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MISCELLANEOUS GERMAN RADIO and COMMUNICATION TARGETS.

BRITISH INTELLIGENCE OBJECTIVES SUB - COMMITTEE.

LONDON - H.M. STATIONERY OFFICE.

MISCELLANEOUS GERMAN RADIO AND COMMUNICATION TARGETS

Reported by:-

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BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE

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MISCELLANEOUS GERMAN RADIO AND COMMUNICATION TARGETS

1.00 Introduction

A great number of reports have been and are being written on the subject of German electronics, and in an effort to avoid duplication, only those items are recorded below which have not been seen in published reports. Duplication may quite easily exist with reports now in the process of publication.

For ease of reading, the information is presented under subject headings, and references to the sources of information will be found in Appendix A.

2.00 Communication Equipment, Land-Line

2.01 Coaxial Cable:- As reported previously, the coaxial cable between Berlin and Hamburg was used for 200-channel carrier and for television programs. It is interesting to note that this cable, in some cases, was also used to transmit 50 cycle power at 550 volts as an emergency supply from a repeater station equipped with an auxiliary power supply to the next repeater station when not so equipped. (Ref.5)

In the case of the coaxial cable from Munich to Berlin, since no television programs were passed, a service was provided whereby one could go to one of two offices in Munich and see as well as talk to a person in a similar office in Berlin or Leipzig. The equipment for this service has been completely destroyed. (Ref. 6)

2.02 Facsimile Equipment:- The commercial (as opposed to military) type of German facsimile equipment is being installed in Hamburg Repeater Station #1. It employs a synchronous motor driven from a 1020 cycle source (which in turn is obtained from a 510 cycle tuning fork) to turn the transmitting and receiving drum. A carrier of 1300 cycles, amplitude-modulated by a photocell, is rectified at the receiving end and the resulting direct current is used to turn a light-weight mirror, thus deflecting a light beam and preventing it from going through an aperture to the lens system and the photographic paper. Negative pictures can also be produced by arranging the aperture so that the light beam will be blocked when the mirror is at rest and will go through the opening when deflected. The system is slow, the time taken for a picture 13x18 cm. being 11.5 minutes, with 5 1/3 lines per mm. being used for scanning. Quality is quite good to judge from examples shown, though

the equipment itself had not been installed when the visit was made. Considerable detail is given on the system in a paper entitled "Grundlagen der Bildtelegraphentechnik" by H. Bitter, published in TFT ("Telegraphen-,Fernsprech-, Funk-, und Fernsen-Technik") Bd.29, Heft 8, 9, & 10 (1940), only the file copy of which was available, at the station. (Ref. 4)

2.03 Teletype Dialling:- Before the system was damaged by bombing a subscriber could dial to any other subscriber connected to a sub-exchange of eight central exchanges in Germany and the occupied countries. Lines had been extended during the war to Kiev, Amsterdam, Paris and other places. Regular teletype carrier equipment was used, with 18 channels on one voice frequency, employing frequencies from 420 to 2460, 120 cycles apart. The subscriber could dial, and if the connection was made, he could press a key and receive the call sign of the subscriber he had dialled. This call sign can be up to 15 characters. By pushing a second key, his own call sign was transmitted to the other subscriber. If the other party was busy, this would be shown by an indicator beside the dial. The circuit was made through an automatic computing device which works on the basis of zone times time, and adds to the particular subscriber's counter. The charge for individual calls could not be told, but experiments were being made with a special counter which could be dialled into the circuit and which would indicate to the subscriber the charge following the call. A limited dialling service is now available from Munich. (Ref. 6)

2.04 Teletype Relay Testing Device:- This device, made by Siemens and Halske, was called a "Schaltgerat fur Verzerrungsmesser", and indicated, by neon lights behind a rotating disc with two slots in it, the distortion introduced by a given relay. (Ref. 6)

2.05 Text-Book on German Teletype Systems:- A good textbook on the German system is "Fernschreibertechnik" by Schiwek, published by C.F. Winter'sche Verlagshandlung, Leipzig. No copies could be located aside from the personal copy of Dr. Abart, technical director of the Munich system. (Ref. 6)

2.06 Wire Circuits for Radio Broadcast:- Many conflicting stories had been heard regarding the quality of German program circuits. Accordingly, curves of frequency response were inspected. For the Lubeck-Hamburg circuit, which is about 45 miles in length, and has no repeaters, the 30 cycle response was plus .02 nepers (.17 db.) relative to 800 cycles, 7000 cycles was -0.12 nepers

(1.04 db.) and 8000 cycles was -0.03 n.(.26 db.). For a longer line, approximately 280 miles in length, with four repeaters (according to the German engineer), the circuit was down 0.3 n (2.6 db.) at 40 and at 7000 c.p.s., relative to 800 c.p.s. The drop-off was rapid above and below these figures.

2.07 Wired Wireless System:- This system as used in the Hamburg area employs a small amplifier for each of three channels (249, 210, and 160 kc/sec.) at each telephone exchange. The programs are passed over the telephone system at approximately 50 millivolts and filters are provided for the subscriber. A radio receiver connected to the two incoming telephone lines, and tuned to one of the three frequencies gives good reception with low background noise. (Ref. 4)

3.00 Communication Equipment, Radio

3.01 Decimetre Communication Equipment:- Since a certain amount of contradiction exists in past reports on technical details of decimetre communication equipment, the table of Appendix B has been compiled from discussions with the manufacturers and from inspection of the equipment itself. In the case of "Rudolph" and "Michael" sets, models produced at different times may have had different features, thus leading to the contradictions. (Ref. 7,8,10)

3.02 Radio-teletype Equipment:- The German Army had developed an extensive radio-teletype network with Berlin as the central point, and links with Paris, Rome, Crete, Smolensk, Narvik and many points between. The principal station was near Golzen, about 40 miles south of Berlin proper, and consisted of two transmitting stations with a total of fifty transmitters, and one receiving station. Stuttgart decimetre communication equipment was used for the link to Berlin, from whence the transmitters could be keyed. Other stations were either permanent or mobile, the mobile equipment being carried in three trucks or in three aircraft.

Two methods of transmission were used. (i) Amplitude modulation with standard Army carrier equipment using three telegraph channels in parallel to give frequency diversity and avoid fading. For instance, frequencies of 900,1620 and 2340 c.p.s. were used for "mark" and 540,1260 and 1980 for "space". (ii) Frequency-shift of the carrier. This was accomplished by keying a condenser in the master-oscillator circuit, and produced a

shift of [illegible] channel of a diversity system. Both [illegible] oscillator tuned above the signal. One was adjusted to give 1850/1620 c.p.s., while the other was adjusted to give 1980/2340 c.p.s. From this point on, standard [illegible] telegraph equipment was used.

The transmitters used were the "1 kw. Sender" or an 800 watt Naval transmitter. [illegible] teletype machines were used in conjunction with [illegible] machines.

The source of the above information was principally an instruction book on the system, since the informant (Ref. 12) was an administrative rather than technical type. His assumed air of knowledge seemed to give many wrong clues until the instruction book was produced. Because of his lack of technical training, such problems as frequency stability of transmitters and receivers for carrier-shift transmission could not be discussed.

4.00 Components for Radio Equipment:- Excellent reports have appeared on the manufacturing process of the Robert Bosch Company for producing paper capacitors which are more compact than the normal variety. An important part of the manufacturing process, the "[illegible]" of these capacitors to remove imperfections in the paper after the winding operation, does not seem to have been covered, however. Details of this process are given in a report now being prepared by Mr. N.L.Kusters on developments in the electrical industry. (Ref. 2)

5.00 Ceramics with High Dielectric Constants:- Several reports have appeared on the work done by Dr. Rother, consultant to Lutz and Co., in Lauf. An interesting sidelight to this is the statement of Dr. Rohde of Munich who is apparently a professional rival of Dr. Rother's and who did consulting work for the ceramic firm of Hescho in Hermsdorf. Dr. Rohde says that the highest theoretically possible dielectric constant is about 400, and that higher values claimed by others (Dr. Rother claims several thousand) are not true values, but are caused by conducting particles in the dielectric which have the effect of decreasing the spacing of the measuring plates, and will result in a lower break-down voltage. (Ref. 15)

6.00 Receivers, Domestic:- Mende of Dresden was the largest seller of receivers to the German market. Then followed in order Telefunken, Saba, and Blaupunkt. Telefunken, however, made approximately 60% of the receivers exported from Germany. Even then, they did not export as many receivers

as did Philips of Holland. (Ref. 17)

The best-engineered receivers were made by Blaupunkt (by their own admission), but this was supported by statements from engineers of rival companies. The German manufacturers association, to which all radio manufacturers were forced to belong by government order, fixed priced but did not control quantities or quality. As a result, there was competition in quality, and Blaupunkt appear to have excelled because of a long-range research program.

A pleasing tone was obtained from their receivers not by attenuating the higher frequencies as in so many sets, but by attenuating the middle frequencies and thus compensating for the non-linear response of the human ear at reduced volume levels. They used negative feedback from the speaker voice-coil to a broadly tuned resonant circuit in the cathode of the audio driver tube. In addition, a stiff material was used for the speaker diaphragm and this combined with a strong magnetic field served to cut down spurious resonances. Blaupunkt did not build the small cheap sets, so that their total volume was not the greatest despite their quality. (Ref. 1)

During the war, domestic receivers were made in the occupied countries and provided with nameplates of the German manufacturers in order to keep their name before the public. Now, the manufacturers are up against many difficulties in the way of tubes, raw materials, machines, factory space and engineers. Most of the Telefunken research staff is now working for the Russians because they are paid high wages, get extra rations, and are not in disfavour if they were previous party members. Blaupunkt is turning out a small crystal receiver, using the crystals originally intended for the Korfu radar intercept receiver. (Ref. 1,3,17)

7.00 Recorder, Magnetophone:- Reports have appeared on the field model of the Magnetophone recorder, made by AEG, and known as "Ton Sb" and "Ton Sc". The studio model of this recorder was seen and heard. It employs an acetate tape with magnetic coating and has excellent fidelity with low background noise. No fidelity curves were available, but the recorder was said to be nearly flat to 10,000 c.p.s. Full details are given in a report now being written by Dr. G.J.Thiessen on acoustic and infra-red targets. (Ref.16)

8.00 Transmitters:- The broadcast transmitters at Hamburg and Munich were seen. In each station, there are two 100 kw. broadcast transmitters, those in Hamburg having been built by Telefunken, and those in Munich by Lorenz. In both stations there is an older, gridmodulated transmitter and a newer, plate-modulated transmitter. The differences between Lorenz and Telefunken design is quite apparent, the new Lorenz unit being quite compact, while the Telefunken unit is spread out. According to Telefunken, this results in fewer troubles, and less time spent in fixing those which do occur. The lack of proper safety interlocks was quite noticeable, and the Lorenz unit was so compact that an r-f burn could be otained from the glass window. Both makes of transmitters had meters to indicate when the output and aerial tuning circuits were tuned. These made the tuning of these circuits a simple matter. Details are given in 8.01 below. Both stations made use of two different aerial systems. One was a portable arrangement with three 150 foot guyed steel masts in triangular array with three flat-tops between the masts. Leads from all three flat-tops were brought to a central tuning unit trailer, and connection to the transmitter was made by buried coaxial feeder. The second aerial arrangement was a self-supporting wooden tower. The one at Hamburg had had the top sections removed for reasons of safety, but the one at Munich was the full height of 547 feet. The radiating wires were designed for 5/8ths wave-length operation and for this reason had a loading coil approximately 2/3rds of the way to the top. Coaxial feeders were used in these cases also. (Ref. 13,14)

8.01 Tuning Indicators:- The aerial tuning equipment of the newer Telefunken transmitter at Hamburg had an ingenious arrangement of instruments to indicate proper tuning of the aerial and proper matching to the coaxial feeder. A general explanation of this arrangement was obtained from Dr. Mailandt of Telefunken. Reference should be made to Fig.1. A bridge circuit connected to the current transformers I_2 and I_3 indicates on a meter when the phase difference between these two currents is 90 degrees. When this is the case, the current through L_2 is in phase with the voltage across C_1, and the aerial circuit is therefore tuned. A bridge circuit connected to V_1 and V_2 indicates on a second meter when the phase difference between these two voltages is 90 degrees. When this is the case, V_1 and the current through L_1 are in phase and the termination of the transmission line is tuned. A crossed coil instrument indicates the ratio of V_1 / I_1, and since the circuit is already in resonance, this gives the resistance terminating the coaxial feeder. If this value is not close to 62 ohms, the characteristic impedance of

the feeder, C_1 is altered and the procedure repeated. (Ref. 19)

8.02 1000 kw. Lorenz Transmitter:- According to the Lorenz engineers, they have built a 1000 kw. LF transmitter for the German Navy which was erected at Calbe, now in the Russian zone. It used four RS-300 tubes in parallel push-pull, and tuned from 15 to 60 kc./sec. U-boats submerged in the Caribbean Sea were supposed to have been able to hear it. The most unusual part of this installation as it was described, was the aerial system, which was said to have an efficiency ranging from 50 to 80% depending on the frequency. As roughly described, this system employed three 250 metre (820 ft.) towers at the corners of a large triangle. Around each large tower were grouped six 220 metre (720 ft.) towers on the circumference of a circle with radius 400 metres (1310 ft.). A flat-top was formed on each of the three tower groups, and the feed-point was at the centre of the whole array. Each of the three large towers was grounded through a loading coil to a radial system of 500 metre galvanized iron ground straps (1640 ft). Ground resistance was 0.03 ohms per tower, or 0.01 ohms total. The "Q" of the antenna was so high that it had to be damped by resistance for high speed keying. (Ref. 9)

9.00 Tubes (Valves):- Two interesting items were encountered in an inspection of radio tube factories. One was the use of aluminum oxide to insulate the filament of small receiving tubes. This was applied either by spraying and oven-baking, or by depositing it electrically from a colloidal suspension in alcohol. After this latter operation, the filaments are self-heated to 1600 degrees Centigrade in an atmosphere of 20% hydrogen and 80% nitrogen. The second was the use of aluminum along with iron in the plates (anodes) of tubes. For tubes where no appreciable heat-radiation was required approximately 1% of aluminum was alloyed with pure iron. For tubes where heat-radiation was required of the plate, a thin film of aluminum was rolled onto steel. This was done on both sides in some cases, or nickel was rolled onto the inner side of the plate in other cases. When high-frequency induction heating was applied in the manufacture of the tube, $FeAl_3$ was formed. This is a dark gray in colour and radiates heat well. This use of aluminum on steel was a Telefunken development, and the rolling of the metals was done by the Trier Walzwerke in Trier in the Rhineland. (Ref. 11,20)

9.01 Telefunken Transmitting Tubes:- The greatest output was from the Rs-564, 200 kw. at 1.5 mc./sec., and 100 kw. at 15 mc./sec. This tube was a war-time development. It is understood that one of them is still at the Telefunken factory in Berlin-Charlottenburg, Sickingenstrasse 71, though this was not seen because of a lack of time in Berlin. No attempt seems to have been made to produce high-power air-cooled tubes. (Ref. 18,21)

10.00 Ultra High Frequency Text-Book:- A series of books on U.H.F. has been written by Dr. Horst Rothe and Dr. Werner Kleen of the Telefunken Company. It is called "Bucherei der Hochfrequen„technik". Dr. Kleen's personal copies were inspected, but no other copies could be found. (Ref. 18)

APPENDIX A

SOURCES OF INFORMATION

Ref.No.	Firm	Address	Individual
1	Blaupunkt Radio G.m.b.H. C7/204	Berlin-Schmargendorf Forckenbeck Str. 9-13	Dr. Gullner
2	Bosch, Robert	Stuttgart, Militarstr.	Dr. Dipper
3	Braun Radio G.m.b.H.	Frankfort, Idsteiner Strasse	Herr Braun
4	D.R.P. Repeater Station #1 C7/163	Hamburg, Binder & Schluter Str.	Major Buchanan R.C.S.
5	D.R.P. Repeater Station #3 C7/167	Lohbrugge, S.E. of Hamburg	Corporal Good R.C.S.
6	D.R.P. Telephone Station	Munich, Maria Josefstrasse 4	Dr. Abart
7	Funkstrahl Gesell fur Nachrichtentechnik m.b.H	Constance, Immelmann-strasse	Herr Behrens
8	Lorenz, C., A.G.	Landshut, Bauhofstr.5	Dr. Haupt
9	" C7/23(d)	"	Dr.Schulze Herringer
10	Munich Decimetre Station	Munich, Arnulfstr.60	Lieut. Boucheron C.S.S.C.
11	Philips Valve Werke G.m.b.H. C7/176	Hamburg-Lokstedt Stresemann Str.	Herr Oertel

APPENDIX A (Cont'd)

Ref.No.	Firm		Address	Individual
12	Poppe, Major of the Wehrmacht		c/o Lieut.Col.Kidd R.C.C.S., Postamt 36 Hamburg	Major Popp
13	Radio Hamburg		Hamburg-Billstedt N.E. of Ismannin.	Herr Gerke
14	Radio Munich			Lieut.Rottermann U.S.S.C.
15	Rohde and Schwarz	7/27	Munich,Tassiloplatz 7	Dr. Rohde
16	Rundfunkgesellschaft Studios		Munich, Mars & Hopfenstr.	Lt.Larue U.S.S.C.
17	Telefunken G.m.b.H.	7/71	Berlin-Friedenau Maxstrasse 8	Dr. Ewald
18	"		Hamburg,Ferdinandstr. 29	Dr. Kleen
19	"		"	Dr. Mailandt
20	"	7/58(a)	Berlin-Charlottenburg, Sickingenstr. 71	Dr.Zichermann
21	"		"	Dr. Ureda

APPENDIX B

CHARACTERISTICS OF GERMAN DECIMETRE RADIO COMMUNICATION EQUIPMENT

Designation	DMG 5K	DMG 3G	FuG 03	FuG 03A	?
Code Name	Michael	Rudolph	Stuttgart I	Stuttgart II	Moritz
Frequency (Mc./Sec.)	502-554.5	600-672	1250-1430	1250-1430	2070-2155
Power Output	¼ watt	0 watts	2 watts	15 watts	0.5 watt
Manufacturer	Telefunken	Siemens	Lorenz	Lorenz	Funkstrahl
Channels	1 voice 1 teletype	1 control 9 voice	10 voice	Std.carrier eqpt to 200 kc./sec.	4 voice
Carrier Equipment	Self-contained	FTF-10 (external)	Special (external)	Std. (external)	External
Mod.Freq.	1)300-5500 2)7400-8000	Up to 63 kc.	Up to 120 kc.	Up to 200 kc.	To 15 kc./sec.
Modulation	FM	FM	FM	FM	FM
Deviation	± 15 kc.	± 60 kc.	± 200 kc.	± 200 kc.	± 100 kc.
I.F.Freq.	650 kc.	6[illegible]0 kc.	6 mc.+ 1 mc.	3 mc.	9.8mc.+2.2mc.

APPENDIX B (Cont'd)

Designation	DuG 5K	DuG 5G	PuJ 03	PuJ 03A	?
Bandwidth	± 30 kc.	± 150 kc.	± 300 kc.	± 500 kc.	?
Type of mixer	Diode	Diode	Diode	Crystal	Diode
Type of oscillator (Rec)	Triode (LD-1)	Triode	Triode (RD 12T)	Triode (RD 12T)	Resotank (Barkhausen)
Output (Xtr)	Triode (LD-1)	Push-pull triodes	Magnetron (MD4La)	Klystron (MD 12La)	Resotank (Barkhausen)
Antenna	2x5 Hor. broad-band full-wave dipoles	as for 5K	(i) two parabolas (ii) same as PuG 03A	Horn with H and V dipoles	Dipole with parabolic reflector
Power Cons. at 220 v.50 cycles	220 watts	430 va.	?	?	200 watts
Reference Appendix A	(10)	(10)	(8)	(8)	(7)

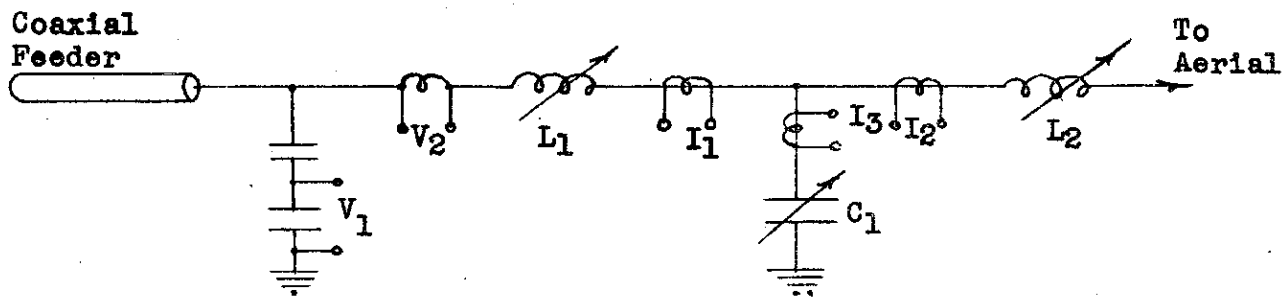

FIGURE I

Aerial Tuning Arrangement for 100 Kw. Telefunken Transmitter