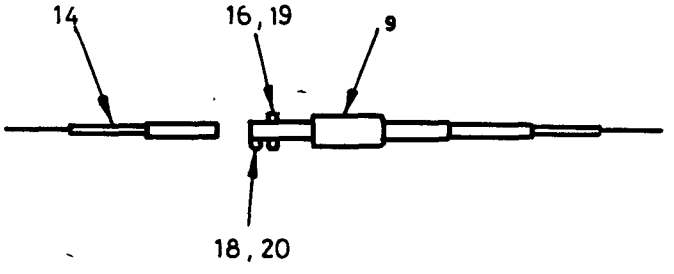
NOTE: ELEMENTS 1–6 ARE PRE-ASSEMBLED



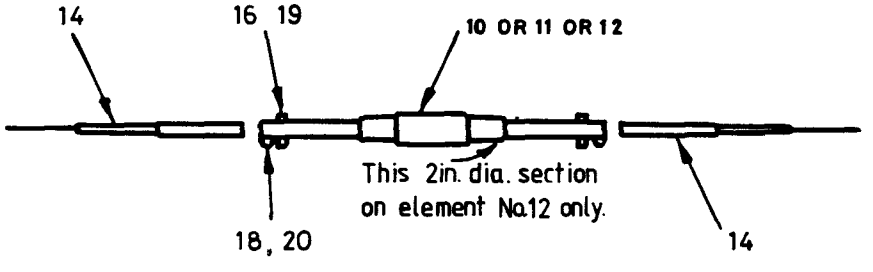
ELEMENTS 1–6



ELEMENTS 7-8

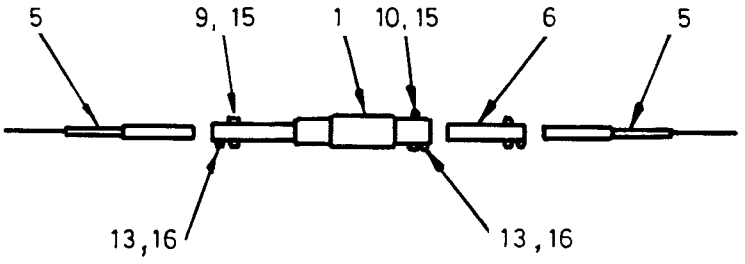


ELEMENT 9

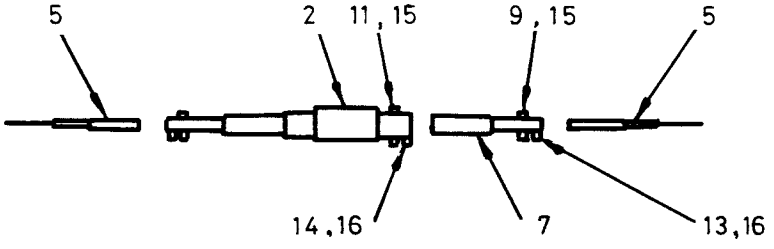


ELEMENTS 10-12

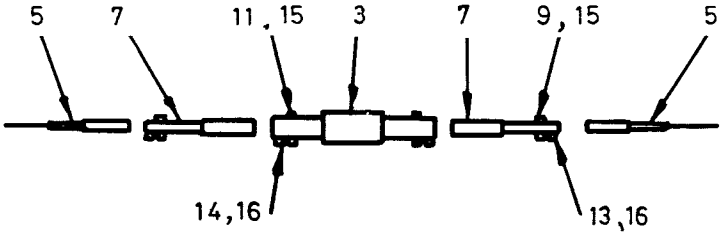
Fig. 45 Element assemblies (1 to 12)



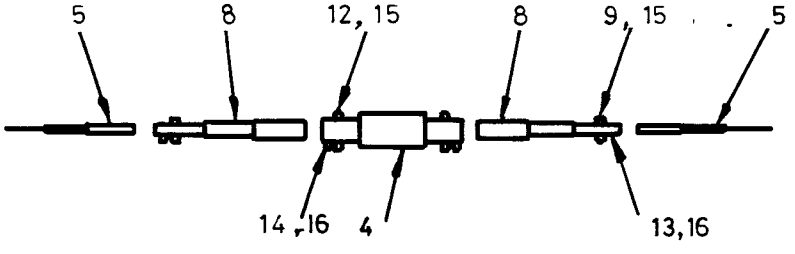
ELEMENT 13



ELEMENT 14



ELEMENT 15



ELEMENT 16

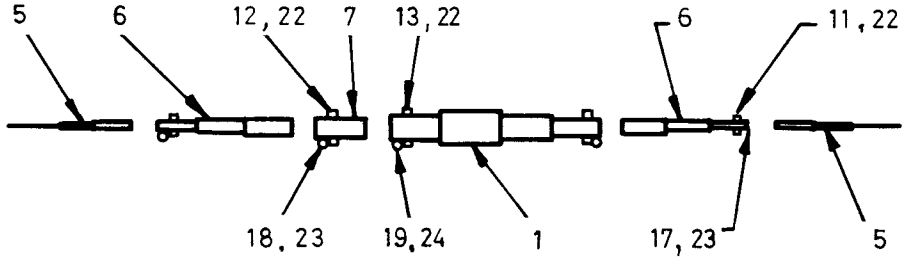
Fig. 46 Element assemblies (13 to 16)

TABLE 46 ITEMS LIST FOR FIG.46

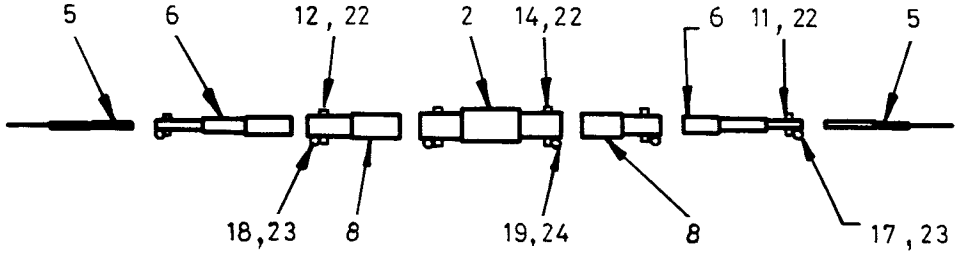
Item	Ref./Part No.	Description	Qty.
1	5985-99-627-2511	Antenna element No.13 centre	1
2	5985-99-627-2510	Antenna element No.14 centre	1
3	5985-99-627-2509	Antenna element No.15 centre	1
4	5985-99-627-2508	Antenna element No.16 centre	1
5	5985-99-627-2502	Antenna element No.9-20 long section	8
6	5985-99-627-2501	Antenna element No.13 joint section	1
7	5985-99-627-2500	Antenna element No.14 & 15 inner section	3
8	5985-99-627-2499	Antenna element No.16-20 inner section	2
9	5306-99-957-3825	Bolt, hex hd, 1/4-20x2, SST	8
10	5306-99-627-2440	Bolt, hex hd, 1/4-20x2 1/2, SST	1
11	5306-99-136-8555	Bolt, hex hd, 1/4-20x3, SST	3
12	5306-99-627-2438	Bolt, hex hd, 1/4-20x3 1/2, SST	2
13	5306-99-738-3684	Bolt, hex hd, 3/8-16x2 3/4, SST	9
14	5306-99-124-7261	Bolt, hex hd, 3/8-16x3, SST	5
15	5310-99-944-2457	Nut, hex, lock, 1/4-20, SST	14
16	5310-99-944-2456	Nut, hex lock, 3/8-16, SST	14

TABLE 47 ITEMS LIST FOR FIG.47

Item	Ref./Part No.	Description	Qty.
1	5985-99-627-2507	Antenna element No.17 centre	1
2	5985-99-627-2506	Antenna element No.18 centre	1
3	5985-99-627-2505	Antenna element No.19 centre	1
4	5985-99-627-2504	Antenna element No.20 centre	1
5	5985-99-627-2502	Antenna element No.9-20 long section	8
6	5985-99-627-2499	Antenna element No.16-20 inner section	8
7	5985-99-627-2498	Antenna element No.17 joint section	1
8	5985-99-627-2497	Antenna element No.18 inner section	2
9	5985-99-627-2496	Antenna element No.19 & 20 inner section	4
10	5985-00-534-9114	Antenna element No.20 inner section	1
11	5306-99-957-3825	Bolt, hex hd, 1/4-20x2, SST	8
12	5306-99-627-2438	Bolt, hex hd, 1/4-20x3 1/2, SST	8
13	5306-99-627-2437	Bolt, hex hd, 1/4-20x4, SST	1
14	5306-99-764-8696	Bolt, hex hd, 1/4-20x4 1/2, SST	2
15	5306-99-627-2436	Bolt, hex hd, 1/4-20x5, SST	4
16	5305-99-723-4532	Bolt, hex hd, 1/4-20x6 1/2, SST	1
17	5306-99-738-3684	Bolt, hex hd, 3/8-16x2 3/4, SST	8
18	5306-99-124-7261	Bolt, hex hd, 3/8-16x3, SST	8
19	5306-99-627-2429	Bolt, hex hd, 1/2-13x3 1/2, SST	3
20	5306-99-738-3683	Bolt, hex hd, 1/2-13x4, SST	4
21	5306-99-627-2427	Bolt, hex hd, 1/2-13x4 3/4, SST	1
22	5310-99-944-2457	Nut, hex, lock, 1/4-20, SST	24
23	5310-99-944-2456	Nut, hex lock, 3/8-16, SST	16
24	5310-99-944-2458	Nut, hex, lock, 1/2-13, SST	8



ELEMENT 17



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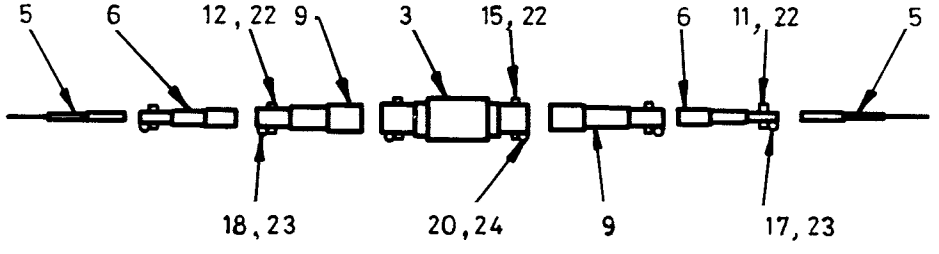

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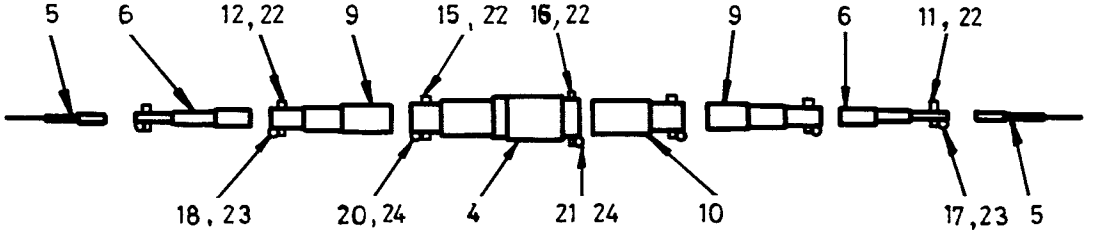


ELEMENT 20

Fig. 47 Element assemblies (17 to 20)

TABLE 48 ITEMS LIST FOR FIG.48

Item	Ref./Part No.	Description	Qty.
1	4010-99-638-9347	Guy	1
2	4010-99-202-9038	Rope, 100ft for Tirfor T13	2
3	4030-99-724-6868	Shackle, small Dee, $^{3}/_{4}$in. dia. pin, SWL $1^{3}/_{4}$t	4
4	3950-99-204-6346	Tirfor winch type T13	2
5	4010-99-638-8410	Chain, long link, $^{5}/_{8}$ in.dia.6ft.long	2

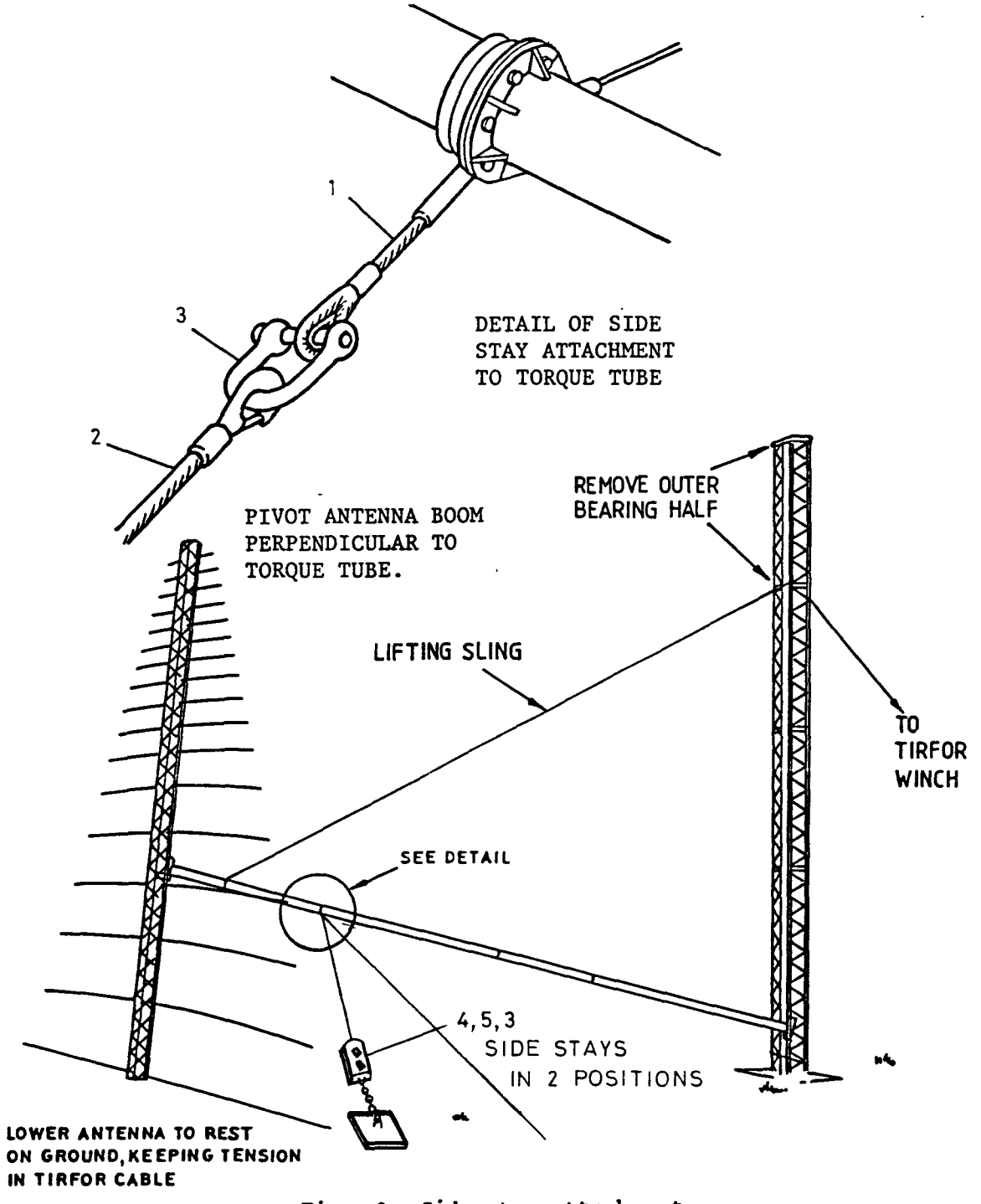


Fig. 48 Side stay attachment

TABLE 49 ITEMS LIST FOR FIG.49

Item	Ref./Part No.	Description	Qty.
6	5985-99-797-5555	Guy	1
7	4030-99-561-2787	Shackle, large Dee, 1 in. dia. pin, SWL 3t	1
8	3940-99-425-3457	Snatch block, 12in. dia. sheave, SWL 5t	1
9	4030-99-638-8199	Shackle, large Dee, $1^{1}/_{4}$in. dia.pin, SWL 5t	2
10	4010-99-798-2590	Rope, 70m for Tirfor T35	1
11	5985-99-798-4457	Guy	1
12	4020-99-933-1562	Rope, polyester, 9mm dia. x 6ft	1
13	5985-99-797-5556	Spreader plate	1
14	4L/4013	Tirfor winch type TU32H	1

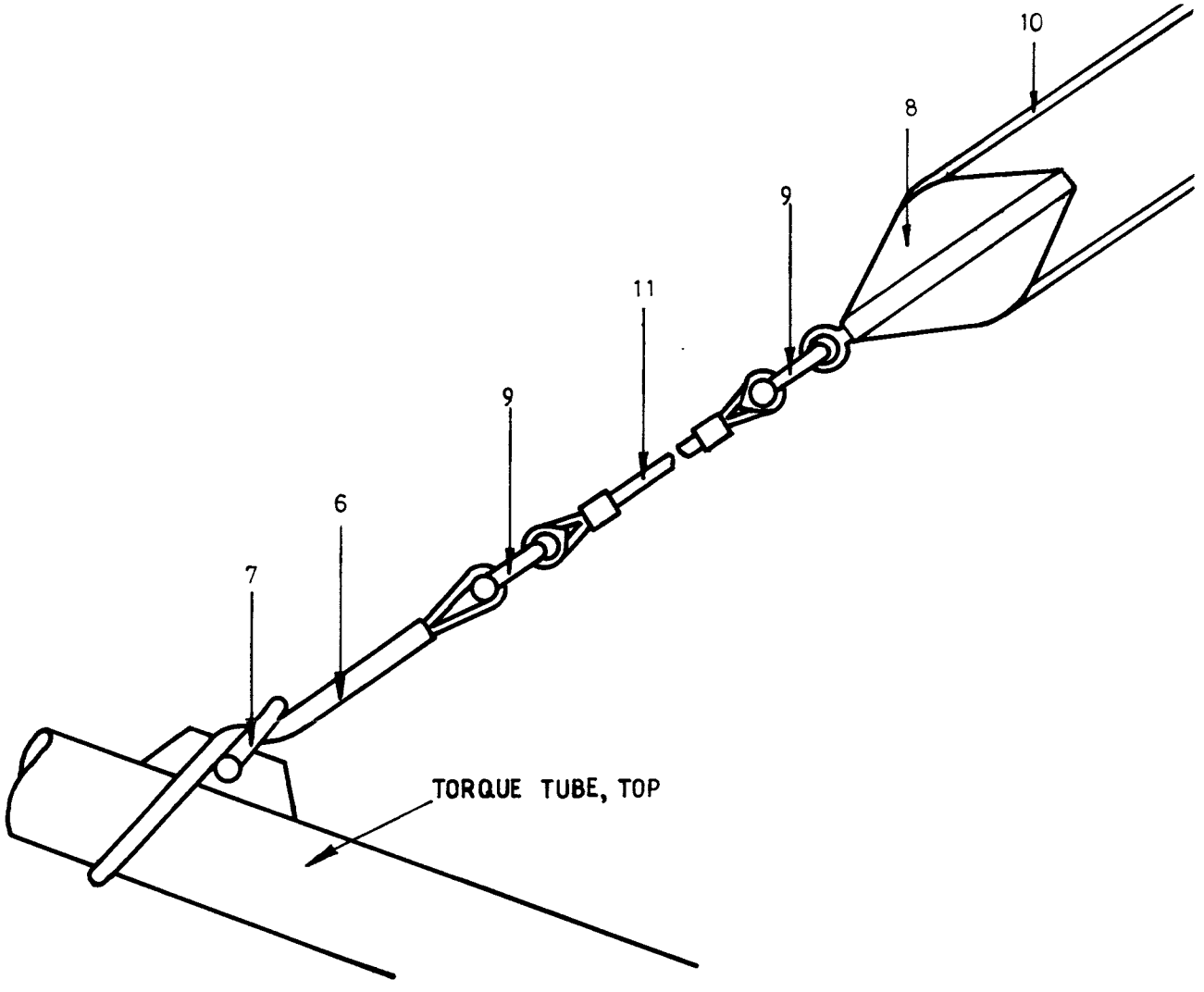


Fig. 49 Antenna lifting point

TABLE 50 ITEMS LIST FOR FIG.50

Item	Ref./Part No.	Description	Qty.
1	0002-5639-201	Reinforcing plate	2
2	2077-7311-001	Bolt, hex hd, $^1/_2$-13x2, galv.	16
3	2300-0155-001	Washer, lock, $^1/_2$, galv.	16
4	2100-0127-001	Nut, hex, $^1/_2$-13, galv.	16
5	5306-99-773-5522	Bolt, hex hd, $^3/_8$-16x1$^3/_4$,	8
6	2310-0597-001	Washer, $^3/_8$, galv.	8
7	5310-99-626-9325	Washer, lock, $^3/_8$, galv.	8
8	5310-99-627-2425	Nut, hex, $^3/_8$-16, galv.	8
9	5306-99-627-2480	Bolt, hinge	1
10	5310-99-627-2411	Washer, lock, 1 in, galv.	1
11	5310-99-627-2422	Nut, hex, 1-8, galv.	1

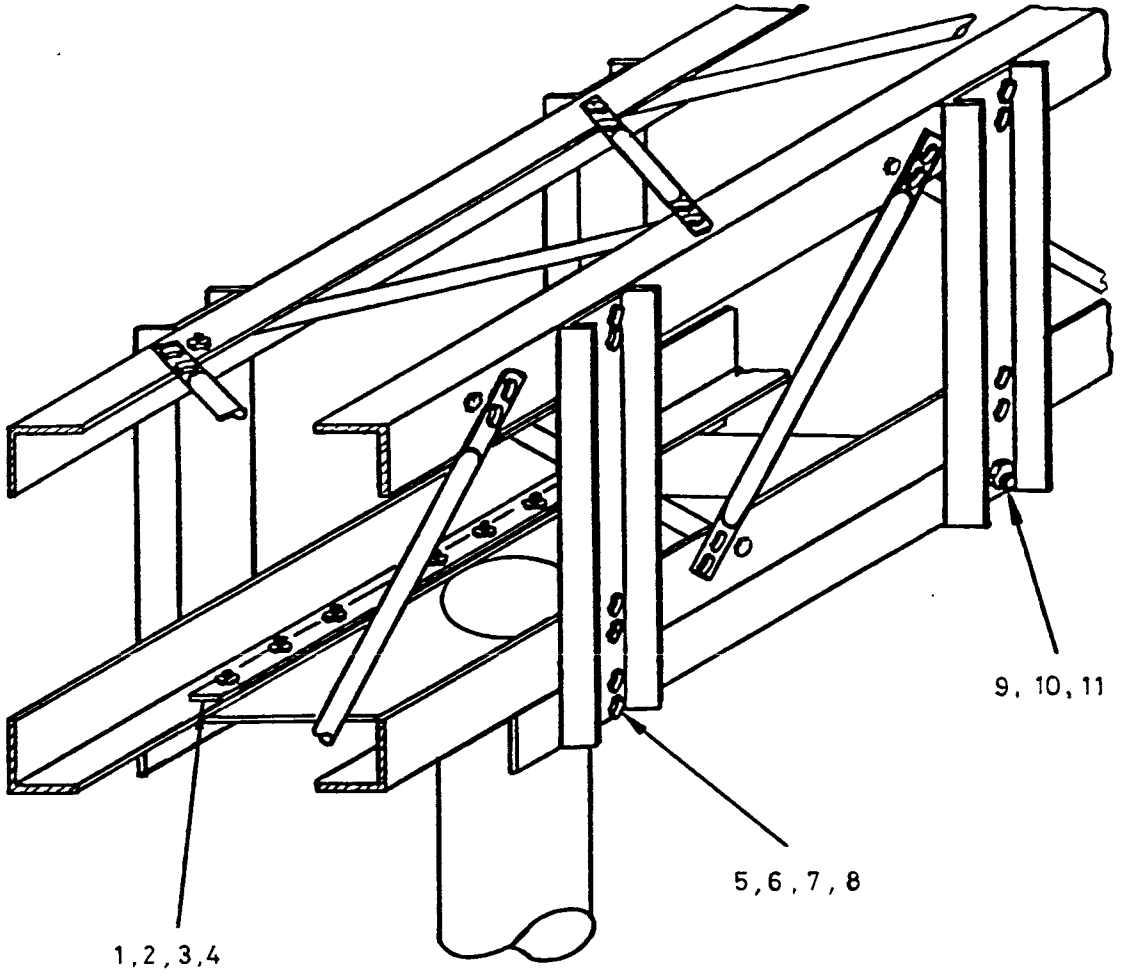


Fig.50 Boom to torque tube joint

TABLE 51 ITEMS LIST FOR FIG.51

Item	Ref./Part No.	Description	Qty.
1	0001-5755-001	Earth wire	1
2	8900-0298-001	Earthing rod	1
3	8900-0250-001	Earth wire clamp	1
4	2450-2171-001	Cable connector	1
5	2009-8861-001	Bolt, hex. hd, $^1/_4$-20x1, galv.	1
6	2100-0119-001	Nut, hex, $^1/_4$-20, galv.	1
7	2300-0151-001	Washer, lock, $^1/_4$, galv.	1

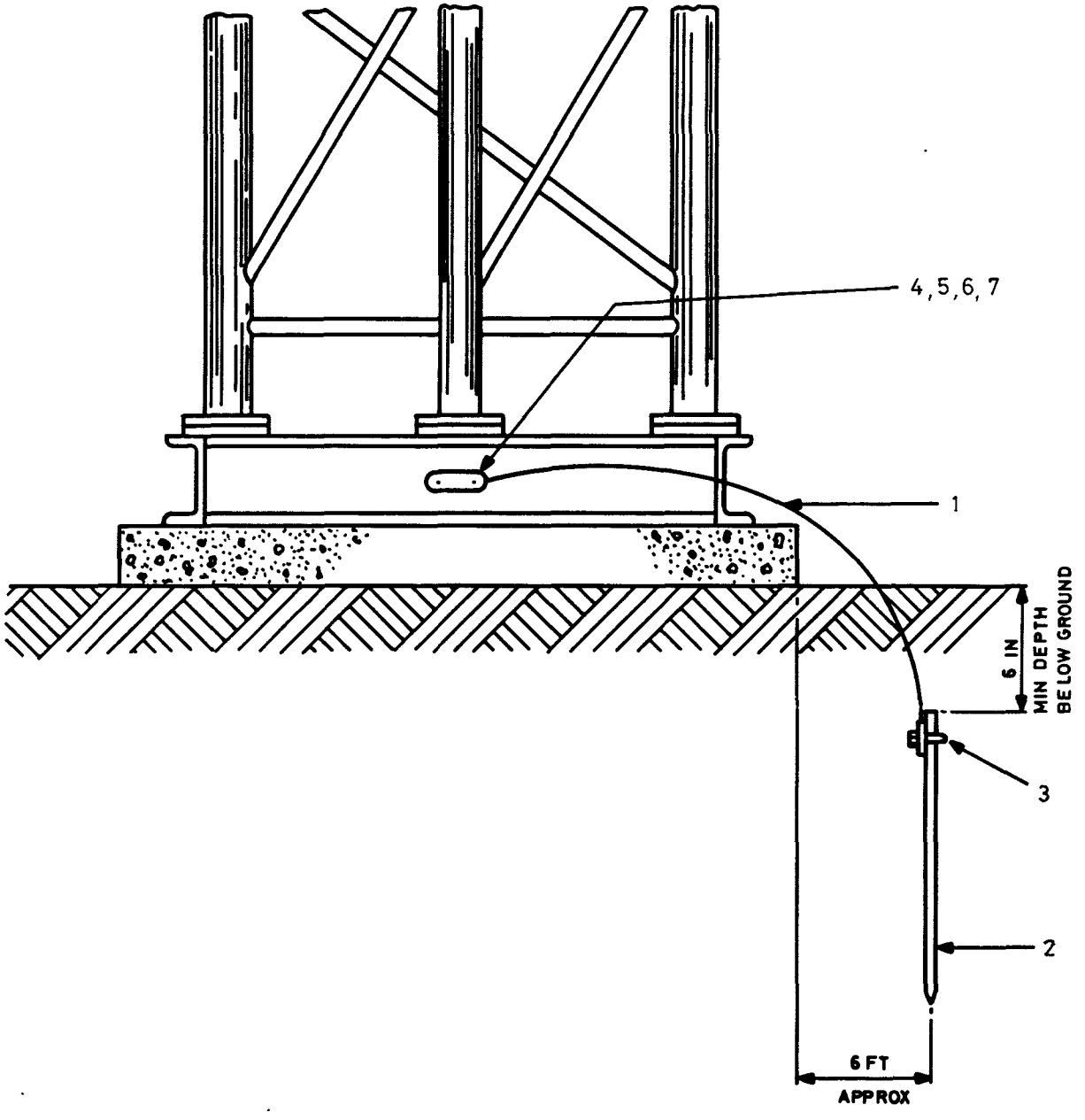


Fig. 51 Earthing of twin lattice mast

TORQUE VALUES - ASSEMBLIES OF METAL PARTS

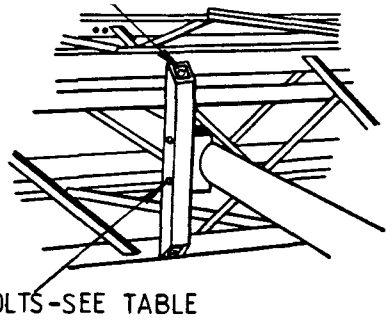
Bolt Dia Inches	Galvanised				Stainless Steel	
	High Strength		Standard			
	Torque lbf.ft	A/Flats Inches	Torque lbf.ft	A/Flats Inches	Torque lbf.ft	A/Flats Inches
1/4	–	–	6	7/16	6.5	7/16
5/16	–	–	–	–	11.5	1/2
3/8	–	–	19	9/16	21	9/16
7/16	–	–	–	–	33	5/8*
1/2	69	7/8	45	3/4	45	3/4
5/8	145	1.1/16	93	15/16	–	–
3/4	234	1.1/4	150	1.1/8	–	–
1	–	–	300	1.1/2	–	–

* The 7/16 Dia. Nut is 11/16 across flats

BOLTED ASSEMBLIES INCLUDING FIBREGLASS PARTS MUST BE TORQUED TO A LOWER VALUE.

OLD TYPE INSULATOR

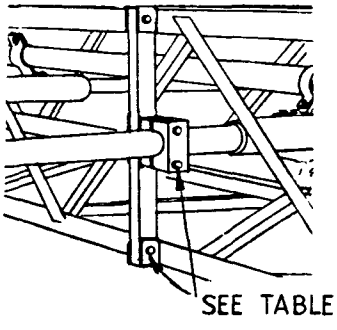
15 lbf.ft



U BOLTS-SEE TABLE

Element	Nut Size Inches	Torque lbf.ft	A/Flats Inches
1–8	1/4	5.8	7/16
9–13	5/16	9	1/2
14–16	7/16	23	11/16
17–18	1/2	32	3/4
19–20	5/8	65	15/16

LATER TYPE INSULATOR



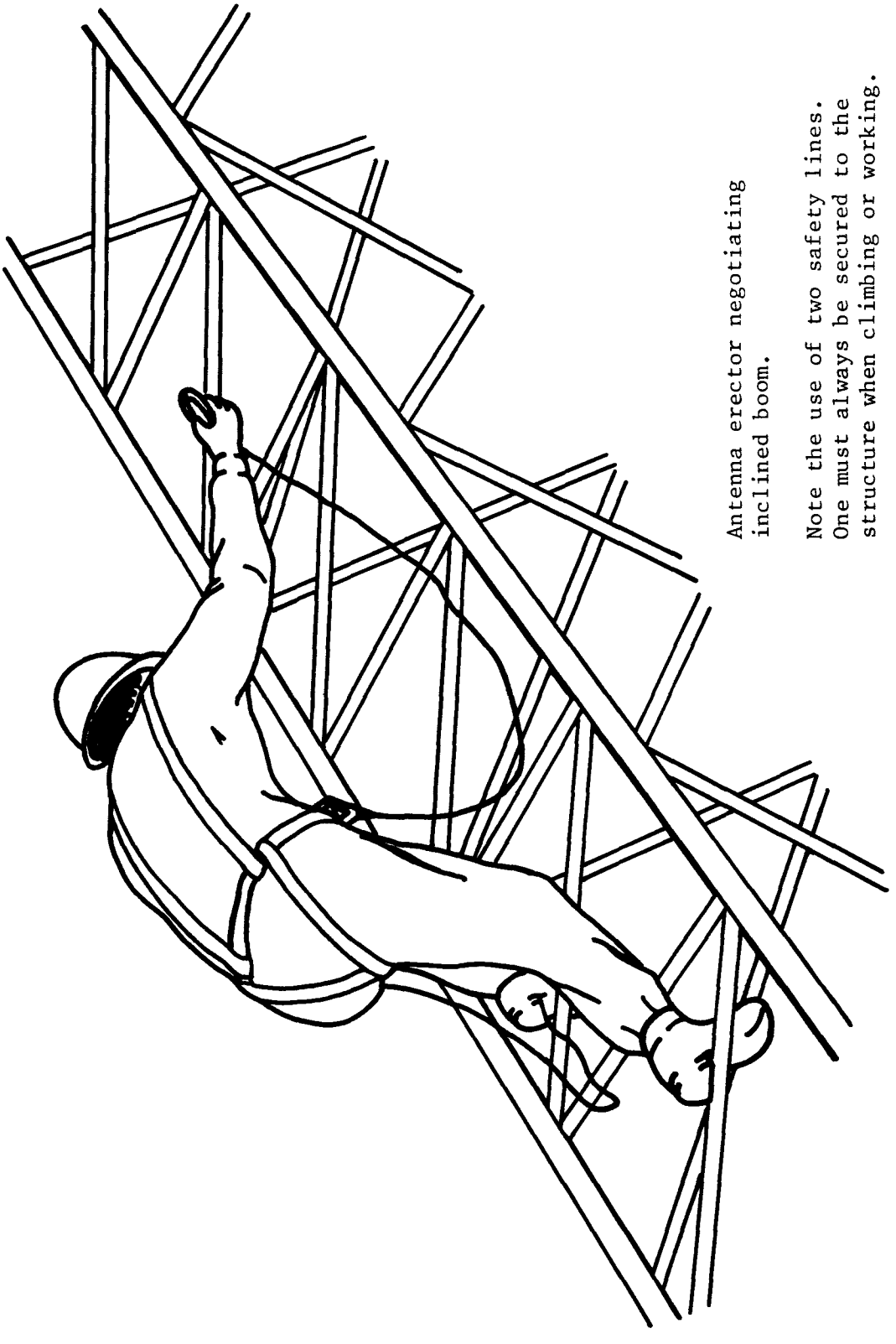
SEE TABLE

Nut/Bolt Size	Torque lbf.ft	A/Flats Inches
1/4	5.8	7/16
5/16	9	1/2
3/8	15	9/16
7/16	23	5/8***11/16
1/2	32	3/4
5/8	65	15/16

GUY TENSIONS: LOWER GUY 12000N
UPPER GUY 15000N

THE TENSION GIVEN FOR THE TOP GUY IS FOR EACH ROPE IN THE PAIR AND NOT THE TOTAL

Fig.52 Torque Values and Guy Tensions



Antenna erector negotiating inclined boom.

Note the use of two safety lines. One must always be secured to the structure when climbing or working.

Fig. 53 Use of safety equipment

Chapter 2.2

LOWERING THE LPH73 ANTENNA

Completely Revised

CONTENTS

Note ...

The following paragraphs give, in the correct sequence, the method of lowering the LPH73 antenna.

WARNINGS ...

(1) REQUEST THE NCO IC GROUND RADIO MAINTENANCE TO ISOLATE THE ANTENNA SYSTEM IN ACCORDANCE WITH CURRENT PROCEDURES AND DISPLAY APPROPRIATE WARNING NOTICES.

(2) WHERE FITTED, ENSURE THAT THE NITROGEN/AIR PRESSURISATION TO THE FEEDER IS SWITCHED OFF.

Mast Condition Certificate

1 The Team Leader, prior to climbing, is to ensure that a valid Mast Conditioning Certificate is held at the Unit, certifying that the structure is in a safe condition.

Visual safety check

2 Using binolulars as necessary, examine the antenna and its supporting structure for signs of damage which could make climbing/lowering hazardous.

3 At the local control, open the hinged cover. Rotate the antenna using the local control switches, so that the high frequency elements (shortest) are pointing towards and directly in line with the main hauling point (block 'D', see Chap.2.1, fig.1). Fine adjustment of the position may be achieved by rotating the drive motor flywheel by hand. Switch off the mains power at the isolator.

4 Disconnect the antenna feeder from the rotary joint below the pedestal unit. Weatherproof the antenna feeder and the rotary joint with polythene and tape. Ensure the feeder is positioned to avoid damage to it and to the connector.

Preparation for lowering

5 Deploy the items of the boom erection equipment in preparation for lowering the boom as follows (Fig.1 and 2 and Tables 1 and 2).

5.1 Attach the leather covered sling (item 1) to the torque tube immediately above the third joint, making two complete turns as shown in Fig.1.

5.2 To each end of the leather covered sling, attach a 30.5m (100ft) T13 Tirfor rope (item 2), using 1 3/4 ton shackle (item 3).

5.3 Shackle a Tirfor winch type T13 (item 4) to chain (item 5) using a 1 3/4 ton shackle (item 3) and shackle the chain to guy anchor block 'A' (see Chap.2.1, Fig.1) using a second 1 3/4 ton shackle (item 3). Similarly, shackle a second winch and chain to the other guy block 'A'.

5.4 Feed the Tirfor ropes (item 2) through the Tirfor winches and take up slack.

5.5 Attach the sling (item 6) to the torque tube at the lifting point, using a 3 ton shackle (item 7) as shown in Fig.2.

5.6 Attach the 5 ton snatch block (item 8) to one end of the sling (item 11) using a 5 ton shackle (item 9).

5.7 Reeve the T35 Tirfor rope (item 10) through the snatch block and lay it out on the ground so that it is free of kinks and twists.

5.8 Feed the free end of sling (item 11) up and over the pulley mounted between the twin lattice masts at the 18.3m (60ft) level and attach it to the two ends of sling (item 6) using a 5 ton shackle (item 9).

Note ...

The following instructions, paragraphs 5.9 to 5.10, are to prevent rotation of the 5 ton snatch block and twisting of the Tirfor rope.

5.9 Thread a length of polyester rope (item 12) through the holes in the side of the 5 ton snatch block and tie it to form a loop.

5.10 Attach a T13 Tirfor rope (item 2) to the loop of polyester rope and reeve the free end through a T13 Tirfor winch (item 4). Attach the T13 Tirfor winch to the anchor block 'C' using a 1 3/4 ton shackle (item 3).

5.11 At the main winch anchor block 'D' attach the spreader plate (item 13) using a 5 ton shackle (item 9).

5.12 Attach a TU32H Tirfor winch (item 14) to the upper hole in the spreader plate using the pin supplied with the winch.

5.13 Attach the hard eye end of the T35 Tirfor rope (item 10) to the lower hole in the spreader plate using a 3 ton shackle (item 7).

5.14 Reeve the free end of the T35 Tirfor rope through the TU32H Tirfor winch.

5.15 Secure the rope (item 15) to the torque tube above the sling (item 6). To the other end of this rope attach a Tirfor rope (item 2).

5.16 At the end of the site remote from the winch anchor block 'D' insert a Molex anchor (item 16) into the ground. To this anchor attach a Tirfor winch (item 4) using a shackle (item 3). Reeve the Tirfor rope (item 2) through the winch (item 4).

5.17 Take up the slack in the ropes by taking in on the T13 Tirfor winches and TU32H Tirfor winch. Check all the connections and the lay of the gear.

5.18 At the 60ft and 80ft (18.3m and 24.4m) levels, take out the 5/8 inch nuts, bolts and washers which secure the gates and open the gates.

5.19 At the pedestal take out the ten 5/8 inch nuts, bolts and washers which secure each side of the pedestal to the mast brackets.

5.20 The antenna is now ready for lowering.

Lowering the antenna

6 Position the men as follows:

One man on each of the side T13 Tirfor winches
Two men on the TU32H Tirfor winch
One man on the T13 Tirfor winch attached to the snatch block
One man on the T13 Tirfor winch attached to the 120ft. rope

Note ...

The supervisor is to control the lowering of the antenna and should move about the site so as to view the operation to the best advantage.

CAUTIONS

(1) During lowering no personnel should be allowed to pass beneath the antenna.

(2) The TU32H Tirfor winch must be operated smoothly so as to avoid exciting undue oscillation into the torque tube and antenna assembly.

(3) To prevent siezure of the TU32H Tirfor winch, lubricate the moving parts frequently during the lowering operation, using oil OMD75.

(4) When sideways adjustment is necessary using the side stay T13 Tirfor winches, cease operating the TU32H Tirfor winch whilst this is carried out.

(5) As lowering proceeds, it will be necessary to maintain some tension on the T13 Tirfor winch attached to the snatch block. Initially this will need to be taken in but later it will need to be paid out.

6.1 Start the antenna moving by operating the winch attached to the 120ft rope. Once the torque tube has moved out of the gates and the antenna weight takes over, the need for this winch and rope ceases and the operator may be redeployed elsewhere on the site.

6.2 Lower the antenna by paying out on the TU32H Tirfor winch. Check that the T35 Tirfor rope (item 11) enters the Vee above the pulley sheave at the intermediate level and is guided onto the pulley sheave. Adjust the side winches to achieve this.

6.3 Continue lowering until the windsail is close to the ground. Cease lowering and take up any slack on the side winches to ensure that the antenna cannot move.

6.4 Unbolt the windsail from the end of the boom and remove it as a complete assembly. Refit eight nuts and bolts to retain the two boom members; safeguard a further eight nuts and bolts for re-use later.

6.5 Continue lowering until the shorting coil can be reached. Cease lowering and stabilise the boom. Remove the shorting coil. Refit the nuts and bolts which held the shorting coil.

6.6 Continue lowering until wooden blocks can be placed between the ground and the end of the boom. Lower the boom onto the blocks, but do not allow the whole weight to be taken by the blocks, as this could damage the boom.

6.7 Approximately 1.5m (5ft) from the end of the boom in the direction away from the pedestal, drive a picket into the ground and secure the boom to it with a length of 10mm diameter polyester rope.

6.8 Climb the boom, wearing safety harness complete with two safety lines. Refer to Chapter 2.1, Fig.5.3 for use of safety equipment.

6.9 At the boom to torque tube joint, loosen the hose clips holding the transmission adaptor (Chapter 2.1, Fig.40, item 1) to the side of the boom. Undo the four 5/16 inch nuts, bolts and lock washers at the transmission line joint. Pull the joint apart and take out the connector and 'O' ring. Safeguard these parts for re-use later.

6.10 Loosen the 1 inch nut at the end of the hinge bolt but do not remove it.

6.11 Remove the eight 3/8 inch nuts, bolts, lock washers and plain washers which secure the two channel sections to each side of the boom. Safeguard these parts for re-use later.

6.12 Remove the sixteen 1/2 inch nuts, bolts and lock washers which secure the boom to the headplate, together with the braces fitted in this position. Safeguard these for re-use later.

6.13 Remove from element No.20 the two outer element sections at each side. Refit the 1/4 inch and 3/8 inch nuts and bolts in the ends of the elements to safeguard them.

6.14 Remove the short restraining guy from the end of the boom.

6.15 Position two or more men on the end of the boom.

6.16 Raise the antenna a short distance, sufficient to allow the end of the boom to clear the ground. The men holding the end of the boom now push it towards the pedestal whilst lowering continues.

6.17 Insert wooden packing between the boom and the ground, so as to support the boom. It may be necessary to rotate the torque tube slightly at this stage, so that the boom approaches the ground squarely. This can be done by turning the flywheel on the drive motor by hand.

6.18 Continue lowering until the whole weight of the antenna is on the ground.

6.19 Unless the boom/torque tube assembly is to be dismantled further, the lowering equipment may be left in position for subsequent re-erection of the antenna.

6.20 Disconnect the 120ft long rope and its associated Tirfor winch and ground anchor, as these are no longer required.

6.21 On completion of the maintenance work, refer to Chapter 2.1, para.30, for instructions regarding the re-erection of the antenna.

6.22 Alternatively, if re-erection is not required, dismantle the lifting equipment and pack it for transit.

TABLE 1 ITEMS LIST FOR FIG.1

Item	Ref./Part No.	Description	Qty.
1	4010-99-638-9347	Guy	1
2	4010-99-202-9038	Rope, 100ft for Tirfor T13	2
3	4030-99-724-6868	Shackle, small Dee, $^{3}/_{4}$in. dia. pin, SWL $1^{3}/_{4}$t	4
4	3950-99-204-6346	Tirfor winch type T13	2
5	4010-99-638-8410	Chain, long link, $^{5}/_{8}$ in.dia.6ft.long	2

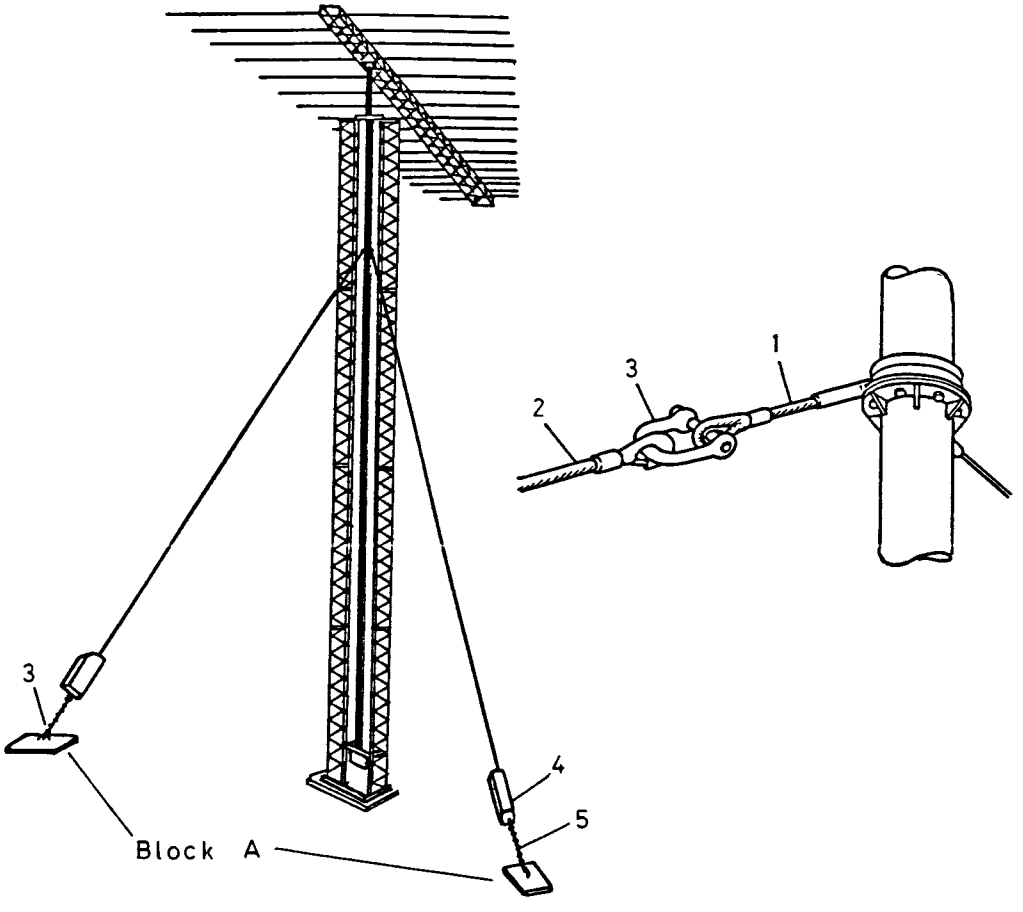


Fig 1 Side stay attachment

TABLE 2 ITEMS LIST FOR FIG.2

Item	Ref./Part No.	Description	Qty.
6	5985-99-797-5555	Guy	1
7	4030-99-561-2787	Shackle, large Dee, 1 in. dia. pin, SWL 3t	1
8	3940-99-425-3457	Snatch block, 12in. dia. sheave, SWL 5t	1
9	4030-99-638-8199	Shackle, large Dee, $1^1/_4$in. dia.pin, SWL 5t	2
10	4010-99-798-2590	Rope, 70m for Tirfor T35	1
11	5985-99-798-4457	Guy	1
12	4020-99-933-1562	Rope, polyester, 9mm dia. x 6ft	1
13	5985-99-797-5556	Spreader plate	1
14	4L/4013	Tirfor winch type TU32H	1
15	4020-99-942-5025	Rope, manilla, $2^1/_4$in.circ.x120ft.	1
16	4020-99-933-3906	Molex anchor, 30in.	1

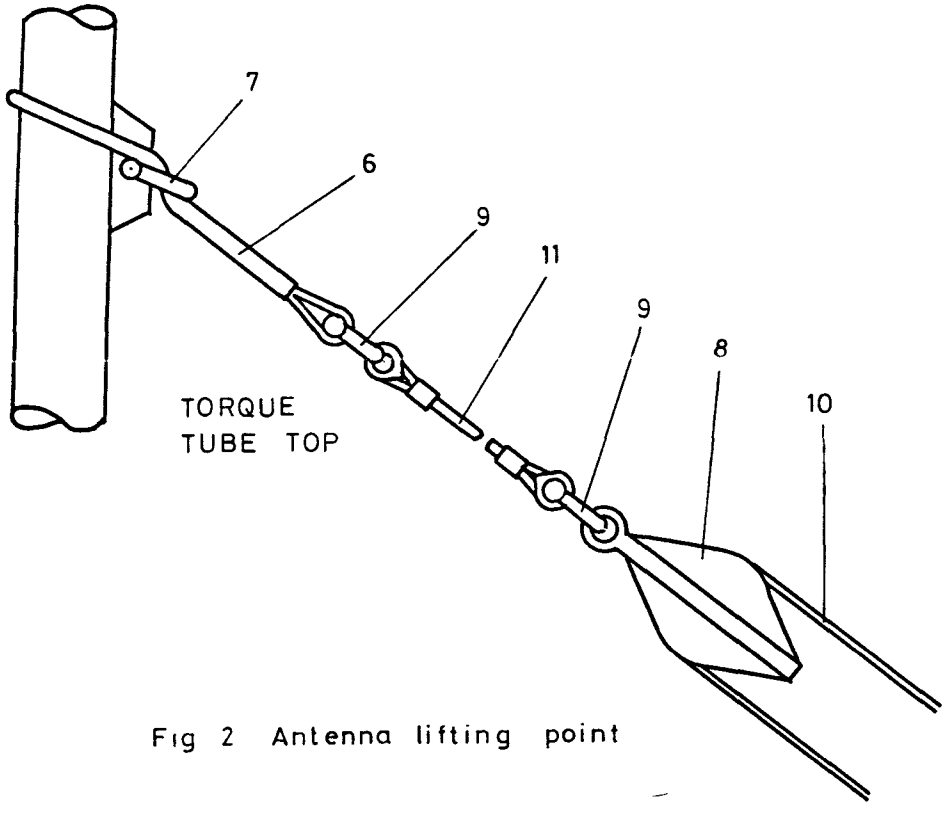


Fig 2 Antenna lifting point

Chapter 2.3

LOWERING THE LPH73 TWIN LATTICE MAST

Completely Revised

CONTENTS

Note ...

The following paragraphs give, in the correct sequence, the method of lowering the LPH73 twin lattice mast.

WARNINGS ...

(1) REQUEST THE NCO IC GROUND RADIO MAINTENANCE TO ISOLATE THE ANTENNA SYSTEM IN ACCORDANCE WITH CURRENT PROCEDURES AND DISPLAY APPROPRIATE WARNING NOTICES.

(2) WHERE FITTED, ENSURE THAT THE NITROGEN/AIR PRESSURISATION TO THE FEEDER IS SWITCHED OFF.

Mast Condition Certificate

1 The Team Leader, prior to climbing, is to ensure that a valid Mast Conditioning Certificate is held at the Unit, certifying that the structure is in a safe condition.

Visual safety check

2 Using binoculars as necessary, examine the antenna and its supporting structure for signs of damage which could make climbing/lowering hazardous.

Note ...

It is assumed that the antenna has already been lowered and dismantled from the pedestal. The disconnection described in the following paragraphs is more easily carried out before lowering the antenna.

Disconnection of mains supply

3 Ensure that the mains power isolator on the panel alongside the antenna is switched off. On the pedestal, open the local control and unscrew the front panel. Disconnect the incoming mains lines from the circuit breaker 2CB1. Disconnect the neutral wire from the terminal block 2TB2. Retighten the terminal screws to prevent their loss.

4 Remove the cable connections from the terminal block 2TB1. Retighten the terminal screws.

5 Slacken the cable glands and pull out the mains and control cables. Retighten the cable glands. Refit the panel and close the local control.

6 At the mast base disconnect the earth connection.

Removal of pedestal

7 Deploy the lifting equipment as follows:-

7.1 Climb to the top of the twin lattice mast. Undo the 5/8 inch shackle which secures the pulley block and rope to the erection bracket and transfer them to one of the crossbraces at the top of the mast. The line, when so attached, may still be used for hauling up tools and equipment, but the load should not exceed about 100kg.

7.2 Refer to Fig.1 and Table 1. Attach a shackle (item 1) to each of the erection brackets. To each of these shackles attach a shackle (item 2). To these shackles attach the two hooks of a two leg sling (item 3).

7.3 To the centre ring of the two leg sling attach a snatch block (item 4) using a shackle (item 2).

7.4 Attach a TU32H Tirfor winch (item 5) to the anchor block 'C' (see Chapter 2.1, Fig.1) using a shackle (item 2).

7.5 Reeve a Tirfor rope (item 6) up the mast, through the snatch block and down through the Tirfor winch (item 5).

7.6 Attach two chains (item 7) to the captive shackle at the end of the Tirfor rope (item 6).

7.7 Attach the two chains to the lifting eyes on the pedestal using two shackles (item 1).

7.8 Take up the slack in the lifting system by operating the Tirfor winch.

7.9 At the end of the pivot shaft, undo the 3/8 inch nut and lock washer and take out the 3/8-16 x 3 1/2 inch bolt.

7.10 Support the weight of the pedestal and push out the pivot shaft (a drift approximately 24mm diameter (1 3/4 inches) would be helpful for this operation). Steady the pedestal to prevent it swinging as the shaft is removed.

7.11 Refit into the end of the shaft the bolt, lock washer and nut to prevent their loss.

ALTERNATIVELY - if a HIAB is available:-

7.12 Omit operations detailed in sub-para.7.1 to 7.5. Position the vehicle to which the HIAB is fitted in a convenient position. Note that the pedestal, which weighs 0.54 tonne, is well within the safe lifting capacity of the HIAB at full extension.

7.13 Attach the two chains as in para.7.6 above. Link the ends of the two chains with a shackle (item 8) and put this shackle over the hook on the HIAB. The HIAB is only to be operated by an operator trained in its use and he is to be satisfied that all the necessary safety procedures are followed.

7.14 Use the HIAB to carry out the procedures detailed in sub-para.7.9 to 7.11.

Preparations for lowering twin lattice masts

8 Deploy the lifting equipment as follows:-

8.1 Refer to Fig.2 and Table 2. On the side of the mast base closest to winch block 'C', position the cross tube of the erection derrick (item 1) in the housings provided and secure with the U bolts (item 19). Leave the U bolts slack. Ensure that the small shackle attachment lug at the derrick head is pointing upwards. Lay the derrick out on the ground and support it, if necessary, with wood blocks.

8.2 Attach two slings (items 8 and 9), one to each of the erection brackets, on the mast at the intermediate guy level, ie, 18.3m (60 ft) from the ground. The rigging screw on the sling (item 9) should be towards the ground.

8.3 To the small attachment lug at the derrick head attach a shackle (item 10). Lift the derrick head and attach the two slings to the shackle (item 10) using two shackles (item 17).

8.4 Attach the snatch block (item 2), using a shackle (item 3), to the large shackle attachment lug at the head of the derrick opposite the erection slings.

8.5 Reeve the erection sling (item 13) through the snatch block (item 2) at the derrick head and attach one end to the hairpin nearest the twin lattice mast base on the downhaul block 'C' using a shackle (item 10).

8.6 Shackle a second snatch block (item 2) to the remaining hairpin on the downhaul block 'C' using shackle (item 10). Reeve the free end of the erection sling (item 13) through this snatch block. Attach a T35 Tirfor rope (item 16) to this free end using two shackles (item 10) back to back.

8.7 Shackle the TU32H Tirfor winch (item 14) to the winch block 'D' using two shackles (item 10) back to back. Feed the Tirfor rope through the Tirfor winch but leave slack.

8.8 Attach two Tirfor ropes (item 11), one to each side of the derrick head, using shackles (items 10 and 12) back to back.

8.9 Attach two Tirfor winches (item 6) to block 'F' on each side of the derrick, using shackle (item 12). Reeve the Tirfor ropes (item 11) through the Tirfor winches (item 6) and take up the slack to centralise the derrick.

8.10 Take up the slack and apply a light tension to the derrick. Check the tension of side stays and adjust if necessary.

8.11 Adjust the rigging screw on item 9 so that there is equal tension in the two slings (items 8 and 9). Tighten the U bolts holding the derricks to the twin lattice mast.

8.12 Refer to Fig.3 and Table 3. Attach the wire rope assembly (item 2) one to each mast leg as shown. To each of these attach a rope assembly (item 1) using a shackle (item 5). Shackle a Tirfor winch (item 3) to each block 'F' at each side of the mast base using a shackle (item 5). Attach a Tirfor rope (item 4) to rope assembly (item 1) using a shackle (item 5). Feed the ropes (item 4) through the winches (item 3) and take up the slack.

8.13 Take up the slack on all the winches and check that all the equipment is deployed correctly.

9 At the mast base, remove the four angle, tie down and the two channel, tie down (items 1 and 2 of Fig.13 and Table 13, Chapter 2.1) by taking off the 3/4 inch nuts and washers. Retain these items.

Lowering of twin lattice masts

10 Proceed with the lowering of the masts as follows:-

10.1 Position two men on the winch at block 'D', two men, one at each side, by the stay anchor blocks 'F' and one man at each rear guy anchor block 'A'.

10.2 Ease off the tension on the front upper and intermediate guys attached to the guy anchor blocks 'E'. Disconnect the guys from the anchor blocks 'E'.

10.3 Apply tension to the two rear guys and at the same time pay out on the winch at block 'D', so that the masts pivot and commence to descend.

10.4 The men on the side stays are to check them continually to ensure that they are not too tight or too slack. The supervisor is to watch carefully the whole lowering operation, to ensure that the twin lattice masts descend in a controlled manner.

10.5 During the final stages of lowering, the two men positioned at the rear guys are to pull them clear of the descending masts. They are also to position wooden packing blocks for the masts to rest on.

11 When the twin lattice masts are resting on the ground, continue paying out on the winch at block 'D'. Push the derrick towards the masts and, in the final stages, support it as it descends. Insert wooden packing between the masts to support the derrick.

12 Dismantle the lifting equipment and pack it for transit.

TABLE 1 ITEMS LIST FOR FIG.1

Item	Ref./Part No.	Description	Qty.
1	4030-99-960-4349	Shackle, large Dee, $^{3}/_{4}$in.dia. pin SWL $1^{1}/_{2}$t	4
2	4030-99-638-8199	Shackle, large Dee, $1^{1}/_{4}$in. dia. pin SWL 5t	4
3	3940-99-425-3432	Two leg sling	1
4	3940-99-425-3457	Snatch block, 12in. sheave, SWL.5t	1
5	4L/4013	Tirfor winch type TU32H	1
6	4010-99-798-2590	Tirfor rope T35 x 70m	1
7		Chain $^{5}/_{8}$in.dia, long link x 6ft	2
8	4030-99-638-8203	Shackle, large Dee, 1in.dia. pin, SWL 3t	1

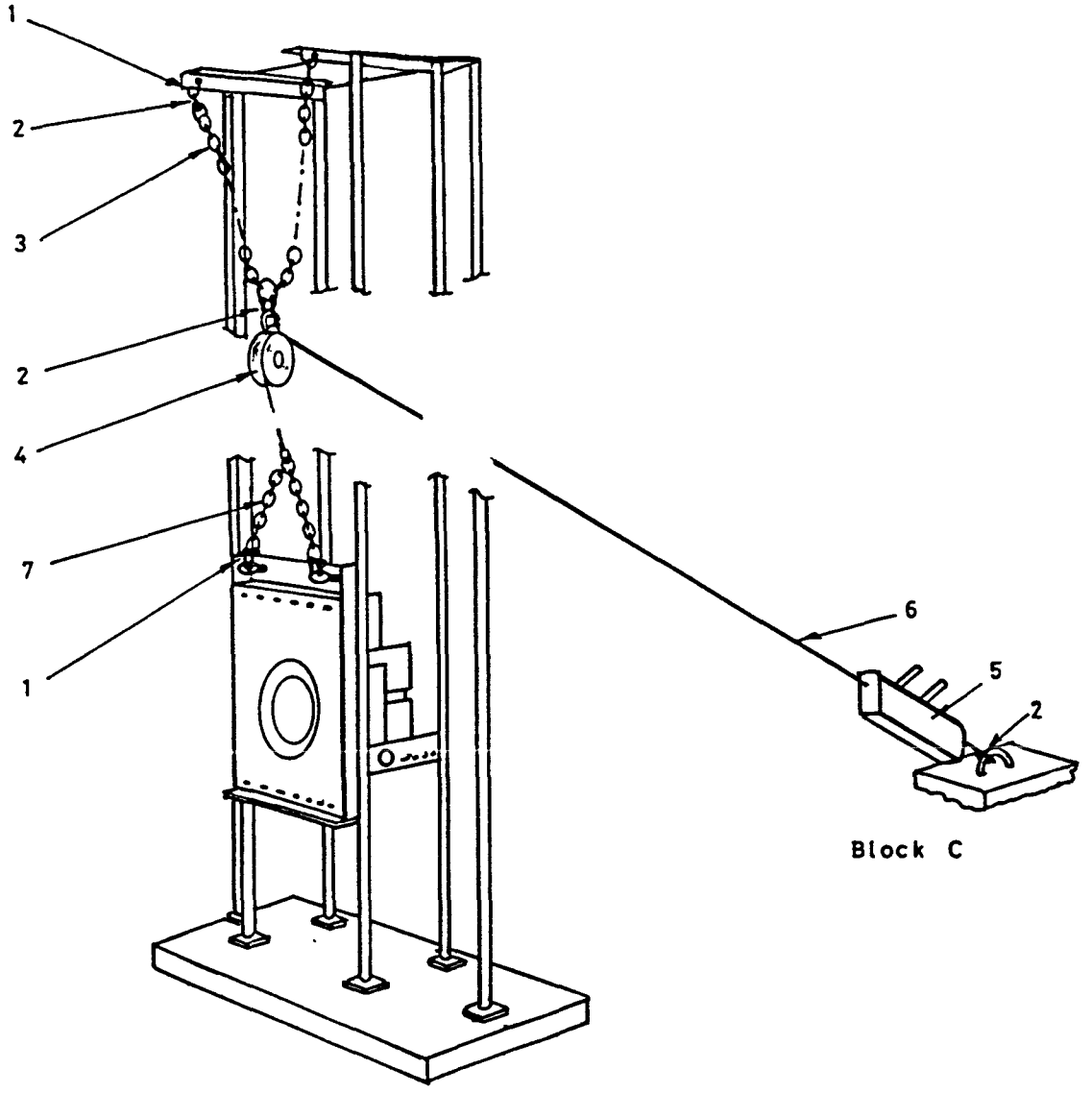


Fig.1 Lifting of pedestal

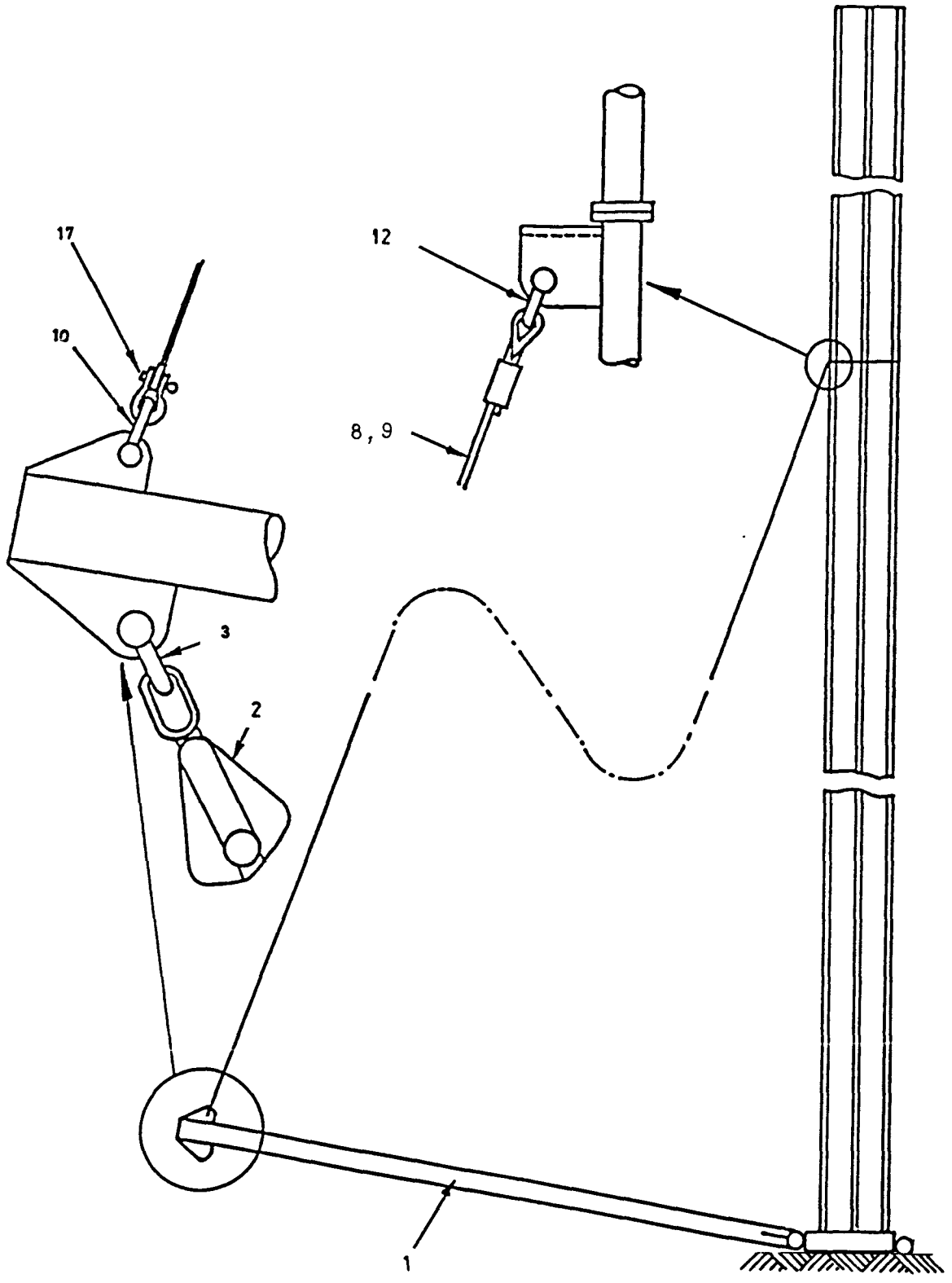


Fig.2 Derrick attachment

TABLE 2 ITEMS LIST FOR FIG.2

Item	Ref./Part No.	Description	Qty.
1	90G 110723	Derrick assembly, tower	1
2	3940-99-425-3457	Snatch block, 12in.sheave SWL 5t	2
3	4030-99-638-8199	Shackle, large Dee, $1^1/_4$in.dia. pin, SWL 5t.	1
4	4010-99-638-9347	Guy	2
5	5985-99-933-3888	Guy	2
6	3950-99-201-3244	Tirfor Winch T7	2
7	3950-99-204-6346	Tirfor winch T13	2
8	4010-99-638-8200	Sling	1
9	4010-99-638-8409	Sling	1
10	4030-99-638-8201	Shackle, large Dee, $1^1/_8$in.dia. pin, SWL $3^3/_4$t	9
11	4010-99-202-9032	Tirfor rope T7x60 ft. lg	2
12	4030-99-960-4349	Shackle, large Dee, $^3/_4$in.dia. pin, SWL $1^1/_2$t	4
13	4010-99-638-8202	Guy	1
14	4L/4013	Tirfor winch type TU32H	1
15		Longlink chain, $^5/_8$in.dia.x6ft.lg	4
16	4010-99-523-8376	Tirfor rope T35x100ft.lg	1
17	4030-99-638-8203	Shackle, large Dee, 1in.dia. pin, SWL 3t	2
18	4010-99-523-8374	Tirfor rope T13x100ft.lg	2
19	F&L Type 4/UB/23	U bolt assembly	2

TABLE 3 ITEMS LIST FOR FIG.3

Item	Ref./Part No.	Description	Qty.
1	5985-99-933-3888	Wire rope assembly, 15.2m (50ft)	2
2	4010-99-638-9347	Wire rope assembly, 10ft.	2
3	3950-99-204-6346	Tirfor winch type Ti3	2
4	4010-99-523-8374	Tirfor rope T13x30.5m (100ft)	2
5	4030-99-960-4349	Shackle, large Dee, $^3/_4$in.dia. pin, SWL $1^1/_2$t	6

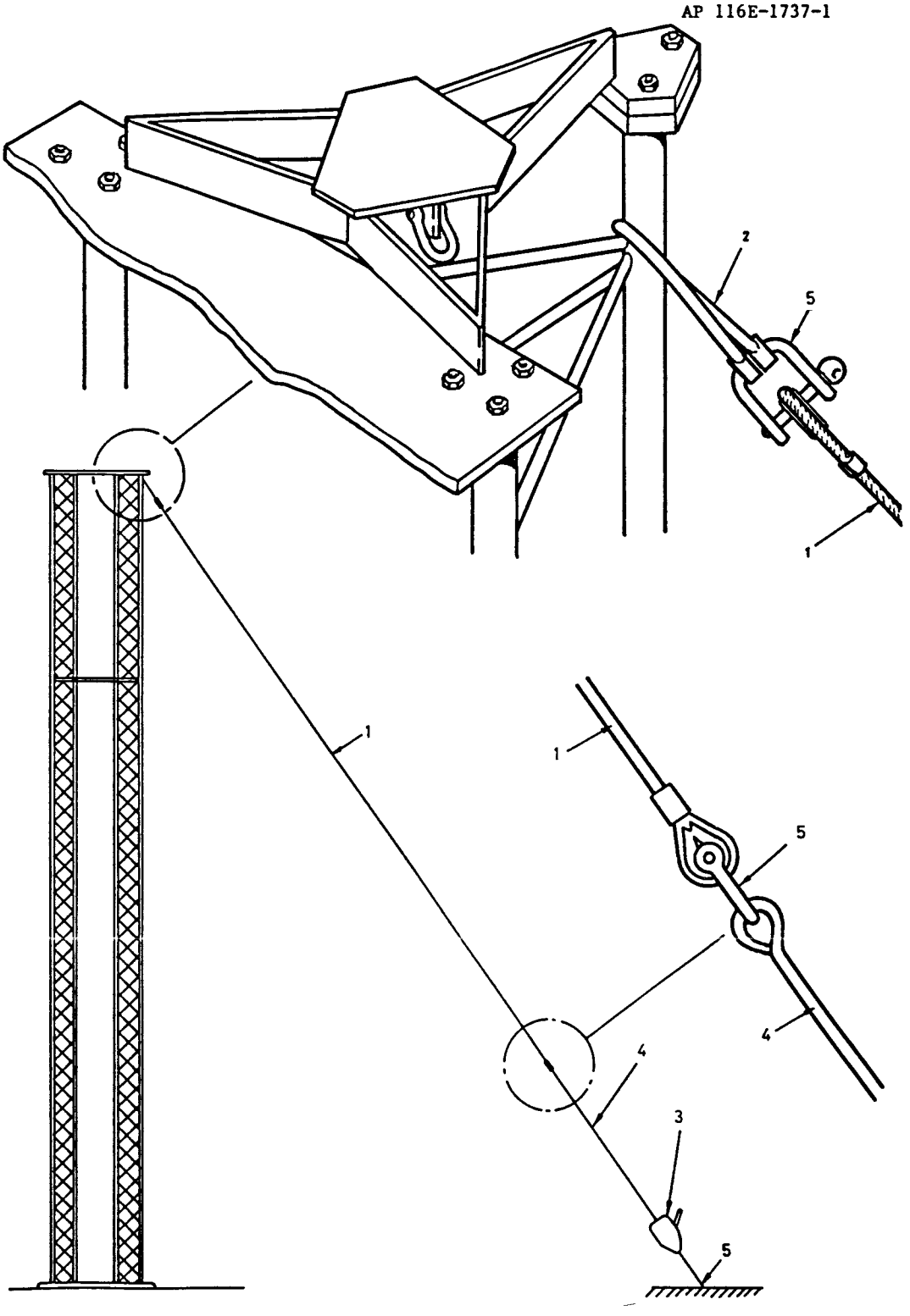


Fig. 3 Temporary stay attachment

Chapter 3.0

INSTALLATION, ERECTION AND LOWERING OF LPH72 ANTENNA

Completely Revised

CONTENTS

1 Chapter 3.1 covers installation and erection of the antenna. Chapter 3.2 covers lowering of the boom assembly and Chapter 3.3 covers lowering of the twin lattice mast.

Safety precautions

SAFETY WARNING ...

PRIOR TO RAISING OR LOWERING THE TWIN LATTICE MASTS OR THE ANTENNA, THE TEAM LEADER IS TO ENSURE THAT THE SITE IS ADEQUATELY CLEARED OF OBSTACLES AND HAZARDS, AND THAT THE APPROPRIATE WARNING SIGNS ARE DISPLAYED.

2 All safety precautions are to be taken during the erection and must not be compromised in any way. The twin lattice mast structure is not to be climbed by more than two persons at any time. Only two persons are to climb the boom when partly erected and no-one is to traverse the boom when fully erected. Safety harnesses are to be worn and fall arrest equipment is to be used at all times when climbing.

PSA responsibilities

3 The twin lattice mast and guys of the antenna are the responsibility of PSA and are not to be adjusted after handover. The PSA are to be informed in writing, a minimum of seven days in advance, the dates of erection, so that an observer may be present if the PSA wishes.

Pre-erection details

4 Six Aerial Erectors and an Aerial Erector Supervisor are required to erect and lower the twin lattice mast and seven Aerial Erectors and an Aerial Erector Supervisor are required to erect and lower the antenna. It is advisable to make a check of local weather conditions for the time period of antenna work, in case of high wind forecast or thunderstorm states/risks.

5 The prefixes 90G, SC, SCSHQ and SEE, where used, are to be considered synonymous. The words 'guy' and 'stay' in relation to the antenna twin mast assemblies are also synonymous, but in this publication the word 'guy' is used to denote a permanent member which supports the twin lattice masts. 'Sling' is used to denote an item of the erection equipment which is used only for steadying.

Notes ...

(1) Three grades of fastener are used in this installation - high strength galvanised, standard strength galvanised and stainless steel. In general, the galvanised fasteners are used to assemble the galvanised steel parts of the twin lattice mast, with the high strength fasteners used in the more critical positions. The use of the high strength fasteners is indicated in the tables of listed parts by the abbreviation 'Hi.St.' The boom assembly, the elements and transmission lines are assembled with stainless steel fasteners. Torque values, which are different for each grade of fastener, are given in the text and are summarised in Fig.44 in Chapter 3.1. Stainless steel fasteners which assemble fibreglass parts are torqued to a lower value than those assembling all-metal parts. All fasteners shall be lubricated on assembly.

(2) In the text, the hydraulically operated Tirfor winch type TU32H is referred to. The instructions shall be construed as applying equally to the hand operated Tirfor winch type T35, which may be used in lieu of the type TU32H. However, when the T35 winch is used, care must be taken to operate it smoothly, to avoid introducing bounce into the lifting system, due to the 'to and fro' action of the winch handle.

Weights

6 The weights of various parts of the antenna are as follows:-

Lattice mast section	159 kg (350 lb)
Twin lattice mast and guys (total)	1297 kg (2860 lb)
Torque tube section (each)	257 kg (567 lb)
Boom assembly complete	499 kg (1100 lb)
Pedestal unit	345 kg (760 lb)

List of Tools

7 The following tools are required for installing, erecting and lowering the LPH72 antenna.

ITEM NO.	SECT/REF	NOMENCLATURE	QTY
1	6E/4466210	Binoculars 7 x 50	1
2	6C/9542399	Compass, prismatic	1
3	6C/9542398	Tripod (used with item 2)	1
4		Theodolite	2
5		Tripod (used with item 4)	2
6	1C/1202797	Wrench, torque, 1/2 in.sq.dr., 200-1200 lbf./in. (16.6-100 lbf.ft.)	1
7	1C/1278258	Wrench, torque, 1/2 in.sq.dr., 400-2000 lbf./in. (33.3-166.6 lbf.ft.)	1
8	1C/1389076	Wrench, torque, 3/8 in. sq.dr., 5-60 lbf.ft.	1
9	1C/1275791	Wrench, torque, 3/4 in.sq.dr., 1200-5000 lbf.in. (100-416 lbf.ft.)	1
10	1A/1255009	Paint brush 1 in.	2
11	1A/1275341	Paint brush 3 in.	2
12	1A/1202537	Wire brush	1
13		Spanner 7/16 in. across flats	A/R
14		" 1/2 in. " "	"
15		" 9/16 in. " "	"
16		" 5/8 in. " "	"
17		" 11/16 in. " "	"
18		" 3/4 in. " "	"
19		" 7/8 in. " "	"
20		" 15/16 in. " "	"
21		" 1 1/16 in. " "	"
22		" 1 1/8 in. " "	"
23		" 1 1/4 in. " "	"
	Note: Both open ended and socket spanners will be required.		
24		Screwdriver, 4 mm blade	1
25		Screwdriver, 6 mm blade	1
26		Screwdriver, 8 mm blade	1
27		Tension Meter type 05C	1
28		Hammer, 4 lb	1

Chapter 3.1

INSTALLATION AND ERECTION OF LPH72 ANTENNA

Completely Revised

CONTENTS

General

Note ...

The following paragraphs give, in the correct sequence, the method of erecting the remotely controlled rotatable log periodic antenna type LPH72, fitted with either synchro, stepped or computer control.

1 A site plan appears in Fig.1. The antenna is assembled in the space between block 'B' and the boundary remote from the winch block 'D'.

Base assembly

2 Assemble as follows (Fig.2 and Table 2).

2.1 Remove the nuts and washers (items 6, 10 and 11) from the 12 studs protruding from the centre concrete foundation block; store in a safe place for refitting later. Clean the threads with a wire brush and lightly oil.

2.2 Clean the top surface of the centre foundation block and check that no protrusions are present in the area on which the lattice mast base fits.

2.3 Locate the base assembly (item 3) on the foundation block using the clamp base hinge (item 4), clamp the hinge down using four of the nuts and washers previously removed (items 6, 10 and 11). Torque nuts to 150 lbf.ft. Ensure that, when clamped down, the base is free to hinge about the pivot point (Fig.2). Check that the base is a snug fit on the surface of the block. If necessary, grout must be used when the twin lattice mast is erected (see sub-para.8.8).

Twin lattice mast assembly

3 Assemble as follows (Fig.2 and Table 2).

3.1 Attach mast section bottom RH (item 2) to the base assembly (item 3) with the mast section lying out along the ground, using bolts 3/4 x 2 3/4 (item 5), washers (item 8), lock washers (item 6) and nuts (item 7). The washers (item 8) should be fitted in the highest and lowest positions where the bolts pass through the bevelled webs of the steel base members. Torque to 234 lbf.ft. Note that the pedestal pivot mounts should be close to the base assembly and towards the ground. Support the masts with suitable blocks as assembly proceeds.

3.2 Attach mast section bottom LH (item 1) in a similar manner opposite the bottom RH as fitted in sub-para.7.1.

3.3 The six similar mast sections are shipped without the diagonal and horizontal braces fitted in position. These must now be assembled (refer to Fig.3 and Table 3). Fit the diagonal and horizontal braces (items 4 and 5) in the positions shown, using 3/8 inch x 1 1/2 inch long bolts (item 6), 3/8 inch lock washers (item 8) and 3/8 inch nuts (item 7). Torque to 19 lbf.ft.

3.4 Refer to Fig.3 and Table 3. Attach two mast sections (item 1), one after the other, to each of the bottom mast sections, using 1/2 inch x

1 1/2 inch long bolts (item 9), 1/2 inch lock washers (item 11) and 1/2 inch nuts (item 10). These sections should be installed with the bolted cross-bracing facing inwards, ie, towards the centre line of the mast. Torque to 69 lbf.ft.

3.5 To the left-hand mast sections, looking from the top down the sections, attach a further mast section (item 1), positioning intermediate guy bracket RH (item 13) between the section being installed and the section already installed. The bracket should be orientated as shown in Fig.4. Note that the holes in the edge of the bracket are not symmetrical. Although the holes are equally spaced, the group is closer to the top (the LH side of the Fig.4 view). Attach the section using 1/2 inch nuts (item 10). Torque to 69 lbf.ft.

3.6 To the left-hand mast sections attach, in a similar manner, the remaining mast section and the LH intermediate guy bracket (item 14).

3.7 Refer to Fig.5 and Table 5. Between the left and right-hand intermediate guy brackets (items 2 and 3), attach bearing plate assembly (item 1) and erection brackets (items 4 and 5), using 5/8 inch by 2 1/2 inch long bolts (item 7) to bolt through the erection brackets. Where the bolts do not pass through the erection brackets, use the 5/8 inch by 1 3/4 inch long bolts (item 6). Secure the bolts using the 5/8 inch lock washer (item 8) and 5/8 inch nut (item 9). Torque to 145 lbf.ft. The gate (item 10) in the bearing (item 1) should be removed, leaving the resulting opening in the bearing facing towards the ground. Safeguard the gate and its fastenings for later use.

3.8 Refer to Fig. 8A and Table 8A. Attach pulley and bracket assembly (item 1) using clamps (item 2), 3/8 inch x 1 1/2 inch bolts (item 3), 3/8 inch lock washers (item 4) and 3/8 inch nuts (item 5). Torque to 19 lbf.ft. Fit this assembly close to the intermediate bearing assembly between the two uppermost mast section members.

3.9 Refer to Fig.6 and Table 6. To the top of both mast legs attach a guy bracket (item 1) using 1/2 inch x 1 1/2 inch long bolts (item 9), 1/2 inch lock washers (item 10) and 1/2 inch nuts (item 11). Torque to 69 lbf.ft.

3.10 Between the two top guy brackets, fit a bearing plate (item 2) and erection brackets (items 3 and 4) in a similar manner to that in sub-para.3.7. In this case, however, the top guy brackets are symmetrical and the erection brackets should be attached on the side closest to the ground. Remove and safeguard the gate (item 12) and its fastenings, as in sub-para.3.7.

3.11 Assemble the bearing halves (item 13) into the bearing plate assemblies (item 2) and the outer welded assemblies (item 12) using No.10-24 screw (item 14), No.10 lock washer (item 15) and No.10-24 nut (item 16). These fastenings should not be torqued.

Attachment of safety line

4 Set up the safety line as follows (Fig.6 and Table 6).

4.1 To the RH erection bracket fitted at the top of the twin lattice mast attach a block, tackle (item 19) using a 5/8 inch shackle (item 20).

4.2 Reeve 6 mm diameter polyester rope (item 21) through the block, tackle, take up slack and attach both ends to the bottom of the mast. Spare polyester rope is to be left coiled at the base of the twin lattice mast.

CAUTION ...

Before fitting item 19, check that the manufacturer's test certificates for items 19 and 20 have been received.

Fitting of guys

5 The attachment of top and intermediate guys is carried out as follows (Fig.4 to 8 and Table 4 to 8).

5.1 Using two 2.5 ton small dee shackles (Fig.8, item 3, supplied with guy), attach a guy (Fig.4, item 7) to the intermediate guy attachment point on the mast and lay it out along the ground at the side of the tower sections towards the base.

5.2 Fit a further three intermediate guys in a similar manner to their respective attachment points.

5.3 Take the two rear (nearest the ground) intermediate guys and attach the rigging screws (Fig.8, item 2, supplied with guy) to the middle of the chains (Fig.8, item 4) using a shackle (Fig.8, item 3). Undo the nut and bolt (supplied with guy) and attach the rigging screw to the second hole up the plates at the respective guy anchorage blocks 'A'.

5.4 Attach each top guy (Fig.7) to the top guy bracket, attaching the top chain by means of the shackle (Fig.7, item 2, supplied with the guy).

5.5 Make off the two rear (nearest to ground) top guys to their respective guy anchor blocks 'A'. Remove the nut and bolt in the end of the rigging screw (Fig.7, item 6) and attach the rigging screw to the top hole in the anchorage plate. Tighten the nut and bolt firmly, but do not overtighten or the fork end of the rigging screw may be distorted. The rigging screw is attached to the lower chain with a shackle (Fig.7, item 2). If necessary, reposition the rigging screw in the centre of the chain.

Note ...

Set all the rigging screws to the centre of their adjustment range.

Twin lattice mast erector gear

6 Assemble and fit the twin lattice mast erector gear as follows (Fig.9 and Table 9).

6.1 Position the cross tube of the erection derrick (item 1) on the two housings provided on the mast base assembly (Fig.2, item 3) and secure with the 'U' bolts provided (Fig.2, item 9). Leave the 'U' bolts slack. Ensure that the small shackle attachment lug at the derrick head is pointing towards the ground when the derrick is laid out above the twin lattice masts, supported with a piece of wood at the derrick head.

6.2 To the small attachment lug mentioned above, attach the two erection slings (items 8 and 9) using one shackle (item 10) and two shackles (item 17).

6.3 Attach the other ends of the slings, one to each of the erection brackets, at the intermediate guy level, ie, 18.3m (60 ft) from the twin lattice mast base. Attach the slings using shackles (item 12).

6.4 Attach the snatch block (item 2) using a shackle (item 3) to the large shackle attachment lug at the head of the derrick opposite the erection slings.

6.5 Reeve the erection sling (item 13) through the snatch block (item 2) at the derrick head and attach one end to the hairpin nearest the twin lattice mast base on the downhaul block 'C' on Fig 1. using a shackle (item 10).

6.6 Shackle a second snatch block (item 2) to the remaining hairpin on the downhaul block 'C' using shackle (item 10). Reeve the free end of the erection sling (item 13) through this snatch block. Attach a T35 Tirfor rope (item 16) to this free end using two shackles (item 10) back to back.

6.7 Shackle the TU32H Tirfor winch (item 14) to the winch-block 'D' using two shackles (item 10) back to back. Feed the Tirfor rope through the Tirfor winch but leave slack.

6.8 Attach two Tirfor ropes (item 11), one to each side of the derrick head, using shackles (items 10 and 12), back to back.

6.9 Attach two Tirfor winches (item 6) to block 'F' on each side of the derrick, using shackle (item 12). Reeve the Tirfor ropes (item 11) through the Tirfor winches (item 6) and take up the slack to centralise the derrick.

6.10 Two men now lift the derrick head and walk slowly towards the twin lattice mast base, pushing the derrick up towards the vertical position until it is approximately 80 degrees to the horizontal (Fig.9). A further man is positioned on the Tirfor winch at 'D' to take up the slack.

6.11 Take up the slack and apply a light tension to the derrick to maintain it in the erected position. Check the tension of side stays and adjust if necessary.

6.12 Adjust the rigging screw on item 9 so that there is equal tension in the two slings (items 8 and 9). Tighten the 'U' bolts holding the derrick to the twin lattice mast.

6.13 Refer to Fig.10 and Table 10. Attach the wire rope assembly (item 2) one to each mast leg as shown. To each of these attach a rope assembly (item 1) using a shackle (item 5). Shackle a Tirfor winch (item 3) to each block 'F' at each side of the mast base, using a shackle (item 5). Attach a Tirfor rope (item 4) to rope assembly (item 1) using a shackle (item 5). Feed the ropes (item 4) through the winches (item 3) and take up the slack.

Erection of twin lattice masts

7 Proceed with mast erection as follows:

7.1 Position two men on the winch at block 'D', two men one at each side by the stay anchor blocks 'F' and one man at each rear guy anchor block.

7.2 Raise the twin lattice masts slowly using the winch at block 'D'.

7.3 The men on the side stays are to check them continually to ensure they are not overtight or slack. The supervisor is to watch carefully the whole erection operation, to see that the twin lattice masts rise smoothly.

7.4 During the final stage of erection, the two men positioned at the rear guy positions are to resist the erection by pulling down on the rear guys and, if necessary, adjust them. When adjusting guys, the erection is to be stopped and only one guy is to be adjusted at any time.

7.5 When the twin lattice masts are vertical, clamp the base down with the angle tie down (Fig.11, item 1) and the channel tie down (Fig.11, item 2), using the nuts and washers removed from the foundation bolts in sub-para.2.1. Torque to 150 lbf.ft.

7.6 Attach the two remaining intermediate guys as described in para.5.3 to their respective guy anchor blocks 'E'.

7.7 Make off two remaining top guys as described in sub-para.5.5 to their respective guy anchor blocks 'E'.

Tensioning Parafil Guys

8 Two conditions have to be achieved simultaneously, that the masts are plumbed vertically and that the prescribed erection tensions are applied to the guys. The two conditions are interactive and are complicated by the fact that, when Parafil is initially tensioned, some relaxation always occurs due to bedding-in effects of the fibres in the end fittings. The following tensioning procedure shall be followed:-

Note ...

When tensioning guys and straightening the twin lattice mast, the Tirfor winches used during erection shall be slackened off but the erection equipment shall be left in position until the tensioning operation is completed.

8.1 Check the masts are vertical using two theodolites at right angles. Check the guy tensions using a Tension Meter type 05C.

8.2 Set the guys to the following 'erection tensions':-

Top guy - 20 kN
Intermediate guy - 10 kN

8.3 Apply tension to the 'erection tension' values and then wait one hour.

8.4 Re-apply the 'erection tension' values and then wait for a second hour.

8.5 After the second hour has elapsed, re-apply the 'erection tension' values.

8.6 During the tensioning, check the verticality of the masts and adjust the tensions appropriately.

8.7 Dismantle the erection equipment. Remove from the site the items no longer required and pack ready for transit.

8.8 Grout the base assembly to ensure good surface contact with the foundation block.

Pedestal mounting

9 Assemble and fit as follows (Fig.12 and Table 12).

9.1 Fit the bearing brackets RH and LH (items 1 and 2) to each side of the twin lattice masts, using 5/8 inch x 2 1/2 inch bolts (item 3), 5/8 inch lock washers (item 4) and 5/8 inch nut (item 5). The bearing brackets must be fitted so that the red indication mark on each one is adjacent to the existing two inch diameter hole in the bottom mast section. Torque to 93 lbf.ft.

9.2 Fit bearing bracket support angle (item 6) between bearing brackets and mast vertical members using 5/8 x 2 1/2 bolts (item 3), 5/8 lock washers (item 4) and 5/8 nut (item 5). Torque to 93 lbf.ft.

9.3 Fit clamping brackets (item 7) in four positions to secure bearing bracket support angles to mast vertical members using 5/8 x 1 3/4 bolts (item 8), 5/8 lock washers (item 4) and 5/8 nut (item 5). Torque to 93 lbf.ft.

Pedestal assembly

10 Assemble and fit as follows (Fig.6 and 13, and Table 6 and 13).

10.1 Climb to the top of the twin lattice mast. Undo the 5/8 inch shackle (Fig.6, item 20) which secures the block and rope (Fig.6, items 19 and 21) to the erection bracket (Fig.6, item 3) and transfer them to one of the cross braces at the top of the mast. The line, when so attached, may still be used for hauling up tools and equipment, but the load should not exceed about 100 kg.

10.2 Refer to Fig.12. Attach a shackle (item 1) to each of the erection brackets. To each of these shackles attach a shackle (item 2). To these shackles attach the two hooks of a two leg sling (item 3).

10.3 To the centre ring of the two leg sling attach a snatch block (item 4) using a shackle (item 2).

10.4 Attach a TU32H Tirfor winch (item 5) to the anchor block 'C' (see Fig.1) using a shackle (item 2).

10.5 Reeve a Tirfor rope (item 6) up the mast, through the snatch block

and down through the Tirfor winch (item 5).

10.6 Attach a chain (item 7) to the captive shackle at the end of the Tirfor rope (item 6).

10.7 Attach the chain to the lifting eye on the pedestal using a shackle (item 1).

10.8 Take up the slack in the lifting system by operating the Tirfor winch.

10.9 Lift the pedestal and guide it carefully into position between the two lattice masts. Turn the pedestal so that the torque tube mounting face points away from the anchor block 'C'. Align the holes in the pedestal with the holes in the mast mounting brackets.

10.10 Grease the pivot shafts and guide them into the support bearings. Retain the pedestal unit with the 1/2-13 x 31/2 inch bolts, lock washers and nuts (items 9, 10 and 11 on Fig.12 and Table 12).

10.11 Block the pedestal with suitable wooden packing blocks, so that the torque tube mounting face is vertical.

10.12 Dismantle the lifting equipment. Restore the block and safety line, which was moved in sub-para.10.1, to its normal position.

ALTERNATIVELY - if a HIAB is available:-

10.13 Omit operations detailed in sub-para.10.1 to 10.5. Position the vehicle to which the HIAB is fitted in a convenient position. Note that the pedestal, which weighs 0.35 tonne, is well within the safe lifting capacity of the HIAB at full extension.

10.14 Attach the chain as in sub-para.10.6 above. To the end of the chain attach a shackle (item 8) and put this shackle over the hook on the HIAB. The HIAB is only to be operated by an operator trained in its use and he is to be satisfied that all the necessary safety procedures are followed.

10.15 Use the HIAB to carry out the procedures detailed in sub-para.10.9 to 10.11.

10.16 Remove the lifting eye bolt and store for future use.

10.17 Remove the front and rear housings from the pedestal. Safeguard the fixing hardware for re-use later.

Torque tube and transmission line assembly

11 If the rotary joint is not already fitted, it should be fitted now as shown in Fig.14, using 5/16 x 1 inch long stainless steel hex bolts, nuts and lock washers supplied as part of the assembly. Torque to 11.5 lbf.ft.

CAUTION ...

The rotary joint must be fitted before assembling the transmission line and checked to see that it will revolve. This joint must not be taken apart on site.

12 Assemble the torque tube and transmission line as follows. Refer to Fig.15. Ensure that the rain shedding flange is fitted between the pedestal flange and the mating torque tube.

12.1 Take a torque tube section (item 1) and support it on trestles at an equal height to mate with the flange on the pedestal, with the spring attachments away from the pedestal.

12.2 Slide a section of transmission line (item 6) into the torque tube section, with the spring attachment tabs away from the pedestal. Ensure that the centre conductor is located in the transmission line.

12.3 Insert the connector (item 8) into the transmission line installed in the pedestal.

12.4 Lubricate the O-ring (item 7) with silicone grease and position it over the inner conductor.

12.5 Pull the inner conductor from the transmission line and slide it into position on the connector previously installed in sub-para.12.3.

12.6 Slide the outer conductor of the transmission line against the transmission line installed in the pedestal. Carefully position the O-ring in its proper groove and secure in position with the 5/16 inch diameter bolts, lock washers and nuts (items 9, 10 and 11). Torque to 11.5 lbf.ft.

12.7 Slide the torque tube section up to the pedestal flange and bolt the two together using 5/8 x 2 bolts (item 2), 5/8 thread seals (item 3) 5/8 lock washers (item 4) and 5/8 nuts (item 5). Torque to 93 lbf.ft.

12.8 Refer to Fig.16 and Table 16. Attach the springs (four off, part of item 7) to their respective positions (one end to the transmission line, the other to the torque tube), so suspending the transmission line in the torque tube.

12.9 Install a further three torque tube sections and feeder as described in sub-para. 12.1 to 12.8, using bolts, nuts and washers (items 3, 4 and 5) and three connector kits (item 7) to join the centre conductors. Safeguard the unused items 8 to 12 of the connector kit for use later. Carry out electrical and pressurization checks on the torque tube transmission line assembly (see Appendix 1 and 2). Cover the open ends of the transmission line to prevent the ingress of moisture.

Note ...

The top torque tube section is item 2, the section with a large head plate, whereas the others are item 1. This top section must be fitted as shown in Fig.17 with the head plate pivot holes at the lower end. At this time, carry out the deployment of the erection equipment described in para.18 below and use this to support and position the torque tube whilst the boom members are assembled beneath it. If the top plate is not exactly vertical, rotate the torque tube by turning the drive motor by hand.

Boom assembly

13 The boom half-sections are assembled first and these are then combined to form complete sections. The boom is assembled upside-down on the ground beneath the torque tube sections, so that the front of the antenna (ie, the end with the smallest elements) is facing away from the pedestal. The boom centre section is attached to the top torque tube section and the remaining boom sections are then attached to this. This procedure avoids the need to lift the completed boom assembly into position for erection. As the assembly proceeds, insert wooden packing pieces to support the boom clear of the ground. All the figures show the boom in the attitude in which it will be when assembly takes place. When it is erected, it will be inverted.

13.1 Assemble section 1 of the boom first, refer to Fig.18. This is a complete assembly. Do not fully tighten the nuts and bolts at this stage.

13.2 Assemble the half-sections of the boom next. Two identical assemblies are required of half-sections 2 and 4 and one each of half-sections 3A and 3B. Do not fit the insulators on which the elements are mounted at this stage. Refer to Fig.19-22 for assembly of these sections. Do not fully tighten the nuts and bolts at this stage.

13.3 Assemble the pairs of half-sections to make complete boom sections by fitting the cross braces, top and bottom. Refer to Fig.23-25 for assembly of the complete boom sections. Do not fully tighten the nuts and bolts at this stage.

13.4 Now fit the insulators to the boom sections. Insulators for elements 1, 2, 5, 8, 9, 13, 14, 15 and 16 are fitted on the outside surface of the boom angles. The insulators for the remainder of the elements are fitted inside the boom angles. The insulators have large holes one side and small holes the other side, and these must be correctly orientated. Insulators for elements 1, 2, 3, 5, 8, 11, 12, 13, 15 and 16 must be fitted with the smaller holes towards the front of the boom. Those for the remaining elements must face the other way. Refer to Fig.19-22 for details of the insulators and the attaching parts. Do not fully tighten the nuts and bolts at this stage.

13.5 Position boom section 3 below the head plate so that the short end is towards the pedestal. Insert the pivot bolt (item 1) as shown in Fig.32. Fit 5/8 nut (item 2) to the pivot bolt but do not tighten. Pack the section level with timber.

13.6 Attach boom section number 4 to number 3 under the torque tube using 3/8 inch screw, nut and lock washer (items 1, 2 and 3 of Fig.26 and Table 26). Attach the cross bracing using 1/4 inch bolt, nut and lock washer (items 4, 5 and 6 of Fig.26 and Table 26). Align the boom sections so that they are straight, with wooden packing inserted as necessary.

13.7 Attach boom section number 2 to number 3 using 3/8 inch screw, nut and lock washer (items 1, 2 and 3 of Fig.27 and Table 27). Attach the cross bracing using 1/4 inch bolt, nut and lock washer (items 4, 5 and 6 of Fig.27 and Table 27). Align the boom section as above and insert wooden packing.

13.8 Attach boom section number 1 to number 2 using 3/8 inch screw, nut and lock washer (items 1, 2 and 3 of Fig.28 and Table 28). Attach the cross bracing using 1/4 inch bolt, nut and lock washer (items 4, 5 and 6 of Fig.28 and Table 28). Align the boom section as above and insert wooden packing.

Note ...

Boom section number 4 is assembled back towards the twin lattice mast, under the torque tube assembly, whereas boom sections 1 and 2 are assembled out away from the twin lattice mast.

13.9 When all the boom sections are attached to each other and are aligned so that the whole assembly is straight and square, tighten up the fixings and torque as follows:-

TABLE 1 TORQUE VALUES

Fastener and function	Torque value
1/4 inch stainless bolts securing metal parts	6.5 lbf.ft.
1/4 inch stainless bolts securing fibreglass parts	5.8 lbf.ft.
5/16 inch stainless bolts securing metal parts	11.5 lbf.ft.
3/8 inch galvanised bolts securing metal parts	19.0 lbf.ft.

Windsail

14 The windsail is already assembled as shown in Fig.29. Do not assemble the windsail to the boom but set it aside in a safe place until required.

Element assembly

15 Assemble the elements to the boom assembly as follows. Refer to Fig.30 and Table 30.

Note ...

Elements 1 to 6 are complete assemblies, elements 7 to 16 are built-up sections.

CAUTION ...

All elements must be assembled with the drain holes facing up so that, after erection, they face down. Protect against ingress of moisture.

15.1 Attach the centre sections of elements 1 to 16 to the boom at the square fibreglass tubes using cast saddles, reinforcing plate, lock washer and nut. See Fig.30 for assembly and items used. Position each element section with the drain holes facing up so that, after erection, they face down. Do not tighten the bolts at this stage, but centralise the centre sections.

15.2 Connect two feed straps to each element, starting with element 16, and alternate their positions on the remaining elements (see Fig.29). Do not tighten the bolts at this stage. Remove the clamps from the

feedstraps by undoing the nuts, bolts and washers supplied with the feedstraps. Safeguard the parts removed.

Note ...

The feed straps connecting the transmission line to the elements must alternate one above and one below the centre insulators from element 1 to element 16, ie, the feed straps at element 1 must connect to the top left and lower right as viewed from the front of the antenna (ie, end furthest from the twin lattice mast). Feed straps at element 2 connect to top right and lower left.

Transmission line and feedline assembly

16 Proceed as follows. Refer to Fig.31-35 and Tables 31-35.

16.1 Position the transmission line adaptor (item 3) as shown in Fig.32, from the centre towards the rear of the boom, with the elbow and flange facing up and positioned 13 5/16 inches from the pivot bolt to transmission line centre.

16.2 Refer to Fig.31. Connect the transmission line (item 2) to the transmission line adaptor (item 1) using the connector kit (item 11), taking care to lubricate the O-ring with silicone grease and to locate it correctly in the groove. Connect an elbow (item 3) to the transmission line, as shown in Fig.33, using the connector kit (item 11) and ensure that the O-ring is correctly lubricated and positioned. Torque to 11.5 lbf.ft.

16.3 Refer to Fig.33. Fix the length of transmission line to the corner of the boom using the five spacers (item 5) and the clamps (item 6) equally spaced. The precise positioning is not critical. Check that the 13 5/16 inch dimension (Fig.32) is correct; adjust if necessary.

16.4 Refer to Fig.31. Attach a further elbow (item 4) to elbow (item 3) as shown in Fig.33, using the connector kit (item 11) and ensure that the O-ring is correctly lubricated and positioned. Torque to 11.5 lbf.ft.

16.5 Attach a transformer line No.3 (item 5) to the elbow previously installed, using the connector kit (item 12), ensuring that the O-ring is correctly lubricated and positioned. Torque to 11.5 lbf.ft.

16.6 Attach the element feed straps previously installed to the transformer line fitted in sub-para.15.5, using the parts removed in sub-para.14.2, as shown in Fig.30. Do not tighten the clamps at this stage.

16.7 Attach the transformer assembly section 2 (item 6) to the transformer line using the connector kit (item 13), ensuring that the O-ring is correctly lubricated and positioned. Torque to 11.5 lbf.ft.

16.8 Attach the element feed straps previously installed, using the parts removed in sub-para.14.2, to the transformer assembly (item 6). Do not tighten the clamps at this stage.

16.9 Attach the remaining transformer assembly (item 7) in a similar manner, using the connector kit (item 14), ensuring that the O-ring is

lubricated with silicone grease and correctly positioned. Torque to 11.5 lbf.ft. Assemble the transformer assembly to element feed straps using the parts removed in sub-para.14.2.

16.10 The dummy line, short (item 8) and jumper strap are pre-assembled. Attach the jumper strap to the transformer line, using the nuts which are supplied assembled to the transformer line. Torque to 6.5 lbf.ft. The dummy line should now be assembled on a line directly beneath the transformer line and under each element (see Fig.34).

16.11 Connect to the dummy line (installed in sub-para.16.10) a further dummy line (item 9) using 5/16 x 1 1/4 inch bolts, 5/16 inch nut and washer (items 15, 16 and 17). Torque to 11.5 lbf.ft. Attach the element feed straps using the parts removed in sub-para.14.2. Do not tighten these clamps at this stage. (Refer also to Fig.35.)

16.12 Connect a further two dummy lines (item 9) as described in sub-para.16.11.

16.13 Connect the dummy line termination (item 10) as described in sub-para.16.11.

16.14 Position all the element centre sections so that the transmission line and feed line are straight. Tighten all the element clamps installed in sub-para. 14.1. Torque the nuts for elements 1-7 to 6.5 lbf.ft. Torque the nuts for elements 8-13 to 11.5 lbf.ft. Torque the nuts for elements 14-16 to 33 lbf.ft. Tighten all the clamps attaching the element feed straps and torque to 6.5 lbf.ft. Tighten the nuts and bolts fixing the element feed straps and torque to 6.5 lbf.ft. Carry out electrical and ► pressurization checks on the boom transmission line assembly (see Appendix 1 & 2). Cover the end of transmission line adaptor (item 1) to ◄ prevent ingress of moisture.

16.15 Fit vibration dampers between the dummy lines and transformer lines (see Fig.33, item 7). Four vibration dampers are to be fitted, approximately equally spaced, between elements 13, 14, 15 and 16. The precise positioning of these dampers is not critical.

Remaining element assembly

17 Complete the element assembly as follows.

CAUTION ...

All elements must be assembled with the drain holes facing up so that, after erection, they face down. Protect against ingress of moisture.

17.1 Refer to Fig.36 and Table 36. Starting with elements 7 and 8, attach short element section (item 12) using the bolts, nuts and washers (items 14, 15, 16, 17 and 18). Torque 1/4 bolts to 6.5 lbf.ft and 3/8 bolts to 21 lbf.ft.

► Clean/grease surfaces prior to assembly and carry out electrical checks (see Appendix 2). ◄

17.2 Refer to Fig.37 and Table 37. Attach the remaining element sections in a similar manner.

Note ...

If the erection site is left after any elements have been installed on the boom, suitable fencing must be provided to prevent damage from animals or personnel. This temporary fencing is to be so installed as not to impede later erection of the antenna.

Antenna pre-erection

18 Prepare for antenna erection as follows (Fig.38 and 39 and Tables 38 an 39).

18.1 Attach the leather covered sling (item 1) to the torque tube immediately above the third joint, making two complete turns as shown i Fig.38.

18.2 To each end of the leather covered sling, attach a 30.5m (100ft) T13 Tirfor rope (item 2) using 1 3/4 ton shackle (item 3).

18.3 Shackle a Tirfor winch type T13 (item 4) to chain (item 5) using a 1 3/4 ton shackle (item 3) and shackle the chain to guy anchor block (see Fig.1) using a second 1 3/4 ton shackle (item 3). Similarly, shackle a second winch and chain to the other guy block A.

18.4 Feed the Tirfor ropes (item 2) through the Tirfor winches and take up the slack.

18.5 Attach the sling (item 6) to the torque tube at the lifting point, using a 3 ton shackle (item 7) as shown in Fig.39.

18.6 Attach the 5 ton snatch block (item 8) to one end of the sling (item 11) using a 5 ton shackle (item 9).

18.7 Reeve the T35 Tirfor rope (item 10) through the snatch block and lay it out on the ground so that it is free of kinks and twists.

18.8 Feed the free end of sling (item 11) up and over the pulley mounted between the twin lattice masts at the 18.3m (60ft) level. Brin the free end down and attach it to the two ends of sling (item 6) using a 5 ton shackle (item 9).

Note ...

The following instructions, paragraphs 18.9 to 18.10, are to prevent rotation of the 5 ton snatch block and twisting of the Tirfor rope.

18.9 Thread a length of polyester rope (item 12) through the holes in the side of the 5 ton snatch block and tie it to form a loop.

18.10 Attach a T13 Tirfor rope (item 2) to the loop of polyester rope and reeve the free end through a T13 Tirfor winch (item 4). Attach the T13 Tirfor winch to the anchor block C using a 1 3/4 ton shackle (item 3).

18.11 At the main winch anchor block D, attach the spreader plate

(item 13) using a 5 ton shackle (item 9).

18.12 Attach a TU32H Tirfor winch (item 14) to the upper hole in the spreader plate, using the pin supplied with the winch.

18.13 Attach the hard eye end of the T35 Tirfor rope (item 10) to the lower hole in the spreader plate using a 3 ton shackle (item 7).

18.14 Reeve the free end of the T35 Tirfor rope through the TU32H Tirfor winch.

18.15 Take up the slack in the ropes by taking in on the three T13 Tirfor winches and TU32H Tirfor winch. Check all the connections and the lay of the gear. The antenna is now ready for erection.

Note ...

The gates at the 60ft and 80ft (18.3m and 24.4m) levels will be open, ready to receive the torque tube, as they were removed in sub-paras.3.7 and 3.11 above.

Erecting the antenna

19 Position the men as follows:

One man on each of the side T13 Tirfor winches
Two men on the TU32H Tirfor winch
One man on the T13 Tirfor winch attached to the snatch block
Two men at the end of the antenna boom nearest the base

Note ...

The supervisor is to control the erection of the antenna and should move about the site so as to view the operation to the best advantage.

CAUTIONS

(1) During erection no personnel should be allowed to pass beneath the antenna.

(2) The TU32H Tirfor winch must be operated smoothly so as to avoid exciting undue oscillation into the torque tube and antenna assembly.

(3) To prevent siezure of the TU32H Tirfor winch, lubricate the moving parts frequently during the erection operation, using oil OMD75.

(4) When sideways adjustment is necessary using the side stay T13 Tirfor winches, cease operating the TU32H Tirfor winch whilst this is carried out.

(5) As erection proceeds, it will be necessary to maintain some tension on the T13 Tirfor winch attached to the snatch block. Initially this will need to be taken in but later it will need to be paid out.

19.1 Remove the pedestal packing positioned in para.10.11.

19.2 Apply an upward lift to the boom and torque tube by operating the TU32H Tirfor winch. Raise the assembly just clear of the ground and the

supporting packing.

19.3 Check that the assembly of the antenna and the deployment of the erector gear are in agreement with the relevant figures contained in this chapter.

19.4 Remove all obstructions and spare equipment from the site.

19.5 Operate the TU32H Tirfor winch so as to raise the boom and torque tube assembly. As the erection proceeds, the two men on the end of the boom must walk forward, steadying the boom all the time. Check that the elements are not likely to collide with any temporary stays. Check from time to time whether adjustment of the side stays is necessary.

19.6 Continue the erection until the boom will swing clear of the ground and make an angle of 90 degrees with the torque tube.

19.7 Now lower the boom assembly so that the end is close to the ground. Place wooden blocks under the end of the boom to protect it. Lower the boom onto the blocks but do not allow the whole weight to be taken by the blocks, as this could damage the boom.

19.8 Approximately 1.5m (5ft) from the end of the boom in the direction away from the pedestal, drive a picket into the ground and secure the boom to it with a length of 10mm diameter polyester rope.

19.9 Refer to Fig.40 and Table 40. Climb the boom, wearing safety harness complete with two safety lines. Refer to Fig.43 for use of the safety equipment. Secure the boom to the top torque tube using two reinforcing plates and twelve 3/8 inch bolts, lock washers and nuts (items 1 to 4), as shown in Fig.40. Torque to 19 lbf.ft.

19.10 Tighten the 5/8 inch nut (item 7) at the end of the hinge bolt (item 6). Do not torque this nut, as this could cause distortion of the assembled parts.

19.11 In order to connect the transmission line at the boom to torque tube joint, loosen the hose clamps holding the adaptor to the side of the boom. Pull the flanges of the transmission line apart and remove the temporary covers. Locate the O-ring (item 9) in the groove, lubricating it with silicone grease. Insert the connector (item 10).

19.12 Push the flanges of the outer conductor together, ensuring the O-ring is correctly positioned, and attach using the bolts, nuts and washers (items 11, 12 and 13), items safeguarded in sub-para.12.9 above. Torque to 11.5 lbf.ft.

19.13 Resecure the transmission line with the hose clamps. Climb down from the boom.

19.14 Remove the short restraining guy from the end of the boom. Raise the boom assembly a short distance from the ground. Fit the shorting coil (item 8, Fig.33 and Table 33) to the centre section of element 20 using the nuts and bolts which already secure the feed strap assembly. Torque to 6.5 lbf.ft.

19.15 Attach the windsail to the end of the boom using 5/16 inch nuts and bolts (items 3, 4 and 5 in Table 29). The windsail stays utilise

nuts and bolts which are part of the boom assembly. Torque to 11.5 lbf.ft.

19.16 Continue raising the boom assembly until the torque tube comes to rest in the bearings.

19.17 Climb the twin lattice mast and secure the torque tube with the two outer bearing halves (item 10 on Fig.5 and item 12 on Fig.6) using 5/8 inch x 1 3/4 inch bolts, nuts and washers (items 11, 8 and 12 on Fig.5 and items 17, 7 and 18 on Fig.6), items safeguarded in sub-para.3.7-3.10 above. Torque to 93 lbf.ft.

19.18 Disconnect all the erection equipment.

Feeder Connection

20 Carry out electrical checks and (if appropriate) pressurization checks on the coaxial feeder cable between the transmitter/receiver building and the antenna (see Appendix 1 and 2). Connect the coaxial feeder to the ▶ antenna and repeat the relevant electrical and pressurization checks (see Appendix 1 and 2). ◀

Earthing of twin lattice mast

21 Earth the twin lattice mast structure as follows (Fig.41 and Table 41).

21.1 Attach the earth wire (item 1) to the earthing rod (item 2) using the clamp (item 3).

21.2 Position the earthing rod several feet from the twin lattice mast and drive it a minimum of 6 inches below ground level.

21.3 Connect the earth wire to the twin lattice mast using the cable connector (item 4) and the 1/4 inch bolt, nut and washer (item 5, 6 and 7).

Site clearance

22 After completing the erection of the antenna, clear the site of all erection equipment. Grease all the shackles and rigging screws. Lock all the rigging screws with siezing wire. Finally, examine the guy anchorages for damage.

Painting

23 Carry out paint treatment to the twin lattice mast in accordance with RAFSEE Drawing No. SEE116319.

Control and power connection

24 WARNING ...

ENSURE ALL POWER IS SWITCHED OFF AND ISOLATED FROM THE TRANSMITTER/RECEIVER BUILDING BEFORE PROCEEDING WITH THE FOLLOWING.

Terminating the control cable

24.1 The control cable is to be terminated in accordance with the

appropriate antenna pedestal circuit diagram. All wires are to be continuity checked to the remote control inside the transmitter/receive: hall by a competent Jun. Tech. Fitter Grade (or above) before applying mains power to the antenna.

24.2 The mains power cable carrying the three phase 415V and neutral a(supply into the antenna pedestal is to be installed by a Trade Group 5 Electrician or by PSA. The person carrying out the installation is to ensure that the antenna rotates in the correct direction, in accordance with the following paragraph.

24.3 Switch on the power to the antenna. Operate a control switch to produce clockwise rotation of the antenna. The switch to be operated depends upon the nature of the control system fitted as follows:-

a. Remote control 1000-0215-301 (5985-99-116-9751) fitted. In this case, operate the three position toggle switch in the remote control in the CW direction.

b. Remote control 1000-1408-401 ( ) fitted. In this case, set the POWER switch to ON and select REMOTE. An antenna bearing will be indicated on the display. Add 20 degrees to the displayed bearing and enter it on the keypad, and then press ENTER.

c. The antenna is fitted with LOCAL/REMOTE and CW/CCW switches. Operate the CW/CCW switch in the CW direction.

24.4 Any of the above actions should produce clockwise rotation of the antenna as viewed from above. If the rotation is not clockwise, switch off the power to the antenna and interchange any two of the three line wires connected to the circuit breaker 2CB1. Restore the power and check that clockwise rotation is achieved.

Antenna alignment

25 When the antenna is first placed into service, or after replacement of parts, it is necessary to align the pointing system. The method of adjustment depends upon the control system used.

Remote Control 1000-0215-301 (5985-99-116-9751) fitted

25.1 Rotate the antenna until it points to true North. Switch off th(power at the antenna. Remove the back cover of the remote control. Loosen the three screws on the clamp of the receiving synchro. Apply power temporarily at the antenna and rotate the receiving synchro until the pointer indicates 0 degrees, corresponding to true North. Tighten the clamp screws.

WARNING

115V supply is present across terminals within the remote control and care must be taken to avoid accidental contact.

Remote Control 1000-1408-401 ( ) fitted

25.2 Rotate the antenna until it points to true North. At the remote control, note the antenna bearing shown on the display. Refer to Chapter 6.3, para.35-37 for information relating to azimuth correction.

Switch off power to the unit and remove the top cover. Operate the azimuth correction switches to correct the displayed bearing. Switch on the power and check that the correct bearing is displayed, ie, '000'. If necessary, re-adjust the azimuth correction switches. Switch off the power and refit the top cover to the unit.

WARNING

115V supply is present across terminals within the remote control and care must be taken to avoid accidental contact.

Gear reducer

26 Remove the gear reducer vent pin, indicated by the attached red tag. Re-install the pedestal front and rear housings with the fastenings removed in sub-para.10.17, fitting the gaskets between the two halves at the top, as shown in Fig.42.

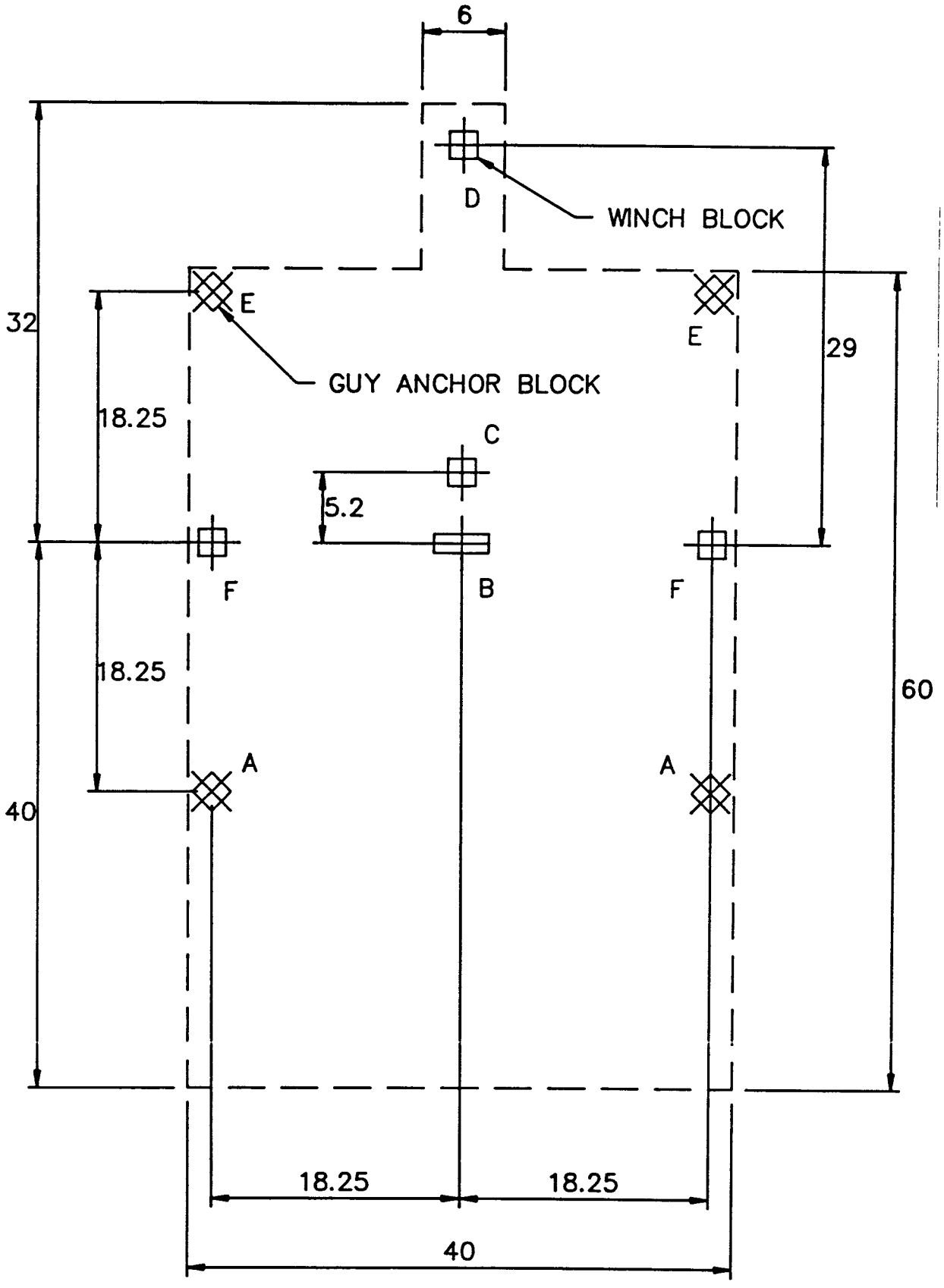


Fig 1 Site Plan– dimensions in metres
(Details in accordance with 90G110166)

TABLE 2 ITEMS LIST FOR FIG.2

Item	Ref./Part No.	Description	Qty.
1	5445-99-627-2481	Mast section, bottom LH	1
2	5445-99-627-2479	Mast section, bottom RH	1
3	0001-7934-002	Base assembly	1
4	0001-7933-001	Clamp, base hinge	2
5	2076-4374-001	Bolt, hex hd, $^3/_4$-10x2$^3/_4$, galv,Hi.St.	18
6	5310-99-627-2412	Washer, lock $^3/_4$, galv.	30
7	2100-0878-001	Nut, hex, $^3/_4$-10, galv.Hi.St.	18
8	2349-0092-001	Washer, square, bevelled, $^3/_4$ galv.	4
9	2450-0191-001	U-Bolt, with nuts	2
10	2310-0153-001	Washer, plain $^3/_4$, galv.	12
11	2100-0133-001	Nut, hex, $^3/_4$-10, galv.	12

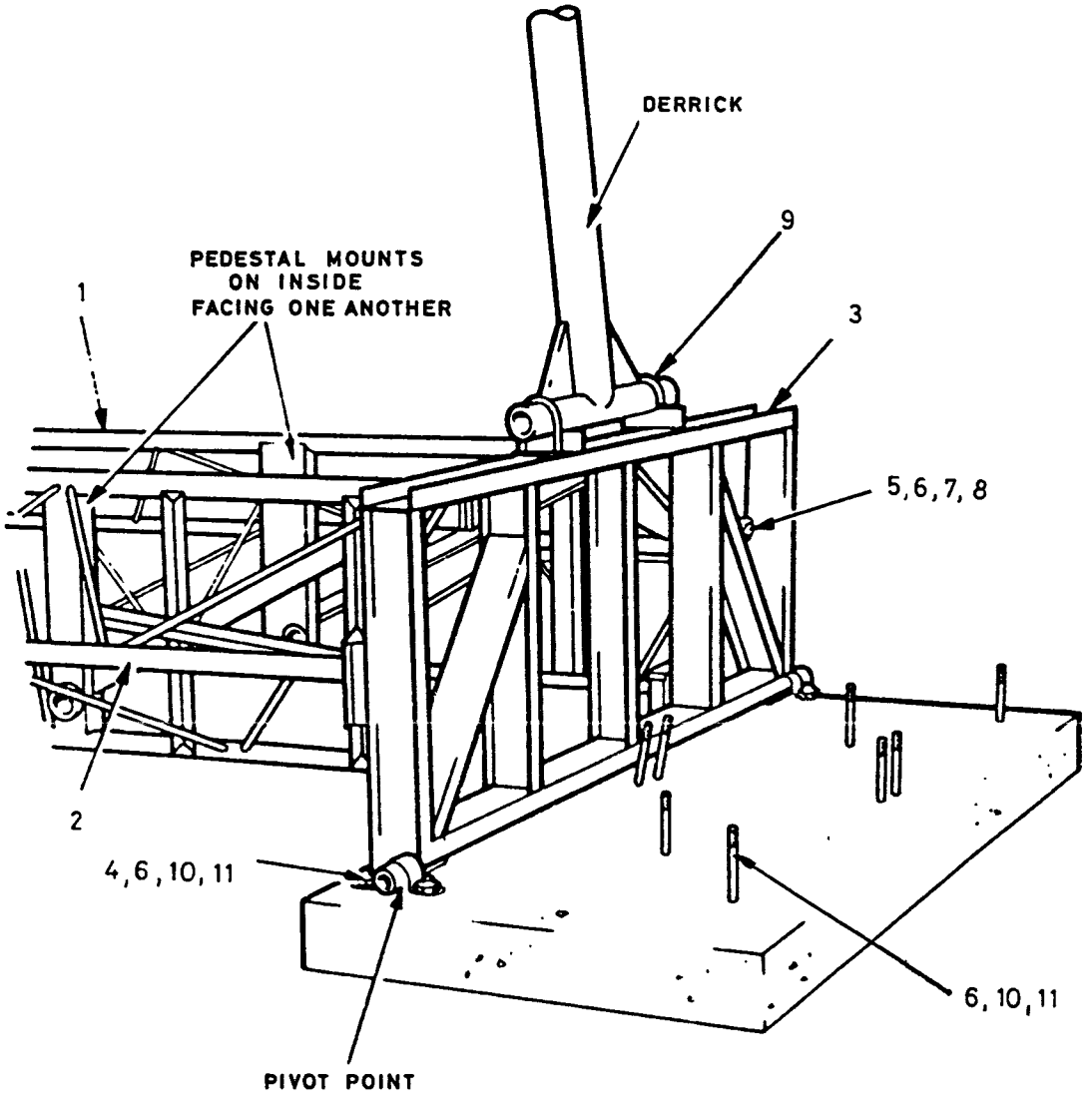


Fig.2 Base and derrick installation

TABLE 3 ITEMS LIST FOR FIG.3

Item	Ref./Part No.	Description	Qty.
1	0001-7920-001	Mast section	6
2	5445-99-627-2481	Mast section, bottom LH	1
3	5445-99-627-2479	Mast section, bottom RH	1
4	0001-7922-001	Brace, diagonal	84
5	0001-7921-001	Brace, horizontal	12
6	2077-6810-001	Bolt, hex hd, $^3/_8$-16x$1^1/_2$, galv.	102
7	5310-99-627-2425	Nut, hex, $^3/_8$-16 galv.	102
8	5985-99-626-9325	Washer, lock, $^3/_8$, galv.	102
9	2076-4316-001	Bolt, hex hd, $^1/_2$-13x$1^1/_2$, galv, Hi.St.	54
10	2100-0876-001	Nut, hex, $^1/_2$-13, galv, Hi.St.	72
11	2300-0155-001	Washer, lock, $^1/_2$, galv.	72
12	2076-4320-001	Bolt, hex hd, $^1/_2$-13x2, galv, Hi.St.	18
13	0002-1604-407	Intermediate guy bracket, RH	1
14	0002-1604-401	Intermediate guy bracket, LH	1

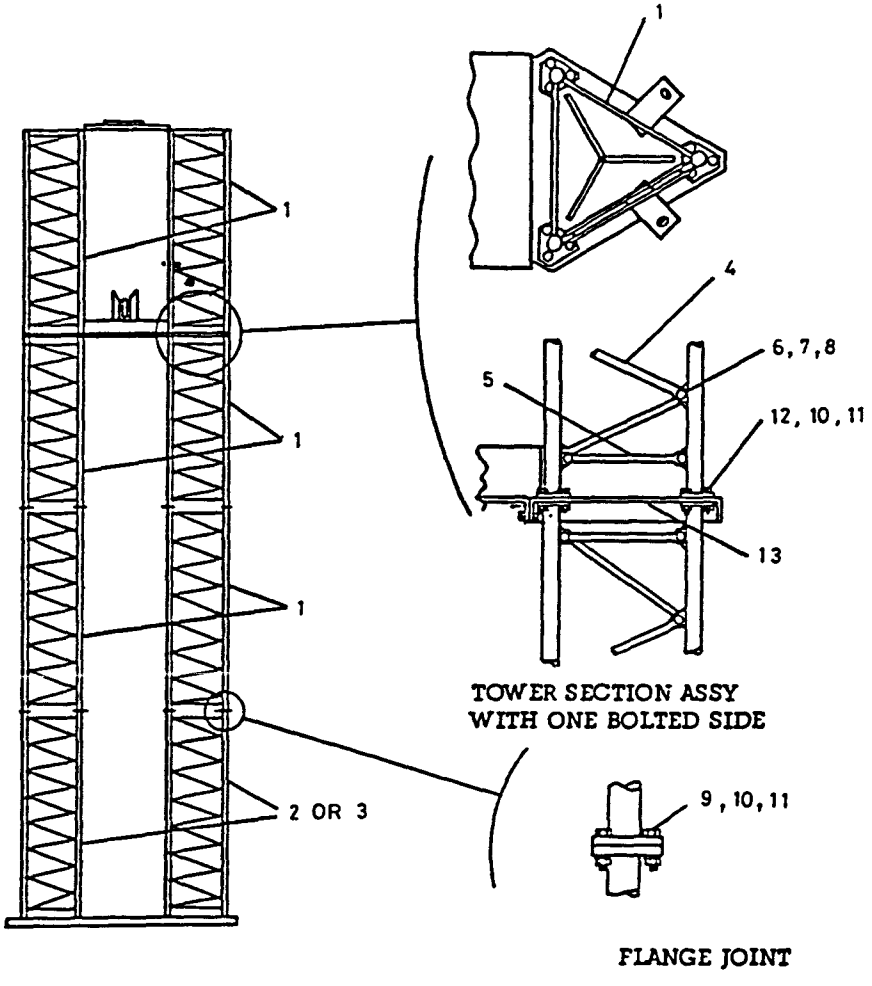


Fig.3 Twin lattice mast assembly

TABLE 4 ITEMS LIST FOR FIG.4

Item	Ref./Part No.	Description	Qty.
1	0001-7920-001	Mast section	6
2	0002-1604-407	Intermediate guy bracket, RH	1
3	0002-1604-401	Intermediate guy bracket, LH (not shown)	1
4	2076-4320-001	Bolt, hex hd, $^1/_2$-13x2, galv, Hi.St.	18
5	2300-0155-001	Washer, lock, $^1/_2$, galv.	18
6	2100-0876-001	Nut, hex, $^1/_2$-13, galv, Hi.St.	18
7	SEE206171	Intermediate guy	4

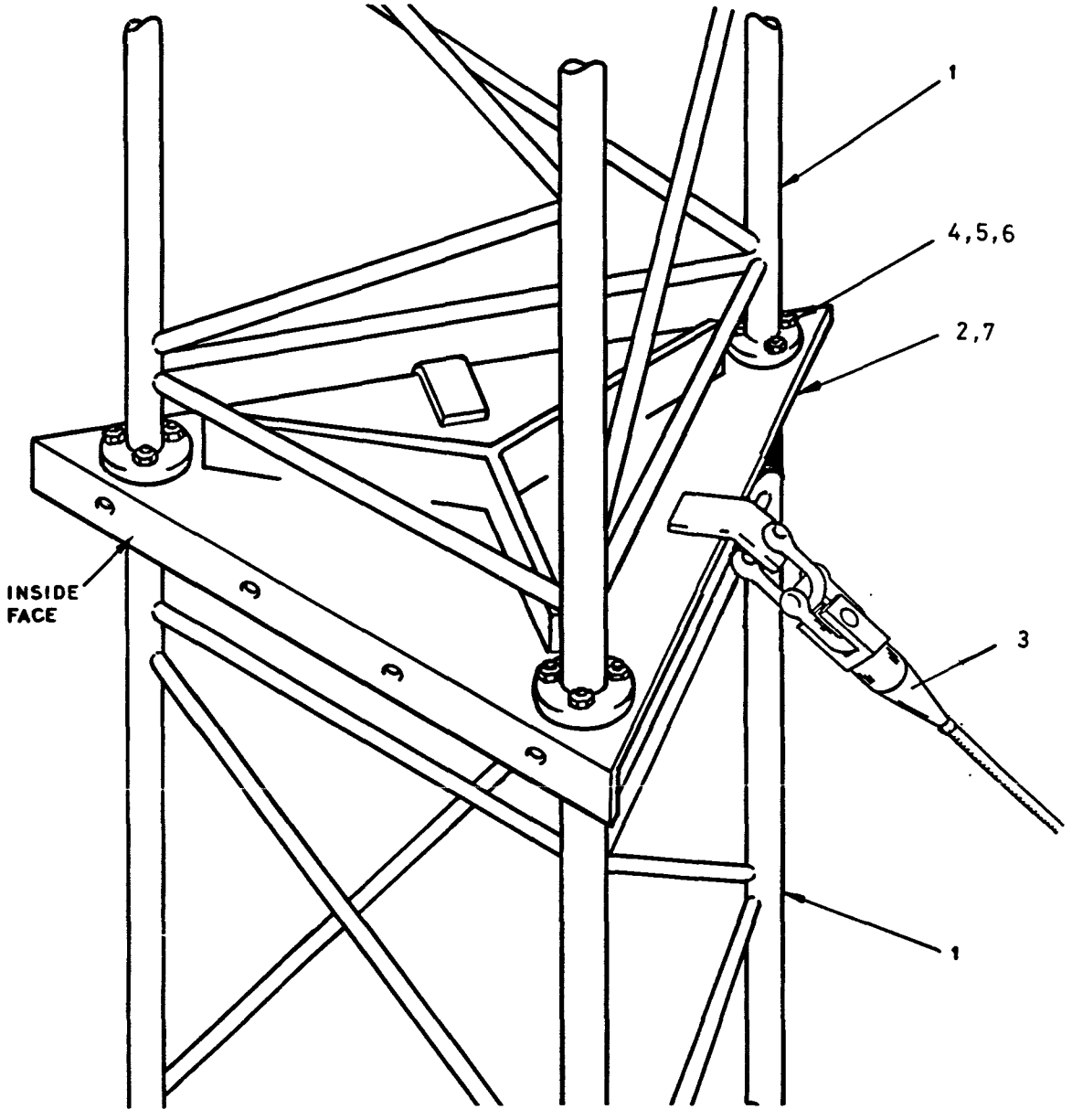


Fig.4 Intermediate Guy Attachment
(viewed in erected position)

TABLE 5 ITEMS LIST FOR FIG.5

Item	Ref./Part No.	Description	Qty.
1	0001-7926-001	Bearing plate assembly	1
2	0002-1604-401	Intermediate guy bracket, LH	1
3	0002-1604-407	Intermediate guy bracket, RH	1
4	0002-8866-302	Erection bracket	1
5	0002-8866-301	Erection bracket	1
6	2076-4341-001	Bolt, hex hd, $^{5}/_{8}$-11x$1^{3}/_{4}$,galv,Hi.St.	4
7	2076-4344-001	Bolt, hex hd, $^{5}/_{8}$-11x$2^{1}/_{2}$,galv,Hi.St.	4
8	5310-99-722-4631	Washer, lock, $^{5}/_{8}$, galv.	12
9	2100-0877-001	Nut, nex, $^{5}/_{8}$-11, galv, Hi.St.	8
10	0001-4250-001	Outer welded assembly	1
11	2077-7907-001	Bolt, hex hd, $^{5}/_{8}$-11x$1^{3}/_{4}$, galv.	4
12	2100-0131-001	Nut, hex, $^{5}/_{8}$-11, galv.	4

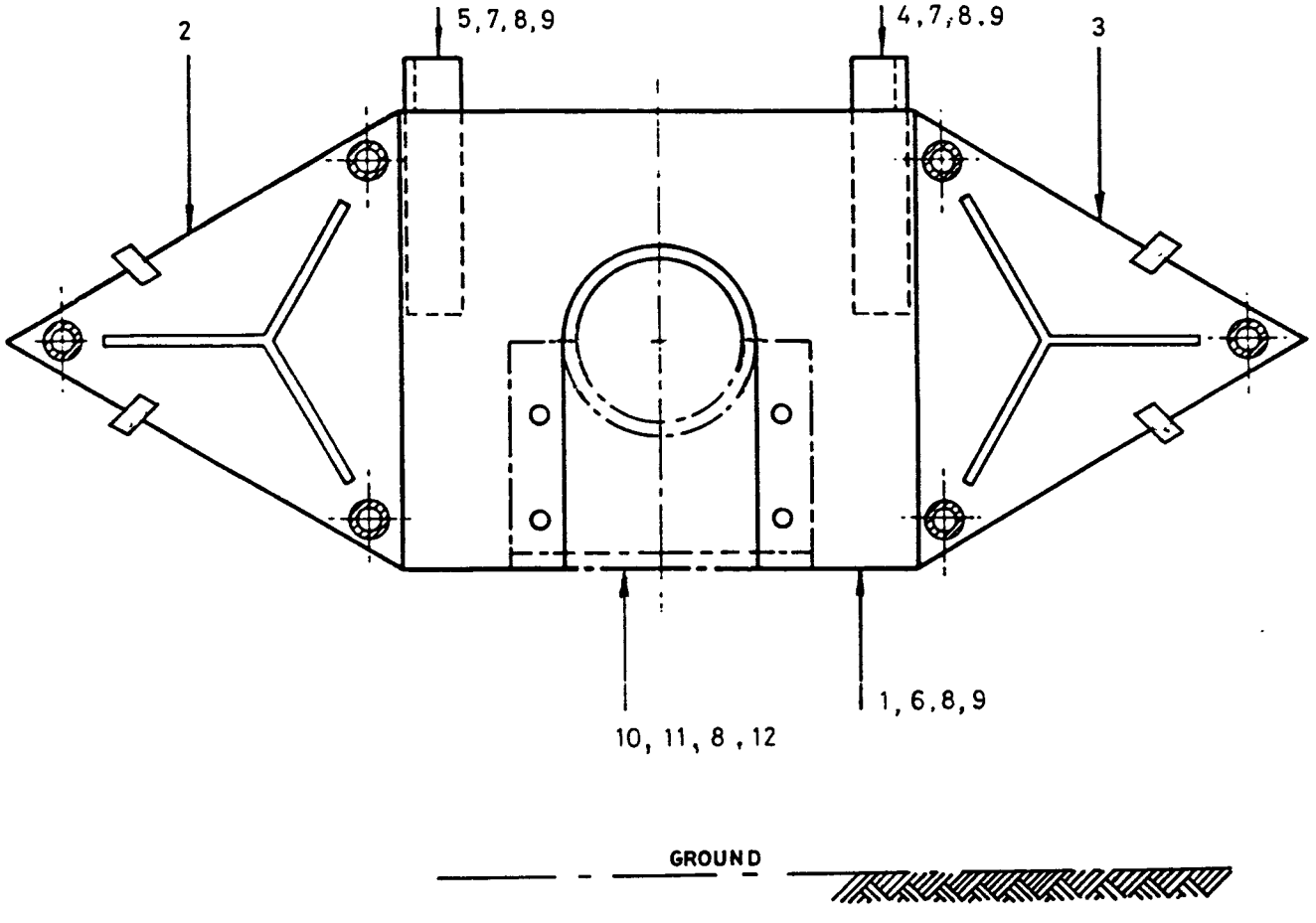


Fig. 5 Intermediate guy attachment and bearing assembly viewed from top of twin lattice mast.

TABLE 6 ITEMS LIST FOR FIG.6

Item	Ref./Part No.	Description	Qty.
1	0001-7913-001	Guy bracket	2
2	0001-7926-001	Bearing plate assembly	1
3	0002-8866-302	Erection bracket LH	1
4	0002-8866-301	Erection bracket RH	1
5	2076-4341-001	Bolt,hex hd, $^5/_8$-11x1$^3/_4$, galv,Hi.St.	4
6	2076-4344-001	Bolt,hex hd, $^5/_8$-11x2$^1/_2$, galv,Hi.St.	4
7	5310-99-722-4631	Washer, lock, $^5/_8$, galv.	12
8	2100-0877-001	Nut, hex, $^5/_8$-11, galv, Hi.St.	8
9	2076-4316-001	Bolt,hex hd, $^1/_2$-13x1$^1/_2$, galv,Hi.St.	18
10	2300-0155-001	Washer, lock, $^1/_2$, galv.	18
11	2100-0876-001	Nut, hex, $^1/_2$-13, galv, Hi.St.	18
12	0001-4250-001	Outer welded assembly	1
13	5820-00-105-5027	Bearing half, sleeve	2
14	5305-99-627-2453	Screw, pan hd slt, No.10-24x$^7/_8$, SST	12
15	5310-99-624-4058	Washer, lock, No.10, SST	12
16	5310-99-120-6257	Nut, hex, No.10-24 SST	12
17	2077-7907-001	Bolt, hex hd, $^5/_8$-11x1$^3/_4$, galv.	4
18	2100-0131-001	Nut, hex, $^5/_8$-11, galv.	4
19	3940-99-519-7422	Block, tackle	1
20	4030-99-960-4348	Large D shackle, $^5/_8$ pin,SWL 0.75ton	1
21	4020-99-933-1559	Rope, polyester 6mm	61m

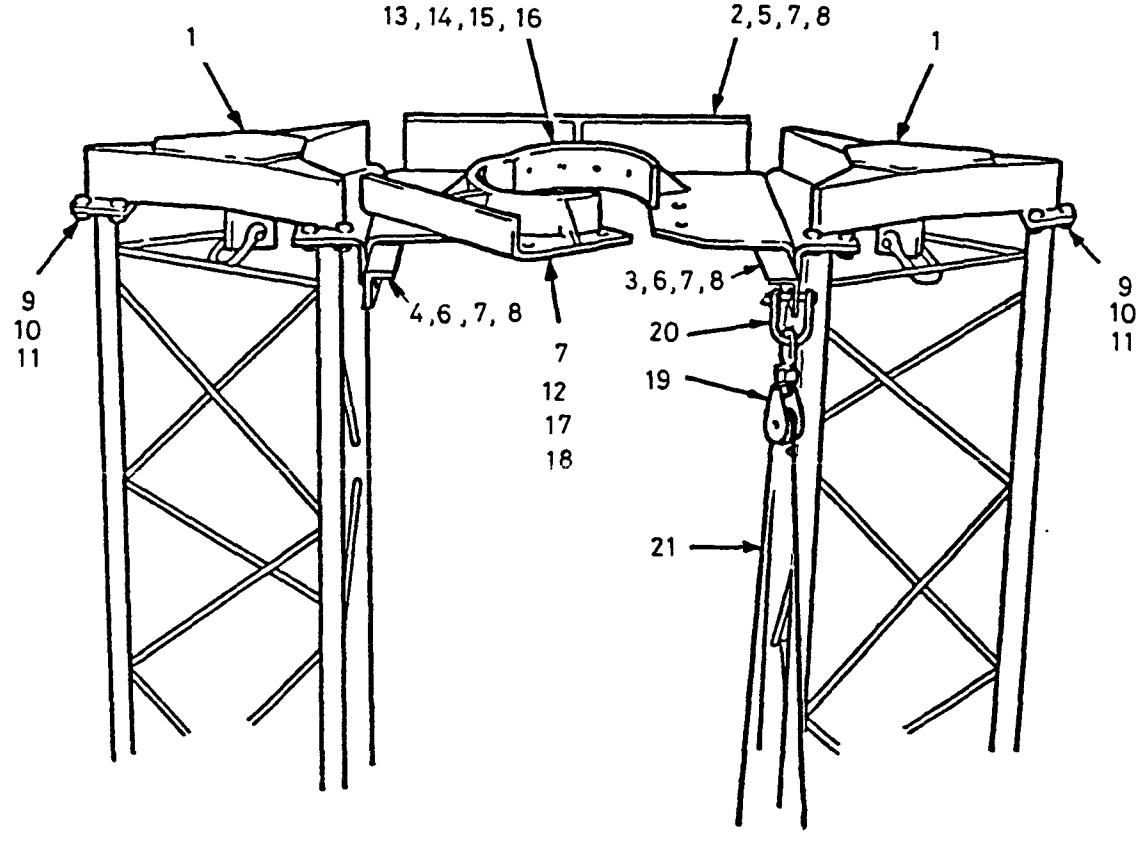


Fig. 6 Top guy attachment and bearing assembly

TABLE 7 ITEMS LIST FOR FIG.7

Item	Ref./Part No.	Description	Qty.
1	SEE193672	Guy	1
2		Shackle, small D, $1^1/_8$in.dia.pin, SWL $4^1/_2$t	2
3		Long link chain $^3/_4$in.dia.x 1ft 6in.lg.	1
4		Long link chain $^3/_4$in.dia.x 6ft lg.	1
5		Rigging screw, Pattern 26, $1^1/_4$in.dia.	1

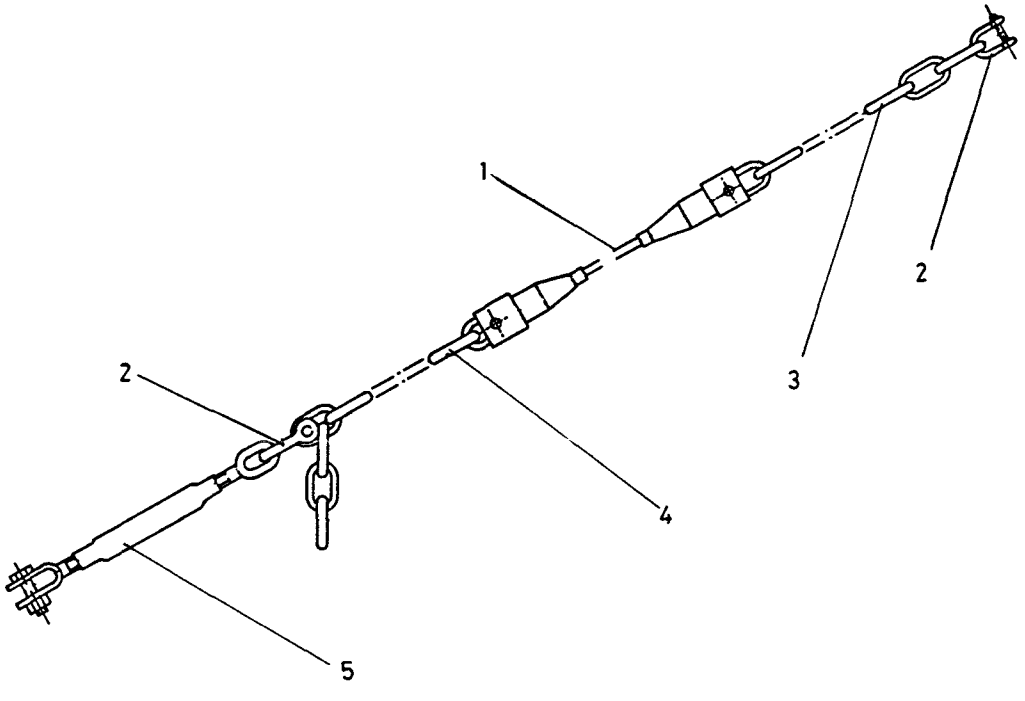


Fig.7 Top guy assembly

TABLE 8A ITEMS LIST FOR FIG.8A

Item	Ref./Part No.	Description	Qty.
1	0002-1616-301	Pulley bracket assy	1
2	0002-1608-001	Clamp	2
3	2077-6453-001	Bolt, hex hd, $^3/_8$ - 16x1$^1/_2$ galv.	8
4	5935-99-626-9325	Washer, lock $^3/_8$ galv.	8
5	5310-99-627-2425	Nut, hex $^3/_8$ - 16 galv.	8

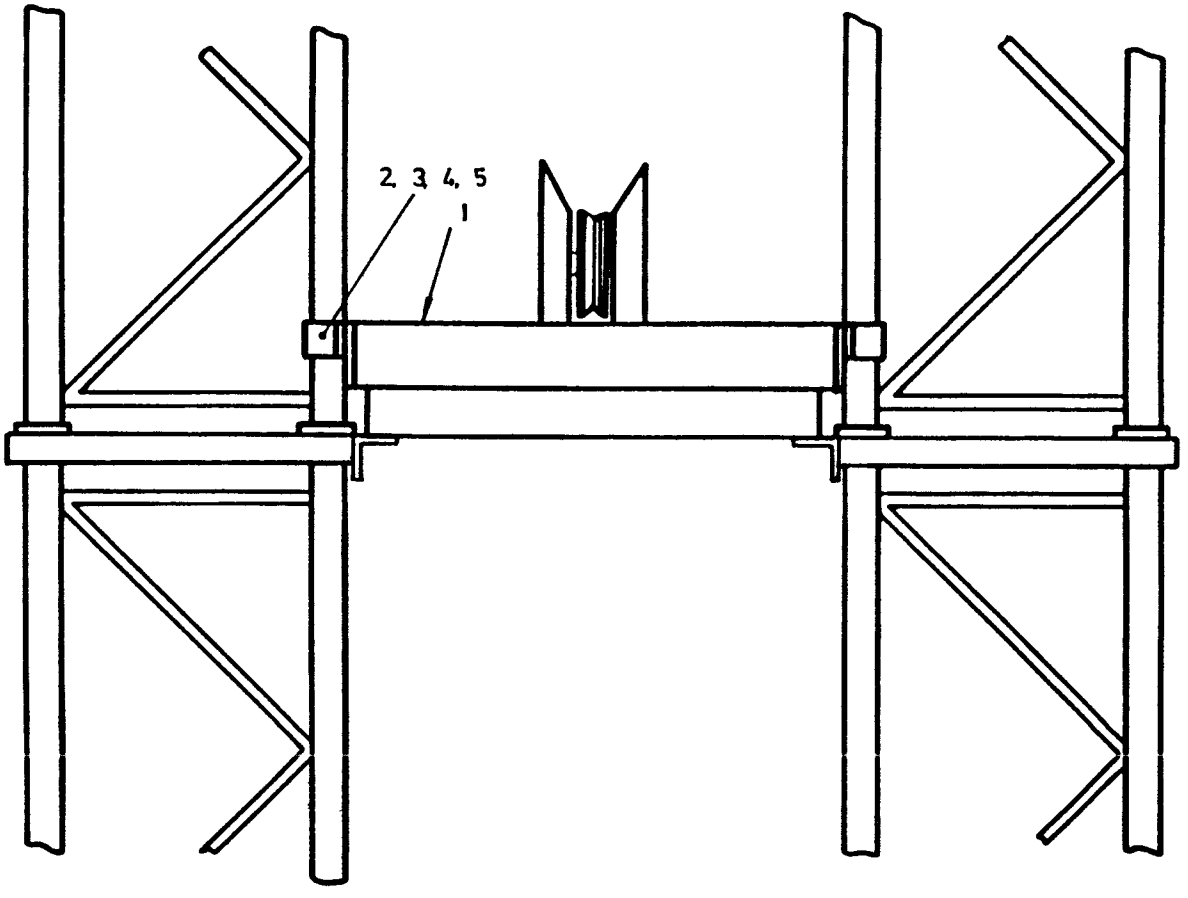


Fig. 8A Pulley bracket assembly

TABLE 8 ITEMS LIST FOR FIG.8

Item	Ref./Part No.	Description	Qty.
1	SEE 188281	Mast intermediate guy	1
2		Rigging screw, Pattern 26, 1in. dia.	1
3		Shackle small D, $^{7}/_{8}$in. pin	3
4		Long link chain $^{3}/_{4}$in. dia.x6ft.lg.	1

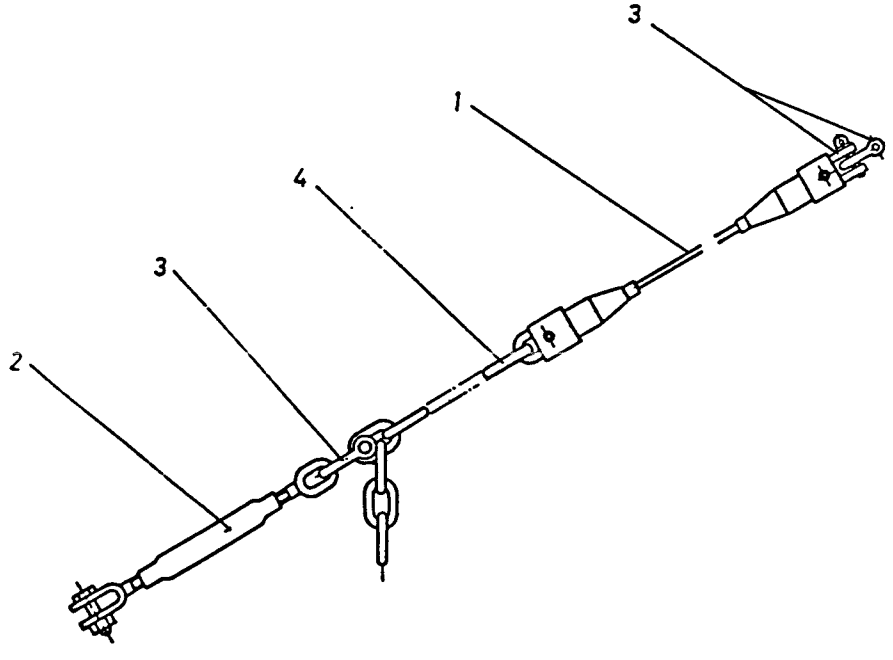


Fig.8 Intermediate guy assembly

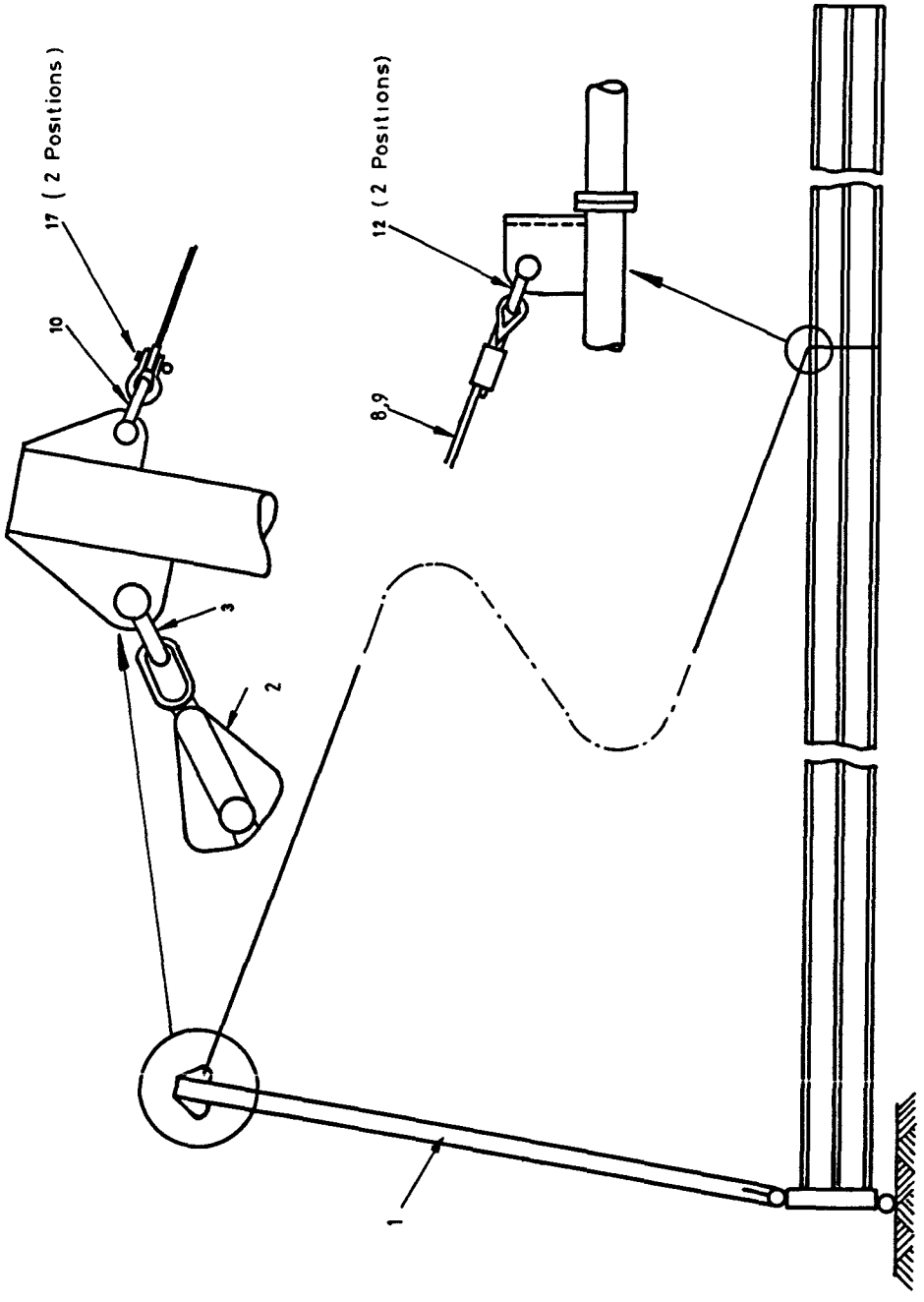


Fig. 9 Derrick attachment

TABLE 9 ITEMS LIST FOR FIG.9

Item	Ref./Part No.	Description	Qty.
1	90G 110723	Derrick assembly, tower	1
2	3940-99-425-3457	Snatch block, 12in.sheave SWL 5t	2
3	4030-99-638-8199	Shackle, large Dee, $1^1/_4$in.dia. pin, SWL 5t.	1
6	3950-99-201-3244	Tirfor Winch T7	2
8	4010-99-638-8200	Sling	1
9	4010-99-638-8409	Sling	1
10	4030-99-638-8201	Shackle, large Dee, $1^1/_8$in.dia. pin, SWL $3^3/_4$t	9
11	4010-99-202-9032	Tirfor rope T7x60 ft. lg	2
12	4030-99-960-4349	Shackle, large Dee, $^3/_4$in.dia. pin, SWL $1^1/_2$t	4
13	4010-99-638-8202	Guy	1
14	4L/4013	Tirfor winch type TU32H	1
16	4010-99-523-8376	Tirfor rope T35x100ft.lg	1
17	4030-99-638-8203	Shackle, large Dee, 1in.dia. pin, SWL 3t	2

TABLE 10 ITEMS LIST FOR FIG.10

Item	Ref./Part No.	Description	Qty.
1	5985-99-933-3888	Wire rope assembly, 15.2m (50ft)	2
2	4010-99-638-9347	Wire rope assembly, 10ft.	2
3	3950-99-204-6346	Tirfor winch type T13	2
4	4010-99-523-8374	Tirfor rope T13x30.5m (100ft)	2
5	4030-99-960-4349	Shackle, large Dee, $^3/_4$in.dia. pin, SWL $1^1/_2$t	6

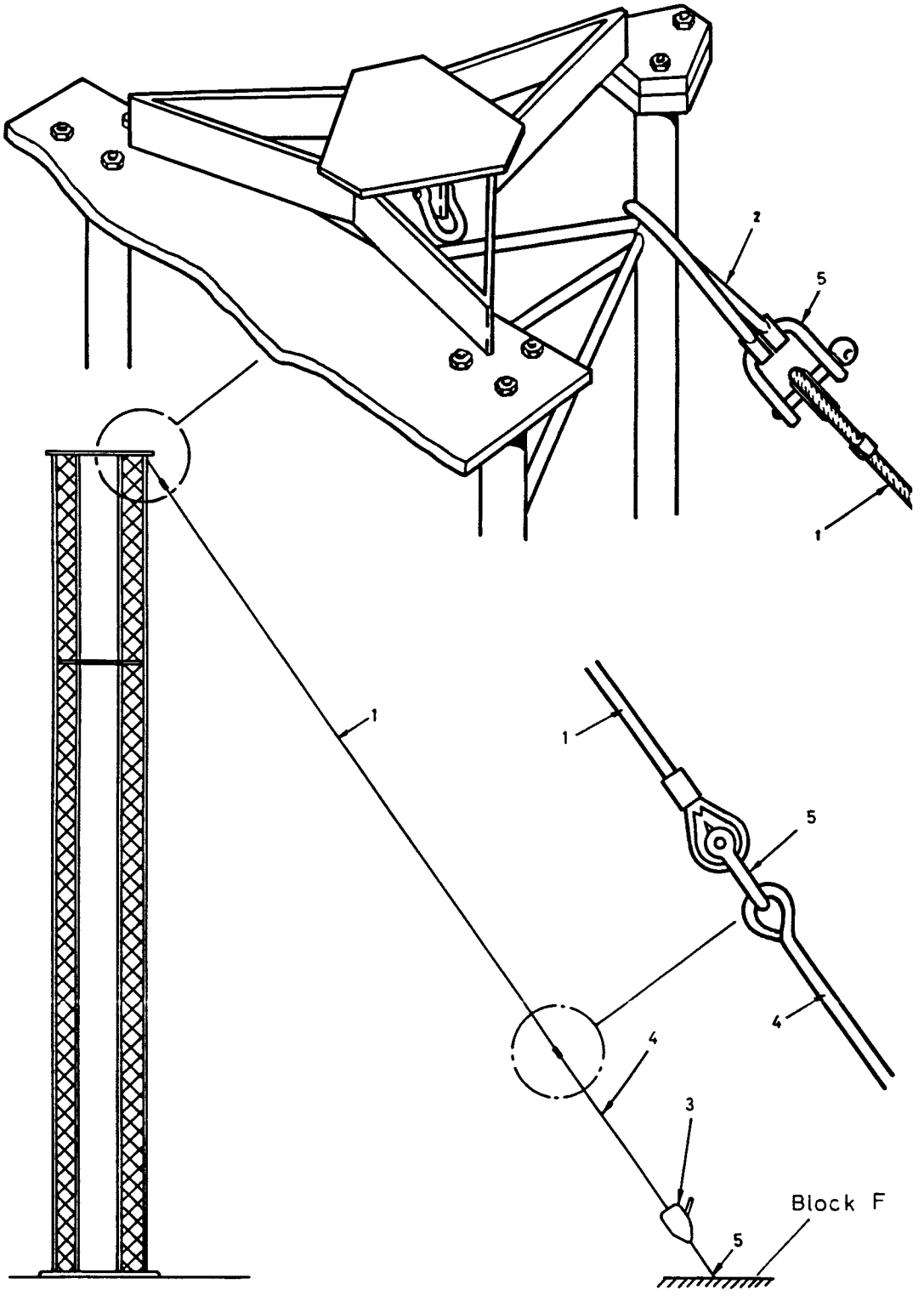


Fig.10 Temporary stay attachment

TABLE 11 ITEMS LIST FOR FIG.11

Item	Ref./Part No.	Description	Qty.
1	0001-7935-001	Angle, tie down	4
2	0001-7945-001	Channel, tie down	2

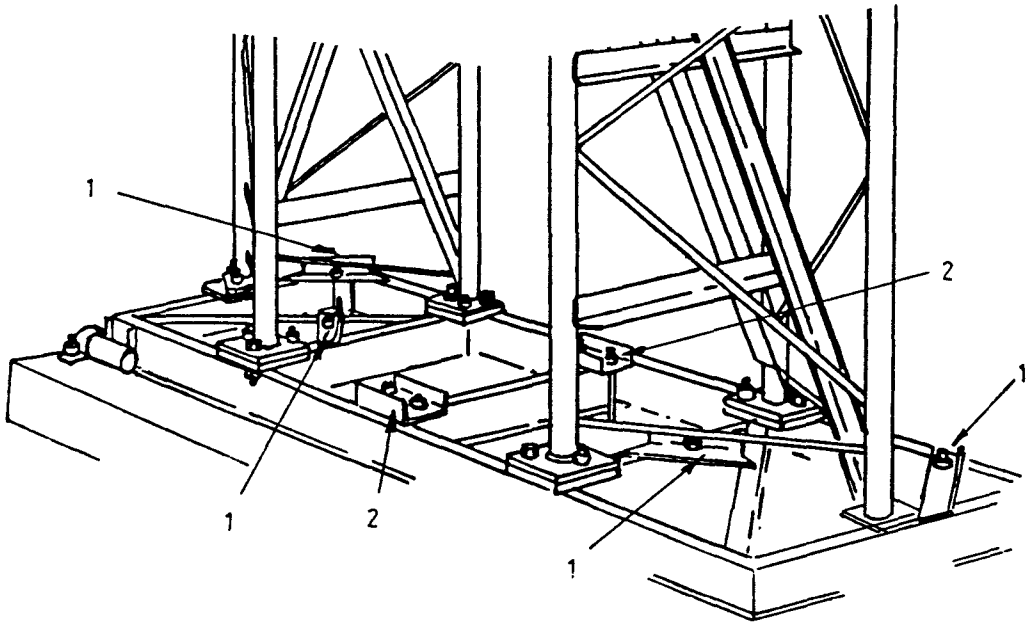


Fig.11 Attachment of mast base

TABLE 12 ITEMS LIST FOR FIG.12

Item	Ref./Part No.	Description	Qty.
1	0002-1623-401	Bearing bracket RH	1
2	0002-1623-402	Bearing bracket LH	1
3	2077-7913-001	Bolt, hex hd, $^5/_8$-11x2$^1/_2$, galv.	12
4	5310-99-722-4631	Washer, lock, $^5/_8$, galv.	20
5	5310-99-627-2424	Nut, hex, $^5/_8$-11, galv.	20
6	0002-1624-301	Bearing bracket support angle	2
7	0002-1625-301	Clamping bracket	4
8	5305-99-771-4713	Bolt, hex hd, $^5/_8$-11x1$^3/_4$, galv.	8
9	2077-6455-001	Bolt, hex hd, $^1/_2$-13x3$^1/_2$, galv.	2
10	2300-0155-001	Washer, lock, $^1/_2$, galv.	2
11	2100-0127-001	Nut, hex, $^1/_2$-13 galv.	2

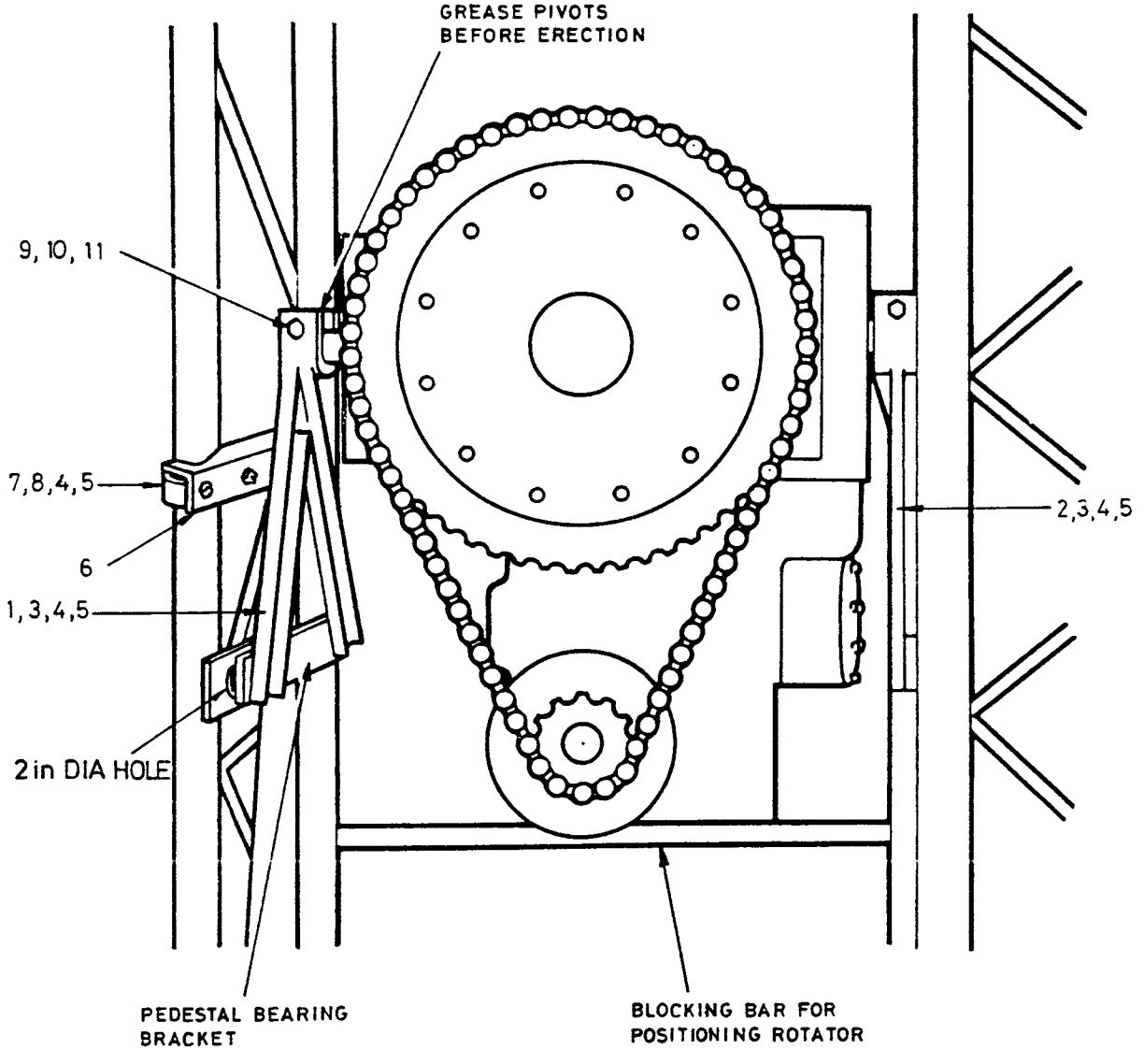


Fig.12 Pedestal mounting

TABLE 13 ITEMS LIST FOR FIG.13

Item	Ref./Part No.	Description	Qty.
1	4030-99-960-4349	Shackle, large Dee, $^{3}/_{4}$in.dia. pin, SWL $1^{1}/_{2}$t	2
2	4030-99-638-8199	Shackle, large Dee, $1^{1}/_{4}$in.dia. pin, SWL 5t	4
3	3940-99-425-3432	Two leg sling	1
4	3940-99-425-3457	Snatch block, 12in.sheave, SWL 5t	1
5	4L/4013	Tirfor winch type TU32H	1
6	4010-99-798-2590	Tirfor rope T35x70m	1

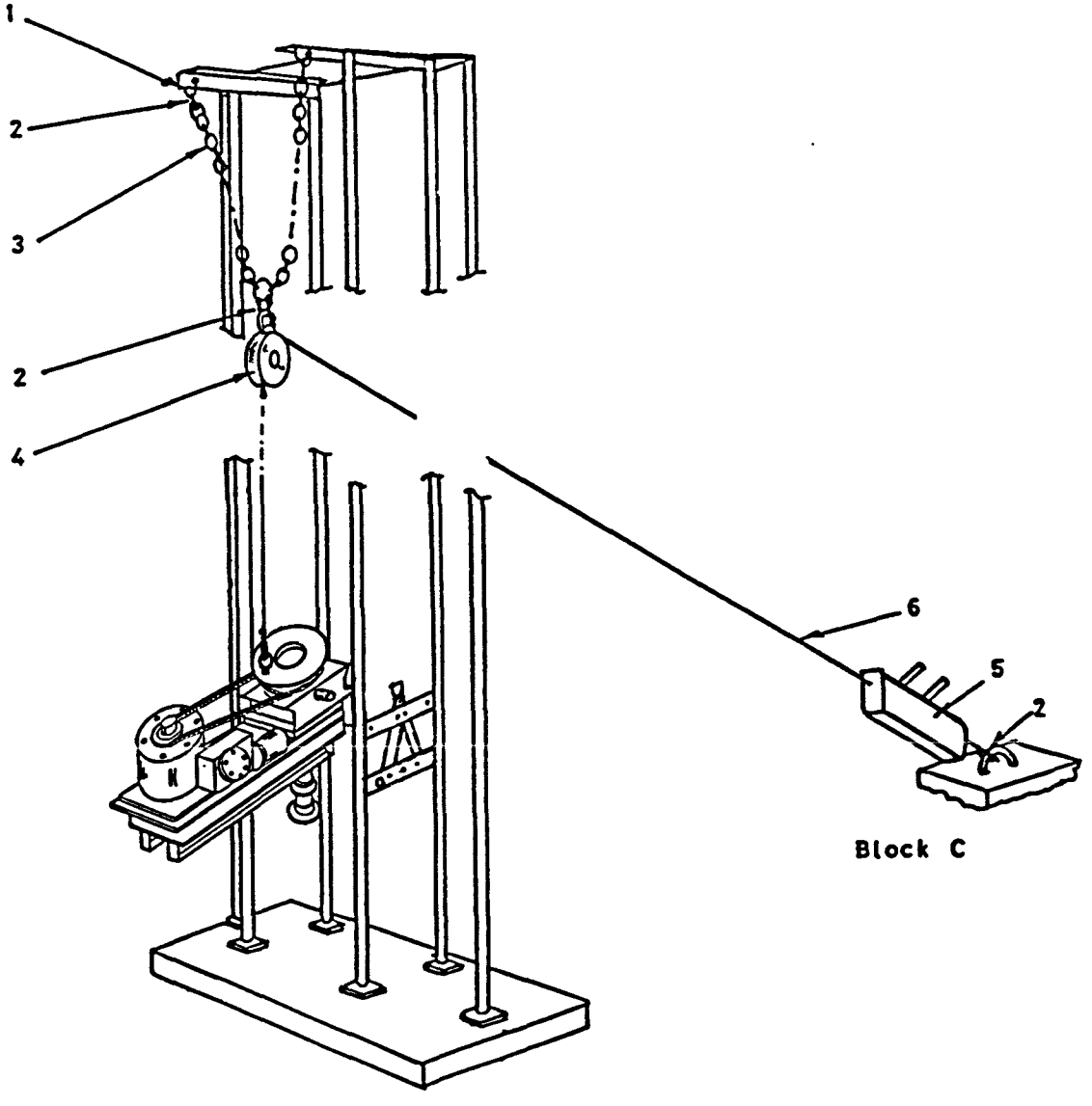


Fig.13 Lifting of pedestal

TABLE 14 ITEMS LIST FOR FIG.14

Item	Ref./Part No.	Description	Qty.
1	5985-99-116-9468	Rotary joint	1
2	0001-4008-001	Transmission line, short section	1
3	5330-99-627-2182	O ring	1
4	5305-99-946-9818	Bolt, hex hd, $^{5}/_{16}$-18x1, SST	4
5	5310-99-139-0551	Nut, hex, $^{5}/_{16}$-18, SST	4
6	5305-99-134-0505	Bolt, hex hd, $^{1}/_{4}$-20x1, SST	4
7	5310-99-111-1293	Washer, lock, $^{1}/_{4}$, SST	4
8	5310-99-944-2936	Nut, hex, $^{1}/_{4}$-20, SST	4

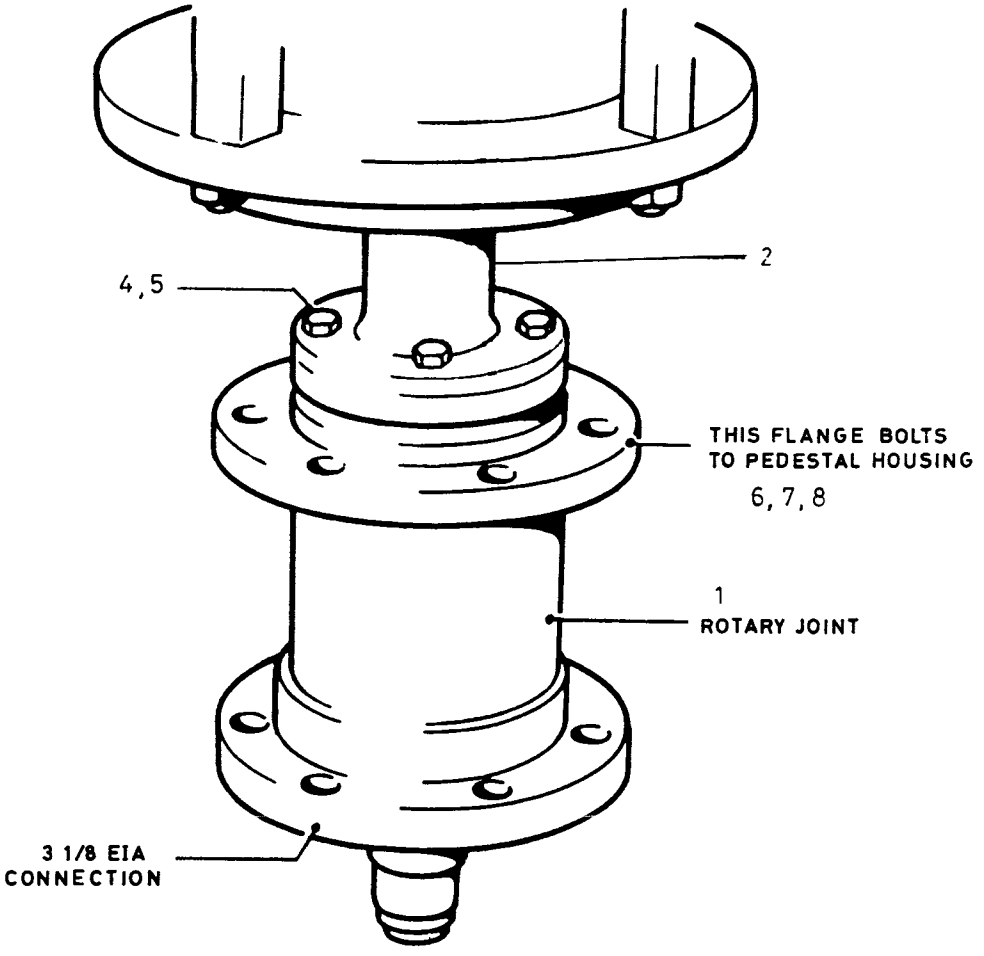


Fig.14 Rotary joint

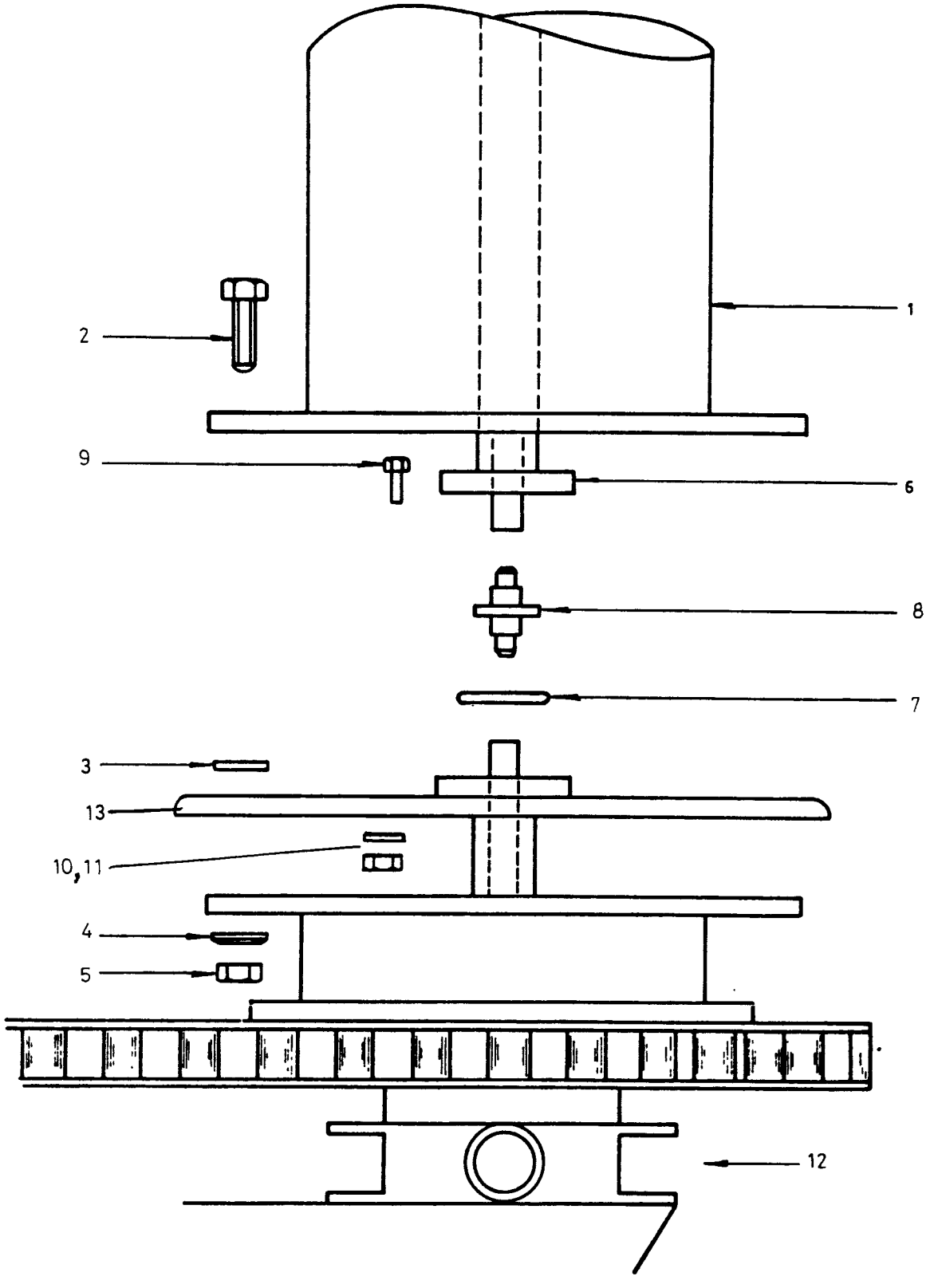


Fig.15 Torque tube to pedestal joint

TABLE 15 ITEMS LIST FOR FIG.15

Item	Ref./Part No.	Description	Qty.
1	0001-3978-001	Torque tube, intermediate	1
2	5306-99-627-3606	Bolt, hex hd, $^5/_8$-11x2, galv.	12
3	8030-99-627-3620	Thread seal, $^5/_8$	12
4	5310-99-722-4631	Washer, lock, $^5/_8$, galv.	12
5	5310-99-627-2424	Nut, hex, $^5/_8$-11, galv.	12
6	5985-00-050-4688	Transmission line	1
7	5330-99-627-2182	O ring	1
8	5985-00-909-3868	Connector, transmission line	1
9	5306-99-947-3788	Bolt, hex hd, $^5/_{16}$-18x1$^1/_4$, SST	4
10	5310-99-120-9059	Washer, lock, $^5/_{16}$, SST	4
11	5310-99-139-0551	Nut, hex, $^5/_{16}$, SST	4
12	5985-99-116-9752	Pedestal	1
13	0001-5365-202	Rainshield	1

TABLE 16 ITEMS LIST FOR FIG.16

Item	Ref./Part No.	Description	Qty.
1	0001-3978-001	Torque tube, intermediate	2
2	0001-3979-001	Torque tube, top	1
3	5306-99-627-3606	Bolt, hex hd, $^5/_8$-11x2, galv.	36
4	5310-99-722-4631	Washer, lock, $^5/_8$, galv.	36
5	5310-99-627-2424	Nut, hex, $^5/_8$-11, galv.	36
6	5985-00-050-4688	Transmission line	3
7	0001-4006-001	Connector kit, comprising:-	4
8	5330-99-627-2182	O ring	1
9	5985-00-909-3868	Connector, transmission line	1
10	5306-99-947-3788	Bolt hex hd, $^5/_{16}$-18x1$^1/_4$, SST	4
11	5310-99-120-9059	Washer, lock, $^5/_{16}$, SST	4
12	5310-99-139-0551	Nut hex, $^5/_{16}$-18, SST	4
13	5360-99-627-2409	Spring, extension	4

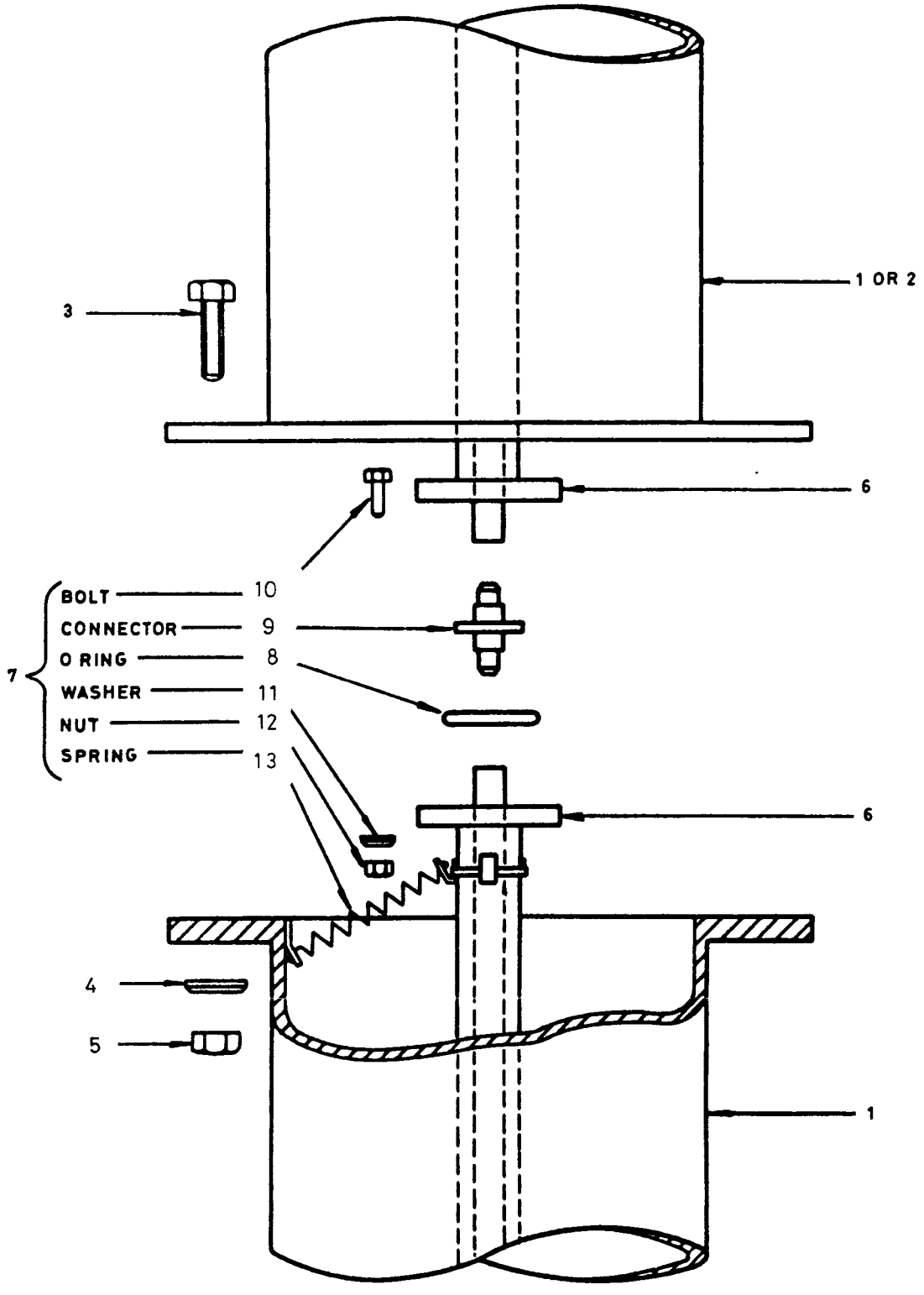


Fig.16 Intermediate torque tube joints

TABLE 17 ITEMS LIST FOR FIG.17

Item	Ref./Part No.	Description	Qty.
1	0001-3979-001	Torque tube, top	1
2	5985-00-050-4688	Transmission line	1
3	5360-99-627-2409	Spring, extension	4

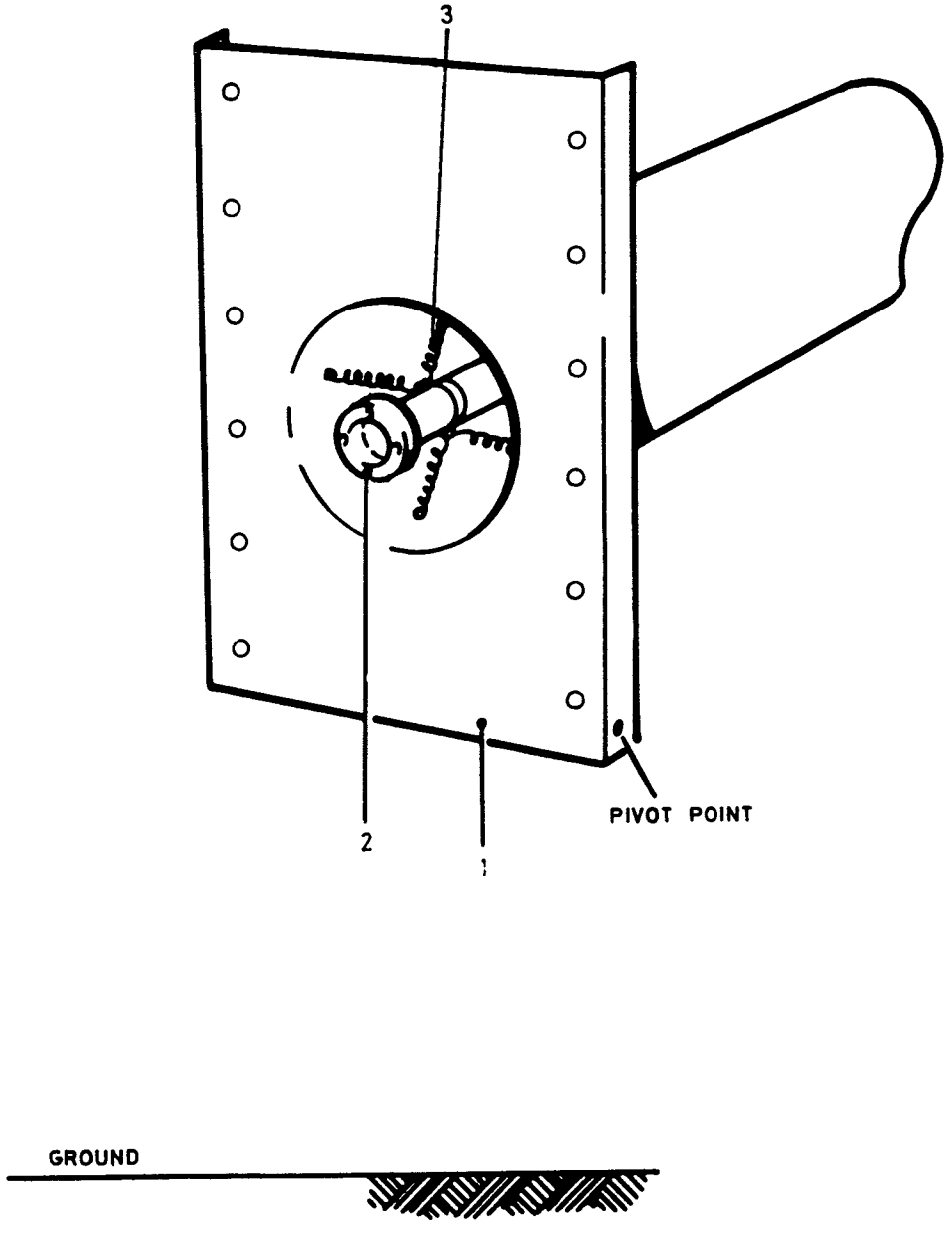
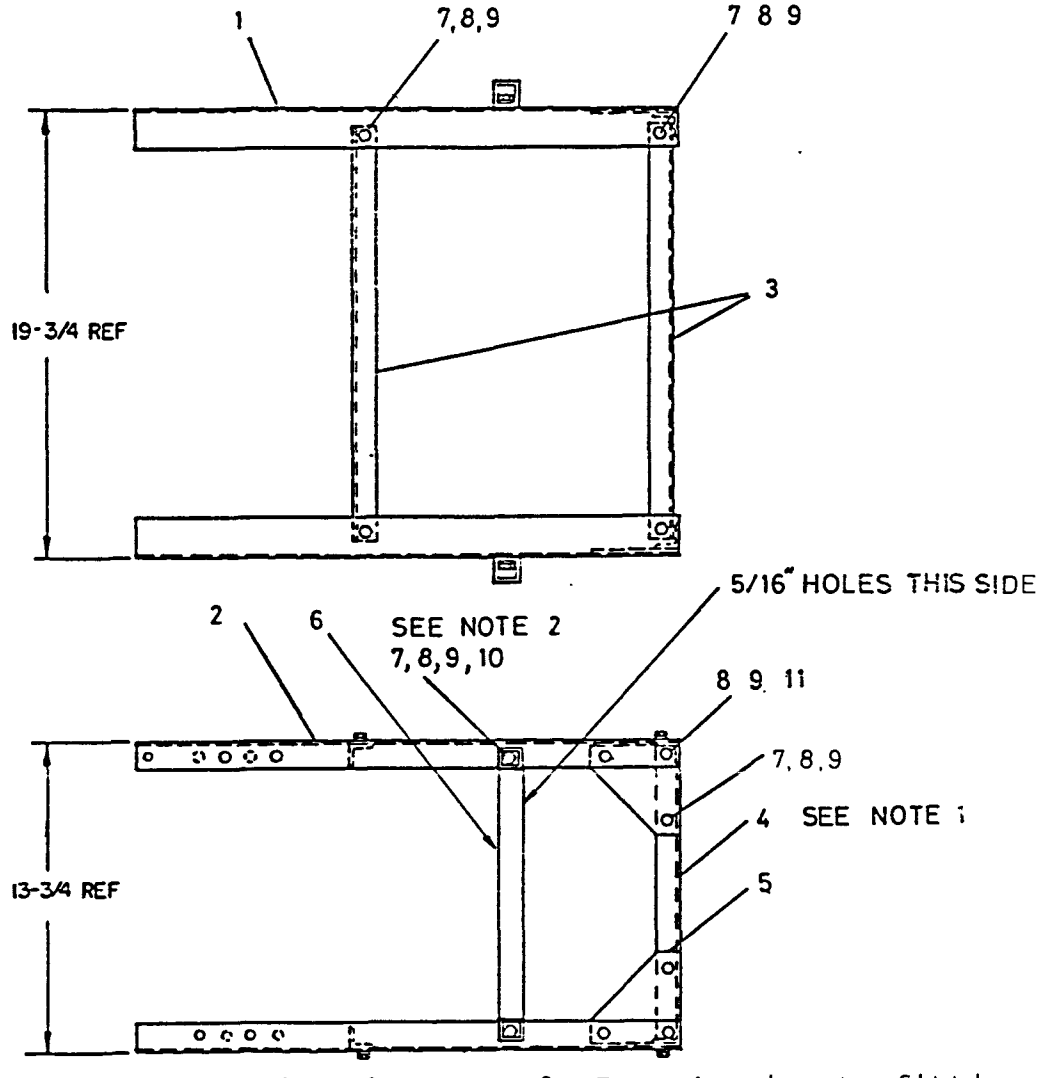


Fig.17 Torque tube top section installation

TABLE 18 ITEMS LIST FOR FIG.18

Item	Ref./Part No.	Description	Qty.
1	0001-3970-001	Leg A, section No.1	2
2	0001-3971-001	Leg B, section No.1	2
3	0001-3969-001	Brace, horizontal No.2	4
4	0001-3968-001	Brace, vertical No.2	2
5	0001-3991-001	Gusset	4
6	0001-6158-001	Tube, element mount	2
7	2009-8856-001	Screw, hex hd, $^1/_4$-20x$^5/_8$, SST	20
8	5310-99-111-1293	Washer, lock, $^1/_4$, SST	24
9	5310-99-944-2936	Nut, hex,$^1/_4$-20, SST	24
10	2310-0433-001	Washer, plain, $^1/_4$, SST	4
11	5305-99-945-9487	Screw, hex hd, $^1/_4$-20x$^3/_4$, SST	4



NOTES:
1. Fit vertical brace No.2, Item 4 prior to fitting horizontal brace No.2, Item 3
2. Fit washers, Item 10 under head of screw, Item 7 in 4 places.

Fig.18 Boom section No.1

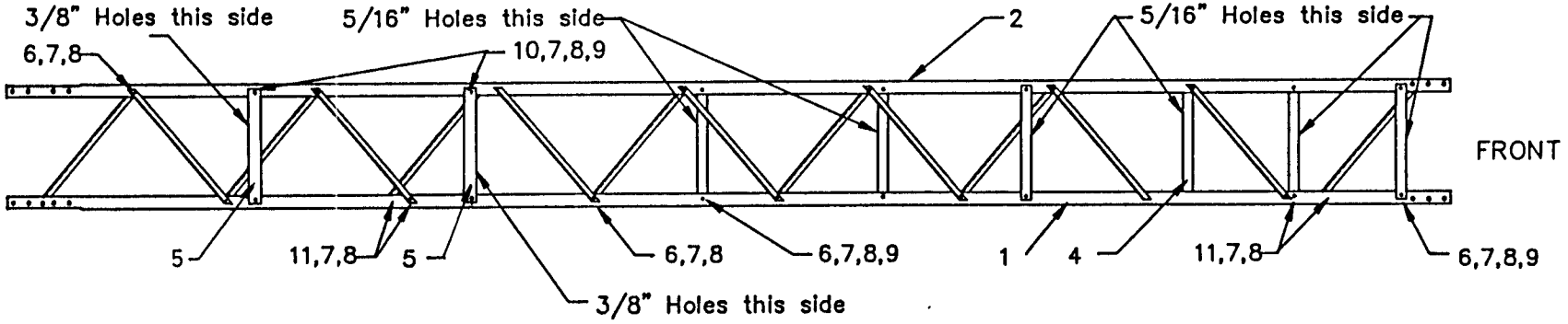


Fig.19 Boom half-section No.2

TABLE 19 ITEMS LIST FOR FIG.19

Item	Ref./Part No.	Description	Qty.
1	0001-3986-001	Leg A, section No.2	1
2	0001-4147-001	Leg B, section No.2	1
3	0001-3972-001	Brace, vertical No.1	14
4	0001-6158-001	Tube, element mount No.1-7	6
5	0001-6159-001	Tube, element mount No.8-10	2
6	5305-99-945-9487	Screw, hex hd, $^1/_4$-20x$^3/_4$, SST	21
7	5310-99-111-1293	Washer, lock, $^1/_4$, SST	33
8	5310-99-944-2936	Nut, hex, $^1/_4$-20, SST	33
9	2310-0433-001	Washer, plain, $^1/_4$, SST	16
10	5305-99-957-0038	Screw, hex hd, $^1/_4$-20x$^7/_8$, SST	4
11	5305-99-947-3794	Screw, hex hd, $^1/_4$-20x$^1/_2$, SST	8

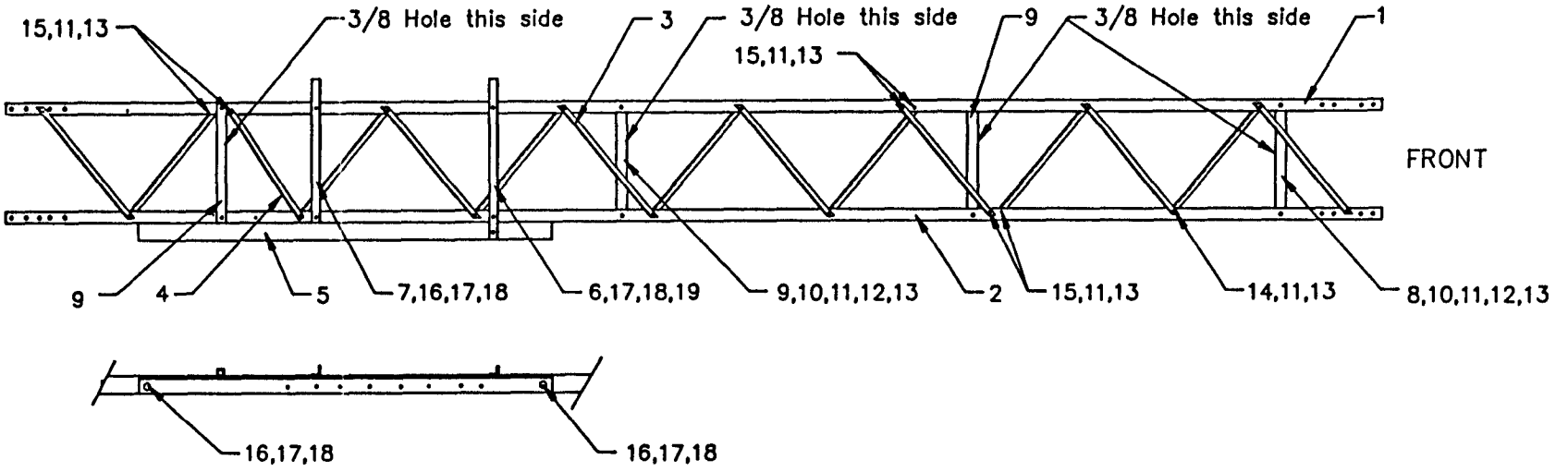


Fig.20 Boom half-section No.3A

TABLE 20 ITEMS LIST FOR FIG.20

Item	Ref./Part No.	Description	Qty.
1	0001-3987-001	Leg A, section No.3	1
2	0001-4078-001	Leg C, section No.3	1
3	0001-3990-001	Brace, vertical No.3	14
4	0001-4075-001	Brace, vertical No.4	1
5	0001-4090-001	Brace, mast to boom No.1	1
6	0001-4082-001	Brace, vertical centroid No.2	1
7	0001-4081-001	Brace, vertical centroid No.1	1
8	0001-6159-001	Tube, element mount No.8-10	1
9	0001-6160-001	Tube, element mount No.11-13	3
10	5305-99-134-0505	Screw, hex hd, $^{1}/_{4}$-20x1, SST	8
11	5310-99-111-1293	Washer, lock, $^{1}/_{4}$, SST	25
12	2310-0433-001	Washer, plain, $^{1}/_{4}$, SST	8
13	5310-99-944-2936	Nut, hex, $^{1}/_{4}$-20, SST	25
14	5305-99-957-0038	Screw, hex hd, $^{1}/_{4}$-20x$^{7}/_{8}$, SST	11
15	5305-99-945-9487	Screw, hex hd, $^{1}/_{4}$-20x$^{3}/_{4}$, SST	6
16	5305-99-946-9818	Screw, hex hd, $^{5}/_{16}$-18x1, SST	8
17	5310-99-120-9059	Washer, lock, $^{5}/_{16}$, SST	8
18	5310-99-139-0551	Nut, hex, $^{5}/_{16}$-18, SST	8

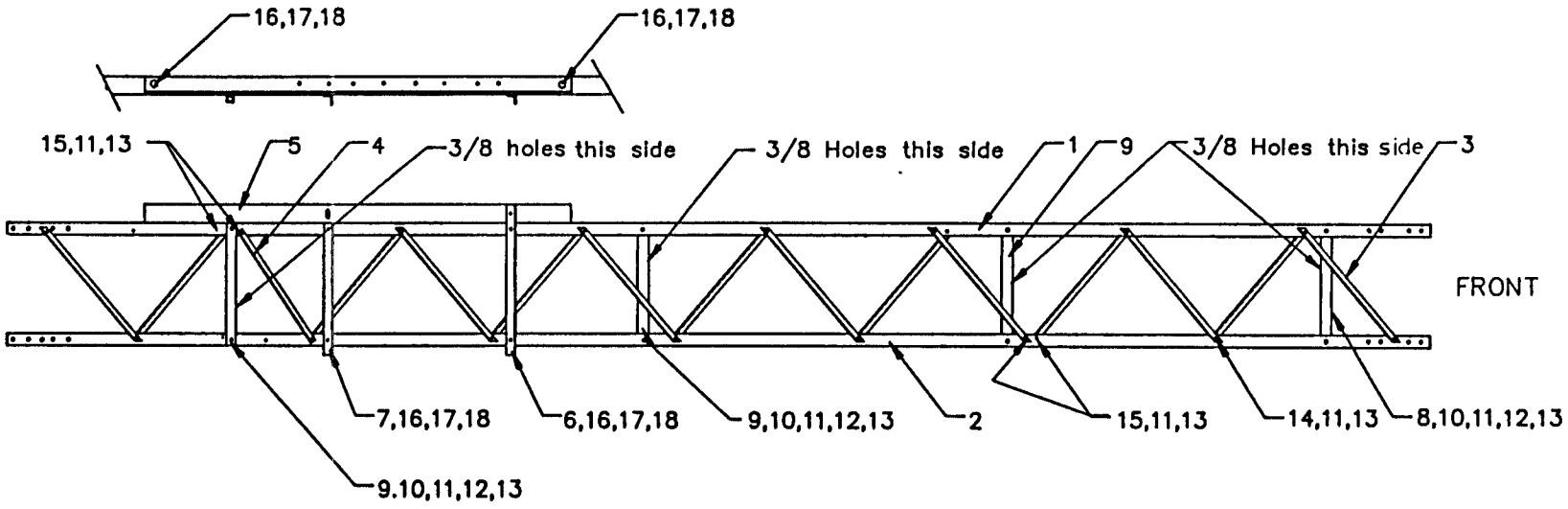


Fig.21 Boom half-section No.3B

TABLE 21 ITEMS LIST FOR FIG.21

Item	Ref./Part No.	Description	Qty.
1	0001-4079-001	Leg D, section No.3	1
2	0001-4076-001	Leg B, section No.3	1
3	0001-3990-001	Brace, vertical No.3	14
4	0001-4075-001	Brace, vertical No.4	1
5	0001-4091-001	Brace, mast to boom No.2	1
6	0001-4085-001	Brace, vertical centroid No.3	1
7	0001-4086-001	Brace, vertical centroid No.4	1
8	0001-6159-001	Tube, element mount No.8-10	1
9	0001-6160-001	Tube, element mount No.11-13	3
10	5305-99-134-0505	Screw, hex hd, $^1/_4$-20x1, SST	8
11	5310-99-111-1293	Washer, lock, $^1/_4$, SST	25
12	2310-0433-001	Washer, plain, $^1/_4$, SST	8
13	5310-99-944-2936	Nut, hex, $^1/_4$-20, SST	25
14	5305-99-957-0038	Screw, hex hd, $^1/_4$-20x$^7/_8$, SST	11
15	5305-99-945-9487	Screw, hex hd, $^1/_4$-20x$^3/_4$, SST	6
16	5305-99-946-9818	Screw, hex hd, $^5/_{16}$-18x1, SST	7
17	5310-99-120-9059	Washer, lock, $^5/_{16}$, SST	7
18	5310-99-139-0551	Nut, hex, $^5/_{16}$-18, SST	7

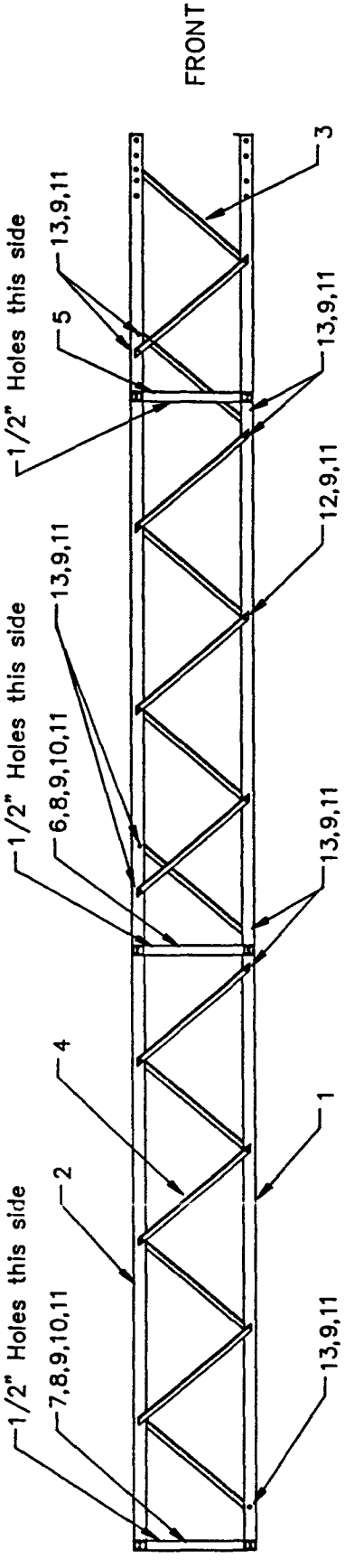


TABLE 22 ITEMS LIST FOR FIG.22

Item	Ref./Part No.	Description	Qty.
1	0001-4073-001	Leg A, section No.4	1
2	0001-4074-001	Leg B, section No.4	1
3	0001-3990-001	Brace, vertical No.3	7
4	0001-3972-001	Brace, vertical No.1	8
5	0001-6161-001	Tube, element mount No.14	1
6	0001-6162-001	Tube, element mount No.15	1
7	0001-6163-001	Tube, element mount No.16	1
8	5305-99-134-0505	Screw, hex hd, $^1/_4$-20x1, SST	12
9	5310-99-111-1293	Washer, lock, $^1/_4$, SST	31
10	0001-6172-001	Plate washer	6
11	5310-99-944-2936	Nut, hex, $^1/_4$-20, SST	31
12	5305-99-957-0038	Screw, hex hd, $^1/_4$-20x$^7/_8$, SST	10
13	5305-99-945-9487	Screw, hex hd, $^1/_4$-20x$^3/_4$, SST	9

Fig.22 Boom half-section No.4

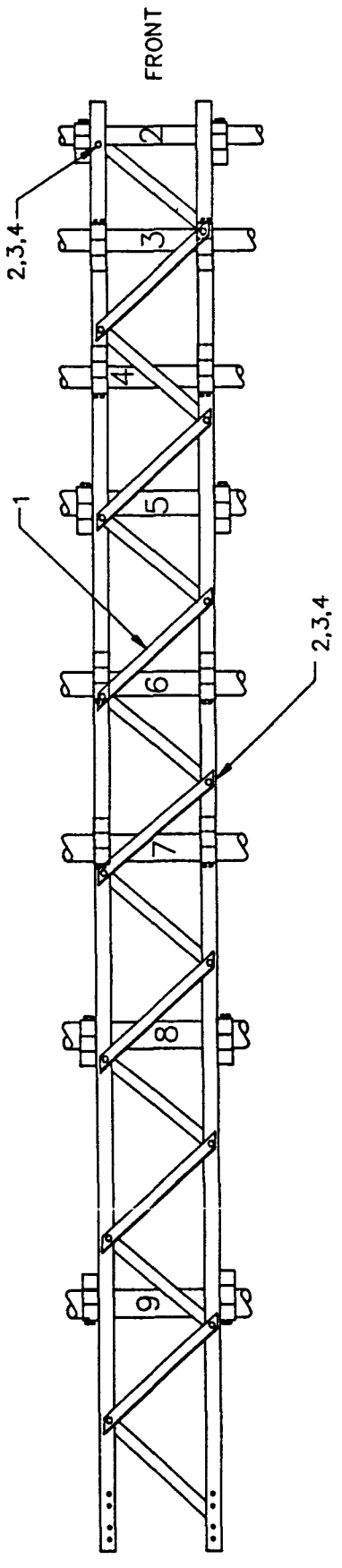


TABLE 23 ITEMS LIST FOR FIG.23

Item	Ref./Part No.	Description	Qty.
1	0001-3974-001	Brace, horizontal No.1	30
2	5305-99-945-9487	Screw, hex hd, $^{1}/_{4}$-20x$^{3}/_{4}$, SST	28
3	5310-99-111-1293	Washer, lock, $^{1}/_{4}$, SST	28
4	5310-99-944-2936	Nut, hex, $^{1}/_{4}$-20, SST	28

Fig.23 Boom section No.2

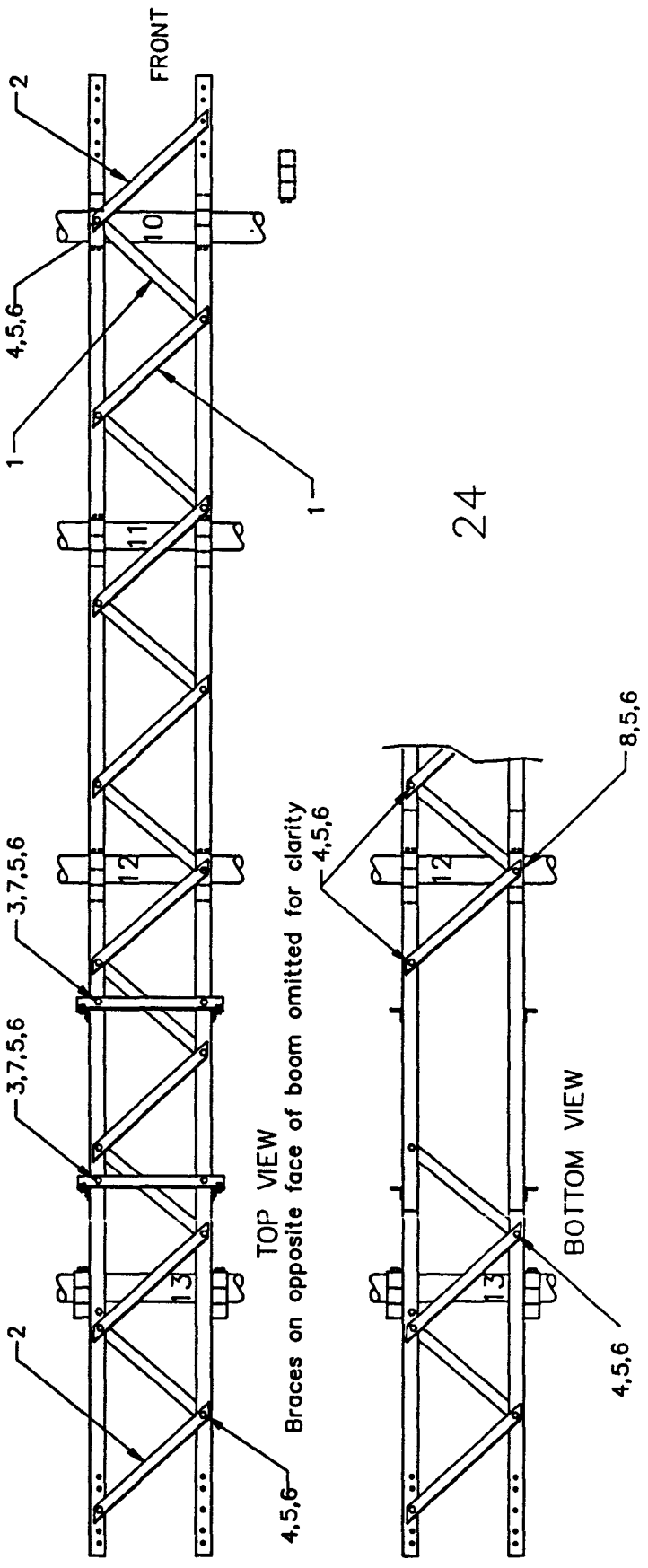


TABLE 24 ITEMS LIST FOR FIG.24

Item	Ref./Part No.	Description	Qty.
1	0001-3988-001	Brace, horizontal No.3	24
2	0002-3998-001	Brace, horizontal No.5	4
3	0001-4156-001	Brace, horizontal centroid	2
4	5305-99-947-3788	Screw, hex hd, $^{5}/_{16}$-18x1$^{1}/_{4}$, SST	26
5	5310-99-120-9059	Washer, lock, $^{5}/_{16}$, SST	35
6	5310-99-139-0551	Nut, hex, $^{5}/_{16}$-18, SST	35
7	5305-99-946-9818	Screw, hex hd, $^{5}/_{16}$-18x1, SST	8
8	2009-9168-001	Screw, hex hd, $^{5}/_{16}$-18x1$^{1}/_{2}$, SST	1

Fig.24 Boom section No.3

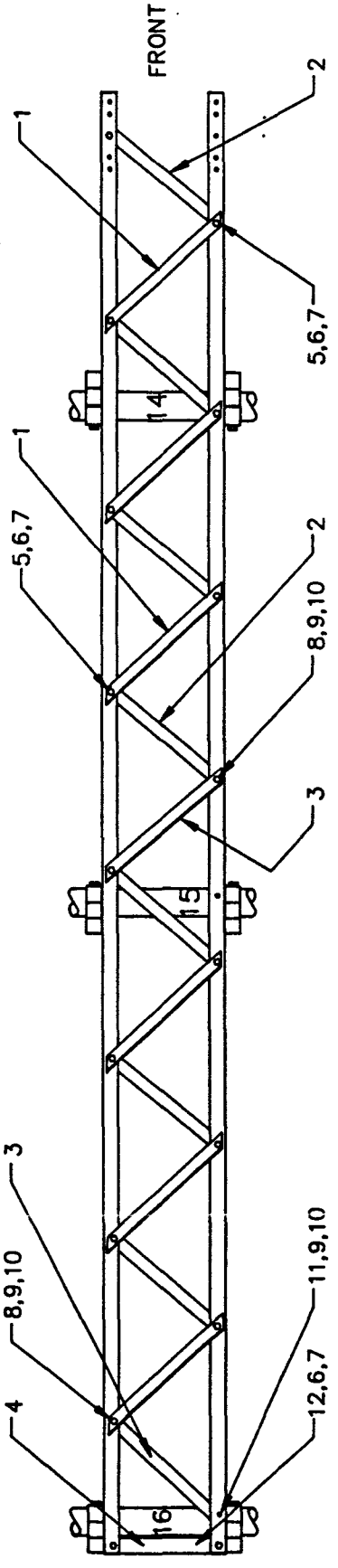


TABLE 25 ITEMS LIST FOR FIG.25

Item	Ref./Part No.	Description	Qty.
1	0001-3988-001	Brace, horizontal No.3	10
2	0001-3998-001	Brace, horizontal No.5	4
3	0001-3974-001	Brace, horizontal No.1	16
4	0001-3989-001	Brace, horizontal No.4	2
5	5305-99-947-3788	Screw, hex hd, $^{5}/_{16}$-18x1$^{1}/_{4}$, SST	12
6	5310-99-120-9059	Washer, lock, $^{5}/_{16}$, SST	16
7	5310-99-139-0551	Nut, hex, $^{5}/_{16}$-18, SST	16
8	5305-99-957-0038	Screw, hex hd, $^{1}/_{4}$-20x$^{7}/_{8}$, SST	16
9	5310-99-111-1293	Washer, lock, $^{1}/_{4}$, SST	18
10	5310-99-944-2936	Nut, hex, $^{1}/_{4}$-20, SST	18
11	5305-99-945-9487	Screw, hex hd, $^{1}/_{4}$-20x$^{3}/_{4}$, SST	2
12	5305-99-946-9818	Screw, hex hd, $^{5}/_{16}$-18x1, SST	4

Fig.25 Boom section No.4

TABLE 26 ITEMS LIST FOR FIG.26

Item	Ref./Part No.	Description	Qty.
1	5305-99-771-4712	Screw, hex hd, $^{3}/_{8}$-16x1$^{1}/_{4}$, galv.	32
2	5985-99-626-9325	Washer, lock,$^{3}/_{8}$, galv.	32
3	5310-99-627-2425	Nut, hex, $^{3}/_{8}$-16, galv.	32
4	5305-99-947-3788	Screw, hex hd, $^{1}/_{4}$-20x1$^{1}/_{4}$, SST	4
5	5310-99-111-1293	Washer, lock, $^{1}/_{4}$, SST	4
6	5310-99-944-2936	Nut, hex, $^{1}/_{4}$-20, SST	4

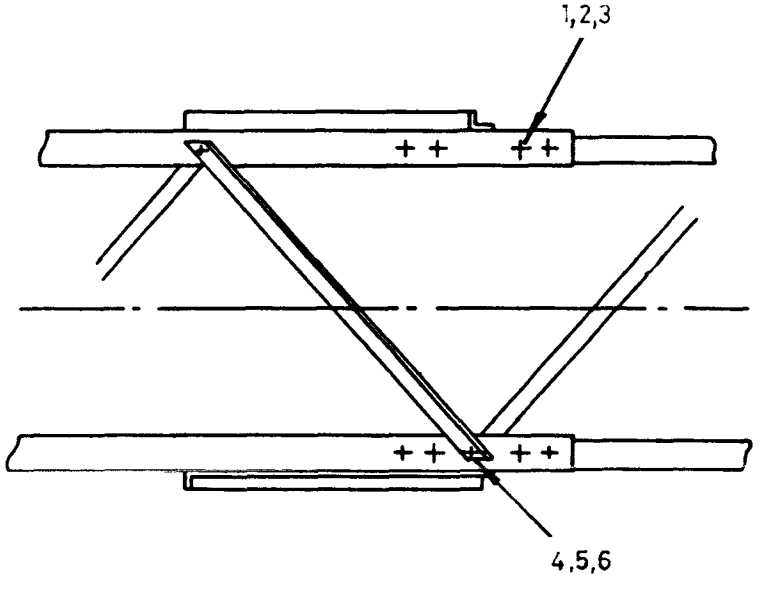


Fig.26 Boom section joint 3-4

TABLE 27 ITEMS LIST FOR FIG.27

Item	Ref./Part No.	Description	Qty.
1	5305-99-771-4711	Screw, hex hd, $^3/_8$-16x1, galv.	32
2	5985-99-626-9325	Washer, lock, $^3/_8$, galv.	32
3	5310-99-627-2425	Nut, hex, $^3/_8$-16, galv.	32
4	5305-99-134-0505	Screw, hex hd, $^1/_4$-20x1, SST	2
5	5310-99-111-1293	Washer, lock, $^1/_4$, SST	4
6	5310-99-944-2936	Nut, hex, $^1/_4$-20, SST	4
7	2009-8865-001	Screw, hex hd, $^1/_4$-20x1$^1/_4$	2

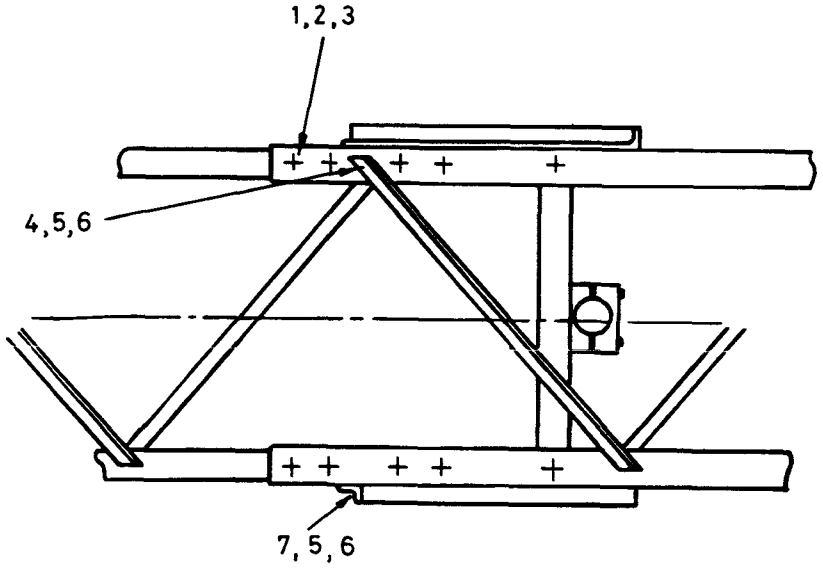


Fig.27 Boom section joint 2-3

TABLE 28 ITEMS LIST FOR FIG.28

Item	Ref./Part No.	Description	Qty.
1	5305-99-771-4710	Screw, hex hd, $^3/_8$-16x$^7/_8$, galv.	8
2	5985-99-626-9325	Washer, lock, $^3/_8$, galv.	8
3	5310-99-627-2425	Nut, hex, $^3/_8$-16, galv.	8
4	5306-99-945-9487	Screw, hex hd, $^1/_4$-20x$^3/_4$, SST	4
5	5310-99-111-1293	Washer, lock, $^1/_4$, SST	4
6	5310-99-944-2936	Nut, hex, $^1/_4$-20, SST	4

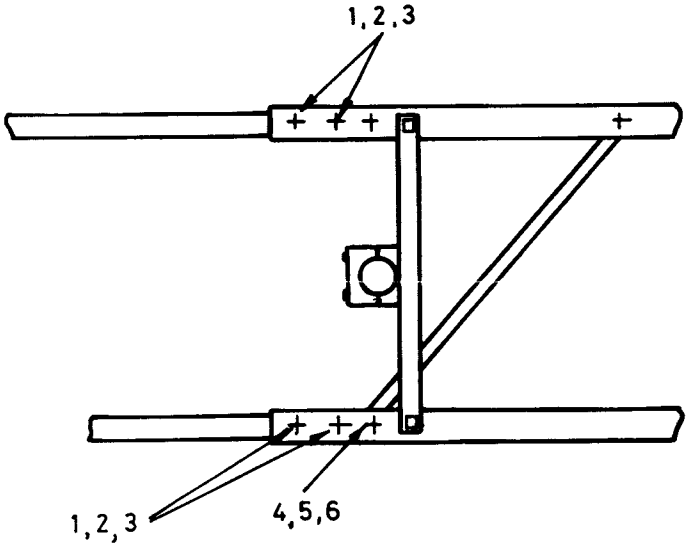


Fig.28 Boom section joint 1-2

TABLE 29 ITEMS LIST FOR FIG.29

Item	Ref./Part No.	Description	Qty.
1	0001-4193-001	Windsail, assembly	1
2	0001-4190-001	Brace	2
3	5306-99-627-3604	Screw, hex hd, $^{5}/_{16}$-18x$^{7}/_{8}$, SST	2
4	5310-99-120-9059	Washer, lock, $^{5}/_{16}$, SST	2
5	5310-99-139-0551	Nut, hex, $^{5}/_{16}$-18, SST	2

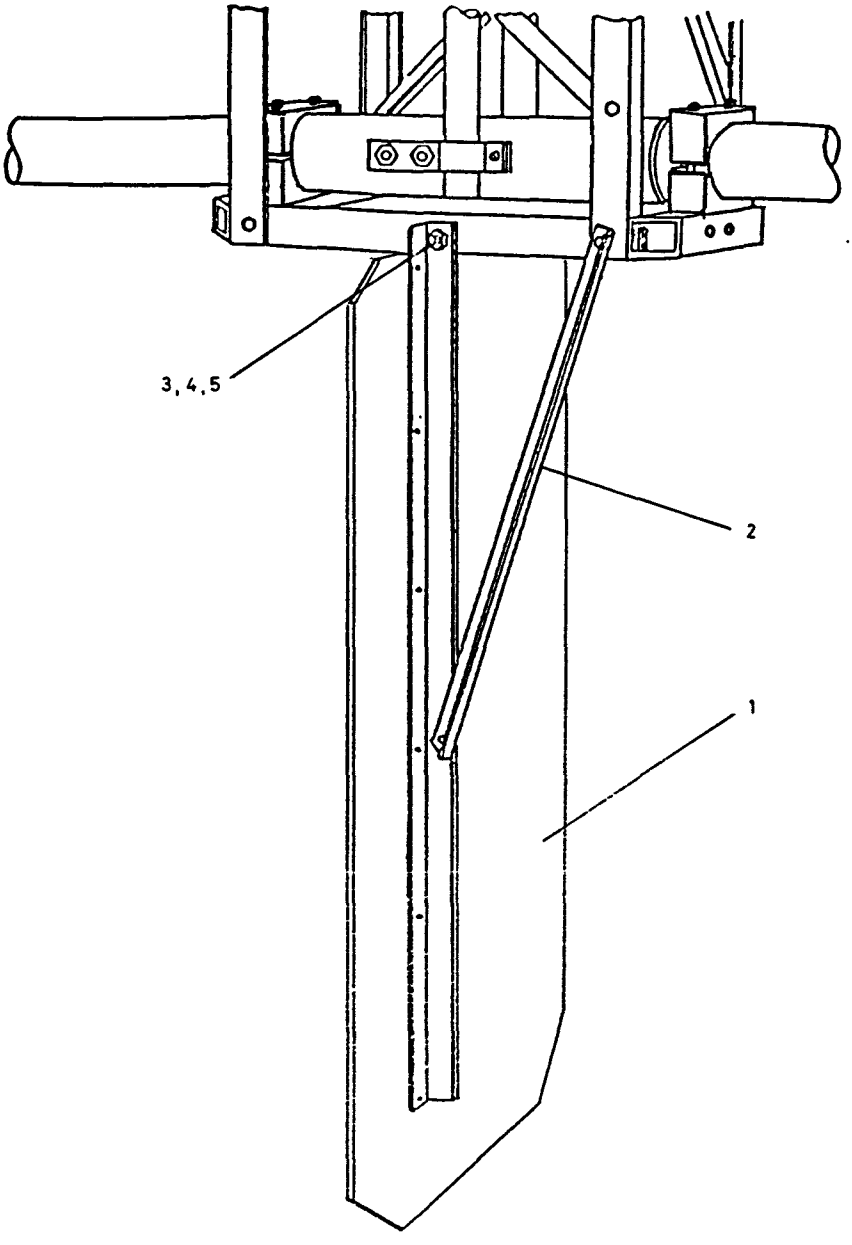
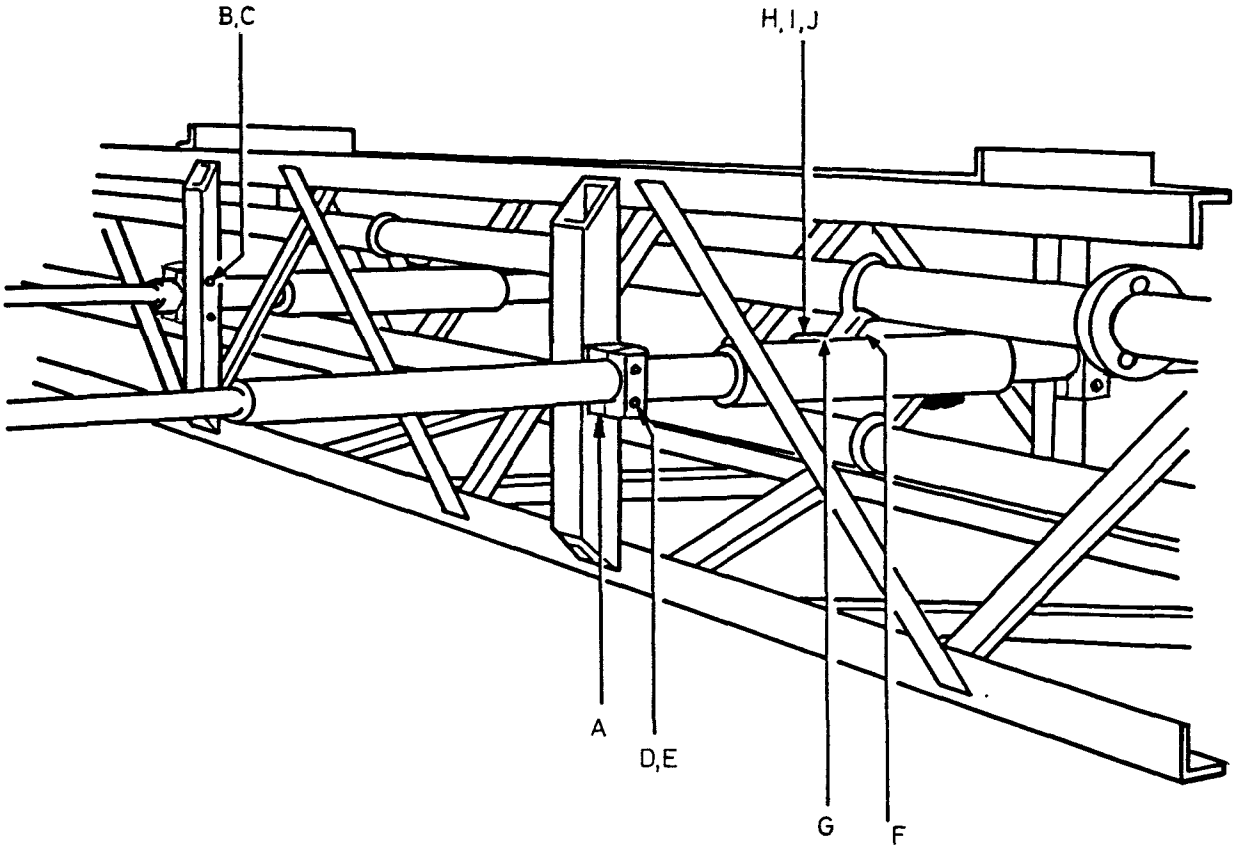


Fig.29 Windsail assembly



ITEM	PART NAME	ELEMENT 1–7	ELEMENT 8–10	ELEMENT 11–13
A	SADDLE, CASTING	1	2	3
B	PLATE, REINFORCING	13	14	15
C	BOLT	7	8	9
D	WASHER, LOCK	19	20	20
E	NUT	22	23	23
F	FEED STRAP	32	33	34
G	SPACER	31	31	31
H	SCREW	25	26	27
I	WASHER,LOCK	19	19	19
J	NUT	22	22	22

ITEM	PART NAME	ELEMENT 14	ELEMENT 15	ELEMENT 16
A	SADDLE,CASTING	4	5	6
B	PLATE,REINFORCING	16	17	18
C	STUD	10	11	12
D	WASHER,LOCK	21	21	21
E	NUT	24	24	24
F	FEED STRAP	35	36	36
G	SPACER	31	31	31
H	SCREW/THRD ROD	28	29	30
I	WASHER,LOCK	19	19	19
J	NUT	22	22	22

Fig.30 Typical element installation

TABLE 30 ITEMS LIST FOR FIG.30

Item	Ref./Part No.	Description	Qty.
1	5985-01-156-6892	Saddle casting 1-7	28
2	5985-01-156-6893	Saddle casting 8-10	12
3	5985-01-156-6894	Saddle casting 11-13	12
4	5985-01-156-6895	Saddle casting 14	4
5	5985-01-156-6896	Saddle casting 15	4
6	5985-01-156-6897	Saddle casting 16	4
7	5306-99-627-3608	Bolt, hex hd, $^{1}/_{4}$-20x2$^{1}/_{4}$, SST	28
8	5306-99-978-0638	Bolt, hex, $^{5}/_{16}$-18x3$^{1}/_{2}$, SST	12
9	5306-99-764-8690	Bolt, hex, $^{5}/_{16}$-18x4$^{1}/_{2}$, SST	12
10	0002-4144-201	Stud, $^{7}/_{16}$-14x6, SST	4
11	0002-4144-203	Stud, $^{7}/_{16}$-14x7, SST	4
12	0002-4144-204	Stud, $^{7}/_{16}$-14x7$^{1}/_{2}$, SST	4
13	0001-6165-001	Plate, reinforcing 1-7	14
14	0001-6166-001	Plate, reinforcing 8-10	6
15	0001-6167-001	Plate, reinforcing 11-13	6
16	0001-6168-001	Plate, reinforcing 14	2
17	0001-6169-001	Plate, reinforcing 15	2
18	0001-6170-001	Plate, reinforcing 16	2
19	5310-99-111-1293	Washer, lock, $^{1}/_{4}$, SST	88
20	5310-99-120-9059	Washer, lock, $^{5}/_{16}$, SST	24
21	5310-99-137-7202	Washer, lock, $^{7}/_{16}$, SST	24
22	5310-99-944-2936	Nut, hex, $^{1}/_{4}$-20, SST	88
23	5310-99-139-0551	Nut, hex, $^{5}/_{16}$-18, SST	24
24	5310-99-134-3782	Nut, hex, $^{7}/_{16}$-14, SST	24
25	5305-99-627-2459	Screw, rd hd, $^{1}/_{4}$-20x2	28
26	5305-99-627-3593	Screw, rd hd, $^{1}/_{4}$-20x2$^{1}/_{2}$	12
27	5305-99-978-1956	Screw, rd hd, $^{1}/_{4}$-20x3	12
28	5305-99-627-3595	Screw, rd hd, $^{1}/_{4}$-20x3$^{1}/_{2}$	4
29	5305-99-627-3596	Screw, rd hd, $^{1}/_{4}$-20x4	4
30	0002-4295-001	Threaded rod w.welded nut $^{1}/_{4}$-20x4$^{1}/_{2}$, SST	4
31	5985-99-627-3589	Spacer	64
32	5985-99-774-5506	Feed Strap 1-7	14
33	5985-99-774-5505	Feed Strap 8-10	6
34	5985-99-774-5502	Feed strap 11-13	6
35	5985-99-774-5503	Feed Strap 14	2
36	5985-99-774-5504	Feed Strap 15-16	4

TABLE 31 ITEMS LIST FOR FIG.31

Item	Ref./Part No.	Description	Qty.
1	5985-00-909-5962	Adaptor, transmission line	1
2	5985-00-050-4921	Transmission line 20ft	1
3	5985-00-909-3849	Elbow, transmission line	1
4	5984-00-909-3872	Elbow, transformer line	1
5	5985-00-043-1352	Transformer assy. No.3	1
6	5985-00-050-4661	Transformer assy. No.2	1
7	5985-00-043-1351	Transformer assy.No.1	1
8	5985-00-909-4265	Dummy line, short	1
9	5985-00-904-2731	Dummy line, 20ft.	3
10	5985-00-909-3852	Dummy line, termination	1
11	5985-99-627-2055	Connector kit, transmission line	3
12	0001-4106-001	Connector kit, transmission line	1
13	0001-4105-001	Connector kit, transmission line	1
14	0001-4104-001	Connector kit, transmission line	1
15	5306-99-947-3788	Bolt, hex hd, $^{5}/_{16}$-18x1$^{1}/_{4}$, SST	16
16	5310-99-120-9059	Washer, lock, $^{5}/_{16}$, SST	16
17	5310-99-139-0551	Nut, hex, $^{5}/_{16}$-18, SST	16

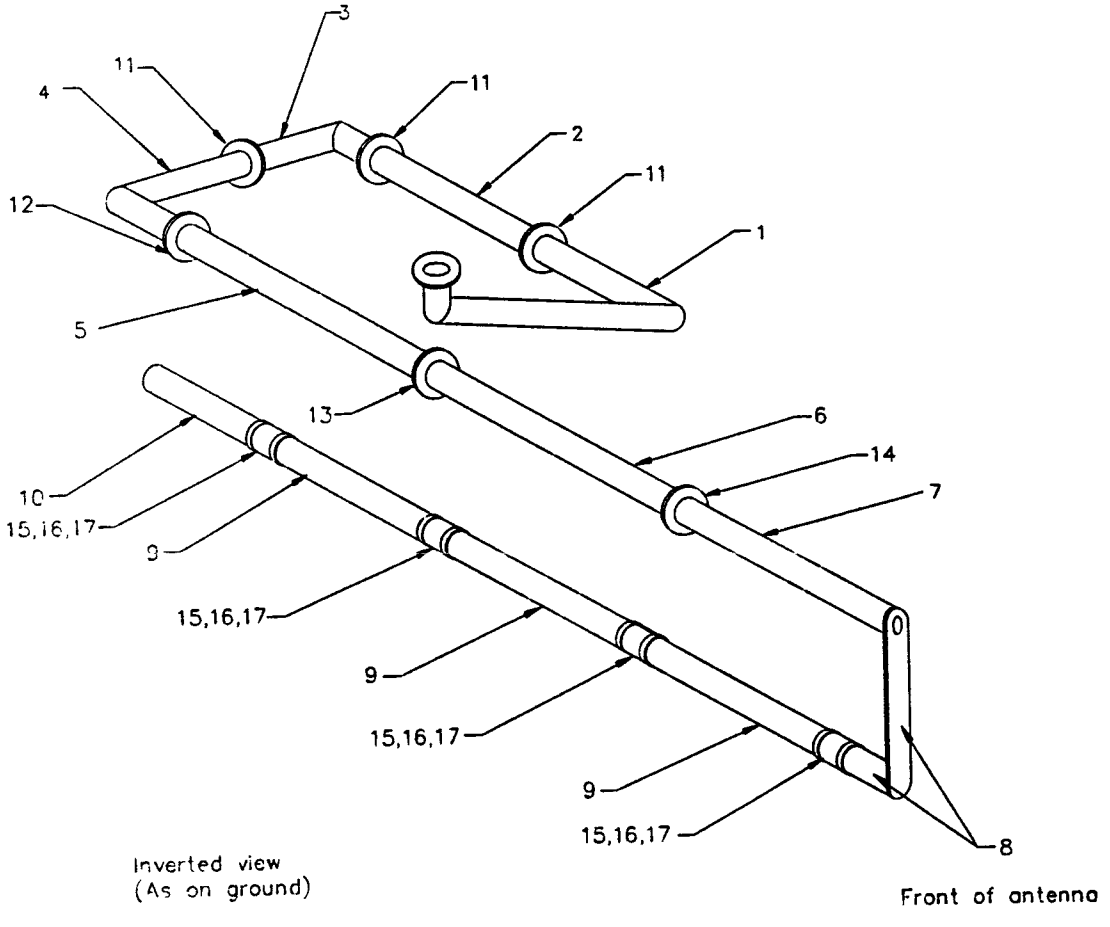


Fig.31 Transmission line assembly

TABLE 32 ITEMS LIST FOR FIG.32

Item	Ref./Part No.	Description	Qty.
1	5306-99-627-3607	Bolt, hex hd, $^5/_8$-11x22, galv.	1
2	5310-99-627-2424	Nut, hex, $^5/_8$-11, galv.	1
3	5985-00-909-5962	Adaptor, transmission line	1

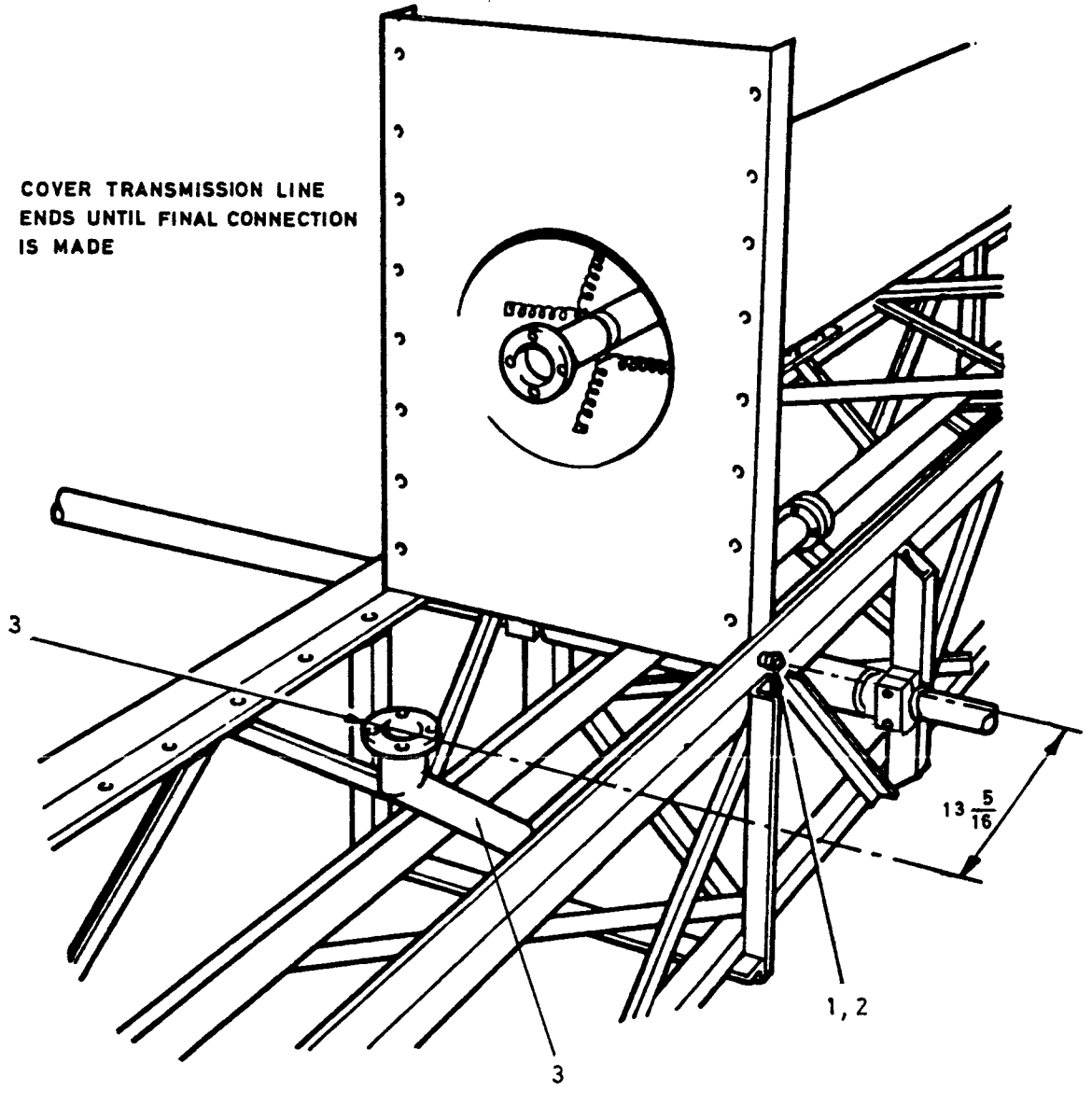


Fig.32 Torque tube to boom installation

TABLE 33 ITEMS LIST FOR FIG.33

Item	Ref./Part No.	Description	Qty.
2	5985-00-050-4921	Transmission line 20ft	1
3	5985-00-909-3849	Elbow, transmission line	1
4	5984-00-909-3872	Elbow, transformer line	1
5	5985-99-627-2524	Spacer, transmission line	5
6	4730-99-627-3619	Clamp, hose	5
7	0001-4292-001	Damper kit, vibration	4
8	5950-00-909-3864	Shorting coil	1

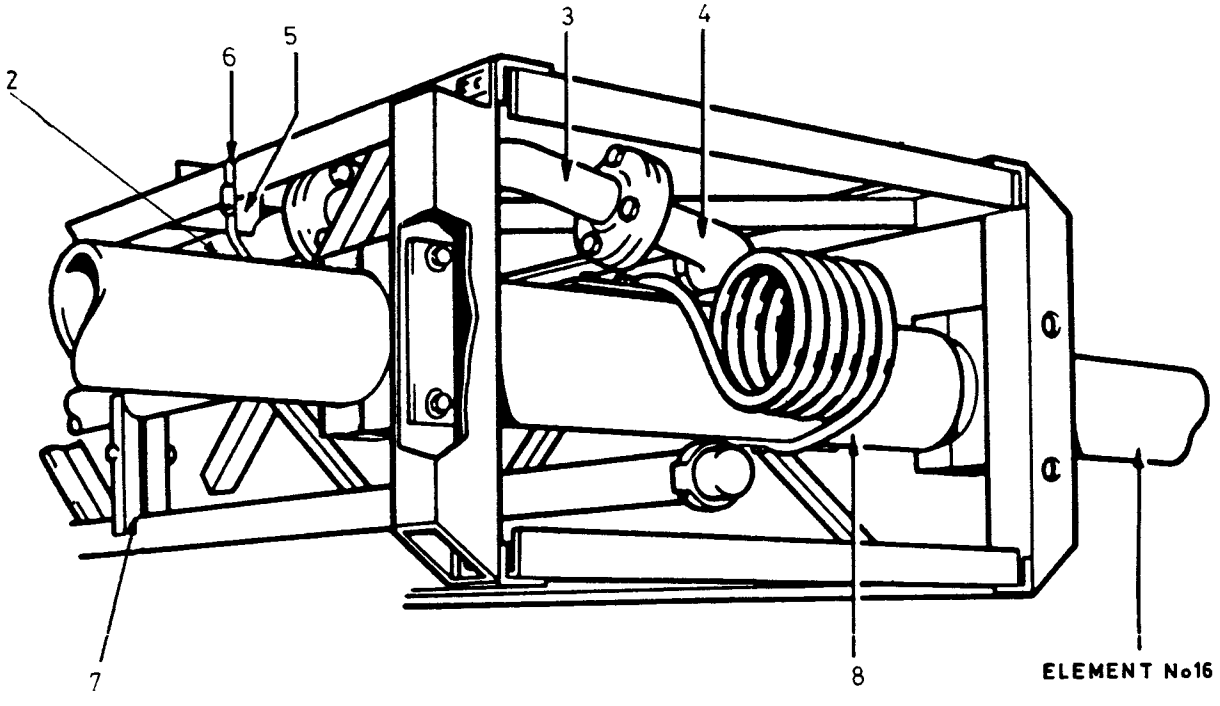


Fig.33 Rear boom installation

TABLE 34 ITEMS LIST FOR FIG.34

Item	Ref./Part No.	Description	Qty.
1	5985-00-043-1351	Transformer assy.	1
2	5985-00-909-4265	Dummy line, short	1
3	5985-00-904-2731	Dummy line, 20ft.	1

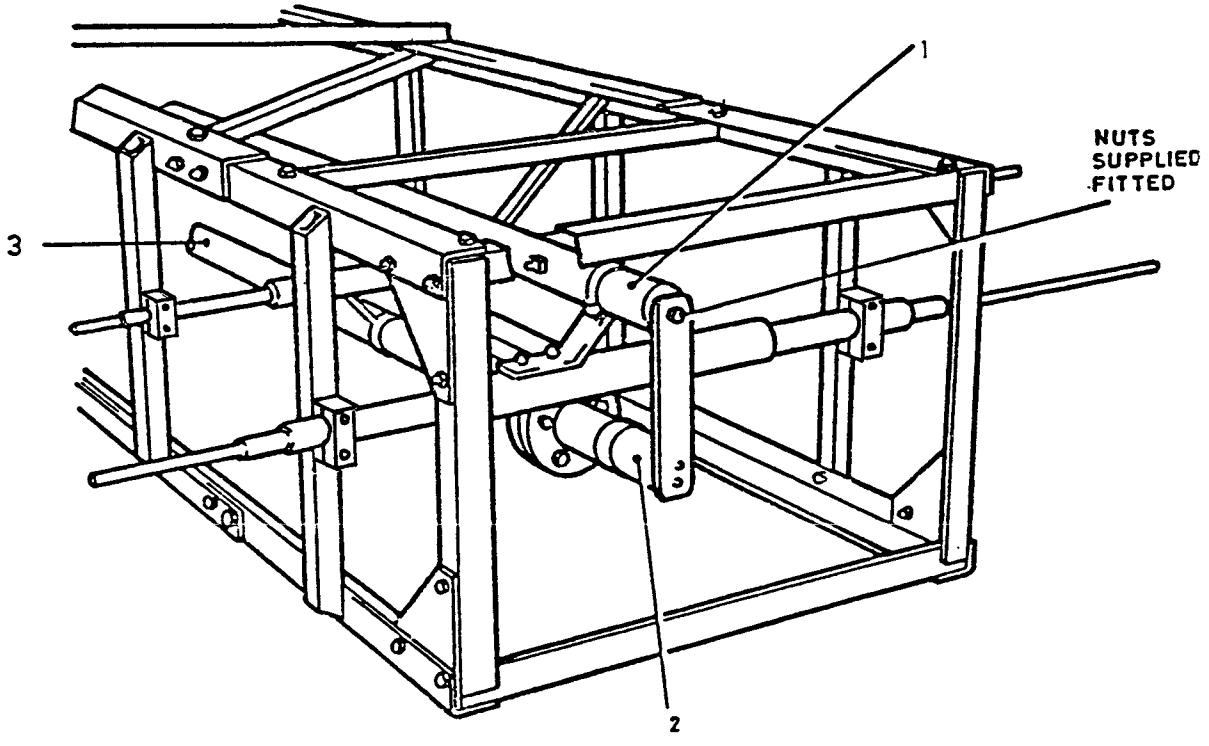


Fig.34 Front boom installation

TABLE 35 ITEMS LIST FOR FIG.35

Item	Ref./Part No.	Description	Qty.
1	5985-00-909-4265	Dummy line, short	1
2	5985-00-904-2731	Dummy line, 20ft	3
3	5985-00-909-3852	Dummy line, termination	1
4	5306-99-947-3788	Bolt, hex hd, $^{5}/_{16}$-18x1$^{1}/_{4}$, SST	16
5	5310-99-120-9059	Washer, lock, $^{5}/_{16}$, SST	16
6	5310-99-139-0551	Nut, hex, $^{5}/_{16}$-18, SST	16

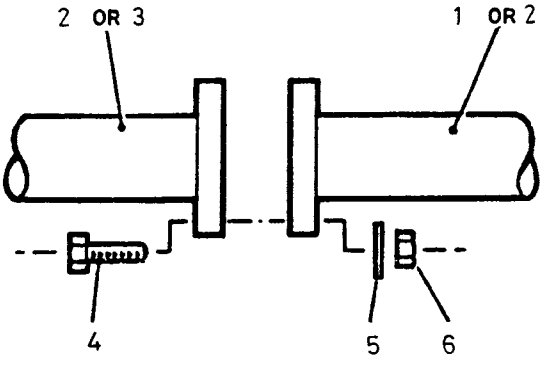
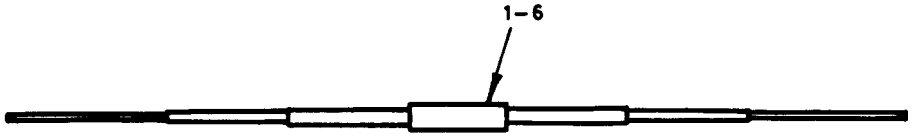
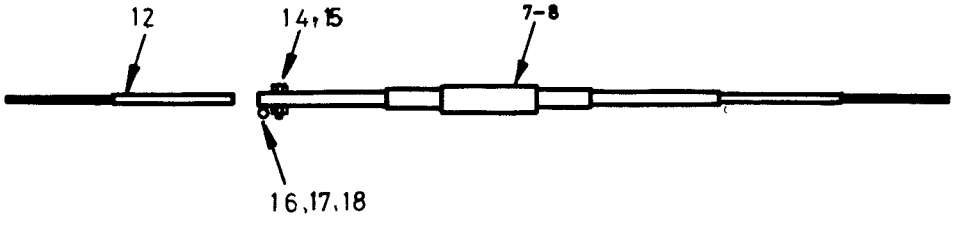


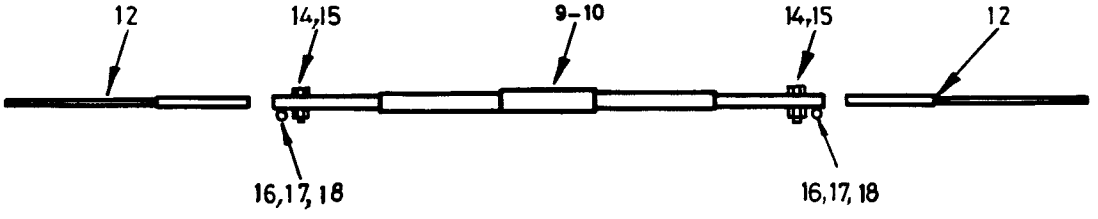
Fig.35 Dummy line joint



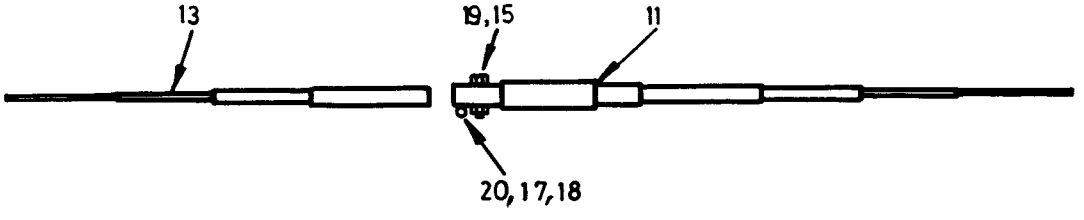
ELEMENTS 1-6 ARE PRE-ASSEMBLED



ELEMENT 7-8



ELEMENT 9-10



ELEMENT 11

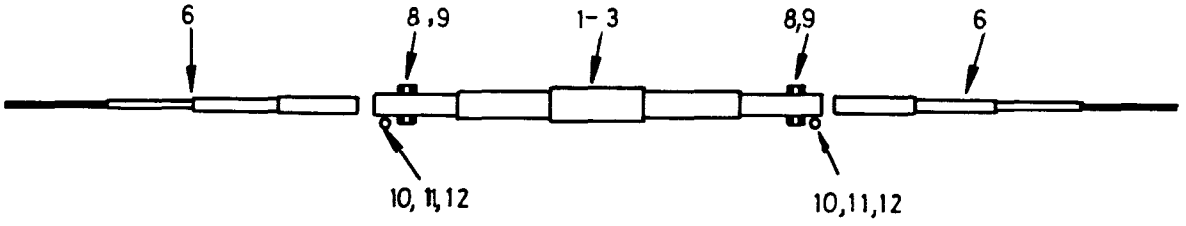
Fig.36 Element assemblies 1-11

TABLE 36 ITEMS LIST FOR FIG.36

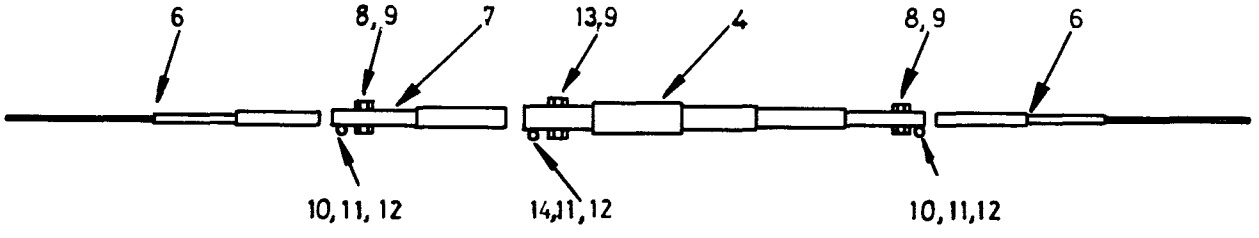
Item	Ref./Part No.	Description	Qty.
1	5985-00-910-6109	Element assy. No.1	1
2	5985-00-909-4256	Element assy. No.2	1
3	5985-00-909-3859	Element assy. No.3	1
4	5985-00-909-3855	Element assy. No.4	1
5	5985-00-909-4257	Element assy. No.5	1
6	5985-00-909-3843	Element assy. No.6	1
7	5985-00-909-4259	Element centre No.7	1
8	5985-00-909-3856	Element centre No.8	1
9	5985-00-909-3858	Element centre No.9	1
10	5985-00-909-4258	Element centre No.10	1
11	5985-00-909-3845	Element centre No.11	1
12	5985-00-909-4263	Element, short	6
13	5985-00-909-3853	Element, long No.11	1
14	5306-99-947-3798	Bolt, hex hd, $^{1}/_{4}$-20x1$^{1}/_{2}$, SST	3
15	5310-99-944-2457	Nut, hex, lock, $^{1}/_{4}$-20, SST	4
16	5306-99-791-3150	Bolt, hex hd, $^{3}/_{8}$-16x1$^{3}/_{4}$, SST	3
17	5310-99-450-6703	Washer, lock, $^{3}/_{8}$, SST	4
18	5310-99-944-2935	Nut, hex, $^{3}/_{8}$-16, SST	4
19	5305-99-627-3608	Bolt, hex hd, $^{1}/_{4}$-20x2$^{1}/_{4}$, SST	1
20	5306-99-772-5162	Bolt, hex hd,$^{3}/_{8}$-16x2$^{1}/_{4}$, SST	1

TABLE 37 ITEMS LIST FOR FIG.37

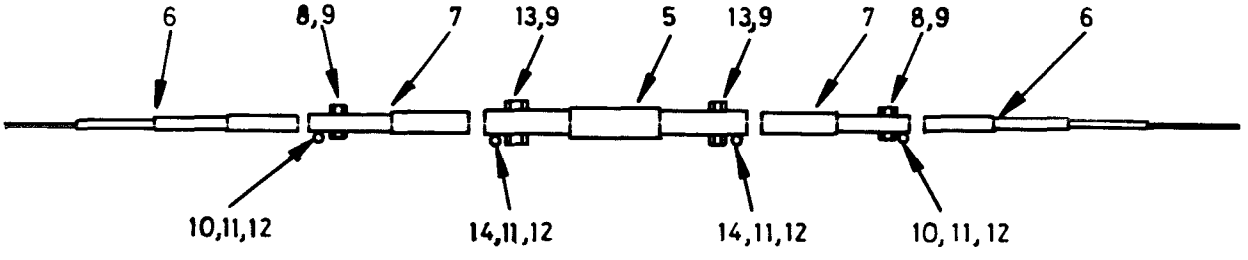
Item	Ref./Part No.	Description	Qty.
1	5985-00-909-4260	Element centre No.12	1
2	5985-00-909-3854	Element centre No.13	1
3	5985-00-909-3860	Element centre No.14	1
4	5985-00-909-4261	Element centre No.15	1
5	5985-00-909-3844	Element centre No.16	1
6	5985-00-909-4262	Element long, end	10
7	5985-00-909-3857	Element inner	3
8	5305-99-627-3593	Bolt, hex hd, $^{1}/_{4}$-20x2$^{1}/_{2}$, SST	6
9	5310-99-944-2457	Nut, hex, lock, $^{1}/_{4}$-20, SST	9
10	5306-99-772-5162	Bolt, hex hd,$^{3}/_{8}$-16x2$^{1}/_{4}$, SST	6
11	5310-99-450-6703	Washer, lock,$^{3}/_{8}$, SST	9
12	5310-99-944-2935	Nut, hex, $^{3}/_{8}$-16, SST	9
13	5306-99-627-2438	Bolt, hex hd, $^{1}/_{4}$-20x3$^{1}/_{2}$, SST	3
14	5306-99-124-7261	Bolt, hex hd,$^{3}/_{8}$-16x3, SST	3



ELEMENT 12-14



ELEMENT 15



ELEMENT 16

Fig.37 Element assemblies 12-16

TABLE 38 ITEMS LIST FOR FIG.38

Item	Ref./Part No.	Description	Qty.
1	4010-99-638-9347	Guy	1
2	4010-99-202-9038	Rope, 100ft for Tirfor T13	2
3	4030-99-724-6868	Shackle, small Dee, $^{3}/_{4}$in. dia. pin, SWL $1^{3}/_{4}$t	4
4	3950-99-204-6346	Tirfor winch type T13	2
5	4010-99-638-8410	Chain, long link, $^{5}/_{8}$ in.dia.6ft.long	2

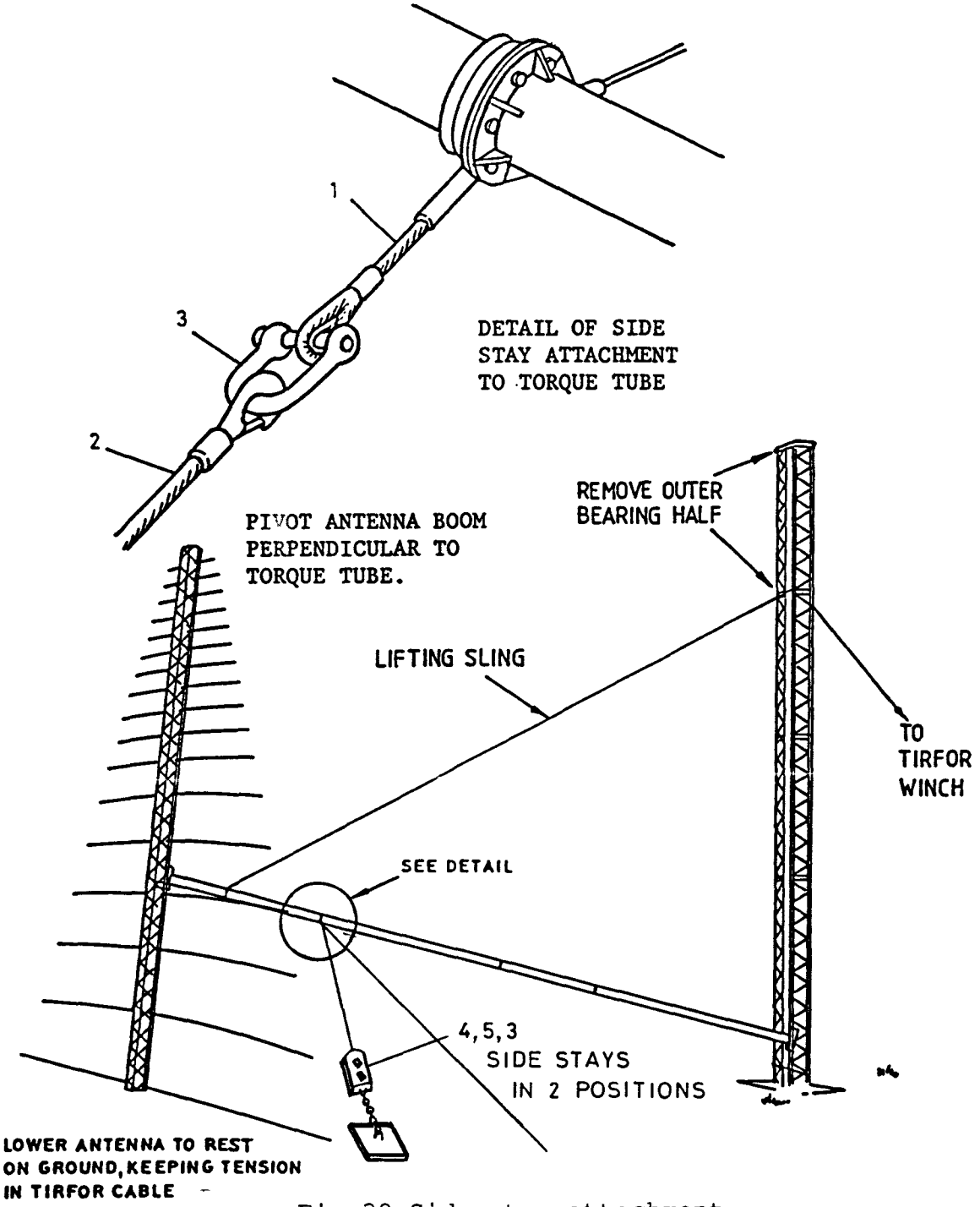


Fig.38 Side stay attachment

TABLE 39 ITEMS LIST FOR FIG.39

Item	Ref./Part No.	Description	Qty.
6	5985-99-797-5555	Guy	1
7	4030-99-561-2787	Shackle, large Dee, 1 in. dia. pin, SWL 3t	1
8	3940-99-425-3457	Snatch block, 12in. dia. sheave, SWL 5t	1
9	4030-99-638-8199	Shackle, large Dee, $1^1/_4$in. dia.pin, SWL 5t	2
10	4010-99-798-2590	Rope, 70m for Tirfor T35	1
11	5985-99-798-4457	Guy	1
12	4020-99-933-1562	Rope, polyester, 9mm dia. x 6ft	1
13	5985-99-797-5556	Spreader plate	1
14	4L/4013	Tirfor winch type TU32H	1

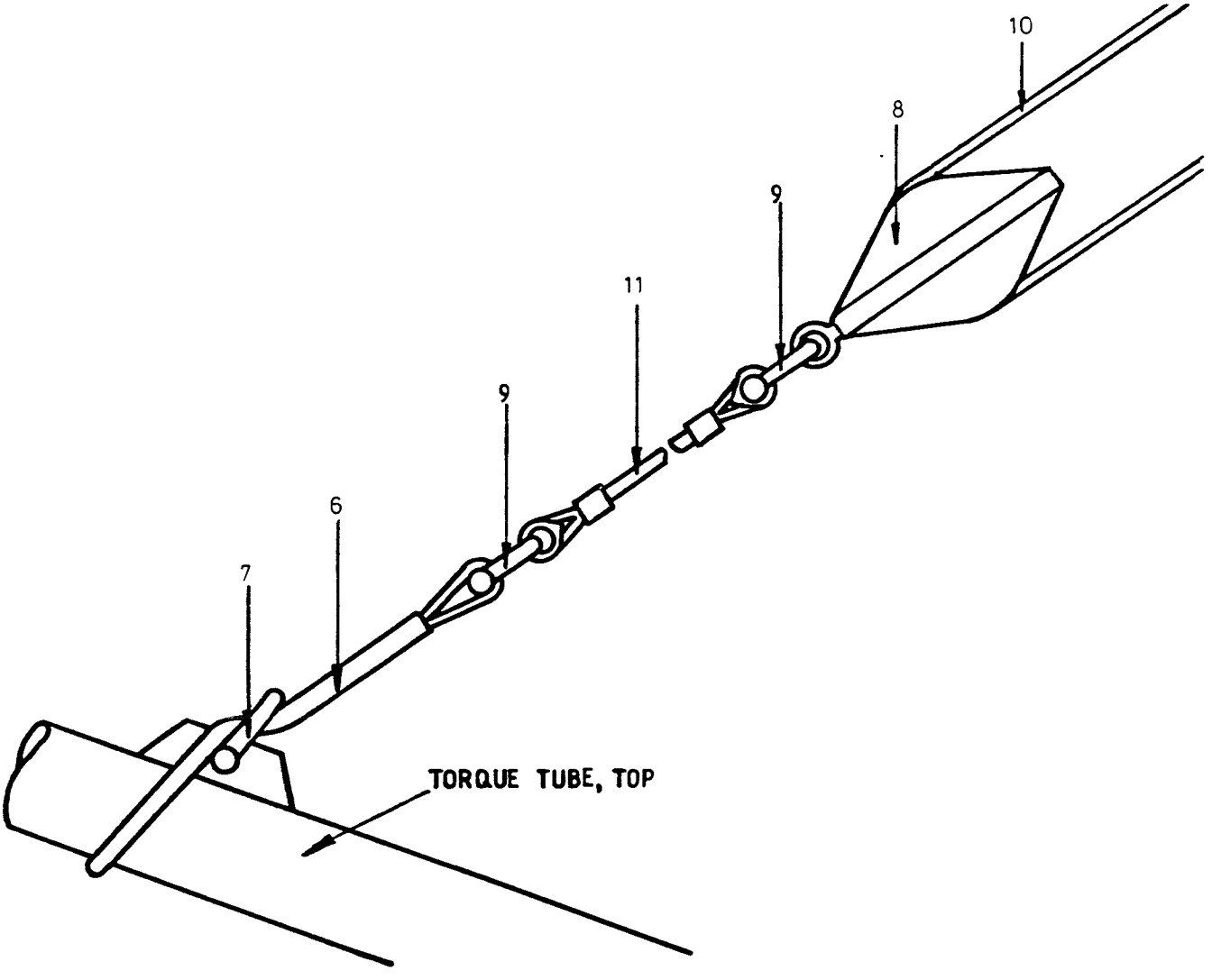


Fig.39 Antenna lifting point

TABLE 40 ITEMS LIST FOR FIG.40

Item	Ref./Part No.	Description	Qty.
1	0002-8852-301	Plate, reinforcing	2
2	5306-99-773-5522	Bolt, hex hd, $^{3}/_{8}$-16x1$^{3}/_{4}$, galv.	12
3	5989-99-626-9325	Washer, lock, $^{3}/_{8}$, galv.	12
4	5310-99-627-2425	Nut, hex, $^{3}/_{8}$-16, galv.	12
5	5985-00-909-5962	Adaptor, transmission line	1
6	5306-99-627-3607	Bolt, hex hd,$^{5}/_{8}$-11x22, galv.	1
7	5310-99-627-2424	Nut, hex, $^{5}/_{8}$-11, galv.	1
8	0001-4006-001	Connector kit comprising:-	1
9	5330-99-627-2182	O ring	1
10	5985-00-909-3868	Connector, transmission line	1
11	5306-99-947-3788	Bolt, hex hd, $^{5}/_{16}$-18x1$^{1}/_{4}$, SST	4
12	5310-99-120-9059	Washer, lock, $^{5}/_{16}$, SST	4
13	5310-99-139-0551	Nut, hex, $^{5}/_{16}$-18, SST	4

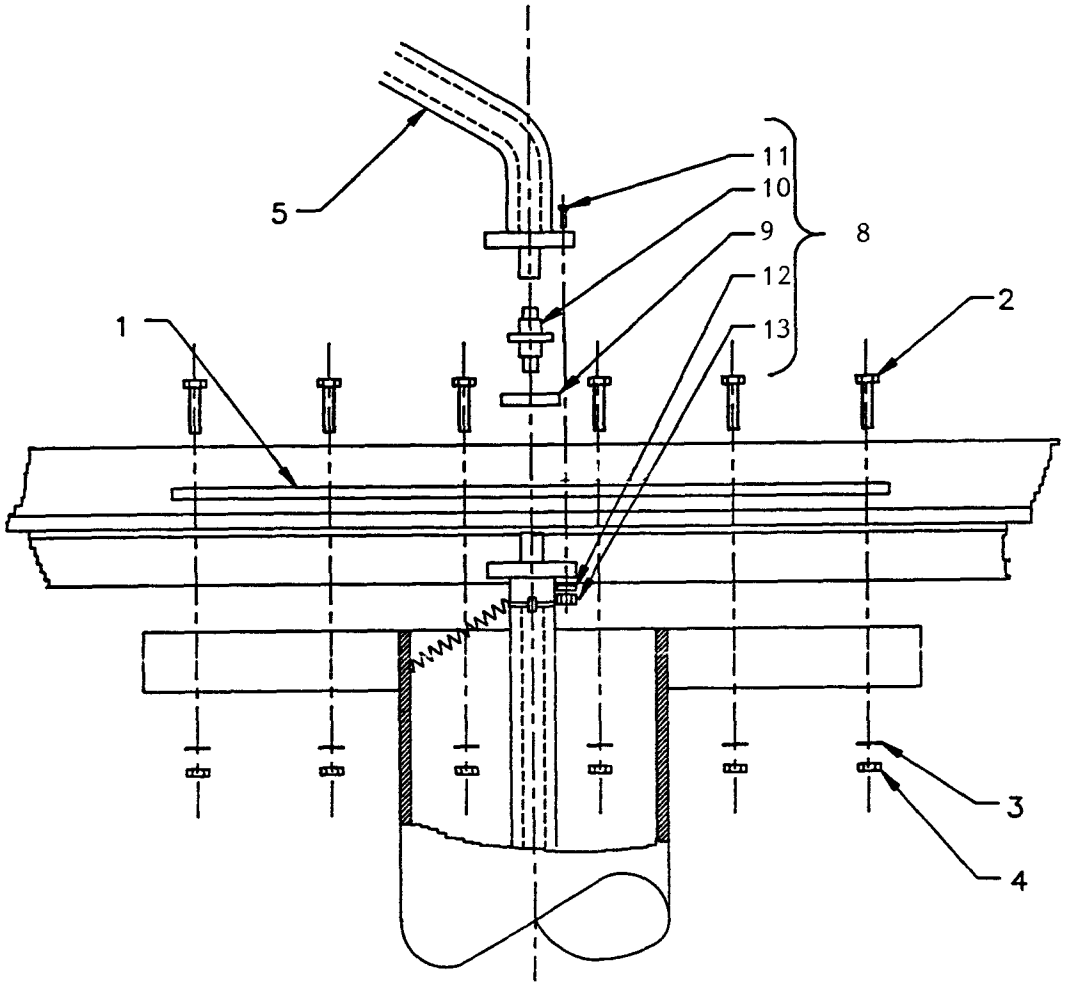


Fig.40 Boom to headplate joint

TABLE 41 ITEMS LIST FOR FIG.41

Item	Ref./Part No.	Description	Qty.
1	0001-5755-001	Earth wire	1
2	8900-0298-001	Earthing rod	1
3	8900-0250-001	Earth wire clamp	1
4	2450-2171-001	Cable connector	1
5	2009-8861-001	Bolt, hex. hd, $^1/_4$-20x1, galv.	1
6	2100-0119-001	Nut, hex, $^1/_4$-20, galv.	1
7	2300-0151-001	Washer, lock, $^1/_4$, galv.	1

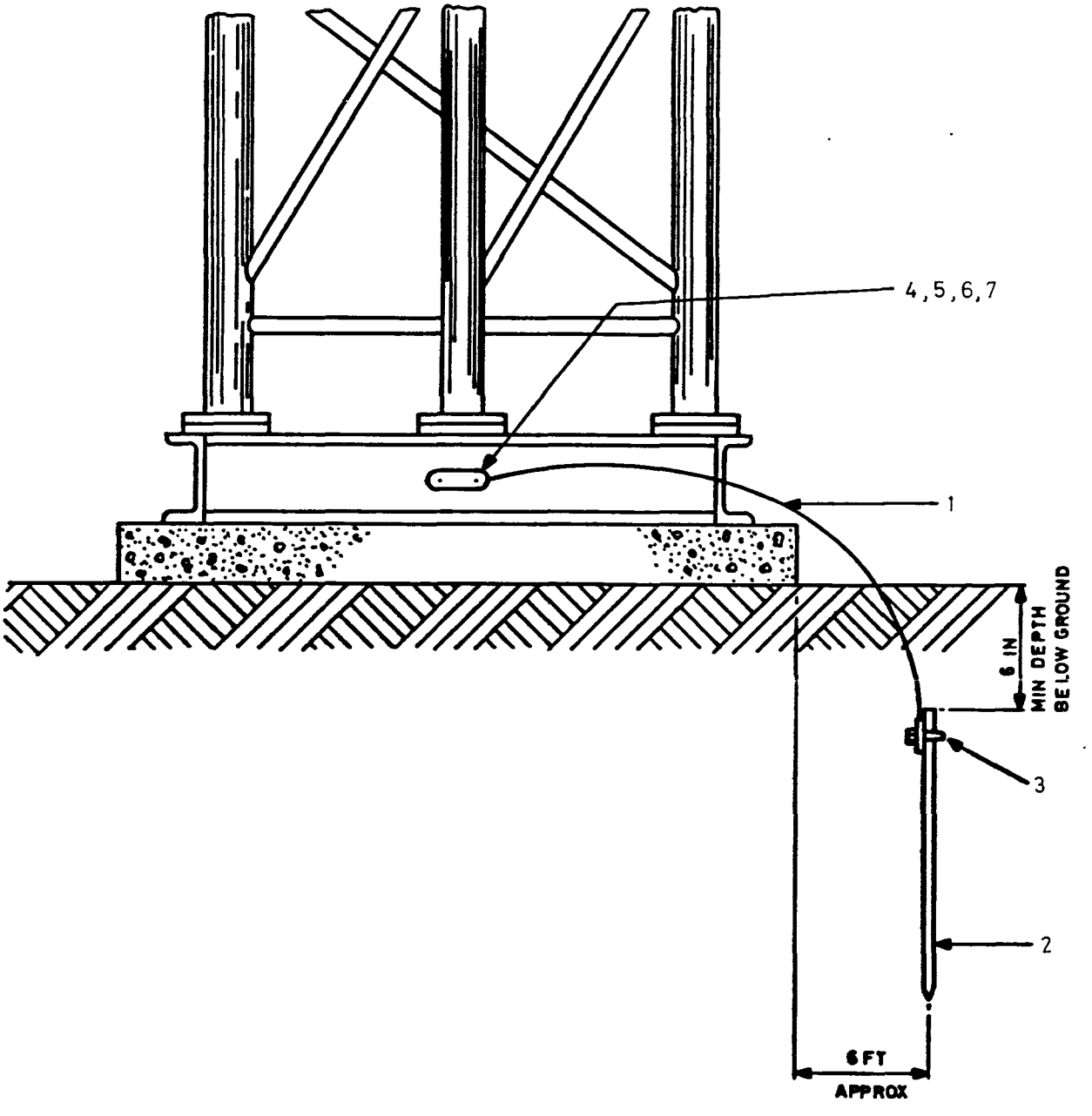


Fig.41 Earthing of twin lattice mast

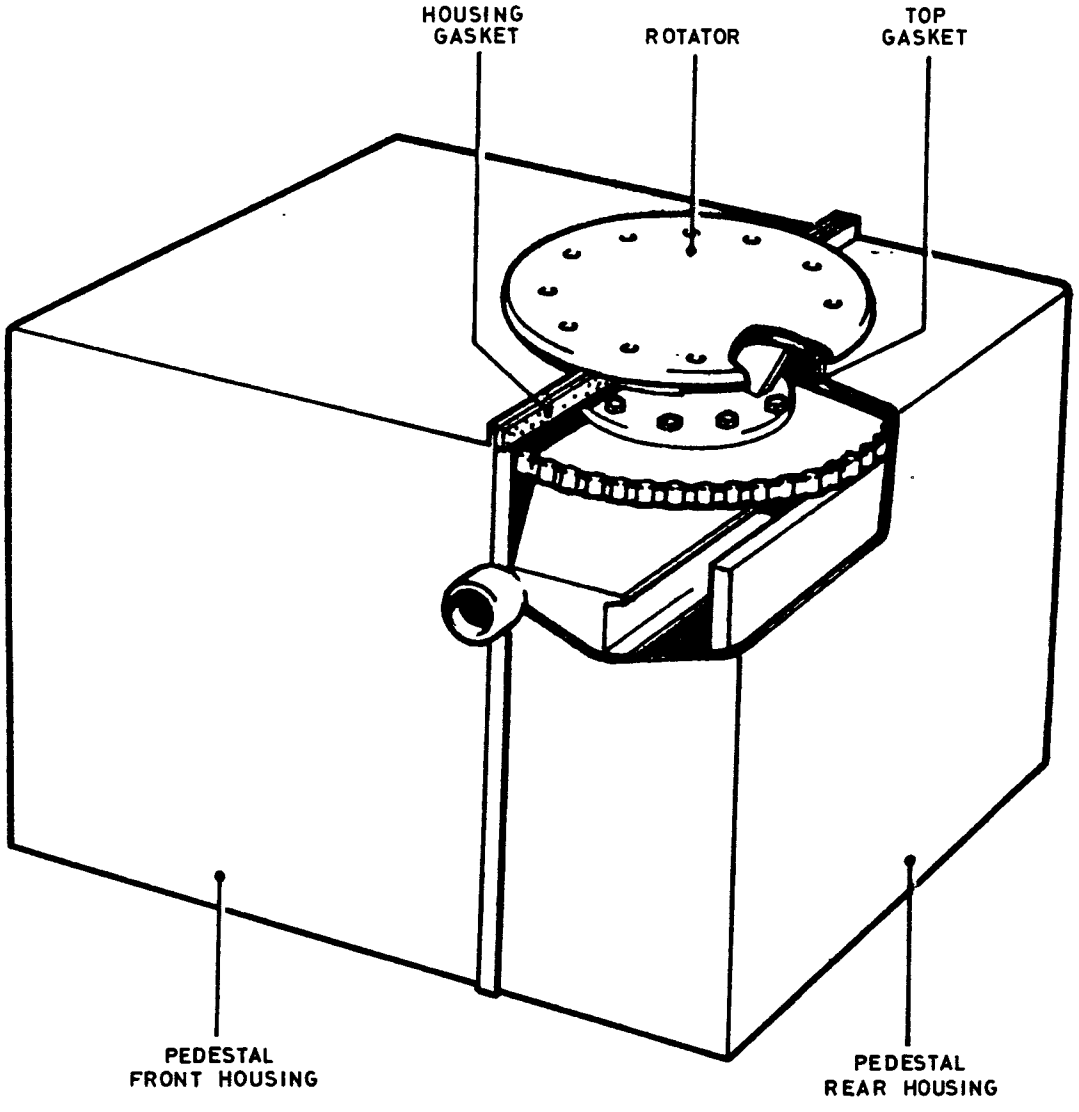


Fig.42 Pedestal assembly

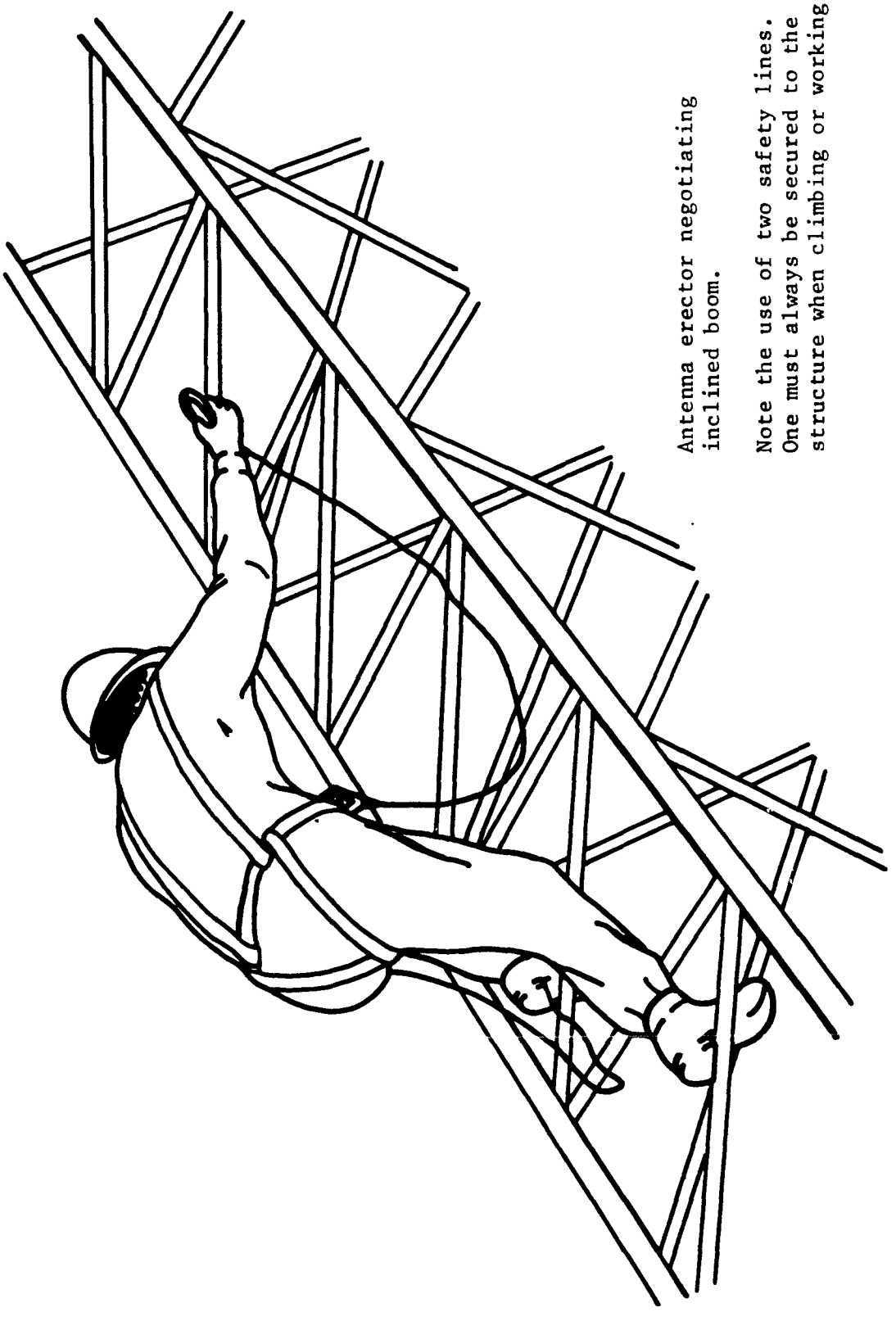


Fig. 4 3 Use of safety equipment

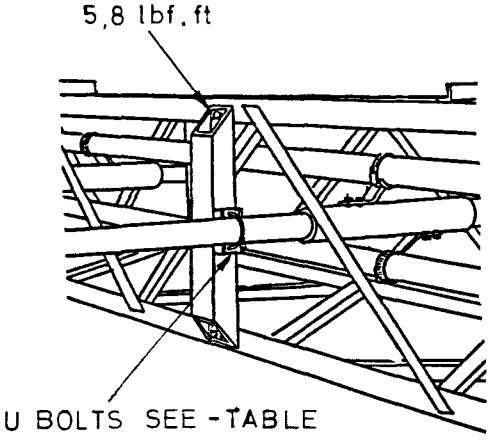
TORQUE VALUES – ASSEMBLIES OF METAL PARTS

Bolt Dia Inches	Galvanised				Stainless Steel	
	High Strength		Standard			
	Torque lbf.ft	A/F size Inches	Torque lbf.ft	A/F size Inches	Torque lbf.ft	A/F size Inches
1/4	–	–	6	7/16	6.5	7/16
5/16	–	–	–	–	11.5	1/2
3/8	–	–	19	9/16	21	9/16
7/16	–	–	–	–	33	5/8*
1/2	69	7/8	45	3/4	–	–
5/8	145	1.1/16	93	15/16	–	–
3/4	234	1.1/4	150	1.1/8	–	–

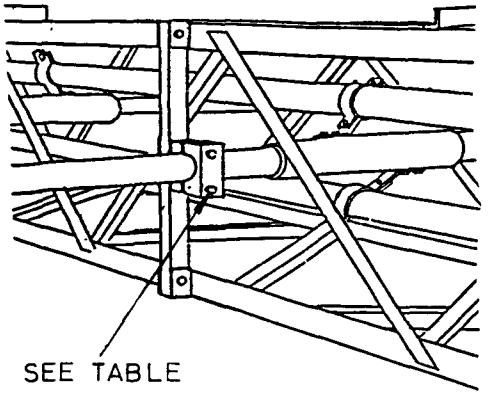
* The 7/16 Dia. nut is 11/16 Across Flats

BOLTED ASSEMBLIES INCLUDING FIBREGLASS PARTS MUST BE TORQUED TO A LOWER VALUE

OLD TYPE - U BOLTS



LATER TYPE - CLAMPS



Element	Size	Torque lbf.ft
1–7	1/4	5.8
8–13	5/16	9
14–16	7/16	23

Nut/Bolt Size	Torque lbf.ft	A/F size Inches
1/4	5.8	7/16
5/16	9	1/2
7/16	23	11/16 5/8

GUY TENSIONS: LOWER GUY 10000N
TOP GUY 20000N

Fig 44 Guy tensions and torque values

Chapter 3.2

LOWERING THE LPH72 ANTENNA

Completely Revised

CONTENTS

Note ...

The following paragraphs give, in the correct sequence, the method of lowering the LPH72 antenna.

WARNINGS ...

(1) REQUEST THE NCO IC GROUND RADIO MAINTENANCE TO ISOLATE THE ANTENNA SYSTEM IN ACCORDANCE WITH CURRENT PROCEDURES AND DISPLAY APPROPRIATE WARNING NOTICES.

(2) WHERE FITTED, ENSURE THAT THE NITROGEN/AIR PRESSURISATION TO THE FEEDER IS SWITCHED OFF.

Mast Condition Certificate

1 The Team Leader, prior to climbing, is to ensure that a valid Mast Conditioning Certificate is held at the Unit, certifying that the structure is in a safe condition.

Visual safety check

2 Using binoculars as necessary, examine the antenna and its supporting structure for signs of damage which could make climbing/lowering hazardous.

3 At the pedestal, remove the front and rear housings, to allow access to the control panel. Safeguard the fixings for re-use later. Rotate the antenna by manually operating the solenoids of relay assembly 2K1, so that the high frequency elements (shortest) are pointing towards and directly in line with the main hauling point (block D, see Chap.3.1, Fig.1). Fine adjustment of the position may be achieved by rotating the drive motor flywheel by hand. Switch off the mains power at the isolator.

4 Disconnect the antenna feeder from the rotary joint below the pedestal unit. Weatherproof the antenna feeder and the rotary joint with polythene and tape. Ensure the feeder is positioned to avoid damage to it and to the connector.

Preparation for lowering

5 Deploy the items of the boom erection equipment in preparation for lowering the boom as follows (Fig.1 and 2 and Tables 1 and 2).

5.1 Attach the leather covered sling (item 1) to the torque tube immediately above the third joint, making two complete turns as shown in Fig.1.

5.2 to each end of the leather covered sling, attach a 30.5m (100ft) T13 Tirfor rope (item 2) using 1 3/4 ton shackle (item 3).

5.3 Shackle a Tirfor winch type T13 (item 4) to chain (item 5) using a 1 3/4 ton shackle (item 3) and shackle the chain to guy anchor block A (see Chap.3.1, Fig.1) using a second 1 3/4 ton shackle (item 3). Similarly, shackle a second winch and chain to the other guy block A.

5.4 Feed the Tirfor ropes (item 2) through the Tirfor winches and take up the slack.

5.5 Attach the sling (item 6) to the torque tube at the lifting point using a 3 ton shackle (item 7) as shown in Fig.2.

5.6 Attach the 5 ton snatch block (item 8) to one end of the sling (item 11) using a 5 ton shackle (item 9).

5.7 Reeve the T35 Tirfor rope (item 10) through the snatch block and lay it out on the ground so that it is free of kinks and twists.

5.8 Feed the free end of sling (item 11) up and over the pulley mounted between the twin lattice masts at the 18.3m (60ft) level and attach it to the two ends of sling (item 6) using a 5 ton shackle (item 9).

Note ...

The following instructions, paragraphs 5.9 to 5.10, are to prevent rotation of the 5 ton snatch block and twisting of the Tirfor rope.

5.9 Thread a length of polyester rope (item 12) through the holes in the side of the 5 ton snatch block and tie it to form a loop.

5.10 Attach a T13 Tirfor rope (item 2) to the loop of polyester rope and reeve the free end through a T13 Tirfor winch (item 4). Attach the T13 Tirfor winch to the anchor block C using a 1 3/4 ton shackle (item 3).

5.11 At the main winch anchor block D attach the spreader plate (item 13) using a 5 ton shackle (item 9).

5.12 Attach a TU32H Tirfor winch (item 14) to the upper hole in the spreader plate using the pin supplied with the winch.

5.13 Attach the hard eye end of the T35 Tirfor rope (item 10) to the lower hole in the spreader plate using a 3 ton shackle (item 7).

5.14 Reeve the free end of the T35 Tirfor rope through the TU32H Tirfor winch.

5.15 Secure the rope (item 15) to the torque tube above the sling (item 6). To the other end of this rope attach a Tirfor rope (item 2).

5.16 At the end of the site remote from the winch anchor block D, insert a Molex anchor (item 16) into the ground. To this anchor attach a Tirfor winch (item 4) using a shackle (item 3). Reeve the Tirfor rope (item 2) through the winch (item 4).

5.17 Take up the slack in the ropes by taking in on the T13 Tirfor winches and TU32H Tirfor winch. Check all the connections and the lay of the gear.

5.18 At the 60ft and 80ft (18.3m and 24.4m) levels, take out the 5/8 inch nuts, bolts and washers which secure the gates and open the gates.

5.19 The antenna is now ready for lowering.

Lowering the antenna

6 Position the men as follows:

One man on each of the side T13 Tirfor winches
Two men on the TU32H Tirfor winch
One man on the T13 Tirfor winch attached to the snatch block
One man on the T13 Tirfor winch attached to the 120ft rope.

Note ...

The supervisor is to control the lowering of the antenna and should move about the site so as to view the operation to the best advantage.

CAUTIONS

(1) During lowering no personnel should be allowed to pass beneath the antenna.

(2) The TU32H Tirfor winch must be operated smoothly so as to avoid exciting undue oscillation into the torque tube and antenna assembly.

(3) To prevent siezure of the TU32H Tirfor winch, lubricate the moving parts frequently during the lowering operation, using oil OMD75.

(4) When sideways adjustment is necessary using the side stay T13 Tirfor winches, cease operating the TU32H Tirfor winch whilst this is carried out.

(5) As lowering proceeds it will be necessary to maintain some tension on the T13 Tirfor winch attached to the snatch block. Initially this will need to be taken in, but later it will need to be paid out.

6.1 Start the antenna moving by operating the winch attached to the 120ft rope. Once the torque tube has moved out of the gates and the antenna weight takes over, the need for this winch and rope ceases and the operator may be redeployed elsewhere on the site.

6.2 Lower the antenna by paying out on the TU32H Tirfor. Check that the T35 Tirfor rope (item 11) enters the vee above the pulley sheave at the intermediate level and is guided onto the pulley sheave. Adjust the side winches to achieve this.

6.3 Continue lowering until the windsail is close to the ground. Cease lowering and take up any slack on the side winches, to ensure that the antenna cannot move.

6.4 Unbolt the windsail from the end of the boom and remove it as a complete assembly. Refit the two boom members and safeguard the remainder of the nuts and bolts for re-use later.

6.5 Continue lowering until the shorting coil can be reached. Cease lowering and stabilise the boom. Remove the shorting coil. Refit the nuts and bolts which held the shorting coil.

6.6 Continue lowering until wooden blocks can be placed between the ground and the end of the boom. Lower the boom onto the blocks but do not allow the whole weight to be taken by the blocks, as this could damage the boom.

6.7 Approximately 1.5m (5ft)from the end of the boom, in the direction away from the pedestal, drive a picket into the ground and secure the boom to it with a length of 10mm diameter polyester rope.

6.8 Climb the boom, wearing safety harness complete with two safety lines. Refer to Chap.3.1, Fig.43, for use of safety equipment.

6.9 At the boom to torque tube joint, loosen the hose clips holding the transmission adaptor (Chap.3.1, Fig.40, item 1) to the side of the boom. Undo the four 5/16 inch nuts, bolts and lock washers at the transmission line joint. Pull the joint apart and take out the connector and O-ring. Safeguard these parts for re-use later.

6.10 Loosen the 5/8 inch nut at the end of the hinge bolt but do not remove it.

6.11 Remove the twelve 3/8 inch nuts, bolts and lock washers which secure the boom to the headplate, together with the braces fitted in this position. Safeguard these for re-use later.

6.12 Remove the short restraining guy from the end of the boom.

6.13 Position two or more men on the end of the boom.

6.14 Raise the antenna a short distance, sufficient to allow the end of the boom to clear the ground. The men holding the end of the boom now push it towards the pedestal whilst lowering continues.

6.15 Insert wooden packing between the boom and the ground, so as to support the boom. It may be necessary to rotate the torque tube slightly at this stage, so that the boom approaches the ground squarely. This can be done by turning the flywheel on the drive motor by hand.

6.16 Continue lowering until the whole weight of the antenna is on the ground.

6.17 Unless the boom/torque tube assembly is to be dismantled further, the lowering equipment may be left in position for subsequent re-erection of the antenna.

6.18 Disconnect the 120ft long rope and its associated Tirfor winch and ground anchor, as these are no longer required.

6.19 On completion of the maintenance work, refer to Chap.3.1, para.19 for instructions regarding the re-erection of the antenna.

6.20 Alternatively, if re-erection is not required, dismantle the lifting equipment and pack it for transit.

TABLE 1 ITEMS LIST FOR FIG.1

Item	Ref./Part No.	Description	Qty.
1	4010-99-638-9347	Guy	1
2	4010-99-202-9038	Rope, 100ft for Tirfor T13	2
3	4030-99-724-6868	Shackle, small Dee, $^{3}/_{4}$in. dia. pin, SWL $1^{3}/_{4}$t	4
4	3950-99-204-6346	Tirfor winch type T13	2
5	4010-99-638-8410	Chain, long link, $^{5}/_{8}$ in.dia.6ft.long	2

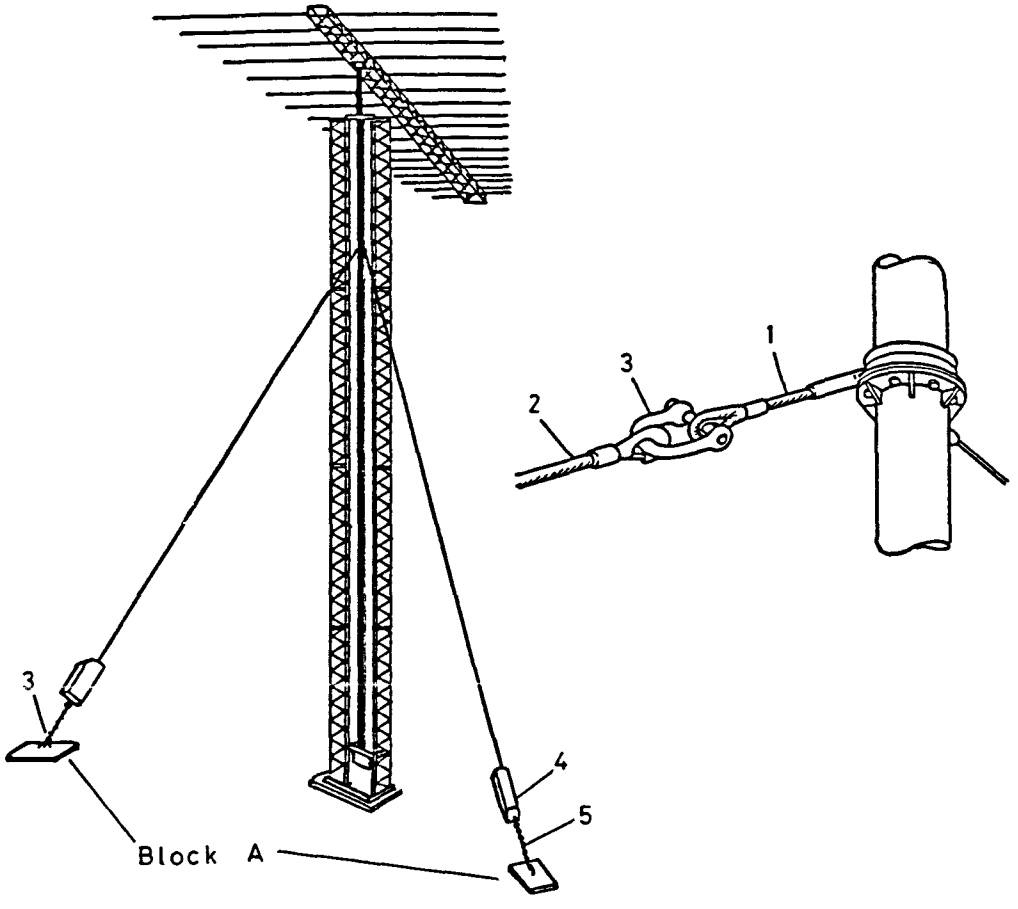


Fig 1 Side stay attachment

TABLE 2 ITEMS LIST FOR FIG.2

Item	Ref./Part No.	Description	Qty.
6	5985-99-797-5555	Guy	1
7	4030-99-561-2787	Shackle, large Dee, 1 in. dia. pin, SWL 3t	1
8	3940-99-425-3457	Snatch block, 12in. dia. sheave, SWL 5t	1
9	4030-99-638-8199	Shackle, large Dee, $1^1/_4$in. dia.pin, SWL 5t	2
10	4010-99-798-2590	Rope, 70m for Tirfor T35	1
11	5985-99-798-4457	Guy	1
12	4020-99-933-1562	Rope, polyester, 9mm dia. x 6ft	1
13	5985-99-797-5556	Spreader plate	1
14	4L/4013	Tirfor winch type TU32H	1
15	4020-99-942-5025	Rope, manilla, $2^1/_4$in.circ.x120ft.	1
16	4020-99-933-3906	Molex anchor, 30in.	1

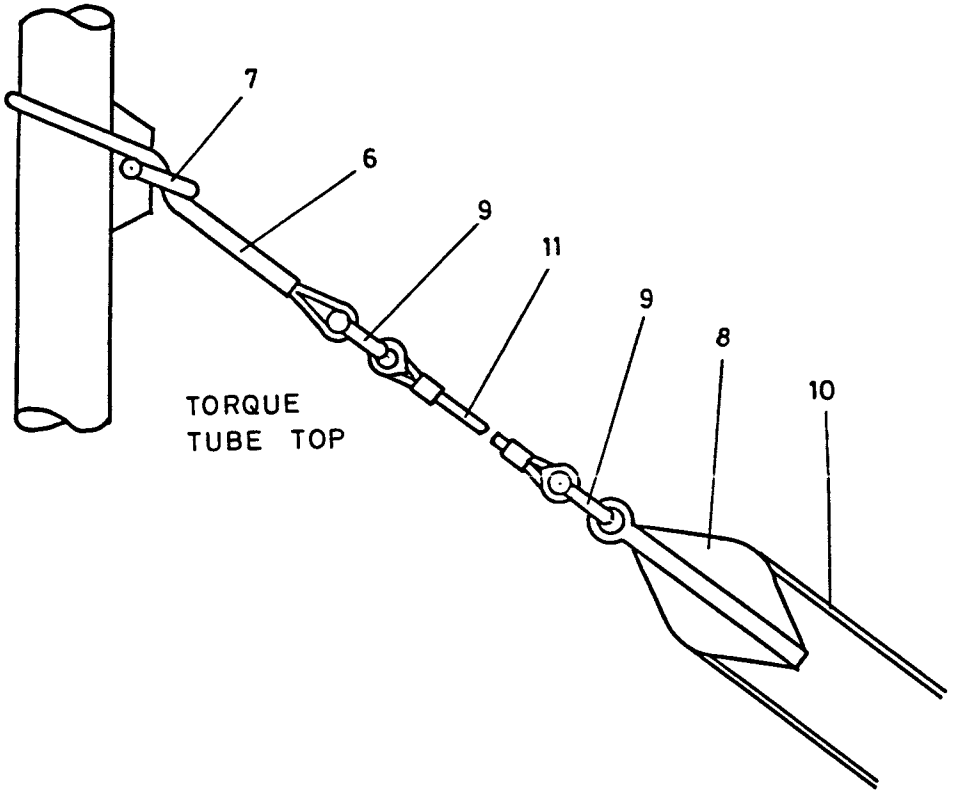


Fig. 2 Antenna lifting point

Chapter 3.3

LOWERING THE LPH72 TWIN LATTICE MAST

Completely Revised

CONTENTS

Note ...

The following paragraphs give, in the correct sequence, the method of lowering the LPH72 twin lattice mast.

WARNINGS ...

(1) REQUEST THE NCO IC GROUND RADIO MAINTENANCE TO ISOLATE THE ANTENNA SYSTEM IN ACCORDANCE WITH CURRENT PROCEDURES AND DISPLAY APPROPRIATE WARNING NOTICES.

(2) WHERE FITTED, ENSURE THAT THE NITROGEN/AIR PRESSURISATION TO THE FEEDER IS SWITCHED OFF.

Mast Condition Certificate

1 The Team Leader, prior to climbing, is to ensure that a valid Mast Conditioning Certificate is held at the Unit, certifying that the structure is in a safe condition.

Visual safety check

2 Using binoculars as necessary, examine the antenna and its supporting structure for signs of damage which could make climbing/lowering hazardous.

Note ...

It is assumed that the antenna has already been lowered and dismantled from the pedestal. The disconnection described in the following paragraphs is more easily carried out before lowering the antenna.

Disconnection of mains supply

3 Ensure that the mains power isolator on the panel alongside the antenna is switched off. On the pedestal, open the local control and unscrew the front panel. Disconnect the incoming mains lines from the circuit breaker 2CB1. Disconnect the neutral wire from the terminal block 2TB2. Retighten the terminal screws to prevent their loss.

4 Remove the cable connections from the terminal block 2TB1. Retighten the terminal screws.

5 Slacken the cable glands and pull out the mains and control cables. Retighten the cable glands. Refit the panel and close the local control.

6 At the mast base, disconnect the earth connection.

Removal of pedestal

7 Deploy the lifting equipment as follows:-

7.1 Climb to the top of the twin lattice mast. Undo the 5/8 inch shackle which secures the pulley block and rope to the erection bracket and transfer them to one of the cross braces at the top of the mast. The line, when so attached, may still be used for hauling up tools and equipment, but the load should not exceed about 100kg.

7.2 Refer to Fig.1 and Table 1. Attach a shackle (item 1) to each of the erection brackets. To each of these shackles attach a shackle (item 2). To these shackles attach the two hooks of a two leg sling (item 3).

7.3 To the centre ring of the two leg sling attach a snatch block (item 4) using a shackle (item 2).

7.4 Attach a TU32H Tirfor winch (item 5) to the anchor block C (see Chap.3.1, Fig.1) using a shackle (item 2).

7.5 Reeve a Tirfor rope (item 6) up the mast, through the snatch block and down through the Tirfor winch (item 5).

7.6 Attach a chain (item 7) to the captive shackle at the end of the Tirfor rope (item 6).

7.7 Insert the lifting eye bolt (removed when the antenna was first erected and stored) into a hole in the flange of the pedestal closest to the reduction gearbox. If the original eye bolt has been lost, obtain a replacement which should have a 5/8 inch (16mm) male thread end and

mating nut.

7.8 Attach the chain (item 7) to the eye bolt using a shackle (item 1).

7.9 At the pivots at each side of the pedestal, take out the 1/2 inch x 3 1/2 inch bolts, lock washers and nuts which retain the pedestal in the bearings.

7.10 Lift the pedestal by operating the Tirfor winch and remove it from between the masts. Refit the bolts, nuts and washers removed in sub-para.7.9.

ALTERNATIVELY - if a HIAB is available:-

7.11 Omit operations detailed in sub-para.7.1 to 7.6. Position the vehicle to which the HIAB is fitted in a convenient position. Note that the pedestal, which weighs 0.54 tonne, is well within the safe lifting capacity of the HIAB at full extension.

7.12 Fit the eye bolt and attach a chain, as in sub-para.7.7 and 7.8 above. To the end of the chain attach a shackle (item 8) and fit this shackle over the hook on the HIAB. The HIAB is only to be operated by an operator trained in its use and he is to be satisfied that all the necessary safety procedures are followed.

7.13 Use the HIAB to lift the pedestal from between the masts.

Preparation for lowering of twin lattice masts

8 Deploy the lifting equipment as follows:-

8.1 Refer to Fig.2 and Table 2. On the side of the mast base closest to winch block C, position the cross tube of the erection derrick (item 1) in the housings provided and secure with the U bolts (item 19). Leave the U bolts slack. Ensure that the small shackle attachment lug at the derrick head is pointing upwards. Lay the derrick out on the ground and support it, if necessary, with wood blocks.

8.2 Attach two slings (items 8 and 9), one to each of the erection brackets, on the mast at the intermediate guy level, ie, 18.3m (60ft) from the ground. Attach the slings using shackles (item 12). The rigging screw on the sling (item 9) should be towards the ground.

8.3 To the small attachment lug at the derrick head, attach a shackle (item 10). Lift the derrick head and attach the two slings to the shackle (item 10) using two shackles (item 17).

8.4 Attach the snatch block (item 2), using a shackle (item 3), to the large shackle attachment lug at the head of the derrick opposite the erection slings.

8.5 Reeve the erection sling (item 13) through the snatch block (item 2) at the derrick head and attach one end to the hairpin nearest the twin lattice mast base on the downhaul block C using a shackle (item 10).

8.6 Shackle a second snatch block (item 2) to the remaining hairpin on the downhaul block C using shackle (item 10). Reeve the free end of the erection sling (item 13) through this snatch block. Attach a T35 Tirfor

rope (item 16) to this free end using two shackles (item 10) back to back.

8.7 Shackle the TU32H Tirfor winch (item 14) to the winch-block D using two shackles (item 10) back to back. Feed the Tirfor rope through the Tirfor winch but leave slack.

8.8 Attach two Tirfor ropes (item 11), one to each side of the derrick head, using shackles (items 10 and 12), back to back.

8.9 Attach two Tirfor winches (item 6) to block F on each side of the derrick, using shackle (item 12). Reeve the Tirfor ropes (item 11) through the Tirfor winches (item 6) and take up the slack to centralise the derrick.

8.10 Take up the slack and apply a light tension to the derrick. Check the tension of side stays and adjust if necessary.

8.11 Adjust the rigging screw on item 9 so that there is equal tension in the two slings, items 8 and 9. Tighten the U bolts holding the derrick to the twin lattice mast.

8.12 Refer to Fig.3 and Table 3. Attach the wire rope assembly (item 2) one to each mast leg as shown. To each of these attach a rope assembly (item 1) using a shackle (item 5). Shackle a Tirfor winch (item 3) to each block F at each side of the mast base, using a shackle (item 5). Attach a Tirfor rope (item 4) to rope assembly (item 1) using a shackle (item 5). Feed the ropes (item 4) through the winches (item 3) and take up the slack.

8.13 Take up the slack on all the winches and check that all the equipment is deployed correctly.

9 At the mast base, remove the four angle, tie down and the two channel, tie down (items 1 and 2 of Fig.11 and Table 11, Chap.3.1) by taking off the 3/4 inch nuts and washers. Retain these items.

Lowering of twin lattice masts

10 Proceed with the lowering of the masts as follows:-

10.1 Position two men on the winch at block D, two men, one at each side, by the stay anchor blocks F and one man at each rear guy anchor block A.

10.2 Ease off the tension on the front upper and intermediate guys attached to the guy anchor blocks E. Disconnect the guys from the anchor blocks E.

10.3 Apply tension to the two rear guys and at the same time pay out on the winch at block D, so that the masts pivot and commence to descend.

10.4 The men on the side stays are to check them continually, to ensure that they are not too tight or too slack. The supervisor is to watch carefully the whole lowering operation, to ensure that the twin lattice masts descend in a controlled manner.

10.5 During the final stages of lowering, the two men positioned at the rear guys are to pull them clear of the descending masts. They are also to position wooden packing blocks for the masts to rest on.

11 When the twin lattice masts are resting on the ground, continue paying out on the winch at block D. Push the derrick towards the masts and, in the final stages, support it as it descends. Insert wooden packing between the masts to support the derrick.

12 Dismantle the lifting equipment and pack it for transit.

TABLE 1 ITEMS LIST FOR FIG.1

Item	Ref./Part No.	Description	Qty.
1	4030-99-960-4349	Shackle, large Dee, $^{3}/_{4}$in.dia. pin SWL $1^{1}/_{2}$t	3
2	4030-99-638-8199	Shackle, large Dee,$1^{1}/_{4}$in.dia.pin SWL 5t	4
3	3940-99-425-3432	Two leg sling	1
4	3940-99-425-3457	Snatch block, 12in. sheave, SWL 5t	1
5	4L/4013	Tirfor winch type TU32H	1
6	4010-99-798-2590	Tirfor rope T35x70m	1
7		Chain $^{5}/_{8}$in.dia. long link x6ft	1
8	4030-99-638-8203	Shackle, large dee, 1in. dia. pin, SWL 3t	1

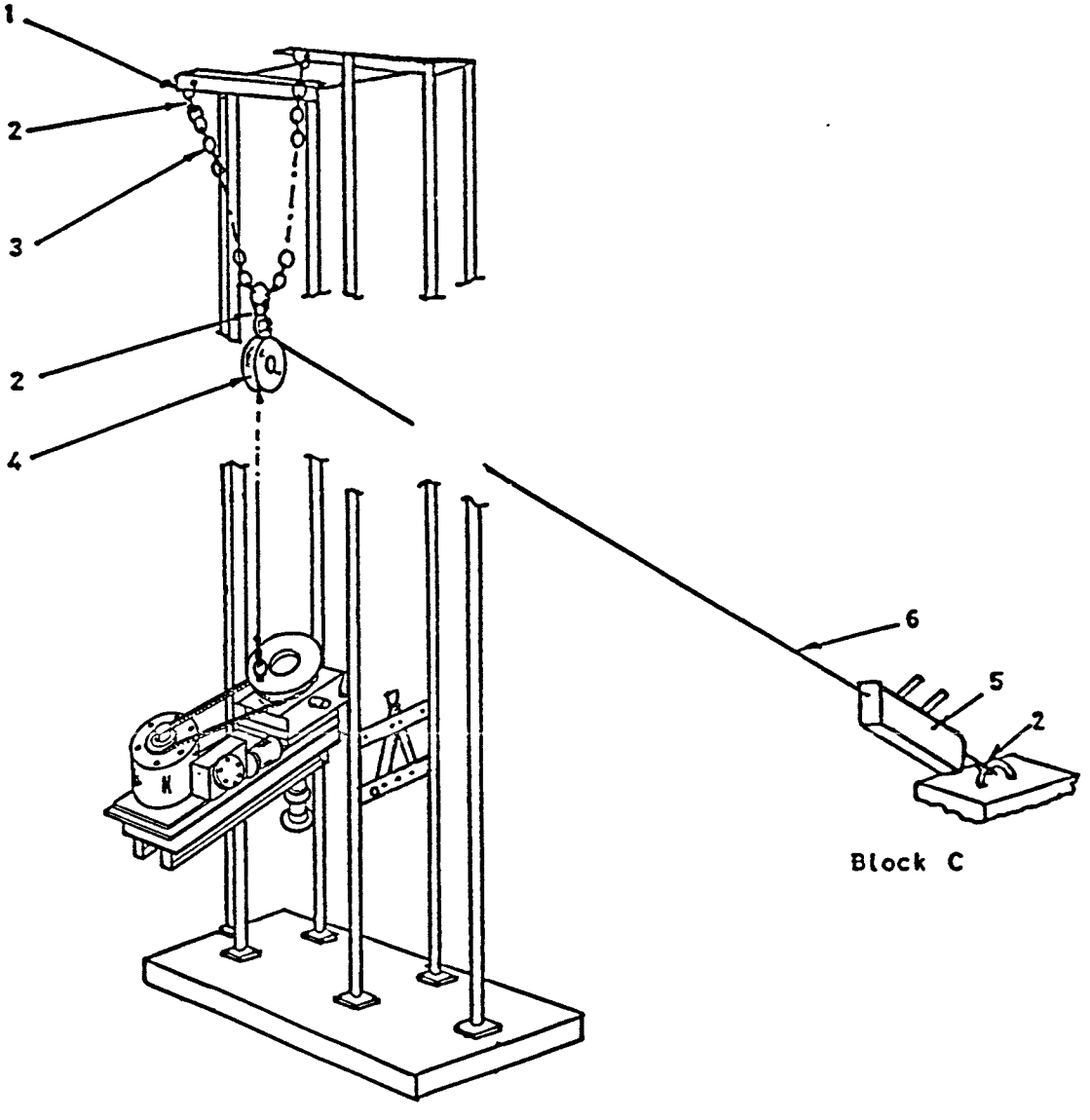


Fig.1 Lifting of pedestal

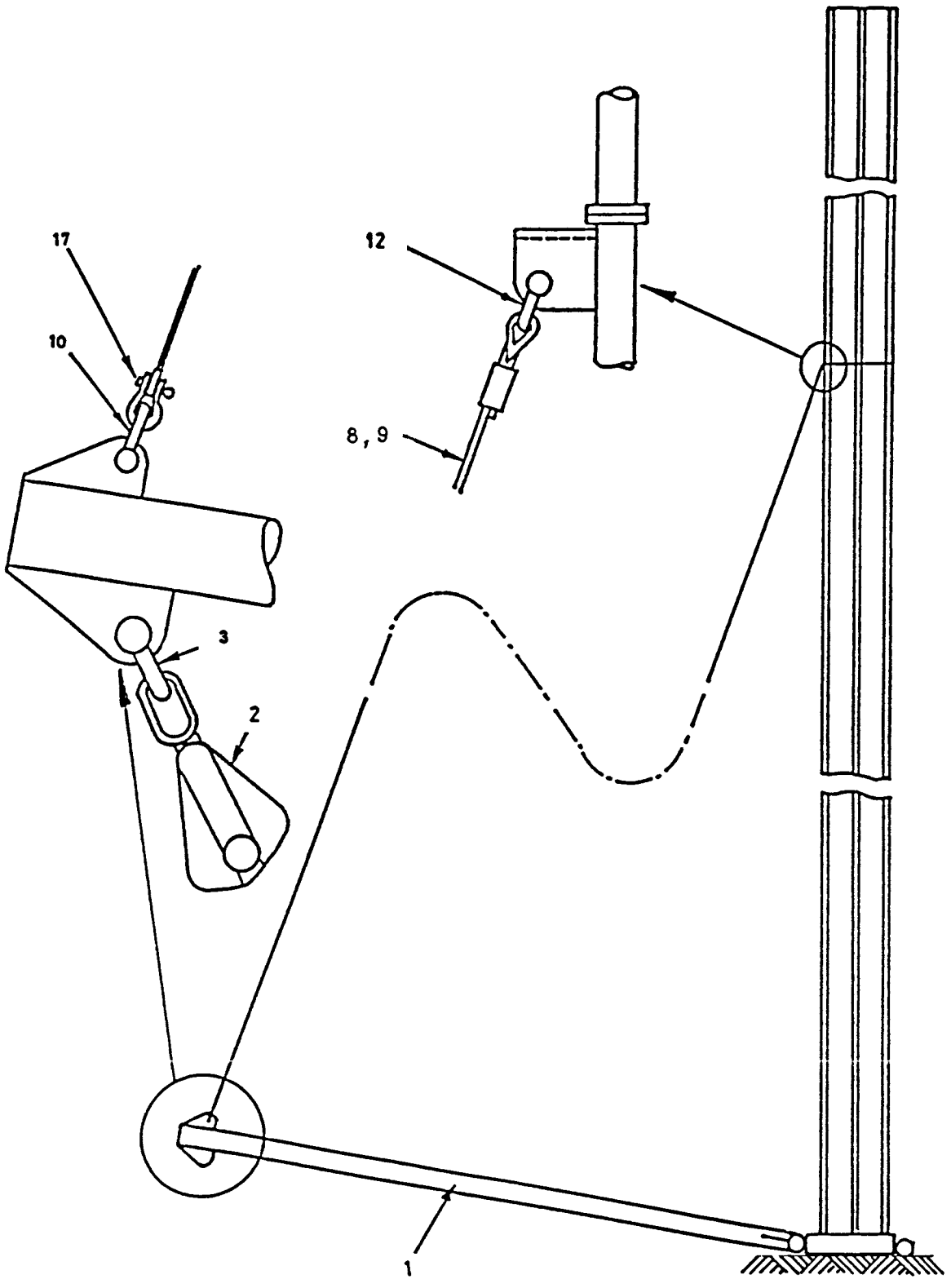


Fig.2 Derrick attachment

TABLE 2 ITEMS LIST FOR FIG.2

Item	Ref./Part No.	Description	Qty.
1	90G 110723	Derrick assembly, tower	1
2	3940-99-425-3457	Snatch block, 12in.sheave SWL 5t	2
3	4030-99-638-8199	Shackle, large Dee, $1^1/_4$in.dia. pin, SWL 5t.	1
4	4010-99-638-9347	Guy	2
5	5985-99-933-3888	Guy	2
6	3950-99-201-3244	Tirfor Winch T7	2
7	3950-99-204-6346	Tirfor winch T13	2
8	4010-99-638-8200	Sling	1
9	4010-99-638-8409	Sling	1
10	4030-99-638-8201	Shackle, large Dee, $1^1/_8$in.dia. pin, SWL $3^3/_4$t	9
11	4010-99-202-9032	Tirfor rope T7x60 ft. lg	2
12	4030-99-960-4349	Shackle, large Dee, $^3/_4$in.dia. pin, SWL $1^1/_2$t	4
13	4010-99-638-8202	Guy	1
14	4L/4013	Tirfor winch type TU32H	1
15		Longlink chain, $^5/_8$in.dia.x6ft.lg	4
16	4010-99-523-8376	Tirfor rope T35x100ft.lg	1
17	4030-99-638-8203	Shackle, large Dee, 1in.dia. pin, SWL 3t	2
18	4010-99-523-8374	Tirfor rope T13x100ft.lg	2
19	F&L Type 4/UB/23	U bolt assembly	2

TABLE 3 ITEMS LIST FOR FIG.3

Item	Ref./Part No.	Description	Qty.
1	5985-99-933-3888	Wire rope assembly, 15.2m (50ft)	2
2	4010-99-638-9347	Wire rope assembly, 10ft.	2
3	3950-99-204-6346	Tirfor winch type T13	2
4	4010-99-523-8374	Tirfor rope T13x30.5m (100ft)	2
5	4030-99-960-4349	Shackle, large Dee, $^3/_4$in.dia. pin, SWL $1^1/_2$t	6

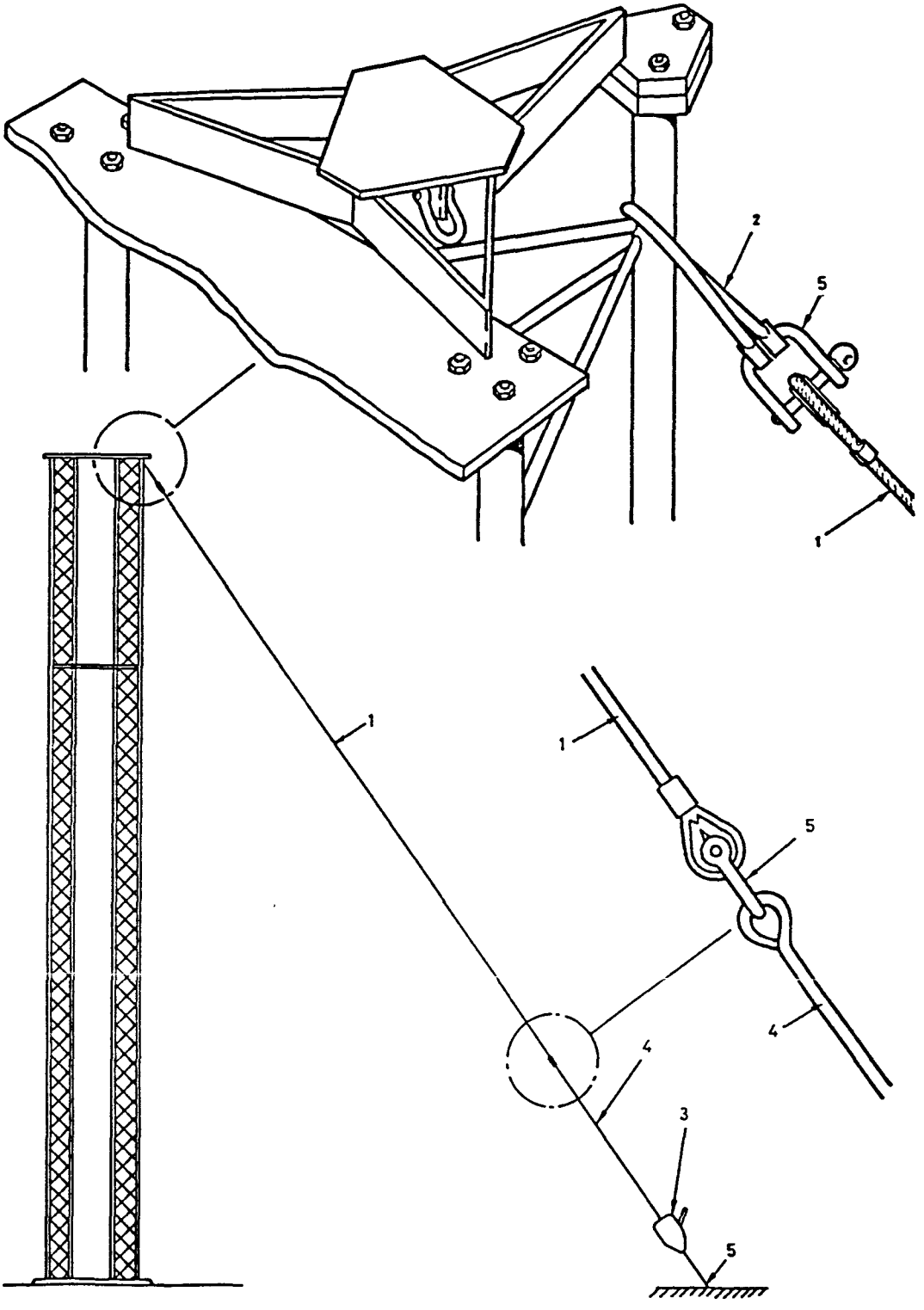


Fig. 3 Temporary stay attachment

Chapter 4.0

INSTALLATION, ERECTION AND LOWERING OF LPH72 (MODIFIED) ANTENNA

Completely revised

1 Chapter 4.1 covers installation and erection of the antenna. Chapter 4.2 covers lowering of the boom assembly.

Drawings

2 This chapter is to be read in conjunction with AP116E-1717-1 and the following drawings:

2.1	90G 107655	LPH72 (modified) antenna (Middle Hill, Gibraltar) general assembly
2.2	90G 107815	LPH72 (modified) antenna (Middle Hill, Gibraltar) installation diagram
2.3	90G 110124	LPH72 (modified) antenna (Middle Hill, Gibraltar) installation notes
2.4	SC 56748	Use of silcoset
2.5	90G 110502	Wiring diagram
2.6	90G 116319	Painting instructions

Safety precautions

SAFETY WARNING ...

PRIOR TO RAISING OR LOWERING THE ANTENNA, THE TEAM LEADER IS TO ENSURE THAT THE SITE IS ADEQUATELY CLEARED OF OBSTACLES AND HAZARDS, AND THAT THE APPROPRIATE WARNING SIGNS ARE DISPLAYED.

3 All safety precautions must be taken during the erection and must not be compromised in any way. The tower structure is not to be climbed by more than two persons at any time. Only one person is to climb the boom when partly erected and no-one is to traverse the boom when fully erected. Safety harnesses are to be worn and fall arrest equipment is to be used at all times when climbing.

PSA responsibilities

4 The tower is the responsibility of PSA and is not to be adjusted after handover. The PSA are to be informed in writing, a minimum of seven days in advance, the dates of erection, so that an observer may be present if the PSA wishes. The tower structure is to be handed over to the station PSA, who are to be requested to issue a safe to climb certificate as soon as the

antenna is completed, in case minor adjustments are required at a later date.

Note ...

The antenna assembly, including rotator, mast and tower, is to be handed over to the station senior electronics officer.

Pre-erection details

5 Six men and a supervisor are required to erect (or lower) the antenna. It is advisable to make a check on local weather conditions for the time period of antenna work, in case of high wind forecast or thunderstorm states/risks.

6 The prefixes 90G, SC, SCSHQ and SEE, where used, are to be considered synonymous. The words 'guy' and 'stay' in relation to the antenna mast assemblies are also synonymous.

Note ...

Two grades of fastener are used in this installation - standard strength galvanised and stainless steel. In general, the galvanised fasteners are used to assemble the steel parts and the stainless steel fasteners are used to assemble the boom and feed line. However, galvanised fasteners are used to join together the boom sections. Torque values, which are different for the two grades of fastener, are given in Fig.44 in Chapter 3.1. Stainless steel fasteners which assemble fibreglass parts are torqued to a lower value than those assembling all-metal parts. All fasteners shall be assembled dry.

Weights

7 The weights of various parts of the antenna are as follows:-

Torque tube section	257kg (567lb)
Boom assembly complete	499kg (1100lb)
Pedestal unit	345kg (760lb)

General description

8 This rotatable, horizontally polarised, log periodic antenna operates in the frequency range 6.5 to 32MHz. The antenna makes use of LPH72 major assemblies, which are identical to those in that antenna. The main difference is in the support structure and that only one 20ft torque tube section is used to support the boom assembly. Only one 20ft section of transmission line is fitted inside the torque tube.

Because of these differences, the methods of raising and lowering the boom assembly are different from those used for the LPH72 and are described in Chapters 4.1 and 4.2. For all other information, reference should be made to Chapters 3.1 and 3.2, as appropriate.

Chapter 4.1

ERECTION OF ANTENNA LPH72 (MODIFIED, GIBRALTAR)

Completely revised

CONTENTS

General

1 The following paragraphs give, in the correct sequence, the method of erecting the remotely controlled rotatable log periodic antenna type LPH72 (modified), (Middle Hill, Gibraltar). The item numbers listed refer to those shown on Dwg. 90G 107655 unless stated otherwise.

Torque tube and pedestal assembly

2 Assemble as follows.

Note ...

Item numbers quoted in the following paragraphs refer to 90G 107815 unless stated otherwise.

2.1 Remove tower bracing from the West side of the tower, up to a height of approximately five metres (14ft). Remove the intermediate and pedestal support beams.

2.2 Slide a 20ft section of transmission line into the torque tube and secure it at the headplate end, using the four springs supplied in the transmission line connector kit (Fig.3).

Manhandle the torque tube into position until it is lying normal with the West face of the tower, with the head of the tube inside the tower and on the centreline. Clamp a timber support to the torque tube, to prevent damage during lifting.

2.3 Fit a Tirfor type T7 to the U-bolt at the centre of the tower and attach a lifting strop (item 9) to the torque tube. Shackle the Tirfor hook to the strop and haul up on the Tirfor. As the torque tube end lifts, manhandle it towards the tower, taking care not to damage the flanges.

2.4 Continue until the torque tube is upright in the tower, positioned on the tower centreline.

2.5 Refer to 90G 107815, Fig.3. Fit two Tirfors to the tower head and connect hooks to eyebolts fitted in torque tube flange. Make torque tube secure on tower centreline, using four ropes fitted round it and made-off to the tower legs.

2.6 Remove the top bearing, support beams and collar. Remove Tirfor fitted in sub-para.2.3.

2.7 Replace bracing to the West side of the tower, removed in sub-para.2.1.

2.8 Haul up on the Tirfors to raise the torque tube, using the four ropes fitted in sub-para.2.5, to maintain it on the tower centreline.

2.9 When the head plate is above the tower head, refit top bearing, support beam and collar removed in sub-para.2.6.

2.10 Refit the intermediate support beams removed in sub-para.2.1.

2.11 Stand pedestal inside tower on timber battens. Pull lower end of torque tube to the side of the tower and secure temporarily using rope.

2.12 Fit Tirfor type T7 to U-bolt on top bearing support beam and shackle Tirfor hook to eyebolt on pedestal flange. Fit a spacer (item 15) (chamfered side first) to each pedestal axle, followed by a bearing (item 7).

2.13 Remove the two halves of the housing from the pedestal and hoist the pedestal into position in the tower, until the support bearings are above the support beam positions. Centre the pedestal so that, when pivoting, it will not foul the tower and cause damage.

2.14 Refit the pedestal support beams removed in sub-para.2.1 and position the pedestal so that the torque tube flange faces upwards. Secure the pedestal by bolting the bearings to the support beams using 5/8 x 5 bolts (item 43), 5/8 lockwashers (item 30) and 5/8 nuts (item 29). Fit the eyebolts (item 39) into the tapped hole in the top of each bearing.

2.15 Support the pedestal, using timber supports placed under the motor unit to maintain the flange in a horizontal position. Remove Tirfor fitted in sub-para.2.12.

2.16 Remove rope securing torque tube to tower legs (fitted in sub-para.2.11). Using Tirfors fitted in sub-para.2.5, centralise the torque tube in the tower.

2.17 Pull the inner conductor out of the transmission line in the pedestal and insert the bullet as shown in Fig.2. Lubricate the O-ring with silicone grease and position it over the inner conductor.

2.18 Pull the inner conductor from the 20ft section and fit into the other end of the bullet. Slide the outer conductor of the 20ft section against the short transmission line, carefully positioning the O-ring in its proper groove, and secure using 5/16 inch diameter bolts and lock washers. Torque to 11.5lbf.ft.

Note ...

The transmission line O-ring must be properly seated to provide an airtight connection.

2.19 Using silicone grease, stick the threadseals (item 278) over the holes in the rainshield. This will hold the threadseals in place until the torque tube can be positioned and the bolts inserted.

2.20 Using the Tirfor winches, lower the torque tube onto the pedestal and bolt the flanges together using 5/8 inch diameter bolts, nuts and washers.

Note ...

The twelve 5/8 inch threadseals (sub-para.2.19) must be positioned between the torque tube flange and the antenna pedestal, as shown in Fig.2. These washers act as spacers and allow drainage of any water which enters the torque tube.

2.21 Tighten the torque tube bolts. Torque to 93lbf.ft.

2.22 Slacken off bolts on pedestal bearings without removing nuts. Remove timber supports fitted in sub-para.2.15. Open collar at top of tower and ease mast sideways until it rests against the side of the tower head (Fig.4). Place timber packing between mast head and tower structure, and temporarily secure the mast to the tower structure.

2.23 Carry out electrical and pressurization checks on the torque tube transmission line (see Appendix 1 and 2). Following the checks, cover the ends of the transmission line to prevent the ingress of dirt and moisture.

Boom assembly

3 Assemble the boom as follows:

3.1 Install the tabernacle (item 3) on the fixing down bolts provided (Fig.4).

Note ...

Assembly of the boom is carried out generally as described in Chapter 3.1, para.13, except that section 4 is assembled first to the tabernacle, followed by section 3, section 2 and section 1.

3.2 Carry out the assembly of the boom sections in accordance with Chapter 3.1, para.13.1 to 13.4. When assembling section 4, do not fit the insulators for No.16 element (item 7, Fig.22) and the horizontal braces (item 4, Fig.25).

3.3 Lay boom section 4 out normal to the North face of the tower. Fit the erection swivel (item 7) to the end of the boom using the nuts, bolts and washers which would normally attach the No.16 insulators and the horizontal braces.

3.4 Grease the swivel pin (item 6) and install the erection swivel into the tabernacle. Raise the extreme end of the boom section 4 into a horizontal position and prop up using a trestle made on-site from carrying bars (item 26) and swivel couplers (item 27), as shown in Fig.4.

3.5 Attach boom section 3 to section 4 in accordance with Chapter 3.1, para.13.6.

3.6 Attach boom sections 2 and 1 in accordance with Chapter 3.1, para.13.7 to 13.9.

Windsail

4 Assemble windsail in accordance with Chapter 3.1, para.14.

Element assembly

5 Assemble the elements in accordance with Chapter 3.1, para.15, with the exception of element No.16.

Transmission line and feedline assembly

6 Assemble the transmission line and feedline assembly in accordance with

Chapter 3.1, para.16, with the exception of the connections to element No.16. Carry out electrical checks on boom transmission line assembly (see Appendix 2).

Remaining element assembly

7 Assemble the remaining elements in accordance with Chapter 3.1, para.17, with the exception of element No.16.

Pressure testing

8 Fit a PET connector (type 10AD/9784755) to the feeder flange (Fig.5). Remove the purging valve in the transmission line at the front of the antenna and replace with a plug. Apply a pressure of 20psi via the Schraeder valve in the PET connector and check transmission line for leaks.

9 After test, remove PET connector. Remove plug and replace purging valve.

Boom erection

10 Erect boom as follows:

Note ...

Item numbers in the following paragraphs refer to Fig.4, unless stated otherwise.

10.1 Bolt the hydraulic jack (item 5) onto the jacking platform in the tabernacle.

10.2 Fit the pulley (item 13) to the U-bolt at the centre of the North face of the tower head, for use when hauling up the boom.

10.3 Fit a Tirfor type T13 (item 15) to an anchorage point approximately 9 metres (25ft) South of the tower.

10.4 At the boom mounting position, identified by steel angle braces bolted to boom section 3, wind a strop (item 8) one and a half turns round the boom and shackle ends together above the boom using a 5/8 inch D-shackle (item 11).

10.5 Install the hook of a Tirfor rope (item 16) into the strop shackle, reeve through the pulley already installed at the tower head and mesh the Tirfor rope into the Tirfor type T13 at the Southern anchorage point.

10.6 Fit stabilizing guys to the boom and make off to anchorage points West and East of the tower (Fig.6).

10.7 At approximately 14 metres (40ft) from the tabernacle, pass a 52 metre (150ft) length of rope (item 17) through the boom and tie the ends together to form an endless loop. This loop is to be left coiled on the ground, underneath the boom, to be used later as a boom back stay.

10.8 Haul in on the Tirfor T13 (item 15) until the boom just begins to lift. Ensure that the boom is on the tower centreline by adjusting the side guys as necessary. Check that the lifting strop round the boom is secure and check the alignment of the pulley in the tower head. Continue to haul up the boom, with the supervisor controlling the erection from behind the Tirfor position.

10.9 Before the boom becomes vertical, four men are to be detailed to the boom back guy and are to be positioned as far North as the rope and/or terrain will allow. These men are to gently lower the boom into the keep gate on the tower head when the boom has passed through top dea centre.

10.10 When the boom is resting against the tower head, close and secure the keep gate. Remove the strop and Tirfor rope.

10.11 Reset torque tube onto tower centreline and tighten up pedestal bearings. Make the tube head fast to the North face of tower head.

10.12 Adjust the position of the boom using the hydraulic jack in the tabernacle until the hinge pin can be installed through the boom hinge point and tube head. If the pivot holes do not line up, rotate the torque tube by turning the motor flywheel or by applying power and operating the pedestal by manual operation of the solenoids.

10.13 Remove the boom back guy rope, refit in the same manner as high u the boom as possible, and pass back to the anchorage point South of the tower (Dwg. 90G 107815, Sheet 3, Detail A).

10.14 Fit a 35 metre (100ft) length of rope, forming an endless loop around the boom just above the tabernacle and make fast to the tower (Dwg. 90G 107815, Sheet 3, Detail A).

10.15 Lower hydraulic jack and remove swivel pin from tabernacle. Remove erection swivel from end of boom.

10.16 Refit horizontal bracing and element support tubes, and install element No.16 ensuring that the moisture drain holes face the tower, in accordance with Chapter 3.1, para.15. Fit the shorting coil in accordance with Chapter 3.1, para.19.14.

10.17 Open the keep gate at the head of the tower. Position two men along each side of element No.16, release the loop from the tower and walk the boom out. Fit the windsail in accordance with Chapter 3.1, para.19.15.

10.18 Position three men on the rope loop on the upper part of the boom to pull down as the rope loop on the other end is gently paid out. Continue, adjusting the side guys as necessary, until the boom rests on the mast head, and hold in position.

10.19 Two men are to climb the tower and secure the boom to torque tube joint and the transmission line connection, in accordance with Chapter 3.1, para.19.9 to 19.13.

10.20 Using a Tirfor T7 or the Tirfor T13 used above, pull the torque tube into a vertical position and retain in the top bearing assembly.

10.21 Remove the side guys and rope loops fore and aft.

Gear reducer

11 Remove the gear reducer vent pin, as indicated by the attached red tag, before full operation.

Rotary joint

12 Connect the antenna coaxial feeder to the rotating joint and carry out electrical/pressurization checks on the antenna system. Weather proof the connector.

Pedestal housing

13 Re-install the two halves of the pedestal housing removed in para.2.13, with the gaskets between the two halves at the top, as shown in Fig.7.

14 Check level of oil in gearbox and top up if necessary, using SAE30 oil.

Power supply

15 Connect power supply and control cables via junction box, referring to wiring diagram 90G 110502 as necessary.

Site clearance

16 After completing the erection of the antenna, clear the site of all erection equipment.

Painting

17 The tower structure should be washed down with clean water and given a final coat of micaceous iron oxide; see Dwg. 90G 116319.

TABLE 1 ITEMS LIST FOR FIG.1
(Items extracted from 90G 107655)

Item	Ref./Part No.	Description	Qty
7	90G 107639	Rotator bearing	2
15	90G 107651	Spacer (rotator)	2
29	29A4179170	Nut, hex, $^5/_8$ Whit, galv.	4
30	29C9418639	Washer, lock, $^5/_8$ galv.	4
39	No.127	Eyebolt, $^5/_8$ Whit	2
43	29A1207054	Bolt, hex hd, $^5/_8$ Whit, galv.	4

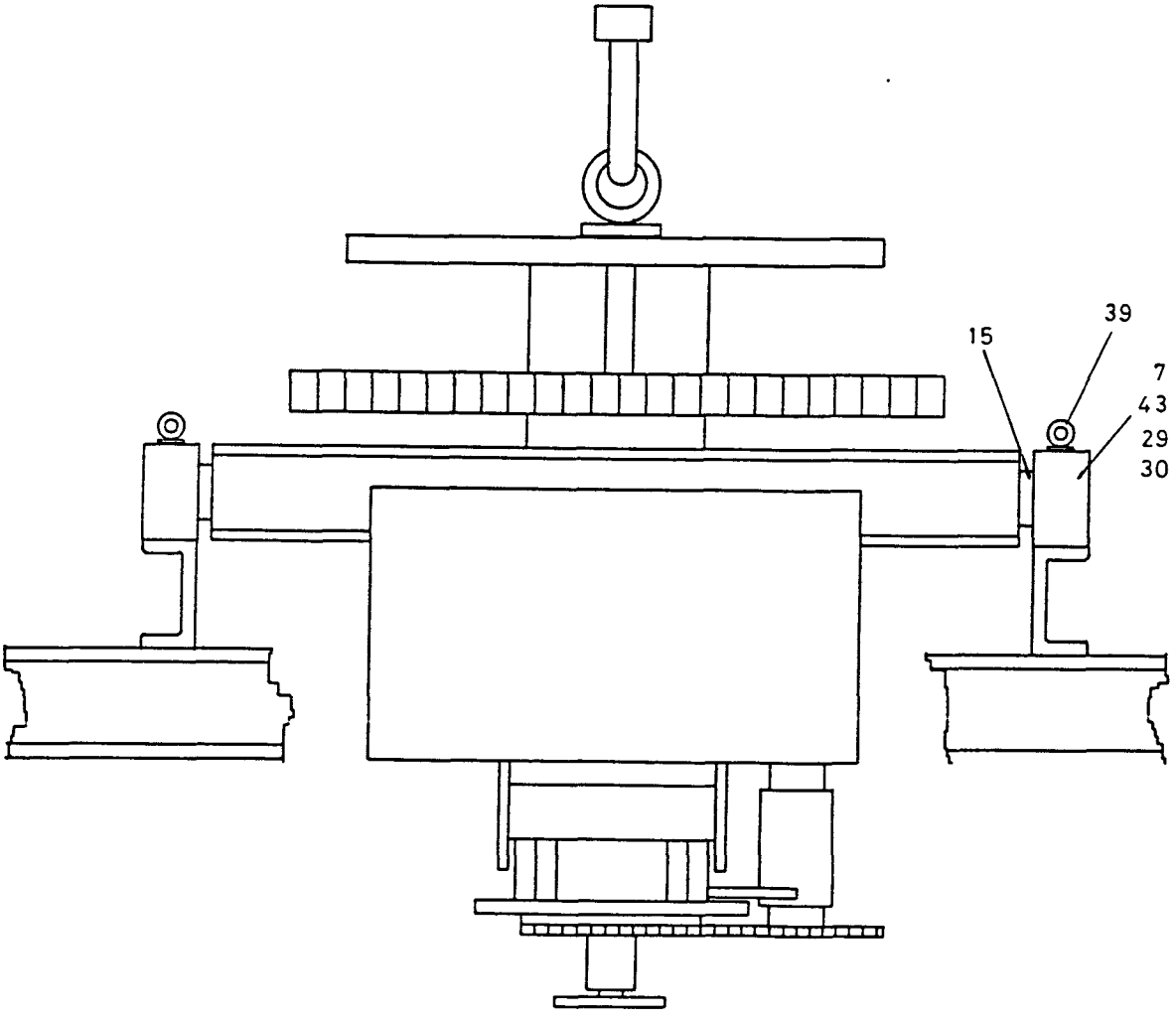


Fig.1 Mounting of pedestal assembly

TABLE 2 ITEMS LIST FOR FIG 2

Item	APC Part No.	Description	Qty	Remarks
206	0001-3985-001	Connector, XMSN line	1	
210	3510-0017-001	O-ring 2-328 (02697)	1	
249	0001-3979-001	Mast section top	1	
250	2077-7909-001	Bolt hex hd 5/8-11 x 2 Galv	12	
251	2100-0131-001	Nut hex 5/8 x 11 Galv	12	
252	2300-0157-001	Washer splitlock 5/8	12	
253	0001-0184-001	Transmission line 20' spr. loaded	1	
278	3530-0023-001	Threadseal, 7500 5/8 (02697)	12	

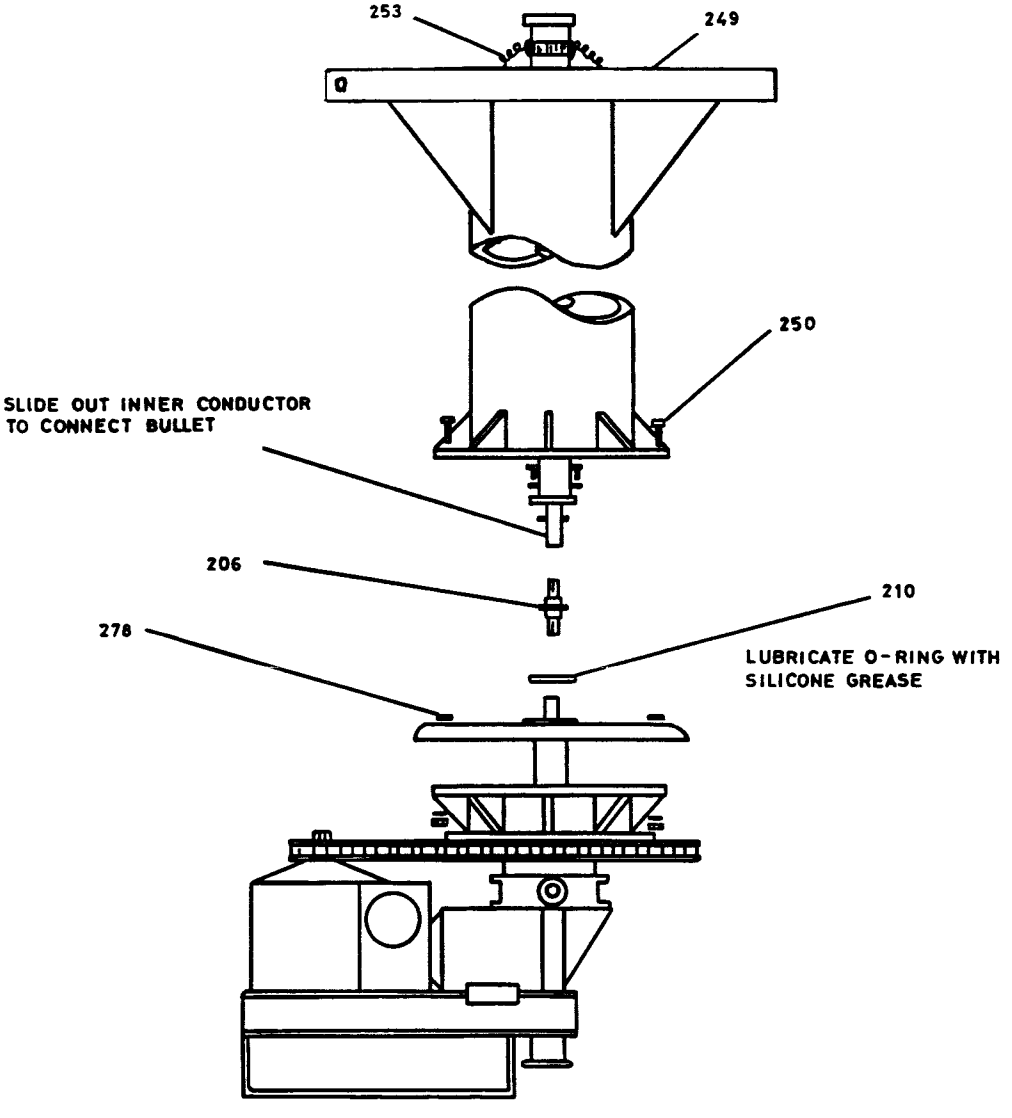


Fig 2 Mast to pedestal installation

TABLE 3 ITEMS LIST FOR FIG 3

(items extracted from 90G 110505)

Item	Dwg No.	Description	Qty	Remarks
2	0001-3979-001	Mast section top	1	
6	1000-0154-001	Transmission line	1	
42	2400-0005-001	Spring extension	4	

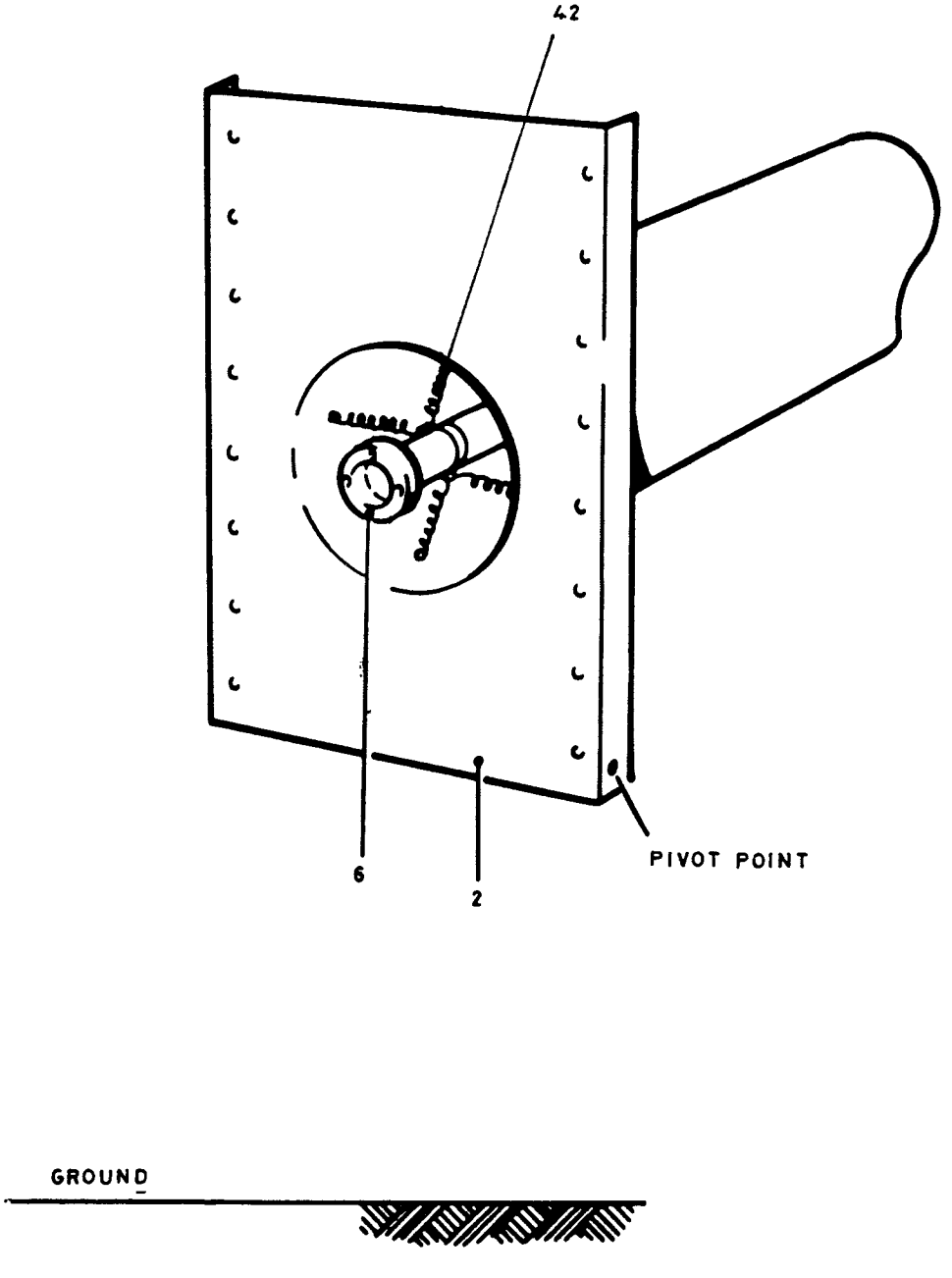


Fig. 3 Mast top section installation

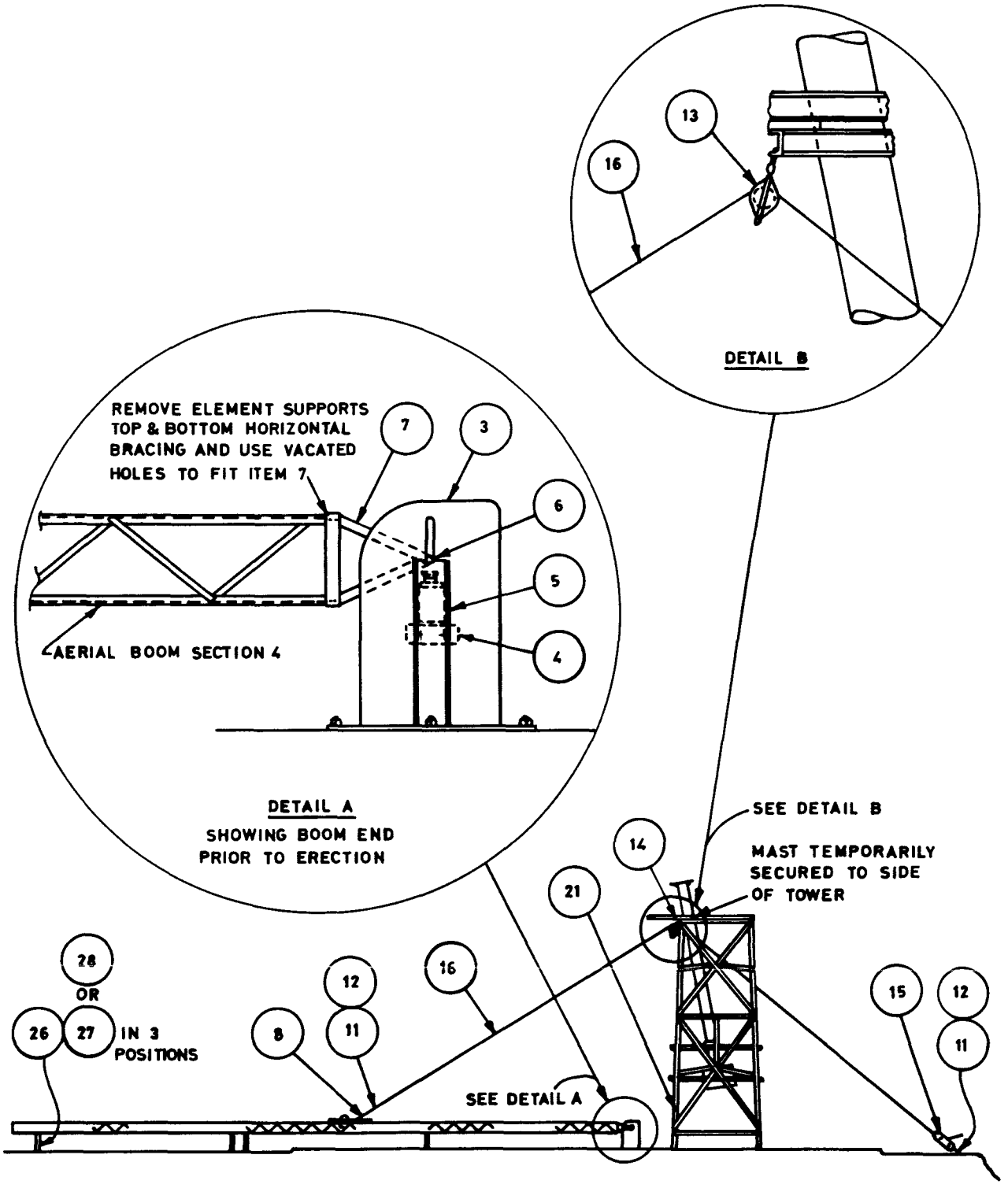


Fig. 4 Boom assembly

TABLE 4 ITEMS LIST FOR FIG 4

(items extracted from 90G 107815)

Item	Dwg No.	Description	Qty	Remarks
3	90G 110119	Tabernacle modified	1	
4	90G 110120	Support, jack	1	
5	90G/SK/	Jack hyd. 3 ton modified	1	
6	90G 110157	Pin, swivel	1	
7	90G 110103	Erection swivel	1	
8		Sling lifting		
		14' long SWL 15 cwt	2	4L/2612
11		Shackle 5/8" Dee	6	28Y/11212
12		Pin, shackle 5/8"	6	28Y/1203492
13		Pulley, single 8" DIA swiveleye	1	WRE Moore
14	90G 110067	Adjuster	1	
15		Tirfor type T13		Ex AFD SEC SCALE
		SWL 30 cwt	1	HOLDING 49B/2046346
16		Tirfor rope, wire		Ex AFD SEC SCALE
		11.3mm x 110 ft lg	1	HOLDING 49B/5238374
21		Junction box	1	WALSALL CONDUITS LTD List No. F41A63 Galv.
26	90G 110409	Bars, carrying - 1 set	1	
27		Coupler, double, alum.	10	30B/2129
28		Coupler, swivel, alum.	10	30B/2130

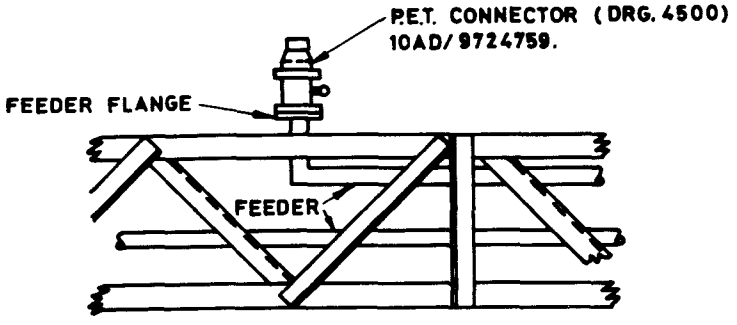


Fig.5 Attachment of pressure test connector

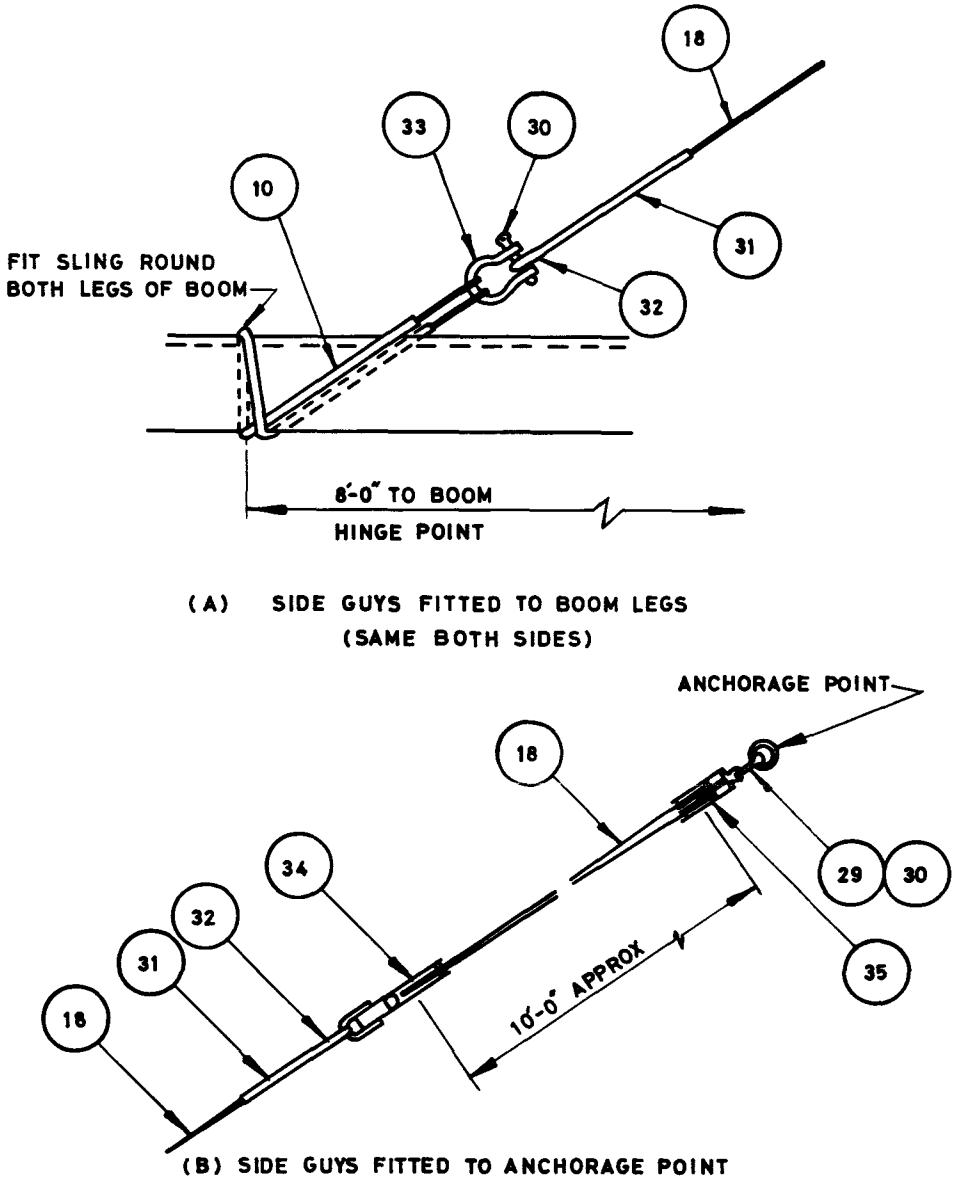


Fig.6 Fitting of guys

Table 5 ITEMS LIST FOR FIG 6

(items extracted from 90G 167815)

Item	Dwg No.	Description	Qty	Remarks
10		Sling lifting 6 ft. long SWL 15 cwt	2	
18		Rope, terylene 3/4 in circ		
29		Shackle dee 3/8"	4	28Y/9563602
30		Pin, shackle 3/8"	8	28Y/9563601
31		Guy grip dead end 35 NADE 1¼ in circ	6	10B/9331568
32		Thimble	6	16H/617
34		Block, single and bracket CAT No 274	3	Gibbs Ltd

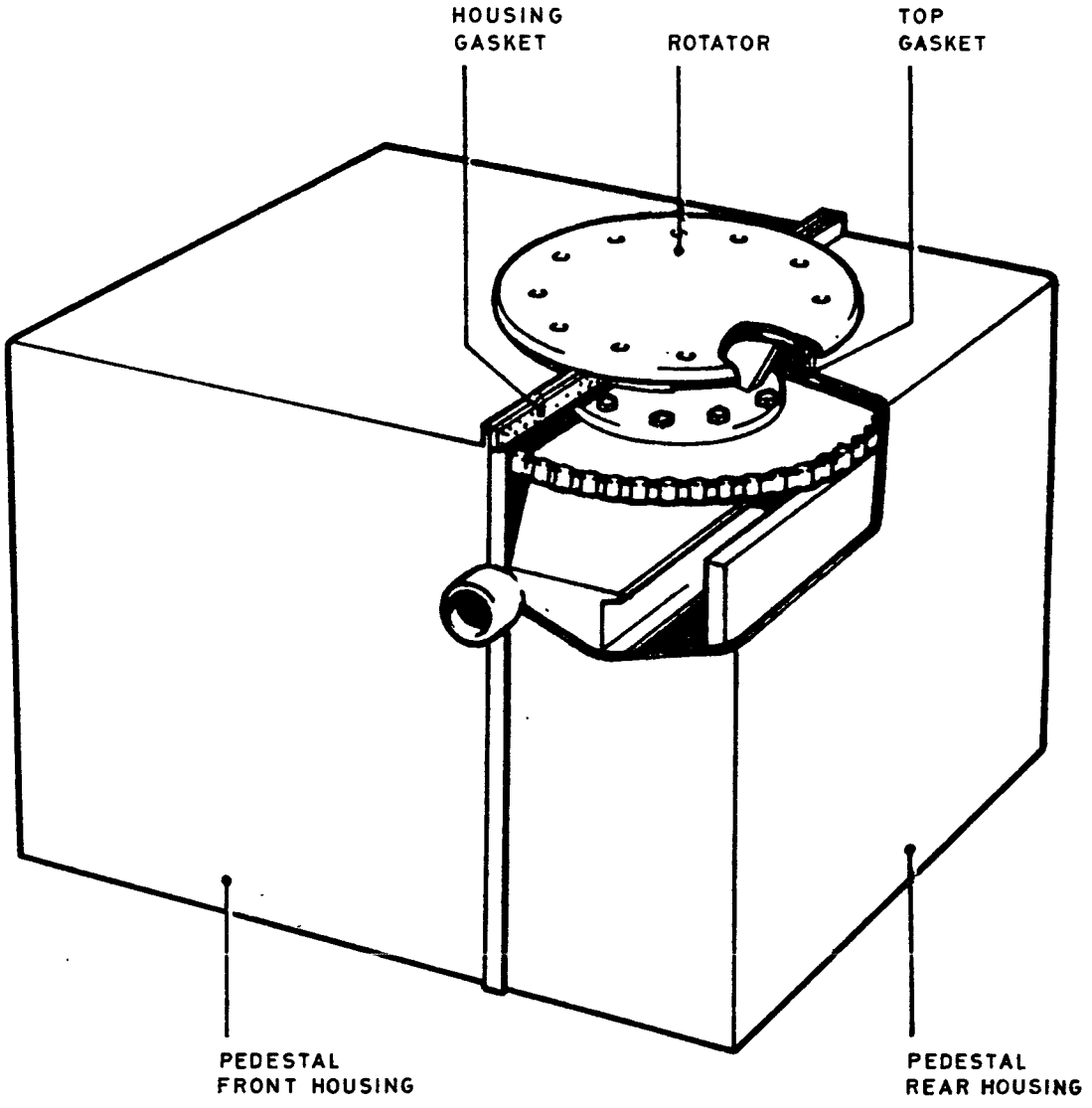


Fig.7 Pedestal assembly

Chapter 4.2

LOWERING THE LPH72 (MODIFIED) ANTENNA

Notes ...

(1) The following paragraphs give, in the correct sequence, the method of lowering the LPH72 (modified) antenna boom assembly.

(2) The item numbers listed refer to those shown on Drg. 90G 107655 unless stated otherwise.

WARNINGS ...

(1) REQUEST THE NCO IC GROUND RADIO MAINTENANCE TO ISOLATE THE ANTENNA SYSTEM IN ACCORDANCE WITH CURRENT PROCEDURES AND DISPLAY APPROPRIATE WARNING NOTICES.

(2) WHERE FITTED, ENSURE THAT THE NITROGEN/AIR PRESSURISATION TO THE FEEDER IS SWITCHED OFF.

Mast Condition Certificate

1 The Team Leader, prior to climbing, is to ensure that a valid Mast Conditioning Certificate is held at the Unit, certifying that the structure is in a safe condition.

Visual safety check

2 Using binoculars as necessary, examine the antenna and its supporting structure for signs of damage which could make climbing/lowering hazardous.

3 At the pedestal, remove the front and rear housings to allow access to the control panel. Safeguard the fixings for re-use later.

Rotate the antenna by manually operating the solenoids of relay assembly 2K1, so that the high frequency elements (shortest) are pointing south. Fine adjustment of the position may be achieved by rotating the drive motor flywheel by hand. Switch off the mains power at the isolator.

4 Disconnect the antenna feeder from the rotary joint below the pedestal unit. Weatherproof the antenna feeder. Ensure the feeder is positioned to avoid damage to it and to the connector.

Preparation for lowering

5 Prepare for lowering the boom assembly.

5.1 Two men are to climb the tower to deploy the lowering equipment.

5.2 Attach two 6ft slings (item 10) to the boom on the tower side, but close to element No.11. To each of these slings attach a 60ft Tirfor rope. Attach two T7 Tirfor winches to the east and west side anchor points. Reeve the two 60ft ropes through these winches.

5.3 Connect the hook of a 110ft Tirfor rope (item 16) to the attachment lug located approximately 4.5m up on the south side of the torque tube. Attach a T13 Tirfor winch to the anchorage point on the south side of the tower. Reeve the 110ft rope through this winch.

5.4 Position a 10mm diameter polyester control rope as far out as can be safely reached on the south side of the boom. Pass the rope through the boom and leave a loop before tying a knot so that it can be reached from the tower when the boom is vertical.

5.5 Release the 10mm diameter polyester rope which is left permanently in position between element 15 and 16, with the end made off to the boom close to the torque tube. This will be used as the northern control rope.

5.6 Disconnect the feeder at the top of the torque tube. Safeguard the parts removed for re-use later.

Note ...

It is advisable to cover the top of the torque tube with a cloth or plastic sheeting, to prevent parts falling inside.

5.7 Position three scaffolding trestles at 4m intervals, with the first one 6m from the tower, so as to support the boom when it is lowered.

5.8 Remove the eastern intermediate support beam complete with the northern bracket, located approximately 3m up the tower. Slacken the two eyebolts either side of the pedestal on the trunnion blocks. This will allow the top end of the torque tube to pivot in a northerly direction when the top collar bearing plate is removed.

5.9 Position men at the side guys and the control ropes to the north and south of the tower. Stabilise the boom by taking up the slack on the side guys.

Note ...

It will be necessary to remove parts of the safety fence, to allow the boom to be lowered onto the trestles.

Lowering the boom assembly

6 Lower the boom assembly as follows:-

6.1 Open the top bearing plate at the tower head. Haul on the northern control rope and pay out on the T13 Tirfor winch until the torque tube is resting against the northern side of the tower. Secure the torque tube to the tower with 10mm diameter polyester rope. Secure the southern control rope to the southern anchorage.

6.2 Bolt the jack (item 5) and the swivel pin (item 6) to the tabernacle.

6.3 At the headplate joint, remove the twelve nuts, bolts and lock washers which attach the boom to the torque tube, together with the two reinforcing plates. Safeguard these parts for re-use. Slacken, but do

not remove, the 5/8 inch nut at the end of the hinge pin.

6.4 Open the keep gate on the north side of the tower. Haul down on the northern control rope whilst restraining on the southern control rope to tilt the boom. Guide it towards the keep gate by adjusting the side guys.

6.5 Tilt the boom sufficiently to allow removal of the windsail, the shorting coil, element No.16 complete with its insulator mounts and the upper and lower horizontal braces. Use the nuts, bolts and washers, just removed, to attach the boom erection swivel (item 7) to the end of the boom.

6.6 At the tower head close and secure the keep gate.

6.7 At the tabernacle raise the jack until it just starts to take the weight of the boom.

6.8 Fit the snatch block (item 13) to the U-bolt on the north side of the tower head.

6.9 Pass the leather covered sling (item 8) twice around and through the boom just below the hinge pin. Join the tails of the sling using the shackle (item 11) and pin (item 12). Unhook the Tirfor rope (item 16) from the attachment point on the torque tube and attach it to the shackle. Reeve the Tirfor rope through the snatch block.

6.10 Take up the slack on the T13 Tirfor winch.

6.11 Transfer the southern control rope to the opposite side of the boom for use as the northern control rope, run out in a northerly direction.

6.12 At the boom/torque tube interface, undo the 5/8 inch nut and remove the hinge pin. If necessary, raise or lower the jack slightly to facilitate this.

6.13 At the tabernacle, lower the jack so that the erection swivel rests on the tabernacle base.

6.14 Open the keep gate. Haul on the northern control rope and pay out on the T13 Tirfor winch until it just clears the torque tube interface.

6.15 Slacken off the 10mm diameter polyester rope securing the torque tube to the tower and pull it towards the east side of the tower to clear the T13 Tirfor rope. Resecure the torque tube with the polyester rope.

6.16 Lower the boom by hauling on the northern control rope and paying out on the T13 Tirfor winch. Adjust the side Tirfor winches as necessary. Avoid inducing oscillation in the boom due to the operation of the T13 Tirfor winch.

6.17 As the weight of the boom comes on to the trestles, adjust their position to support the boom without damage.

6.18 Refit any sections of safety fence which were removed during lowering.

6.19 If the boom is to remain in the horizontal position overnight, or if rain or mist is forecast, pressurise the feeder in accordance with 90G/107815, sheet 2, detail D and tape over the element drain holes which are now facing upward.

6.20 Refit the protective covers on the pedestal.

6.21 Carry out maintenance work on the boom. Refer to chapter 4.1, para.10, for instructions for restoring the boom assembly to its operating position.

6.22 When the boom assembly has been re-erected, tie off the northern control rope (attached between elements 15 and 16) to the boom close to the torque tube.

Chapter 5

LPH 9

Details to be issued later

Chapter 6.0

REMOTE CONTROLS

Introduction

This chapter describes the remote controls which are used with the LPH series of antennas.

Chapter 6.1 - Continuous remote control

Chapter 6.2 - Stepped remote control

Chapter 6.3 - Computer remote control

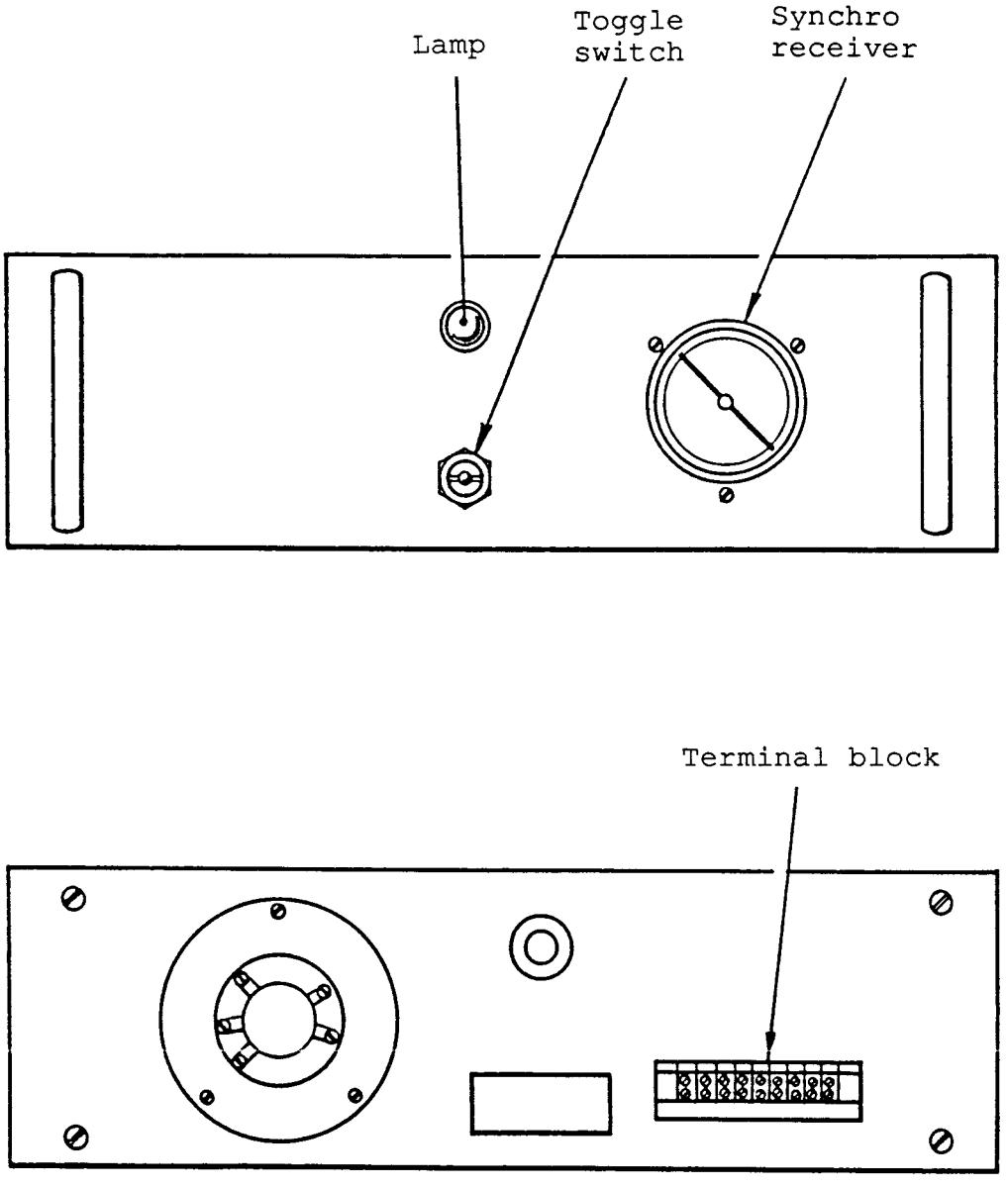


Fig.1 Remote control unit

Continuous control

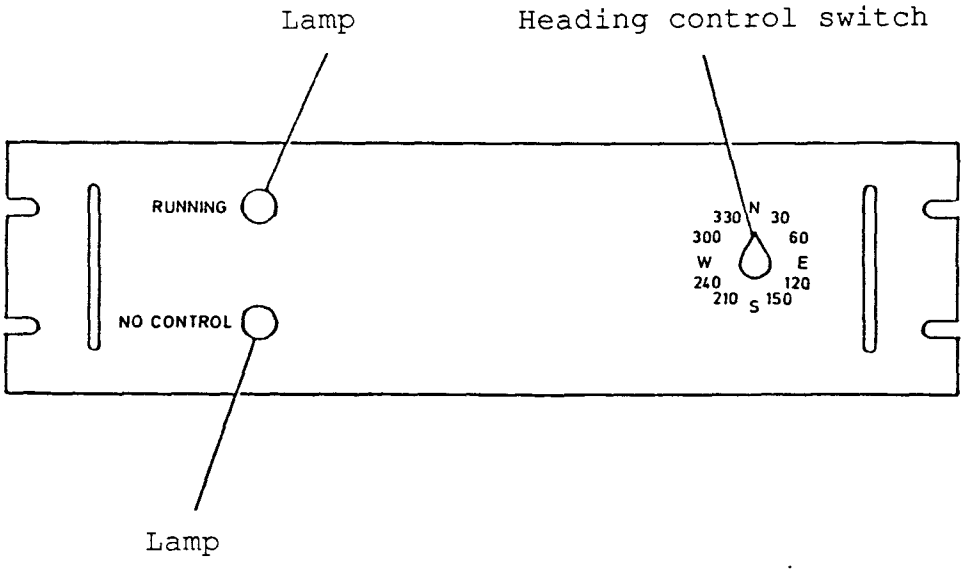
Chapter 6.2

STEPPED REMOTE CONTROL

1 In the stepped remote control system the antenna is remotely rotated by setting a twelve-position rotary switch to a position corresponding to the desired heading of the antenna. This causes the antenna to rotate. As the antenna rotates, a gear driven switch with an open contact rotates in sympathy with the antenna. When the open contact reaches the position which corresponds with the setting of the switch in the remote control, rotation ceases. The switch wiring is arranged so that the antenna always takes the shortest route from its present position to the new one selected.

2 Two signal lamps are provided. The RUNNING lamp lights when the antenna is rotating. The NO CONTROL lamp lights when LOCAL control is selected at the antenna control unit and operation by the remote control unit is not then possible.

3 The remote control unit is illustrated in fig.1 and its circuit diagram appears in chap.1, fig.5. Connections to the remote control unit are made via the terminal block.



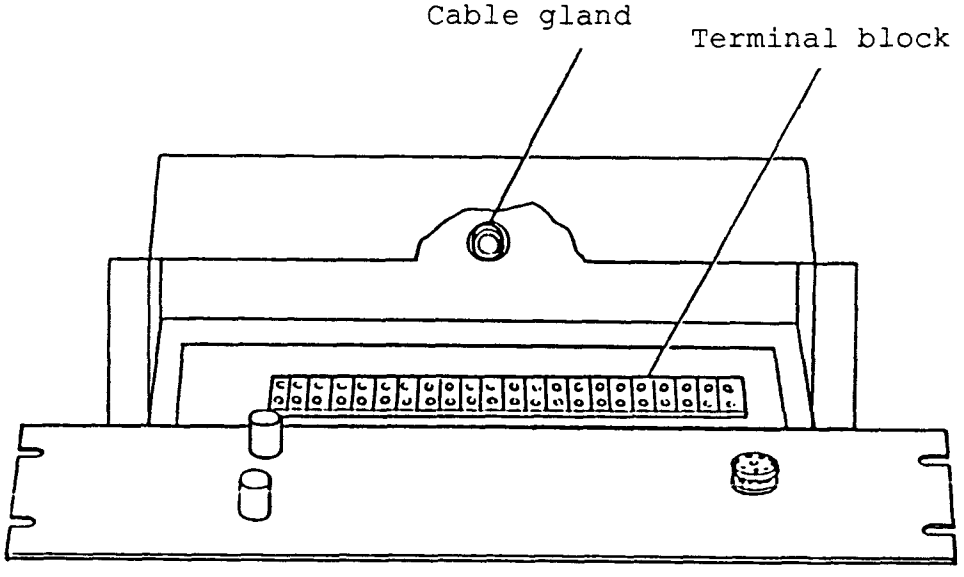


Fig.1 Remote control unit

Stepped control

Chapter 6.3

COMPUTER REMOTE CONTROL

CONTENTS

CAUTION

Electrostatic Sensitive Devices. This equipment contains electrostatic sensitive devices. To avoid damage, handle in accordance with BS5783.

Introduction

1 Using this control system, operation of the antenna and its associated transmitter (or receiver) can be carried out by a a pre-programmed computer management system. At selected times the transmitter can be shut down, the antenna rotated to a different bearing, the transmitter frequency changed, if necessary, and the transmitter power then restored. Both LPH73 and LPH72 antennas can be controlled by this system.

2 A gear driven synchro transmitter at the antenna is used to indicate the antenna bearing. The three phase 50Hz signal from the synchro is decoded electronically and used to operate a three digit l.e.d. display on the panel. The antenna bearing is indicated from 000 degrees to 359 degrees in one degree increments. A keypad on the panel allows manual operation of the antenna. CW and CCW indicator lamps show in which direction the antenna is rotating.

3 When switched from REMOTE to COMPUTER the various functions are controlled by the computer. A status request from the computer results in the displayed antenna bearing being transmitted to the computer. A rotate request from the computer results in antenna rotation to the requested bearing.

4 Up to a maximum of sixteen controllers may be connected in parallel to the computer, by means of a common line. Four preset switches in the controller provide sixteen selectable addresses. Only the controller addressed by the computer will respond; commands addressed to other controllers will be ignored.

5 A facility is provided to allow the displayed bearing to be corrected to the true bearing of the antenna. Ten preset switches in the controller are used to add an azimuth correction in various sized increments of degrees. No mechanical adjustment at the antenna is necessary to achieve this.

6 When the antenna is operated under LOCAL control from the control panel at the pedestal, the remote control is disabled. Power is still available to the remote control unit which continues to indicate the antenna bearing. The CW and CCW lamps also continue to indicate antenna rotation.

7 Power for the remote control unit is obtained from the 110V ac supply in the antenna pedestal. This is provided by a double-wound transformer whose primary is connected between one of the three-phase lines and neutral. One side of the 110V ac supply is earthed in the antenna pedestal and is connected to the chassis of the remote control unit, which is also earthed.

8 Before installing the computer control unit ensure that the antenna rotates correctly at the pedestal i.e. antenna turns clockwise when CW switch is operated. If incorrect, the remedy is to reverse any two of the three 415v incoming power supplies.

Operation of the unit

9 Set the POWER switch to the ON position. The POWER lamp will light and characters will appear in the l.e.d. display corresponding to the bearing of the antenna. Set the REMOTE/COMPUTER switch to REMOTE. The REMOTE CONTROL lamp will light. All operations are now under the control of the keypad on the panel.

10 Enter a new bearing by pressing the desired keys on the keypad. The entered bearing will be indicated on the display in place of the current bearing of the antenna. The digits will be scrolled to the left and any leading zeros will be suppressed. Errors can be corrected by continuing to enter digits until the desired bearing is indicated by the display. When the desired bearing is indicated, press the ENTER key and the controller will then rotate the antenna to the desired bearing. The digital display must indicate the same direction as the turning indicator i.e. display going clockwise then clockwise indicator lamp lit. If not, refer to paragraph 8. After the ENTER key is pressed the display reverts to indicating the antenna bearing. If the entered bearing is within 5 degrees of the present bearing, the command will not be accepted and the antenna will not rotate. During the rotation and for 11 seconds after rotation stops, the controller will not accept a new bearing. Bearings greater than 359 degrees will be ignored.

11 To operate the controller from the computer, set the REMOTE/COMPUTER switch to COMPUTER. The COMPUTER CONTROL lamp will light and the REMOTE CONTROL lamp will go out. To enable operation by the computer, the baud rate links (see para.34) and the address switches (see para.35) must first be correctly set.

12 The controller will generate an output message only in response to a valid input message. All messages to and from the controller are composed of seven ASCII characters. The controller ignores the parity bit of each character and returns only even parity. Two types of input messages are accepted by the controller, a status request and an azimuth (bearing) command. The responses to these input messages are shown in Table 1.

13 The controller will begin sending the output message within one character time after the end of the input message. Any errors in the input message to the controller will result in the controller not producing an output message. The formats of the input and output messages are shown in Table 2. The encoding of the unit address is shown in Table 3.

Physical arrangement

14 The controller, see fig.2, is housed in a cabinet with a 5 1/4 in x 19 in front panel and is designed for rack mounting. The front and rear panels are shown in fig.3. The front panel carries the switches, lamps, keypad and display. The rear panel carries a plug and a socket for the input and output connections, and also a bolt for the earthing connection.

15 Removal of the top cover allows access to the interior of the unit. A microcomputer pc board assembly is fixed to the bottom plate of the unit. A smaller interface pc board assembly is mounted on brackets fixed to the left hand side panel. The two pc boards are interconnected by several ribbon cable assemblies and a multi-way connector allows disconnection of the interface pc board to permit its removal for access and testing. A modular power supply unit provides dc power supplies to the pc board assemblies.

Circuit description

16 The microcomputer is a single pc board assembly which utilises a 6502 microprocessor. Fig.6 shows a simplified diagram of the microcomputer. The board contains 1024 bytes of Random Access Memory (RAM), 2048 bytes of Read

Only Memory (ROM), four 6522 Versatile Interface Adaptors (VIA), a Universal Asynchronous Receiver Transmitter (UART) and the necessary circuits to provide an RS-232C interface. Each VIA provides two eight-bit Input/Output (I/O) ports and two timers. Each bit of each I/O port may be individually defined as an input or an output. Thus, the four VIAs provide a total of 64 I/O lines. The assignment of these 64 I/O lines is given in Table 4. The operation of the computer board is controlled by the program instructions contained in the ROM and is described in the section on Program Operation (para.24 to 32).

17 The baud rate of the RS-232C interface is controlled by one of the timers in the A5 VIA. The clocking signal produced by this timer is supplied to UART and is 16 times the baud rate. The frequency of this signal may be measured at test point TP1 on the microcomputer board.

18 A simplified diagram of the display used in the controller appears in fig.7. The output to the display is in Binary Coded Decimal (BCD) form. The display is an assembly of three seven-segment Light Emitting Diode (LED) indicators. Contained on the rear of each display is a decoder which converts the BCD format into the seven-segment format required by the indicator. The decoder also includes the necessary drivers to drive the indicator segments. The decoder is connected to suppress leading zeros.

19 A simplified diagram of the Synchro/Digital converter interconnection appears in fig.8. The S/D converter receives 110V ac at the reference input. It also receives a three-phase signal from the synchro transmitter at the antenna. The S/D converter converts these ac signals into a ten-bit digital output. The microcomputer feeds an inhibit signal to the S/D converter when the S/D output is sampled. The inhibit input to the S/D converter is taken low prior to the microcomputer reading the output from the converter. This action produces a stable indication from the S/D converter. At the conclusion of the read cycle, the inhibit input is returned to a high state.

20 A simplified diagram of the keyboard interconnection appears in fig.9. The keyboard is composed of eleven normally open switches. Each switch is connected to an individual output line. The other side of each switch is connected to earth. Pull-up resistors are used to maintain the outputs at a high state when the keys are not depressed.

21 The interconnection of the input and output couplers is shown in fig.10. The input coupler is connected to +5V dc and earth. When 110V ac is applied to the coupler, the output of the coupler is switched from a high state to a low state. Pull-up resistors on the inputs maintain the outputs at a high state in the absence of an input. The output couplers are connected to the microcomputer through line drivers U4C and U4D. The line drivers provide the necessary current drive to the output couplers. The output from the microcomputer is normally a high state signal. The line drivers invert this signal and provide a low state signal to the output couplers.

22 When the antenna is to be rotated, the microcomputer switches one of the output signals from a high state to a low state. The signal is inverted by the line driver and a high state signal is thus fed to the output coupler. This high state input causes the output coupler to switch the ac circuit at its output terminals and this causes the antenna to rotate.

23 A simplified diagram of the azimuth correction switches, the address switches and the baud rate selector links appears in fig.11. Both the azimuth correction and address switches are wired to place an earth on the associated output line when they are closed. Pull-up resistors are used to maintain the output lines at a high state when the switches are open. Ten lines are used for azimuth correction and four lines are used for unit address. The ten lines used for azimuth correction are encoded in a BCD format with a line being used for each of the tens and units digits. The baud rate selection is by means of three lines which are linked to either earth or +5V dc.

24 The line receivers and line drivers U1, U2, U3 and part of U4 are concerned with the ability of the controller to operate with the RS-422 and RS-423 interface conditions, as are the straps A, B, C, D, E and F. These facilities are not used in the present application and are therefore ignored.

Program operation

25 The microcomputer operation is controlled by a program contained in a Read Only Memory (ROM). The inputs to the microcomputer are the azimuth information from the synchro at the antenna and the outputs from the keyboard (or the external controlling computer). The outputs from the microcomputer are the display data and the control signals to the antenna rotator (also the responses to the controlling computer).

26 On application of power, the microcomputer accesses the azimuth correction information, the unit address and the baud rate information which are provided by switches and links on the interface pc board. This data is stored in the memory of the microcomputer. The baud rate information is used to preset timers in the microcomputer to provide the proper baud rate from the serial interface. At this time, all of the I/O lines to and from the microcomputer are initialized. The display is loaded with 000 and the serial interface is cleared.

27 A simplified flow chart of the operation of the program after the initialization sequence appears in fig.12, 13 and 14. The synchro transmitter in the antenna rotator produces a three phase ac signal which indicates the antenna position. This signal is applied to the Synchro to Digit (S/D) converter on the interface pc board. The (S/D) converter digitizes the signal and provides a ten-bit digital signal to the microcomputer. The azimuth of the antenna is a relative azimuth. The difference in orientation and what the LED display indicates is already entered by means of the azimuth correction switches. This angle will be added to the azimuth from the S/D converter, adjusted to the range of 000 to 359 degrees and fed to the display. Thus the display indicates the true heading of the antenna.

28 The microcomputer continuously scans the remote control line via input coupler A7 to determine if control of the antenna is extended to the controller. If the control line is on, the microcomputer then scans the REMOTE/COMPUTER switch to determine if keyboard control is necessary. If this switch is in the REMOTE position, the microcomputer then scans the keyboard for input. If no keys are depressed, the microcomputer then repeats the above cycle.

29 If a key on the keyboard is depressed, the microcomputer will blank the

display screen and then decode the keyboard output to determine which key is depressed. If the key is not the ENTER key, this digit is entered into the right hand digit of the display. A flag is set in the memory to inhibit the reading and display of current antenna azimuth. The keyboard continues to be scananed and, upon receipt of another digit, the display is scrolled to the left and the new digit is entered into the right hand position. When the ENTER key is depressed, the azimuth is recalled from the display and checked, to ensure that it is in the range of 000 to 359. If it is not, the azimuth is discarded and display of the antenna azimuth is resumed. If the azimuth is acceptable, the azimuth is converted from a true heading to a relative heading by subtracting the azimuth correction. The resulting azimuth is adjusted to the range 000 to 359 degrees and compared with the current azimuth to determine in which direction the antenna is to be turned. The programme is arranged to take the shortest path to the new heading. If the requested azimuth is within 5 degrees of the current antenna azimuth, the antenna is not rotated. The requested azimuth is adjusted by 3 degrees, so that power to the antenna motor is cut off 3 degrees before the requested heading is reached. This is to allow for the slowing down of the motor and deceleration of the antenna. After this adjustment, the output command is issued to the output coupler for the desired rotation direction.

30 At this time, the microcomputer again displays the antenna heading on the display. While the antenna is rotating, the microcomputer compares the antenna azimuth with the requested azimuth. When the two azimuths are equal (within 3 degrees), the microcomputer removes the rotate signal from the output coupler, thus stopping the antenna rotation. The microcomputer times the rotation period. If the rotation exceeds the maximum time allowed of 3 minutes, the rotate command is reset and the rotate fault flag is set. When the antenna rotation ceases, the microcomputer starts an 11 second timer. This timer inhibits the controller from rotating the antenna during this period. During the 11 second time out period, keyboard entry is inhibited. This ensures that the antenna comes fully to rest before rotating further.

31 If the microcomputer finds the REMOTE/COMPUTER switch in the COMPUTER position, the keyboard is not scanned. On each pass through the program, the microcomputer scans the serial interface for incoming characters. All characters are examined and discarded until an STX character is received. The buffer which will receive the incoming message is initialised and the next five characters are stored in the buffer. If an ETX character is received prior to the sixth character, the contents of the buffer are discarded and scanning for an STX character is resumed. When six characters are received, the contents of the buffer are examined to determine that the STX, ETX and address characters are correct. The address character must match the address set into the switches on the interface pc board. If this test is satisfied, the three command characters are examined, to determine if the command is a status request or an azimuth command. If the three characters are not either a status request or an azimuth command, the message is ignored and the controller reverts to its normal scanning. If the command is a status request, the azimuth indication from the antenna is examined. If the remote control line is not on or if the REMOTE/COMPUTER switch is in the REMOTE position, the microcomputer generates a Local message (LLL). Next, the rotation time fault flag is examined. If this indicator is on, the fault is then coded into the Fault message (F10). If no fault exists, the motion indication is examined and if it is on, a Rotating message (RRR) is generated. If the antenna is not rotating, the current antenna heading is obtained from the display and encoded into an azimuth message (000 to 359).

32 If the incoming message is an azimuth command, the azimuth is examined to determine if it is in the range of 000 to 359 degrees. If the azimuth is outside these limits, the request is ignored and no response is sent. If the azimuth is acceptable, the rotation and time delay timers are examined. If either timer is not zero, a Busy message (BBB) is sent and the request is discarded. If both timers are zero, the azimuth is corrected by the subtraction of the azimuth correction and adjusted to the range of 000 to 359 degrees. A Rotating message (RRR) is generated and the antenna is rotated as described in the previous paragraph.

33 The output message is then placed in the output buffer and the first character delivered to the serial interface. As each character is sent from the serial interface, the next character is obtained from the buffer and transmitted. This continues until all characters have been sent.

Selection of baud rate

34 The controller can operate at 110, 150, 300, 600 and 1200 baud for reception and transmission of messages. Wire links, soldered in position, are used to select the required baud rate (see table on fig.1). These links are located on the interface pc board.

Selection of unit address

35 Sixteen unit addresses are selected by setting the switches U9-3 to U9-6 in accordance with Table 3. The switches are located on the interface pc board and are identified in fig.1. The controller power must be turned off and back on again for a changed address to be accepted.

Azimuth correction

36 To enable the controller to display the correct heading for the antenna, an azimuth correction angle must be set into the controller at the time of installation. The correction angle is the clockwise angle from the bearing indicated to the actual true bearing of the antenna. This angle must be between 0 and 359 degrees.

37 All the azimuth switches on the interface PC board must be in a closed position (on) prior to setting up correction factor. If not, turn the controller power off, set the switches by closing switch U8 numbers 1-8 and switch U9 numbers 1 and 2. Turn the controller power on and note the bearing of the antenna indicated.

38 As an example of an azimuth correction, the switches would be set for a correction of 176 degrees as follows:-

SWITCH	CORRECTION DEGREES	SETTING	DEGREES SELECTED
U8-1	200	Closed	-
U8-2	100	Open	100
U8-3	80	Closed	-
U8-4	40	Open	40
U8-5	20	Open	20
U8-6	10	Open	10
U8-7	8	Closed	-
U8-8	4	Open	4
U9-1	2	Open	2
U9-2	1	Closed	-
		TOTAL	176

CAUTION ...

Do not simultaneously open both U8-3 (80 degrees) and U8-4 (40 degrees), nor open U8-7 (8 degrees) and U8-8 (4 degrees). Instead use U8-2 (100 degrees) and U8-5 (20 degrees) for 120 degrees and use U8-6 (10 degrees) and U9-1 (2 degrees) for 12 degrees. Use of the banned combinations above will produce abnormalities in the readout.

TABLE 1 INPUT AND OUTPUT MESSAGES

INPUT MESSAGE RECEIVED	ANTENNA CONDITION WHEN INPUT MESSAGE WAS RECEIVED	OUTPUT MESSAGE RETURNED
Status Request	Not rotating - no faults	Current Azimuth
	Antenna rotating	Rotating
	Antenna exceeded maximum rotate time the last time it was commanded to rotate. (See Note 1)	Fault 10
Azimuth Command	Antenna not rotating	Rotating
	Antenna rotating or 11-second time-out after rotation stops.	Busy
	Any fault condition (Next status request will return the fault indicator).	Rotating

NOTE 1. The rotate time is reset by the next azimuth command.

TABLE 2 FORMAT OF MESSAGES

INPUT MESSAGE

CHARACTER NUMBER	CHARACTER (ASCII)	HEX EQUIVALENT
1	STX	X'02
2	ADDRESS	See Table 3
3	COMMAND	
4	COMMAND	
5	COMMAND	
6	ETX	X'03

The command string for a rotate request is three ASCII characters in the range of 000 to 359.
The command string for a status request is three ASCII characters of SSS (S=X'53).

OUTPUT MESSAGE

CHARACTER NUMBER	CHARACTER (ASCII)	HEX EQUIVALENT
1	STX	X'02
2	ADDRESS	See Table 3
3	RESPONSE	
4	RESPONSE	
5	RESPONSE	
6	ETX	X'03

The response string is as follows:

AZIMUTH	000 to 359	Azimuth in Degrees
Busy	BBB	Controller Cannot Accept Azimuth Command
Rotating	RRR	Antenna Currently Rotating
Local	LLL	Controller in Local Mode
Fault	F10	Rotate Time-Out Fault

TABLE 3 UNIT ADDRESSES

ADDRESS CHARACTER	ADDRESS CODE	U9-3	SWITCH POSITIONS U9-4	U9-5	U9-6
@	0	CLOSED	CLOSED	CLOSED	CLOSED
A	1	CLOSED	CLOSED	CLOSED	OPEN
B	2	CLOSED	CLOSED	OPEN	CLOSED
C	3	CLOSED	CLOSED	OPEN	OPEN
D	4	CLOSED	OPEN	CLOSED	CLOSED
E	5	CLOSED	OPEN	CLOSED	OPEN
F	6	CLOSED	OPEN	OPEN	CLOSED
G	7	CLOSED	OPEN	OPEN	OPEN
H	8	OPEN	CLOSED	CLOSED	CLOSED
I	9	OPEN	CLOSED	CLOSED	OPEN
J	10	OPEN	CLOSED	OPEN	CLOSED
K	11	OPEN	CLOSED	OPEN	OPEN
L	12	OPEN	OPEN	CLOSED	CLOSED
M	13	OPEN	OPEN	CLOSED	OPEN
N	14	OPEN	OPEN	OPEN	CLOSED
O	15	OPEN	OPEN	OPEN	OPEN

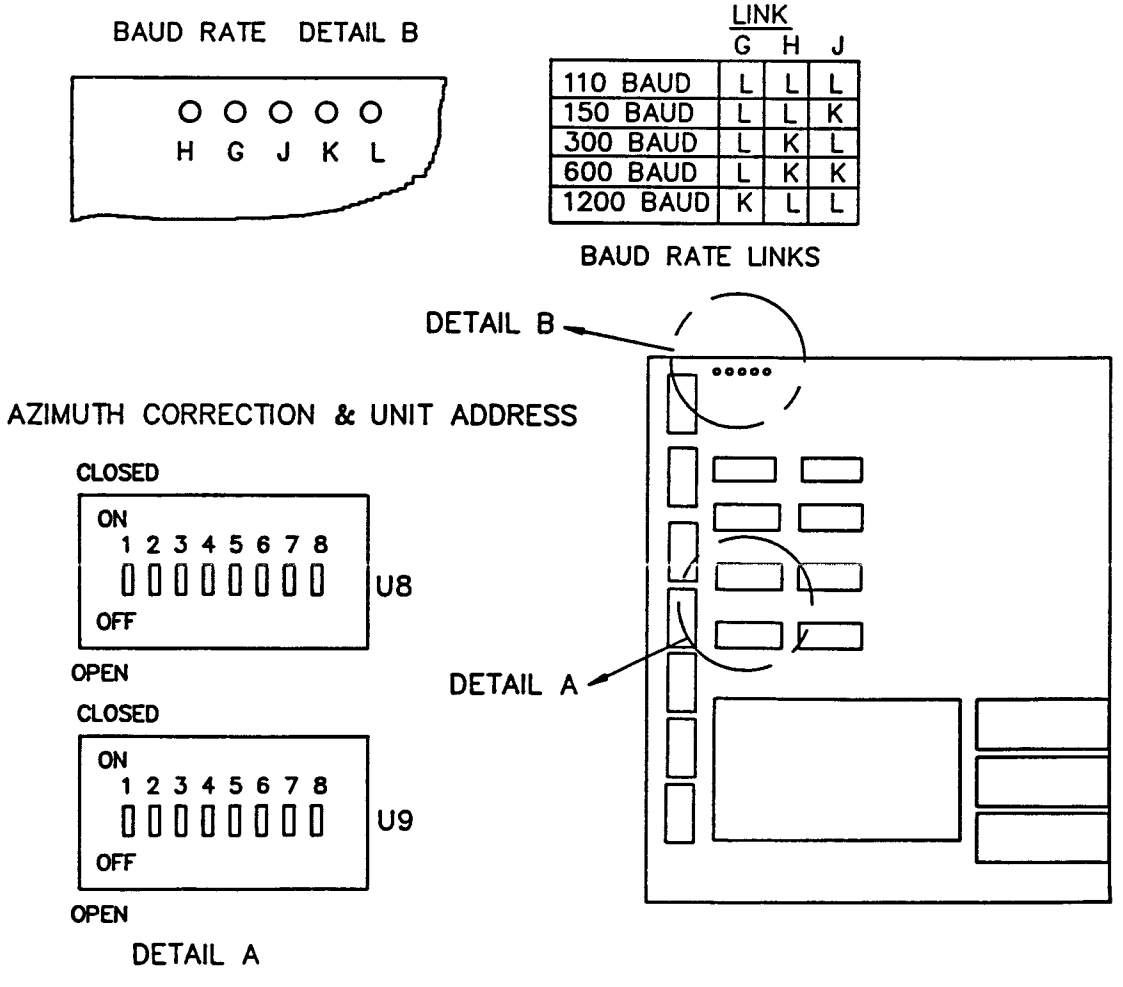


Fig.1 Azimuth correction, unit address and baud rate selection

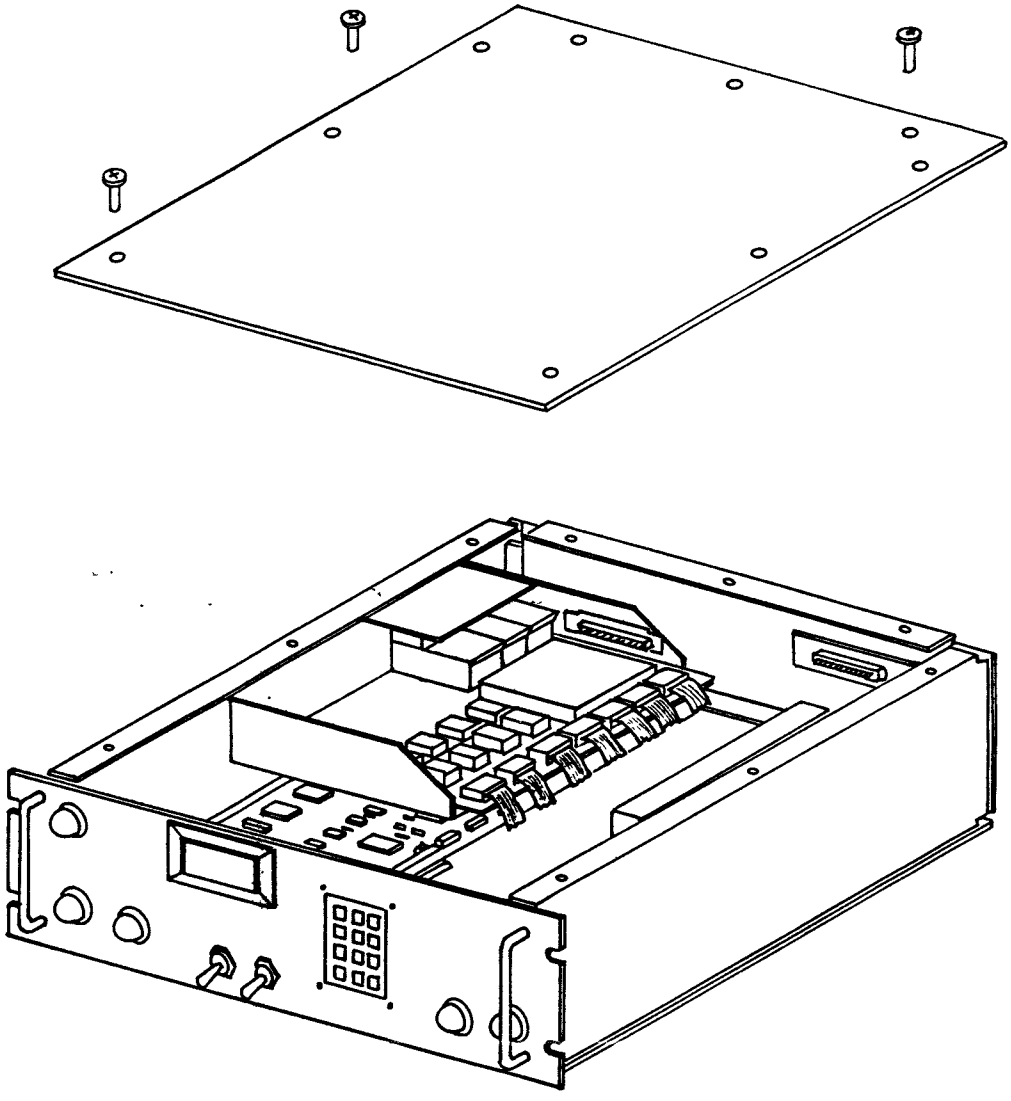
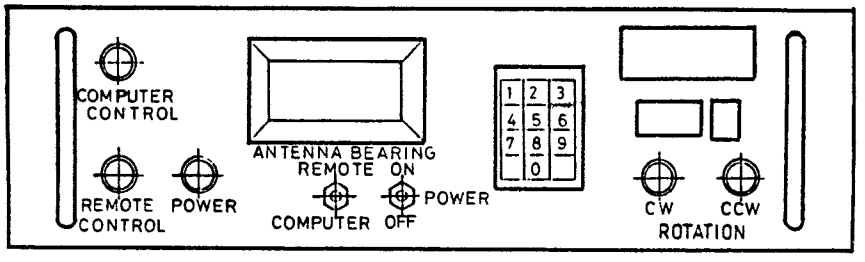


Fig.2 Computer remote control



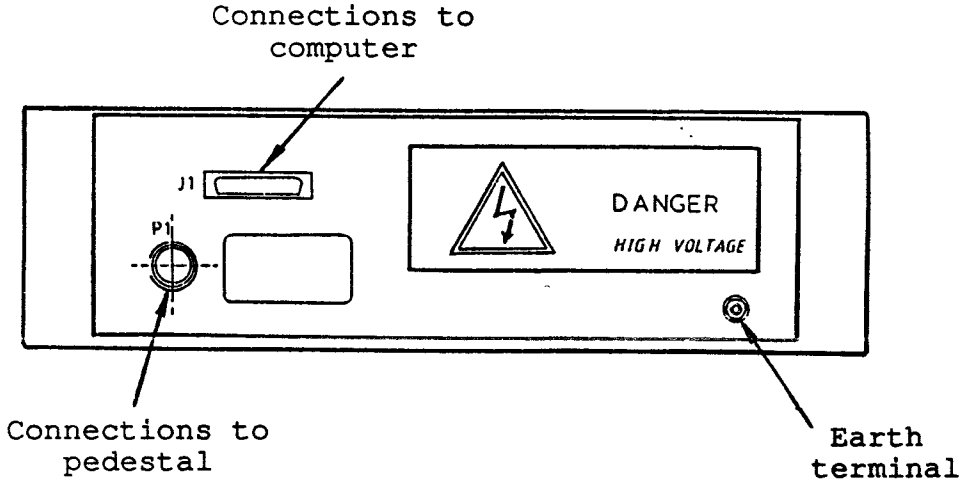


Fig.3 Front and rear panels

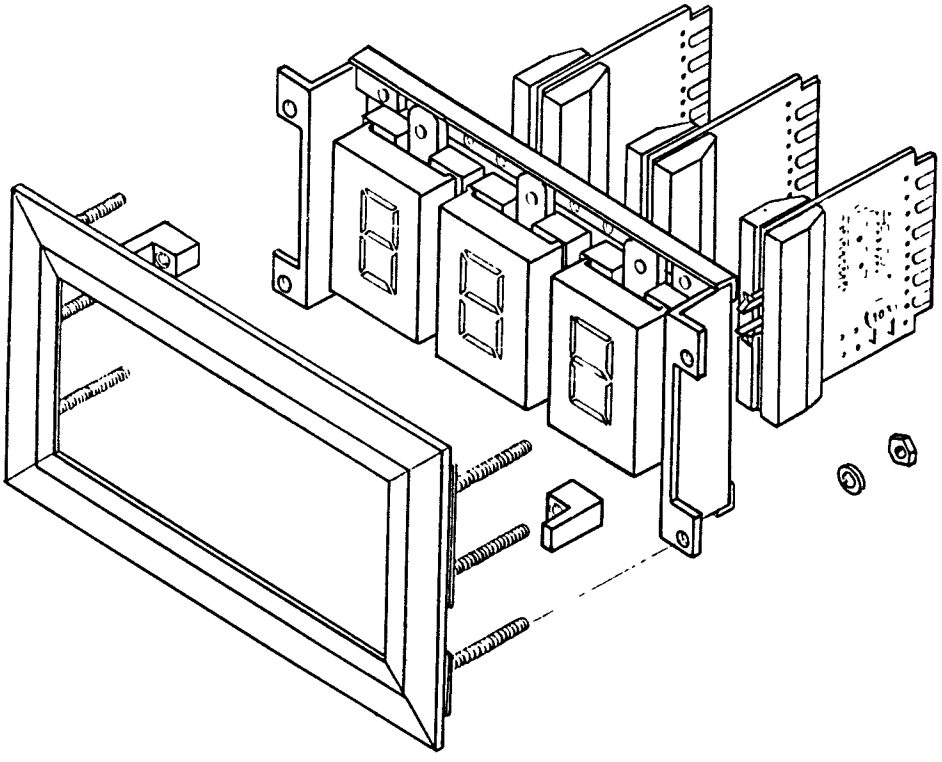


Fig.4 LED indicator assembly

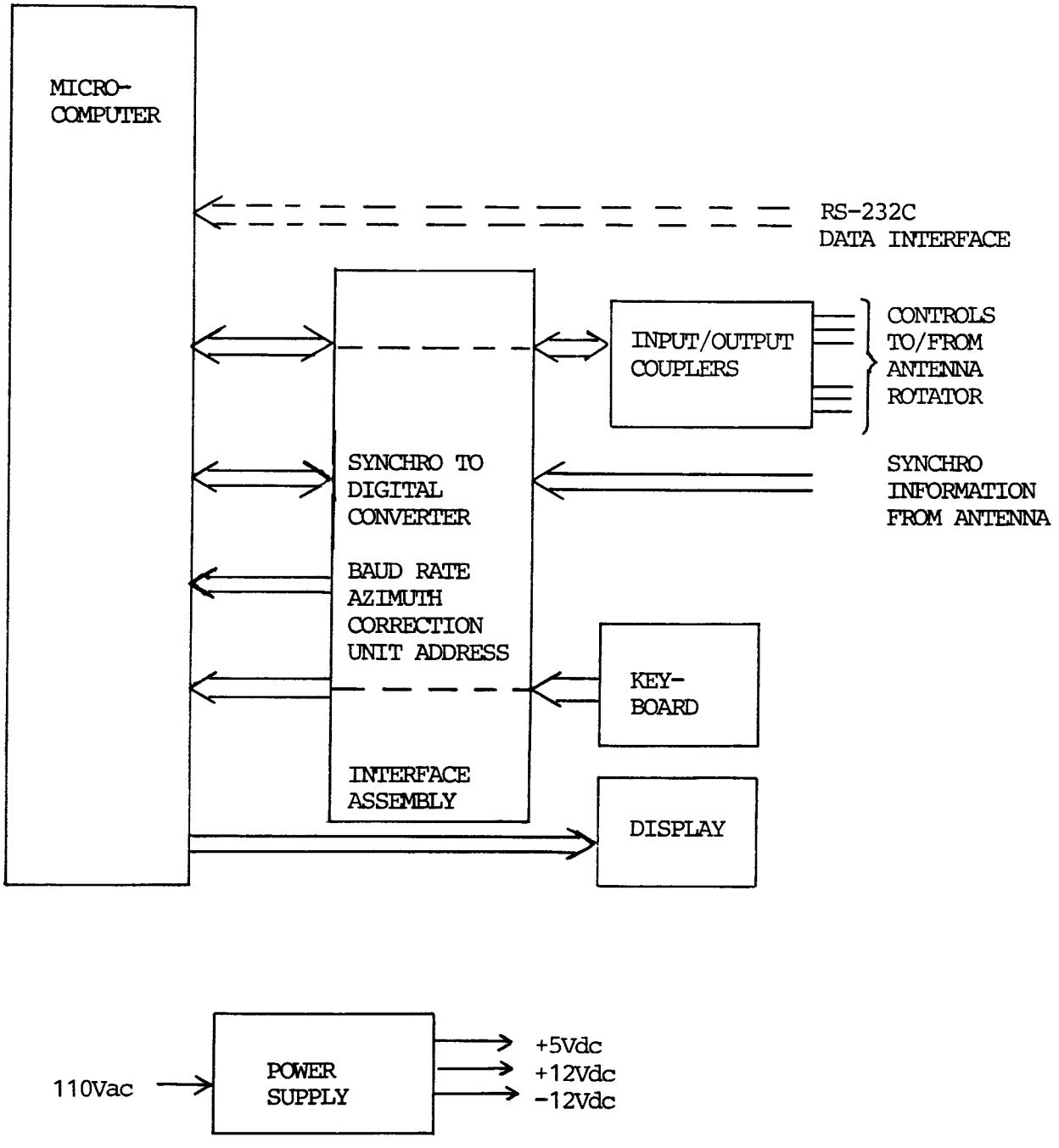


Fig.5 Block diagram of controller

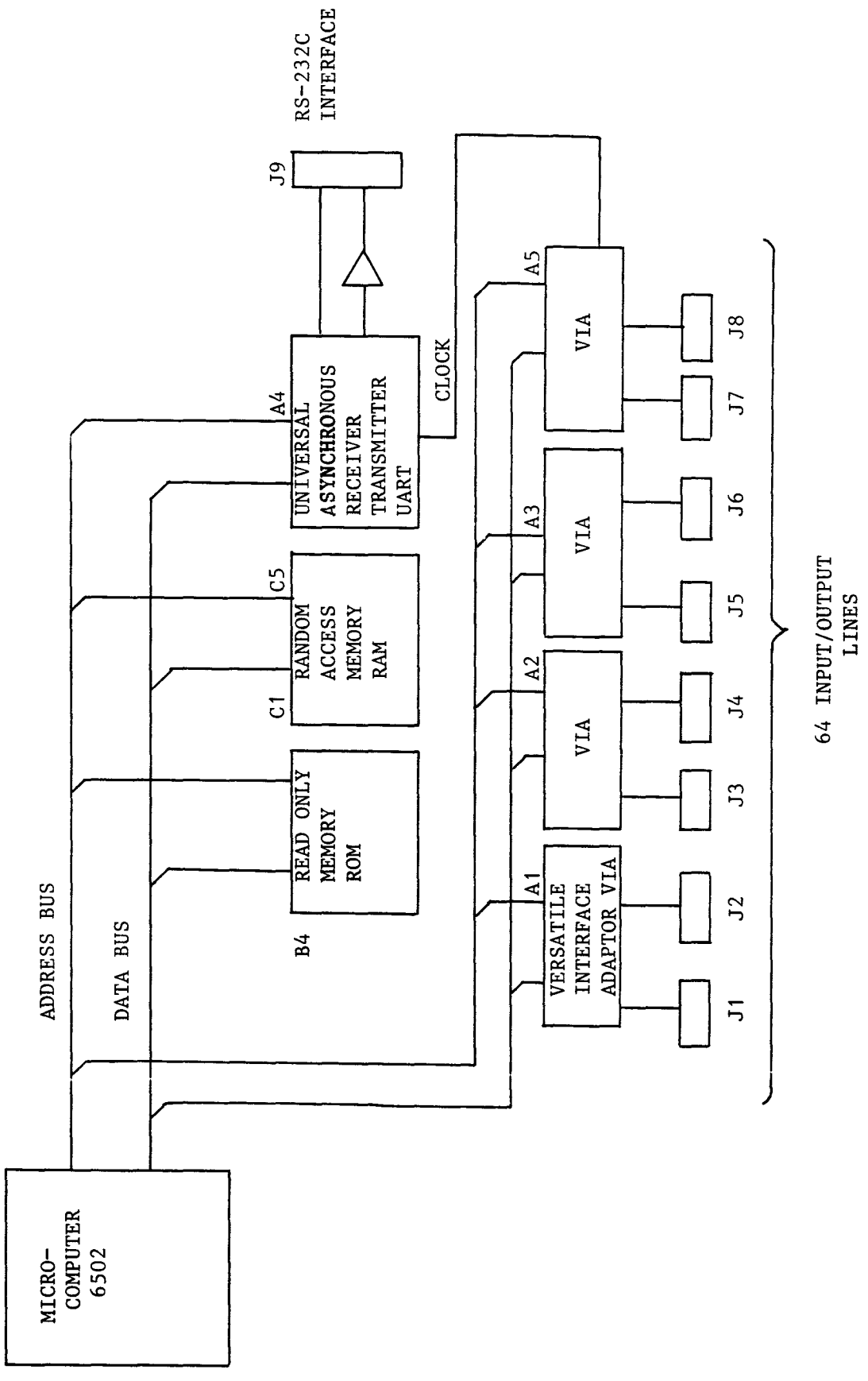


Fig.6 Simplified diagram of microcomputer pc board

TABLE 4 INPUT/OUTPUT ASSIGNMENTS

FUNCTION		I/O	CONNECTOR	DESCRIPTION
VIA A1				
PORT A	PA7	I	J1-8	S/D Output MSB 100 Degrees
	PA6	I	J1-7	S/D Output MSB 90 Degrees
	PA5	I	J1-6	S/D Output MSB 45 Degrees
	PA4	I	J1-5	S/D Output MSB 22.5 Degrees
	PA3	I	J1-4	S/D Output MSB 11.3 Degrees
	PA2	1	J1-3	S/D Output MSB 5.6 Degrees
	PA1	I	J1-2	S/D Output MSB 2.6 Degrees
	PA0	I	J1-1	S/D Output MSB 1.4 Degrees
PORT B	PB7	O	J2-8	Display Digit #1 800 Degrees
	PB6	O	J2-7	Display Digit #1 400 Degrees
	PB5	O	J2-6	Display Digit #1 200 Degrees
	PB4	O	J2-5	Display Digit #1 100 Degrees
	PB3	O	J2-4	Display Digit #2 80 Degrees
	PB2	O	J2-3	Display Digit #3 40 Degrees
	PB1	O	J2-2	Display Digit #2 20 Degrees
	PB0	O	J2-1	Display Digit #2 10 Degrees
VIA A2				
PORT A	PA7	I	J3-8	S/D Output Bit 9 0.7 Degrees
	PA6	I	J3-7	S/D Output Bit 10 0.4 Degrees
	PA5	O	J3-6	Converter Inhibit
	PA4	I	J3-5	Motion
	PA3	I	J3-4	Motor Fault
	PA2	I	J3-3	EM Limit
	PA1	I	J3-2	CW Limit
	PAO	I	J3-1	CCW Limit
PORT B	PB7	O	J4-8	Display Digit #3 8
	PB6	O	J4-7	Display Digit #3 4
	PB5	O	J4-6	Display Digit #3 2
	PB4	O	J4-5	Display Digit #3 1
	PB3	O	J4-4	Not Used
	PB2	O	J4-3	Not Used
	PB1	O	J4-2	Not Used
	PB0	O	J4-1	Not Used

(Continued)

TABLE 4 (Continued) INPUT/OUTPUT ASSIGNMENTS

FUNCTION		I/O	CONNECTOR	DESCRIPTION
VIA A3				
PORT A	PA7	I	J5-8	Remote
	PA6	I	J5-7	Bus Control
	PA5	I	J5-6	Azimuth Correction 200 Degrees
	PA4	I	J5-5	Azimuth Correction 100 Degrees
	PA3	I	J5-4	Unit Address MSB 8
	PA2	I	J5-3	Unit Address MSB 4
	PA1	I	J5-2	Unit Address MSB 2
	PA0	I	J5-1	Unit Address MSB 1
	CA2	O	J5-10	CW Rotate Output
PORT B	PB7	I	J6-8	Azimuth Correction 80 Degrees
	PB6	I	J6-7	Azimuth Correction 40 Degrees
	PB5	I	J6-6	Azimuth Correction 20 Degrees
	PB4	I	J6-5	Azimuth Correction 10 Degrees
	PB3	I	J6-4	Azimuth Correction 8 Degrees
	PB2	I	J6-3	Azimuth Correction 4 Degrees
	PB1	I	J6-2	Azimuth Correction 2 Degrees
	PB0	I	J6-1	Azimuth Correction 1 Degree
	CB2	O	J6-10	CCW Rotate Output
VIA A5				
PORT A	PA7	I	J7-8	Key 0
	PA6	I	J7-7	Key 1
	PA5	I	J7-6	Key 2
	PA4	I	J7-5	Key 3
	PA3	I	J7-4	Key 4
	PA2	I	J7-3	Key 5
	PA1	I	J7-2	Key 6
	PA0	I	J7-1	Key 7
PORT B	PB7	I	J8-8	UART Clock Output
	PB6	I	J8-7	Key 8
	PB5	I	J8-6	Key 9
	PB4	I	J8-5	Key Enter
	PB3	I	J8-4	Not Used
	PB2	I	J8-3	Baud Rate Strap 4
	PB1	I	J8-2	Baud Rate Strap 2
	PB0	I	J8-1	Baud Rate Strap 1

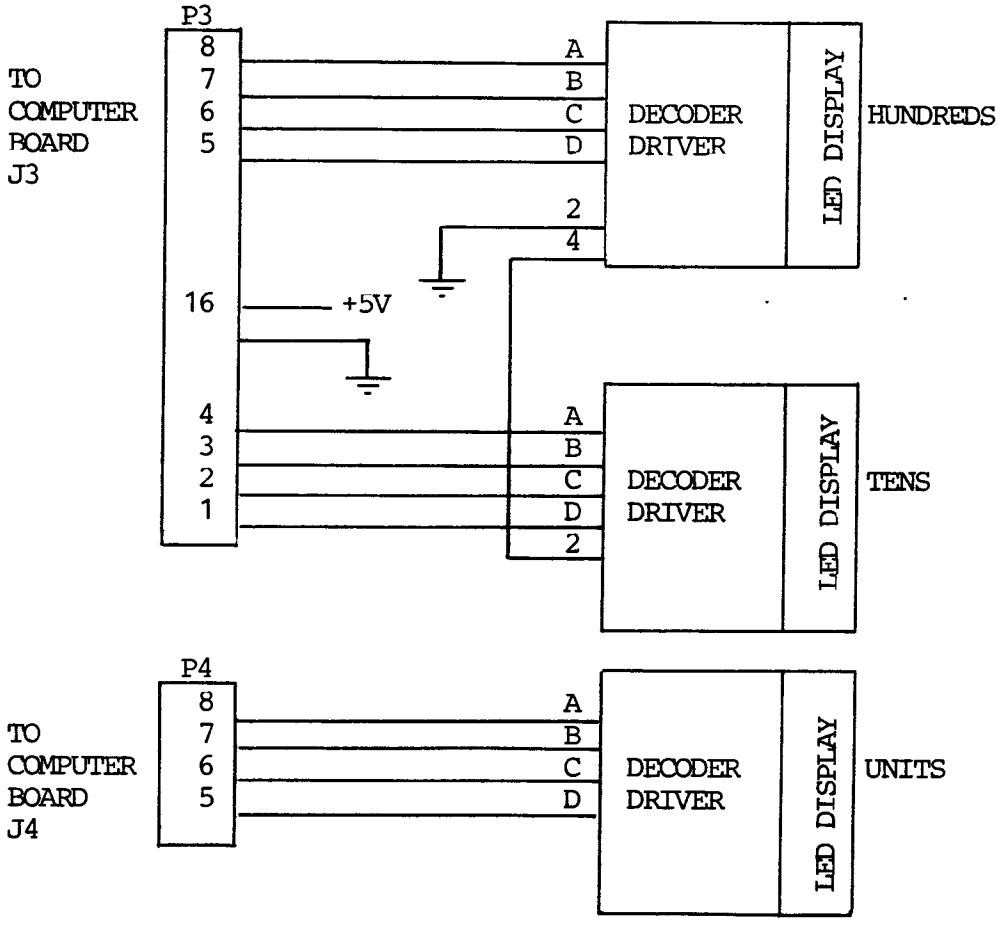


Fig.7 Simplified diagram of display

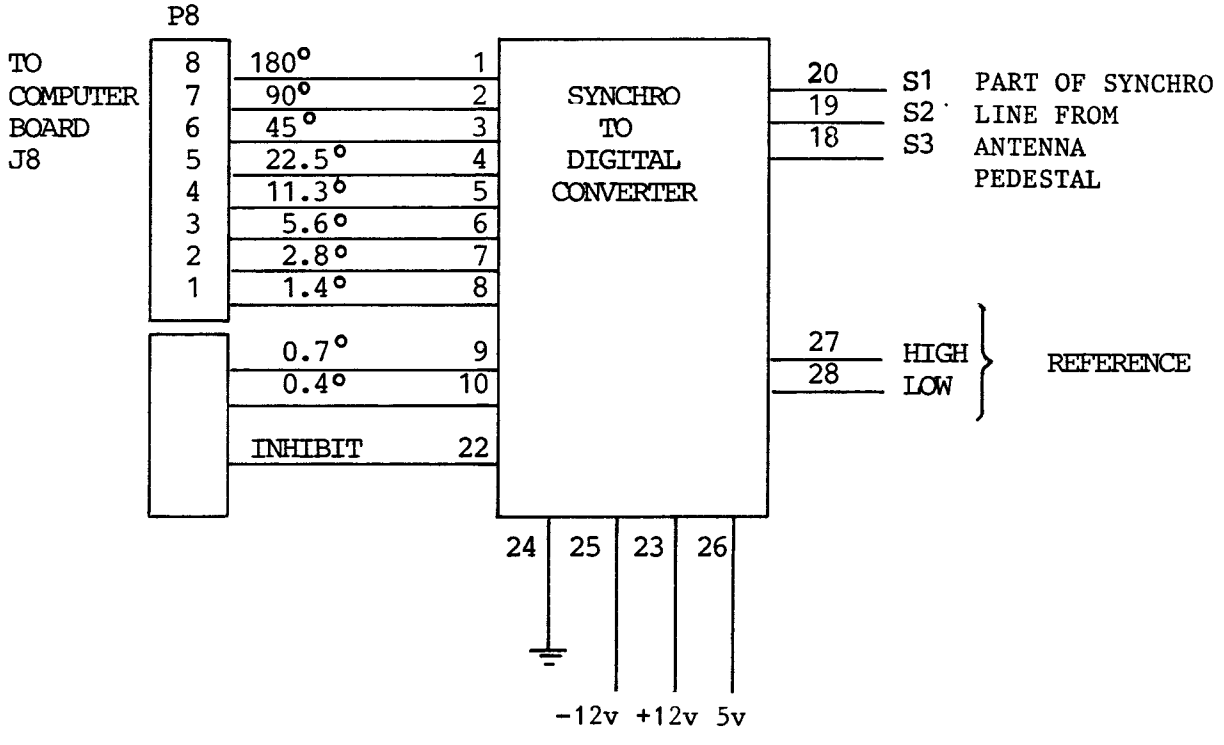


Fig.8 Simplified diagram of synchro to digital converter

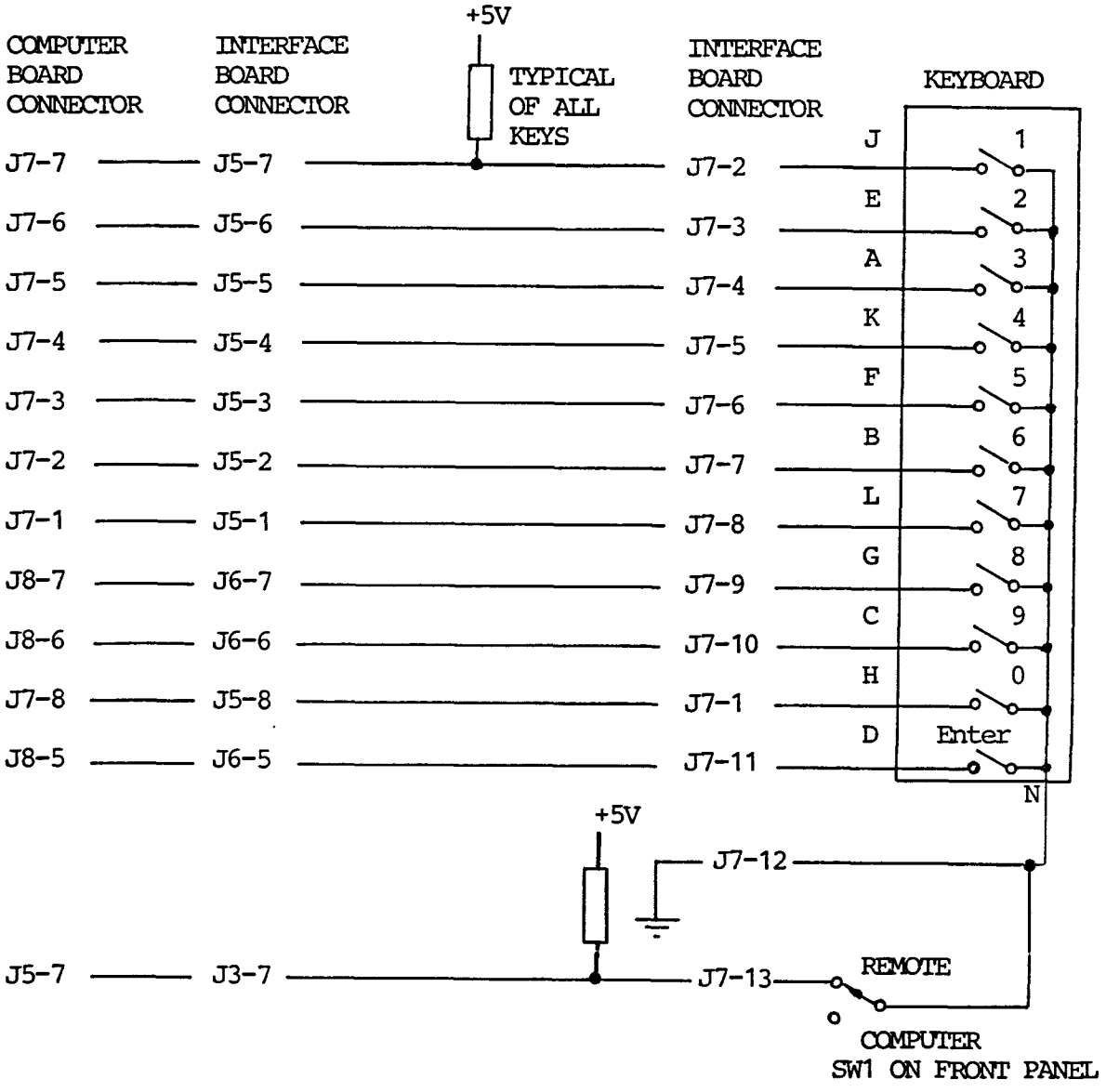


Fig.9 Simplified diagram of keyboard

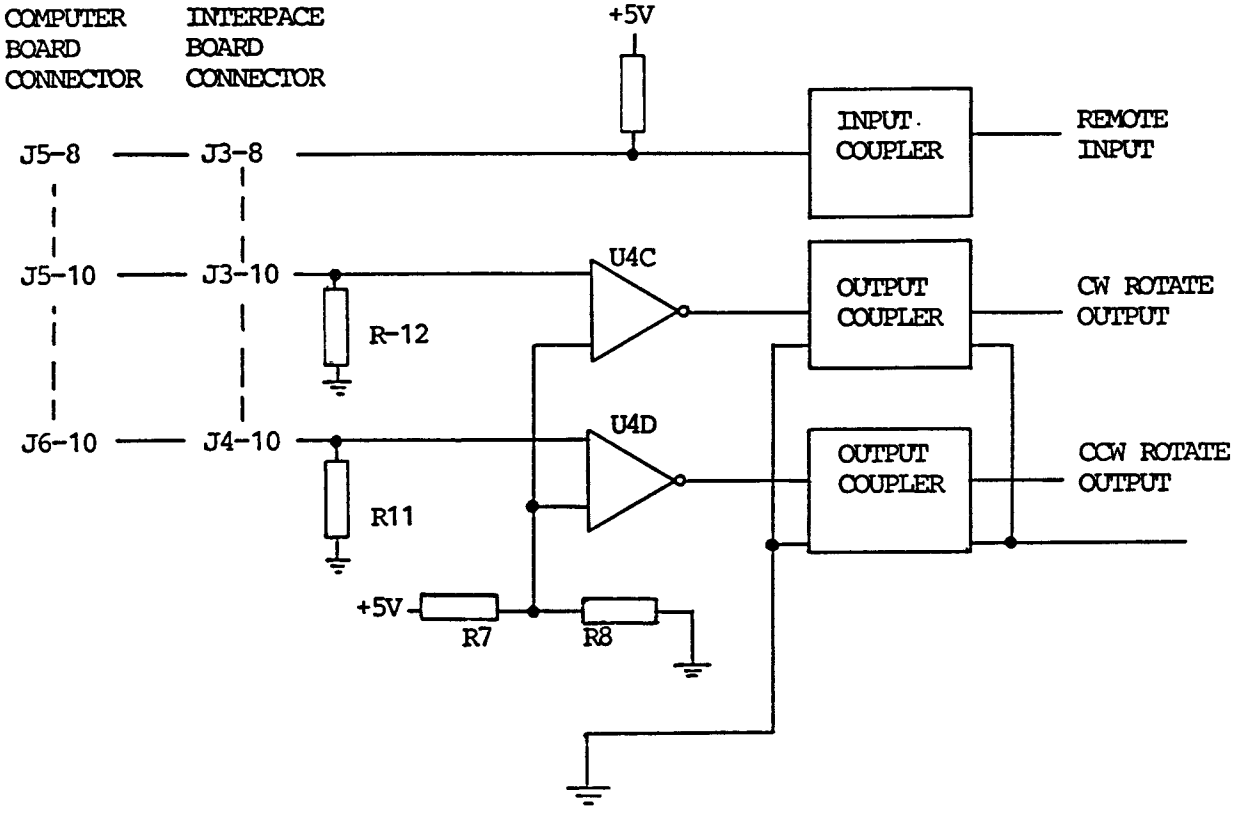


Fig.10 Simplified diagram of input/output couplers

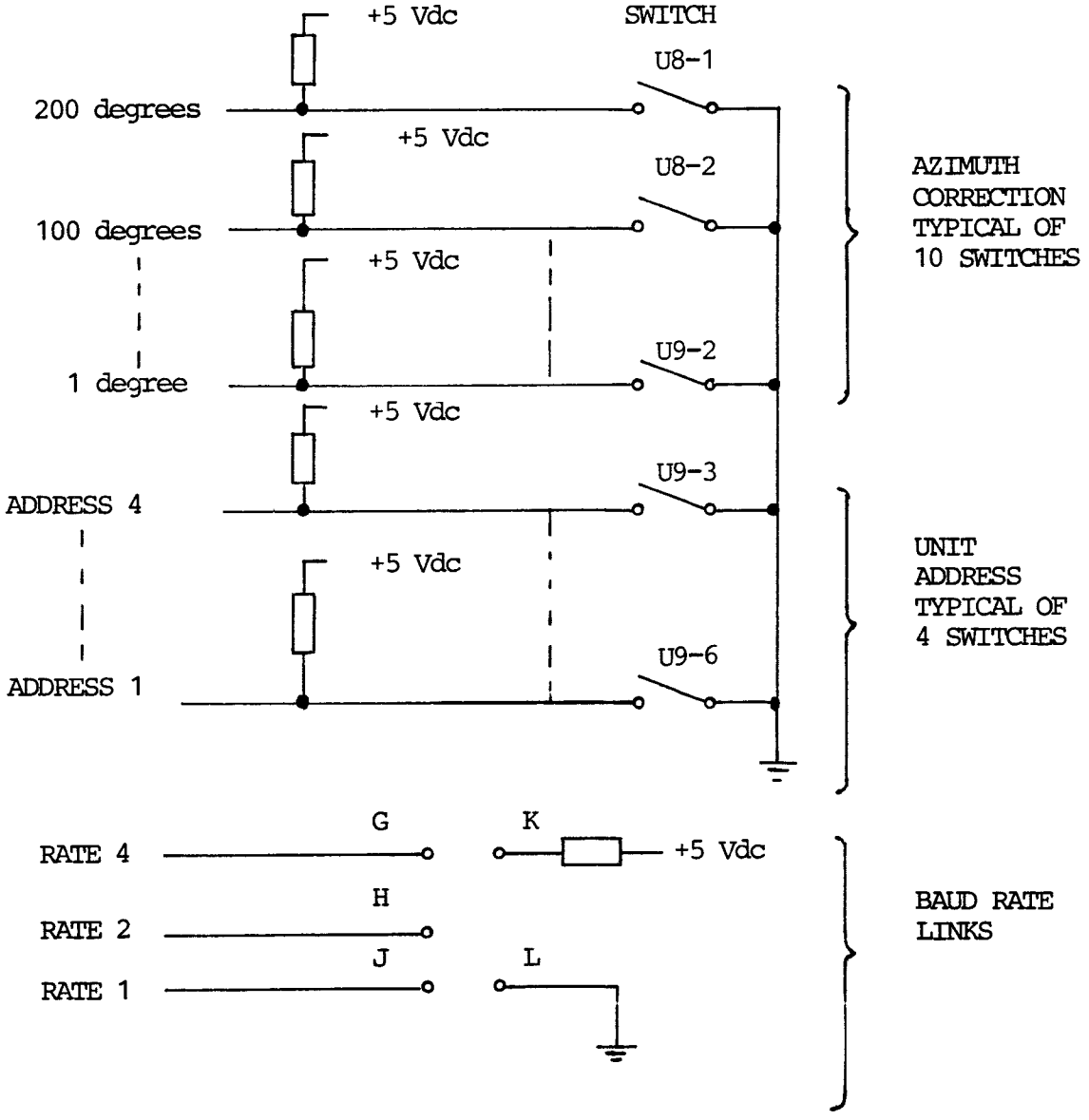


Fig.11 Simplified diagram of azimuth correction, unit address and baud rate selection.

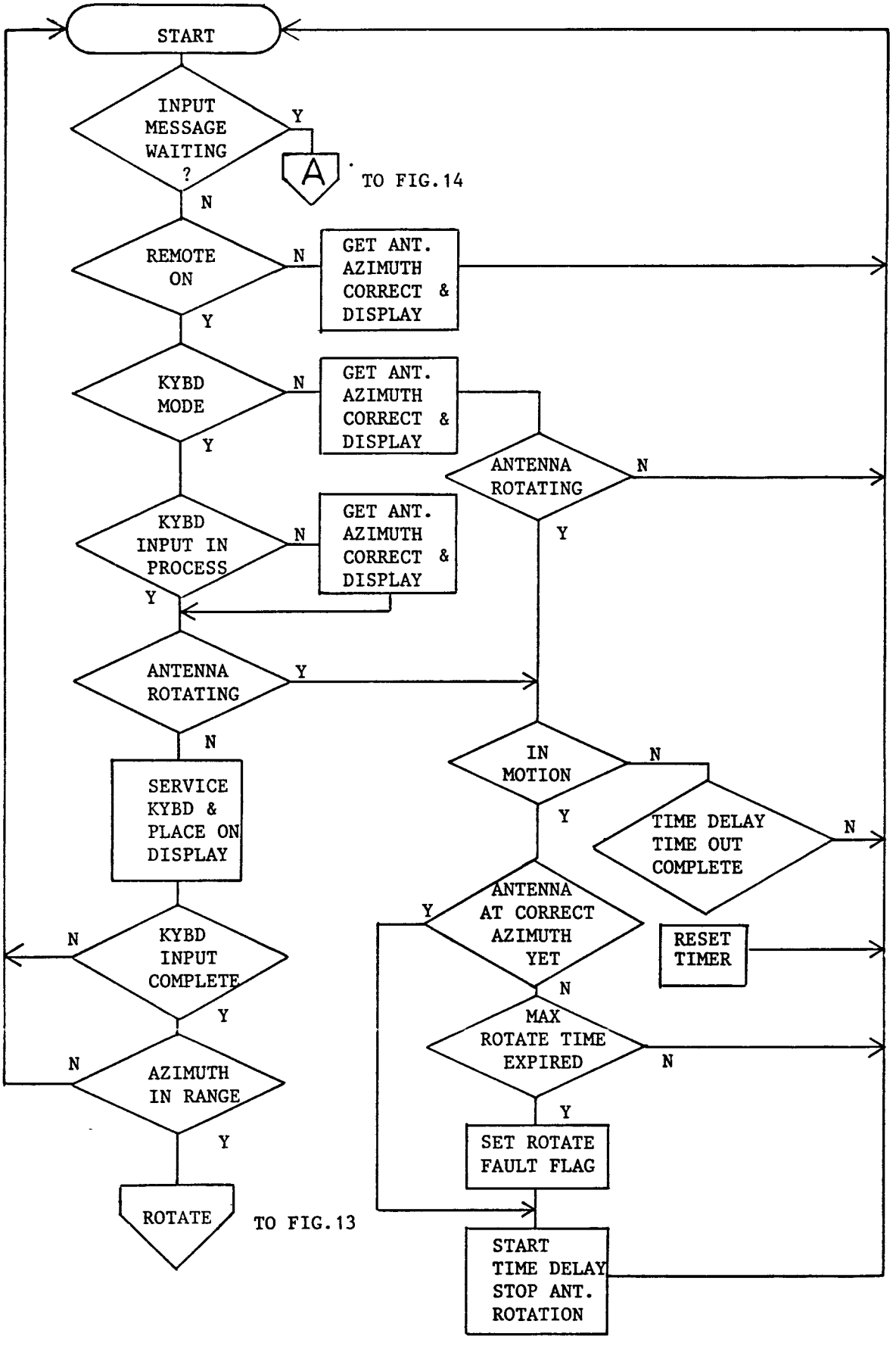


Fig.12 Program logic

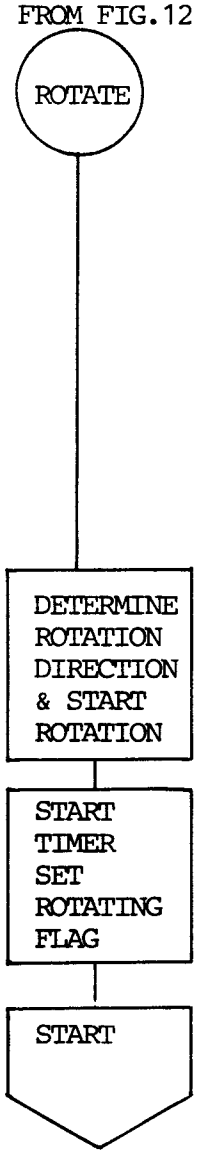


Fig.13 Program logic

FROM FIG.12

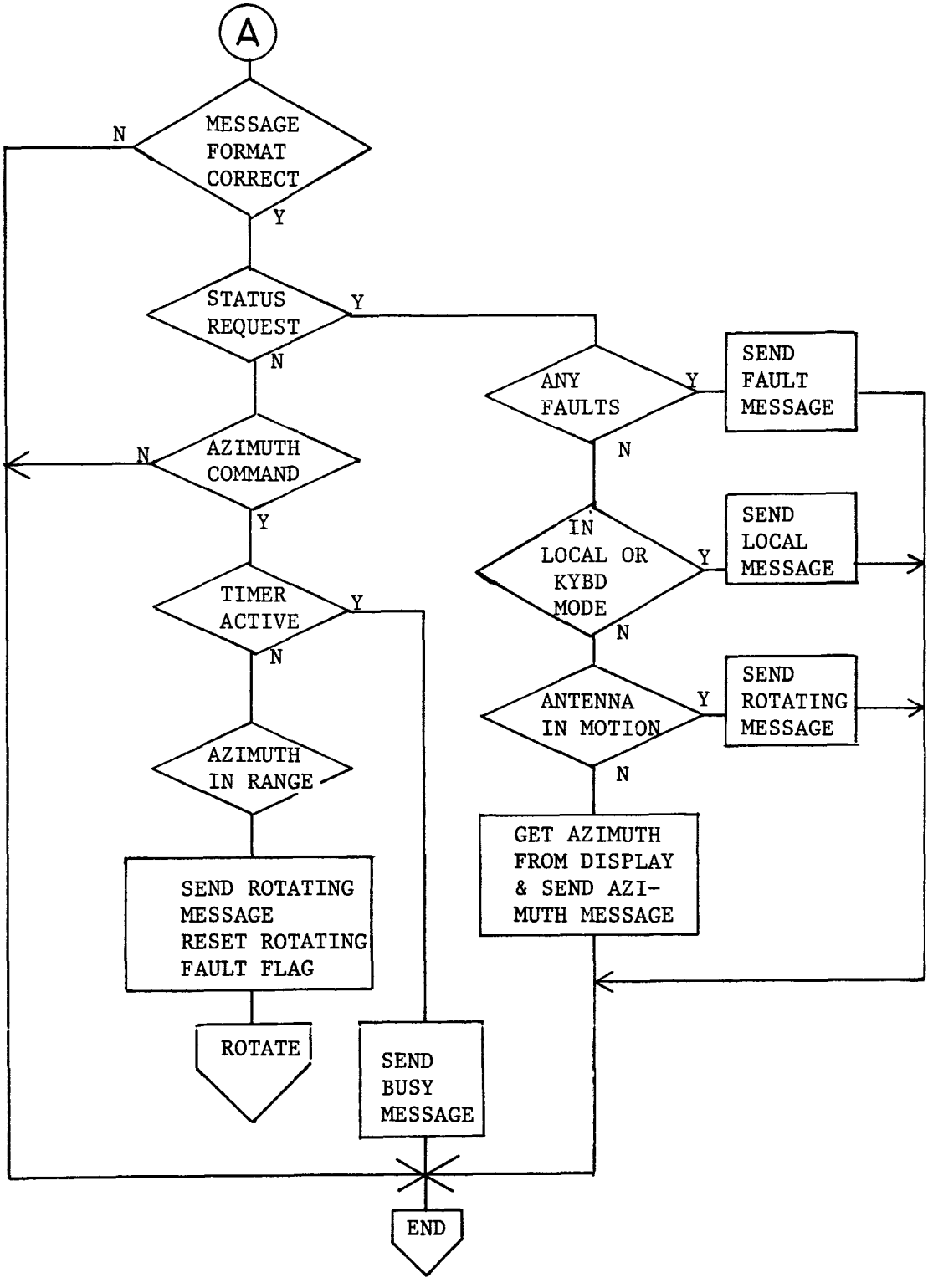
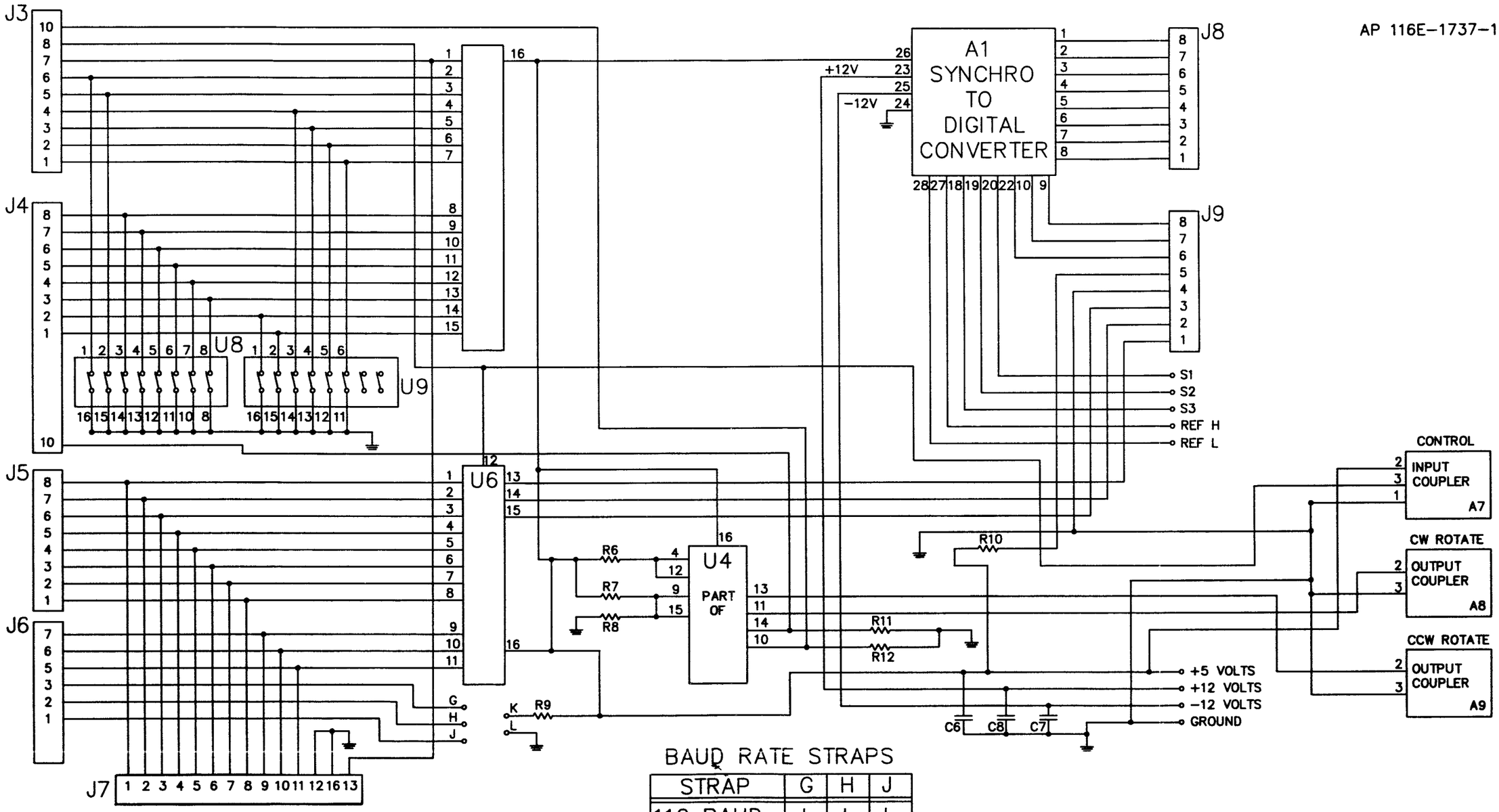


Fig.14 Program logic



BAUD RATE STRAPS

STRAP	G	H	J
110 BAUD	L	L	L
150 BAUD	L	L	K
300 BAUD	L	K	L
600 BAUD	L	K	K
1200 BAUD	K	L	L

Fig. 16 Circuit diagram of interface pc board

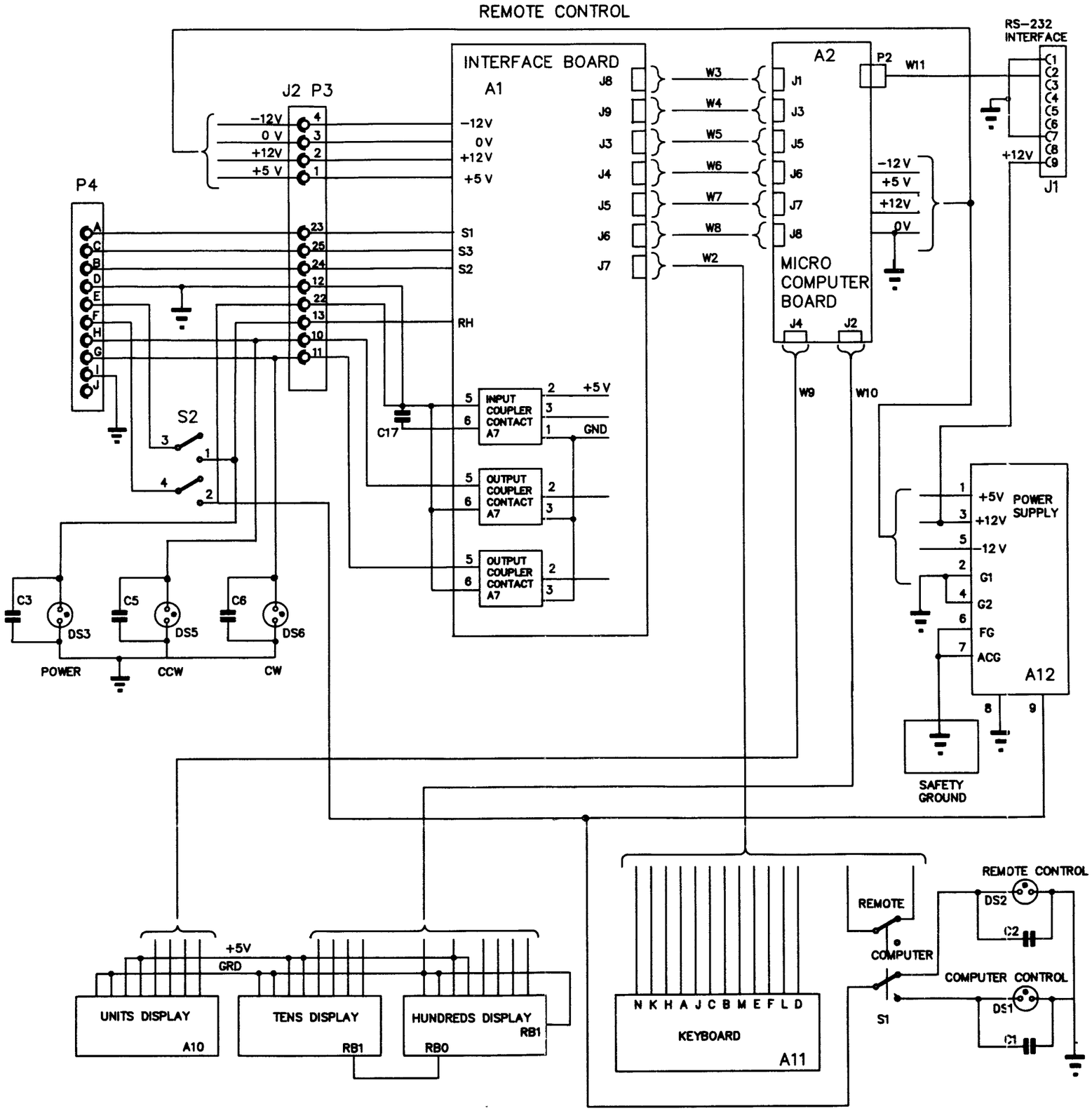


Fig 15 Circuit diagram of controller

Chapter 7

PRODUCTION VARIATIONS

CONTENTS

Introduction

1 The LPH series of antennas have been manufactured by Antenna Products Corporation (USA) since about 1964. During this time some minor changes have taken place, mainly of a design improvement nature. Generally, the policy in the service has been to use up stocks of old-type spare parts and only replenish stocks with the later type parts. This has resulted in a mixture of parts on some antennas. Where the old-type parts continue to function satisfactorily, there is no reason to replace them. However, it is important that maintenance personnel are aware of which parts are affected, particularly where there are consequential changes as a result of changing the prime part to a later type. Further, where an older antenna is to be dismantled and resited, some of the earlier parts and constructions may be encountered. It should be understood that chapters 2.1 and 3.1 of this publication reflect current constructions and parts. The purpose of this chapter is to explain these differences and to guide the user.

LPH73 ANTENNA VARIATIONS

Element centre insulators

2 The centre section of each antenna element consists of aluminium tubes joined together by a fibreglass tube. The fibreglass tube provides a strong mechanical joint between the two aluminium tubes and also serves to insulate them from each other. Originally, a cylindrical plug of expanded polystyrene was placed at the centre and surrounded by polyurethane foam. Unfortunately, this tended to attract and retain moisture which reduced the insulating qualities. In some cases, arcing and tracking occurred, and in a few cases fires resulted which destroyed the centre insulator.

3 The plug and foam were omitted and drain holes were drilled in the fibreglass insulator. In the latest construction the inner ends of the aluminium tubes are closed off by discs welded into place. This prevents the ingress of any foreign matter into the central space.

4 It is not very easy, using only external examination, to differentiate between the different methods of construction. The use of a Fibrescope inserted through one of the drainage holes may be necessary. The most important check is the insulation resistance measured between the two aluminium tubes. Comparison with previously logged values of resistance will indicate whether there is a downward trend and allow possible future replacement to be planned.

5 It is believed that most of the early foam filled centre elements will have already been removed from service, but this is by no means certain. Provided that acceptable values of insulation resistance are monitored, there is no reason that any remaining should not continue in service. No changes of part numbers took place.

Element support insulators

6 Originally, hollow, square-section fibreglass insulators were used to support and insulate the elements in the boom assembly. These are illustrated in AP116E-1737-3, chap.2-7-1, fig.1. They were attached to the boom members by nuts and bolts, with a reinforcing plate inserted under the head of the bolt or the nut, to avoid locally crushing the fibreglass material. The insulators varied in size, becoming increasingly larger as element No.20 was approached. From element No.17, two nuts and bolts were used at each end of the insulator to attach it to the boom members.

7 The square section insulators were changed to rectangular section solid fibreglass. These are illustrated in AP116E-1737-3, chap.2-7-1-A, fig.1. The method of attachment to the boom member is different. A 'U' shaped bracket is first bolted to the boom and utilises the same hole to which the square section insulator was attached. From element No.17, the 'U' shaped bracket is wider and two bolts are used, utilising the same holes as were used for the square section insulator. Changing to the later type insulator is therefore very simple and does not entail the drilling of holes. The new insulators are then attached to the brackets by means of through bolts and nuts. From element No.17 two insulators are used alongside each other to give greater strength.

8 There is no reason why the insulators for individual elements should not be changed from the earlier to the later type, although it is recommended that they are changed in pairs.

9 The part numbers are all changed and the attaching hardware is also different. The item numbers are detailed adjacent to the elements in fig.1A, fig.1B, etc, in AP116E-1737-3, chap.2-7-1-A.

Element attachment

10 With the exception of elements numbers 19 and 20, the elements were originally attached by means of 'U' bolts and saddles fabricated from sheet steel. These are illustrated in AP116E-1737-3, chap.2-7-1, fig.1. They resulted in fairly high localised loading on the elements at the points of contact. Elements numbers 19 and 20 were attached using pairs of saddles fabricated from sheet metal and fixed by through bolts.

11 All the above were changed to pairs of cast aluminium saddles fixed to the insulators by through bolts. These are illustrated in AP116E-1737-3, chap.2-7-1-A, fig.1. This change was brought in at the same time as the

change of insulators and it is recommended that both changes should be carried out together, otherwise non-standard length bolts would be required.

12 The part numbers are all changed and the attaching hardware is different. The item numbers are detailed adjacent to the elements in fig.1A, fig.1B, etc, in AP116E-1737-3, chap.2-7-1-A.

Feedstraps

13 The original feedstraps were attached to the feedlines by means of hose clips. Because the hose clips were able to provide only limited clamping pressure, indefinite electrical contact resulted. These feedstraps are illustrated in AP116E-1737-3, chap.2-7-1, fig.1. The same item was used to connect to all twenty antenna elements.

14 An improved feedstrap assembly was introduced. This has a two-part shaped end which is clamped round the feedline by two nuts and bolts. This provides adequate clamping force to ensure reliable electrical contact with the feedline is maintained. These feedstraps are illustrated in AP116E-1737-3, chap.2-7-1-A, fig.1. Again, the same item, with a changed part number, is used to connect to all twenty antenna elements.

15 It is believed that all the earlier type feedstraps have already been replaced by those of the later type. However, if any of the earlier type are found, they should be changed at the earliest opportunity.

Local control

16 The earliest antennas were produced using a rotation system known as 'continuous control'. This utilises a synchro transmitter at the antenna to operate a synchro receiver at the remote control, to indicate the pointing direction of the antenna. In the remote control a three position, CW/OFF/CCW, toggle switch is used to rotate the antenna and the antenna can thus be stopped pointing in any direction. A similar three position toggle switch is fitted on the local control panel at the antenna. (Fig.4 in chap.1 shows details of this system.)

17 Later antennas were produced using a rotation system known as 'stepped control'. In the remote control a twelve position switch is used to rotate the antenna to one of twelve positions or steps. At the antenna a gear driven switch is fitted which rotates in sympathy with the antenna. When a heading is selected remotely, this switch, in effect, looks for the open contact which corresponds with that heading and when the antenna reaches this, the rotation ceases. A twelve position switch, similar to that in the remote control, is fitted on the local control panel at the antenna. (Fig.5 in chap.1 shows details of this system.)

18 At some time after the 'stepped control' antennas were introduced, a modification was devised by the manufacturer, to convert a 'continuous control' antenna to 'stepped control'. This was applied to some, but not all, of the 'continuous control' antennas. At the antenna, the gear driven synchro transmitter was removed and a gear driven switch was fitted in its place, together with a certain amount of rewiring. The remote control was changed to one of the 'stepped control' type. However, at the antenna, the three position, CW/OFF/CCW toggle switch was left unchanged. (Fig.6 in chap.1 shows details of this system.)

LPH72 ANTENNA VARIATIONS

Element centre insulators

19 All the comments detailed above in para.2 to 5 apply equally to the centre elements of the LPH72 antenna. No changes of part numbers took place.

Element attachment

20 All the elements were originally attached by means of 'U' bolts and saddles fabricated from sheet steel. These are illustrated in AP116E-1737-3, chap.2-6-1, fig.1. They resulted in fairly high localised loading on the elements at the points of contact.

21 All the above were changed to pairs of cast aluminium saddles fixed to the insulators by through bolts. These are illustrated in AP116E-1737-3, chap.2-6-1-A, fig.1. It should be noted that the square section hollow fibreglass insulators continue to be used on this antenna.

22 The part numbers are all changed except for the plate, reinforcing. The same item continues to be used. The attaching parts, which are all different, are listed in the table following each size of saddle casting in AP116E-1737-3, chap.2-6-1-A.

Feedstraps

23 The comments detailed above in para.13 and 14 apply in general to this antenna. The old type feedstraps are illustrated in AP116E-1737-3, chap.2-6-1, fig.1 and the later type in chap.2-6-1-A, fig.1. However, instead of a single type of feedstrap, there are five different types. A slight complication is the fact that the manufacturer retained the same part number for the new type feedstrap assembly, the only difference being that the drawings were raised to 'revision A'. This has been reflected by adding 'A' to the part numbers listed in chap.2-6-1-A. However, the new type feedstraps have been codified and the NSNs (listed in chap.2-6-1-A) are quite different from those allocated to the original feedstraps.

Boom assembly

24 Early production antennas were supplied with the boom sections partially pre-assembled. Half-sections, which consisted of two long members with the vertical cross bracing and element support insulators fitted together, also had the horizontal cross braces fitted by one hole to the top member and then folded in line with it. Two half-sections, when bolted together, formed a complete boom section. The half-sections were partly bolted together and partly riveted.

25 There is some evidence that the riveted-together assemblies did not survive satisfactorily for long periods. It is believed that, in most antennas built in this way, the rivets have been removed and replaced with nuts and bolts. This method of production has been discontinued. No pre-assembly now takes place. All the component parts of the boom are supplied as pieces which are assembled on-site.

Chapter 8

CROSS REFERENCE LISTS, TABLES AND DATA

CONTENTS

Chapter

Chapter 8.1

CROSS INDEX OF NATO STOCK NUMBERS TO ANTENNA PRODUCTS CORPORATION PART NUMBERS

Many of the parts of the equipment covered in this publication are NATO codified but are only marked with the APC part numbers. The APC part numbers also appear in APC documentation supplied with the equipment. This chapter provides a convenient cross reference between NATO Stock Numbers and APC part Numbers.

Nato Stock No.	APC Part No.	Nato Stock No.	APC Part No.
5330-00-021-3853	0001-7089-001	5985-00-909-3848	0001-4022-001
5985-00-043-1351	0001-4097-001	5985-00-909-3849	0001-4045-001
5985-00-043-1352	0001-4099-001	5985-00-909-3852	0001-4260-001
5985-00-050-4661	0001-4098-001	5985-00-909-3853	0001-4163-001
5985-00-050-4688	1000-0184-001	5985-00-909-3854	0001-4159-001
5985-00-050-4921	1000-0185-001	5984-00-909-3855	0001-4130-001
5820-00-105-5027	0001-4259-001	5985-00-909-3856	0001-4162-001
4730-00-359-9487	2450-2127-001	5985-00-909-3857	0001-4148-001
5985-00-409-5604	0001-8068-001	5985-00-909-3858	0001-4164-001
5950-00-412-0920	0001-7860-001	5985-00-909-3859	0001-4129-001
5820-00-528-6951	0001-9640-301	5985-00-909-3860	0001-4157-001
5985-00-534-8625	0001-7666-001	5950-00-909-3864	0001-4283-001
5985-00-534-8727	0001-7782-001	5985-00-909-3867	0001-4102-001
5985-00-534-8781	0001-7783-001	5985-00-909-3868	0001-3985-001
5985-00-534-8820	0001-7784-001	5985-00-909-3872	0001-4100-001
5985-00-534-8866	0001-7785-001	5985-00-909-4256	0001-4128-001
5985-00-534-8904	0001-7786-001	5985-00-909-4257	0001-4131-001
5985-00-534-8913	0001-7787-001	5985-00-909-4258	0001-4165-001
5985-00-534-8917	0001-7788-001	5985-00-909-4259	0001-4158-001
5985-00-534-8933	0001-7683-001	5985-00-909-4260	0001-4160-001
5985-00-534-8968	0001-7789-001	5985-00-909-4261	0001-4149-001
5985-00-534-9078	0001-7790-001	5985-00-909-4262	0001-4118-001
5985-00-534-9090	0001-7691-001	5985-00-909-4263	0001-4119-001
5985-00-534-9098	0001-7717-001	5985-00-909-4265	0001-4111-001
5985-00-534-9109	0001-7739-001	5985-00-909-5961	0001-4291-001
5985-00-534-9114	0001-7763-001	5985-00-909-5962	0001-4055-001
5985-00-534-9620	0001-4100-002	4730-00-910-0289	2450-2130-001
5985-00-536-0421	0001-4045-002	5985-00-910-6109	0001-4127-001
5985-00-539-3301	0001-9701-404	4730-00-917-7689	2450-2125-001
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5365-00-556-7287	0001-7827-001	5985-01-156-6893	0002-3323-402
5330-00-558-1012	0001-7991-001	5985-01-156-6894	0002-3323-403
5305-00-562-2663	0002-0696-202	5985-01-156-6895	0002-3323-404
5305-00-562-2669	0002-0696-204	5985-01-156-6896	0002-3323-405
5305-00-612-5310	2001-1288-001	5985-01-156-6897	0002-3323-407
5306-00-615-1551	2078-2438-001	5985-01-156-6898	0002-3323-408
5305-00-616-6799	2078-3323-001	5985-01-156-6899	0002-3323-409
5985-00-904-2730	0001-4103-001	5985-01-156-6900	0002-3323-410
5985-00-904-2731	0001-4084-001	5985-01-156-6901	0002-4013-301
4730-00-908-6294	2450-2128-001	5985-01-156-6902	0002-4013-302
5985-00-909-3843	0001-4132-001	5985-01-156-6903	0002-4013 303
5985-00-909-3844	0001-4155-001	5985-01-156-6904	0002-4013-304
5985-00-909-3845	0001-4161-001	5985-01-156-6905	0001-4013-307

Nato Stock No.	APC Part No.	Nato Stock No.	APC Part No.
5985-01-156-6906	0002-4013-305	5975-99-627-2395	8900-0298-001
5985-01-174-5497	0002-4016-201	5340-99-627-2396	8000-0275-001
5985-01-174-5498	0002-4017-201	5395-99-627-2397	8900-0250-001
5985-01-174-5499	0002-4019-201	5999-99-627-2407	2450-2171-001
5985-01-174-6892	0002-4021-201	4370-99-627-2408	2450-2128-001
5985-01-174-5501	0002-4022-201	5360-99-627-2409	2400-0005-001
5985-01-174-5502	0002-4023-201	5310-99-627-2411	2300-0163-001
5985-01-174-5503	0002-4024-201	5310-99-627-2412	2300-0159-001
5985-01-174-6834	0002-4020-201	5310-99-627-2414	2300-0151-001
5985-01-180-9230	0001-7826-201	5310-99-627-2422	2100-0137-001
5985-01-208-8983	1000-0588-405	5310-99-627-2423	2100-0133-001
5985-01-216-6847	0002-4013-306	5310-99-627-2424	2100-0131-001
5365-01-230-0002	0002-4018-201	5310-99-627-2425	2100-0123-001
		5310-99-627-2426	2100-0119-001
		5306-99-627-2427	2078-3333-001
5310-99-111-1293	2300-0909-001	5306-99-627-2429	2078-3323-001
► 5985-99-116-9460	LPH72 (modified) ◄	6306-99-627-2436	2078-2438-001
5330-99-116-9465	0001-5806-001	5306-99-627-2437	2078-2430-001
5985-99-116-9468	1000-0356-001	5306-99-627-2438	2078-2426-001
5985-99-116-9751	1000-0215-301	5306-99-627-2440	2078-2418-001
5985-99-116-9752	1000-0522-401	5305-99-627-2445	2026-9335-001
5310-99-120-6257	2100-0215-001	5305-99-627-2453	2005-6261-001
5310-99-120-9059	2300-0910-001	5305-99-627-2455	2001-1288-001
5306-99-124-7247	2078-3011-001	5305-99-627-2459	2001-1270-001
5306-99-124-7261	2078-2822-001	5985-99-627-2460	1000-0506-401
5305-99-127-8012	2009-9462-001	5305-99-627-2462	0002-0696-204
5305-99-134-0505	2009-8861-001	5305-99-627-2464	0002-0696-202
5305-99-134-0519	2009-9477-001	5305-99-627-2465	0002-0696-201
5305-99-134-0522	2009-9164-001	5985-99-627-2467	0001-9712-301
5310-99-134-3463	2100-0216-001	5985-99-627-2468	0001-9701-403
5310-99-134-3782	2100-0225-001	5985-99-627-2469	0001-9701-402
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5306-99-136-8555	2078-2422-001	5985-99-627-2471	0001-9641-201
5310-99-137-7202	2300-0912-001	5985-99-627-2472	0001-9640-301
5306-99-138-2291	2009-9470-001	5985-99-627-2473	0001-9631-304
5306-99-138-2965	2009-8893-001	5985-99-627-2474	0001-9631-303
5310-99-139-0551	2100-0221-001	5985-99-627-2475	0001-9631-302
3950-99-201-3244	Tirfor Winch T7	5985-99-627-2476	0001-9631-301
4010-99-202-9032	Tirfor rope T7	2445-99-627-2479	0001-7997-001
3950-99-202-9038	Tirfor rope T13	5306-99-627-2480	0001-7965-001
3950-99-204-6346	Tirfor WinchT13	5455-99-627-2481	0001-7898-001
3940-99-425-3433	2-leg sling	5985-99-627-2482	0001-7896-001
3940-99-425-3457	Block Snatch 5t	5985-99-627-2483	0001-7895-001
5310-99-450-6703	2300-0911-001	5985-99-627-2484	0001-7827-001
► 3940-99-519-7422	Block ◄	5985-99-627-2493	0001-7868-002
4010-99-523-8374	Tirfor rope T13	5985-99-627-2494	0001-7868-001
4010-99-523-8376	Tirfor rope T35	5985-99-627-2495	0001-7837-001
4030-99-561-2787	Shackle 3t	5985-99-627-2496	0001-7745-001
4820-99-620-3013	6900-0014-001	5985-99-627-2497	0001-7739-001
5310-99-624-4058	2300-0907-001	5985-99-627-2498	0001-7732-001
5985-99-626-8382	8600-0046-001	5985-99-627-2499	0001-7719-001
5985-99-626-9325	2300-0181-001	5985-99-627-2500	0001-7717-001
5985-99-627-2055	0001-4007-001	5985-99-627-2501	0001-7712-001
5330-99-627-2182	3510-0017-001	5985-99-627-2502	0001 7691-001

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5985-99-627-2503	0001-7688-001
5985-99-627-2504	0001-7684-001
5985-99-627-2505	0001-7683-001
5985-99-627-2506	0001-7682-001
5985-99-627-2507	0001-7681-001
5985-99-627-2508	0001-7680-001
5985-99-627-2509	0001-7679 001
5985-99-627-2510	0001-7678-001
5985-99-627-2511	0001-7677-001
5985-99-627-2512	0001-7676-001
5985-99-627-2513	0001-7675-001
5985-99-627-2514	0001-7674-001
5985-99-627-2515	0001-7673-001
5985-99-627-2516	0001-7672-001
5985-99-627-2517	0001-7671-001
5985-99-627-2518	0001-7670-001
5985-99-627-2519	0001-7669-001
5985-99-627-5250	0001-7668-001
5985-99-627-2521	0001-7667-001
5985-99-627-2522	0001-7666-001
5985-99-627-2523	0001-7665-001
5985-99-627-2524	0001-6990-001
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5305-99-627-3595	2001-1275-001
5305-99-627-3596	2001-1276-001
5306-99-627-3604	2009-9159-001
5306-99-627-3606	2077-7909-001
5306-99-627-3607	2077-7983-001
5306-99-627-3608	2078-2416-001
4730-99-627-3619	2450-2126-001
8030-99-627-3620	3530-0023-001
5985-99-630-2079	90G 110723
5985-99-631-3690	90G 110815
5985-99-633-4023	90G 110817
5985-99-633-4024	90G 110818
5985-99-633-9086	90G 110503
5985-99-635-0736	90G 110816
4010-99-635-4327	Chain lg.link
4030-99-638-8199	Shackle 5t
4010-99-638-8200	90G 114951
4030-99-638-8201	Shackle $3^3/_4$t
4010-99-638-8202	90G 116450
4030-99-638-8203	Shackle 3t
4010-99-638-8409	90G 116429
4010-99-638-8410	Chain lg.link
4010-99-638-9347	90G 116589
5310-99-639-0695	2310-0429-001
► 5306-99-647-9959	2076-4373-001 ◄
5985-99-653-5743	SCSHQ 137393
5310-99-722-4631	2300-0157-001
5307-99-723-4529	0002-4144-201
5307-99-723-4530	0002-4144-203
5307-99-723-4531	0002-4144-204
5305-99-723-4532	0002-0696-203
4030-99-724-6868	Shackle $1^3/_4$t
5305-99-738-3681	2100-1273-001
5306-99-738-3682	2078-2448-001
5306-99-738-3683	2078-3327-001
5306-99-738-3684	2078-2820-001
4030-99-763-6453	Shackle $1/_2$t
5306-99-764-8689	2078-2612-001
5306-99-764-8690	2078-2634-001
5306-99-764-8691	2078-2642-001
5306-99-764-8695	2078-3355-001
5306-99-764-8696	2078-2434-001
5306-99-764-8697	2077-7962-001
5306-99-764-8698	2077-7964-001
5305-99-765-9439	2001-1263-001
5305-99-771-1993	2001-1286-001
5305-99-771-4710	2009-3457-001
5305-99-771-4711	2009-3458-001
5305-99-771-4712	2009-3462-001
5305-99-771-4713	2077-7907-001
5305-99-772-4451	2001-1287-001
5306-99-772-5162	2078-2816-001
5306-99-773-5522	2009-3470-001
5985-99-774-5502	0001-4140-001A
5985-99-774-5503	0001-4141-001A
5985-99-774-5504	0001-4142-001A
5985-99-774-5505	0001-4139-001A
5985-99-774-5506	0001-4138-001A
5985-99-774-5507	0002-3323-406
5310-99-780-7499	2100-2246-001
5306-99-791-0044	2099-9300-001
5306-99-791-3150	2078-2812-001
5985-99-797-5555	SEE 178995
5985-99-797-5556	SCSHQ 164253
4010-99-798-2590	Tirfor rope T35
5985-99-798-4457	SEE 178996
4020-99-933-1559	Rope, polyester
4020-99-933-1562	Rope, polyester
5985-99-933-3888	SC/B64041B
4020-99-933-3906	Molex anchor 30in.
3950-99-933-4256	Tirfor winchT35
4020-99-942-5025	Rope, manilla
5310-99-944-2453	2100-2242-001
5310-99-944-2456	2100-2244-001
5310-99-944-2457	2100-2240-001
5310-99-944-2548	2100-2248-001
5310-99-944-2935	2100-0223-001
5310-99-944-2936	2100-0219 001
5305-99-945-9487	2009-8858-001
5305-99-946-9818	2078-2606-001
5306-99-947-3788	2078-2608-001

Nato Stock No.	APC Part No.	Nato Stock No.	APC Part No.
5305-99-947-3794	2009-8854-001		
5306-99-947-3798	2078-2410-001		
5305-99-947-4211	2078-2806-001		
5305-99-957-0038	2009-8860-001		
5306-99-957-3825	2078-2414-001		
4030-99-960-4348	Shackle $^{3}/_{4}$t		
4030-99-960-4349	Shackle $1^{1}/_{2}$t		
5305-99-978-0638	2078-2626-001		
5305-99-978-0639	0001-4295-001		
5305-99-978-1956	2001-1274-001		

Chapter 8.2

CROSS INDEX OF ANTENNA PRODUCTS
CORPORATION PART NUMBERS TO NATO STOCK NUMBERS

Many of the parts of the equipment covered in this publication are NATO codified but are only marked with the APC part numbers. The APC part numbers also appear in APC documentation supplied with the equipment. This chapter provides a convenient cross reference between APC part numbers and NATO Stock Numbers.

APC Part No.	Nato Stock No.	APC Part No.	Nato Stock No.
0001-3968-001		0001-4103-001	5999-00-904-2730
0001-3969-001		0001-4104-001	
0001-3970-001		0001-4105-001	
0001-3971-001		0001-4106-001	
0001-3972-001		0001-4111-001	5985-00-909-4265
0001-3974-001		0001-4118-001	5985-00-909-4262
0001-3978-001		0001-4119-001	5985-00-909-4263
0001-3979-001		0001-4127-001	5985-00-910-6109
0001-3985-001	5985-00-909-3868	0001-4128-001	5985-00-909-4256
0001-3986-001		0001-4129-001	5985-00-909-3859
0001-3987-001		0001-4130-001	5985-00-909-3855
0001-3988-001		0001-4131-001	5984-00-909-4257
0001-3989-001		0001-4132 001	5985-00-909-3843
0001-3990-001		0001-4138-001A	5985-99-774-5506
0001-3991-001		0001-4139-001A	5985-99-774-5505
0001-3998-001		0001-4140-001A	5985-99-774-5502
0001-4006-001		0001-4141-001A	5985-99-774-5503
0001-4007-001	5985-99-627-2055	0001-4142-001A	5985-99-774-5504
0001-4008-001		0001-4147-001	
0001-4022-001	5985-00-909-3848	0001-4148-001	5985-00-909-3857
0001-4045-001	5985-00-909-3849	0001-4149-001	5985-00-909-4261
0001-4045-002	5985-00-536-0421	0001-4150-001	5985-99-627-3589
0001-4055-001	5985-00-909-5962	0001-4155-001	5985-00-909-3844
0001-4073-001		0001-4156-001	
0001-4074-001		0001-4157 001	5985-00-909-3860
0001-4075-001		0001-4142-001	5985-00-909-4259
0001-4076-001		0001-4159-001	5985-00-909-3854
0001-4078-001		0001-4160-001	5985-00-909-4260
0001-4079-001		0001-4161-001	5985-00-909-3845
0001-4081-001		0001-4162-001	5985-00-909-3856
0001-4082-001		0001-4163-001	5985-00-909-3853
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0001-4086-001		0001-4190-001	5985-00-909-4258
0001-4090-001		0001-4190-001	
0001-4091-001		0001-4191-001	
0001-4097-001	5985-00-043-1351	0001-4192-001	
0001-4097-002	5985-99-627-2527	0001-4193-001	
0001-4098-001	5985-00-050-4661	0001-4250-001	
0001-4099-001	5985-00-043-1352	0001-4259-001	5820-00-105-5027
0001-4100-001	5985-00-909-3872	0001-4260-001	5985-00-909-3852
0001-4100-002	5985-00-534-9620	0001-4283-001	5950-00-909-3864
0001-4102-001	5985-00-909-3867	0001-4291-001	5985-00-909-5961

APC Part No.	Nato Stock No.	APC Part No.	Nato Stock No.
0001-4292-001		0001-7745-001	5985-99-627-2496
0001-4295-001	5305-99-978-0639	0001-7763-001	5985-00-534-9114
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0001-5755-001	9525-99-627-2525	0001-7783-001	5985-00-534-8781
0001-5806-001	5330-99-116-9465	0001-7784-001	5985-00-534-8820
0001-6158-001		0001-7785-001	5985-00-534-8866
0001-6159-001		0001-7786-001	5985-00-534-8904
0001-6160-001		0001-7787-001	5985-00-534-8913
0001-6161-001		0001-7788-001	5985-00-534-8917
0001-6162-001		0001-7789-001	5985-00-534-8968
0001-6163-001		0001-7790-001	5985-00-534-9078
0001-6165-001		0001-7805-001	
0001-6166-001		0001-7806-001	
0001-6167-001		0001-7807-001	
0001-6168-001		0001-7808-001	
0001-6169-001		0001-7812-001	
0001-6170-001		0001-7813-001	
0001-6172-001		0001-7815-001	
0001-6990-001	5985-99-627-2524	0001-7816-001	
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0001-7668-001	5985-99-627-2520	0001-7824-001	
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0001-7672-001	5985-99-627-2516	0001-7829-001	
0001-7673-001	5985-99-627-2515	0001-7830-001	
0001-7674-001	5985-99-627-2514	0001-7830-002	
0001-7675-001	5985-99-627-2513	0001-7831-001	
0001-7676-001	5985-99-627-2512	0001-7831-002	
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0001-7682-001	5985-99-627-2506	0001-7839-001	
0001-7683-001	5985-99-627-2505	0001-7840-001	
0001-7684-001	5985-99-627-2504	0001-7841-001	
0001-7688-001	5985-99-627-2503	0001-7842-001	
0001-7691-001	5985-99-627-2502	0001-7843-001	
0001-7712-001	5985-99-627-2501	0001-7844-001	
0001-7717-001	5985-99-627-2500	0001-7845-001	
0001-7719-001	5985-99-627-2499	0001-7846-001	
0001-7722-001		0001-7847-001	
0001-7723-001		0001-7848-001	
0001-7724-001		0001-7849-001	
0001-7725-001		0001-7850-001	
0001-7725-002		0001-7851-001	
0001-7726-001		0001-7852-001	
0001-7727-001		0001-7853-001	
0001-7732-001	5985-99-627-2498	0001-7859-001	
0001-7739-001	5985-99-627-2497	0001-7860-001	5950-00-412-0920

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0001-7865-001		0002-1624-301	
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0001-7868-001	5985-99-627-2493	0002-3323-402	5985-01-156-6893
0001-7895-001	5985-99-627-2483	0002-3323-403	5985-01-156-6894
0001-7896-001	5985-99-627-2482	0002-3323-404	5985-01-156-6895
0001-7898-001	5445-99-627-2481	0002-3323-405	5985-01-156-6896
0001-7913-001		0002-3323-406	5985-99-774-5507
0001-7920-001		0002-3323-407	5985-01-156-6897
0001-7921-001		0002-3323-408	5985-01-156-6898
0001-7922-001		0002-3323-409	5985-01-156-6899
0001-7926-001		0002-3323-410	5985-01-156-6900
0001-7933-001		0002-4013-301	5985-01-156-6901
0001-7934-002		0002-4013-302	5985-01-156-6902
0001-7935-002		0002-4013-303	5985-01-156-6903
0001-7945-002		0002-4013-304	5985-01-156-6904
0001-7965-002	5306-99-627-2480	0002-4013-305	5985-01-156-6906
0001-7991-001	5330-00-558-1012	0002-4013-306	5985-01-216-6847
0001-7997-002	5445-99-627-2479	0002-4013-307	5985-01-156-6905
0001-8068-002	5985-00-409-5604	0002-4016-201	5990-01-174-5497
0001-8161-002		0002-4017-201	5990-01-174-5498
0001-8180-002		0002-4018-201	5990-01-230-0002
0001-9631-301	5985-99-627-2476	0002-4019-201	5990-01-174-5499
0001-9631-302	5985-99-627-2475	0002-4020-201	5990-01-174-6834
0001-9631-303	5985-99-627-2474	0002-4021-201	5990-01-174-5500
0001-9631-304	5985-99-627-2473	0002-4022 201	5990-01-174-5501
0001-9640-301	5985-99-627-2472	0002-4023 201	5990-01-174-5502
0001-9641-201	5985-99-627-2471	0002-4024-201	5990-01-174-5503
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0001-9689-202		0002-4144-202	
0001-9689-203		0002-4144-203	5307-99-723-4530
0001-9689-204		0002-4144-204	5307-99-723-4531
0001-9701-401	5985-99-627-2470	0002-4295-001	
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0001-9712-301	5985-99-627-2467	0002-8866-301	
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0002-0696-204	5305-99-627-2462	0003-3727-301	
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0002-1394-201		◄	
0002-1395-201			
0002-0936-401			
0002-1192-301			
0002-1402-201			
0002-1604-401			
0002-1604-407			
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0002-1616-301			
0002-1623-401			
0002-1623-402			

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1000-0356-001	5985-99-116-9468
1000-0506-401	5985-99-627-2460
1000-0522-401	5985-99-116-9752
1000-0588-302	
1000-0588-405	5985-01-208-8983
2001-1263-001	5305-99-765-9439
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2001-1272-001	5305-99-627-3593
2001-1273-001	5305-99-738-3681
2001-1274-001	5305-99-978-1956
2001-1275-001	5305-99-627-3595
2001-1276-001	5305-99-627-3596
2001-1286-001	5305-99-771-1993
2001-1287-001	5305-99-772-4451
2001-1288-001	5305-99-627-2455
2005-6261-001	5305-99-627-2453
2009-3457-001	5305-99-771-4710
2009-3458-001	5305-99-771-4711
2009-3462-001	5305-99-771-4712
2009-3470-001	5305-99-773-5522
2009-8854-001	5305-99-947-3794
2009-8856-001	
2009-8858-001	5305-99-945-9487
2009-8860-001	5305-99-957-0038
2009-8861-001	5305-99-134-0505
2009-8865-001	
2009-8893-001	5305-99-138-2965
2009-9159-001	5306-99-627-3604
2009-9164-001	5305-99-134-0522
2009-9462-001	5305-99-127-8012
2009-9470-001	5306-99-138-2291
2009-9477-001	5305-99-134-0519

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2076-4320-001	
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2076-4342-001	
2076-4344-001	
2076-4372-001	
2076-4374-001	
2077-6453-001	
2077-6455-001	
2077-7311-001	
2077-6810-001	
2077-7907-001	5305-99-771-4713
2077-7909-001	5306-99-627-3606
2077-7913-001	
2077-7962-001	5306-99-764-8697
2077-7964-001	5306-99-764-8698
2077-7983-001	5306-99-627-3607
2078-2410-001	5306-99-947-3798
2078-2414-001	5306-99-957-3825
2078-2416-001	5306-99-627-3608
2078-2418-001	5306-99-627-2440
2078-2422-001	5306-99-136-8555
2078-2426-001	5306-99-627-2438
2078-2430-001	5306-99-627-2437
2078-2434-001	5306-99-764-8696
2078-2438-001	5306-99-627-2436
2078-2448-001	5306-99-738-3682
2078-2606-001	5305-99-946-9818
2078-2608-001	5306-99-947-3788
2078-2612-001	5306-99-764-8689
2078-2626-001	5306-99-978-0638
2078-2634-001	5306-99-764-8690
2078-2642-001	5306-99-764-8691
2078-2806-001	5306-99-947-4211
2078-2810-001	5305-99-134-5878
2078-2812-001	5306-99-791-3150
2078-2816-001	5306-99-772-5162
2078-2820-001	5306-99-738-3684
2078-2822-001	5306-99-124-7261
2078-3011-001	5306-99-124-7247
2078-3323-001	5306-99-627-2429
2078-3327-001	5306-99-738-3683
2078-3333-001	5306-99-627-2427
2078-3355-001	5306-99-764-8695
2099-9300-001	5306-99-791-0044

APC Part No.	Nato Stock No.	APC Part No.	Nato Stock No.
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2100-0123-001	5310-99-627-2425		
2100-0127-001			
2100-0131-001	5310-99-627-2424		
2100-0133-001	5310-99-627-2423		
2100-0137-001	5310-99-627-2422		
2100-0125-001	5310-99-120-6257		
2100-0216-001	5310-99-134-3463		
2100-0219-001	5310-99-944-2936	2400-0005-001	5360-99-627-2409
2100-0221-001	5310-99-139-0551	2450-0191-001	
2100-0223-001	5310-99-944-2935	2450-2125-001	4730-00-917-7689
2100-0225-001	5310-99-134-3782	2450-2126-001	4730-99-627-3619
2100-0876-001		2450-2127-001	4730-00-359-9487
2100-0877-001			
2100-0878-001			
2100-2240-001	5310-99-944-2457		
2100-2242-001	5310-99-944-2453	2450-2128-001	4730-99-627-2408
2100-2244-001	5310-99-944-2456	2450-2171-001	5999-99-627-2407
2100-2246-001	5310-99-780-7499	2450-2130-001	4730-00-910-0289
2100-2248-001	5310-99-944-2548	3510-0017-001	5330-99-627-2182
2199-0015-001		3530-0023-001	8030-99-627-3620
		6900-0014-001	4820-99-620-3013
		8600-0046-001	5905-99-626-8382
		8900-0250-001	5935-99-627-2397
		8900-0275-001	5340-99-627-2396
		8900-0298-001	5975-99-627-2395
2300-0151-001	5310-99-627-2414		
2300-0153-001	5310-99-626-9325		
2300-0155-001			
2300-0157-001	5310-99-722-4631		
2300-0159-001	5310-99-627-2412		
2300-0163-001	5310-99-627-2411		
2300-0907-001	5310-99-624-4058		
2300-0909-001	5310-99-111-1293		
2300-0910-001	5310-00-120-9059		
2300-0911-001	5310-00-450-6703		
2300-0912-001	5310-99-137-7202		
2310-0153-001			
2310-0429-001	5310-99-639-0695		
2310-0433-001			
2310-0597-001			
2349-0092-001			

CHAPTER 8.3

CONVERSION TABLE - TORQUE VALUES

lbf.ft	Nm
5.8	7.9
6	8.1
6.5	8.8
9	12
11.5	15.6
15	20
19	25.8
21	28.5
23	31
32	43
33	45
45	61
65	88
69	94
93	126
145	197
150	203
234	317
300	407

CHAPTER 8.4

FASTENERS USED ON LPH ANTENNAS

CONTENTS

GENERAL

1 The information given in this annex applies to the threaded fasteners of USA origin used on the various assemblies of the LPH9, LPH72 and LPH73 antennas. Three grades of fasteners are used:

1.1 Galvanised high strength. (abbreviated to galv. Hi.St. in the text and tables)

1.2 Galvanised standard. (abbreviated to galv.)

1.3 Stainless steel. (abbreviated to SST)

RECOGNITION OF FASTENERS

Galvanised high strength bolts and nuts

2 Galvanised high strength bolts may be recognised because the heads are marked "A325" and carry a symbol which indicates the manufacturer. In addition they may carry three short radial lines spaced at 120 degrees, although this marking is not mandatory.

3 Galvanised high strength nuts are marked on one face with three equally spaced circumferential lines.

Galvanised standard bolts and nuts and stainless steel bolts and nuts

4 The heads of the galvanised standard bolts and the stainless steel bolts are unmarked. The standard and stainless steels nuts are also unmarked. If these fasteners are painted, recognition may be difficult, however, in the unpainted state the slightly yellowish even colour of the stainless steel is quite readily distinguished from the light grey, slightly variable colour of the galvanised finish.

LOCATION OF FASTENERS

5 Table 1 gives details of the correct grade of fastener for each part of the installation.

TABLE 1 LOCATION OF FASTENERS

Location	Type of fastener
Joints between lattice mast sections	High strength galvanised
Attachment of lattice mast base assembly	High strength galvanised
Attachment of bearing plates and guy brackets	High strength galvanised
Joints between torque tube sections (LPH 73)	High strength galvanised
Note: The bolts which attach the bottom torque tube to the LPH 73 pedestal are standard galvanised.	
Attachment of LPH73 pedestal to lattice mast	High strength galvanised
Joints between torque tube sections (LPH 9) and LPH 72)	Standard galvanised
Attachment of tower base to foundation	Standard galvanised
Attachment of earthing wire to tower base	Standard galvanised
Attachment of braces on tower sections	Standard galvanised
Attachment of pulley bracket assembly to tower	Standard galvanised
Attachment of boom to torque tube top plate	Standard galvanised
Attachment of spring loaded transmission line to pedestal	Standard galvanised
Attachment of elements No 19 and 20 to boom (LPH 73)	Standard galvanised
Joints between spring loaded transmission line sections	Stainless steel
Joints between transformer line sections	Stainless steel
Attachment of feed straps to elements and transmission line	Stainless steel
Assembly of boom sections although joints between LPH 72 boom sections use standard galvanised.	Stainless steel
Attachment of elements to boom	Stainless steel

APPENDIX 1

PRESSURIZATION OF HELICAL MEMBRANE COAXIAL CABLES

WARNING:

COMPRESSED GASES. Compressed gas is used in the maintenance/installation of this equipment. Refer to AP100B-10 Data Sheet S1300.

SAFETY PRECAUTIONS

1 The following precautions must be strictly observed:

1.1 Nitrogen gas is stored under high pressure, the stored cylinders must be handled with great care.

1.2 Nitrogen gas cylinders are coloured **LIGHT GRAY** with a **BLACK** neck and black lettering.

1.3 Gas cylinders are to be stored in a cool, dry area.

1.4 When gas cylinders are being moved they must not be lifted by their valves or valve protecting caps, do not jolt or drop cylinders in any way.

1.5 Do not alter or tamper with gas cylinders colour coding, markings or valve threads.

1.6 Do not attempt to dismantle regulators.

1.7 Do not attempt to mix gases in a cylinder or to transfer gas from one cylinder to another.

1.8 Do not under any circumstances apply grease, oil or any other form of lubricant to the valves of the regulator connections.

INITIAL INSTALLATION OF CABLE-PRESSURIZING EQUIPMENT

CAUTION:

EQUIPMENT DAMAGE. Not all cylinders have the same gas pressure, only the NITROGEN cylinder 220cu ft (71A 386) is to be used.

2 The above cylinder, specified for this purpose, has a gas pressure of 1980 lbf/in when full.

NOTE:
Equipment demands are to be endorsed 'Cylinders having a pressure greater than 2000 lb/in^2 cannot be accepted in lieu'.

3 If a cylinder has been in use, ensure that the cylinder outlet valve is closed (clockwise) before moving the cylinder to another position.

4 Connect one end of the hose to the tyre inflator and the other end to the nitrogen regulator. Ensure that each connection is secure.

WARNING:

COMPRESSED GAS: DO NOT DIRECT HIGH PRESSURE NOZZLES TOWARDS CLOTHING, OR ANY PART OF THE BODY. REFER TO THE WARNINGS PAGE.

5 Ensure the outlet valve is not facing any personnel.

6 Remove the plastic blanking cap from the valve outlet. Insert the valve key into the top of the cylinder and ensure that the valve is tightly closed by turning the key fully clockwise.

7 Clear any accumulated dust from the cylinder outlet socket threads by venting gas.

8 Slightly open the cylinder valve by turning the valve key a quarter turn counter-clockwise. Allow gas to escape for one or two seconds and then close the valve. Ensure that the valve is closed.

NOTE:

When viewed from the operating handle side, the regulating valve is opened by turning the handle clockwise and closed by turning the handle counter-clockwise.

9 Ensure that the nitrogen regulator valve is fully closed.

10 Ensure the bull-nose nipple on the regulator and the cylinder valve are free from foreign matter, which could prevent a gas-tight seal. Clean as necessary.

11 Fit the nipple of the nitrogen regulator into the cylinder valve and tighten the nut with a spanner, ensure that only sufficient force is used to obtain a gas-tight seal.

CAUTION:

(1) EQUIPMENT DAMAGE. The cylinder valve must be opened very slowly, to avoid a sudden increase of pressure on the contents gauges.

(2) EQUIPMENT DAMAGE. If the pressure indicated by the gauge exceeds 2000 lbf/in^2, close the cylinder valve immediately and check that the correct type cylinder is being used.

12 Slowly open the nitrogen cylinder valve one turn while observing the pressure build-up on the cylinder contents gauge.

13 Slowly open the nitrogen regulator valve (clockwise) until an indication of 30 lbf/in^2 is indicated on the working pressure gauge.

14 Operate the tyre inflator for a few seconds and allow the gas to blow out any dust or protective chalk powder from the system.

PRESSURIZATION OF CABLES

15 Remove the cap from the Schraeder valve to the cable concerned.

16 Using the tyre pressure gauge, check the pressure of gas already in the cable, a working figure for an average installation is 5 lbf/in^2 to 10 lbf/in^2.

NOTE:

On initial installation only, the cable gas pressure is raised to 15 lbf/in^2 for 24 hours to show up any pressure loss caused by leaks. It is then reduced to the normal working pressure.

17 If the pressure is found to be low, remove the tyre pressure gauge, connect the tyre inflator to the Schraeder valve and operate the inflator until the correct pressure is obtained. Disconnect the tyre inflator.

18 Refit the cap of the Schraeder valve.

19 When all required cable pressurization tasks are completed, close the cylinder valve firmly and release the pressure in the nitrogen regulator by opening the tyre inflator.

TESTING FOR GAS LEAKAGE

20 If it is suspected that nitrogen gas is escaping from any part of the cable or the pressurization equipment, the presence of a leak may be detected by applying a solution of leak fluid (33C 5212690) to the suspect point. The leakage will be indicated by the forming of bubbles.

THAWING OF FROZEN VALVES

21 If a cylinder valve or a regulator valve should freeze over, the ice should be melted by repeated applications of a cloth soaked in hot water.

REPLACEMENT OF A CYLINDER

CAUTION:

EQUIPMENT DAMAGE. Cylinders are not to be discharged to a pressure lower than 50 lbf/in^2

22 When the cylinder contents gauge, on the regulator, indicates a pressure lower than 100 lbf/in^2, the cylinder is to be replaced by a fully charged cylinder of the specified type.

23 Ensure that the cylinder valve is firmly closed and all remaining pressure in the regulator has been released by operating the inflator.

24 Loosen the nut which secures the regulator to the cylinder, then unscrew and remove the regulator.

25 Refit the valve blanking cap and the gas cylinder protective cap. Return the cylinder through the appropriate channels for recharging.

26 Connect the fully charged replacement cylinder as detailed in Paras 2 to 14.

ANTENNA PRESSURIZATION

NOTE

At certain locations pressurization of feeder cables is achieved and monitored by automatic mechanisms. At these locations the procedure for checking pressure is detailed in the Air Publication specific to the equipment concerned.

FITTING OF BLANKING CAPS

27 To pressurize the antenna system during installation, fit four blanking caps to the following locations allowing the system to be separated into three sections:

(a) antenna end of the feeder
(b) at the rotary joint and at the top of the torque tube transmission line
(c) the torque tube end of the boom transmission line.

28 Using the pressurizing equipment, apply a gas pressure of 15 lbf/in^2 for a period of 24 hrs to each section. If no leak is suspected, adjust to a working pressure to between 5-10 lbf/in^2.

APPENDIX 2

ELECTRICAL CHECKS

ANTENNA FEEDER CHECK

1 Disconnect the antenna feeder from the radio equipment and the underside of the pedestal unit.

2 At the radio end of the feeder cable, connect the insulation tester between the inner and outer conductors of the feeder cable and ensure that the insulation resistance is greater than 10 M Ohms.

3 Disconnect the insulation tester.

4 Place a shorting link at the antenna end of the feeder cable, connect the multimeter set to inner/outer conductors and to the appropriate range. Ensure that the continuity is less than 1 Ohm.

5 Remove the shorting link and disconnect the multimeter.

TORQUE TUBE TRANSMISSION LINE CHECK

6 At the pedestal unit, connect the insulation tester between the inner and outer conductors of the rotating joint. Ensure that the resistance is greater than 10 M Ohms.

7 Disconnect the insulation tester.

8 At the top of the torque tube, connect a shorting link between the inner and outer conductor of the transmission line. At the pedestal unit, connect the multimeter set to the inner/outer conductors of the rotary joint, set to the required range and ensure that the resistance is less than 1 Ohm.

9 Remove the shorting link and disconnect the multimeter.

BOOM TRANSMISSION LINE CHECK

NOTE

The following paragraphs are to be completed with the coil removed.

10 At the antenna boom and torque tube interface, locate the boom transmission line and carry out the following checks:

10.1 Connect the insulation tester between the inner/outer conductor and ensure that the insulation resistance is greater than 10 M Ohms. Disconnect the insulation tester.

10.2 Connect the multimeter between the inner/outer conductor and set to the appropriate range. At the high frequency end of the antenna (front end), connect a shorting link across the inter-connecting strap which links the upper and lower transmission lines. Ensure that the continuity

resistance is less than 1 Ohm. Remove the shorting link and disconnect the multimeter.

ANTENNA ELEMENT ELECTRICAL CHECKS

NOTES

The insulation figure will be affected by the following:
(a) Leaving Tirfor ropes lying across the elements
(b) Damp, wet or humid weather conditions
(c) Allowing elements to come into contact with the ground.

11 Using the insulation tester:

11.1 Connected between the element and boom on either side of the element fibreglass insulator, ensure that the insulation resistance is greater than 10 M Ohms.

11.2 Connected between either side of the element fibreglass insulator, ensure that the insulation resistance is greater than 10 M Ohms.

11.3 Ensure that the continuity resistance is less than 1 Ohm.

12 Using the multimeter, set to the appropriate range, ensure that the continuity resistance indicated between the relevant transmission line and each antenna element is less than 1 Ohm. On completion of the check, disconnect the multimeter.

13 Repeat paragraphs 11 and 12 for all elements on the boom assembly.

CONTENTS