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RADIO REPORT No. 120.

Title - Comparison of the behaviour of the Chedzoy Wave Antenna System and the Marconi System installed at Burnham Radio in the reception of Special Test Transmissions from S/S Cedric and S/S Rajputana.

120

Carried out by - C. F. Booth and N. Bourdeaux.

Carried out at - Chedzoy Radio Station and Burnham Radio Station.

Date - April, May, June, 1928.

Case No. 309.

Radio Section
Engineer-in-Chief's Office,
G.P.O.
Alder House,
E.C.1.

Signature A.S.Angwin.
for Engineer-in-Chief.
6th Nov., 1928.

The object of these experiments was to compare the Chedzoy Wave Antenna system with the Marconi system employed at Burnham Radio, in the reception of traffic from distant Atlantic and Mediterranean ships.

To obtain a direct comparison of the two systems tests were arranged with two boats, the S/S Cedric bound from Liverpool to New York, and the S/S Rajputana bound from Southampton to Yokohama, (via the Suez Canal). The transmissions consisted of four tests per day from each boat, two on 2013 metres and two on 2100 metres. Each test consisted of 5 minutes calling 1 minute dash and 10 groups of 10 letter code, known only to the ships operator.

The transmission times were as follows:-

S/S Rajputana (GLWV).

G.M.T.	Wavelength in metres.
1100	2100
1148	2013
2200	2100
2218	2013

S/S Cedric (GLSM)

G.M.T.	Wavelength in metres.
1020	2100
1048	2013
2300	2100
2318	2013

The test messages were received at Burnham and Chedzoy, and the results obtained compared with the original messages forwarded by the ships operator.

The/

THE CHEDZOY RECEIVING SYSTEM

The Wave Antenna and Terminating Equipment.

A diagram of the wave antenna and terminating equipment is indicated in figure 1.

The wave antenna employed consists of two copper wires supported on telegraph poles and the length used for these tests was approximately 4½ miles.

The receiving hut was situated at the western end of the line and the direction of the line was roughly east and west. The great circle direction passing through New York, Chedzoy and Constantinople.

In the reception of the signals from a transmitting station to the west of the antenna, the two wires act as one conductor with the earth as the return circuit. The current produced in this circuit by signals from the west reaches a maximum at the east end of the antenna, here it is reflected by means of a special reflection transformer and returns over the metallic circuit formed by the wires to the terminating equipment at the western end of the antenna.

The antenna terminating equipment consists of two transformers, known as the Signal transformer, and the Compensation transformer respectively. The Signal Transformer transfers currents from the metallic circuit of the wave antenna to the so called signal line, and the Compensation Transformer transfers the near end currents from the earth return wave antenna circuit to the so called Compensation Line.

The provision of variable phase shift and attenuation, with switching devices to apply them to either the signal or compensation line, enables

complete/

complete or partial balances to be obtained on undesired signals coming from approximately the opposite direction to the desired signal.

The phasing equipment was designed to give a maximum phase change of 185°, a continuously variable 50° section was incorporated, while an additional small fixed phase shift was available to ensure overlap.

The attenuator was designed to give a maximum of 41 T.U. in 0.1 T.U. steps.

The output of the signal and compensation lines was combined in a 600 ohm resistance bridge, then passed through a band pass filter designed to pass frequencies from 125 k.c. to 167 k.c. (2400 to 1800 metres) to the input transformer of the balanced detector system. A band curve of the filter is shown in Figure 3.

The Receiver.

A diagram of the receiver employed is indicated in figure 2. The receiver is of the suporheterodyne type, and to save time the intermediate frequency amplifier of a standard seven valve Burndept Broadcast Receiver was employed. It was, however, considerably modified for the work, by the addition of separate heterodyne oscillators and filters. The intermediate frequency of the receiver was 48.92 kilocycles.

The output from the band filter was taken through a transformer circuit to a balanced detector circuit employing anode bend rectification, and the first heterodyne was fed from a constant frequency oscillator to the centre tap of the grid transformer.

The/

The signal was then amplified through the above mentioned 3 stage transformer coupled intermediate amplifier and detected by a fourth valve employing cumulative grid rectification The second heterodyne was fed from a constant frequency oscillator to the grid circuit of the second detector valve. A considerable amount of interference was picked up by the intermediate frequency amplifier. To minimise this, rejector circuits accurately tuned to 48.92 kilocycles were fitted across the grid windings of the 1st intermediate stage transformer and the second detector transformer. By this means the overall bandwidth of the H.F. portion of the receiver was reduced to 120 cycles and the pick up on the intermediate frequency amplifier was practically eliminated.

A band curve of the H.F. Portion of the receiver is indicated in Figure 4.

Two stages of L.F. amplification, one of which could be cut out at will were employed, a standard type of P.O. Note filter, which could be cut out of circuit by switch S, was incorporated in the receiver.

The/

THE BURNHAM RECEIVING SYSTEM

A diagram of the receiving system is shown in Drawing W.L. 4321.

Three receivers of Marconi design are employed to cover the range 1050 to 2600 metres. The receivers employ the Bellini Tosi type of directional reception, each one being associated with a separate aerial system consisting of Bellini Tosi loops mounted on 100 ft. steel tubular masts. The receivers are arranged for "open" figure of eight or "cardioid" reception followed by 5 stages of neutrodyned H.F. amplification, one rectifier stage, two stages of L.F. amplification, and an optional Note Filter. The local heterodyne oscillator is coupled to the rectifier ~~STAGE~~ Stage.

Operation and Performance of the Chedzoy Receiving System.

The second heterodyne was set to give a readable note with the intermediate frequency signals. It was therefore only necessary to vary the first heterodyne to bring in the required signals.

The note filter was rarely used, sufficient selectivity was usually obtained in the Intermediate frequency stage, and during the tests atmospherics were of such an order as to cause severe ringing with the note filter in circuit.

Good/

Good balances were obtained on any one of the European Land Stations (FFP, Havre, PCH, Scheveningen, FFS Marseilles etc) when listening to the Atlantic traffic. Balances could also be obtained on Atlantic ships when observing Mediterranean traffic.

Results.

Comparative tables of Burnham and Chedzoy results are shown in Tables 1 and 2 respectively.

The percentage columns represent the correct number of code letters received at each transmission out of the 100 letters transmitted. The results were checked from the original messages forwarded by the Ships operators.

S/S Cedric.

The results obtained at Chedzoy were slightly better than the Burnham results. No readable signals were heard at Burnham after the boat was 4 days out, approximately 1154 miles from Burnham, while percentages of 78 and 75 were obtained at Chedzoy on the fifth day when the boat was approximately 1325 and 1558 miles respectively from Burnham.

The average percentages for the first five days were Chedzoy 85.1 and Burnham 77.4

S/S Rajputana.

The results indicate that up to June 25th (boat 500 miles W. of Alexandria) there was not much difference in the results from the two systems. On June 25th, however, the morning transmissions were not heard by Burnham while percentage of 95 and 100 were obtained at Chedzoy.

The/

The evening transmissions were heard but unreadable at both stations. On the 26th June the morning transmissions were unheard at both stations, but Chedzoy showed a decided improvement on the evening transmissions.

No further transmissions were made after June 26th.

The reception percentage for the period ended June 26th was Chedzoy 74.2, Burnham 65.5

Conclusions.

1. The results indicate that good readable signals could be obtained at Chedzoy from both ships when the signals were unreadable and even unheard at Burnham, and that by the installation of such apparatus it should be possible to obtain one day additional contact on West bound ships and about two days extra contact with East bound ships.

In reaching the above conclusion account has not been taken of the following points.

1. The Chedzoy receiver could be considerably improved if it were re-designed and reconstructed as a complete unit for this service.
2. In the foregoing tests the Chedzoy receiver had to be used on two different wavelengths and tuned and balanced up for each transmission whereas at Burnham separate receivers were available on each wave length and could be left in adjustment.
3. The operator at Chedzoy was an ex R.A.F. operator with less than two months service in the Post Office and was totally unfamiliar with the service.
4. As regards East bound traffic the wave antenna was directed 10^{0} to 15^{0} north of the actual direction of reception with consequent diminution of received signals.

ANALYSIS OF RECEPTION FROM G.K.U.H.L. (Cedric)

TABLE I

DATE	TIME G.M.T.	WAVE LENGTH IN METRES.	RADIATION IN AMPS.	Reception % CHADZOY	Reception % BURNHAM	Position of Ship.	REMARKS (Chadzoy)	REMARKS (Burnham)
						Distance from GKD		
	10.20	2100	5.9	98	99	Left for		
16. 6.28	10.48	2013	5.9	100	100	New York		
	23.00	2100	5.8	89	100	140 N.W.	Atmospherics heavy.Bad jamming.	
	23.18	2013	6.0	98	99	130 N.W.	Signals stronger on 2013 metres.	
	10.20	2100	5.7	99	100	205 N.W.	Conditions good.	
17. 6.28	10.48	2013	5.7	100	100	205 N.W.		
	23.00	2100	5.5	100	99	360	Conditions good.	
	23.18	2013	5.5	99	99	369		
	10.20	2100	5.5	99	100	540		
18. 6.28	10.48	2013	5.5	98	100	549		
	23.00	2100	5.6	100	100	745	Atmospherics heavy	Atmospherics bad.
	23.18	2013	5.5	98	99	754		
	10.20	2100	5.5	100	97	925		Fault in receiver.1st H.F. stage.
19. 6.28	10.48	2013	5.7	72	57	934	Heavy jamming	Mutilated.Interference from station calling CLR.
	23.00	2100	5.5	99	100	1145	Conditions good.	
	23.18	2013	5.5	100	100	1154		
	10.20	2100	5.4	78	Not heard	1325	Heavy jamming.Last group missed.	Not heard.
20. 6.28	10.48	2013	5.5	Unreadable	Unreadable	1334	Heard calling but groups cut up hopelessly by heavy jamming.	Heard but unreadable.
	23.00	2100	5.7	Unreadable	Not heard	1549	Very weak signals.Only fragments of groups heard.	Not heard.Atmospherics heavy.
	23.18	2013	5.8	75	Unreadable	1558	Signals stronger on 2013 metres,but jamming and atmospherics made reception difficult.	Heard....essage not received. A's heavy.
	10.20	2100	5.6	Not heard	Not heard	1729		
21. 6.28	10.48	2013	5.8	"	"	1738	Conditions fair.Some jamming.	
	23.00	2100	5.5	"	"	1936	Atmospherics heavy.G.K.U.worked	
	23.18	2013	5.5	"	"	1945	through 2013 metre period.	
	10.20	2100	5.4	""	"	2143	Heavy jamming.	
22. 6.28	10.48	2013	5.4	"	"	2152		
	23.00	2100	5.5	"	"	2340	Some jamming.	
	23.18	2013	5.5	"	"	2349	Atmospherics troublesome.	
	10.20	2100	5.4	"	"	2547	Conditions fair.Some jamming.	
23. 6.28	10.48	2013	5.4	"	"	2556		
	23.00	2100	5.5	"	"	2741	Considerable jamming.	
	23.18	2013	5.4	"	"	2750		
Average Reception % for five days ending 20. 6.28.				85.1	77.4			

ANALYSIS OF RECEPTION FROM G.L.W.V. (Rajputana)

TABLE 2.

DATE	TIME G.M.T.	WAVE LENGTH IN METRES.	Reception at CHEDZOY	Reception at BURNHAM	Position of ship.	REMARKS (Chedzoy)	REMARKS (Burnham)
16. 6.28	22.00	2100	100	99	90 N.E.Ushant. Left for		
	22.18	2013	99	100	90 N.E.Ushant Yokohama.		Sending Faulty.
	11.00	2100	99	97	100 S.Ushant		
17. 6.28	11.48	2013	100	100	" "		
	22.00	2100	80	99	200 S.Ushant.		
	22.18	2013	65	91	" "	Interference from Telephony Carrier.	Few letters missed. Crashing X's.
18. 6.28	11.00	2100	95	100	130 W.Monsanto	Atmospherics troublesome	
	11.48	2013	80	96	130 " "	Jammed during second transmission. Unable to check groups. X's trouble-some.	Faulty sending.
	22.00	2100	00	21	50 S.Monsanto	Atmospherics heavy.	Letters missed. Havre calling all stations.
	22.18	2013	52	99	" " "	Atmospherics heavy	Atmospherics.
	11.00	2100	No transmission	No transmission			
19. 6.28	11.48	2013	do	do			
	22.00	2100	99	100	10 W.Gibralter	Increase in signal strength	
	22.18	2013	99	100	10 E.Gibralter	Atmospherics moderate	
20. 6.28	11.00	2100	Not heard	Not heard	210 E. "	Conditions fair. Not heard.	Not heard.
	11.48	2013	92	93	215 E. "	Some jamming	Faulty sending. Reception doubtful.
	22.00	2100	98	98	100 S.Soller	Conditions good. Atmospherics stronger on 2013M than on 2100M	
	22.18	2013	97	99	100 S.Soller		
21. 6.28	11.00	2100	99	98	75 S.Marseilles	Slight jamming. Signals stronger on 2013M than on 2100M	Faulty sending.
	11.48	2013	99	100	70 S. "		
22. 6.28	11.00	2100	83	87	35 S. "	Severe jamming. 10th group jammed out. Unable to check other groups.	
	11.48	2013	100	100	45 S. "	No jamming.	
	22.00	2100	Heard but unreadable	Heard but unreadable.	30 N.W.Bonifacio	Heard calling on both wavelengths Strength good, but heavy crashing atmospherics made reception of groups impossible.	Unreadable through atmospherics.
	22.18	2013	do	do	30 N.W. "		
24. 6.28	11.00	2100	97	92	120 W.Messina	Conditions fair except for occasional crashing atmospherics.	One group wiped out by atmospherics.
	11.48	2013	100	99	110 W. "		
	22.00	2100	100	99	45 S.E.Straits Messina	Conditions good.	One letter missed through atmospherics.
	22.18	2013	99	99	55 S.E. " "		
25. 6.28	11.00	2100	95	Not heard	500 W.Alexandria	First transmission jammed out	Not heard.
	11.48	2013	100	do	500 "	Slight jamming	Not heard. Heavy interference
	22.00	2100	Heard but unreadable	Heard but unreadable	350 N.W. "	Signals good strength, but severely cut up by crashing atmospherics only portions of groups received.	Atmospherics prevent reception
	22.18	2013	do	do	350 N.W. "		

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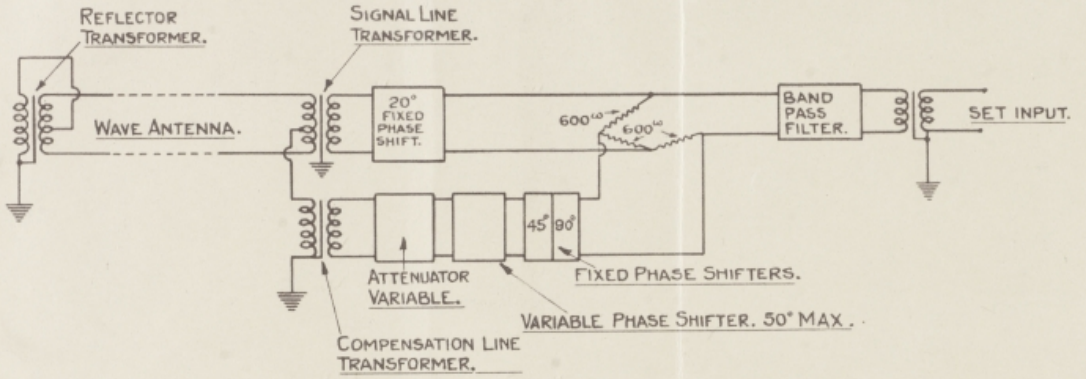
ANALYSIS OF RECEPTION FRO. G.L.W.V. (Rajputana) (Contd.)

TABLE 2 (Contd.)

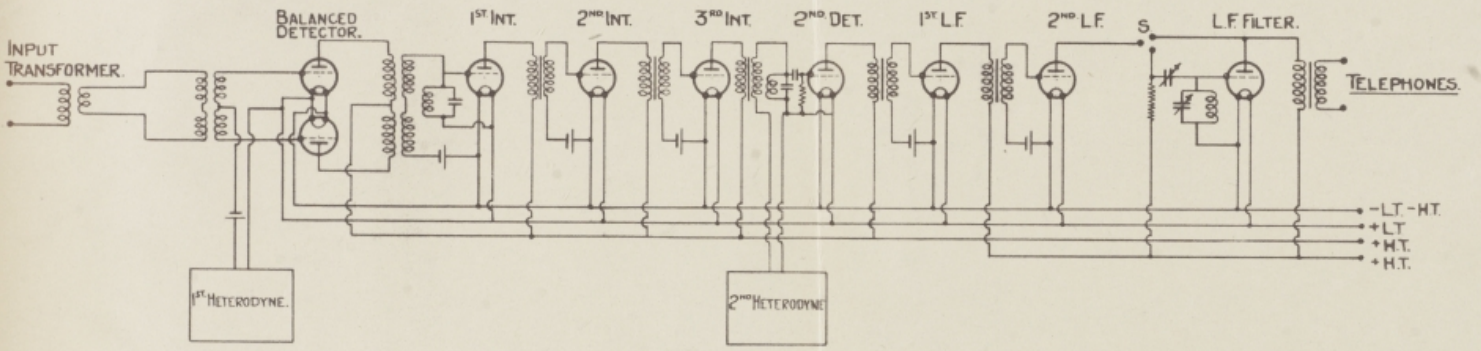
DATE	TIME G.M.T.	WAVE LENGTH IN METRES.	Reception % CHEDZOY	Reception % BURNHAM	Position of Ship.	REMARKS (Chedzoy)	REMARKS (Burnham)
	11.00	2100	Not heard	Not heard	220 W.Port Said	Atmospherics heavy	Unheard.Interference from Leviathan etc.
26. 6.28	11.48	2013	do	do	220 W. " "		
	22.00	2100	62	do	50 W.Port Said	Atmospherics heavy.Groups severely cut up.	Unheard. Heavy X's and Interference received in parts.
	22.18	2013	93	61	50 W " "		
	11.00	2100	No transmission	No transmission		Atmospherics moderate.	
27. 6.28	11.48	2013	"	"			
	22.00	2100	"	"		Atmospherics heavy	
	22.18	2013	"	"			
	11.00	2100	"	"		Atmospherics moderate	
28. 6.28	11.48	2013	"	"			
	22.00	2100	"	"		Conditions good	Nothing further heard of ship.
	22.18	2013	"	"			
	11.00	2100	"	"		Conditions good	
29. 6.28	11.48	2013	"	"			
	22.00	2100	"	"		Conditions fair	
	22.18	2013	"	"			
30. 6.28	11.00	2100	"	"		Conditions good.	
	11.48	2013	"	"			
Reception % for period ended 28. 6.28			74.2	65.5			



SCHEMATIC WAVE ANTENNA TERMINATING EQUIPMENT.

FIG. 1.

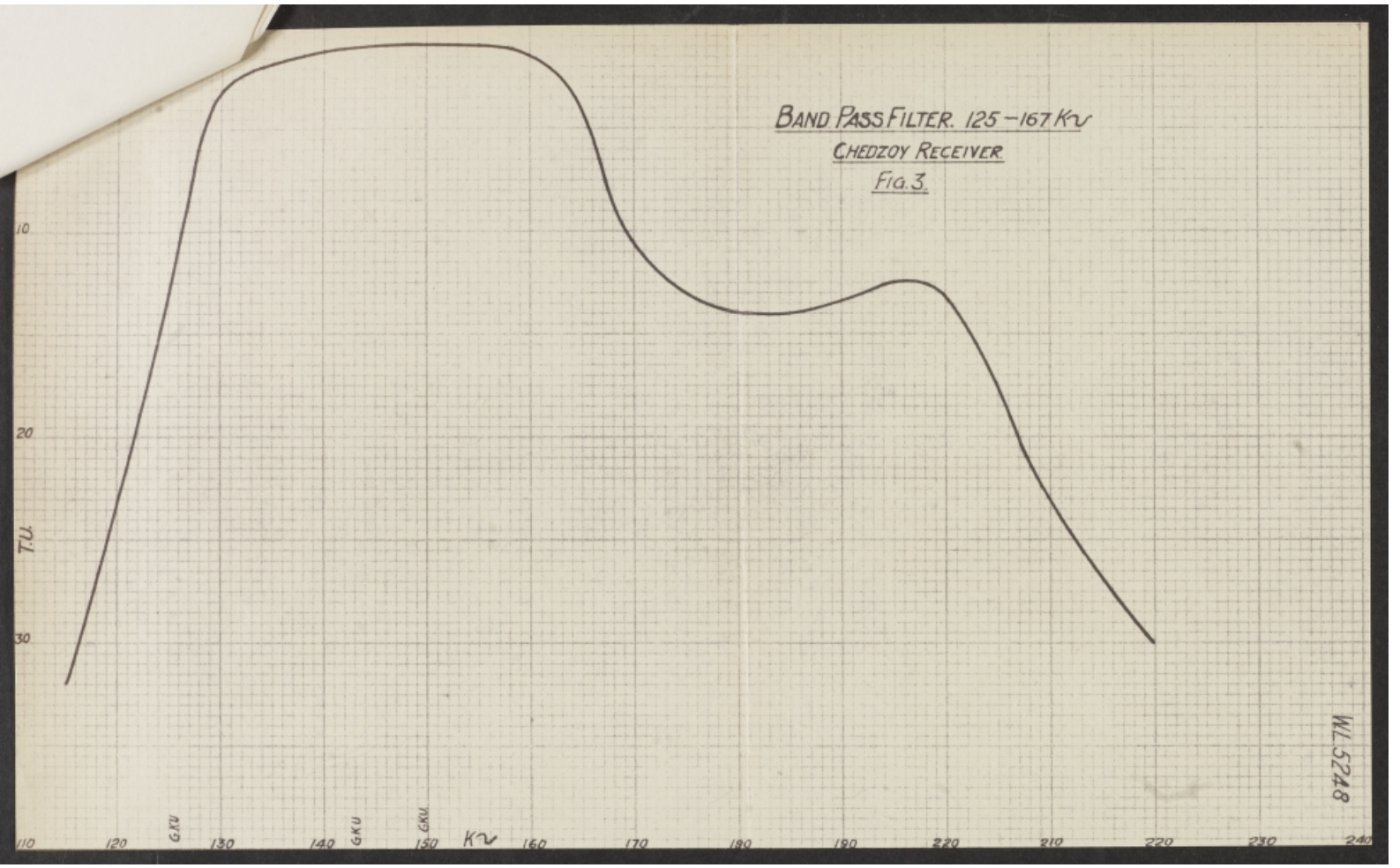
WL 5246

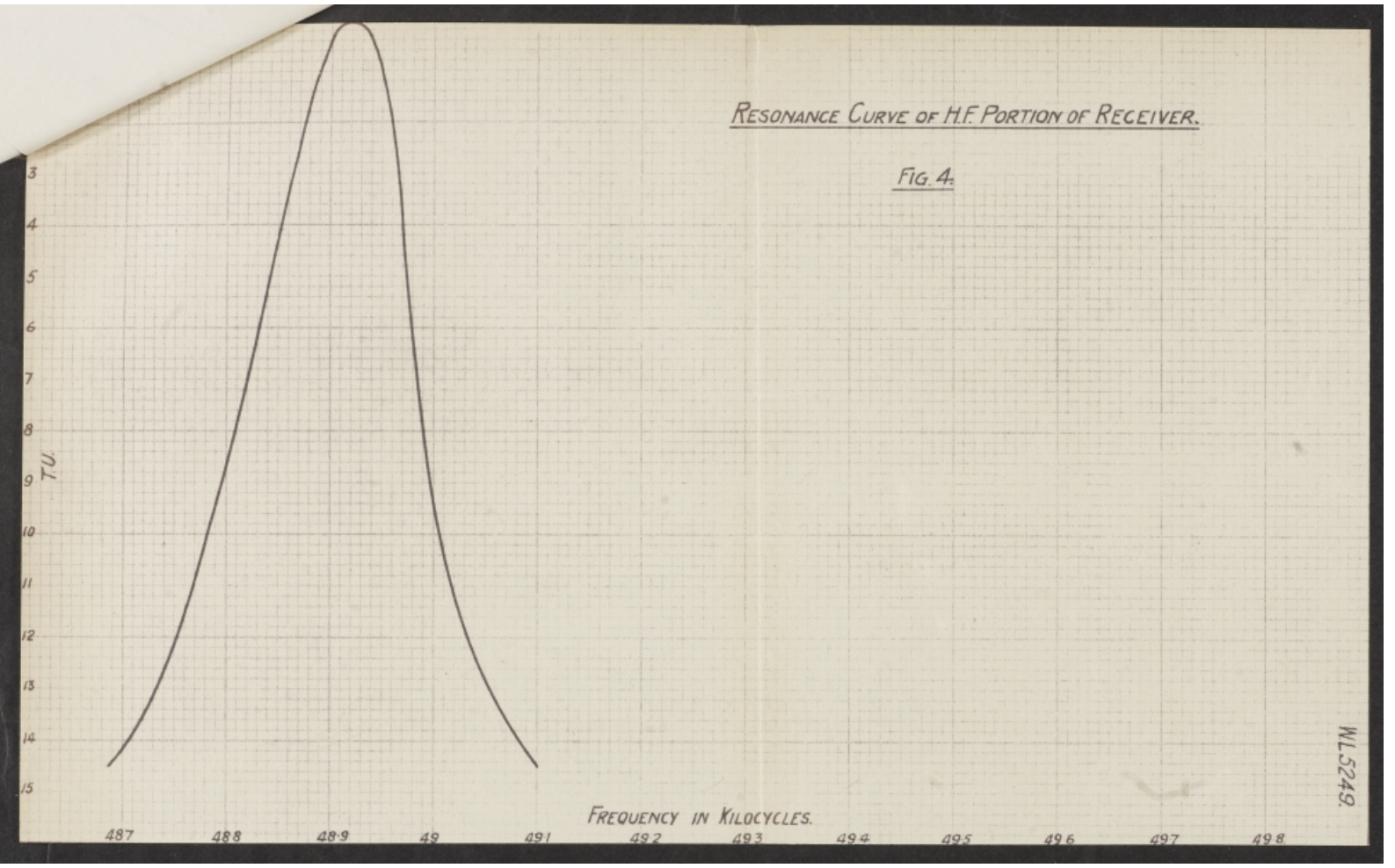


CHEDZOY RECEIVER.

FIG. 2.

WL 5247


BAND PASS FILTER. 125 – 167 Kv
CHEDZOY RECEIVER
Fig. 3.
10
20
30
T.U.
110
120
GKU
130
140
GKU
150
GKU
Kv
160
170
180
190
220
210
220
230
240
WL 5248


RESONANCE CURVE OF H.F. PORTION OF RECEIVER.
FIG. 4.
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T.U.
487
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488·9
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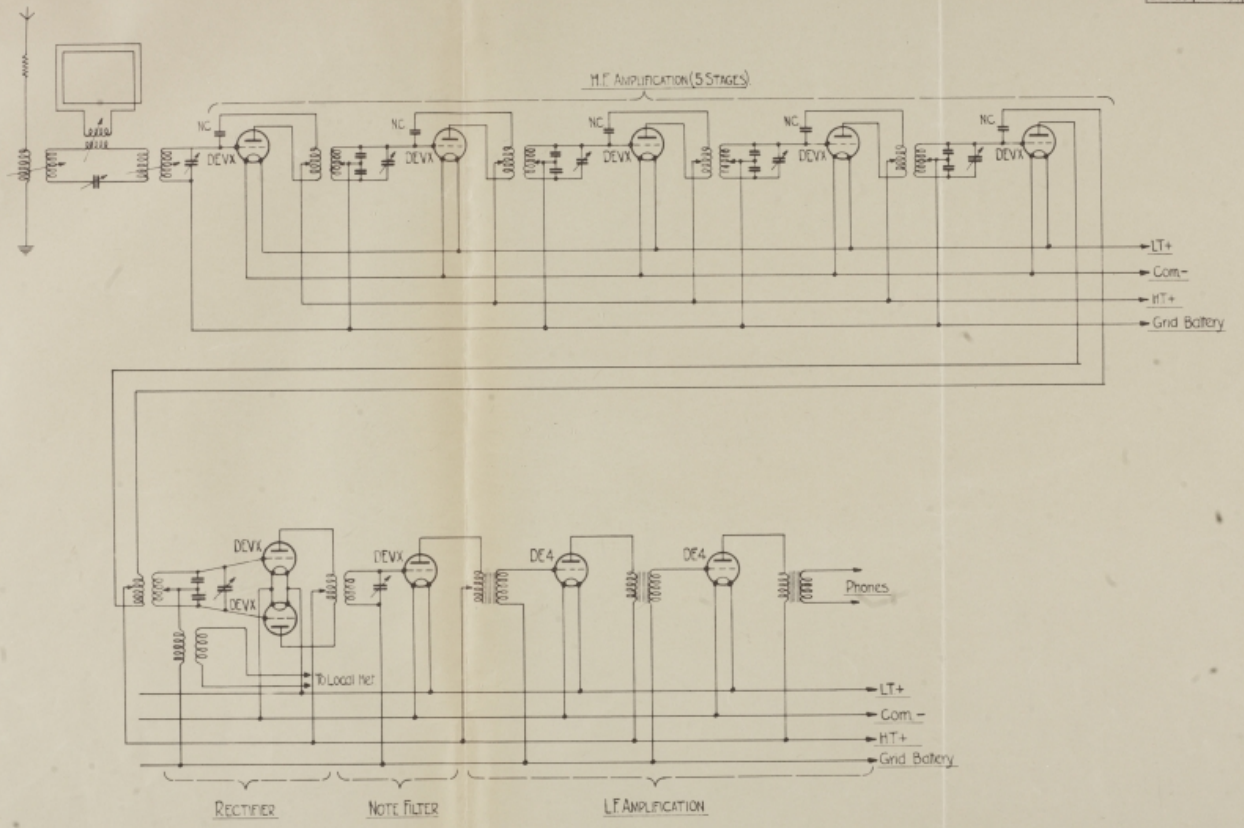
FREQUENCY IN KILOCYCLES.
WL5249.

DRAWING Nº WL 4321

WIRELESS SECTION, ENGINEER-IN-CHIEF'S OFFICE, G.P.O. LONDON

Skeleton Diagram of Receiver (Marconi Type) at Burnham.

DRN. [illegible] | TCD. [illegible] | CKD. [illegible] | 15 - 9 - 26



RECTIFIER NOTE FILTER L.F. AMPLIFICATION

WL4321.