ITEM No. 5
FILE No. XXVI—83

BAYERISCHE MOTOR WERKE
(BMW)

COMBINED INTELLIGENCE OBJECTIVES
SUB-COMMITTEE

LONDON - H.M. STATIONERY OFFICE

BAYERISCHE MOTOR WERKE (BMW)

12 May, 19 June 1945

Reported By

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CIOS Target Number 5/74

Jet Propulsion

COMBINED INTELLIGENCE OBJECTIVES SUB-COMMITTEE
G-2 Division, SHAEF (Rear), APO 413

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I. TARGET LOCATION (Sheet M49 at 11274811)

The main entrance to the BMW plant is 6 km. SSE of Dachau and 0.7 km. SSE of Karlsfeld on the west side of the Munich road. The rocket motor test pits are in the SE corner of the plant.

II. SUBJECT COVERED

Liquid fuel rocket motor testing installation and associated shops.

III. SUMMARY

This report covers an inspection made about 12 May by Lt. Col. G. J. Gellin (British), Squad Leader E. J. A. Kenny (British), 1st Lt. Oxel (U. S., Ord.), and H. A. Liebhafsky (U. S. T/O) of CIOS No. 183 and a later trip made by R. H. Norris and E. H. Hull (U. S. T/O) on 19 June 1945.

The target contains an important rocket motor testing station, briefly described below, which might be studied further if the German operators could be obtained for explanations in order to answer certain questions concerning methods of measurement and operation, safety precautions, reasons for explosions, test results, etc.

IV. REPORT

There is no doubt that the target is one of the outstanding German stations for stationary tests on rocket motors. Stations of comparable importance seem to have been only at Peenemunde and Berlin.

Our first party was conducted through the station by Dr. Hemsath, chief chemist of BMW for rocket fuels, who claims to be the inventor of hypergole fuels utilizing nitric acid as oxidant. He claims further that some 6000 rocket-fuel combinations have been tested at the target. Nitric acid was the only oxidant used in these tests; many reducing agents (fuels) were tried, the choice of these being dictated largely by supply considerations. Hydrogen peroxide has been studied for submarine purposes in the laboratory, but never in a rocket motor.

The station was begun early in 1943. It was to consist of 12 pairs of test pits, each pair having one control room. Most of these pits were built, but not all were operated.

Thrust was measured hydraulically through a membrane. There was also an electrical method of thrust measurement, but this did not

involve a quartz crystal; a reasonable guess is that it involved changing the capacity of a condenser by a mechanical displacement proportional to the thrust. (The CIOS team expects to clear up this matter and to obtain samples of the thrust-measuring devices). The reactants are delivered by pressurizing, air or nitrogen being used. Reaction is begun by having an explosive rupture of a metal membrane, which starts the flow of reactants. (Lt. Col. Gellin says that he is thoroughly familiar with this method, which he uses). The hypergoles are self-igniting; for the other fuels, ignition by means of gunpowder, by means of an electric spark, and by means of hypergoles in small quantity has been used.

Although pressurized tanks, see Photo No. 1, filled by means of electrically driven portable pumps, were used for reactant supply, a more elegant system was practically complete. Four sets of large metal acid tanks and smaller fuel tanks were suspended on scales for accurate weighing. Pipes led from these tanks to a pipe tunnel passing under the floor of the test pits for distribution of the reactants. The acid tanks are cylindrical in shape and laid horizontally on their weighing apparatus (See Photo No. 3). Acid tanks hold about 750 gals. and the fuel tanks, 200 gals., approximately.

Apparently no precautions have been taken to keep the reactant systems separate. Fuel and acid tanks are located in the same room and the supply pipes lead through the same duct. There is no visible protection for these supply lines in the test pits and apparently no means of keeping blast or fire from travelling along the pipe tunnel from one pit to the next, or to the tank rooms.

Exhaust gases from the motor tests are taken care of in an elaborate duct system. A long horizontal brick duct, 5 x 7 ft. inside, is built parallel to the row of test pits. At each pit a short brick section, built at right angles to the main duct, ends in an open-ended telescoping steel tube about 4 ft. in diameter, as shown in Photo No. 4. Exhaust gases collected by this tube run along the horizontal duct to a vertical stack about 50 ft. high, up which they are forced by a centrifugal fan. There is a gate valve in each individual test stand duct. Some of these side ducts have built beside them a brick observation room for looking axially into the rocket motor from the exhaust end.

As mentioned above the test pits are built in pairs with a common observation room between each pair. There are sections between these units for workrooms and the reactant storage spaces. The test pits, 13 x 20 x 12 ft. high, are enclosed by 30-inch concrete walls except on the front, which is covered by a rolling steel door to be opened during tests. Steel T-slots are built into the floor and walls to facilitate fastening equipment. Excellent lighting is provided by lamps near the ceiling covered by safety glass, some of which has been cracked by explosions. Photo No. 5 is a general view of one of these

test pits showing the stand for mounting the rocket and measuring thrust on the right and on the left reading from bottom to top, a reactant supply pipe, observation window, wire screen for the window, the screen being raised at the time the picture was taken, and two lights. In the far corner an entrance door can be seen standing open. This leads into a vestibule opening into the observation room, the test pit on the other side of that room, and to the outside. The T-slots in the floor and walls can be seen also. Each pair of test pits opens on the exhaust side into a paved yard divided by walls at the sides and enclosed by the duct at the rear.

Two long windows lead from each observation room to each test pit (shown in Fig. 1). The glass in these windows contains 4 laminations totaling 2" in thickness. In one of the pits a severe explosion had spalled the concrete walls and cracked the outer glass window but nothing penetrated. Photo No. 5 shows an investigator holding this cracked window. Spalling of the concrete wall between the two windows and above the nearer can be seen as well. During tests these windows are covered by a heavy wire screen which was missing from the cracked window, probably having been removed for repair. The space between the two pieces of glass is either heated electrically or dried with a dehydrating agent to insure non-fogging.

Explosions are not uncommon since nitric acid tends to form explosive organic nitrates if oxidation of the fuel does not proceed rapidly in mixing.

The observation rooms are equipped with neat control boards mounted under the observation windows as well as a large instrument panel which appeared to be arranged for movie photography. On this panel were 2 tachometers, a clock, several pressure gauges and 2 temperature indicators.

Some of the test pits appeared to be arranged for testing the entire propulsion unit of the Henschel 8-117 including tanks. This assumption is strengthened by the fact that several partially destroyed 117 power plants were seen nearby. Also in the shop across the street from the test pits were found several 117 tanks, pistons and a burned-out combustion pot. Experiments were also made in motors of the X-4 type in which the reactant rate is 0.8 kg/sec. for 20 sec. duration. Work has been done on ATO units for rocket planes on a 10 times larger scale than the above, as well as for longer times. Specific impulses of 200 sec. are claimed but this point has not been verified.

Dr. Hemsath feels that nitric acid is the most promising of all oxidants for rocket purposes. He admits, however, that no operational use has yet been made of it in Germany but says there have been trial flights. Most experiments were made with a 5 to 1 ratio of nitric acid to fuel which indicates an excess of acid.

V. PHOTO TITLES

1. Pressurized reactant tank suspended for weighing.

2. Acid supply tank mounted on scales.

3. Fuel supply tank suspended for weighing.

4. Exhaust gas telescoping duct.

5. General view of a test pit.

6. A pit in which an explosion had occurred.

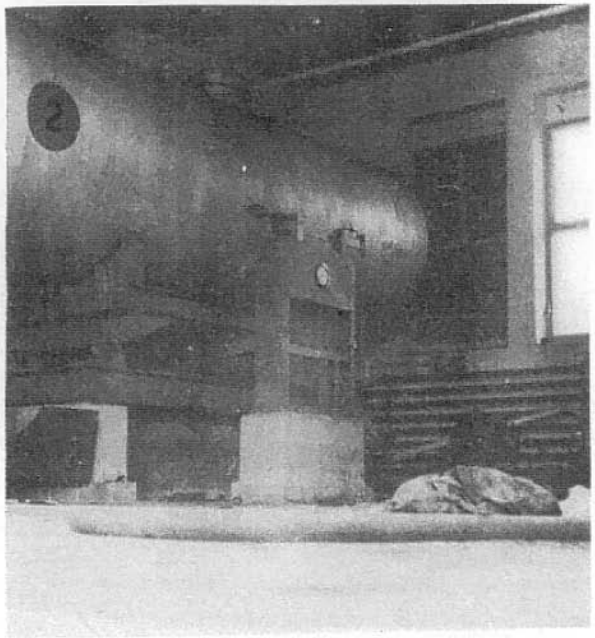


Photo No. 2

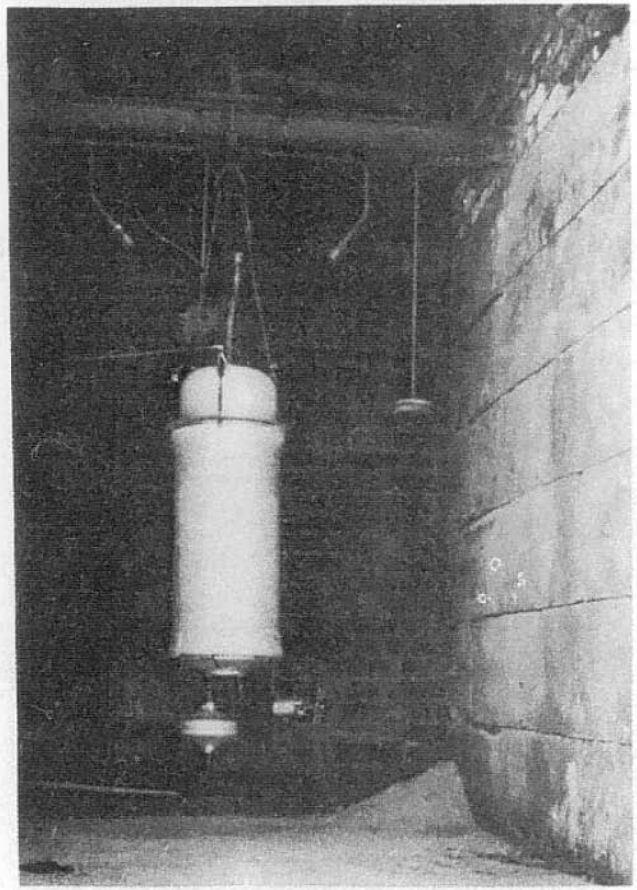


Photo No. 1

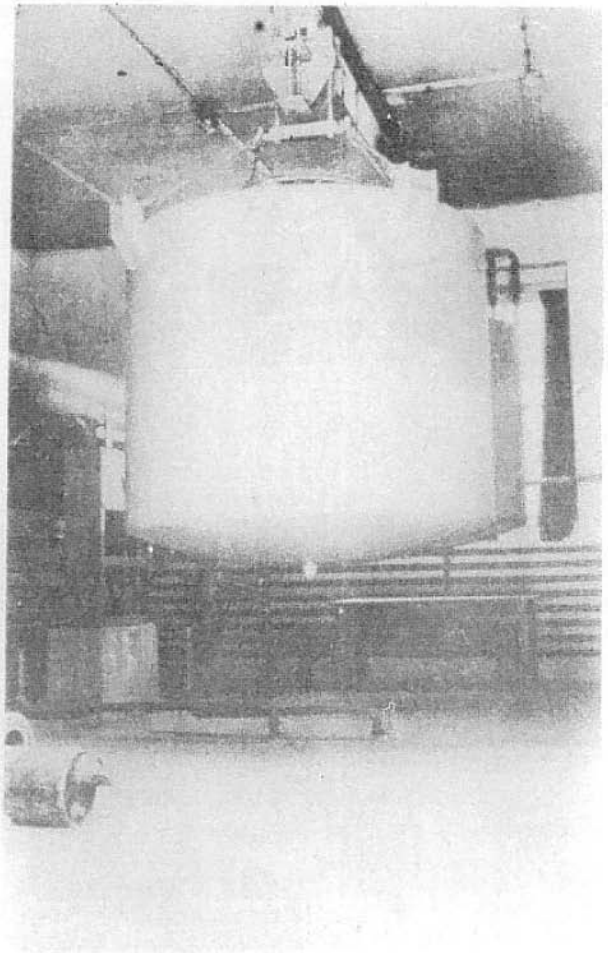


Photo No. 3

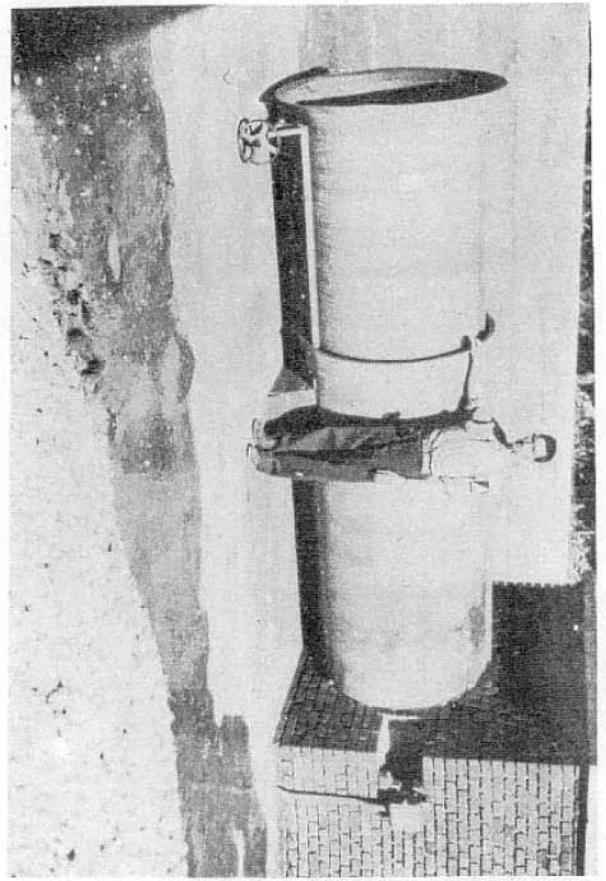
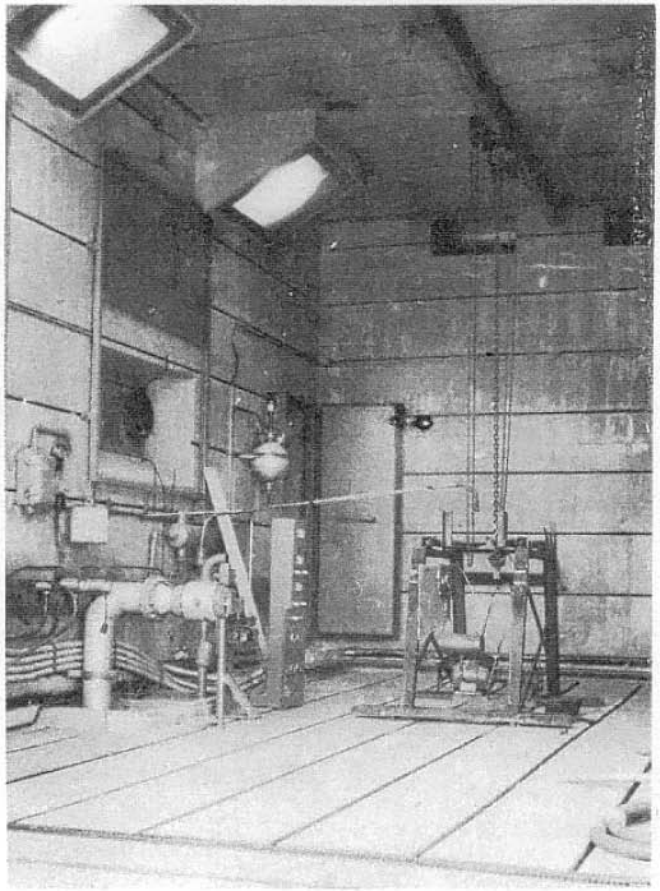


Photo No. 4



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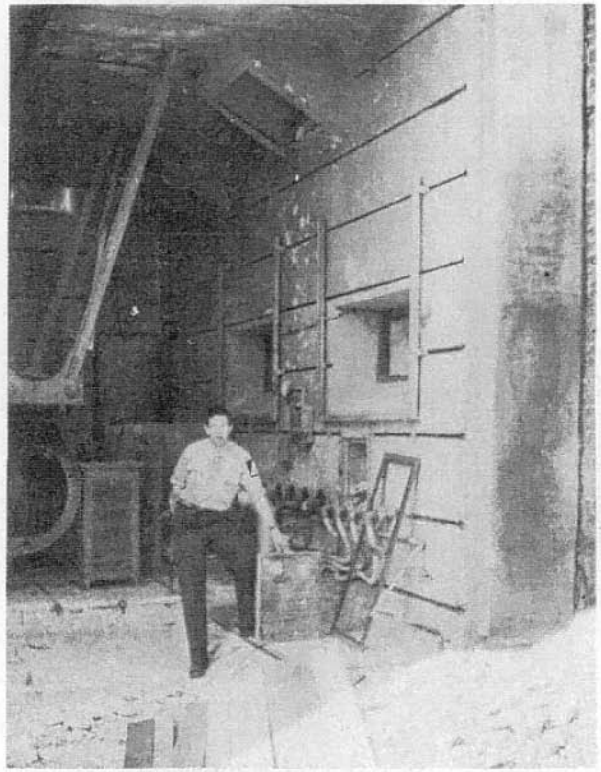

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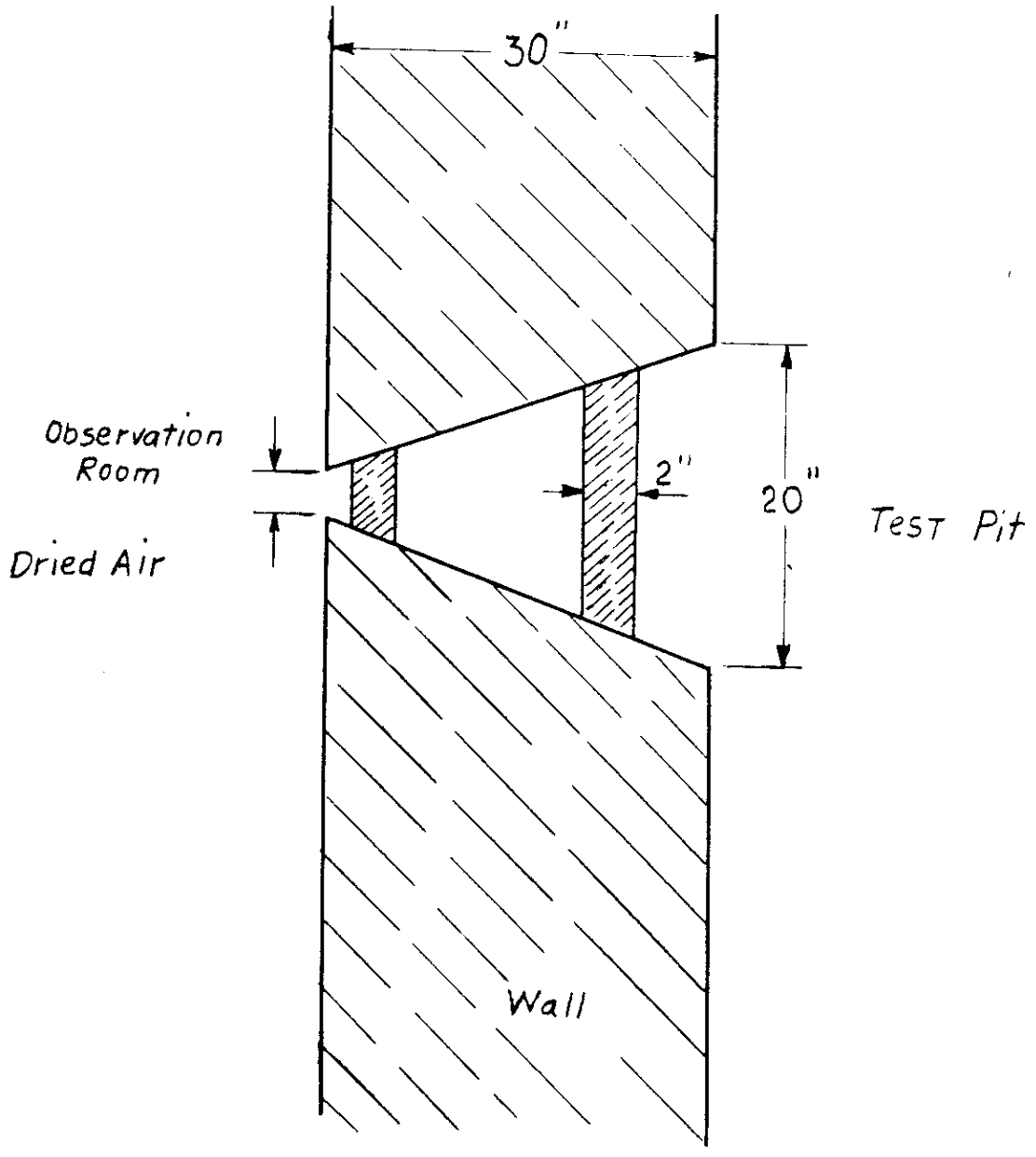

FIG. 1