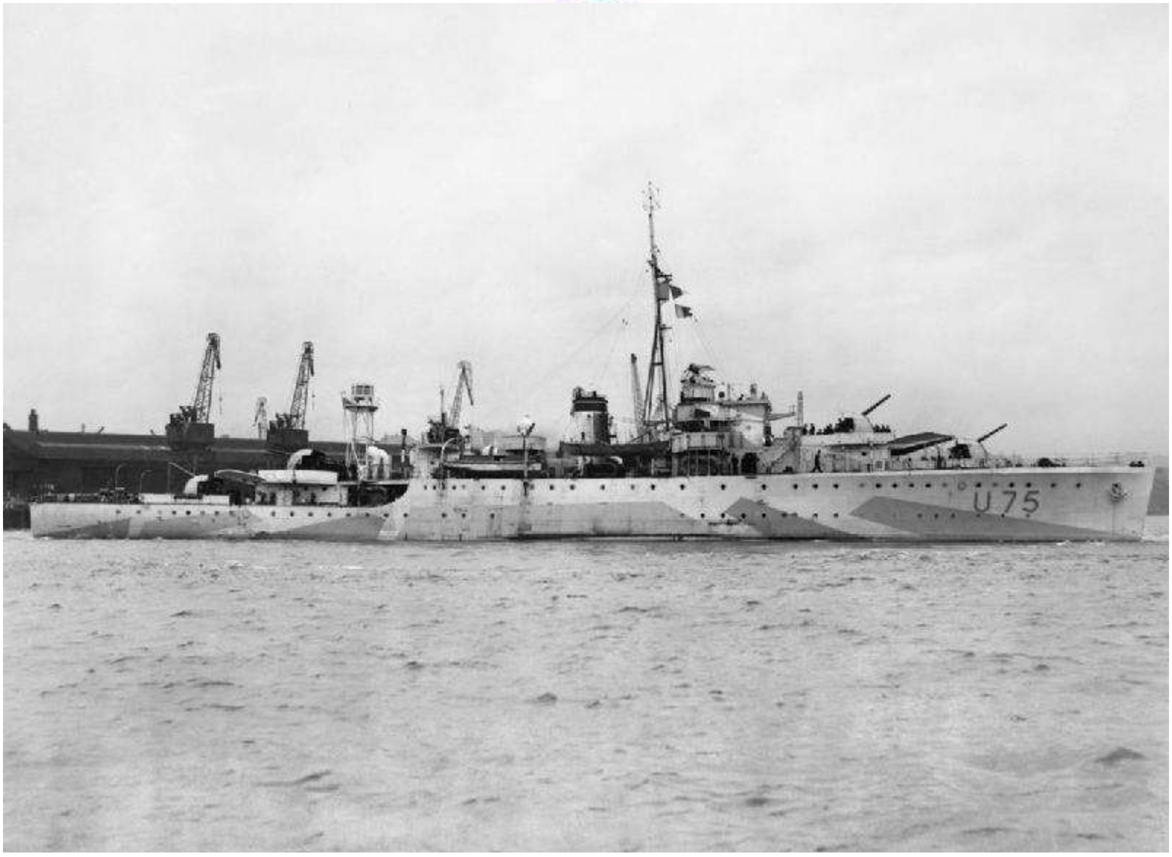
Defence Electronics History Society

e-DEFENCE ELECTRONICS NEWSLETTER

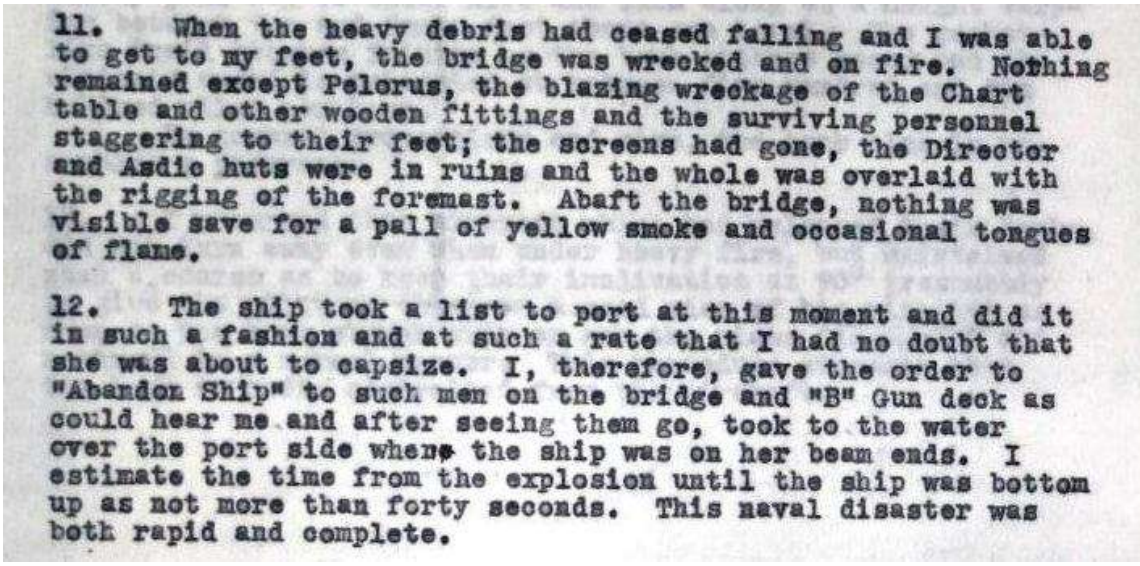
The e-NEWSLETTER OF THE DEFENCE ELECTRONICS HISTORY SOCIETY
No 40: November 2015



REMEMBERING

It is our practice at this time of year, when Remembrance is a particular theme, to draw attention to groups or individuals connected with military electronics who may be less immediately in mind than those directly engaged in front-line action; so, for example, we have in previous years called to mind SOE radio operators, and those engaged on intercept duties. This year, we feature a group of front-line sailors whose involvement with military electronics was direct and unexpected; the vessel pictured is HMS *Egret*, the first ship to be sunk by guided missile, a Henschel 293, on 25 August 1943, with the loss of 194 crew. HMS *Egret* had been built by J. Samuel White at Cowes, Isle of Wight, and launched on 31 May 1938. On the 27th August, 1943, in the Bay of Biscay, she led the 40th Escort Group, comprising the sloop *Pelican* and frigates *Jed, Rother, Spey* and *Evenlode,* covered by the destroyers *Grenville* and the Canadian *Athabaskan,* and relieved the 1st Escort Group in

patrol duty, hearing their unsettling tales of strange bombs used against the 1st two days earlier; HMS *Landguard* had been slightly damaged by a near miss, and one sailor killed on HMS *Bideford*. The results of the next attack, on *Egret* herself, are best described by her senior surviving officer:



11. When the heavy debris had ceased falling and I was able to get to my feet, the bridge was wrecked and on fire. Nothing remained except Pelorus, the blazing wreckage of the Chart table and other wooden fittings and the surviving personnel staggering to their feet; the screens had gone, the Director and Asdic huts were in ruins and the whole was overlaid with the rigging of the foremast. Abaft the bridge, nothing was visible save for a pall of yellow smoke and occasional tongues of flame.

12. The ship took a list to port at this moment and did it in such a fashion and at such a rate that I had no doubt that she was about to capsize. I, therefore, gave the order to "Abandon Ship" to such men on the bridge and "B" Gun deck as could hear me and after seeing them go, took to the water over the port side when the ship was on her beam ends. I estimate the time from the explosion until the ship was bottom up as not more than forty seconds. This naval disaster was both rapid and complete.

Egret's **loss was especially serious as, in a tragic irony, there were four RAF Y-Service electronics specialists on board, all of whom died in the attack, bringing the total killed to 198. *Egret* had been fitted with ELINT, electronic intercept equipment, designed to monitor Luftwaffe bomber communications and these Y-Service technicians were aboard to operate this equipment; but the bomber communications were HF and the missile control system (for which they would not, of course, have been searching) low VHF. The story of guided weapons in WW2 has been told previously in *eDEN*; but at this time of remembrance, think for a moment of Egret's crew, that day the first naval people to experience the shape of future wars.**

The concept behind the German Henschel Hs 293 guided missile originated in the Spanish Civil War, in which Luftwaffe crews under the guise of 'volunteers' took part. They saw how inaccurate unguided bombs could be, and so the German Air Ministry was open to ideas. One of two such ideas came from Dr Herbert Wagner, who left Junkers to join Henschel in 1940, where he proposed a winged version of the SC 500kg bomb, to be fitted with a Walter rocket motor and radio-guided. Flares were fitted in the tail to help the bomb-aimer guide the missile. Its warhead was in the front of a cylindrical fuselage, with the rocket motor suspended underneath, and the radio guidance system behind the warhead. The 293 was usually carried by a Dornier 217 or, later, a Heinkel 177, flying at about 3,000 feet, and releasing the bomb about 7 miles, 12,000 yards, from the target – the launch aircraft would therefore be a difficult target for ships' gunners. The Walter rocket motor gave the 293 a speed of 600 km/hr, nearly 400mph, which, given its small size and sea-skimming height,

made it a tricky target – and, being guided from the launch aircraft, it was liable to sudden and unpredictable changes of course.

In *eDEN 40,* we take a look at our extremely successful 2015 Autumn Symposium, of which a full account will appear in December's *Transmission Lines*, and in particular focus on ERT, the winners of the DEHS 2015 Restoration Award for their work on GEE Mk I. We then try, as usual, to span both the years and the wide interests of DEHS members, seeking in particular to answer some apparently easy – but deceptively difficult – questions! We first ask for your help on the precise definition of WW1 sounders, vibrators and buzzers; then, from the interwar period, we look at Marconi's airborne transmitters and receivers; and we move on to consider a query from our colleagues in the Newcomen Society, on Chain Home aerials, and find that all may not be quite as simple as it seems! An easier time for Mike Dean in answering John Kaesehagen's query on a test set which resembled that for 'Boozer' – the set was in fact for 'Green Bottle'! From the 1950s and 60s rocket tests in Australia, John Kaesehagen also provides both questions, and some answers, in identifying 1950s and 60s telemetry equipment from his collection. Coming up-to-date, John 'Jacey' Wise shares his substantial knowledge and wisdom on radars from Iran, and a perspective on DSEi 2015. For Xmas/ Eid/name your festival presents this year, I review Max Hasting's '*The Secret War*' and Gordon Corera's '*Intercept*', and note that there's excellent material on our own Publications List, and Ops Board features both Arthur Bauer's Open Day and the extended opening of the Oxford exhibition on the physicist Henry Moseley. In Tailpiece, which visualizes the naval vessels and operations rooms (holographic, of course) proposed under the Dreadnought programme, we go beyond the present day to 2050, and of course a full century beyond the luckless *Egret*, to defences – and attacks – of which her crew could not have dreamed.

As always, suggestions for improvements, offers of articles and all general comments to me at philjudkins@btinternet.com or chairman@dehs.org.uk.

Dr. Phil Judkins, DEHS Chairman.

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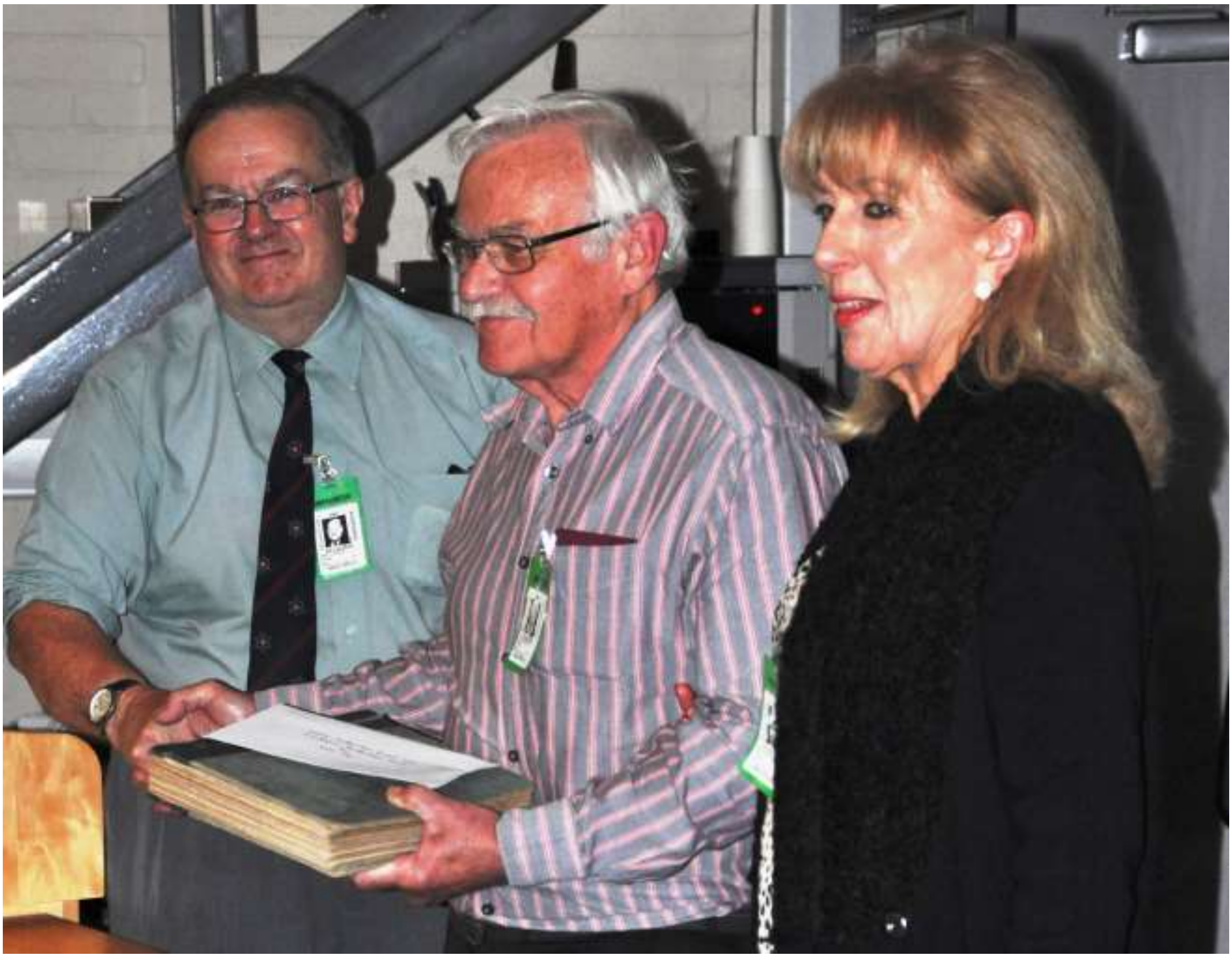
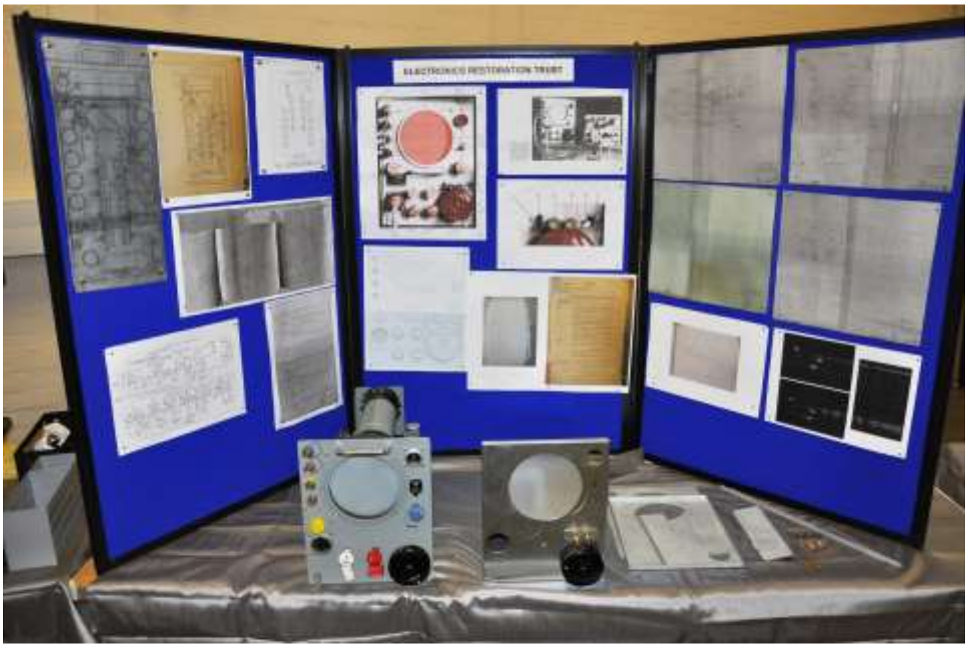
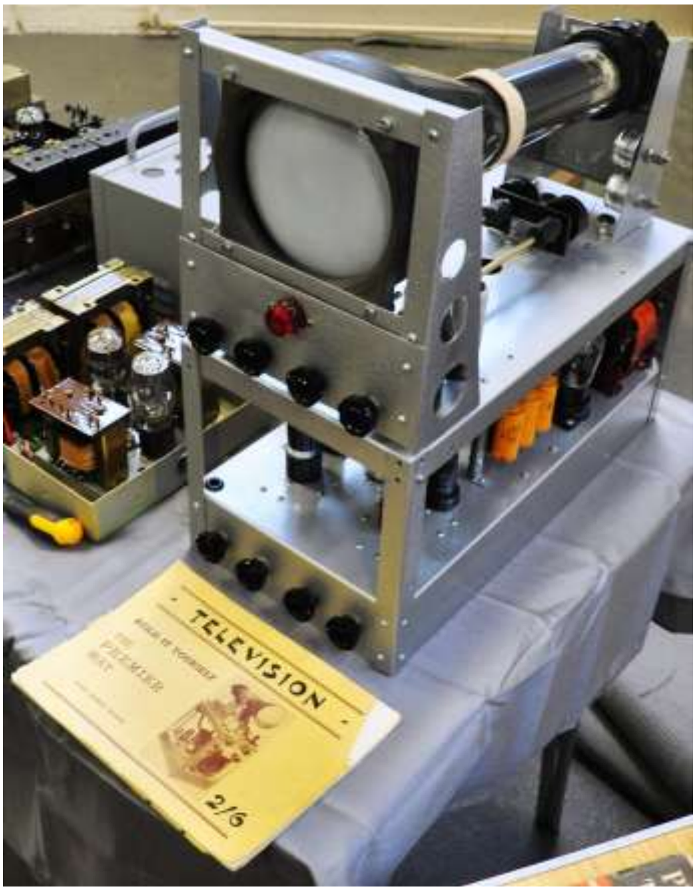
DEHS AUTUMN SYMPOSIUM
RESTORATION AWARD 2015



Tony Waller and his wife Viv receive the DEHS 2015 Restoration Award on behalf of the Electronics Restoration Trust , whose 'managing partners' are Tony and Richard Hankins, for their work on GEE Mk I. The pictures below - all copyright Chris Cooper, to whom many thanks - show the work of the Trust in more detail.





Many DEHS members 'of a certain age' will recall modifying GEE set components and units into a television; others may ask their parents/grandparents! This is ERT's tribute to that 'heroic age' of home construction. Below, ERT's impressive display of GEE receivers and indicators at the DEHS 2015 Autumn Symposium

GEE Mk I Indicator under construction, showing ERT's immaculate detailing of metalwork and their close attention to detail

Much of Tony's invaluable work for ERT starts here, with the winding of high-cycle transformers and suitable chokes to the original specifications. Most of these were, of course, removed and thrown away by those who purchased this equipment as War Surplus (your Chairman being as guilty as anyone else), and remanufacturing this class of equipment to the highest restoration standards takes hours and days of Tony's time.

Having whetted your appetite with ERT's outstanding display, we will leave you with a view below of one of the three other displays;Tony Helm's, Anthony Howard's and my own display will feature, with a full report on the Symposium, in December's *Transmission Lines*

WW1 BUZZERS, SOUNDERS AND VIBRATORS

Hopefully DEHS members are following the **BBC Radio 4 series** '**Tommies'**, recounting the WW1 experiences of the fictional signaller **Mickey Bliss** over the four years of that conflict; each episode is broadcast on the centenary of the events it portrays, and already – it being now late in 1915 - the listener has been drawn into the deadly game of interception and counter-interception across a series of battlefronts. You can catch the repeats on the BBC website to get up to date.

The producer of '***Tommies'*** is **Jonathan Ruffle**, a meticulous researcher (*your Chairman had always thought the BBC had none left working for it!)*, whom DEHS members may recall as the producer for radio of **Len Deighton's '*Bomber'***, an outstanding broadcast whose CD version is on your Chairman's bookshelf as he types this *eDEN*.

Jonathan has gone to great trouble to ensure that the events portrayed in '***Tommies'*** sound authentic, including recording actual spark sets in operation, and quizzing **Dr Liz Bruton** and myself on many points of detail. Most recently, Jonathan mentioned that he was having problems "*distinguishing what contemporary books mean when they use various terms, generally about methods of calling which then become the name of the method of operation (I think).*
But in the years preceding WW1, we read of

- ***buzzers***
- ***sounders***
- ***vibrators***

- and in 1916 these various methods can get imposed on the same line. I think buzzer is moderately obvious; it is the literal audible buzzer in any unit. Sounder should be this too, but the two terms get used in the same sentence and therefore must be different in some way. And vibrator I think may be a descendent of the old Wheatstone arrow vibrating from one letter to another".

Did Liz and I know, asked Jonathan, of an unimpeachable source which detailed a distinctive role for each? Liz provided a detailed response:

*"In answer to your question about buzzers, sounders, and vibrators all of which were used in transmitter apparatus and with quite a bit of credit to Murray, James Erskine "A handbook of wireless telegraphy" (1907) available online via Internet Archive at*https://archive.org/stream/ahandbookwirele00erskgoog*:*

A buzzer is an electric bell with the gong off, being a producer of electric jigs, or in modern terminology an electromechanical device which interrupts the circuit at a very high rate.

Sounders and vibrators could sometimes be used in place of one another.
- A sounder is a telegraph sounder, that is a device which produces an audible sound (a 'click' rather than the audible buzz of a buzzer) when connected to an operating electrical or wireless telegraph system most usually the Morse key. Essentially, the sounder makes a sound both when the circuit is broken and when it is restored - which makes it easier to identify the long and short presses of the Morse key.

- A vibrator is a conductor or combination of conductors bound by a dielectric which reflects the electrical surges back on themselves (feeds back?) and so maintains a stationary vibration of definite period. In the early period of wireless telegraphy around the late 19th century, an electro-magnetic vibrator was sometimes used as a de-coherer and was commonly used in combination with a sounder in the transmitter; other times in this early period, "a Hertz vibrator" seems to refer to the electromagnetic transmitter itself.
But, Liz pointed out, *"And then I believe the use of the term may have changed between this early period and WW1".*

Now, undoubtedly, DEHS members may know better! Please write in and let us know, especially those of you who have books and sources of the period, and help us help Jonathan in his quest!

MARCONI INTERWAR AIRBORNE RADIO

With the appointment of Kapil Subramanian at Leeds University to research the interwar period, part-supported by DEHS and most generously by our President Keith Thrower, *eDEN* will be printing several articles of interwar interest, beginning with this summary of Marconi's late-1930s state of the art in airborne radio communication.

MARCONI AIRCRAFT EQUIPMENT

New Developments in the Past Year

With the very substantial increase in the traffic carried by the established air transport companies, the increase in the number of air operating organizations, and the development of new air routes in Great Britain and in all parts of the world, wireless communication has become a matter of great importance in connection with all air operations, and is indeed an integral part of all air organization.

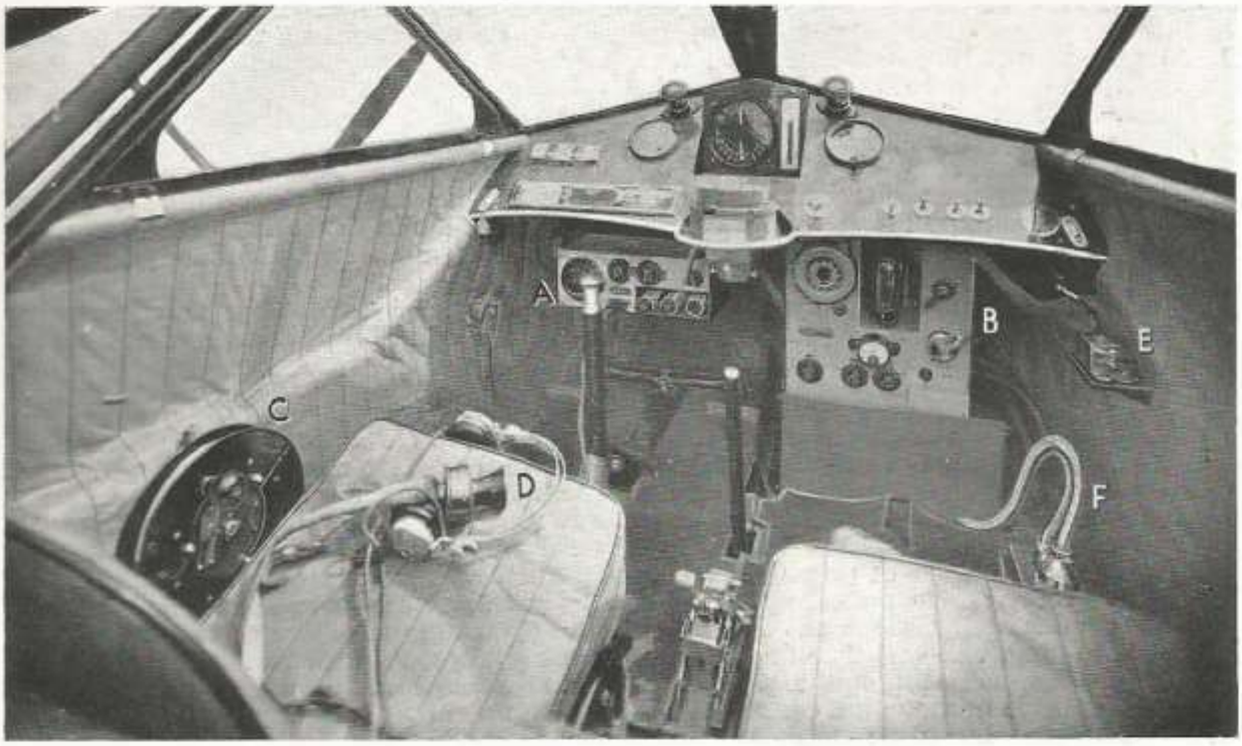
It is fortunate, therefore, that a company with the experience and resources of the Marconi Company is available to serve all air-operating companies and private individuals who may require wireless equipment for communication between aircraft and aerodrome ground stations.

The Marconi Company has spent many years in investigating the special conditions governing communication between aircraft and the ground, both in temperate zones and under such exacting conditions as are to be met with on the Empire air routes where a great variety of atmospheric conditions are experienced. This Company has developed a range of aircraft and aerodrome wireless apparatus which can be depended upon to give the most reliable service at minimum maintenance costs and to assist air-operating companies to run to a very exacting schedule both by day and night.

Some of the principal Marconi equipments available for aircraft were described in the last issue of the Air Annual and should be referred to in connection with the further developments described in this article.

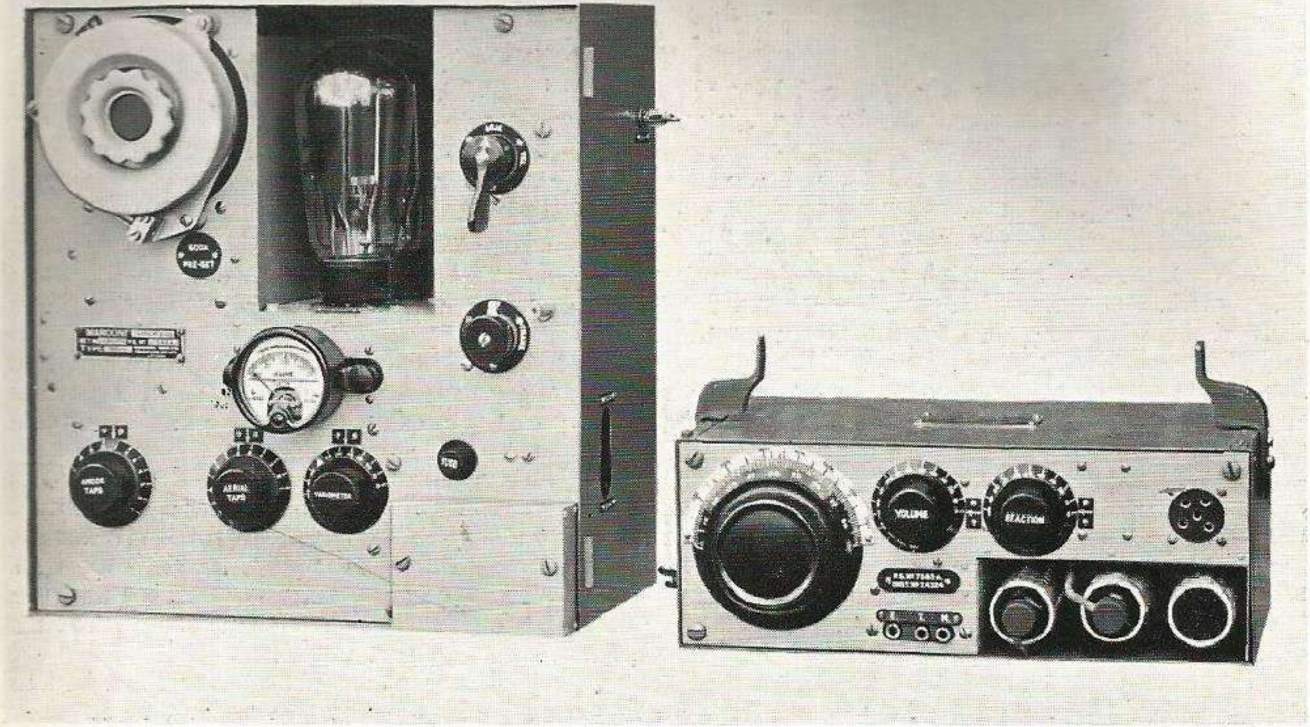
MEDIUM WAVE AIRCRAFT EQUIPMENT

One of the most interesting of the new types of apparatus is the Marconi AD 49/50 equipment which has been specially designed for use on the smaller types of civil, military and naval aircraft, where restricted space for service requirements precludes the use of a



MARCONI TYPE AD 49/50 MEDIUM WAVE AIRCRAFT TRANSMITTING AND RECEIVING EQUIPMENT INSTALLED IN A MONOSPAR TYPE ST4

A. Receiver *C.* Aerial Winch *E.* Operating Key
B. Transmitter *D.* Microphone and Telephones *F.* Junction Unit



Marconi Type AD 49/50 Medium Wave Aircraft Transmitting and Receiving Set

higher power equipment. The use of medium waves renders it particularly suitable for use on commercial aircraft which, by International regulations, are bound to use wavelengths between 826 and 923 metres.

The set can be used for telegraphy by Continuous and Interrupted Continuous Waves, and for telephony. The transmitter is designed to cover a continuous wave band of 800–1,000 metres (375 kcs.–300 kcs.) and an alternative fixed wavelength of 600 metres (500 kcs.). The receiver is designed to cover a continuous wave band of 600–1,200 metres (500 kcs.–250 kcs.). The power rating of the transmitter is approximately 65 watts to the anode of the magnifier valve on C.W. and I.C.W. telegraphy, and approximately 45 watts on telephony.

Power supply for the transmitter and receiver can be derived from a double output wind-driven generator fitted with a constant speed windmill, and an alternative power supply in the form of a rotary transformer is available for use in aircraft already equipped with a twelve-volt battery, for heating and lighting purposes.

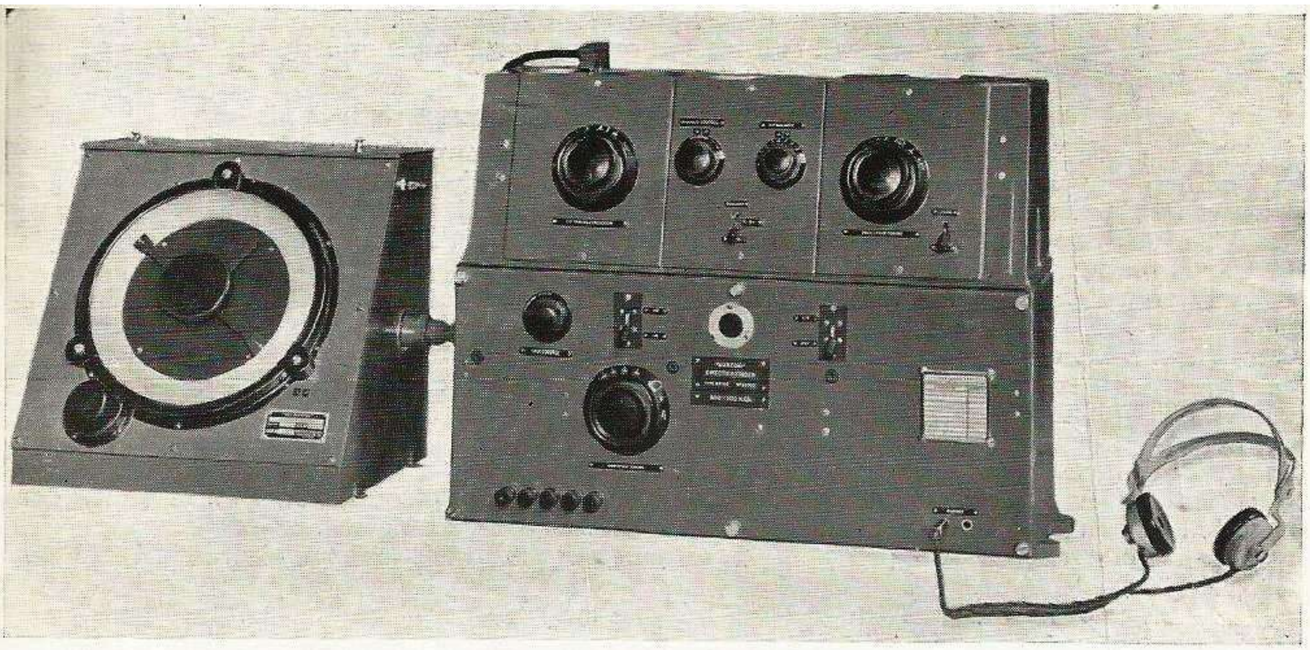
Facilities for direction finding by either the "homing" system or by taking bearings on two transmitters, can be provided by means of the addition of a frame aerial and a small amplifier to the normal receiver.

AIRCRAFT DIRECTION FINDING

Another new development is the Marconi Type AD/52 Direction Finding attachment which is designed for use in conjunction with Marconi aircraft receivers, thus providing a direction finding equipment in a convenient and economical form. Although designed primarily for use with the Type AD 38 and AD 42 receivers, it is also suitable for use with the majority of Marconi medium wave aircraft receivers. The direction finding attachment eliminates the necessity of providing a complete direction finding receiver in addition to the normal receiver, thus effecting a considerable saving in cost, weight and space.

The type AD 52 attachment is designed for operating on either of two systems of direction finding, viz.—(1) The fixed aerial "homing" system, in which use is made of a single fixed loop aerial in conjunction with a trailing aerial and a loop reversing switch. (2) The rotatable frame aerial system which enables bearings of a transmitter to be taken in the usual way, but also retains the special features of the "homing" system.

The provision of direction finding facilities in no way interferes with the normal reception carried out on the trailing aerial, change from normal reception to direction finding being instantaneously effected by means of a small change over switch mounted in the D.F. attachment.



Marconi Type D.F.G. 11 Medium Wave Aerodrome Direction Finder

MARCONI "HOMING SYSTEM"

This is essentially a simple method which enables a pilot to set the course of his aircraft directly towards a known wireless transmitter on the ground. It is particularly suitable for use on aircraft where no special wireless operator or navigator is carried, and where the aircraft flies mainly on routes passing no direction finding stations on the ground but where ground communication of beacon transmitters is situated along the route, e.g. at the various aerodromes.

In this system use is made of a single loop aerial installed so that its plane lies at right angles to the fore and aft line of the aircraft, and of a loop reversing switch, in addition to the normal receiver and trailing aerial. By the operation of a three-position switch it is possible to determine from the signals received whether the transmitting station lies to port or starboard of the fore and aft axis of the aircraft. By suitably correcting the course until no difference in signal strength can be observed, whichever way the loop is connected, the aircraft will be automatically headed towards the transmitting station.

MARCONI ROTATING LOOP SYSTEM

This system provides a full direction finding service in cases where an operator and/or navigator is carried on large civil, military or naval aircraft, and which fly over territory where no direction finding stations are available, or over the sea. The system enables the aircraft to be headed towards a transmitting station, as previously described under the "homing" system and in addition, provides a convenient means whereby bearings may be taken on stations which lie off the normal course of the aircraft, and from which the position of the aircraft may be determined by plotting, in the usual way, the bearings of two or more such stations on the chart.

In this system use is made of a small screened loop aerial mounted externally on the aircraft and provided with a hand wheel and mechanism for rotating the loop from inside the aircraft. The mechanism incorporates a clutch so arranged that the loop is automatically locked in the desired position when the hand wheel is reversed.

The method of taking bearings is similar to that already described under the "homing" system so that if "homing" only is required it is only necessary to set the loop at right angles to the fore and aft access of the aircraft, to operate the loop reversing switch, and to correct the course accordingly.

In the case of bearings taken on stations lying off the line of flight, however, the loop itself is rotated until no difference in signal strength can be observed whichever way the loop is connected. When this condition is obtained the bearing of the desired station relative to the "head" of the aircraft may be read from a scale attached to the mechanism.

The screened loop can be of the retractable type if required, whereby it can be drawn into the body of the aircraft when direction finding observations are not required.

29—(Ae.9005)

The Type AD 52 equipment has been approved by the British Air Ministry for fitting in British commercial aircraft and is installed on the aeroplanes of Imperial Airways and their Associated Companies.

MARCONI LIGHT WEIGHT AIRCRAFT RECEIVER

This is a small and economical aircraft receiver of the super-heretodyne type, designed particularly for the service of owners of light aeroplanes who may wish to fit a wireless receiver to intercept the weather broadcasts detailed in Air Ministry Notice to Airmen No. 63 (11th June, 1935), and also transmissions from the aeronautical stations operated by the Air Ministry, entertainment broadcasts, etc.

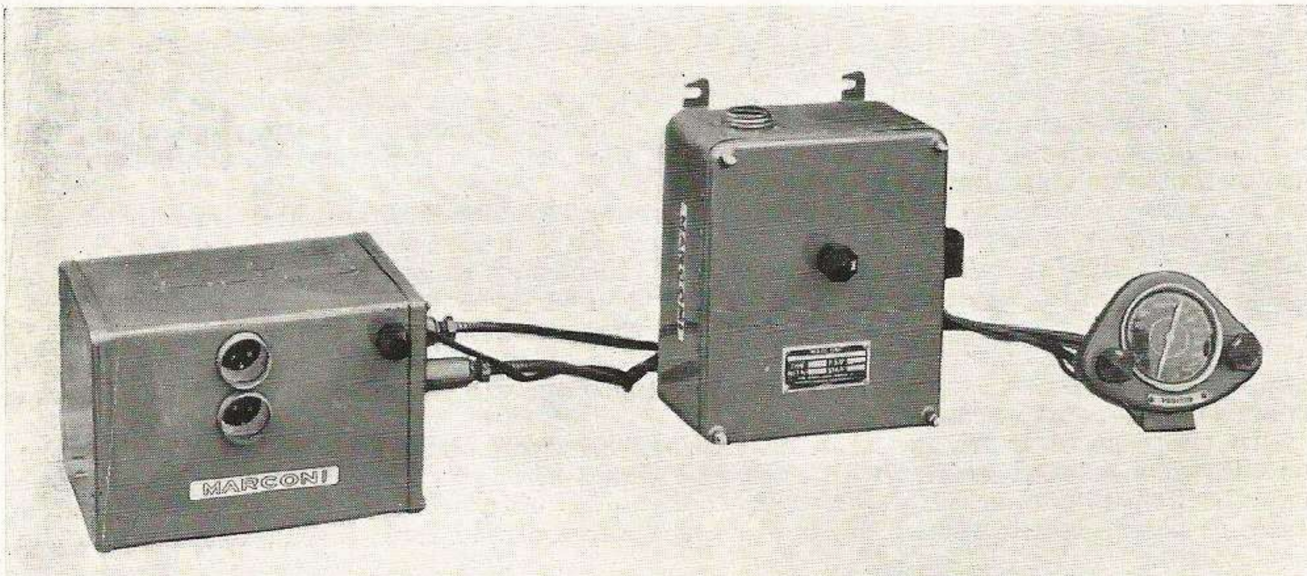
A further use of these sets is their installation on air liners where broadcast entertainment is desired. Attendants on these air liners can, by means of this set, switch on entertainment broadcasts for passengers equipped with head 'phones, as in the case of the railway broadcasting service. Gramophone records can also be used to entertain the passengers, and a microphone can be incorporated in the circuit so that the officer in charge can make announcements to passengers, give information with regard to landing times, or describe the country over which the aeroplane is travelling.

The receiver embodies a five-valve super-heterodyne circuit and two wave bands are provided—220 metres to 600 metres, and 800 metres to 1700 metres.

The total weight of this complete installation including all cables, etc., is only 24 lb.

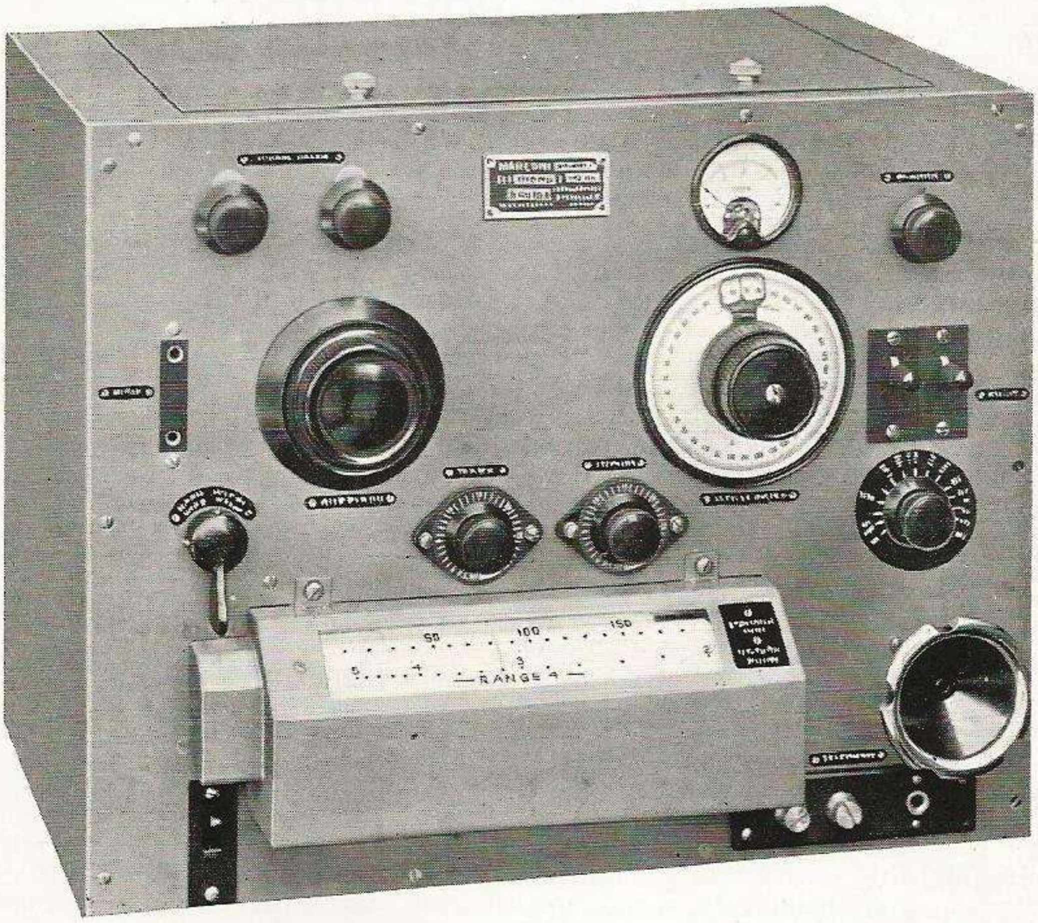
MARCONI TYPE AD 52 AMPLIFYING ATTACHMENT AND LOOP REVERSING SWITCH FOR MARCONI AIRCRAFT D.F. EQUIPMENT.

A. Loop Tuning Condenser
B. H.F. Tuning Condenser
C. "D.F."–Plain Aerial Change-over Switch
D. Loop Reversing Switch



MARCONI LIGHT WEIGHT AIRCRAFT RECEIVER

developed during the past year with full remote control arrangements enabling the transmitter and aerial to be placed clear of the aerodrome without affecting its flexibility of performance in any way. By means of this new remote control system the machinery can be started and stopped, the transmitter can be used for morse keying or speech (C.W., I.C.W. or telephony), and set to any one of four spot waves from the distant control point. When it is desired to communicate with an aircraft which is about to land on the aerodrome, and the transmitter is switched to the special landing wavelength the radiated



MARCONI SHORT WAVE RECEIVER, TYPE R.G.34

power is automatically reduced to two metre-amps as is required by international regulations, returning to full power when the normal communication wavelength is switched on. This transmitter can be supplied for all mains operation when desired, thus obviating the use of running machinery.

OTHER MARCONI EQUIPMENT

Marconi aircraft equipment which was described in last year's Air Annual, but which should be mentioned again, includes the well-known Type AD37/38 combined medium and short wave equipment which has been adopted by Imperial Airways Ltd. for the Atalanta class of aeroplanes on the African air route, in Australia, and by other companies operating long distance air routes; Type AD41/42 medium wave aircraft equipment such as is used by Imperial Airways Ltd. for their Short *Scylla* and *Syrinx* aircraft; Type AD43/44 sets specially designed for military aircraft of the high-speed fighter class, for communication between units in the air and with the ground; the Type AD45/46 equipment which is particularly applicable to military aviation services and is suitable for artillery co-operation and reconnaisance aircraft.

WIRELESS OPERATOR'S SERVICE

The past year has seen a striking growth in the demand for fully qualified wireless operators for the rapidly increasing air services. The Marconi Company has, therefore, established a school for training wireless personnel for the air services, and has inaugurated a service for the supply of uniformed aircraft wireless operators to air operating companies or private individuals who may require their services.

A TANGLED WEB: CHAIN HOME AERIALS

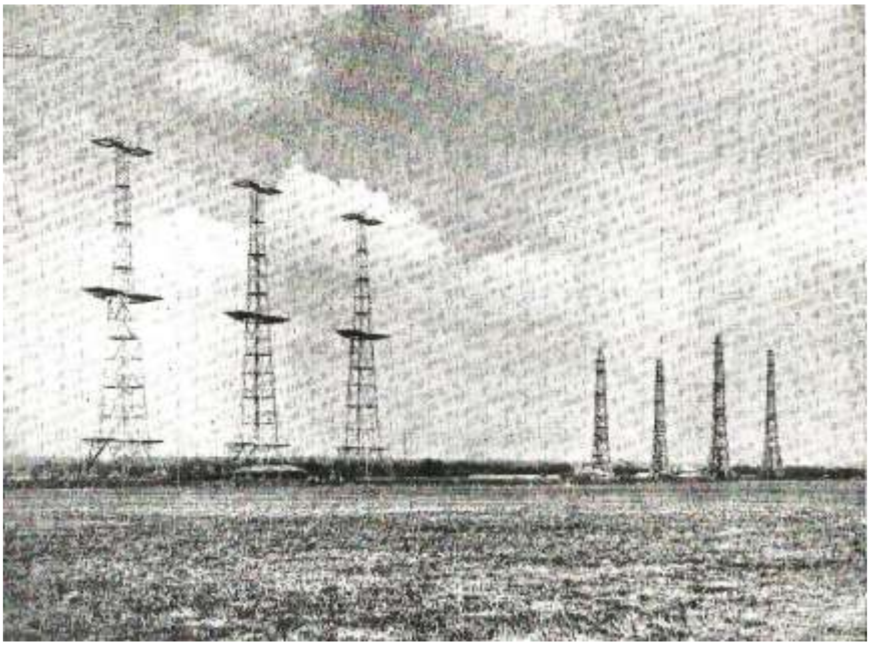
The deceptively simple question from our good friends and colleagues in the Newcomen Society read

"***Could you get one of your members to answer the following basic queries about the Chain Home system, which may be obvious to them, but not to a non-electronics person! I have in mind the usual pictures of the transmitter towers.......***

1. ***There are three of them....they all seem to be facing in same direction. Are they?***
2. ***Or is there some kind of reinforcement of the beam direction by having three aerials?***
3. ***None of the pictures ever show how the actual aerial wires were arranged. I don't even know whether the wires ran from tower to tower, from each of the "platforms".***
4. ***Could one of your readers provide a sketch of the aerial layout and a brief explanation of why this arrangement was used?***

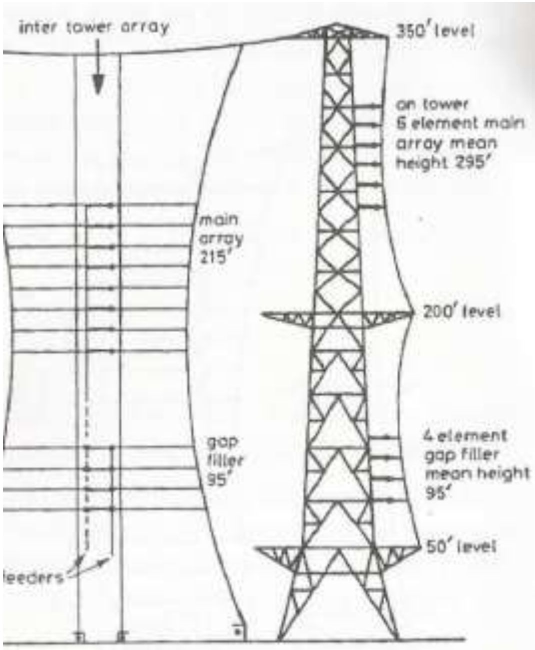
Your Chairman put forward an initial response

"*The Newcomen Society will be familiar with the fact that apparently simple questions often have long answers! Let me first be sure we're talking about the same photo – that of Poling Chain Home, the attached being taken from HMSO's 'Science at War' (1947).*

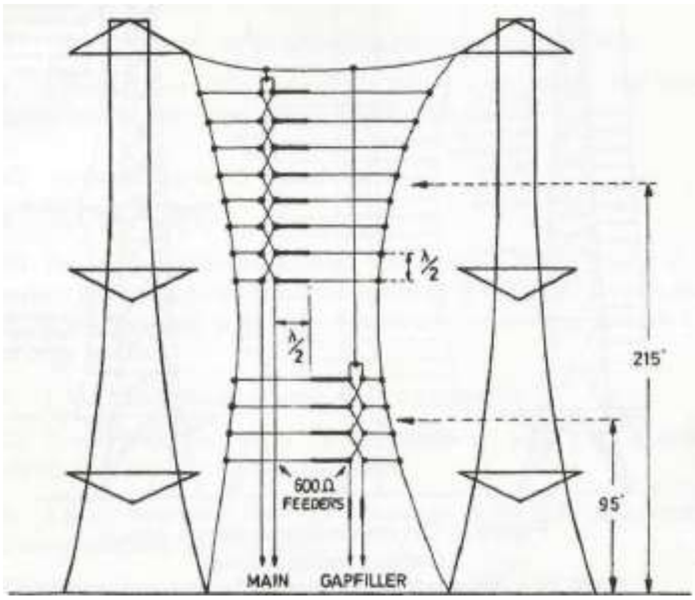


The starting point is that each site was originally planned for four transmitter towers, not 3. The reason behind this was that there were originally planned to be four different frequencies between which the Chain Home transmitters could quickly switch, in order to guard against German jamming of any given frequency; hence each of the 4 towers was to have its aerial set up for one of those 4 frequencies. The aerials were at that stage planned to be verticals between the outrigger platforms.

In the event, and partly because of the speed with which war came, no station ever had more than two operational frequencies. That meant that some economy could take place in transmitter towers, which were reduced to three on many sites (a process which resulted in some which had just been erected being taken down again and moved to another site, much to the verbal disgust of the aerial erectors!!) and also that the aerial system could be replanned and improved. In this case, the outrigger platforms were again to be used, but aerials were also strung between the remaining towers – so, two curtain arrays between the remaining three towers as shown in Fig 2.



A later, further, change took place after the Battle of Britain. Marconi's led the planning and erection of a new aerial system which was entirely between the towers, as shown in Fig 3. The outriggers, with the exception of the uppermost, were not used.



The answers to the posed questions are therefore:
1. Yes, the towers are all facing in the same direction, and no, there is no beam reinforcement by having three towers – that is to do with different operating frequencies.
2. See the diagrams, and bear in mind the revisions of the aerial systems.
3. See diagrams. More information is in Skip Wilkins' memoir, "The Birth of British Radar" edited by Colin Latham, (Radio Society of Great Britain/ Defence Electronics History Society) Appendix 2, pages 81-95.

Now, there is a great deal of revisionism in what is often quoted about CH aerials, not least because later Marconi advertising liked to claim for itself Chain Home's 'Finest Hour'; it was not so – transmitters by Metropolitan Vickers, receivers by Cossor, and Marconi's refit of Chain Home aerials came *after* the Battle of Britain. It's worth reproducing the original Radar Supervisor's Handbook aerials chapter in full, which thanks to S/Ldr Mike Dean MBE I can do -

PART. II.

CHAPTER.I.

R.D.F. AERIAL SYSTEMS.

1. The aerial systems of an R.D.F. station are of fundamental importance not only to the station at which they are erected but also to adjacent stations in the coastal chain of R.D.F. stations. There are two distinct aerial systems at each R.D.F. Station, one coupled to the transmitter designed to transmit energy at a low angle over the sea, and one coupled to the receiver designed to accept re-radiated energy from aircraft over the sea.

2. The transmitting aerials are erected on metal towers, see figure 1 and the receiving aerials on wooden towers, see figure 4 both constructed as high as economically practicable in the particular district required.

3. An ideal site for these aerial systems consists of high ground with a smooth surface sloping gradually downwards to the sea. On a site of this nature energy re-radiated from an aircraft at a distance of the order of 100 miles is reflected at the surface of the sea. This ensures maximum energy at the D.F. array which enables a bearing to be determined sufficiently accurately to provide an early warning of approaching aircraft.

4. Whilst this ideal condition for obtaining a bearing gradually deteriorates as aircraft approach the site, the energy available at the D.F. array progressively increases as the distance of the aircraft from the site decreases, the two conditions tending to provide an appreciably constant result.

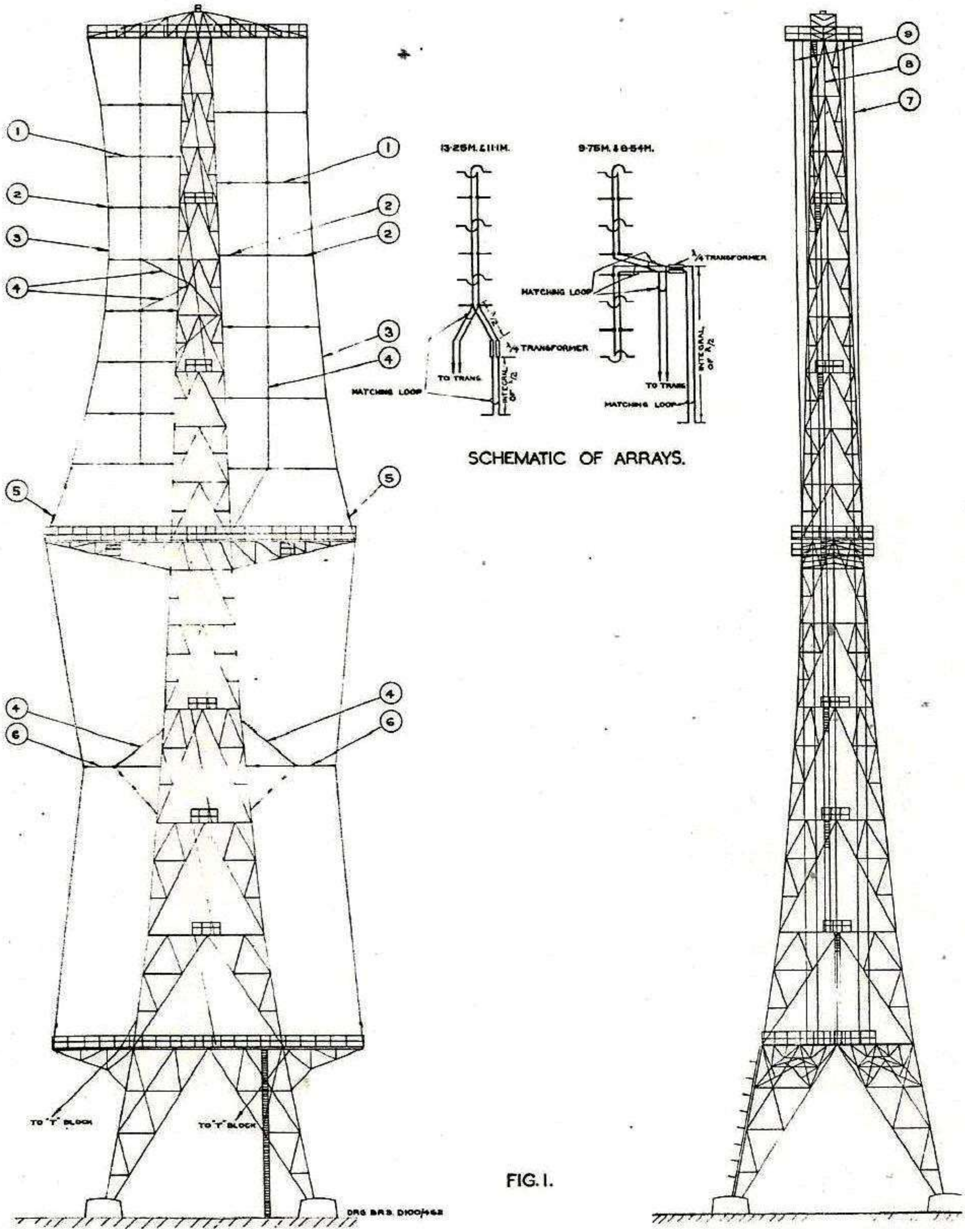
5. As aircraft approach nearer to the site the re-radiated energy is reflected by the ground, a condition necessary to make reliable height measurements by the AMPLITUDE COMPARISON METHOD. See chapter on this subject.

6. The results obtained at an R.D.F. station depend to a large extent upon the combined properties of the transmitting and receiving aerials; it is therefore essential to obtain maximum electrical efficiency together with the required standard of structural strength. The design of the aerial systems must also be such that the component parts are readily accessible for maintenance purposes.

7. Detailed layouts of the transmitting and receiving aerial systems are illustrated in figures 1, 2, and 4. The main components referred to throughout the text are annotated by numerals.

8. At an R.D.F. Station four transmission towers are erected on each of which are fitted two entirely separate arrays, thus providing a total of eight aerial arrays.

9. At present four spot frequencies are employed viz:- 22.64 Mc/s (13.25 Metres) 27.03 Mc/s (11.1 Metres) 30.77 Mc/s (9.75 Metres) 35.13 Mc/s (8.54 Metres).



13·25M. & 11·1M.
9·75M. & 8·54M.
λ/4 TRANSFORMER
MATCHING LOOP
TO TRANS
INTEGRAL OF λ/2
SCHEMATIC OF ARRAYS.
TO "T" BLOCK
TO "T" BLOCK
DRG BRS D100/462

FIG. 1.

10. The arrangement of arrays on the towers is as follows:-

Tower number T1 - 13.25 M and 9.75 M.
T2 - 11.1. M and 8.54 M.
T3 - 13.25 M and 9.75 M.
T4 - 11.1 M and 8.54 M.

Transmitting arrays are duplicated as a precautionary measure to reduce the risk of breakdown.

TRANSMITTING AERIAL SYSTEM.

11. A single transmitting aerial system for one frequency consists of six or eight centre fed, horizontal half wavelength aerials erected in the form of a "STACKED ARRAY" (7) with which is associated one or two curtains of reflectors of similar dimensions, (8) (9). See figures 1 and 2.

12. The primary function of the reflectors is to reduce radiation inland as much as possible, and the curtains of reflectors are critically spaced with respect to the excited aerial elements to achieve this object. The radiation to seaward is also increased by the action of the reflector curtains. The transmitting arrays are supported on either side of metal towers, 360 ft high, of which the detailed layout is shown in figures 1 and 2.

13. The half wavelength aerials (1) constructed of 11 S.W.G. copper wire are supported at the centre by one insulator and at each end by two insulators (2) of special design, thus forming a strong and flexible insulated system.

14. One end of each aerial element is secured to the tower and the other end to a stainless steel stay (3) which is held in position between two platforms erected on the towers at heights of 200 ft. and 350 ft. A mechanical fuse (5) is inserted in this stay close to the lower platform to protect the tower from undue strain in abnormal weather conditions.

15. Transmission lines (4) constructed of similar wire to that used for the aerials, are secured rigidly throughout their length from the array to the transmitter by means of specially designed insulators. These insulators are mounted on the sides of the towers down to approximately 12 ft. above the ground and then on telegraph poles from the bases of the towers to the transmitter building, where the lines are coupled to the transmitter with a variable impedance transformer.

16. The closed loop method of matching the aerial array and transmission line termination impedances is adopted as standard in R.D.F. transmission practice because of the simplicity of erection and ease of adjustment for maximum efficiency. Closed loops are shown at (12) in figure 2.

17. When the initial difference of impedances is too large for a direct match to be effected the array is divided at its centre and the two halves are matched to an impedance value suitable for matching to the transmission lines. The two methods of matching are shown schematically in figures 1 and 2 and are explained in detail in a separate chapter.

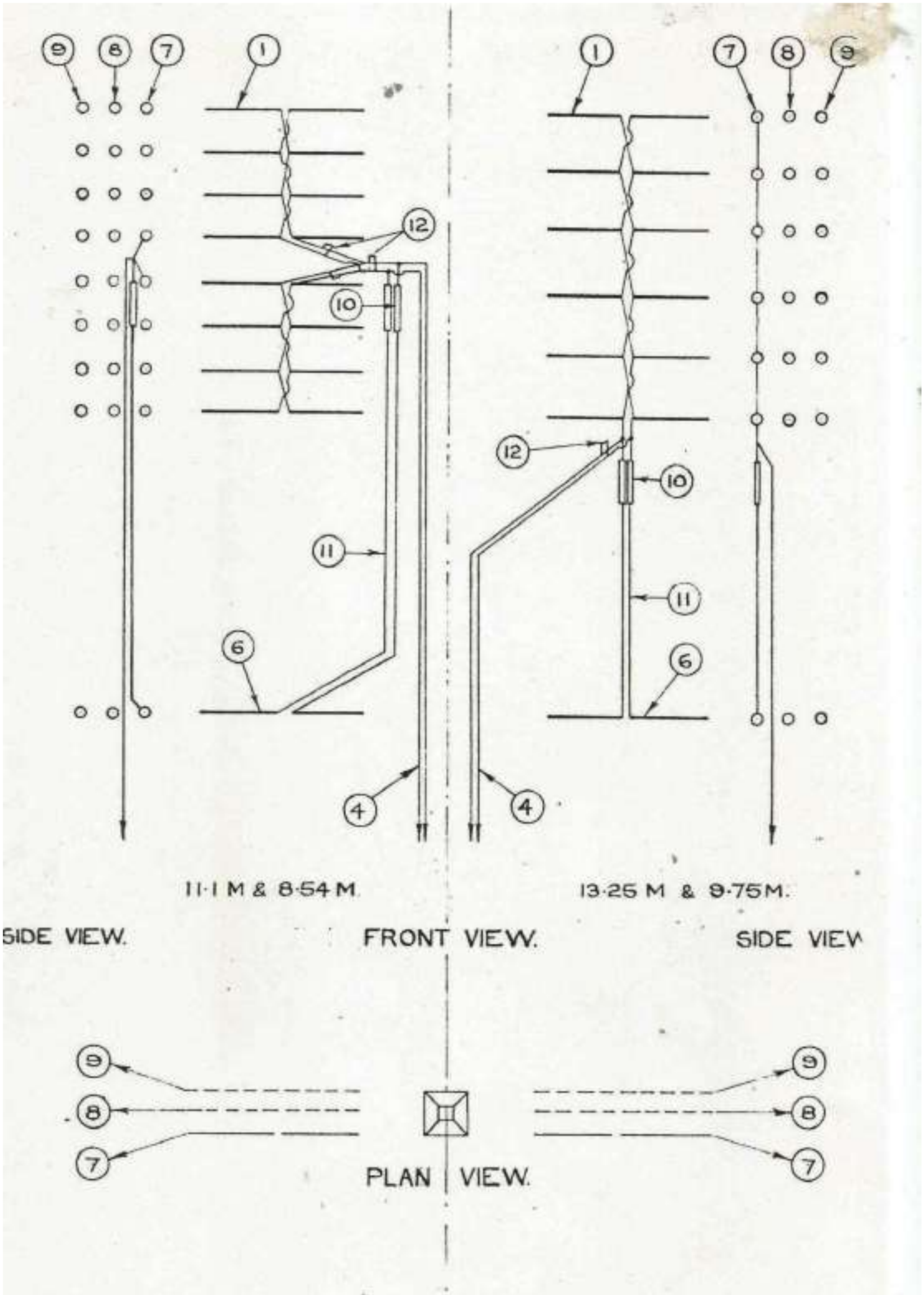


FIG. 2.

DIAGRAM OF TRANSMITTING ARRAYS SHOWING ALTERNATIVE METHODS OF MATCHING.

DRG.E 100/555/1

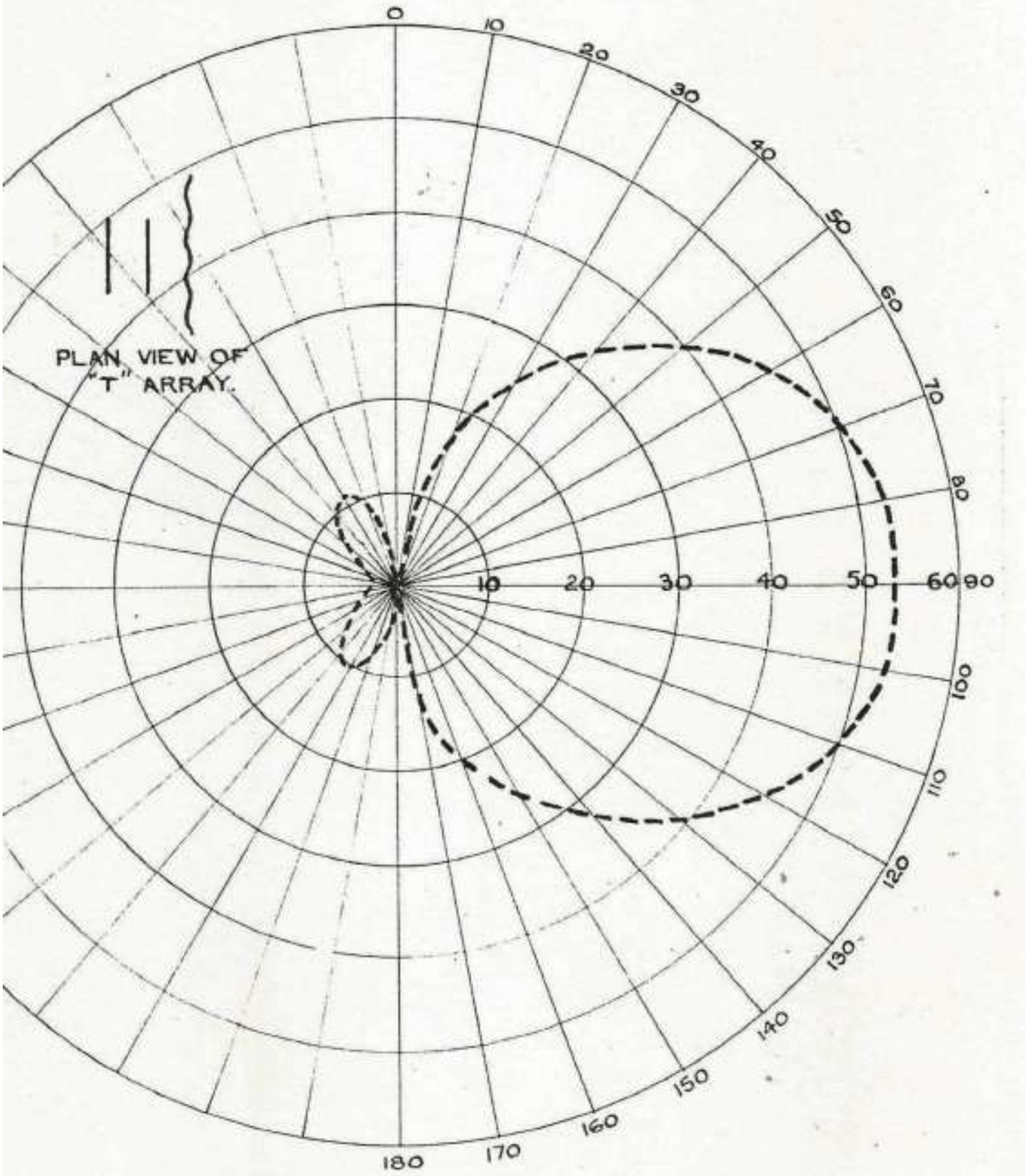


FIG 3a.

HORIZONTAL POLAR DIAGRAM OF FIELD STRENGTH OF TRANSMITTING ARRAY.

DRG.E100/555.

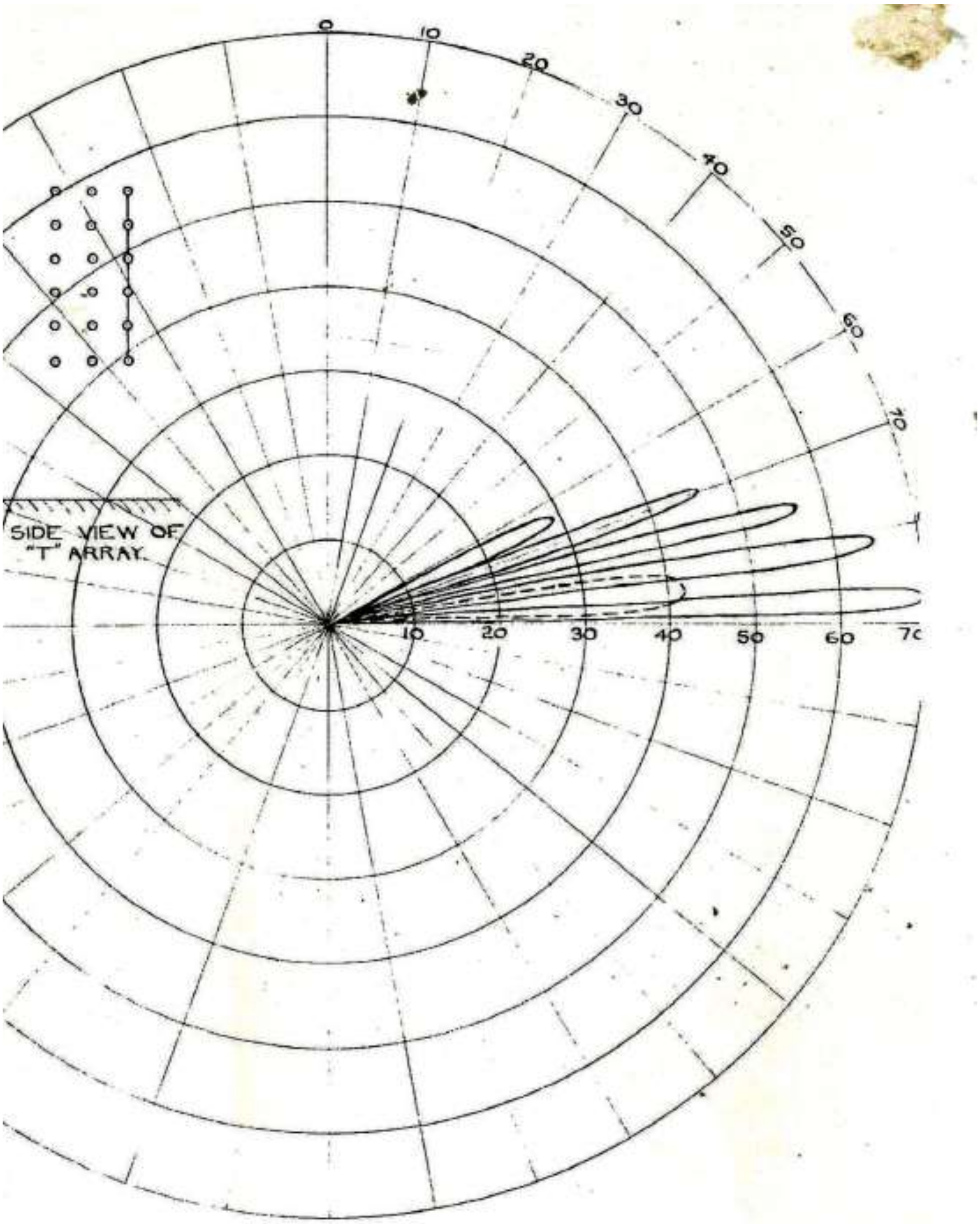


FIG 3b.

VERTICAL POLAR DIAGRAM OF FIELD STRENGTH OF TRANSMITTING ARRAY.

DRG.E100/555/3

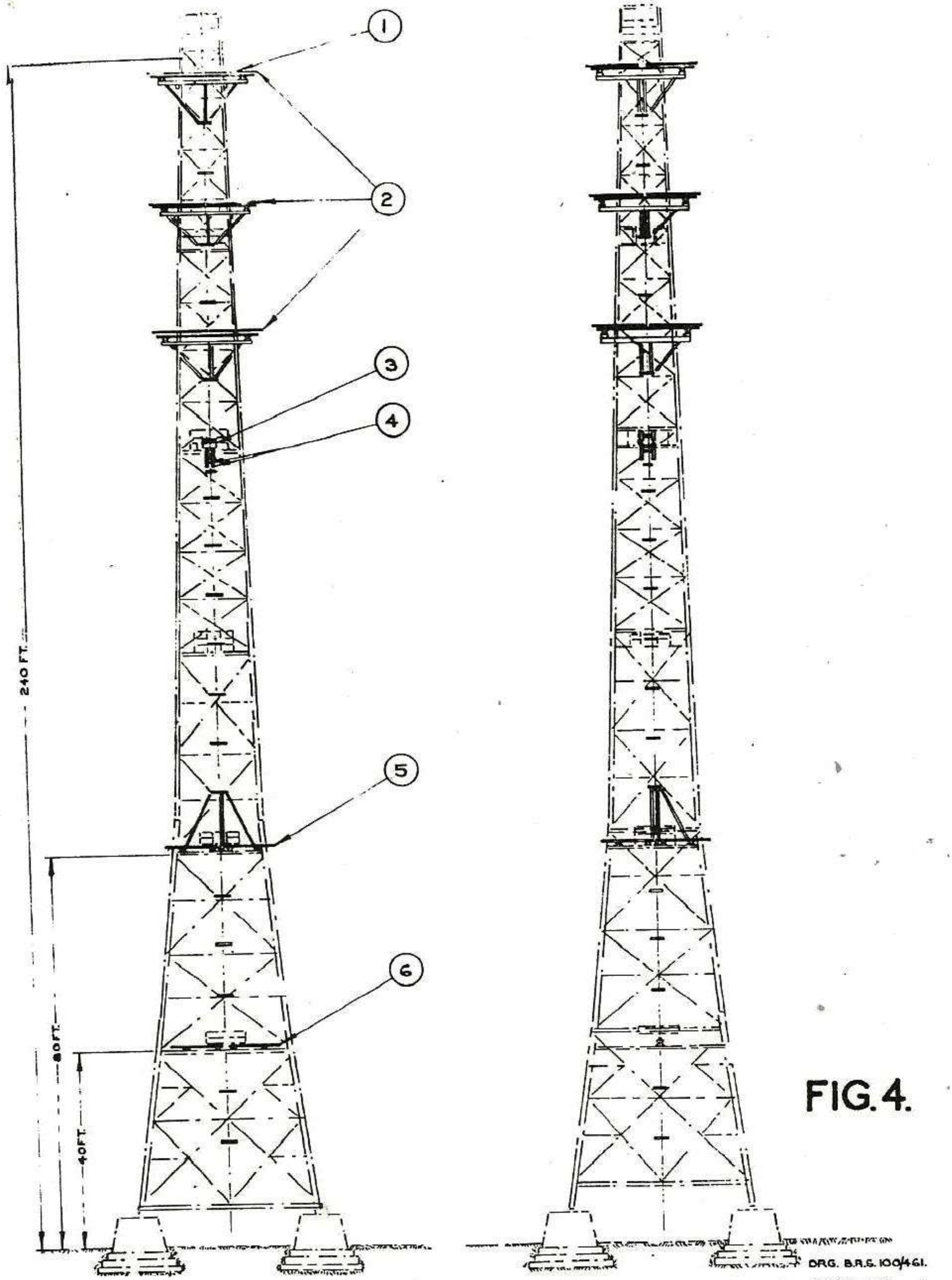


FIG. 4.

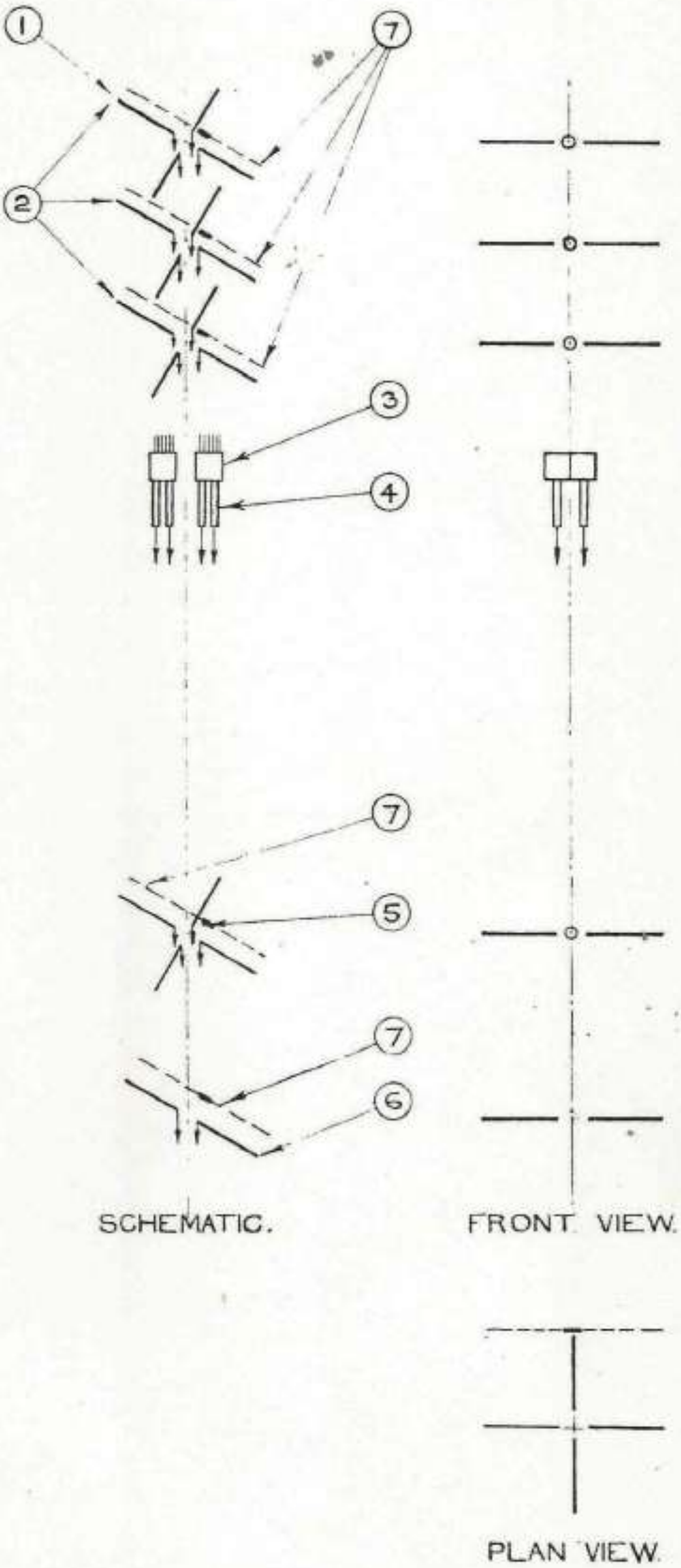


FIG 5.

SCHEMATIC DIAGRAM OF RECEIVER ARRAY.

DRG E 100/555/

Polar Diagrams.

18. Typical polar diagrams which show the directional characteristics of the transmitting arrays in horizontal and vertical planes are given in figure 3.

19. In the vertical plane, figure 3(b), the sharply defined lobes fail to illuminate small areas between each lobe as a result of which aircraft in these areas are not observed. To remedy this a single half-wavelength aerial (6) fitted 80 ft. from the base of the tower, is fed with power, of the order 50 K.W., with a peak voltage 90 degrees out of phase with that of the main array which is supplied with 200 K.W.

20. The power fed to the single aerial is limited to 50 kilo watts by suitably spacing a pair of quarter-wavelength matching lines (10) inserted at the main array end of the transmission lines which connect the main array to the single aerial.

21. These quarter-wavelength lines also effect the 90 degrees phase change by virtue of their length. The transmission lines (11) linking the quarter-wavelength lines and the single aerial are constructed with an overall length of integral half-wavelengths to maintain this phase difference.

22. The phase difference between the energy in the main array and that in the single dipole ensures that power is radiated by the single dipole at periods when the array is not radiating. If energy were radiated from these two aerial systems in phase the resultant field would still have gaps between the lobes but when a phase difference of 90 degrees is introduced the whole of the area in which we are interested is illuminated.

23. The overlapping lobe radiated by the 80 ft. dipole is shown as a broken line in figure 3(b).

RECEIVING AERIAL SYSTEM.

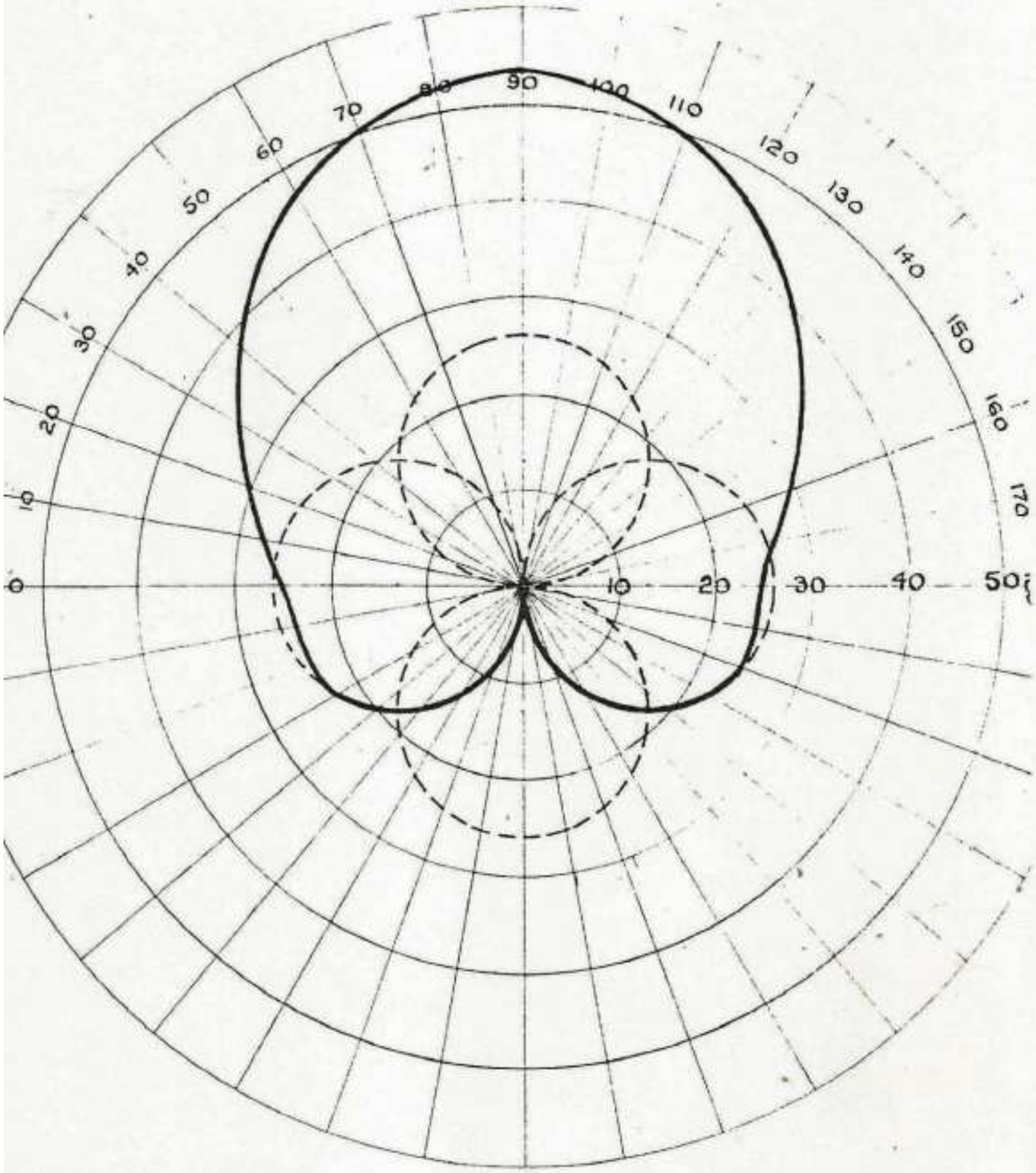
24. Four towers constructed of wood, each 240 ft. high, see figure 4, are used to support the horizontal half-wavelength aerials (1) and reflectors which comprise the receiving aerial system. These components are made of 1¼ inch brass tube.

25. Three pairs of crossed dipoles placed vertically one above the other in the form of a "Stacked Array" (2) and secured as near to the top of the tower as possible are used for the determination of bearings in a horizontal plane over the surface of the earth (Azimuthal bearings).

26. The phasing of this array is effected at the 160 ft. platform and the connections are housed in a weather proof box (3) shown in figures 4 and 5. A detailed explanation of the phasing arrangements and method of adjustment are given in a separate chapter.

27. It is necessary to match the D.F. array to the feeder lines, to obtain maximum efficiency and this is effected with quarter-wavelength matching transformers (4) fitted in each feeder line immediately below the phasing box.

28. Reflectors (7) operating parasitically are associated with the crossed dipoles forming the D.F. array as shown in figure 5 to enable the "sense" of bearings to be determined.



1.) BROKEN LINE = 2 CROSSED λ/2 DIPOLES.

2.) FULL LINE = 2 CROSS λ/2 DIPOLES WITH REFLECTOR.

FIG. 6a

DRG E100/555/5

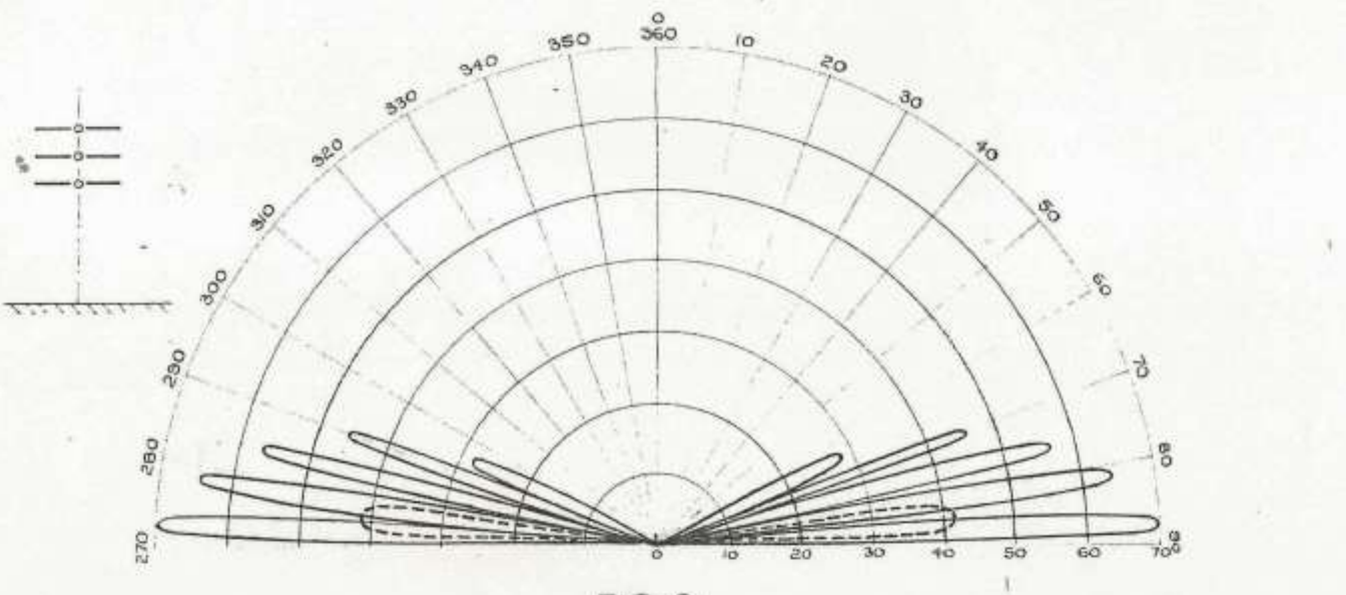


FIG. 6b.

ERTICAL POLAR DIAGRAM OF FIELD STRENGTH OF RECEIVING ARRAY

29. The reflectors are normally open-circuited at their centre by means of an electrical relay, operated by a switch fitted to the receiver desk, and are consequently not operative.

30. The sense of a bearing is determined by using the relays to short circuit the gaps at the centre of the reflectors thereby bringing the reflectors into operation. This causes the amplitude of the observed echo to increase if the aircraft is to seaward and to decrease if it is inland.

31. The horizontal and vertical directional characteristics of the D.F. system are shown in the polar diagrams of figure 6.

32. The small gap between the lobes, figure 6(b) which occurs at a low angle of elevation, (4¼ degrees at Bawdsey) is filled in by employing another pair of crossed dipoles, (5) secured at approximately 80 ft. from the base of the tower, in place of the D.F. array. When an aircraft is at this "dead" angle of elevation it is near the receiving station for normal altitudes of flight but the amplitude of echo with the D.F. array in circuit is too small for the accurate determination of the bearing. In these circumstance the 80 ft. crossed dipoles are switched in circuit at the receiver instead of the D/F array and the amplitude is increased sufficiently for satisfactory operation.

33. The bottom lobe of the polar diagram for the 80 ft. dipole is superimposed upon the array polar diagram in figure 6(b) from which it is seen that the gap is effectively covered.

34. Energy received by the D.F. aerials is fed into the fixed coils of a radio-goniometer and the azimuthal angle is obtained directly by a minimum method of operation with a pointer moving over a circular scale engraved in degrees.

35. In operational practice a pointer is not required, as the movement of the goniometer spindle drives a rotating arm which forms part of the automatic plotting devise.

36. The height of aircraft (Zenithal angle) is determined under certain conditions to an accuracy of ∓ 500 ft, by an amplitude comparison method. The energy received by a dipole at 80 ft. (5) is compared with the energy received by either the top dipole of the D.F. array (1) or a dipole secured 40 ft. from the base of the tower (6) depending upon the altitude and distance of the aircraft from the R.D.F. station.

37. When the 80/40 ft. combination is used the distance of the aircraft from the R.D.F. station is not very great therefore the use of a 40 ft. aerial in the place of a 240 ft. aerial does not too seriously affect the amplitude of the received signals.

38. All the dipoles used to determine the height of aircraft are in the same vertical plane at right angles to the "line of shoot" of the R.D.F. station. The required dipoles are selected by electrically operated relays controlled by a switch on the receiver desk and connected to the field coils of the radio-goniometer.

39. The amplitudes of the received signals in each field coil, which vary with the height of the aircraft, are compared by the minimum method and read off the goniometer circular scale as an angle.

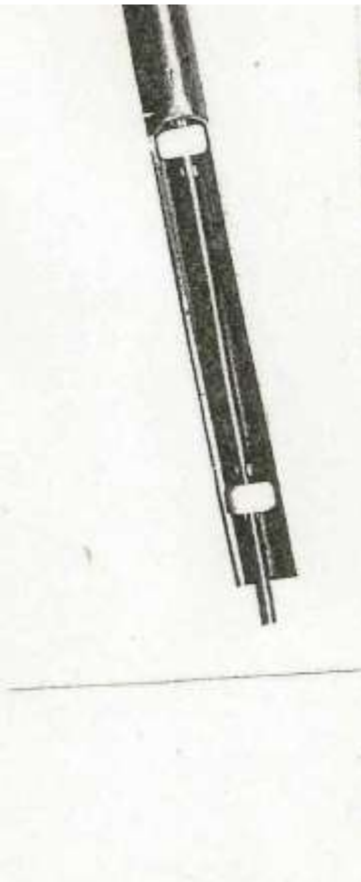


FIG. 7.

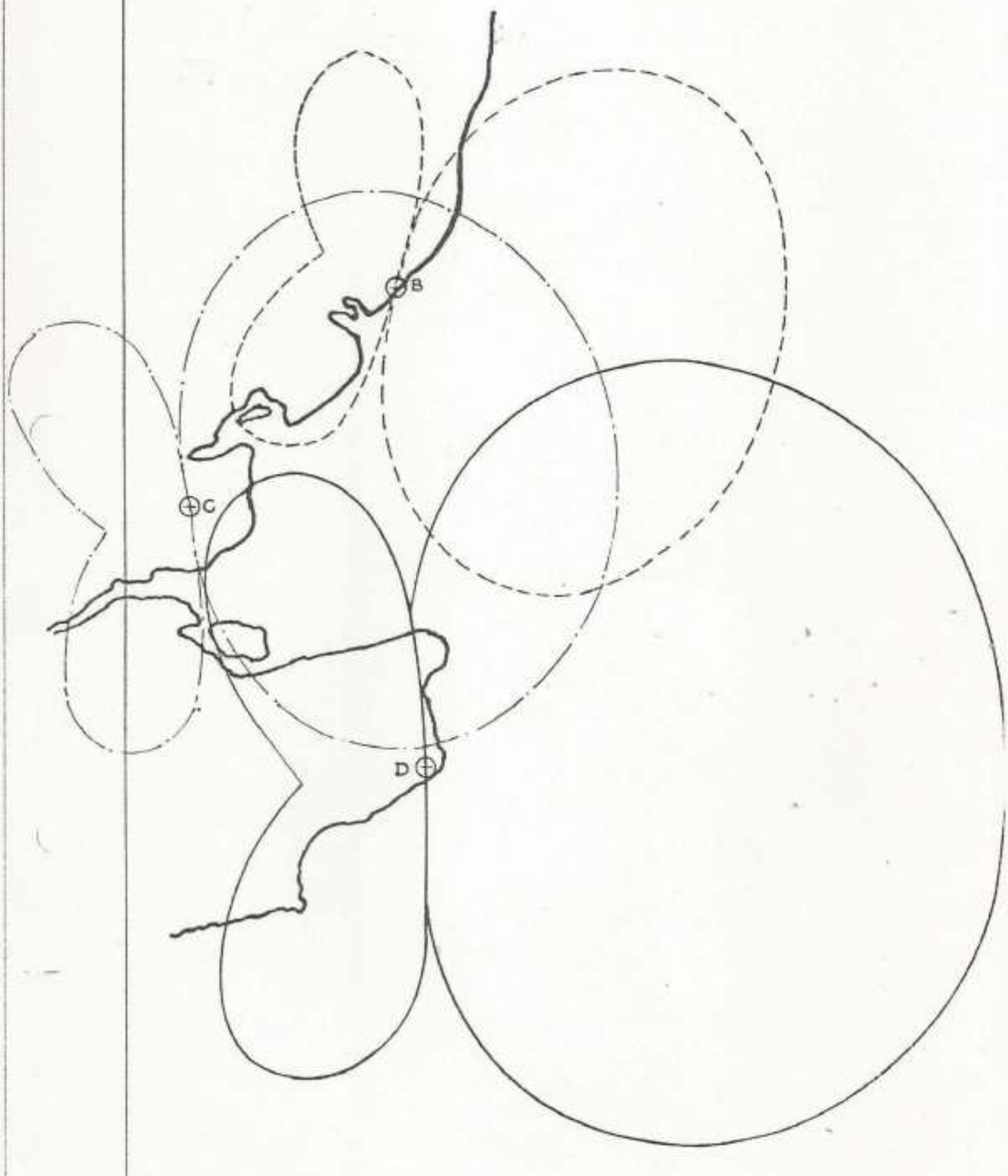


FIG.8

OPERATIONAL AREAS OF 3 R.D.F. STATIONS

40. Actual height is obtained from a set of curves which are plotted from known values of aircraft height and goniometer bearing obtained during calibration flights. Allowance is made for the effect of the curvature of the earth and, for operational purposes, the resultant height is indicated automatically by a cursor moving over the plotted height curves. A detailed explanation of height determination is given in a later chapter.

41. All feeder lines of the receiving aerial system are of concentric or co-axial design. The lines are constructed of 11 S.W.G. copper wire secured concentrically inside 3/8 inch copper tubing by means of high grade insulating beads. These beads are made of non-hygroscopic ceramic material and spaced 2.25 inches apart as shown in figure 7.

42. The outer tubes are carefully sealed to render them airtight as the feeder lines are kept under pressure, of the order 4½ lbs per square inch to ensure constant performance. A pressure gauge is fitted to show the pressure and the air is rendered dry by pumping it through a container of silica - gel.

43. Practical considerations prevent the pairs of feeder lines joining the various aerial elements to the goniometer being constructed of identical lengths. This necessitates additional phasing of the feeder lines which is effected at the receiver before the lines are connected to a selector switch of special low-loss design fitted on the receiver desk.

OPERATIONAL AREA.

44. The results obtained at an R.D.F. station depend to a large extent upon the combined properties of the transmitting and receiving aerial systems. A plan view of the operational area covered by the combined aerial systems described in this chapter for three adjacent coastal chain stations is given in figure 8 and is discussed in detail later.

DEFINITION OF TERMS APPLICABLE TO AERIAL SYSTEMS.

AERIAL ARRAY.

1. A combination of elements so disposed in space that they carry currents in phase. A concentration of energy in one or more directions may be obtained by using an array.

RADIATING ELEMENT.

2. A conductor of length either $\lambda/4$ or $\lambda/2$ fed with energy at one end and capable of radiating energy away from itself.

DIPOLE.

3. Two radiating elements which together form a complete radiating system. The two elements of a "current fed" dipole are both $\lambda/4$ long, and the two elements of a "voltage fed" dipole are both $\lambda/2$ long.

REFLECTOR.

4. A system of dipoles similar to the excited dipoles, but spaced, $\lambda/4$ from them in simple arrays. The spacing may be varied from $\lambda/4$ and the phases adjusted accordingly to produce any special desired effect.

CURTAIN.

5. A term used to describe the plane front of several associated radiating elements.

TRANSFER LINES.

6. A pair of lines of length an integral multiple of $\lambda/2$ used to interconnect different parts of an array.

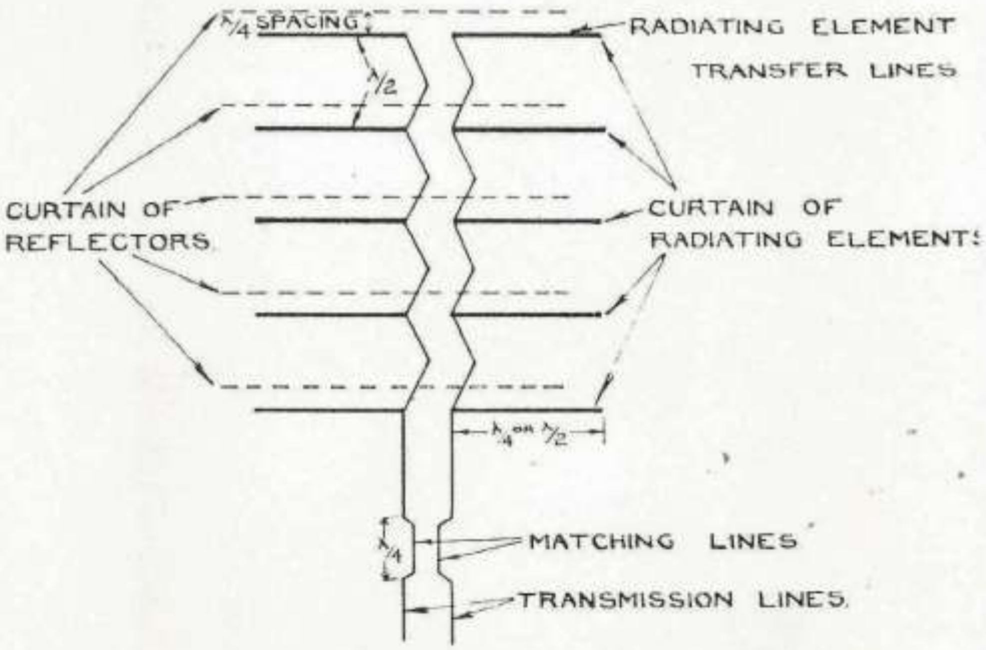
MATCHING LINES.

7. A pair of lines the length of which is a $\lambda/4$ used for matching different impedances to each other.

FEEDER OR TRANSMISSION LINES.

8. A pair of leads of any length conveying energy from the aerial to the receiver or from the transmitter to the aerial.

AERIAL ARRAY.



TERMS APPLICABLE TO AERIAL SYSTEMS

I'd be interested in hearing further from DEHS members with thoughts and ideas on the Chain Home aerials.

BOOZER – OR NOT?

In the last eDEN, John Kaesehagen illustrated a mystery test set, possibly for Boozer, and asked if anyone could help; there was no identifying plate on the equipment but under the front panel was 'A.M.REF 10V/16023'.

.

The scale in the picture below is calibrated from 300 – 450 MHz.

Mike Dean had had a similar query from another collector some 18 months ago, followed then almost immediately by a query from the National Museum of Scotland (NMS) asking if he could identify the purpose of a Test Set 228 held in their collection.

Immediately, on Mike's seeing the pictures which accompanied the collector's request, there was obviously a great similarity between the two equipments.

After exchanging a few e-mails with the Museum and the collector to gather as much information as possible, the only identification was "A M REF 10V/16023" on one panel and, at the time, this proved impossible to trace.

However, the NMS example, although missing all of the electronics and accessories, now provided the breakthrough, as it still carried a plate listing all the equipment and the Electronics Panel was listed as 10V/16023, giving confirmation that the Mystery Item was indeed a Test Set Type 228.

Test Set Type 228 was used for system functional test of the 'Greenbottle' search receiver, a modified version of Serrate.

GREENBOTTLE

Greenbottle was a search receiver developed to aid Coastal Command aircraft detect and home onto U-boat radars.

In January 1943 prisoner-of-war statements indicated that Gema were manufacturing a 80 to 90 centimetre wavelength radar to enable U-boats to locate and range surface vessels. Professor P M S Blackett recommended development of a search receiver to cover the U-boat radar frequencies, while Coastal Command saw potential use for such a receiver in aircraft escorting convoys.

The Telecommunications Research Establishment developed a prototype homing system by modifying Serrate, and renamed it as GREENBOTTLE (ARI 5574).

Installations in a Liberator and a Wellington XII were prototyped on the highest priority. The trial installation Liberator crashed.

By mid-September 1943 the Wellington Greenbottle prototype was at the Coastal Command Development Unit (CCDU) for trials and 50 sets of Greenbottle equipment and aerial arrays were ready for installation.

Greenbottle installations in the Wellington Mark XII aircraft of No 407 Squadron were completed in October 1943.

The relevant references are:

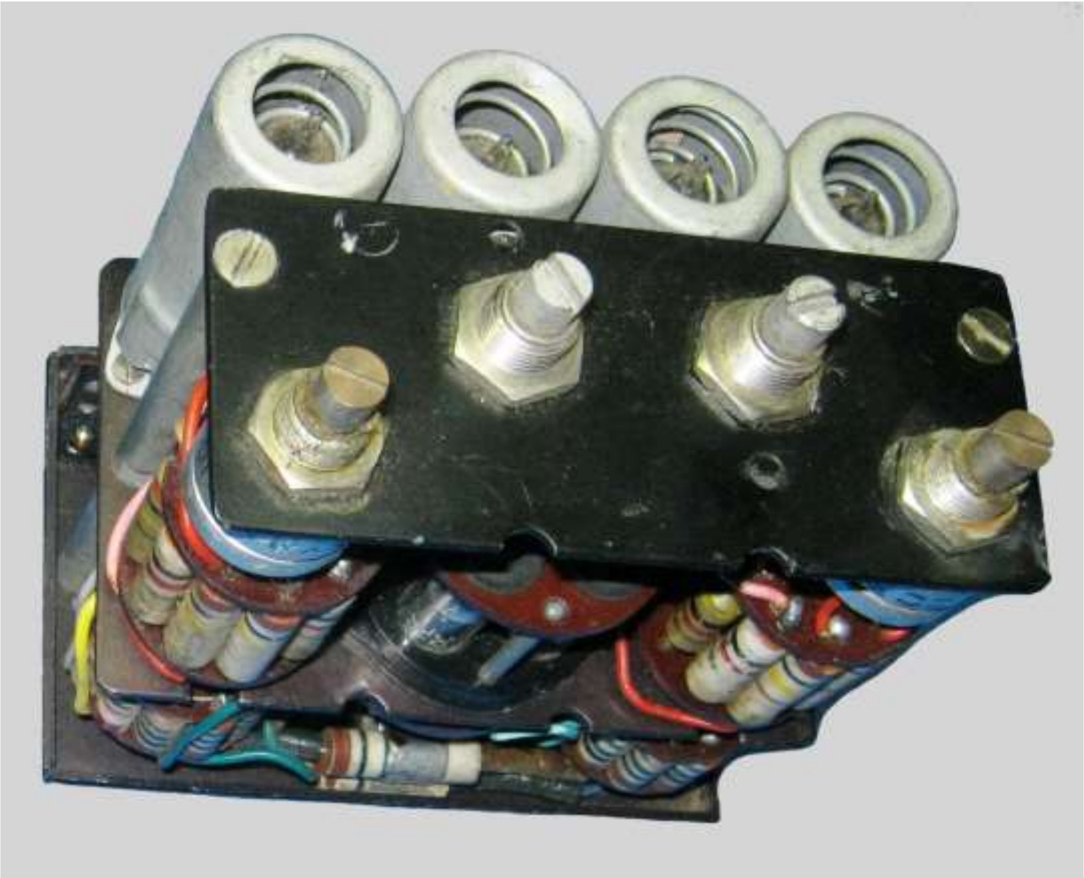
- **Air Publication (AP) 2463 - Index to Signals and Radio Publications.**
- **RAF Signals History 1939-1945 Volume 6 Radio in Maritime Warfare**
- **The National Archives at Kew holds files on Greenbottle/ Green Bottle ARI 5574.**

WOOMERA, MISSILE CONTROL AND TELEMETRY - V

John Kaesehagen

John's puzzle this month is, to quote him, "something that I collected over a large time span. I found one module when I was still at school in the late 1960s, and then in the late 1980s I recognised a chassis that might accept the module, so acquired that, and then in the late 1990s I found another module. (*In the picture, the box-shaped module is plugged into the chassis*)

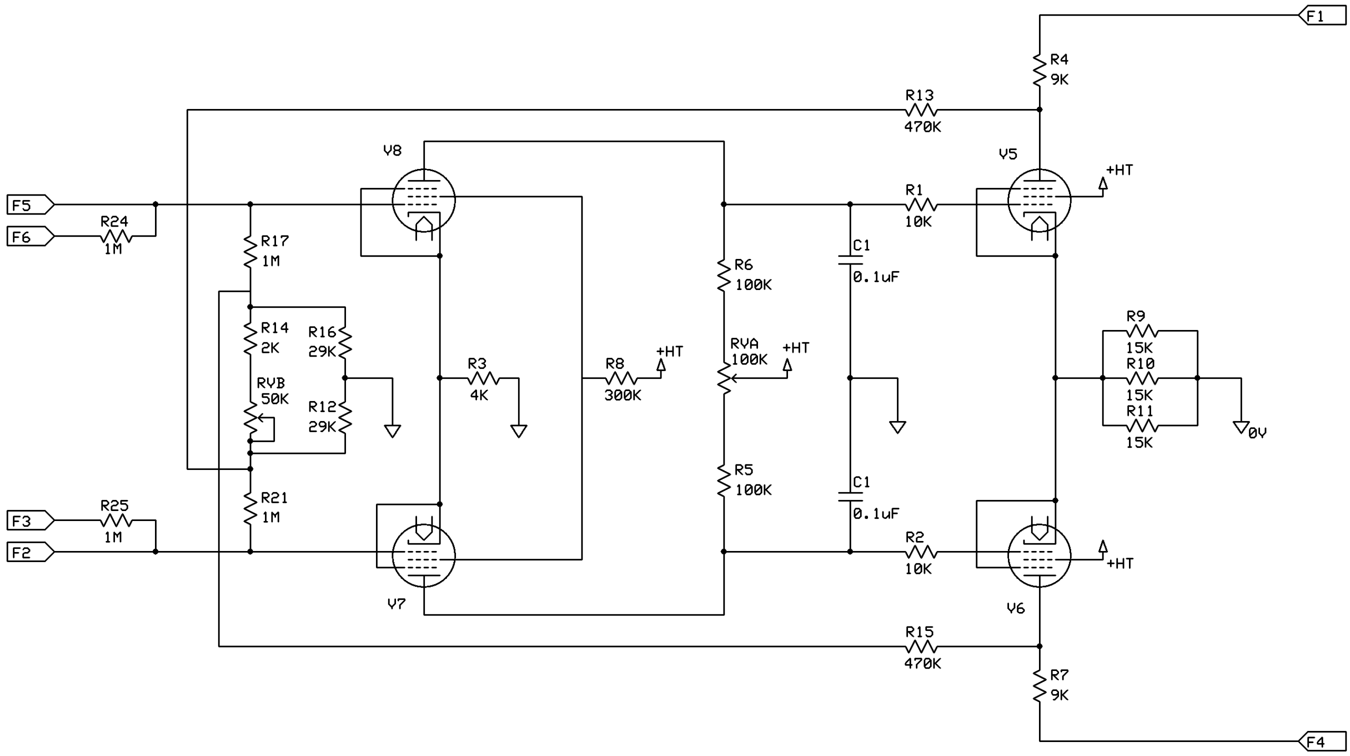
The first module I had already partially disassembled for circuit tracing and bench testing, probably in 1967. From a glance at the layout the valves appeared to be wired in a flip-flop arrangement, but it soon appeared that the circuit is a DC coupled differential amplifier. The small valves are CV466 and the larger are CV138. The valve dates are 1952 and 1953.



The flying leads to the sub-miniature's grids seem to be an afterthought: possibly there was too much stray coupling if the intended, but unused, connection on the support was used. The four capacitors tucked into the wiring might be an addition too as they are not clamped or restrained. The construction is more compact and more rigid than seems usual for airborne equipment, so I suspect missiles again.

The construction is quite rugged. The resistors under the main chassis (*below*) are clamped in blocks of rubber and the resistors in the modules are either clamped or mounted between disks of SRBP.

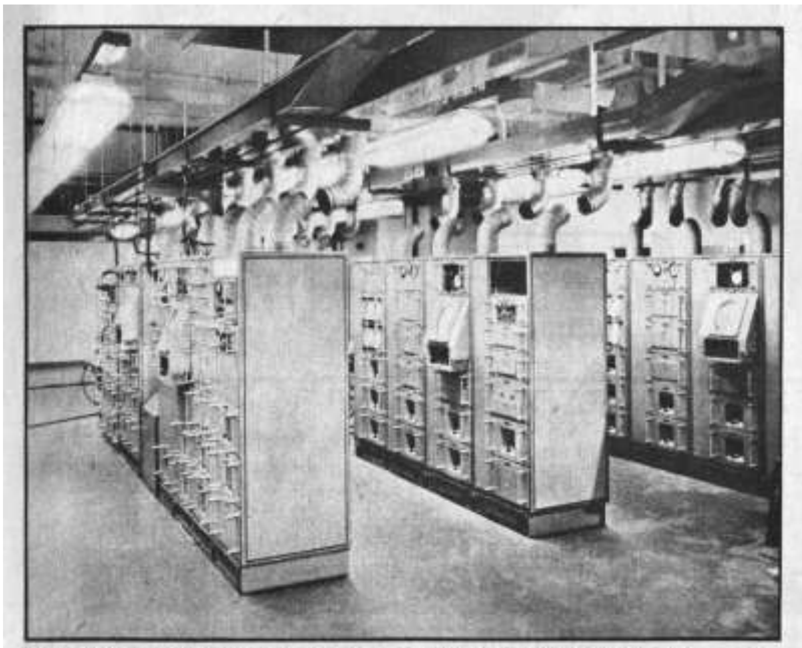
I have redrawn the circuit of one half of one of the modules.



There are letters stamped into the metal of the chassis - McK 414, McK 416, McK 277, and there is an ink stamp comprising a crown and some letters just visible on the main chassis.

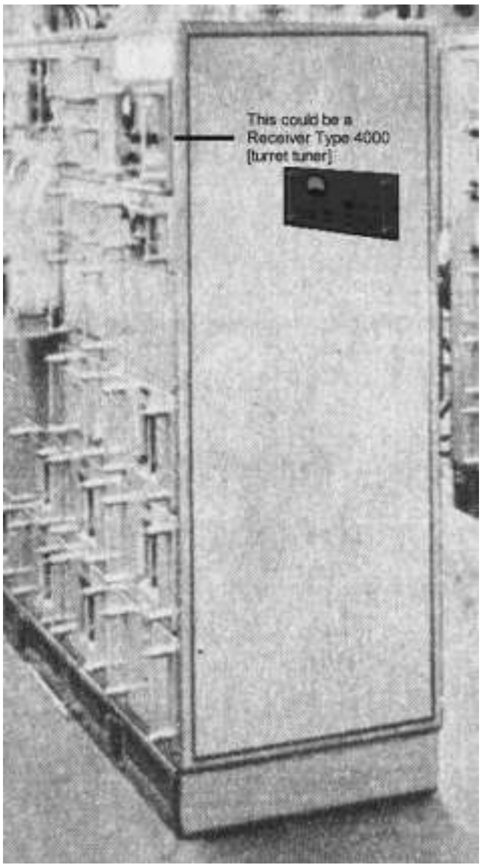
So, ladies and gentleman – ideas, please!

John does his own detailed research on his collection also, and has surfaced more information about the turret tuner receiver featured in previous eDENs, finding this picture of equipment at Spadeadam.

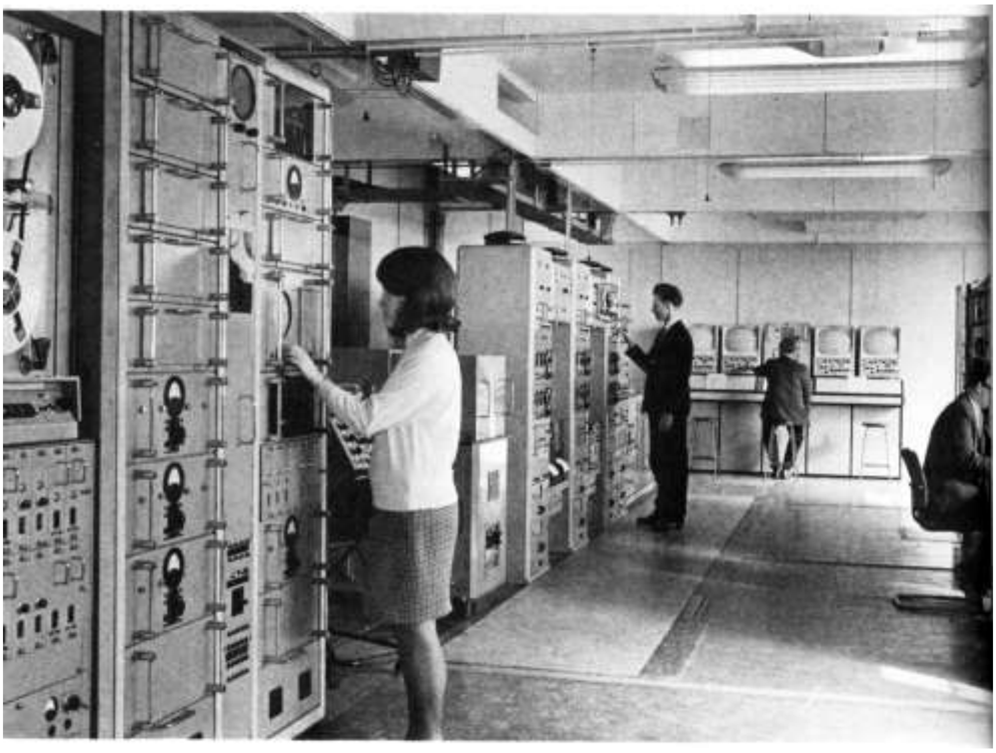


The recording equipment at Spadeadam Rocket Establishment in the process of installation for the Blue Streak testing.

John also cropped out a part of the left-hand group of racks and highlighted what he believes to be one of 'his' Rx Type 4000 [the turret tuner variety], noting that the power supplies and double-beam monitor scopes also look the same as 'his'.



Additionally, from the website http://www.rafaberporth.org.uk/page3.html John asked for a better scan of the Telemetry room.



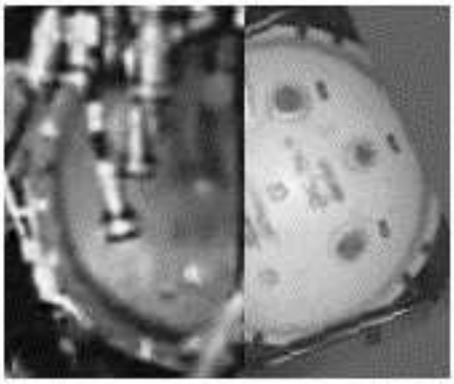
The caption is "This was the Telemetry section and Timing Systems centre in the late 1960's."

This original scan of the Telemetry Room was taken from an in-house RAE publication of 1973 on what seems like a Gestetner printed history of the RAE. The man in the picture, Bill "Curly" Birchenough, who could have helped, alas died a couple of years ago in his early 80's. "

John also trawled a Blue Streak video at https://www.youtube.com/watch?v=Ne8shDmcd5g - very well worth watching, by the way! - and spotted something interesting in the guidance bay.

In closer view:

Below, a composite showing what certainly looks like a definite match with the unit of John's which we first featured, and which we picture again below the composite.



Connectors match
Handles match

John's mystery unit, below, as originally featured in eDEN

More to come next month, but in the meantime, all pictures and reminiscences of these tests welcome!

IRANIAN RADARS

John 'Jacey' Wise

Notwithstanding ongoing embargoes, Iran has made some significant progress in the field of radar developments if all the press reports seen are to be accepted at face value. Historically Iran's air defence radar developments have been based largely on knowledge gained from inherited American military equipment, in particular the Hawk acquisition

and tracker radars (right) now known, in their revised form, as the MERSAD system.

In early September it was announced that two new radars, named as NAZIR, a long-range, high-precision system and another called BINA had been commissioned at a mountain site in Southwest Iran, although I have yet to identify their location. In a video conference the Commander of Khatam ol-Anbia Air Defence Base Brigadier General Farzad Esmayeeli

explained that the radars are frequency agile and function in different (special) bands "which cannot be heard by enemies" Sounds interesting! There will be more to come on this subject.

DSEi 2015

What a great show! There was plenty of everything for soldiers, sailors, airmen and the scientific community that so ably supports our military requirements. I was particularly interested in some of the radars, not just those on view but others tucked away inside brochures. RADA Electronic Industries have been around for some time with interesting and highly portable EF-band AESA systems for battlefield use but have improved and extended their products - www.rada.com. An interesting kit, I totally misunderstood for lack of compatible language, concerned the Mitsubishi Electric's new 40GHz AESA. It is being used on trials for high quality tracking of surface targets by airborne platforms and, alternatively used for a high capacity communications system between aircraft and ground stations.

Coming back to radar, RETIA of the Czech Republic offered a brochure about their upgrade capability for a range of ex-Russian kit including the P-10, P-12, P-14, P-18 (1RL131), P-37, ReVISOR, a short-range radar for use against low-flying targets and ReVEAL, loosely the Company's own modern version of a P-18. Staying with P-18, this VHF radar is seen as a discrete threat to all flying machines, manned or unmanned and some companies have not been slow to pick up on this anti-stealth approach. The Litak-Tak concern of Lithuania also presented a range of upgrade capabilities for old Russian systems but what really caught my eye was their introduction of AMBER-1800, again a play on P-18, but a thoroughly modern example which would probably make life quite difficult for hostile combat airframe and UMV pilots; please see www.litaktak.com. Staying with this P-18 modification theme, another site worth viewing is www.defence24.com/229730.wisla-and-narew-missiles-for-the-army-technologies-for-the-industry, which carries a full explanation that is very useful for the new personnel entries to radar EW.

Battlefield man-portable radars are to be seen in increasing abundance and obviously have value so how come man-portable tactical radar ESM systems are relatively so rare? This issue is now being addressed by ESROE. AOC member Jon Roe has with support from Selex designed and built a prototype hand-held RESM that is hosted on smartphone technology and I for one can see that it might have a bright future. Please see IHS Jane's International Defence Review for Sept 2015 page 30/31 for full details.

During the early 1980s a survey of the helicopters losses in Vietnam showed that if they had been equipped with RESM, at least the Pilot would have been in a position to make a choice when confronted with hostile weapon signatures, whereas without probably both the airframe and its crew would be lost. Airframes can quickly be replaced, not so Pilots and crews. Subsequently the US DoD increased the helo tactical EW budget significantly. It strikes me that the same premise might be true on the battlefield for troops detected by man-portable battlefield radars. Should they not have the same protection as helo crews ? This is not a new concept but current technology is being seen to produce a highly portable solution of a type never previously available.

CHRISTMAS BOOK REVIEWS

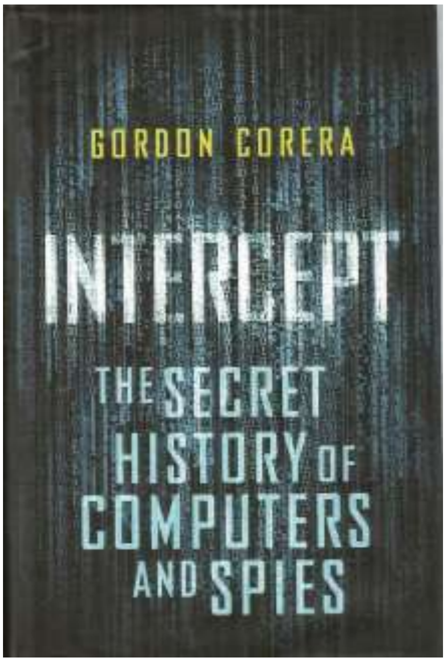
***The Secret War: Spies, Codes and Guerillas 1939-45* Max Hastings (Harper Collins, hardback £25 RRP, £12 Amazon, £5 upwards on Amazon 2nd hand)**

Max Hastings' most recent book follows a popular modern trend among writers about World War 2, that of extending their researches to cover events across the world, rather than deep analysis of strictly home-country activities; see, for another example of this, Richard Overy's masterwork on the air war. We therefore are plunged by Hastings into the Secret War not only as it was fought in Bletchley, in Medmenham, or inside MI5, MI6 and SOE HQs – though all these are covered – but also in Stalin's Kremlin, NKVD and GRU, in Japan, in the USA, in France and so on. This trend is much to be welcomed, not least because it provides a proper balance to an otherwise Eurocentric view of the world and its war and in so doing gives the UK reader a true appreciation of the monumental pressures affecting the war leaders, in particular, for the Allies, Churchill, Stalin and Roosevelt, and for the Germans, Hitler; it has not been your reviewer's experience that UK audiences generally recognise that ninety per cent of German casualties were suffered on the Eastern Front, nor the unimaginable scale of Soviet loss – much of it brought about by Stalin's own decisions, military and political. Hastings traces the secret war against this background, and accurately points out the degree to which Stalin fought his spying war with his eye very firmly on the longer term rather than on the task of defeating Hitler. Much of immediate post-war history becomes more comprehensible with this background, and Hastings does a good job of sorting out the wheat from the chaff of the various unreliable war memoirs published by those in the intelligence business. The problem he faces, of course, is that of finding anything to say which is both new and of significant import, as opposed to filling in relatively modest details; each reader will have to reach their own conclusions, as their view will obviously depend on how much they have already read. Your reviewer's bookshelves in the purely intelligence field (as opposed to military electronics) are not extensive, a quick count showing some 250 relevant volumes, but I was pleasantly surprised by the number of interesting facts and episodes uncovered by Hastings of which I was unaware or had forgotten. Equally, it is difficult to disagree with Hastings' conclusions that, so far as WW2 Humint was concerned, only a fraction of one per cent of it ever influenced the outcome of any conflict; this was increasingly a Sigint and Elint war. The most major challenge Hastings' readers will face, I suspect, is the ability to keep track of events in multiple different countries as the war progresses; either a photographic memory, or many sheets of notepad, will be a necessity, and without them, I'm afraid Hastings' style is more likely to induce a hypnotic turning of pages without much information becoming absorbed, or, alas, slumber. I can recommend the work as a

necessary read, and can promise the reader that there will be something new for everyone to discover – but I suspect the actual reading will be a duty rather than a pleasure, unless the reader makes up their mind consciously to skim-read rather than read and remember.

Overall, Hastings' *Secret War*: Very good - but 4 stars rather than 5.

We move on to the story of Intercept from 1914 to date, but focusing mainly post-WW2:



Intercept: the Secret History of Computers and Spies **Gordon Corera (London: Weidenfeld and Nicholson, hardback £20 RRP, £13.60 Amazon, paperback £6.00 upwards on www.abebooks.co.uk)**

DEHS members will know Gordon Corera as a BBC security correspondent, commenting in particular on security in the electronic world. In this book, he traces the story of electronic security and intercept from its beginnings in WW1, through the cryptanalytical heroic period of WW2, through the years of the Cold War and on into the security demanded of today's computer networks and the attempts by companies and nation states (and their surrogates) to create computer security and to breach it. He does so in a structure which thankfully does not dwell too long on WW2, but focusses instead on explaining, in crystal-clear and easy-to-read language, the post-war problems and challenges of a rapidly developing technology, introducing us to the main players whether individual, corporate or state, their changing objectives and alliances, their successes and failures (and the reasons behind each) and brings us right up-to-date with the tale of Edward Snowden and his doings. Unlike Richard J Aldritch's *GCHQ*, which suffered (in this reviewer's view, greatly) from being episodic by the very nature of the limited material on which it could work, Corera's world-wide canvas allows him to access much more material, and – technology knowing few boundaries – to tell a much more complete and fascinating story.

I can distinguish this book from Hastings' *Secret War* very simply – Corera's work is a page-turner, where the reader is caught up with the pace of development and wants to know more and more; I read it through at two sittings, and at once turned to the beginning to read it again. Corera's *Intercept* is a pleasure to read; Hastings' *Secret War*, a duty.

Overall, Corera's *Intercept*: Outstanding - 5 stars.

DEHS PUBLICATIONS

Year	Title	Members	Non-Members
1995	The Origins and Development of Radar	Out of print at present	
1996	Topics in the History of Sonar	7.00	8.50
1997	The History of Navigation Aids	6.50	8.00
1998	History of IFF and DF	7.50	9.00
1999	History of Military Communications	£8.50	£10.00
2000	History of Guided Weapons	£6.50	£8.00
2001	Air Defence 1940–1990	£7.00	£8.50
2002	Naval Electronics	£6.50	£8.00
2003	Clandestine Radio Communications	£8.50	£10.00
2004	Battlefield Electronic Systems (Land, Sea and Air)	£6.50	£8.00
2005	Electronics that Revolutionized Warfare	£8.50	£10.00
2006	Airborne Electronics	£8.50	£10.00
2007	Government & Commercial Electronics R&D	£6.50	£8.00
2008	Applications of Defence R&D	£8.00	£9.50
2010	2010 International Conference on the origins and evolution of the cavity magnetron	£11.00	£12.50
2010	CD-ROM version of above	£5.00*	£6.00
2010	Key Components for EW. The Lessons for Today	£9.00	£10.50
2011	CD-ROM of HISTEST2011 proceedings	£5.00*	£6.00
2012	Communications: Clandestine & Tactical	£10.00	£12.00
2012	Communications: Strategic & General	£12.00	£14.00
2012	Intercept	7.00	£8.50
2014	Chess: Electronic Warfare & Bomber Offensive in Europe: an Attempt at Balance	£8.00	£9.50
2015	WW1 Papers: Looking Forwards, Looking Backwards	7.50	9.00
	The Beginnings of British Radar, by Brian Callick	£7.00	£8.50
	Russell Burns' book 'The Prof, Churchill and Science at War'	£25.00**	25.00**

(For all transactions add £2.50 for UK delivery and 25% for overseas orders to cover p&p. *For CD-ROMS add £1 for p&p. Send cheques, payable to the DEHS to Keith Thrower, 9 The Conifers, Emmer Green, Reading, RG4 8AQ. Email: kthrower@waitrose.com; **For the Burns book, please send £25, payable to the DEHS, to Simon Blumlein, 13 Heathfield Road, Petersfield, Hants, GU31 4DG.

OPS BOARD

We are always delighted to feature members' lectures, exhibitions and events in Ops Board – let me have the details in good time; philjudkins@btinternet.com or 07971449451

ARTHUR BAUER - MUSEUM OPEN DAY

DEHS members already know of Arthur Bauer's outstanding collection in his museum at Duivendrecht, Amsterdam. All DEHS members are invited to his Open Day this year on

10.00am – 17.00, SATURDAY 21ST NOVEMBER

www.cdvandt.org/opendag-2015.htm

6 November: ***Biggin Boys – the story of the recent Battle of Britain event*** **Clive and Linda Denney,** Martlesham Heath Aviation Society, Martlesham Heath IP 5 3UZ **www.mhas.org.ouk** .

9 November: ***The Blenheim – now flying again*****, John 'Smudge' Smith,** Arun & Chichester Air Enthusiasts, Chichester Park Hotel, Chichester, PO19 7QL, **www.airaces.org.uk.**

11 November: ***BAC One Eleven – the whole story,*** **Stephen Skinner,** London Society of Air-Britain, Victory Services Club, 63-79 Seymour Street, London.

OXFORD EXHIBITION OPEN TO JANUARY 2016

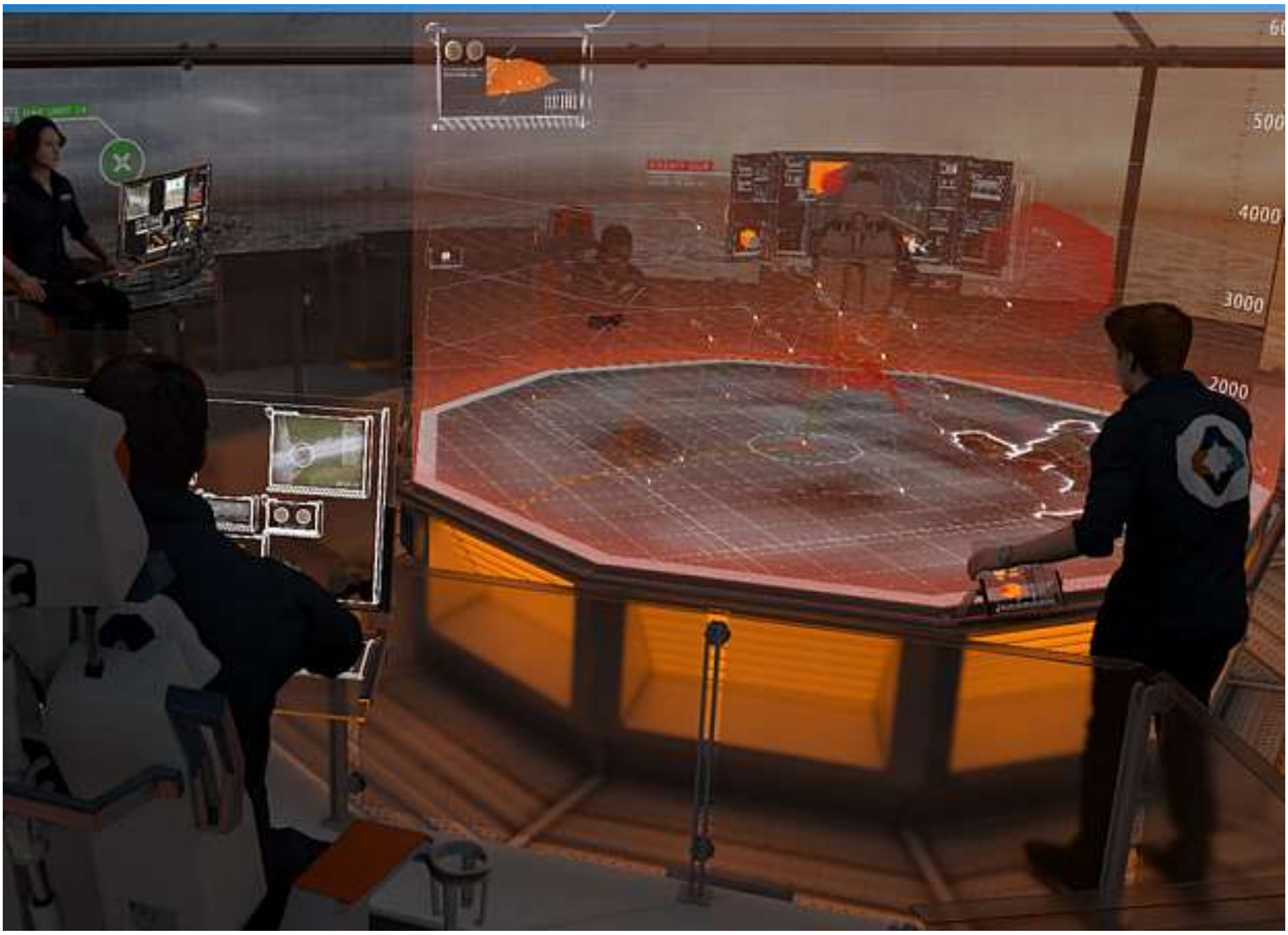
"'Dear Harry…' Henry Moseley: A Scientist Lost to War", Museum of the History of Science, Oxford.

Having visited this excellent exhibition, I was delighted to be told that its run at the Oxford Museum of Science (well worth a visit in its own right) has now been extended until January 2016. DEHS members now have no excuse – go and visit it!

Henry 'Harry' Moseley was an exceptionally promising young English physicist in the years immediately before World War I. His work on the X-ray spectra of the elements provided a new foundation for the Periodic Table and contributed to the development of the nuclear model of the atom. He was killed in 1915, aged 27, in action at Gallipoli, Turkey. The Museum of the History of Science, Oxford, with support from the Heritage Lottery Fund (HLF), is staging a centenary exhibition, **'Dear Harry…' – Henry Moseley: A Scientist Lost to War**. Had he lived, the young Moseley would surely have been a prime candidate for one of the 1916 Nobel Prizes. Instead, as Isaac Asimov wrote, "in view of what [Moseley] might still have accomplished ... his death might well have been the most costly single death of the War to mankind generally." Rarely-seen artefacts from the Royal Engineers Museum, Library and Archive, the Royal Signals Museum, the Department of Physics at the University of Oxford, and Trinity College, Oxford, where Moseley studied. will be featured in the exhibition. 'Dear Harry…' which will be **open until 15 October 2015**.

TAILPIECE

Finishing *eDEN 40* as we started, on a naval theme, Tailpiece this month features the 'Dreadnought 2050' Startpoint holographic operations room, doubtless soon to appear in 007's next outing.



For those who haven't caught up with their necessary reading, the picture above is of warfare in the not-too-far distant future, as conceived by the MoD project 'Dreadnought 2050', a project to envision naval platforms (= ships, in this case) taking as revolutionary an approach as then conceived the original Dreadnoughts a century ago. The initiative was launched at DSEi 2015 (for DSEi, see report above by John 'Jacey' Wise). Under the aegis of 'Startpoint', teams of scientists and engineers from MoD DE&S and DSTL together with Britain's leading commercial companies have generated a vision with an ultra-strong graphene-coated-acrylic hulled trimaran design, at the heart of which is the Operations Room featuring a 3-D holographic command table and communications hubs. Hardware for defence consists of a bow-mounted electromagnetic railgun, side-mounted hypersonic (Mach 5+) missiles, and directed energy weapons – see *eDEN* last month. The 'mast' would comprise a tethered quadcopter flown above the ship; the stern consists of a floodable dock to deploy Unmanned Underwater Vehicles (UUVs) for mine detection and other operational deployment; the deck above, a flight-deck for launching multiple UAVs and on-board-printed drones. It would be envisaged that as few as 50 personnel would serve on-board; the operations room would be staffed by 5 or so people.

Above, tethered quadcopter mast; below, UAV aviation deck; bottom, UUV 'garage'