SUBJECT: DEVELOPMENTS IN SOVIET AIR NAVIGATION

[redacted]

[redacted]

the significance of the project is that the Soviets now have something they ardently desired i.e. a navigation system reasonably simple to operate and with good accuracy at long ranges.

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[redacted]

(iii) Comment

[redacted] the Germans set out to combine the best features of Loran and Gee, and that they consider they achieved success. [redacted] 25X1

[redacted] 25X1

Tasks at Zavod 619

[redacted] commenced work at Zavod 619, which was subordinate to the Ministry of Signals Industry, on the 15th January 1947, in company with Paul KOTOWSKI, Helmut TEUSSNER and Gerhard AMMON. They had discussions with fnu. ZADOVNIKOV, the Department Head for Navigation, who made a considerably favourable impression of technical competence. The discussions ranged round the topic of long range navigational problems, and reference was made to the visit to OSW in May 1946 of a Commission consisting of General Vassiliy STALIN (whose father occupied a position of some prominence in the USSR), General BEL YAKOV, the one time Radio Operator who is now considered in the USSR to be an authority on navigational matters, and Professor STIL ERMAN, a member of BELLYAKOV's group, who attended the 1946 P.I.C.A.O. Conference in LONDON. [redacted] 25X1 note: It will be recalled that STEIMEL stated that BEL YAKOV had an experimental long range navigation group at SKAL OVO Airfield [redacted] 25X1 [redacted] After the visit of the Commission to OSW, [redacted] already made a start on the comparison of Loran and Gee, but had not progressed very far up to October 1946. 25X1

[redacted] 25X1

ZADOVNIKOV with his own group copied in Zavod 619 a Loran airborne set which was bought in the USA in 1946. This is referred to later in the report. 25X1

[redacted]

4. Proposed Navigation System

The first point raised [redacted] was the choice of wave length. [redacted] 1900 metres was chosen as being most suitable for a system having a large transmitter base and which must be entirely free from liability to ionospheric reflections. The system, which never received a code name or specific designation, is basically Gee in that it employs a master station and two slaves, each slave 1500 kms from the master, giving a total coverage of 3,000 kms. A double time base with variable amplification for long range fixing and expansion of the pulses for fine measurement is provided. Annexe 'A' shows an explanatory block diagram of the system with the arrangement for control pulse amplification. [redacted] the development of the amplifier for fine measurement was [redacted] main useful contribution. It will be seen that with a main time base of 20 m/s the master (A) P.R.F. is 50; giving two master pulses to each slave pulse, slave P.R.F. is 25. The quartz crystal was thermostatically controlled. Power supply was from an aircraft generator 24v, 400 c/s. Annex 'B' is a series of explanatory sketches showing the principle of pulse expansion and amplification. Annexe 'C' is a sketch of the physical appearance of the airborne receiver. 25X1 25X1 25X1

5. In December 1948 ZADOVNIKOV asked [redacted] if [redacted] ready to stage a demonstration of [redacted] airborne receiver using synthetic ground transmissions. [redacted] gear was set up in ZADOVNIKOV's laboratory [redacted] All other equipment was covered up [redacted] 25X1 25X1

It was on this occasion that ZADOVNIKOV told [redacted] that he had had a US Loran receiver since 1946. After the demonstration, ZADOVNIKOV is [redacted] stated that he preferred [redacted] system to Loran, owing to its comparatively simple operation, and he gave the impression that the system would be taken up officially. After this demonstration, [redacted] receiver was retained by ZADOVNIKOV. With a receiver sensitivity of 5 mc/v, and a pulse width of 250 μ.s. he had now achieved a positional accuracy of 10^{-3} and could match his master and slave pulses to better than 2 μ.s. The valves used were Soviet copies of U.S. types 6 S.J.7, 6 S.N.7, etc. [redacted] the Soviet valves reasonably good but unreliable as regards life. A total of 35 valves was used. The question of aerial type for the aircraft was never raised [redacted] Test gear was of good quality, and came from East Germany and U.S.A. 25X1 25X1 25X1 25X1

6. [redacted] 25X1

match master and slave to very fine limits. This problem was tackled experimentally with interesting results. It was, of course, essential to use T.R.F. as opposed to a super-het receiver, and a straight R.F. set was built consisting of an input filter of 11 stages followed by R-C amplification. In the first stage [redacted] utilised the principle of the Wallmann circuit. An overall amplification of 40 x 10^6 was achieved, using 6.S.N.7's (STIB Note: 6 S.N.7 has the Soviet equivalent 6 H.8.C. and is a double triode). The main difficulties were in the control of pulse amplification to the ratio 1:1400. By this system of matching actual R.F. oscillations an accuracy of 0.3 μ.s. was obtained in the laboratory in 1949. [redacted] 25X1 25X1

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7. No further practical work was done but towards the end of 1950 [redacted] some theoretical work on the possibility of using single side-band. [redacted] the steep leading edge of the pulse would place impossibly high standards of frequency stability on the transmitter tuning circuits. 25X1

8. N.I.I. 330 (Now known as N.I.I. 431, [redacted] 25X1

In early 1951 [redacted] transferred to the Lesnoy division of N.I.I. 330. At the request of the Soviet engineer, Dr. fnu. STARIK, [redacted] made a précis of RICE's work, 'THEORY OF NOISE' which appeared in the Bell System technical ~~engineering~~ for 1944 or 1945. [redacted] further work was undertaken as a result of a request [redacted] which [redacted] demonstrated an experiment [redacted] that with the synchro detector one could actually achieve S/N ratio, output to input of unity even with S/N in less than unity. This seems to have been a fairly straightforward experiment in which he fed controlled noise and controlled pulse through the synchro detector to a C.R.T. After this task, [redacted] let it be known that [redacted] interests were only mathematical, and after undertaking some theoretical work on the theory of distributed amplifiers up to 200 mc/s [redacted] 25X1 25X1 25X1 25X1 25X1 25X1

9. Soviet Scientific and Technical Literature

[redacted] made a great point of stressing the high quality of certain published scientific and technical literature in the USSR. [redacted] mentioned specifically the work of the following:- 25X1 25X1

KOLMOGOROV)
KHIN SHIN) - First class work on probability theory

ZYPKIN - Excellent work on servo mechanism theory appearing mostly in 'AVTOMATIKA and TELEMEKHANIKA' 25X1

SOLODOVNIKOV - Servo theory and author of an excellent book entitled 'INTRODUCTION to STATISTICAL DYNAMICS of CONTROL SYSTEMS.'

BLOKH)
AYSERMAN) - Book on dynamics of machine control, which contains much good work on servos.

GAVRILOV - Theory of relay circuits 25X1

MALKIN - Theory of stability.

[redacted]

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25X1

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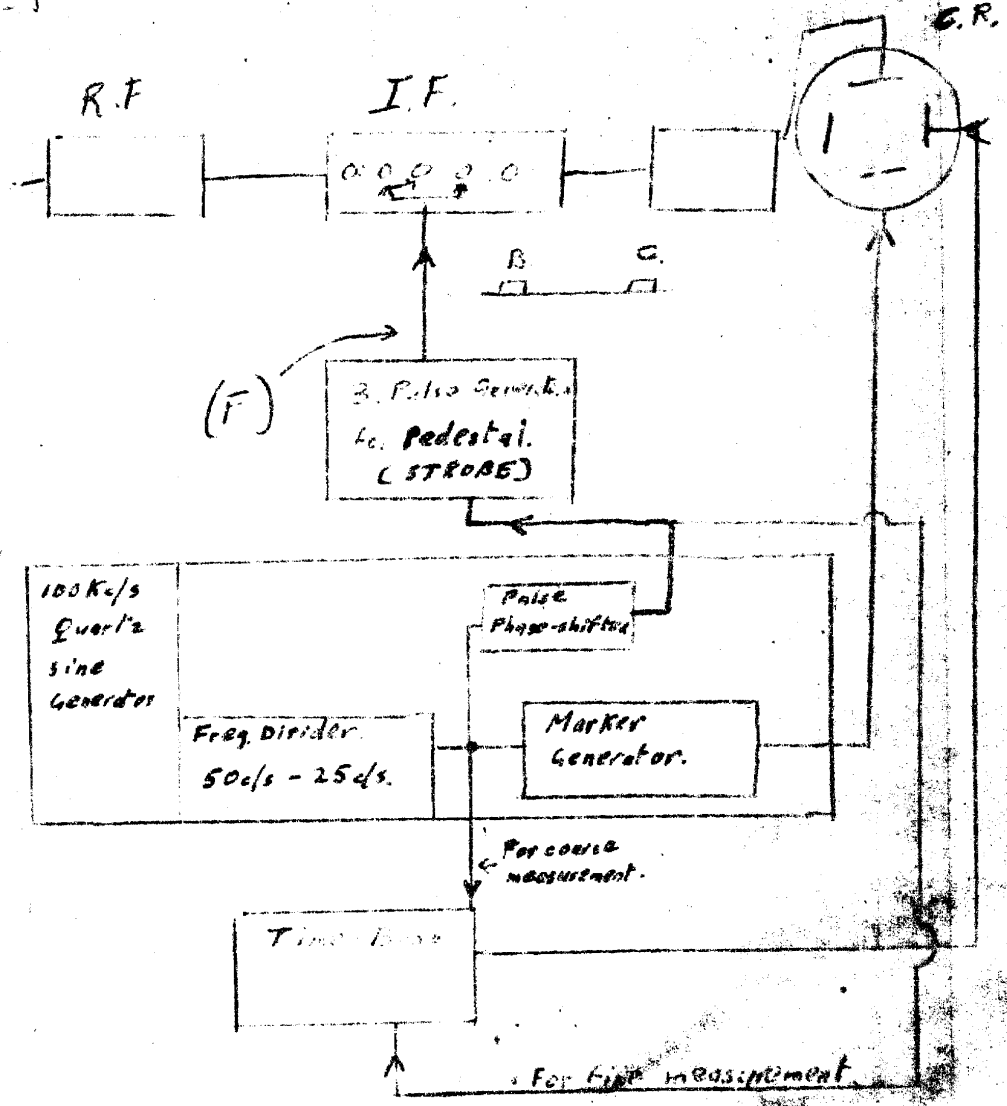
B } slaves
C



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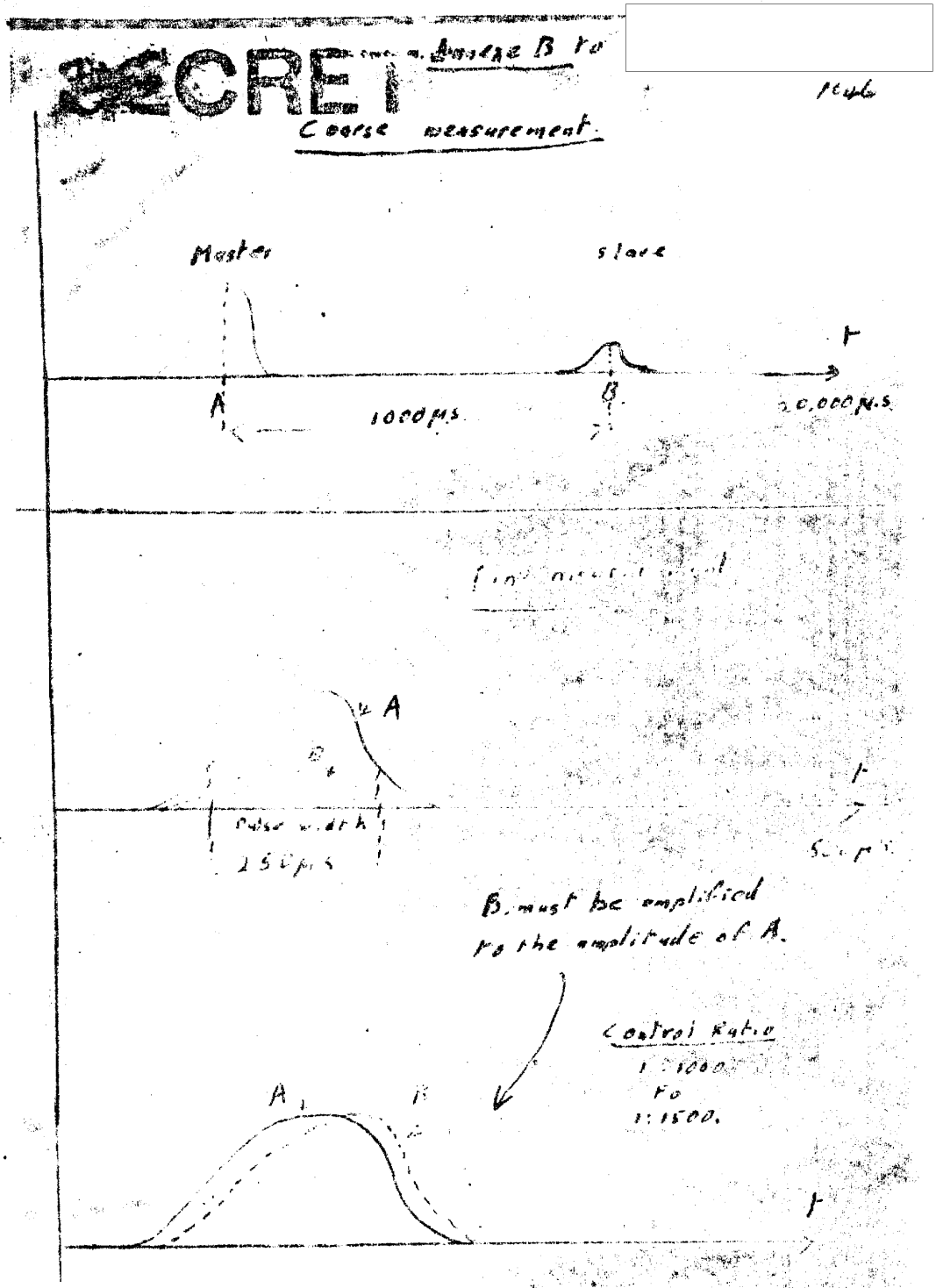
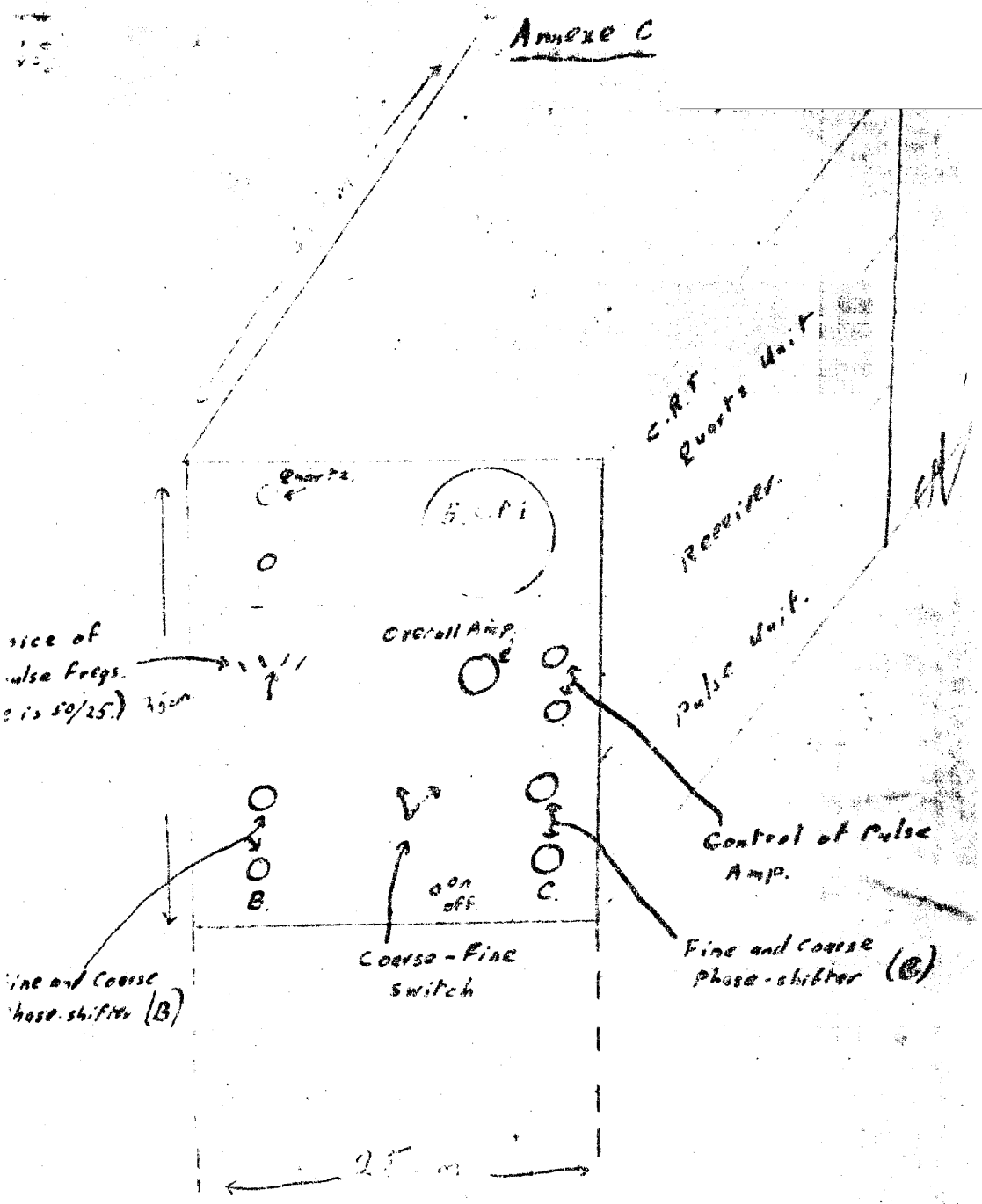
Block Diagram - Principle of Slave Pulse amplifier for long range reception.



Explanatory sketch - Fine and Coarse measurement.

25X1

Annexe C



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Sketch of Airborne Receiver