THE I.T.T., SIEMENS AND ROBERT BOSCH ORGANIZATIONS

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COMBINED INTELLIGENCE OBJECTIVES

SUB-COMMITTEE

LONDON—H.M. STATIONERY OFFICE
VARIOUS REPORTS ON THE I.F.T. (INCLUDING INDIAN AIRSHIPS AND ROBOTIC BOAT) ORGANIZATIONS IN GERMANY.

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CIOS Items 1, 7 & 9.

CIA

F/Adm. Signal Communication
Physical & Optical Instruments
and Devices.

COMBINED INTELLIGENCE OBJECTIVES SUB-COMMITTEE
C-2 Division, SHAEF (Gen) APO 413
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ORGANISATION AND OFFICERS AD INTERIM
OF THE J.T.T. CORP.
IN GERMANY 1945

STANDARD ELEKT. GES
GEN. MANAGER: C. SCHMID
MANAGER: —
ASSISTANT: ROBERTSON
COMPTROLLER (BRENNER)

GES. TEL. BET.
MANAGER: —
ASSISTANT: ROBERTSON
COMPTROLLER (KAUFMANN)

SAF HÜRNBERG
MANAGER: STEGMANN
COMPTROLLER: ELLERER

INACTIVE
TEL. FABR.
BERLINER

MIX u. GENEST
JOINNT MANAGER: MEHLISS
" BERGMANN
COMPTROLLER (KAUFMANN)

50%
LOVA-KABEL
BERLIN

51%
E. F. HUTH
JOINNT MANAGER: D. MESSERSCHLINGER
" BERGMANN
COMPTROLLER (KAUFMANN)

26.2%
FOCKE-WULFF
BREMEN

C. SCHMID
ASSISTANT
F. BEHRINGER

C. LORENZ A.G.
GEN. MANAGER: C. SCHMID
MANAGER: SABERSKI
ASS. MANAGER:
F. BEHRINGER
COMPTROLLER: L. W. GEBB

100%
LORENZ RADIO VERTRIEB
GMBH
JOINNT MANAGER: L. RÖSSING
" C. SCHMID
COMPTROLLER (BRENNER)

100%
SCHAUB PFORZHEIM
MANAGER: —

100%
TEFAG
JOINNT MANAGER: L. RÖSSING
" C. SCHMID
COMPTROLLER (BRENNER)

FIRMS IN SOUTH GERMANY
( ) AT PRESENT AWAY
INVESTIGATION REPORT

TARGET: 
Lorenz at Landshut

DATE OF INVESTIGATION: 
29th May 1945

INVESTIGATORS: 
Mr. Ombarg U.S.Sig.
Capt. Caplin S.R.D.E. CIOS Group I
Lt. Redgmont A.S.E.
S/Ldr. Farvis T.R.E.

(No attempt is made in this report to describe the Lorenz organisation as this had been fully covered by Commander Ratzes' Team in 12th Army Group).

ESTABLISHMENTS:

Two sites were investigated:

1. The old Grafmühle mill at No. 6 Wannhofstrasse, Landshut. This mill was taken over by Lorenz for the manufacture of small motors and rectifiers.

2. The Vereinigte Kunstmühle (grain mill) at 5 Mühlenstrasse, Landshut. This is an inoffensive grain-mill work at top priority under Allied supervision. The interest in the target lies in one of its engineers, Dr. Goldmann, who previously worked with Lorenz in Berlin and later in Vienna. Finally when Vienna had to be evacuated because of the Russians approaching, Dr. Goldmann changed his job and came to Landshut so that he could be near a Lorenz factory, where he could be in touch with any Lorenz developments. Also in the same building is housed Dr. Kramer, one of the senior people in the Lorenz organisation. He is merely an evacuee and does not work for the mill.

A considerable amount of useful technical information was obtained from both Dr. Goldmann and Dr. Kramer.

DOCUMENTS:

No documents of any sort were available. These had been all burnt in Vienna before fleeing from the Russians. Dr. Goldmann was asked to prepare a document on the history and technical details of some of the navigational systems which it had not been possible to discuss in great detail during the interrogation. The substance of
this document is included in this report.

GRAFÉNHÖLE 5 RÜHNOF STRASSE

The mill housed a department of Lorenz dealing with the design and prototype model shops for small motors and generators. The department was evacuated from Berlin 12 months ago.

PERSONNEL

Mr. Blatt Dipl. Ing. - Works Manager.

Mr. Hammerl - Chief Designer.

Motors and generators of various types were designed by Mr. Hammerl and a model ship in the premises made pre-production models.

They concentrated on large motors and generators, 3kw - 1/2kw. Some work was done on small motors and also "Magalip", single-phase and three phase, 500, 200, and 50 cycle supply.

One of their latest type inverters was as follows:

750 watts
45% efficiency
28v. D.C. input.
A.C. output at 500 cycles
Ball bearings
6 1/2" Diameter
12" Long.

They also assembled power units in which Selenium rectifiers were used. These rectifiers were made by Sud-Deutsche Apparate factory.

A rotor was examined which was stated to be for a 3 phase "Magalip". It had two slip rings. The main windings were divided into two sections at approximately + 30° to the main magnetic axis. The iron between these sections was cut away. An auxiliary coil was wound in two close spaced slots at right angles to the main shaft. It was stated that these avoided any dead points and made the torque more uniform.

Other manufacturers for motors and generators for Lorenz were:

Kreiselgeräte Berlin
Oehmig, Martha in Saxony.
The last named specialised in motors of the "Megalip" type.

**VEREINIGTE KUNSTMÜHLE**

Particular interest was paid to Dr. Goldmann, who has been heard of many times in CIOS navigational aid interrogations as the most important Lorenz engineer on the subject, and the holder of a number of patents.

When Dr. Goldmann left Siemens and Halske Central Lab. in Feb. 1936, to join Lorenz, his first development work was on 50 cm ground radar type A2. (Separate T & R, 2 paraboloids, one above the other). (It is interesting to note that a German firm was developing 50 cm ground radar at this early date and well before the war). A few sets were completed but were not very successful and the project was dropped.

In Dec. 1937, Dr. Goldmann was sent to the USA to take part in the development at L.T & T of 125mc/s B.A. equipment. Also a B.A. beacon was installed by him at Fort Worth on behalf of Lorenz. Goldmann was recalled to Germany in Dec. 1939.

On his return he was put to various jobs in Lorenz. He worked with Neill & Gerauer for a time on "Heil"tube development, but the team soon broke up as Heil was so difficult to work with (and after a year, left Lorenz).

He then went to navigational aids and had working under him a man who, it turned out subsequently was developing ELEKTRA. This development work had started in April 1939. The first equipment was built at Huisen in Holland, using 10.5 spacing and 460 kc/s. Prof von Handel of DVL took part in the trials and Dr. Goldmann came in at this stage. He did not like this first installation and modified the design for the next station, which was built at Bayeux in November 1940. Dr. Goldmann helped to install it, reduced the spacing to 5.7 A (300 kcs working). However A.M. decided not to use it. At the end of 1943, Lorenz dismantled it, but then A.M. wanted it all put back again within a few days.

The order of installation was:

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Then one near Warsaw to cover the Russian front. Others later by junior engineers and so cannot give date.
The aerials used in these installations were only about 50 meters high and thus offered a large capacitative impedance, so there were considerable variations in the impedance of the aerials with weather conditions. Since the accuracy of the system depended on exact balancing the two outer aerials, a monitoring device had to be incorporated which would indicate to the control engineer the standing wave ratios on the 600 Ω feeders. These meters were permanently incorporated in the feeders, but not designed to provide automatic correction. The arrangement used are as shown:

**Standing Wave Indicator**

The aerial constants can be adjusted by a) & b) in conjunction until a correct match is obtained.

For instance if circle (1) represents the locus on the cartesian impedance diagrams for some standing wave ratio \( \rho \). Adjustments to a \& b can make the load purely resistive and equal to 600 ohms.

**Aerial Coupling**

A goniometer type phase shifter is incorporated in order to swing the beam into the required position (hand operation). This led directly to the Sonne system in which the lobes rotate continuously.

The Luftwaffe did not take very well to Flektra. It was not until a high Luftwaffe official flew on it that it really became used. Then it was rather overused, because although it had been stressed that this system was for daylight use only, the Luftwaffes insisted they were getting satisfactory operation with it at night.

-7-
The British jamming of Elektra was first noticed in Feb.
1941, not by bad reception reported by AJ, but by the remote
monitoring stations. They had decided we must be re-radiating the
carrier. No steps were taken to locate the jammers. As regard AJ,
although nothing could be done so the only counter-measures was to put
more Elektras on the air than were actually used.

Sonne

Sonne is simply Elektra rotated. Because of troubles
experienced in the U.K. in trying to copy a Sonne type beacon,
detailed questions were put to Dr. Goldmann on difficulties during
the development. Questions on keying:

One of the first technical points to decide was whether two
or three aerial systems should be employed (both Sonne and Elektra).
The +90° phase switching on the radiators of a two aerial system
was almost certain to produce key clicks during reversal, so the
3 aerial system was adopted where the keying and phase shifting
operations are performed on the outer aerials. No special anti-click
circuits were found necessary on the normal Sonne or Elektra but
there had been a request from the Luftwaffe for a 60 Kw Sonne and it
was expected there would certainly be trouble with clicks when
handling this power. A switch circuit avoided the change of load on
keying and was developed and patented by Dr. Hoffmann (left behind in
Berlin) Dr. Goldmann did not know the circuit.

In the Sonne and Elektra systems the power distribution
between aerials can influence the sharpness of "cross over" and while
the normal distribution was 250W 1000W 250W (dotted curves) increased
accuracy could be obtained by using 375W 750W 375W (full curve) but
key click troubles were then introduced.

All the keying and phase shifting was done at output power
level, the keying in the latest models being by means of vacuum
switches.

Dr. Goldmann explained that the change in carrier frequency
we had observed during part of the Sonne cycle was intentional. A
complete 360° service area was not possible with Sonne but it was more
convenient to rotate the goniometers continuously than to re-reverse the
motion and confuse the observer. During the rotation through the un-
servicable part of the cycle an unkeyed signal was sent but a slightly
different carrier frequency so that the observer would not mistake
this for an on-course indication.

Suitable power dividing networks had to be incorporated in
the line matching arrangements to give the above results. The two
halves of the goniometer stator were said to be isolated by a bridge
-8- 1-circuit
circuit to avoid one half reacting on the other. In Sonne this bridge circuit was of a capacity type; on the Erika equivalent a line bridge was used.

The Sonne system was, as implied by its name, intended for daylight use only, when ranges up to 1500km were expected. For this reason no special precautions against the radiation of horizontally polarised components were taken apart from running a portion of the feeder quite near to the radiator underground; the rest of the feeder run was open wire 600 Ω line above ground.

It was realised that there was a minimum range at which reliable indicators would be given; it had not been accurately determined but Dr. Goldmann thought it was about 15 km. It was inconvenient for coastal stations to have to put a monitor station so far in front and the decision was made to put the monitor site well within the minimum range, but in one of the "satisfactory" zones. 2.6km was in fact chosen. The monitor information was passed back over telephone lines, but considerable trouble was at first experienced due to pickup on the landline. Operation was not automatic.

Mond (Moon) - was the name given to the system which would give navigational facilities by night, complementary to Sonne facilities by day. It was to have been in the 30mc/s band, but was never carried out.

Knickerbock was developed by Telefunken (near Lohmann).

Erika was the next system made by Lorenz and developed by Dr. Goldmann middle 1944. Prof. von Handel had put forward a scheme much earlier and the researches of von Handel and Dr. Pfister had indicated the limits of accuracy which were possible. These results were used by Lorenz. Dr. Pfister was responsible for the 6 aerial suggestion and this also was incorporated by Lorenz. The phase meters and the whole of the aircraft equipment for Erika were developed by Lorenz.

Transmitters for the ground equipment were made by LMT (up to driver stage) with 50w and 5kw PA being done by Sadir. Both people made a very bad job of their transmitters, and in any case, it was decided by the AM that the French ones (Boulogne and Cherbourg) were not required after all. An order was then placed for two complete ground installations for training purposes, one to be installed near Vienna (checks with stories from other sources) the other near Munich this will undoubtedly be the Immenburg site already investigated. These sites were to be completed by the end of 1943.
The Erika system is described elsewhere in detail, but an important technical detail which has not previously been covered, was explained by Dr. Goldmann, namely the phase shifters which were handling 500 watts and gave linearity of 0.75°. The loss was 5-10°.

The goniometers were of the "plane" rather than cylindrical type, the form of the coils being as shown below:

The angle of the "figure of eight" search coil and the shape of the field coil were determined experimentally to give the required law of variation of mutual coupling. The leads cut from the search coil were connected to the outside circuit by a rotating capacity joint so as to avoid contact troubles: the inductance compensating capacitors $c_1$ & $c_2$ were formed by the capacity joints also.

The center taps of the coils were not earthed. The circuit of the complete phase shifter is given below, the line bridge circuit being included so that no coupling occurred between the two circuits. No trouble had been experienced due to the change of impedance of the field coils as the search coil rotated, and this was attributed to the use of the bridge. The 90° phase was produced by a tuned line and the apparatus was therefore for a fixed frequency.

[Diagram of the circuit with labels "90° SHIFTER", "Z", "GONIO", "CONSTANT IMPEDANCE", "DOUBLE BRIDGE (LINE) TO AVOID COUPLING BETWEEN GONIO STATOR COILS"]
This phase shifter was placed in the driving stage handling 500W, and the outputs fed the 5kw power amplifiers of which one was provided for each aerial array. The phase shift across this amplifier had to be controlled and a continuous watch was kept on this by means of a monitor station feeding back its indication automatically over audio lines to the main control desk. It was stated that a considerable amount of trouble was experienced mainly due to the beat between the comparison frequency of Erika (450cps) and the 500cps mains pickup approximating to the mechanical resonance of the meter (about 400cps). The comparison frequency was then changed to 400cps.

A special "Line Goniometer" which Lorenz made up to test these phase shifters may be of interest. Two matched single wire lines fed from opposite ends run parallel. When properly adjusted the phase difference between the ERM on the two lines is a simple function of distance along this line.

After Erika came KOMET, built to the spec. of Prof. von Handel early in 1944 and installed in Denmark. There arose the problem of how to eliminate or make allowances for the coupling between the large numbers of aerials (both of one system and between systems, since the wavelengths were harmonically related \( \lambda = 12.5m \), \( \lambda = 25m \) and \( \lambda = 50m \)).

So many difficulties were introduced by the harmonic resonances that it was finally decided to drop the project. (This is where Dr. Pfister went to develop the simpler 5 aerial system now in use at Tamaning).

Another beam system developed about the same time was known as R.S.A. (Dr. Neidhardt) when 2 beam systems overlapped. A fine system due to A & C gave the accuracy, while A & B gave a rough system to resolve ambiguities of minimum. The rough system was given the normal keying rate of 1/sec, and the fine was keyed rapidly at a different audio frequency. This system was developed for the Army (Waffenamt) and was for tanks. Dr. Goldmann had heard of no application of this to robots.

**GOLDWEVER.**

Not finished. Substitute for "Komet".

/1.
In order to use the receivers and teleprinters which have been developed for "Komet", a different type of transmitting antenna "the circular group" has been proposed. Such type of antenna has been used for taking bearings with minimum-maximum-methods under the name of "Wullensewer" by the E.N.K. Konstanz, Dr. Bachem. The C. Lorenz A.G. Wien-Tulln has been in charge with:

a) Conversion of maximum-minimum methods into intersection of two symmetrical diagrams.
b) Alternative keying of the diagrams with 70 cs.
c) Monitoring device.
d) All technical details of the final station.

The E.N.K., Konstanz has been in charge of:

Phase shifter. New development of the old one used for reception for transmitting purposes.

2. General Technical Data:

a) Type of beacon: Rotating beacon, sector of 60°
b) Frequency range: 12.5 - 55m
c) Radiated power: 2 x 800 Watts,
   Phase keying
   2 transmitters: type: Ehrenmal.
d) Gain: 2 x 4 dipoles with reflecting screen.
e) Range: Depending on ionospheric conditions (sunspera act)
   Not tested yet.
f) Accuracy: Sharpness of beam: ± 0.125°
   Accuracy of received signal: According to investigations of Prof. v. Gandl.
g) Indicator on craft: Teleprinter, specially designed by S.U.H.
h) Protection against jamming: Wide frequency range.

Interesting Technical Details:

3. Antenna system and operation.

The antenna system consists of 40 broad band dipoles located on a circle 120 m in diameter. Only 2 x 4 antennas are energized at the same time. The left group of these antennas is keyed against the right group alternatively by 90° with a frequency of 70 cs. By changing slowly the phase relations between the two groups, the equal signal zone will shift. After a shift of -4,5° to +4,5° one antenna is switched off and on the other side a new
one is switched on. This is done by a capacity coupled phase shifter developed by the E.N.K. Konstanz.

In addition to this phase keying is interrupted for a short moment every 30°.

At the measuring station (ship aircraft etc.) a specially designed teleprinter gives a mark on the paper if there is no 70 cm keying in the received signal as in Kocet. From what has been said above only the marks for every 30° and for the course are to be seen on the paper of the printer.

4. Keying device.

Phase keying by 90° is effected in the following way:
The voltages e1 and e2 are mixed.
The voltage e1 is kept constant, the voltage e2 is keyed by 180°. This is done by an alternative opening of the tubes of a balanced amplifier. The opening voltage is delivered by a multivibrator.

The keying device has been finished and the first field tests have been carried out. (Radiated power 4 watts).

The keying system included:

Control of the frequency of the modulator
Control of the balance of the modulator
Control of the amount of the keyed phase
Phase shifters to adjust the course

HERMINE (Talking beacon).

1. General Technical Data:

a) Type of beacon: Rotating beacon, all around.
b) Frequency: 30 - 33,3 Mcs.
c) Power: 150 Watts, modulated,
   Transmitter A S 3

-13-
d) Height of transmitting antenna above ground: Located on top of 16 m steel tower.

e) Gain: Single dipole

f) Range: From c + d + e.

g) Accuracy: ± 2°

h) Indicator on aircraft: Headphone.

i) Effect of jamming: Not observed.

Interesting technical points.

2. Indication of course by speech.

a) Field strength pattern of beacon when modulated with 1100 pS

![Diagram of field strength pattern]

Similar to cardioid

Antenna currents:

Antenna 1,2 : 1.00
Antenna 3,4 : 1.80
Antenna 5 : Adjusted to min.

b) Field strength pattern of beacon when modulated with speech Circular, only antenna 5 is fed.

c) Alternative modulation with tone and speech:

The five antennas make a complete revolution in 60 seconds. During this time the tone (field strength pattern a) is interrupted 36 times and the figures 1 - 36 are transmitted with field strength pattern b (circular) when the position of the minimum is true north the name of the station (i.e. Bertha) is transmitted.

3. Antenna construction

The outer dipoles are supported at center of the middle dipole. There are three feeders (coaxial cable type) running down to the transmitter hut inside a hollow metal shaft. This shaft drives the talking device (film in connection with a photoelectric cell in order to give proper coordination of speech and direction of minimum. The antenna has been designed to cover a range of ± 0.5 M° without changing the length of the outer dipoles. The total range with changing the length of the outer dipoles only had been 30 - 33.3 M°/a.
4. Keying, phase correction and monitoring device.

a) Keying. By vacuum relays.

Special circuit to maintain the same input impedance if transmitter is loaded with five antennas or if loaded with one antenna.

b) Phase shifters have been used:

1. for compensating the different lengths of cables.
2. for corrections of course due to slight variations of dipoles.

c) Monitoring device.

Monitor: Signal picked up by aircraft type receiver, output sent back to transmitter hut over telephone line (appr. 200 - 300 m).

Control of course by headphone.

Control of depth of minimum and true course by instrument.

GOLDSOMNE

This system was proposed by Dr. Goldman with the object of overcoming these disadvantages of the "Sonne" and "Komet" beacons.

1. Sonne is satisfactory over a limited sector only and has lobes of unequal sizes.

2. In the case of the Komet where sky waves are used the equisignal surfaces away from the normal plane are hyperboloids, and one must resort to a chart to obtain the correct bearing.

In Goldsorne the aerial system consists of 2 parts, each being a ring of "n" aerials on a common circumference. The aerials of one half are arranged to come midway between those of the other half. The aerials in each system are fed alternately in phase and in anti-phase. Such a system has minima at every \( \frac{\pi}{2n} \) radians; its polar diagram can be represented by:

\[
E = E_1 \cos \frac{n \theta}{2} + E_3 \cos \frac{3n \theta}{2} + E_5 \cos \frac{5n \theta}{2} + \ldots + E_1, E_3, \text{ and } E_5 \text{ are constants.}
\]
Providing the spacing between aerials is not excessive $E_1$, $E_2$, etc. of the series can all be made less than $E_4$, and the polar diagram can thus be made to approximate to a $\cos n \theta$ curve. The polar diagram of the second system can similarly be represented by a $\sin n \theta$ function.

Such an aerial system can be made the basis for a switched lobe beacon by the addition of a suitable centre aerial. It can be regarded as a development of an Adcock D/F system, and appears to form the link between conventional D/F practice and the rotating phase beacon. Goldsman was only at the "idea" stage, but probably represents the highest development of the line-of-bearing navigational systems. The aerials of the two systems must be accurately balanced, and the amplitudes of the signals fed to the two aerial systems must vary accurately according to sine and cosine laws. The accuracy of the system clearly depends upon the linearity of the goniometer, which must either be capable of handling the full power, or else must be followed by amplifiers which are strictly linear.

A method of avoiding these linearity difficulties (due to a brother of Dr. Goldsmann) is to aim for phase stability in the aerial system at constant level. Effectively, the two alternating fields are converted into a rotating field, amplified in this form, and then recombined to provide two alternating fields, viz:
A third amplifier (not shown) was added to give 'sense'.

There is the disadvantage that a strong signal is radiated.

The system seems to have been developed independently of any similar work done by the Allies, but is very similar to a scheme of Janaky (U.S.A.).

The range covered in the experimental model was 5-10 Mc/s, but it was intended to cover 1.5 - 20 Mc/s in the final model.

Capt. Caplin,
Lt. Redgament,
S/Ldr. Farvis.
The double bridge circuits used for division and recombination of the signals are similar to those used in Sonne and Erika. After shifting one voltage 90 degrees, sum and difference voltages are developed in the first bridge. The voltages are then amplified and the further sum and difference voltages from the recombination bridge are fed to the aerials.

Miscellaneous D/F Projects.

Lorenz had done a considerable amount of work on normal D/F apparatus in addition to the work on special beacons intended for aircraft navigation.

They produced two standard types of Adcock system, one covering 15-200 metres (1.5-20 Mc/s) the other covering 200-2000 metres (150 kc/s - 1.5 Mc/s). It appeared that these were made in both fixed and transportable forms and that in the latter case considerable difficulty was experienced with the feeders. The MF instrument had a normal type of cable for feeders, but a special high quality feeder had to be developed for the HF instrument. It appeared that the normal difficulties due to imperfect ground had been experienced and some work on earth mats had been done. The first arrangement was to use small radial mats at the foot of each aerial but, although used in practice, these were not entirely satisfactory. Experiments then proceeded with much larger mats, with the aerial system in the centre. No details of such mats were available, but Dr. Kramer remembered that they found the size of the mats was closely connected with the wavelength in use.

The standard Lorenz Adcocks all used the 6 mast system - stated to have been extracted from a British patent - to enable larger spacings to be used without introducing serious octantual errors. The system was found to be highly satisfactory. Among the advantages were mentioned reduced coupling errors in the goniometer allowing the use of tight coupling between coils, (ferrous cores were used) and site errors were reduced. The sensitivity of the 6 mast systems were said to be such that atmospheric noise exceeded internal noise for most of the time.
Work had been done on visual presentation in the two usual forms:
a) Spinning goniometer form
b) Twin channel C.R.D.F.

The C.R.D.F. system, made by Schurzer was described in principle, and claims the advantage over the more usual types of being provided with automatic line up. This it does by the use of a second beating oscillator and A.G.C. circuits.

The ordinary 4 aerial system was used for this job.

The "aligning" oscillator is arranged to have a frequency approximately 2 Kc/s away from the R/F to be D/F'd and an amplitude at least 10 times as great as the incoming signals on either channel. The A.G.C. Voltage is therefore controlled by the amplitude of the aligning oscillator, which is fed equally into both channels. D/F inaccuracies due to line-up are therefore eliminated. The phase relation is satisfactory providing the alignment between the channels is not so bad that the signal in either channel is off the linear part of the phase characteristic of the amplifiers.

Sensitivity is adjusted by altering the output of the aligning oscillator.

Two refinements are used in practice:

1) The aligning oscillation is obtained from the common L.O. by beating it with a 2 Kc/s oscillator.

2) A form of discriminator is used to black out the trace if the receiver is tuned off the linear part of the characteristic. No circuit details were available.
INTERROGATION REPORT OF

Dr. Kramer
Dr. Goldman

OF LOENZ AT LANDSHUT 2/6/45

INTERROGATED BY: S/Ldr. B. A. Sharpe.

SUBJECTS:
1) Blind Approach
2) Automatic Blind Approach
3) Automatic Control V2.

BLIND APPROACH

Dr. Kramer stated that Lorenz had kept to their original dot-dash system and had no intention of changing. A change of system during the war would not have been acceptable to the German Air Force in view of the large number of aircraft installed with the present type of equipment.

In the opinion of Dr. Kramer, the Lorenz Blind Approach system had the following advantages over other systems:

1) The simplicity of the aircraft equipment. If aural indications were used a simple receiver was all that was necessary in the aircraft.

2) Reliability whether phones or kicking meter was in use it was always obvious to the pilot as to whether the apparatus was working or not.

Dr. Kramer admitted that the interpretation of dot-dash signals was sometimes difficult to a tired pilot but did not consider this serious. He considered that, while a meter presentation either kicking or steady reading was useful as a check, aerial indications to the pilot were the most satisfactory for Blind Approach.

A list of the types of equipment that had been designed for the Lorenz Blind Approach System was then given as follows:

GROUND TRANSMITTERS

There had been three types of ground transmitter.
Type A.S.J. This was the original Lorenz design. It operated...
over a frequency band of 30 to 33 Mc/s had a power output of 500 watts and was grid modulated.

**Type A.S.2.** This transmitter was built by Telefunken. It had a similar specification to the A.S.1, but was anode modulated.

**Type A.S.3.** This was the most recent design of transmitter produced by Lorenz. It had a frequency band of 30 to 34.8 Mc/s was anode modulated and had a power output of 120 watts.

---

**AERIALS**

The original tried dipole system, Type AFN1 was now obsolete. It had been replaced by the type AFN2. This had the same dipole arrangement but was now mounted in a transported frame.

---

**ARICRAFT EQUIPMENT**

The original Lorenz aircraft receiver was used up to the end of 1940.

This consisted of a straight receiver unit known as unit type ERL1 containing the RF amplifier and detector only and a unit type ERL2 containing the low frequency amplifiers and marker beacon receivers. This unit provided outputs of meter and headphones. The equipment consisting of the units ERL1, ERL2, and pilots meter etc. was known as the Func ERL1. The ERL1 was replaced by a superheterodyne receiver type ERL3. This was used with the amplifier unit ERL2 to form the complete equipment Func B13. Originally the receiver type ERL3 had normal type tuning but this was later replaced by the ERL3(f). This was the same design of receiver but was fitted with a remote control giving a selection of 32 preset channels. Circuit stability relied on temperature compensated circuits using condensers of negative temperature coefficient.

More recently it has been required to use the ERL3 (f) with the Hermione Talking Beacon. The frequency response of the ERL3 was not suitable for speech as it cut off above 1700 c/s. A switch has therefore been fitted to the receiver so that its audio characteristic can be altered when required for the reception of speech.

The remote control system used is the same as that in the FUG16 Communication equipment. The equipment was designed that for a fighter aircraft installation consisting of the Func ERL3(f) and the FUG16 the pilot would only have two knobs to operate. One was a four position switch for communication Homing, Hermione, and Blind Approach. The second knob was a frequency selector. Communications and long distance homing were provided by the FUG16. Hermione and Blind
Blind Approach by the modified Funk BL3(f).

AUTOMATIC BLIND APPROACH

Work had been carried out on the automatic control of aircraft on beams. This had only been carried to the end of the experimental stage and had then been taken over by Peenemunde. Only automatic approach had been attempted and automatic touch down had never been contemplated.

The general problems of automatic Blind Approach were discussed with Dr. Kramer. He was of the opinion that fully automatic approach was not necessary. He would prefer automatic control in azimuth only giving the pilot control in elevation. To carry out this control the pilot should be provided with either 1) glide path and a Radio altimeter or 2) glide path and range indication from the beacon, or 3) range indication and a Radio Altimeter. His own preference was for a glide path and a Radio altimeter. He considered that even with Radio Aids a safe landing could not be made through a cloud base lower than 50 meters. Method of feeding dot-dash signals into an automatic pilot:

Lorenz had only been involved in the conversion of the dot-dash signals into proportional steady indications. All the work on the automatic pilot had been carried out by Siemens Halscke.

The Lorenz converter unit operated as follows:

In the dot sector the signal varies with time as shown in above diagram. At the same time the average signal level varies due to several causes. Such as contours of the ground, screening of aircraft aerials, movements of the aircraft etc. It is required to compare the signal amplitudes in the periods t₁, t₂ and t₂, t₃ without error due to the variation of mean signal strength. This is achieved by selecting two short intervals of time, t₁ and t₂, which are very close together but on opposite sides of the changeover instant C₂. This comparison is repeated once per cycle and integration of the results gives the steady signals required.

/Originally
Originally it was found that interference could give wrong indications of a change-over time, thus causing a comparison to be made at the wrong instant. This was overcome in the following manner:

During the time interval \( t_1 \) in addition to the normal 1100 c/s modulation a 5000 c/s modulation was put on the carrier. This was of only low percentage modulation (about 10\%). During the period \( t_2 \) the extra modulation was changed to 7000 c/s. Also at 10% modulation. In the converter unit the 5000 c/s and 7000 c/s were filtered out and arranged to operate relays, the action of which indicated the changeover instants. The intervals \( 8t_1 \) and \( 8t_2 \) are defined by timing circuits operated by the relays.

For this work the keying spread of the system had been increased from 1 c/s to 50 c/s.

A very narrow beam system was developed for use with this equipment.

**NARROW CONTROL BEAM FOR AUTOMATIC FLYING**

The aerial system consists of two vertical dipoles placed 40 wavelengths apart. The phase of the currents supplied to these two dipoles was varied at 50 c/s by a rotating condenser system, the details of which Dr. Kramer did not remember. The maxima of the lobes were separate by an angle of 2 degrees. The aircraft equipment could detect an error from the beam of 47 seconds of arc. As the adjacent beams give opposite indications there is no tendency of the aircraft to stray from one beam to the adjacent one even though it is only 2 degrees away.

The system operated on a Radio Frequency that could be varied from 45 to 65 Mc/s, to overcome jamming.

The complete system was covered by the name "Victoria Seistrahl".

The main difficulty with the system was the avoidance of cross talk between the 5000 - 7000 c/s tones and the 1100 c/s tone.

Dr. Kramer stated that Peenemunde had been extremely secretive about the use to which this equipment was to be put.

Most of the flight trials had been carried out by an Air Force test flight. A man by the name of Von Hautville was in charge of this flight. This man who Dr. Kramer believed was now in or near Hamburg had had long experience of this automatic flying.
Most of the equipment development had been carried out by Dr. Johannson at the Lorenz laboratories which had evacuated to either Hamburg or Kiel.

The staff engineer on the project was Mr. Kreuztrager who was in Rechlin. Most information of the detailed design of the narrow beam system could be obtained from Dipl.Ing. Von Uttenthal who was now in Innsbruck, where his father was a Professor.

OTHER SUBJECTS COVERED:

1) Blind Approach Display -

For azimuth guidance Dr. Kramer was of the opinion that the kicking meter was superior to the steady deflection type as the kicking meter attracted the pilots' attention more. He also considered that the kicking system was more reliable as it did not involve balanced filters or amplifiers.

For use with glide path he had no definite opinion on the combined azimuth glide path display.

With regard to the use of range indication on a cathode ray tube, he expressed the very definite opinion that all information must come directly to the pilot and not be relayed by an operator.

GLIDE PATH

There had never been any definite requirement for a glide path in Germany. A system had been installed at Leipzig airport but had been used for experimental purposes only.

The system operated on 33 mc/s and used a vertical dipole array, which was off-set from the runway as shown.
The aircraft flies down an equipotential line. The polar diagram of the array is arranged as shown in order to produce a straight glide path.

Dr. Kramer claimed that the great advantage of the system was that the angle of the glide path could be varied to suit individual aircraft, by choosing different equipotential lines.

This system had been demonstrated in the United States by Dr. Goldman in 1938.

Nothing further had been done on glide path development as far as Dr. Kramer knew.

**FURTHER ACTION**

1) Details of the Victoria Leitzstrahl equipment can be obtained from - Dipl. Ing. Von Ottenthal in Innsbruck.

2) Experience of Automatic Beam Flying can be obtained from Dr. Johansson, who is reported to be in the Hamburg or Kiel area at an evacuation centre of Lorenz.
C. Lorenz A.G. Laboratories, Auerbach, Th., Germany.

D. Lorenz A.G. Laboratories, Falkenstein, Th., Germany.

A. CIOS Team 301 report of investigation 4-5 June 1945 (does not cover complete exploitation of target).

Capt. K.H. Kolks, 0444.100, Sig Sec 12th Army Group, APO.655.
J.M. Riddle, Civilian, X-021854, USSTAF, A2 Technical Intelligence, APO.413.

C.A. Hachemeister, Civilian, 003738, CIOS, APO.413.

B. Description.

1. The Auerbach laboratory is located in the Knoll Building. The Falkenstein plant is in an old warehouse. The Auerbach premises are intact but much test gear and equipment is cached in basements around town.

2. a. Personnel - Auerbach (Appendix A)

   Dr. Christ - Acting Leader
   Dr. Helmut Carl - Engineer

   b. Personnel Falkenstein (See Appendix A).

3. Documents are all intact and available.

C. AEBRACH -

1. Manufactured Klystrons. Designed PUG 200 "Hohentweil" for ASV in 1941. New plans call for change of PRF from 50 to 500 P.P.S., pulse width from 5 to 2 micro-sec and minimum range down to 600 meters. To be used for torpedo or bomb dropping with a computer and for gunnery. Jamming sets were manufactured in small lots.

   Plans are in hand for a new "Egon B" system for fighter control, providing for 20 "Egon B" stations to be operated in conjunction with each Jagadgeschloss station. Egon B will give distance and direction only. The antenna (a system of vertical rods) is to be made by Telefunken in Berlin. Electronic rotation will be used.

   Wavelength 1.2 - 2.4 meters. Pulse rate is 500 cycles. The "Egon B" system requires PUG 25A in the aircraft.

   Two A-type presentation tubes are provided, with three rough range scales covering 0-120, 100-220, and 200-300 km, with a single expanded 10 km "back to back" presentation for fine range and bearing determination.
This system is to replace "Ypsilon" and appears to be an expedient for providing a large number of fighter control stations.

2. Equipment
   a. Klystrons
   b. Hohentwiel FUG 200.

3. This is one of the Lorenz radar and tube laboratories. The tube facilities were recently evacuated from Czechoslovakia. Facilities are not completely set up. Some of the Jagschlose work was done by Lorenz engineers in Berlin whose location are unknown.

4. Information was obtained that General Hartini, Luftwaffe Air Ministry (Berlin) is familiar with the German long range airborne electronic program. He should be found and interrogated if possible. The team was advised that Dr. Rottgardt - Dir. Gen. of Telefunken was also Pres. of Industrial Radar Commission in Berlin. He should also be located. 

D. FALKENSTIN

1. This laboratory employed about 600 people. They were concerned with research and design only of radio and radar for the Luftwaffe. A new universal interrogator and responder was developed for aircraft. Details of this equipment has been obtained by CIOS teams who previously covered this target.

   Working on Time Modulation trans/receivers known as FUG 13 (2.5 - 4.0 meters) and FUG 139 (70 - 100 Kc). FUG 139 was to have been ready for production in 3 months. Its use is for fighter directing. Pulses modulated in time phase by voice are coded into groups of three, each group covering 30 microsec. By altering the spacing of the center pulse within the 30 microsec group a selective calling system is realized. Seven channels can be provided on one radio frequency.

   Pulse width is 1 - 2 microsec.
   Average PHP 6000 cycles.
   Audio range 300 - 2500 cycles.
   Max PHP displacement ± 1500 cycles. A short summary is attached as Appendix C.

   A circuit diagram and description of an anti-jamming attachment developed for Ypsilon is shown in Appendix B. Trials of this attachment showed it to be very effective, but the development came too late in the war to be of any use.

"Frishling" is "Neuling" plus three receivers covering 50-80 cm, 9 cm and 3 cm. It permits interrogation by FFI (Berlin) equipped aircraft. This device is planned on paper only.
Fug 24 is new at 30-45 kc. Several hundred models were produced to date.

Pulse Time Modulation work also done at Siemens, Telefunken, Lorenz (Berlin), Dr. Jenimel at Munich, and LMT/Lyon.

Fug 21A "Erstling" responder beacon developed by Gema (Berlin) is built at the Brand Plant at Falkenstein. This plant was not visited.

Fug is Telefunken navigation system. Air equipment consists of ARI receiver, amplifier and Teleprinter. Rotating ground beacons give signals to the teleprinter which indicates bearings.

Fug 120A uses a newer and smaller Hellenschreiber.

Posen I is a single channel 100 watt ground portable transmitters 1-100 in three bands for AM-FM-Hellschreiber, Telegraph and Facsimile.

Posen II is a 150 watt set similar to Posen I except covering a wavelength of 25-200 meters.

Fug 224 (Berlin) antennae are made at Kallassen/Th. (Klassplant). A ground jammer was built for use against the Allied air navigation system called "Rotterdam" by the Germans. The code name for the jammer was "Feuermolch". The following are characteristics of the jammer.

Peak power output 600 watts
Pulse modulation frequency 5,000 and 100,000 pps.
Pulse mark/space 1/10 to 1/5
Valve "Schreiben Kohre"
Wavelengths 8.8 - 9.8 cm.

A total of 20 sets were built with the lower pulse rate - 5,000 pps. These were not successful. One set was built with the higher pulse rate and under trial was found to effectively jam at a range of 100 km from the aircraft.

A single jammer was also built for use against air voice communications equipment, with the name of "AEG Herverten". This set had the following characteristics:

Frequency 96-136 mc/s
Power output 50 watts
Modulation FM

A jammer operating on 3.2 cm wavelength is under development, using a magnetron (Telefunken LMS 32). The power output is expected to be about 1 Kw at low pulse rates.
The "Stuttgart" 10-channel decimeter communication equipment was designed and built by Lorenz in 1940. A total of 220 sets were built and all were supplied to the German Army. This equipment is mobile and operates on wavelengths of 21-24 cm. A new model "Stuttgart II" has been completed and two sets have been sent to the Army Test Station at Blanken near Gardelogen. The new sets have improved signal/noise ratio and are provided with facilities for use with all carrier equipment employed in Germany having carrier frequencies up to 300,000 c/s. The maximum range without relay stations is about 40 km.

FuG Wobbelbiene is a 50-70 cm ground beacon scanning the frequency band. Puts out 10 watts of CW for 1/2 second when Allied 50-70 cm pulses hit it. This jammer was little used.

Antenna work. They have developed the communications antennas for jet fighters. Scale models and frequencies were used for designing these antennas.

2. Equipment of interest.
   a. Centimeter Lab.
   b. FuG 224 (Berlin) arranging to evacuate thru T Branch
   d. Klystrons (Made at Auerbach).
   e. Time modulation gear.
   f. Antenna scale models for jets.
   g. FuG 13 Time modulated sets. Could be test flown after about 3 weeks work.
   h. FuG 24 New T/R with DF.

3. This is the Lorenz Company research laboratory. Nearly all personnel are available. Herr Schmit is Director. Dr. Kloepper is engineer in charge. Their work was done exclusively for Luftwaffe. They are very co-operative.

4. Required Action.
   a. Suggest that the time modulation set be completed and a test flown. This principle of communication is important.
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|             | Mess. - Entw.   | Lembeke   |                |
| 447         | Navigation T.A. | Tonisch   | 609            |
| 448         | Forschung       | Dr. Muller/Beneske | 516       |
| 457         | Funkmess-Ger.   | Dr. Christ | 523            |
| 458         | Fernseh-Labor   | Dr. Schmider | 560          |
| 460         | Fernseh-T.A.u. Verkl | Kopp |                |
| 461         | Forsch-lat.     | Brunswig  |                |
| 469         | Werkluftschr.u.N.S.B.O. | Lerner |            |
Attachment is effective against pulses introduced into receivers from FM jamming sweeping over a wide band, such as has been used by the Allies in the band 38-42 mc/s. The device functions to reduce the sensitivity of the receiver during the time the jammer frequency is within the pass band of the receiver. If the Y-signal is of greater strength than the jamming it is necessary to disconnect the attachment by means of switch "A".
Summary of Time Modulation

Principle: Transmitter need only send pulses, great field strength. Modulation is based on the interval between the pulses, the impulse frequency being subjected to frequency modulation. On the receiver side it is possible to employ limiters (Begrenzer) and gate valves (Schwellen?). Rectification is effected by normal audio stages, the number of pulses being integrated. In order to eliminate interference, the single pulse is converted into a triple pulse by a time delay network (Laufzeitkette?) on the transmitter side and the interval between the pulses serves as a key.

The receiver is also fitted with a time delay network and a gate valve only opens up with the coincidence of the three pulses, these having arrived at the correct interval. Thus the receiver will only receive properly spaced triple pulses. It is also possible to provide multiplex reception by transmitting several messages through the same high-frequency channel with different pulse spacings. In this case it is only necessary to use several gate valves (or coincidence tubes) after the delay circuit. The triple impulse renders the system extremely free from interference. An impulse frequency of 6000+1500 c/s has been used and the impulse frequency is swept at a rate of 300–2500 c/s determined by the audio-frequency waveform. The radio-frequency was in the band 2.5–4 meters.

Transmitter Diagram I

The modulator consists of two parts:
1. FM generator (tubes 8,7,6)
2. Pulse generator (tubes 5,4,3,2,1.)

The FM generator consists of a frequency modulated oscillator of fundamental frequency of about 1 mc. (tubes 8,7) with a maximum frequency range of 10 kcs, and a stable oscillator, tube 6, whose frequency can be set at 6.8 or 15 kcs. from the frequency of the first oscillator. By superposition at tube 5 a carrier frequency of 6.8 or 15 kcs. is produced having a maximum frequency range of 10 kcs. This carrier is filtered, amplified and converted into a pulse of approx. 2 microseconds by the action of tube 2 of the impulse generator. This pulse is produced in the oscillatory circuit by the differentiation of the anode current in stage 2.

Receiver Diagram II

The receiver consists of four parts:
1. High frequency section 100–150 Kcs. tubes 1,2,3.
2. I.F. section, 20 mcs. range 600 Kcs. tubes 4,5,6,7.
3. Impulse amplifier and decoding section tubes 8,9.
4. Demodulation section tubes 10,11,12,13.

The pulses are received in the normal manner and demodulated in tube 7 and subsequently amplified and decoded in tube 9. Tube 9 is insensitive to any single pulse, but responds by emitting a single pulse upon receiving a definite group of three pulses which can be set at the delay circuit. (Laufzeitkettes). From the series of pulses thus obtained, the fundamental wave is extracted, (tube 10) limited, (tube 11), and demodulated (tube 12), followed by low frequency amplification (tube 13).
C.I.O.S. Evaluation Report

1. **Type of target**
   Associated company of Luftfahrtgeratwerk Hakenfelde, Berlin - Spandau, of the Siemens combine. Exists solely as a testing, repair and redistribution centre for aircraft instrument electric motors and radio altimeters.

2. **Target No.** Not known

3. **Full title.** Montage Werkstatt, Lichtenfels.

4. **Location.** At Lichtenfels in Oberfranken (50°N, 10°E).
   a. School - Kronacherstrasse 32.
   b. U-Barracks - at edge of town.

5. **Condition.** No bomb damage but badly looted.

6. **Evaluation of discoveries.**
   Stocks of small electric motors, actuating solenoids and small relays are intact. Samples were brought back and passed to Elec. Engineering Dept. A number of refrigerators, thermostats and vibrating tables for testing components and instruments are intact. Details were obtained of balancing machines made by Carl Schenck, Darmstadt. The firm was engaged on the repair and testing of radio altimeters manufactured by Luftfahrtgeratwerk Hakenfelde - details obtained.

7. **Documents evacuated**
   Catalogue of small electric motors.
   Handbooks on balancing machines.
   Handbook on radio altimeter.

8. **Equipment evacuated.**
   Samples of electric motors.
   3 vibrating tables (to be forwarded to R.A.E. by 19th U.S.A. Tac. Air Force).

9. **Conclusions**
   Factory is being guarded until decision obtained on usefulness of stocks of electric motors and radio altimeters.
TARGET INSPECTION REPORT
(Submitted and signed in Duplicate)

ORGANIZATION CIOS GROUP NO. 1

TARGET NO. Target of Opportunity DATE May 16, 1945

SUBJECT: OFFICIAL TARGET INSPECTION REPORT

TO: A.C. OF S., "G-2" HEADQUARTERS NINTH UNITED STATES ARMY, APO 339.

1. THE FOLLOWING OFFICIAL TARGET INSPECTION REPORT IS SUBMITTED AS:

TARGET: Siemens-Reiniger-Werke A/G

ADDRESS: Rudolstadt

WHICH WAS INSPECTED DURING THE PERIOD May 16, 1945 TO May 16, 1945,
UNDER YOUR AUTHORITY TO INSPECT TARGET NO. DATED TO

1945.

2. A COMPLETE INVENTORY OF ALL DOCUMENTS, "EQUIPMENT", MACHINERY", ETC.
REMOVED FROM THE TARGET BY REASON OF SUCH INSPECTION IS INCLOSED
HEREWTH, AND THE PROVISIONS OF PAR II, SEC II, ADMINISTRATIVE
MEMORANDUM NO.51, "SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE"
DATED 18 MARCH 1945, HAVE BEEN COMPLIED WITH.

(This report should contain sufficient detail to inform
other Allied specialists of the intelligence available
at this target)

1. This plant manufactured a complete line of X-ray tubes, and
valve tubes for use in X-ray equipment. They have also
recently manufactured amplifier tubes for use in telephone
systems, surge arresting tubes for protecting communications
lines, several types of small gas filled detectors for use in
"timing" circuits for bombs and shells, and fluoroscopic
copies and intensifying screens.

2. This target is the largest X-ray tube development and manufac-
turing organization in Germany. They recently employed
approximately 550. The plant is very well equipped and
there has been no bomb damage and practically no damage by
looting.

3. A number of tubes were found that were superior in certain
respects to tubes now being manufactured in the United States.

NAME C.R. Biersley RANK Civ ASNN-003982
ADDRESS U.S. Embassy FEA APO 413

A-000778
4. The following personnel was interviewed:

Dr. Albrecht Wolfel, Chief Director
Dr. Josef Hartmann, Production and Research Manager
of Chemical Dept.
Dr. Theodor Zimmer, Head of Physical Research Laboratory
Mr. Walter Dohler, Business Manager
Mr. Hans Frank, Sales Manager

Dr. Werner Jacoby (Dr. Jacoby was in charge of all research, engineering, and development work for all tubes, except X-ray tubes and value tubes for X-ray equipment, that were manufactured by any branch of Siemens and Halake. Siemens and Halake owns Siemens-Reiniger, and has many branch plants. Dr. Jacoby recently came to Rudolstadt, from Vienna).

All of the above men were exceedingly cooperative, and a considerable amount of seemingly valuable information was obtained from them regarding:

A. The entire German X-ray industry.

B. Recent magnetron and other U.H.F. tube developments by Siemens-Halake.

C. The names and addresses of a number of physicists who have recently been doing work on isotope separation.

D. The possible location of a number of men who have been in charge of recent U.H.F. developmental and experimental work.

The above matters will be covered in detail in the report to be submitted to CIOS Headquarters in London.

5. The following items were taken from the plant for further examination or for inclusion in the final CIOS report.

A. Eight tubes, each of which were of special interest.

B. A detailed write-up by Dr. Hartmann of their processes for manufacturing fluoroscopic and intensifying screens.

C. Copies of assembly drawings of all of their tubes. (They manufacture something in the order of 100 different types of tubes) Rating charts for each tube.

D. Miscellaneous additional engineering information including write-ups of special processes by Dr. Zimmer and Dr. Jacoby.
E. Samples of all of their fluoroscopic and intensifying screens, including special phosphorescent screens for "blackout" use.

F. Photographs were taken of all of the different types of tubes they produce, and also of a number of their special processing and manufacturing set-ups.
Note: Only copies of drawings, etc., were taken.
All originals were left at the plant.

6. These people say that they have enough material on hand to continue manufacturing tubes for medical use for the next seven or eight months. They are anxious to do this. Most European hospitals and clinics have X-ray equipment that uses tubes of the type manufactured by this plant and generally speaking, cannot use tubes manufactured in the U.S. or England. Accordingly, it would seem desirable for this plant to operate on, at least a limited basis.
TARGET INSPECTION REPORT
(Submitted and Signed in Duplicate)

ORGANIZATION CIOG GROUP NO. 1

TARGET NO. Target of Opportunity DATE May 19, 1945

SUBJECT: OFFICIAL TARGET INSPECTION REPORT
TO: A.O. of S. "G-2", HEADQUARTERS NINTH UNITED STATES ARMY, APO 33

1. THE FOLLOWING OFFICIAL TARGET INSPECTION REPORT IS SUBMITTED ON:

TARGET: Siemens-Reiniger-Werke A/G

ADDRESS: Erlangen (15 Kilometers north of Nuremberg)

WHICH WAS INSPECTED DURING THE PERIOD May 17 1945 May 19 1945,
UNDER YOUR AUTHORITY TO INSPECT TARGET NO. DATED TO 1945

2. A COMPLETE INVENTORY OF ALL DOCUMENTS, EQUIPMENT, MACHINERY, ETC.
   REMOVED FROM THE TARGET BY REASON OF SUCH INSPECTION IS ENCLOSED HEREWITH,
   AND THE PROVISIONS OF PAR.14, SEC II, ADMINISTRATIVE MEMORANDUM
   NO.51, "SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCES", DATED
   18 MARCH 1945, HAVE BEEN COMPLIED WITH.

   (THIS REPORT SHOULD CONTAIN SUFFICIENT DETAIL TO INFORM OTHER ALLIED SPECIALISTS OF THE INTELLIGENCE AVAILABLE
   AT THIS TARGET)

1. This plant designs and manufactures X-ray apparatus and other
   electro-medical equipment. It is the largest plant of its kind
   in Germany. It recently had about 3,000 employees. During the
   last several years it has also manufactured, but not designed,
   some components for aircraft radio, instrument and control
   equipment.

2. There has been some damage by looting, but no bomb damage to
   this plant.

3. The following men were interviewed:
   - Dr. Max E. Anderlohr, Chief Director
   - Dr. Johannes Patzold, Chief of Research
   - Dr. Theo. Schmer, Sales and Service Manager
   - Mr. Carl Lasser, Technical Director of Sales & Service
   - Mr. Kurt Bisdhoff, Chief X-ray Development
   - Mr. Karl Silbermann, Liaison between Erlangen and
     Rödelstadt plants
   - Dr. Albert Marcus, M.D. Specialist on electro-medical
     techniques
   All of the above men were very cooperative.

NAME C.B. Horsley RANK Civ ASN 1003282
ADDRESS U.S. Embassy FBA APO 413
4. A considerable amount of information was obtained regarding:

A. Their latest developments in X-ray equipment, one and six meter high frequency medical equipment, meter locators, shock therapy equipment, supersonic therapy equipment, and Betatrons.

B. The location and general description of the most important Betatron, cyclotron, Van de Graaff generator, and mass spectrograph installations in Germany and territory that has been occupied by the Germans.

C. Recent German research in atomic physics; particularly regarding isotope separation.

D. The possible present location of a number of German physicists and directors of research programs.

5. Removed from this plant for further study:

A. Copies of wiring diagrams, assembly drawings, photographs, technical and sales bulletins, copies of all patent application drawings since 1938, and data regarding the corporate setup of all Siemens companies. Only copies were taken; all original documents were left in the plant.

B. A recently developed high tension coil of unusual design.

C. Recently developed (by Patin in 1943) Stabilizing Unit for aircraft gyro-compass, and several other recently developed component assemblies for aircraft controlling devices.

6. These people are anxious to resume production of X-ray and other electro-medical equipment. Because of the need of European hospitals for replacement, and also additional equipment, it seems that the production of this equipment, at least on a limited scale, would be desirable.
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Investigating Team:
M/Col. G.L. Hunt - Party Leader.
Mr. C.A. Hackemeister - U.S. Civilian.
1. **Introduction**

The Siemens Halcke factory at Aashe was investigated on 15th May, 1945. The plant occupied Hanneman Mills and was in good condition. The investigating team were accompanied by Alfred Meier, manager of the factory, who was quite willing to give any information required.

Siemens Halcke had occupied the Hanneman Mills since May 1944 but they had encountered considerable difficulty in assembling their plant, which was intended mainly for the production of 4-channel carrier telephone equipment. As a result, the amount of production which had taken place was practically nil. A subsidiary activity, although one where more manufacturing progress had actually taken place, was the manufacture of test apparatus.

2. **4-Channel Carrier Telephone Equipment**

The whole of the ground floor of the factory was taken up with the machinery, wiring and assembly benches, stores, etc., necessary for the manufacture of carrier equipment. Arrangements were such that one type of equipment could be produced, this being a 4-channel duplex system, operating up to a maximum frequency of 26,000 c/s. The layout and rack assembly of the equipment was very similar to that made by Western Electric Co. some years ago and known as their Type C carrier system. Although the members of the investigating team cannot claim to be carrier telephone experts, there appeared to be no unusual features in the design of the Siemens Halcke equipment. This opinion is based on a rather superficial examination.

About half the upper floor of the factory was taken up with engineering offices. In these offices there was a large number of files containing the manufacturing details of the carrier system with which the factory was involved. These files were solely concerned with manufacturing drawings and similar information, and there was no indication from them that development work had taken place at Aashe.

A small test room contained an equipment occupying three or four racks on which overall tests of completed equipment could be made. This test equipment comprised the usual variable frequency oscillator and power level indicators and was quite normal except for one feature, which allowed for the automatic recording of gain or loss/frequency characteristics. This equipment had been brought to Aashe from the Dutch border and had not been installed very long. It had never really been put to use and Mr. Meier was not able to say very much about it. It does not justify very detailed examination from a technical point of view.
3. **Test Equipment and Development.**

Much of the test equipment that was available was of the type required for ordinary telephone and carrier telephone engineering, that is to say it included attenuators, level indicators (power output meters), capacitance bridges and resistance bridges, but a good deal of work had taken place on the development of wavemeters and frequency meters. These extended in range from carrier frequencies up to 1,000 x 10^6 c.p.s. and there was one additional wavemeter covering the range 2,600-3,200 x 10^6 c.p.s. This wavemeter could not be thoroughly examined for method of construction but appeared to work on the principle of varying the length of a section of waveguide and examining the standing wave pattern. Its accuracy was not outstanding and the instrument did not appear to be worth any detailed examination.

For checking purposes there was installed a standard frequency measuring equipment, using quartz crystal controlled oscillator as the reference standard. This equipment was quite standard in type and construction.

4. **Other Developments.**

The firm were experimenting with oscillators operating in the region below 10 cms., for which purpose they were using split anode type magnetrons and klystrons. The type of magnetron in use was the HD2W12 which they claimed to be using at 3 cms., but it should be noted that in the Telefunken rating for this valve it is intended for operation over a range centering about 9.5 cms. The klystrons in use were the Kly.1 and another valve having no type number but obviously of very experimental type. The Kly.1 is stated in German literature to be a copy of the British 9 cm. klystron, and the sample which was being used at Asche was very similar to the British CV.67. The experimental klystron had been made for operation in the 3 cm. region and brief notes which were available showed that it had been operating at a wavelength of 3.95 cms. with about 3 kV. on the anode and a reflector voltage of -50 to -110 V. From all appearances the experiments with these magnetrons and klystrons had not progressed very far, and as nothing very novel was being attempted the work did not justify very close investigation.

5. **Other interests and personnel associated with Siemens Halske, Asche.**

Alfred Meier gave the following names of senior individuals in the Siemens Halske organisation:

Technical Manager - Mr. Rabanus, last heard of at Siemensstadt, Berlin.
In charge of technical development - Mr. Hoffman, also of Siemensstadt, Berlin.

All tests on the wavemeter covering the range 2,800-3,200 x 10^6 c.p.s. had been made by a Mr. Becker, who was no longer at Asche but was to be found at Hoffmannstrasse, 51, Munich.

The experimental klystrons found were made by Osram and Siemensrohrenwerke, both in Vienna.

6. Documents evacuated through army channels.

Samples of the RD2Md2 and the klystrons being used for experimental work.

2nd July, 1945
HEADQUARTERS
THIRD UNITED STATES ARMY
INTELLIGENCE CENTER

25 May, 1945

SUBJECT: CIOS Team Report.

TO: Commanding General, 12th Army Group, G-2, "T" Branch, APO 655, U.S. Army.

1. CIOS Team No. 161
   Major A. Oxford       British M of S
   Captain F.S. Caplin   British M of S
   Captain E.T. Bann.    British M of S
   Captain N.G. Stewart  British M of S
   F/Lt. R.G. Silversides British M.A.P.
   F/Lt. B. Snowden      British M.A.P.
   F/Lt. D.M. Johnston   British M.A.P.

2. Target
   Siemens Halake, Otto Hinnemann Textile Mills, Asch.

3. Date of Investigation
   21 May 1945

4. Persons Interviewed
   Dr. Alfred Mayer, Adolf Hitler Strasse 61, Asch.

5. Information Obtained
   This establishment has production facilities only.

   The only equipment that appeared to be in quantity production, were the TFB3 and TFB4, respectively 3 and 4 channel carries frequency sets. They are conventional multichannel telephone systems.

   Dr. Mayer appears to be the production manager only, and has little technical knowledge of the equipment produced.

s/A. J. Oxford

t/A. J. OXFORD
Professor Georg Siemens.

Investigators: Mr.R.M. Whitmer O.S.R.D.
Capt. R.Snowden R.E.D.E.

Date of Visit: 9-6-45.

Address: Litscher Str., 10, Uberlingen, Boden See.

Interrogation: Prof. Siemens was once a part-time Prof. of engineering at Munster. During the war he has been in the Production and Administrative Dept. of Siemens Halske in Essen. This firm has been concerned with the manufacture of telephone and measuring equipment. No Radar or Radio work is done at Siemens Halske.

Siemens Halske had research laboratories in both Essen and Berlin.

From 1942 onwards Prof. Siemens had an Institute for training women as technical assistants both for design and constructional work.

In addition to telephone work Siemens and Halske did teletype and audio frequency work for broadcast stations. They had no contracts for military equipment.

It was apparent therefore that Professor Siemens had been concerned purely with the production of standard equipment and had no information of interest to Group 1.
Target: Opportunity.

Name: Siemens Schuckert.

Location: Pretzfeld, the Schloss, N.E. of Fachheim.

Personnel: Dr. Hans Prinz, head of laboratory.

Dr. Claussner, chemist
Bruckmann, technician
8 lab. assistants.
Dip. Ing. Koelbl, head of sales and repairs.
Wolff, head of sales.
Pohle, head of repairs.
25 other people.

Description:
Part of power transformer plant of Nurnberg, which was bombed out of Nurnberg and came to Pretzfeld at the beginning of 1944.

The main plant that this served was engaged in production of transformers ranging from 1 kVA to 100,000 kVA, for 50 cycle power services. In addition it handled repair of installations. The portion of the plant located at Feltzfeld comprised 3 departments.

1. Sales
2. Installation and Repairs
3. Transformer material testing laboratory

The installations and Maintenance departments, under Dip. Ing. Koelbl, deals with

Electroacoustic installations.
Telephones and Sound distribution systems for factories, concert halls, theatres, stadiums etc.
Temperature control sets.
Sound recording systems, gramophone records and sound tracks in films, Cinema projectors and microphones.

They claimed to have developed a gramophone record capable of recording and reproducing a frequency range of 30 to 7500 c/s.

The major portion of work at present is repairs for U.S. Army.

The Material Testing Laboratory under Dr. Hans Prinz was engaged in making routine tests for quality control of raw materials used in transformer construction. Research was being carried out on non-inflammable cooling fluids for power transformers. Siemens apparently still used nothing but flammable mineral oil in spite of their knowledge of the development of non-inflammable "Pyranol" and "Inerten" in U.S.A. They did not favour these new fluids because they are not permanently inert chemically. Dr. Prinz looked on glass as the coming material in conjunction with non-inflammable high temp. cooling fluid for the insulation of power transformers. No work has been done on silicon compounds.

Siemens has a patent exchange agreement with Testhouse.

The laboratory was equipped with the normal complement of material testing instruments.
INVESTIGATORS SUMMARY

16 July, 1945

TARGET Siemens Halble

LOCATION Munchen

Date 9th July, 1945.

REPORT

Interviewed Dr. Schnesderman and Engineer Thilo.

They worked on the design of Radar test equipment at Asche for 30, 10 and 3 cm radar equipment. This line of equipment covered frequency meters, Power meters, Signal generators and range calibrators. They had developed a special thermistor which they claimed to be superior to any design known to them. This thermistor was made by mixing a 50-50 mixture of Selenium Oxide and Thalagen (a dried fruit powder) with distilled water until a rubber like consistency was obtained. This mixture was then extended into a 4 mm dia. rod which centered in a hydrogen atmosphere. Lead wires were attached by the use of silver paste. The unit was mounted in a glass envelope which was evacuated to the 10^5 mm.
TARGET Robert Bosch

LOCATION Stuttgart

Date 7th July, 1945

PERSONS INTERVIEWED Dr. Dipper and Dr. Klingler.

SUBJECT Glass impregnated fabric used as substitute for mica to insulate commutator segments in motors and generators.

REPORT

The material is obtained by mixing china clay with Bakelite varnish and using this mixture to impregnate glass fabric. The impregnated fibre is pressed between heated platens under a pressure of 250-Kg. per sq. cm. at a temperature of 110 deg. C. for 5 mins. This material can be produced to close thickness limits. The Bosch Co. consider it more satisfactory than Mica for insulating commutator segments - It is non-hygroscopic, has high insulation resistance and electrical breakdown characteristics and is highly stable mechanically under all temperatures up to 300 deg. C.

F. E. Henderson.
TARGET
Robert Bosch Co.

LOCATION
Stuttgart

INTERVIEWED
Dr. Zipper and Dr. Dorn

SUBJECT
Metalised paper used in fixed condenser.

REPORT

This type of condenser is about 5/8 size of conventional paper condensers, due to the elimination of metal foil. It also has self-healing properties so that the electrical breakdown does not destroy the condenser for further use. The base paper used is Kraft paper .0004" thick. This paper is varnished on the side to be metalised with a coat of Cellulose Nitrate Varnish in the order of three microns in thickness. This is done in a very complicated machine which represents a considerable development of expense. The metal coating is also of the order of three microns in thickness and is zinc. This coating is vapourised on to the paper in vacuum of .1 mm at a speed of 6 meters per sec. This machine is also a very expensive development project. The remainder of the process is normal in the manufacture of paper condensers.

Dispersal plant located at Tubingen.
EVALUATION REPORT
(C.I.O.S. Trip No. 591)

1. **Type of Target**  
   Manufacture of metallised paper capacitors.

2. **Target Number**  
   Not known.

3. **Full Title of Target**  
   Robert Bosch.

4. **Location**
   (a) Stuttgart. Offices.
   (b) Ebersbach. Dispersal plant for manufacture. Housed in what was previously a textile mill.
   (c) Goppingen. Research laboratory.

5. **Condition of Target**
   (a) Major part bombed out. Some offices intact.
   (b) Intact. Plant is being dismantled as the premises are being reconverted to the textile mill.
   (c) Intact.

6. **Evaluation of Discoveries**

6.1 **Production**

The Bosch process for the manufacture of metallised paper capacitors has apparently satisfied German requirements for some years utilising plant with an output of approximately 7000 capacitors per day.

Much of the plant is complicated and expensive and shows no advance on known technique.

6.2 **Paper**

About 50% of the capacitor tissue was supplied by Schoeller and Hoesch, Gernbach in Baden, and 50% by Julius Glatz, Neidenfels. (see respective evaluation reports).

Only Kraft tissue is used by Bosch.

6.3 **Lacquering**

A collodion based lacquer is applied to the tissue before metallising. The lacquer was supplied by Lechler, Feuerbach (see evaluation report).
The lacquering is said to give a 50% improvement of insulation resistance of the completed capacitors as compared with capacitors made with unlacquered paper.

6.4 Metallising

A thin layer of zinc is applied to the tissue by evaporation in vacuo.

6.5 Capacitor assembly

This follows standard practice. One or two points are of interest such as the use of "E" wax, made by I.G. Farben, for impregnation; use of spot welding and vapourisation of copper for sealing the cans and use of metallised ceramic terminals.

6.6 Laboratory

An electron microscope, electron diffraction grating and an X-ray apparatus were available for tests. The microscope was used for study of surface films, and was arranged to take stereoscopic views. The grating and X-ray apparatus were used for studies of crystal structure.

Life tests and "tropical" tests were made on pre-production samples. Tests indicated that ceramic terminals were superior to glass, the latter made by Schott and Genmosee, Jena.

7. Documents etc. evacuated

Following documents brought back by team leader:

Performance Specification of "E" and "Z" waxes.

" " " " metallised paper capacitors.

Following evacuated through FIAT. at Frankfurt:

Samples of "E" and "Z" waxes.

" " capacitors and components parts.

8. Other Interest

Laboratory at Soppingen contained plant for manufacture of electrolytic capacitors.
9. **Conclusions**

The use of Kraft tissue may offer advantages over rag tissue. The improvement in performance obtained by lacquering the tissue confirms results already obtained in the U.K. The metallising process is complicated and it is not felt to possess any particularly novel feature.

Some of the processes were evolved purely as a result of an anticipated shortage of tin.

10. **Investigating Team**

- 7/Lt. J.J. Borgars, M.A.P. **Leader**
- Capt. J.H. Richards, M.O.S. **Deputy Leader**
- Mr. K.G. Brereton, M.A.P.
- Mr. J.E. Cotton, M.A.P.
- Mr. R.A. Grouse, M.A.P.
- Mr. C. Hunt, M.A.P.
- Mr. J.P. Scarrett, M.A.P.
- Mr. C.M. Whiley, M.A.P.

10th August, 1945
TITLE OF TARGET: Her Gunther Breukopf.

LOCATION: 28 Braumweg between Sulldorf and Blankenese near Hamburg.

DATE OF VISIT: 19th July 1945.

REMARKS: Herr Breukopf until the end of the war was employed by Blaupunkt in their factory in Berlin-Wilmersdorf, Forckenbeck Str 9-13. He had been engaged most recently in the development and production of Feuerland models 1-6, these being aircraft RT jamming transmitters covering the 10 to 140 meter bands. Although quite a number had been made and sent to Western Germany he doubted whether they had ever been used operationally.

He had heard of other developments of Blaupunkt, such as magnetron development, but had no useful technical information to import on these subjects. Dr. Laemmlan and Dr. Hanlo were in charge of the on work and these two he believed had escaped to Saltzwedel.
The engineers at Taufkirchen (32581) are part of the staff of Fernseh G.m.b.H. which was evacuated from the Peenemunde area. They had with them nine railway wagons containing their apparatus and effects; the contents of these are now stored in neighbouring farmhouses. Four more wagons and about 10 members of the staff were lost on the way.

We interrogated Dr. Goetz, Managing Director of Fernseh G.m.b.H. and also a director of Blaupunkt G.m.b.H. a firm which had pre-war connections with British and American firms, (Baird, Farmsworth and A.T. & T) and Dr. Rolf Holler, Technical director of Fernseh G.m.b.H. Both these engineers had been brought to Taufkirchen recently by Lt. Col. French of the weapons Technical staff, No. 21 Army Group who had located them near Kiel. Dr. Goetz has collected together a complete set of the television apparatus described later in the report, and Lt. Col. French is making arrangements to evacuate it, with Dr. Goetz and Dr. Holler.

The principle problem the firm worked on was the production of a television head to mount in a controlled glider bomb or rocket, so that the controlling operator (airborne or on ground, according to the application) could direct the bomb on to the target. They knew very little of the control system used in the bombs and rockets having been kept closely to the television problems. Although they had been allowed to have an engineer present at the trials (carried out by a Luftwaffe Unit) he was not allowed to do any controlling, most of which was done by Prof. Wagner of Herteschel Flugzeugwerke.

The controlling operator directed the bomb by means of a joystick, so that its image seen on the television screen was brought into correct relation with a graticule. They had not decided whether it was better for him to attempt an interception course, or to follow a simple collision course. The bomb was rocket accelerated for about 20 seconds.

Work on the bomb was started in 1939 and experimental work was stated to be 80% complete (about 60 bombs have been dropped). Work on the rocket was started about 6 months ago and no complete equipment has so far been tested. Work on both projects was still going on up till the end of the war.

Detailed information on the engineers at Taufkirchen, and the systems developed by them is given in appendices 1 and 2.
Time base generating circuit. The master oscillator worked on 11,11 kHz and line and frame frequencies were produced by dividing circuits of orthodox design.

Power supply. Power was supplied from a 24v driven motor generator, giving a 500 cy. output. While still attached to the aircraft, the bomb was supplied with power from the aircraft system: in flight it ran on a battery.

Pentode and Neon tube stabilising circuits were used to keep the voltages on the Iconoscope and time base oscillator steady. All tuning up was done on the ground before attaching the bomb to the aircraft.

Miscellaneous notes
(a) Mr. Noller mentioned a system of diagonal scan, in which the X and Y plates were each fed with waveforms of frequencies of the order of the line frequency, but differing by the frame frequency. This avoids the necessity of producing low frequencies for the time base.

(b) The following anti-jamming measures had been contemplated:
(a) use of different frequencies for the send-back in the bands 50-80 and 85-112 cms.
(b) Use of a continuously changing send-back frequency, synchronising transmitter and receiver.
(c) To avoid synchronisation being upset by jamming they had tried using quartz crystals to control the time bases in both bomb and aircraft receivers. This was very satisfactory, but expensive.
(d) Use of a broadcasting station for synchronising.
(e) Dispensing with special synchronising signals and using the whole picture signal, to lock a stable high v oscillator in the receiver. This oscillator then drives the time base circuits. This method was very satisfactory and was adopted as standard.

(2) Aircraft receiver. This followed normal practice and no particular comments are necessary.

(3) Television head for anti-aircraft rocket (Sprotte)
This had to be smaller than the bomb head and had to have approximately the dimensions of a proximity fuse it was to replace.
(14 cm dia. by about 60 cm long), the antenna and battery were separate items. The total weight was about 10 kg excluding power supply, output stage and aerial. In order to save weight and space the definition was reduced to 220 lines, 25 frames, not interlaced. To keep the battery size down a wind generator is used to charge it continuously.

Dr. Goetz did not know in which type of rocket his device would be used.
APPENDIX 3

Control System

The Fernsah engineers had no detailed knowledge of the control system as they were concerned only with the television system.

It was understood, however, that the latest system is as follows:

Three modulation frequencies are used on the 70 cm transmission, 50 k-cys, 100 k-cys, 150 k-cys, of these one if for elevation and one for azimuth. The use of the third is uncertain but may be for exploding the bomb in a particular application where the bomb is exploded from an aircraft other than the one which drops it. This method was to be used when the bombs were dropped on aircraft. In general the bombs are detonated by impact.

The sine wave modulating frequencies are subject to square wave modulation of which the ratio determines the direction of control. In the bomb receiver the square waves are used to produce opposing currents equal in ratio to the square wave ratio, and these currents control directly solenoid-operated air brakes.

To drop the bomb, the bomb-aimer first aims his aircraft at the target. This can be done by radar means if necessary.

He then releases a gyro in the bomb in order to maintain a spot of light on the Iconoscope for use as a synthetic target. A graticule in front of the Iconoscope is controlled by a wind vane to show true line of flight. Both graticule and light spot are therefore televised back to the control aircraft.

The bomb-aimer finally drops the bomb, using a joystick to keep the synthetic target central in the graticule on his G.R.T. Under conditions of good visibility he will, at some stage, see the real target and he can then keep this central in the graticule.

N.B. An engineer named Dr. Rudirt, said to know all about the control system, is returning to Taufkirchen in about three weeks.

The authority on the control system is Prof. Hafter of Hartsche Fiegzeugwerke.
Appendix 4

Stemschreiber

Work on this development was started four years ago, but was stopped. It was re-started about a year ago at the request of the Luftwaffe.

Briefly, it is equivalent to a F.P.I. with a very long after-glow which can be as much as 45 minutes.

The incoming signals are used to modulate an electron beam which describes a rotating radial time base, as in a F.P.I. The beam is focussed on a special screen consisting of a semi-conductor (e.g., aluminium Oxide) backed by a metal plate to which a potential is applied.

A radar echo thus gives rise to a charge at a particular place on the screen. The circuits are so arranged that the same beam is also used for scanning the screen, as in an Iconoscope, and once a charge has been established on the screen it can be scanned many times before the charge is finally removed. The output is then applied to an ordinary F.P.I. It should be noted that the Stemschreiber tube itself is simply a storage device, and is not itself viewed by the operator.