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TECHNICAL REPORTS

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INTRODUCTION

When the Ministry of Supply Establishment, Cuxhaven, was first proposed it was stated that one of its primary objectives would be to complete the recording of technical information on the A-4 rocket, with especial reference to its stabilization and control. It was expected that this would be carried out by means of prolonged interrogation and combined work in the laboratory by British scientists, skilled in the art of rocketry, and their German opposite numbers. Unfortunately practically no British scientists could be recruited and laboratory work was handicapped by the almost complete lack of scientific and technical equipment, so that, in general, the only remaining method of recording the information in the possession of the German scientific staff was by requesting them to write technical reports on that part of the A-4 development and design with which they were most familiar. The actual decision as to who should write on what, being left to their leader - Dr. Kirschstein.

Although, in theory, such a method of obtaining the information for British use, should have been successful, it had the following distinctly important shortcomings.

(i) The Germans were able to give or withhold such information as they thought fit. When the first reports were handed over, it was obvious that they were considerably lacking in quality and detail. When tackled about this, an admission was obtained to the effect that information was being withheld so that the British would not become possessed of the whole story and so be able to dispense with the further services of the Germans. The effect of straight talk on this subject could not be judged prior to the wind-up of MOSEC.

(ii) The fact that practically all the reports were written in German and that the translational facilities at Cuxhaven were so limited, necessitated the majority of the reports being translated in London after the wind-up. It was therefore impossible to elucidate doubtful points or to make enquiries where there were obvious omissions.

(iii) The almost entire lack of British technical staff with MOSEC made it impossible to survey the vast mass of technical reports already written by British and American agencies. It is therefore probable that much, if not all, of the material of the present reports is to be found elsewhere. Much of that written is, in fact, common knowled

(iv) The German technicians were admittedly handicapped severely in the writing of the reports by the entire absence of all the German technical reports on the subject. Efforts which were made by the MOSEC British Staff to obtain originals or copies were entirely fruitless. Even such drawings and reports as were in the possession of S.P.O.G. had been "given away" before the formation of MOSEC

In view of the known limitations of the reports, it has been thought advisable to repeat in the English version all matter which was contained in the German originals. Whilst not giving an exactly literal translation, every effort has been made to retain the character of the individual reports and not to rewrite them as it might be thought that they should be written. Omissions have not been filled in and no attempt has been made to correct statements which would appear to be at variance with other reports on the same subject although, in cases where it is known, these divergencies have been indicated. Only obvious slips have been rectified. In order that the ready may judge the value of the statements made by the individual authors, brief details of their careers and position in the rocket world are given in a special section.

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In addition to the reports written by the Germans, two reports written by British technicians visiting MOSEC and incorporating the information they derived there, have been included in this series since they have not been published elsewhere.

In one respect, MOSEC has exceeded its charter. Some of the German scientists who were employed, had been working on the "Wasserfall" project and it was therefore considered that no harm would be done if they contributed reports on this rocket also. These reports are included in the present series.

E. BOLTON KING
(ex-Superintendent
M.O.S.E.C.)

25th July, 1946.

AUTHORS

GRAETER — Karl. Dipl.Ing. Age 37. Prior to 1941, laboratory engineer at Siemens & Halske. At Peenemunde, at first engaged on development and testing of special apparatus for Wasserfall and later on the general electrical control of this rocket.

HABERMANN — Helmut. Dipl.Ing. Age 29. Technical University, Bruenn. A short period in the High Frequency Laboratory at Telefunken. Did not join the Peenemunde staff until 1943. After working on radio beam control, became head of the section dealing with transverse integration.

HÖHNE — Erich. Qualified Engineer. Age 35. Prior to war held several positions interspaced between courses at technical colleges. Joined Peenemunde in 1941 and engaged on a variety of duties until he specialised on integrating accelerometers. Finally became a Section Leader and second to a departmental chief.

KAUBA — Fritz. Dipl.Ing. Age 32. Spent most of the eight years prior to 1941 at the Technical University, Vienna. Then joined Peenemunde and engaged on general A-4 control until he became head of the section dealing with the Mischgerate and Hydraulic Servos.

KIRSCHSTEIN — Friedrich. Dr.Ing. Age 42. Educated at Berlin Technical University. Seven years on television with German Post Office and Broadcasting Company. Lecturer on "oscillations" at Berlin Technical University, 1936-42 but from the beginning of the war was engaged on development of integrating Accelerometers for A-4. Joined Peenemunde 1942, as Head of Department for "Range Control" and "Electrical Measurement of trajectory and rocket behaviour".

KÖCHEL — Herbert. Dipl.Ing. Age 32. Apprenticeship and part time courses at Berlin Electro-technical High School. Laboratory assistant. Peenemunde from 1939. Computer and later on, designer of electric circuits. Deputy Departmental Chief.

LÄMMERHIRT — Horst. Dr. rer. Nat. Age 32. Berlin University and working student with Siemens and Halske. Prior to Army Service, engaged on ballistics in Berlin University Physics Institute. In 1944 released from Army for work at Peenemunde. A series of electronic developments terminating with work under Kirschstein on Messina and flame cut-off.

LANGE — Oswald. Dr.rer. Nat. Age 34. University of Breslau. Assistant at the Heinrich-Hertz Institute of the Berlin Technical University from 1936 till the war. Then at Peenemunde worked on control problems, especially remote control, until in 1943 was put in charge of all the control for Wasserfall.

MÜLLER — Otto. Dr.Ing. Age 36. Darmstadt University. Six years as Assistant at his University after a spell with Siemens and Halske. Joined Peenemunde in 1941 and was soon made head of Telemetering Section. Late in 1942 was made head of the main section working on precision control and deputy head of the overall control department.

PEHLE — Max. Surveying technician. Age 33. Typical surveyor's training and employment. Sent to Peenemunde from the Army in 1942, where was engaged on observations and computing.

/ROSENTHAL

ROSENTHAL — Gottfried. Dr.Ing. Age 35. Technical Institutes of Dresden and Berlin. John Hopkins University U.S.A., Assistant at Dresden University and various appointments in industry. After call up to armed forces and two years on active service, was sent to Peenemunde as a soldier early in 1943. However, in 1938, carried out research on liquid oxygen combustion with different fuels. At Peenemunde worked under Weiss on infra-red homing devices and gyros, reaching the rank of senior group leader.

RUHLE — Ferdinand. Dr.Ing. Age 34. After some industrial experience, spent ten years on electrical engineering at the Berlin Technical University, the latter part as scientific assistant in the electronics laboratory. A short period in the Army and joined the A-4 project in 1943. Engaged chiefly on external research, especially on the electrolytic cell for the integrating accelerometer for which he established the production unit.

SCHIRRMACHER — Karl.Heinz. Dr.rer.Nat. Age 33. Jena University. Physicist with Lorenz & Telefunken from 1938 and throughout the war. Collaborated with the A-4 and Flak rocket programme from 1939 chiefly on the development of remote control including the H & V method and "Sirkel". A space rocket enthusiast since 1928.

SCHUBERT — Reinhard. Dr.Ing. Age 34. Technical University of Darmstadt where became Assistant. Joined Peenemunde in 1939. Theoretical work on stability of A-4 and later proposals, especially with simulators.

WEISS — Helmut. Dr. rer. Nat. Age 33. Universities of Stuttgart, Goettingen, Tuebingen & Berlin. Assistant in Physics at Berlin Technical University. Research physicist with Telefunken. Peenemunde from 1942 and for two years was head of homing device section.

ZIMMERMAN — Karl Heinz. Electrical Engineer. Age 33. Various employments until 1939. Army 1936-44. Became engineer in charge of experimental rocket battery at Peenemunde.

REPORT NO. 1

INTRODUCTION

The A.4 development personnel were faced with the problem of obtaining th greatest possible accuracy from a rocket, which, on account of its constructio and low acceleration, had to be fired vertically. In their solution, accuracy for line was achieved by keeping the rocket as close to the desired vertical trajectory plane as possible throughout burning, while, to obtain range accuracy, the rocket was gradually tipped over by a "programme" so that it reached an elevation of approximately 43° by all burnt, the actual end of burning being effected by interrupting the fuel supply when a pre-determined velocity, equivalent to the range required, had been reached.

The basic control apparatus carried in the projectile consisted of gyros, the "Mischgeräte" or control amplifier, the hydraulic servo mechanism and the trim-motors with their associated jet and external control vanes. This apparatus will keep the rocket stable but auxiliary apparatus is required to maintain the desired performance and accuracy. The method of control is shown diagramatically in Fig.1. A voltage is tapped off from the gyro potentiometer which is proportional to the yaw angle, ϕ , of the rocket, i.e. the angle between the vertical planes through the desired trajectory and the actual longitudinal axis of the rocket. Similarly a voltage is obtained from the gyr potentiometer A which is proportional to the rotation or roll, ϕ , of the rocket about its longitudinal axis. Actually, one gyro, the "Vertikant" and i gimbal mounting may serve to provide both the "E" and "A" data. Another gyro, the "Horizont" carries a potentiometer D which provides a voltage proportional to the pitch angle, ϕ , between the momentary and prescribed angles of elevation of the rockets longitudinal axis. This prescribed angle of elevatio in accordance with the pre-arranged "programme", is defined by the multiple time switch which varies the biasing of the potentiometer. An alternative to to this gyro system is the use of a gyro-stabilised platform which has the same equivalent potentiometers attached to its gimbals.

The three gyro voltages are fed into the "Mischgeräte" which produces the amplified and modified signals required to actuate the servo mechanisms operating the various control vanes. Three separate signals are produced:

$f_1(\phi_E) + f_2(\phi_A)$ for servo 1

and $f_1(\phi_E) - f_3(\phi_A)$ for servo 3

which operate the vanes corresponding to the fins lying in the plane of the trajectory and being under and over the trajectory respectively, and so control both yaw and roll. Also:

$f_2(\phi_D)$ for servos 2 and 4

which operate the vanes corresponding to the fins lying at right angles to the plane of the trajectory and which control pitch as well as interpreting the "programme".

The difference between signals 1 and 3 is used to operate a relay activating the "trim-motors", which in turn adjust the external vanes in such a way that the primary load of the roll control (chiefly caused by asymmetry and malalignment) is neutralised, leaving roll stabilisation to be carried out by the servo motors.

While the jet control vanes adjust themselves so that the longitudinal axis of the rocket lies in the desired direction of flight, external forces will, in general, prevent the rocket from travelling exactly in the direction of its axis. The inaccuracies in range thus introduced are neutralised to a great extent by the fact that the effective Q.E. at burnt is close to 45° and the range is controlled by flame cut-off when the desired velocity is reached. Lateral control is, however, not eliminated and to obtain accuracy, a corresponding adjustment must be fed into the Mischgeräte. This has been achieved by two methods.

1. The lateral deviation from the desired trajectory is measured by means of a radio beam system installed on the ground and the necessary corrective signals are sent to a special receiver built into the rocket, from which signals are fed into the Mischgeräte.

2. If a stabilised platform is employed and has a mechanism mounted on it for measuring the lateral acceleration, this may integrate giving the total lateral direction from the desired trajectory. Corrective signals can then be introduced to, and issued by, the Mischgeräte.

The various parts of the control equipment are described in detail in the reports which follow.