Luftwaffe Profile Series No. 17

Vertical Takeoff Fighter Aircraft of the Third Reich

J. Miranda & P. Mercado

A SCHIFFER MILITARY HISTORY BOOK

Miranda/Mercado LUFTWAFFE PROFILE SERIES NO.17 • Vertical Takeoff Fighter Aircraft Schiffer Military/Avia

A provisional launch tower made of wood was used pending introduction of the production version made of steel. Unmanned test launches were conducted with this apparatus. Here one of the Bachem Ba 349 prototypes is seen being raised onto the tower.

Vertical Takeoff Fighter Aircraft of the Luftwaffe

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In 1932 the *Heereswaffenamt* formed a department for rocket research. In 1934, however, a lack of funding forced the department to be shut down.

The civilian "Association for Space Flight" and several of its most important members (Wernher von Braun, Klaus Riedel) joined the Heereswaffenamt as engineers under Hauptmann Dornberger.

The new team's first rocket development, the A1 (Aggregat 1), failed on liftoff. The cause was found to be the engine, which burned liquid oxygen and alcohol. The rocket was stabilized by a gyro system installed in the nose cone.

The next model, the A2, was equipped with a gyro stabilizer located in the rocket's center of gravity. In December 1934 it reached an altitude of 2,400 m.

The A3 combined a number of critical new developments, including guide vanes in the rocket nozzle to provide stabilization during liftoff. A number of launches were made from Greifwald in 1937, revealing several problems in the gyro control system.

The A5, which was built in 1939, was the first design to find the correct combination of propulsion system, stabilization, and flight controls, and made possible the design of the A4 (V-2).

In addition to his work with the army, Wernher von Braun also conducted research on a rocket propulsion system for installation in a conventional aircraft with the objective of increasing its performance.

At the end of June 1937 a Heinkel He 112 flew with a rocket engine burning liquid oxygen and alcohol.

On 6 July 1939 von Braun made a proposal to the RLM for a vertical-takeoff rocket interceptor based on the lessons learned from the A3. The aircraft would be stowed in a hangar on two vertical guide rails spaced six meters apart. An undercarriage, which could be jettisoned electrically after liftoff, was used to transport the machine from the hangar to takeoff position over a jet blast deflector.

When a target was detected by an air defense radar, for example the Fu MG 39T "Wurzburg," the flight control center would calculate the optimal flight path and launch the aircraft by remote control. During the first 53 seconds of the climb, stabilization and the exhaust guide vanes would be controlled automatically by the gyro system.

On reaching 8,000 meters the pilot assumed control and switched to auxiliary propulsion. While this was less powerful, it also required less fuel. Intercept speed was in the 700 kph range. Drawings of the machine reveal that it was to have been equipped with a parabolic radar antenna in the nose similar to that of the FuG 240/1 "Berlin N-1" of 1945.

It appears that this project was part of an advanced all-weather interception system. It was also planned to equip the machine with a target locator, probably a predecessor of the "Spanner" infrared detector of 1941. The pilot sat in a pressurized cockpit with a double-glazed windscreen. The outer skinning provided the aerodynamic form, while the inner was probably an integrated armored part of the cockpit.

After completing its intercept mission, the aircraft would glide back to base and land on a skid in the fashion of the Me 163.

The design was remarkably similar to the Bell X-1, which flew supersonically for the first time on 14 October 1947.

The project was extremely advanced in concept, and the RLM believed that such an exotic design could not be realized.

One of the main problems was the storage, handling, and transport of the fuel, which had to be maintained at a very low temperature.

The RLM supported development of the Walter HWK R I-203 rocket motor which, while not as powerful, was safer. It used a different fuel that was cheaper than liquid oxygen and easier to procure.

Following this decision Wernher von Braun reworked his design, and on 25 May 1941 he presented the RLM with an improved version of his interceptor fighter based on the technology of the A8 rocket.

The aircraft was powered by a rocket motor with two combustion chambers, which burned a mixture of Visol and SV-Stoff. Both propellants were easy to store at a standard temperature.

The *Luftwaffe* was not interested in the idea, however. Its interest centered on Erich Bachem, technical director of the Fieseler Werke. In 1941 Bachem had published two designs for a vertical-takeoff rocket interceptor.

The first, known as the Fi 166 *Höhenjäger I* (High-Altitude Fighter I), consisted of a rocket similar to the A5 in which was incorporated a jet fighter with engines beneath the wings.

The second design, the Fi 166 *Höhenjäger II*, was a large two-seat rocket aircraft. It was very similar to Wernher von Braun's first design for an interceptor fighter.

In spring 1944 the RLM requested submissions for a point-defense fighter. The manufacturers again proposed a rocket-propelled aircraft.

This request gave birth to the Projekte P1077 "Julia" by Heinkel, the Junkers EF 127 "Dolly," and the BP-20 "Natter" by Erich Bachem. By that time Bachem had already established his own aircraft company.

The "Dolly" was designed to take off conventionally on a takeoff trolley propelled by rockets whose thrust could be regulated.

There were two versions of the "Julia." In the "Julia I" the pilot occupied a prone position in the cockpit. This was designed to avoid loss of consciousness in maneuvers at high speed.

The "Julia II" was designed to take off from a near-vertical ramp. The pilot occupied a sitting PN so as to be able to withstand the acceleration during takeoff. This position is standard today in manned spacecraft.

The BP-20 was very similar. It was anticipated, however, that after completing its mission its main components

Technical Data A6

State of Development:	Design
Purpose:	Supersonic research aircraft
Wings:	Metal structure and skin
Fuselage:	Metal structure with metal skinning covering the nosewheel, the pressurized cockpit, the methyl-alcohol tank, the gasoline tank (Br-Stoff) for the turbo-ramjet engine, the undercarriage wells and the payload (instruments, cameras). Also contained in the fuselage are the tank for the liquid oxygen, the rocket motor and the combustion chamber.
Tail Section:	Metal structure with metal skinning, plus small guide vanes in the rocket nozzle. The ventral fin normally installed on the A4 and A4b could be deleted to accommodate the turbo-ramjet engine.
Undercarriage:	Tricycle undercarriage
Power Plant:	One EMW rocket producing 27 500 kg of thrust and acceleration up to 6 g. One turbo-ramjet engine of un known type and performance.
Fuel:	A-Stoff (liquid oxygen) and M-Stoff (methanol)
Wingspan:	6.33 m
Length:	15.75 m
Height:	4.07 m
Maximum diameter:	1.73 m
Maximum speed:	2 900 kph
Service ceiling:	9 500 m

Technical Data von Braun Interceptor Version I

State of Development:	Project
Structure:	Metal
Power Plant:	One liquid-fuel rocket motor based on the A-3 rocket, with two combustion chambers. It was hoped that the combustion chamber for vertical takeoff would produce 10 000 kg of thrust and the combustion chamber for cruising flight 725 kg.
Fuel Tanks:	Three tanks in the fuselage, one for A-Stoff (liquid fuel), one for M-Stoff (75% methyl-alcohol) and the third for the energizer (nitrogen).
Guidance:	Stabilization by gyroscope. In vertical flight by guide vanes in the rocket nozzle and the nozzle itself. In cruising flight conventional controls operated by the pilot.
Armament:	Four machine-guns in pairs in the wing roots.
Wingspan:	8.5 m
Length:	9.3 m
Height:	3.02 m
Payload:	5 000 kg
Cruising Speed:	700 kph
Rate of Climb:	151 m/sec
Service Ceiling:	8 000 m

Technical Data von Braun Interceptor Version II

State of Development:	Project
Structure:	Metal
Power Plant:	One liquid-fuel rocket motor based on the A6 rocket, with two combustion chambers. It was hoped that the main combustion chamber would produce 10 160 kg of thrust and the combustion chamber for cruising flight 770 kg.
Fuel Tanks:	Four tanks in the fuselage, one for SV-Stoff (94% nitric acid, 6% nitrogen), one for Visol and two for T-Stoff and Z-Stoff.
Armament: wing roots.	Four machine-guns in pairs in the
Wingspan:	8.6 m
Length:	9.3 m
Height:	3.2 m
Payload:	5 080 kg
Cruising Speed:	690 kph
Rate of Climb:	1 431 m/sec.
Service Ceiling:	8 000 m

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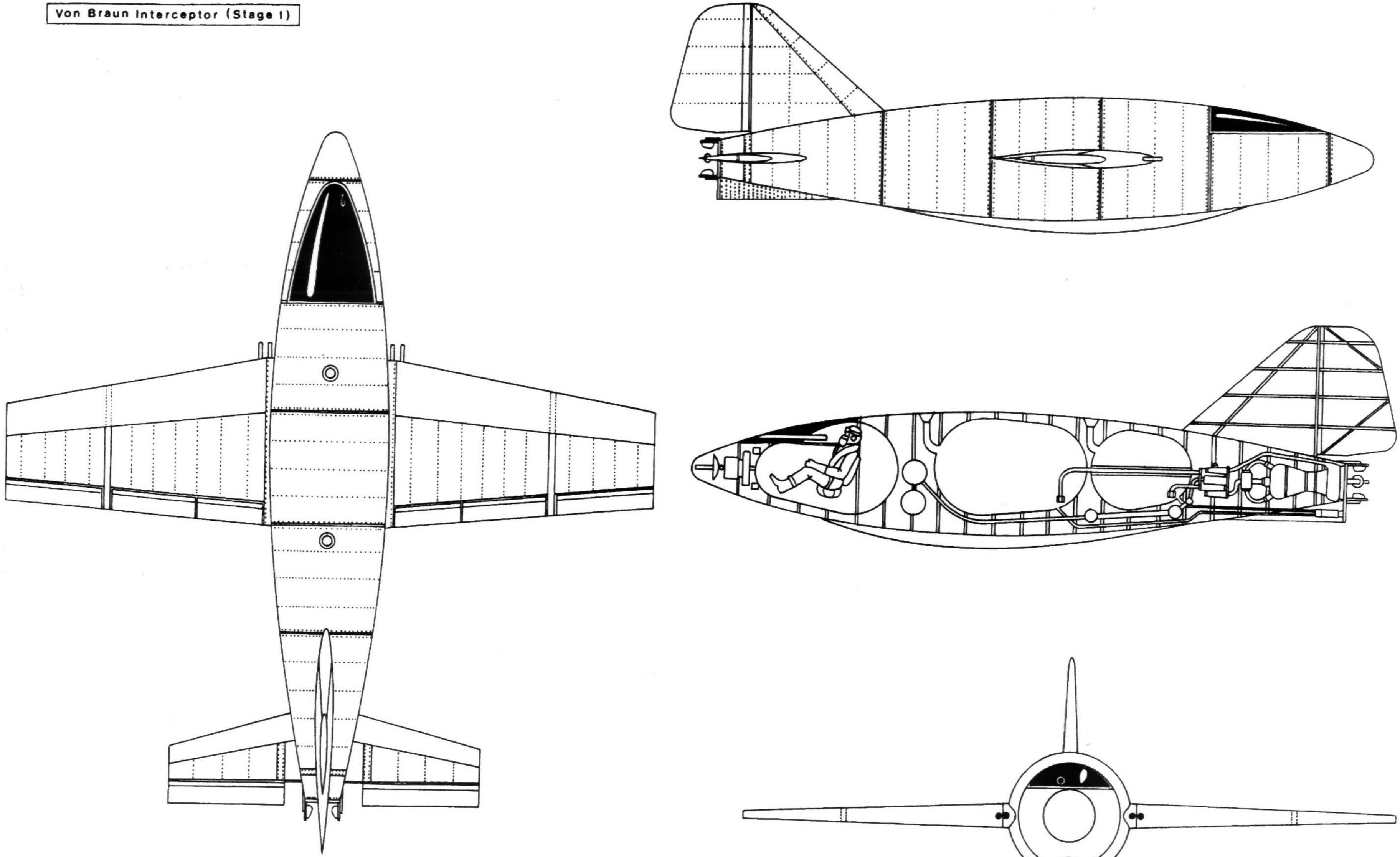
Von Braun Interceptor (Stage I)



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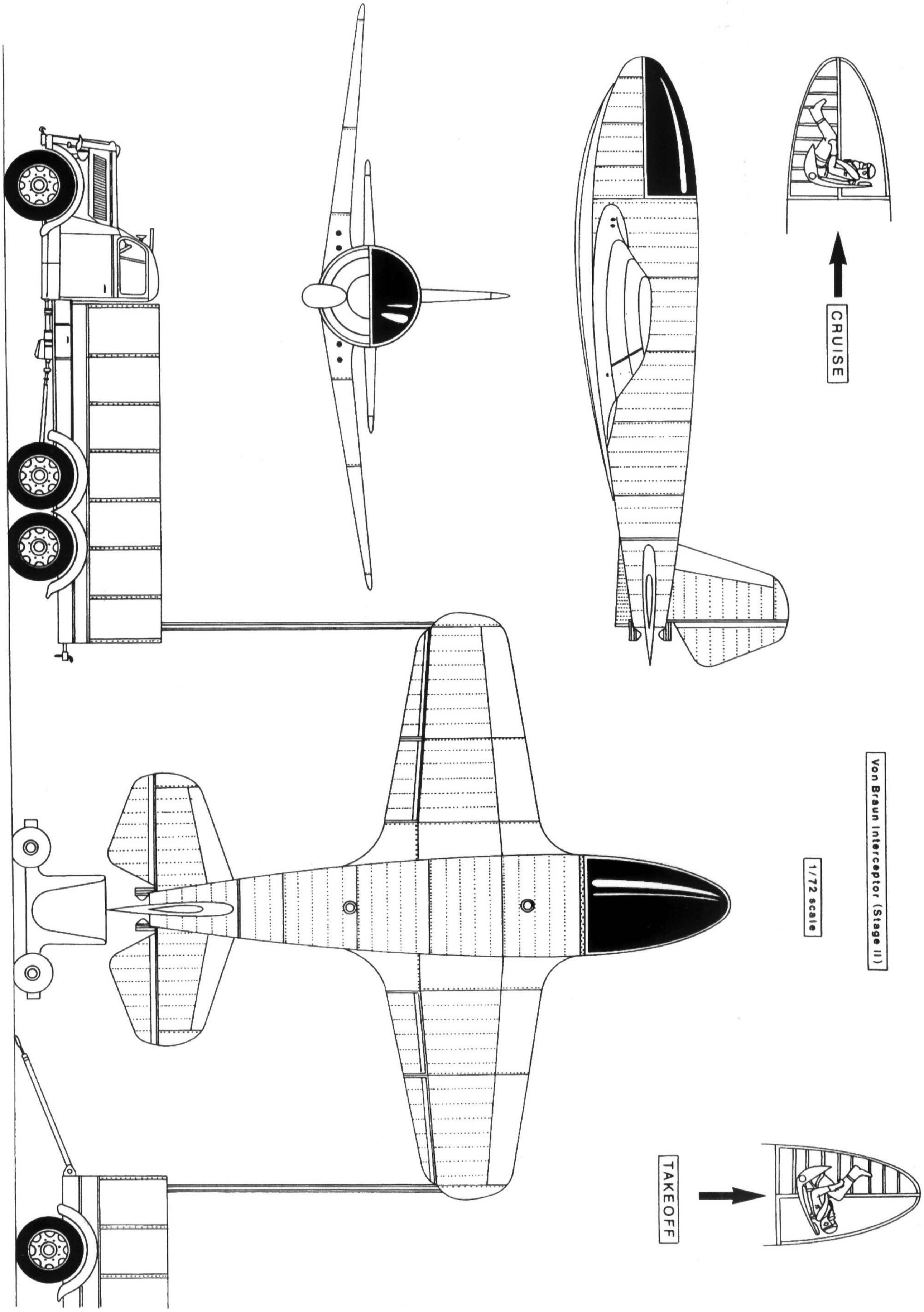
CRUISE
Von Braun Interceptor (Stage II)
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TAKEOFF

Proposed storage and launch facility for the rocket-powered fighter.

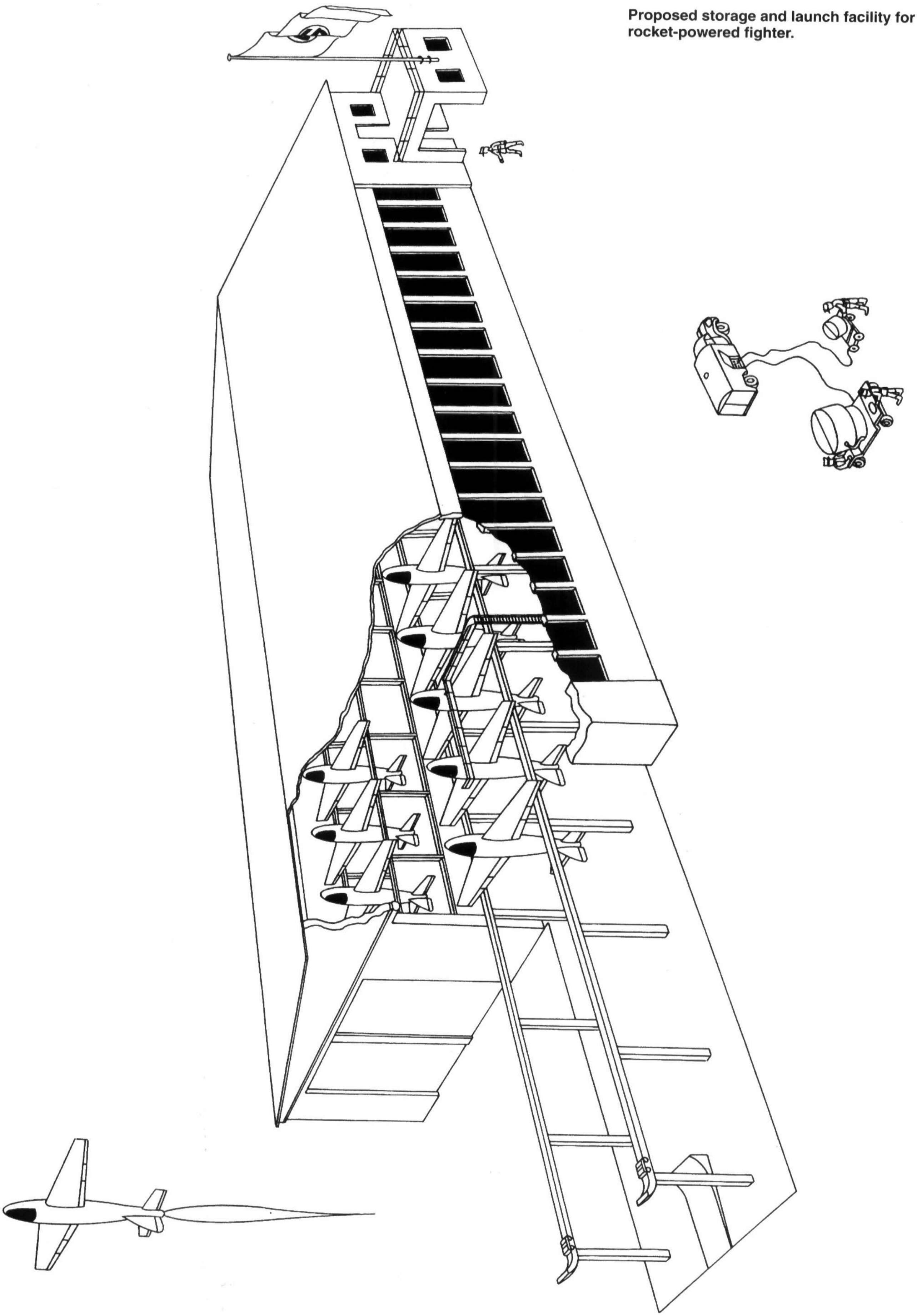
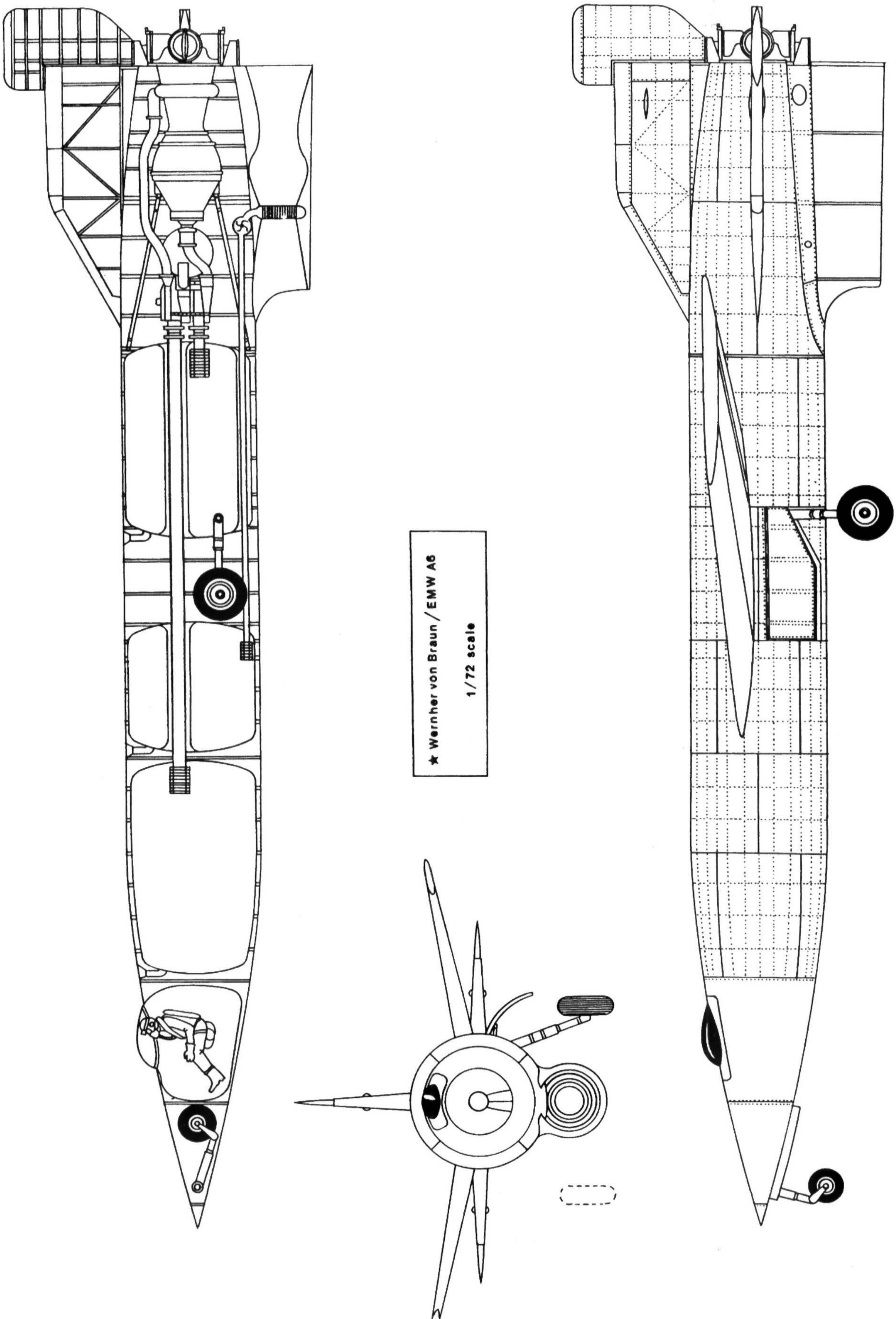


Abbildung und Startenordnung für Rückstoßjäger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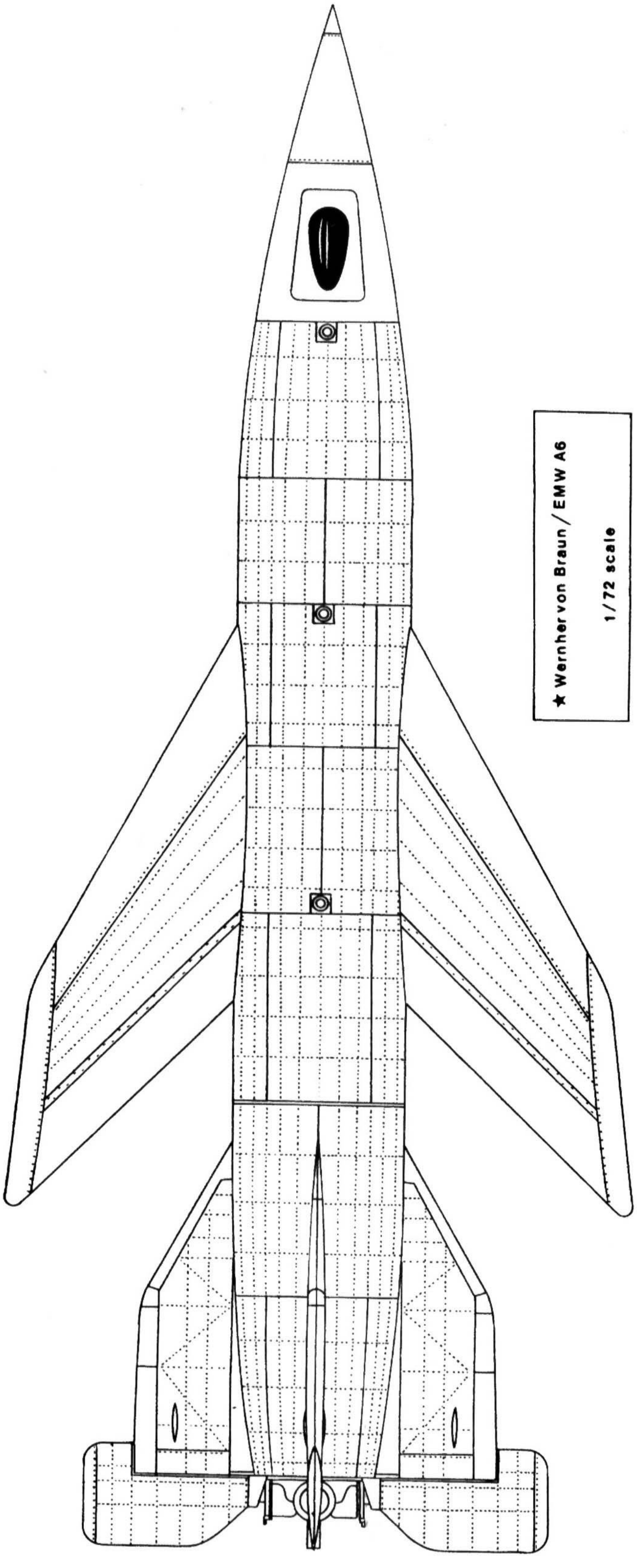

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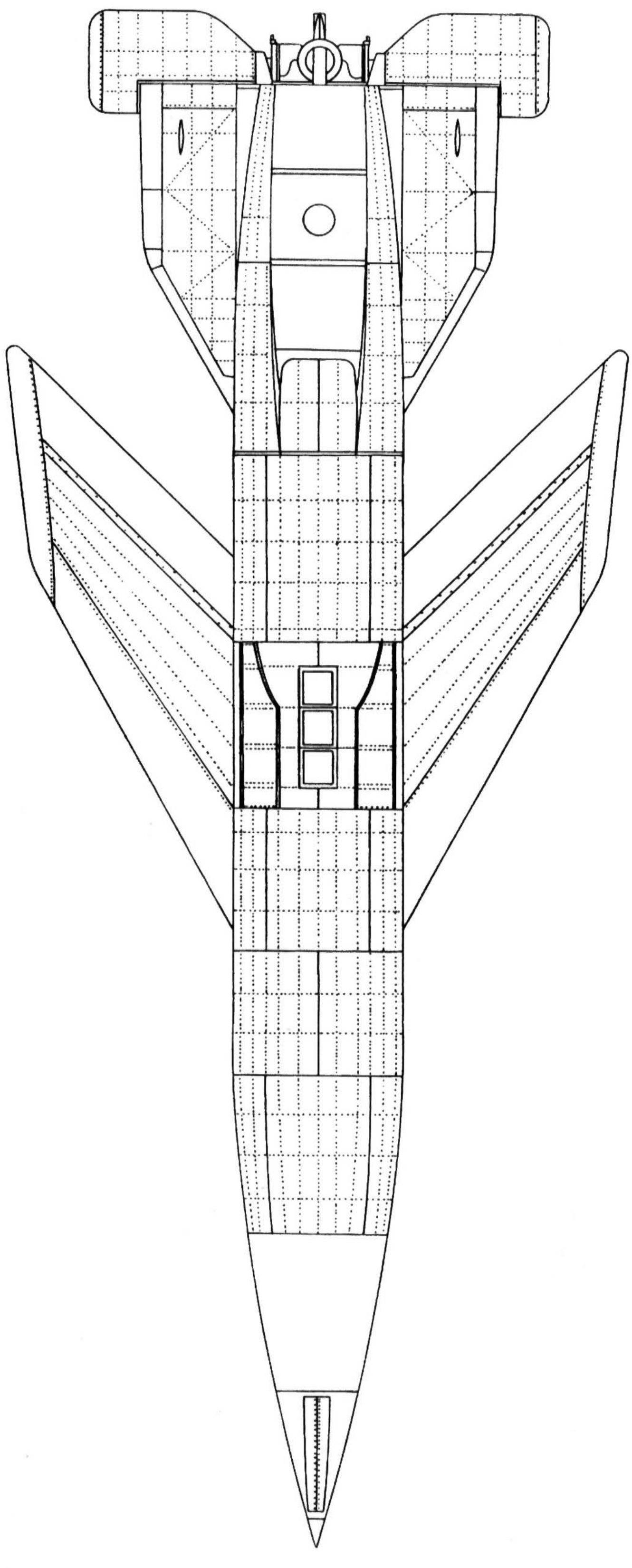


Technical Data Heinkel He 112 V5 (Werknummer 1292)

State of Development:	Flight test
Purpose:	Experimental rocket-powered aircraft
Wings:	Metal structure and skinning, metal landing flaps plus two fuel tanks between the mainwheel wells and the fuselage.
Fuselage:	Metal structure and skinning, a tank for liquid oxygen in front of the cockpit, a tank for methyl-alcohol behind the cockpit and one for gasoline beneath the pilot's seat as well as several bottles of compressed air. The rocket motor was located in the aft fuselage.
Tail Section:	Metal structure and skinning with braced tail sur faces.
Undercarriage:	Retractable mainwheels and fixed tailwheel.
Power Plants:	One liquid-cooled Junkers Jumo 210 C 12-cylinder inverted-vee engine producing 600 H.P. One EMW rocket motor with an output of 300 kg for 90 seconds.
Fuel:	Liquid oxygen and methyl-alcohol
Propeller:	One VDM three-blade propeller with a diameter of 1.58 meters
Wingspan:	11.79 m
Length:	8.96 m
Height:	3.24 m
Wing area:	21 m^2
Maximum speed:	480 kph with a rocket motor burn time of 90 sec.

would separate and return to earth beneath parachutes for reuse.

The increase in range which resulted from the addition of wings to the A4 (V-2) caused Wernher von Braun to develop three different manned versions of the rocket.

The A4b was a manned research aircraft, the A9 an intercontinental bomber, and the A6 a high-altitude, high-speed photo-reconnaissance aircraft.

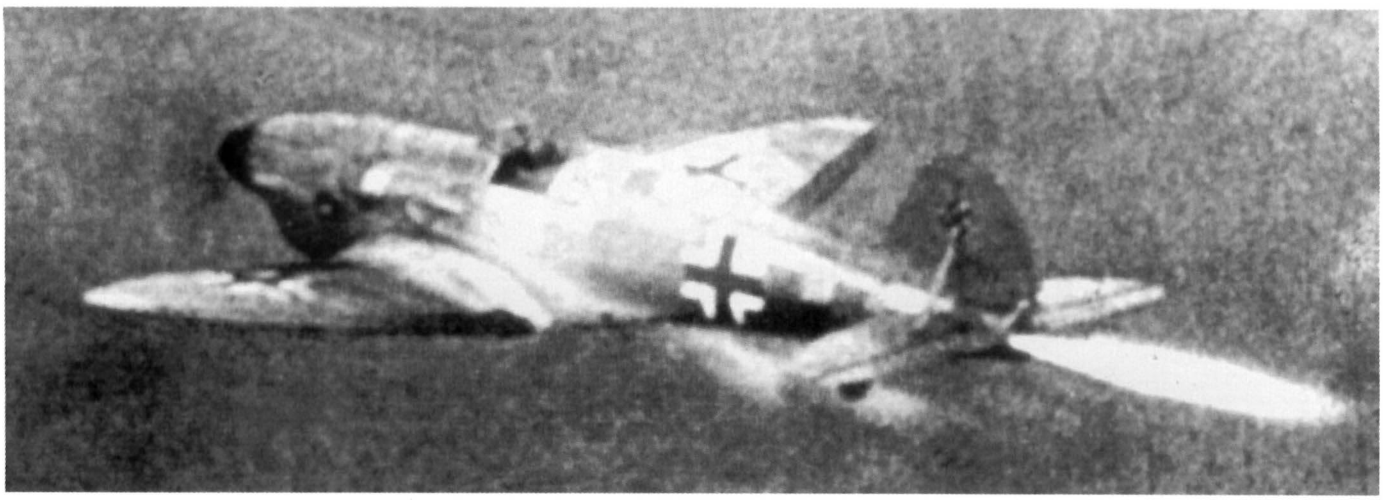
The A6 was a supersonic research aircraft equipped with a turbo-ramjet engine in addition to the primary rocket motor. The ramjet could only be started at very high speeds, however. Start-up would take place at the apex of the flight path, as that was where the highest speed was achieved and where the rocket engine expended its fuel.

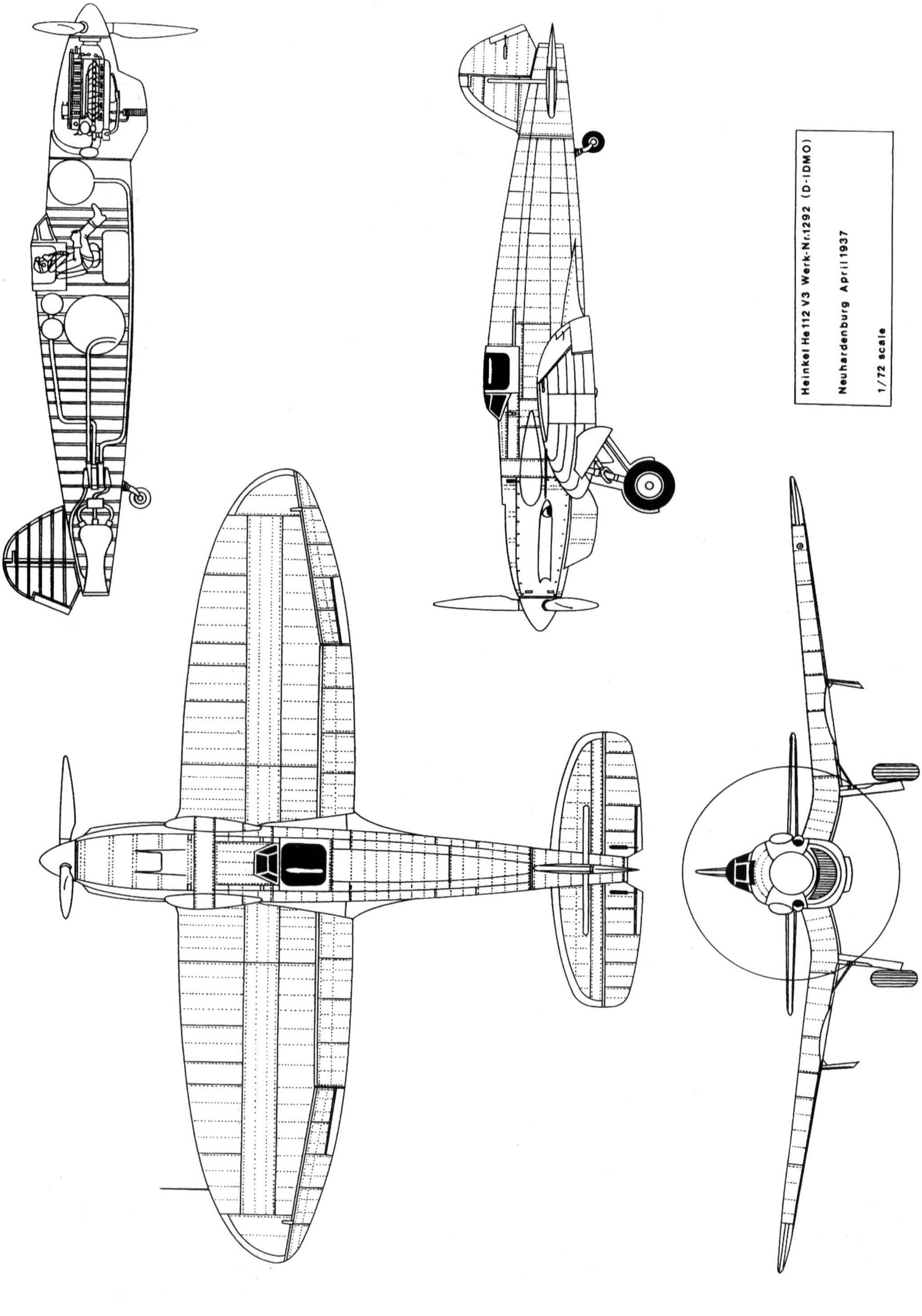
Under these conditions the turbo-ramjet engine, which burned synthetic fuel, made it possible for the A-6 to continue its flight for an additional 10-20 minutes with no loss of speed or altitude.

Although the A6 was a reconnaissance machine, it had the potential to be used as an interceptor fighter. Its performance exceeded the OKL requirements, and the project was therefore rejected.

The A6 was equipped with a pressurized cockpit, undercarriage, and braking parachute. The aircraft took off vertically like the A4 but made a conventional horizontal landing.

Elements of the A6 design found their way into the American X-15 project. Some of the X-15's missions and results remain classified. There are photos showing an X-15 equipped with a turbo-ramjet engine in exactly the same position as on the A6.





Heinkel He 112 V3 Werk-Nr.1292 (D-IDMO)

Neuhardenburg April 1937

1/72 scale

Bachem Ba 349 Natter

In April 1944 the Allies were on the verge of achieving air superiority over Germany. The large number of fighter groups equipped with the North American P-51 Mustang made it possible for some to be diverted from the bomber escort role to take the offensive against the German fighter force.

In spite of heavy flak defenses, the German airfields remained vulnerable. Increasingly the German units abandoned their permanent airfields for second-line fields disguised as farms or villages. German fighters took off from straight sections of the autobahn, but were subject to attack by enemy fighters while returning to land.

Had the vertical-takeoff fighter's time arrived? All the projects which the generals had laughed at in 1939 were now seen in a different light. What a great advance it would be to be able to dispense with conventional airfields.

The more conventional proposals used the tilt-rotor principle, which could draw on the experience gained with the twin-engined helicopters already in service.

The Focke-Achgelis Fa 269 could turn its rotors downward. This system was used by the Do 29, which first flew in December 1958.

The other projects, like the Junkers EF50 and the Weserflug WP 1003/E, featured rotors which turned upward.

The MM Bell XV-3 (1955) and Bell XV-15 (1977) research aircraft and the Bell/Boeing Vertol V-22 Osprey were all based on this principle.

Heinkel proposed two ring-wing aircraft, the "Wespe" and the "Lerche." Both had a shrouded propeller and took off and landed vertically. The same system was used by the Lockheed XFV-1 Salmon of 1954 and the Convair XFY-1 Pogo.

The French adopted the ring-wing for the SNECMA C 450 Coléoptère (1959).

Focke-Wulf developed the powered wing. This was a fighter aircraft whose wing turned like a giant propeller powered by ramjet engines at the wingtips (see FLUGZEUG Profile No. 23).

This technology was later used in Great Britain on the Fairey Rotodyne (1958). Two German manufacturers proposed small rocket-propelled aircraft which would take off from a ramp.

Heinkel reworked its Projekt P.1077 "Julia," adding a new cockpit which better enabled the pilot to withstand the g-forces on takeoff.

Drawing on the development work by Wernher von Braun and the Fieseler Flugzeugwerke on the Fi 166 project, Bachem developed the Ba 349. Instead of an unpowered glide and curved approach, which had caused numerous accidents with the Me 163, the Ba 349 would come apart in the air, with each component returning to earth by parachute.

This project offered advantages compared to its competitors. Mass production of the Ba 349 was requested in autumn 1944.

The Fairey Delta I, a small point-defense interceptor, was built in England after the war. It employed the same takeoff principle, a vertical takeoff with the aid of booster rockets.

The following conditions affected development of the Natter:

- the overtaxing of German industry
- poor supply situation for metals and fuel
- shortage of operational airfields and qualified pilots.

Construction time for the wooden aircraft was 250 hours. It would be built in small workshops and required no previous experience with aircraft construction.

The planned propulsion system was a single Walther rocket engine (400 man-hours), which was already in quantity production for the Me 163.

So that qualified pilots would not be needed, the Natter was equipped with an autopilot which was programmed to guide the aircraft to within visual range of the enemy. The pilot would launch his salvo of rockets at the enemy and then eject from the aircraft.

Manufacture of the armament, the booster rockets, the instruments, and auxiliary equipment would require another 350 man-hours.

The total for an operational Natter was thus 1,000 man-hours, with 600 hours for each subsequent sortie as the engine could not be reused.

The selected method of takeoff resulted in numerous problems with the control system. Like the V-2 rockets, the Natter's takeoff speed was very low for the first few meters. Under these conditions there was too little air resistance for the control surfaces to be effective. Even a gentle gust of wind could put the rocket off course during the vital takeoff phase. Four Schmidding takeoff-assist rockets were installed to stabilize the Natter during the initial phase of flight. These accelerated the Natter to a safe height in case of main engine failure.

The 20-meter-high launch tower also provided guidance in the first seconds of flight. This was also a safety measure, as the Schmidding rockets sometimes produced unequal thrust and vibration which could send the Natter off course. In spite of these measures, there was always an uncontrolled area between takeoff and the achieving of a safe speed.

Another measure was the installation of four guide vanes in the engine nozzle. These were controlled mechanically by the LGW/Patin autopilot. The guide vanes were water-cooled to prevent them being damaged by the high-temperature exhaust jet.

Tests with scale models with tail sections of various sizes showed that stability on takeoff improved as the size of the tail was increased. The best solution would have been to match the span of the tail with that of the main wing, however, this would have had a negative affect on maneuverability, making the aircraft too sluggish. In the end a compromise was reached for the production Ba 349 Natter in that the chord of the tail surfaces was doubled.

Thirty-four M-series prototypes were built, their role being to determine the potential of the project.

The Bachem BP 20 M1 (Werknummer 1) was built as a glider to investigate the type's handling characteristics. Two water tanks were installed to bring the glider up to the operational weight of the service aircraft.

The M1 made its first flight on 14 December 1944. An He 111 H-6 (DG+RN) towed the aircraft to a height of 5,500 m and subsequently released it over the Heuberg test field.

It was shown that maneuverability and stability were good over the entire range from 200 to 700 kph. Landing was not possible, and the pilot abandoned the aircraft by parachute.

The good handling characteristics of the M1 meant that it was not necessary to assume that an aircraft would be lost at the end of each test flight.

The M2 was equipped with a fixed undercarriage and braking parachute. The braking chute was installed in the same location as the combustion chamber on production aircraft. The braking chute reduced landing speed to 225 kph and was necessary on account of the type's short wingspan and lack of landing flaps.

The M2 took to the air for the first time on 22 December 1944, towed by a Klemm Kl 35.

The M3, also equipped with a fixed undercarriage, was used to test the "Tragschlepp" tow system. This system had been developed to extend the range of the Ju 87. Once again an He 111 H-6 was used as the tow aircraft.

The M4, M5, M6, and M7 were used to test cockpit separation from the fuselage. These tests were conducted with the aircraft unmanned.

The M8 was also used to test the separation process in flight. This time, however, there was a pilot aboard the Natter. First flight took place on 14 February 1945.

On 25 February 1945 the M9 took off from the 20-meter-high launch tower. The M9 was powered by two Schmidding rockets. A dummy pilot was placed in the cockpit and was recovered by parachute.

The M10 was used for further cockpit separation tests. The M11 and M12 were used for unmanned vertical launch tests.

The M13, M14, and M15 were used to test the automatic control system. These tests revealed that the Natter's stability during takeoff was insufficient.

The M16 was used to test wings with increased chord. The aircraft took off from a 17-meter-high takeoff ramp. The flight was also used for further tests on the automatic control system. The M17 was launched from a 12.5-meter-high launch tower.

The M18, M19, M20, and M21 were used to test various combinations of Schmidding rockets.

The M22 was used to evaluate the system's installation and the rescue parachute on unmanned flights. On 1 March 1945 the M23 made the first manned vertical takeoff. It was powered by four Schmidding rockets and a Walther liquid-fuel rocket motor. For reasons unknown the Natter veered off course and exploded. The pilot, Oberleutnant Lothar Siebert, was killed.

The M24 was used to calibrate the autopilot. The aircraft was unmanned.

In March-April 1945 the M25 completed a successful manned flight.

Nothing is known about the use of the M26, M27, M28, M29, and M30. It is possible that the machines were used for static tests to destruction.

The M31 was launched unmanned from an 8-meter launch tower to test the braking parachute.

The M32 was used in launch rail torsion experiments.

The M33 was launched without a pilot. The flight was used to test the separation of the Schmidding rockets from the fuselage.

The M34 completed another successful manned takeoff in March-April 1945.

Werknummer 35 was the first pre-production aircraft. It was designated the BP 20A or Bachem Ba 349A. Sixteen pre-production aircraft (up to Werknummer 50) were built. These differed from the M-series machines in having larger cockpit windows with armor-glass panels and a broader-chord ventral fin which incorporated a T-shaped guide.

An additional guide rail was added to the takeoff ramp to accept the guide on the ventral fin. The Schmidding rockets were also modified.

One aircraft was equipped with the "Grosse Rohrbatterie 108" (Large Tube Battery 108), which consisted of thirty-two 30-mm cannon barrels. A shell was placed in each barrel, all of which were fired electrically in a single salvo. Range was 500 meters.

No one knew what effect the recoil from the salvo would have on the airframe. Testing of the entire system was transferred to the test unit in Stuttgart-Kirchheim, which in April 1945 had ten aircraft. Other aircraft were armed with a rocket pack containing 24 Hs 217 Föhn unguided 73-mm rockets. These weapons had a range of 1,200 meters.

The Hs 217 had been developed as an air-to-ground weapon and was designed to be fired in a salvo of 35 projectiles. Stabilization was provided by guide vanes in the rocket nozzle. They were housed in containers with twelve six-sided chambers, which were dubbed *"Bienenwabe"* (Honeycomb).

It is not known if the Kirchheim test unit achieved any kills before the takeoff ramps were captured by American troops.

The next version, the Ba 349 A-1, was equipped with ailerons, a larger nose capable of accepting more rockets, a fully glazed canopy to improve view for the pilot and a larger ventral fin. The Ba 349 A-1 was an improved version for air combat, however, production was abandoned in favor of the B-version.

The Ba 349 B was powered by a Walther HWK 109-509 C-1 rocket motor with two combustion chambers, one for takeoff and one for cruise. The power plant used less fuel, giving the Ba 349 B a greater range than its predecessors.

The installation of a second combustion chamber made it necessary to redesign the rear fuselage, resulting in an elliptical cross-section. The new variant also incorporated the aileron-equipped wing of the A-1 and the tail surfaces of the A.

Armament consisted of a chamber for thirty-two R4M "Orkan" 55-mm unguided rockets. The R4M was designed with folding fins and was housed in a cylindrical chamber. It had a range of 1,500 meters, and maximum speed and accuracy were superior to those of the Hs 217.

It was also planned to equip the Natter with two MK 108 cannon beneath the pilot's position. The fuselage was deepened by 20 cm and lengthened by 30 cm. A reflector gunsight was supposed to be installed in place of the primitive aiming system of the A-version. When the aircraft sections separated at the end of the mission, the gunsight went with the nose section and was lost.

For cg reasons the four Schmidding rockets were moved aft. It was anticipated that these would later be replaced by two Series 533 rockets. Developed to assist in launching the Hs 117 "Schmetterling" (Butterfly), these rockets produced 1,750 kg of thrust.

Two armor plates were installed in front of and behind the cockpit to protect the pilot.

Just three Ba 349 B machines (Werknummer 51, 52, and 53) were built before the end of the war.

In the planning stage was the Ba 349 C, which took off from a mobile launcher, each of which could carry two Ba 349 C. The launch ramp was 12 meters long and could be raised to an angle of 80 degrees.

Takeoff, Combat, and Recovery

The Ba 349 B was assembled, checked, and delivered to its launch position. This process was carried out by SS units designated "Sonderkommando-N." Like the Me 328 and Fi 103, the Ba 349 B was to be flown by members of the SS. This may also have been the reason why no nationality markings were applied to the aircraft.

When a formation of bombers passed over an area of Germany defended by the Natter, the responsible command post (Jagdschloss) alerted the affected units.

T –5 Minutes

When the order "air alert" was issued, the pilot went to his aircraft and took his place in the cockpit with the assistance of the ground crew. He put on his parachute harness, fastened the safety belt, connected the oxygen equipment, and contacted the control tower.

T –3 Minutes

The interception plan was set and the autopilot set to the altitude, speed, and course of the target assigned by "Jagdschloss."

T –1 Minute

The order "Achtung Eins" (one minute to takeoff) was issued. The pilot started the pump for the hydrogen mixture, and the aircraft was shrouded in a white cloud. The ground crew made their way to the control bunker. Pump revolutions were increased, and the order "Achtung Start" (stand by for takeoff) was issued.

T

The pilot placed his head on the neck support, grasped the control stick, and pressed the takeoff button. The rest of the flight to a height of 10,000 meters was completed automatically.

As the aircraft took off under the power of the four takeoff-assist rockets, the T-Stoff and C-Stoff were injected under very high pressure into the combustion chamber of the Walther rocket motor.

T +2 Seconds

One white and four yellow flames spurted from the rear of the aircraft. The machine moved up the takeoff ramp under 5,700 kg of thrust.

Telephone communication was severed. Friction between the metal-covered wingtips and the guide rails produced sparks...the Natter was flying!

The autopilot activated the guide vanes in the thrust nozzle to make course corrections.

T +10 Seconds

The four Schmidding rockets are jettisoned at a height of 200 meters. Their burn time is just 10 seconds.

Climbing almost vertically, the Natter leaves behind it a plume of violet smoke. At this time the pilot is breathing pure oxygen and feels the growing G-forces.

T +60 Seconds

One minute has passed. The aircraft has reached an altitude of 10,000 meters and is approximately two kilometers from the enemy bombers.

The pilot now assumes manual control, the nose drops, and the attack begins in horizontal flight.

T + 120 Seconds

The pilot arms the weapons and selects one of the bombers in his primitive sight. When the wingtips of the selected target aircraft touch the aiming circle, the pilot knows that he has reached the optimal firing range of 600 meters.

T + 130 Seconds

The pilot presses the release button on the control stick, igniting the 24 rockets. The rockets leave the firing tubes, destroying the frangible plastic nose cap. The Hs 217 rockets have no tail fins and rely on their own rotation for stabilization. Accuracy is not particularly good.

T + 150 Seconds

The Natter is now within range of the enemy's defensive weapons, however, the armor plate is capable of withstanding projectiles up to 12.7 mm caliber. In a few seconds the Natter is again out of range.

At an altitude of 4,000 meters the pilot disconnects his oxygen supply, the controls, and all mechanical and electrical linkages. He then activates the braking parachute. Explosive charges blow off the nose section with the windscreen, the forward armor plate, and the rudder pedals.

The pilot lets himself fall from the aircraft and lands by parachute.

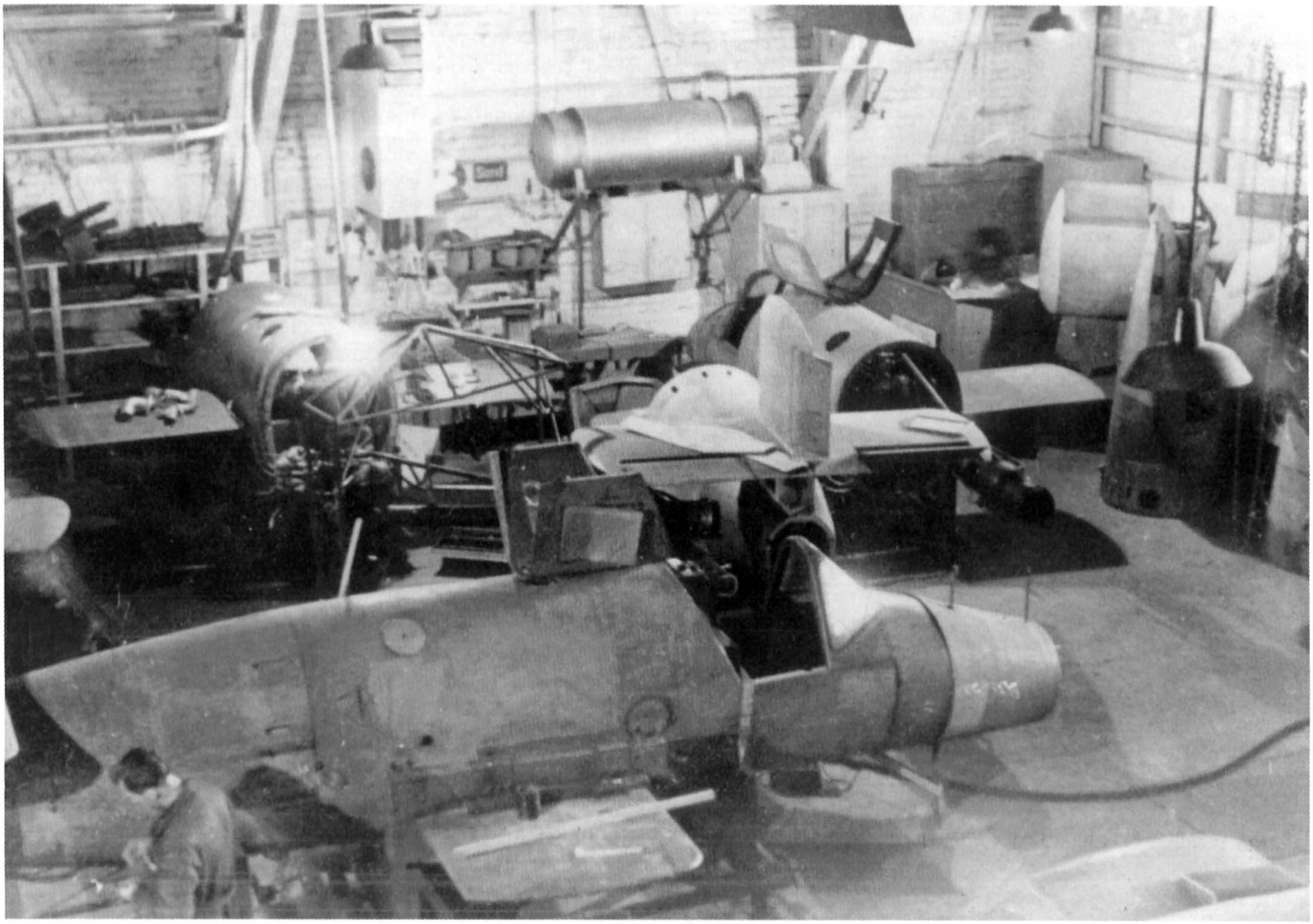
After landing, the rear section is recovered and several weeks later can be used again.

Technical Data Bachem BP 20 M23

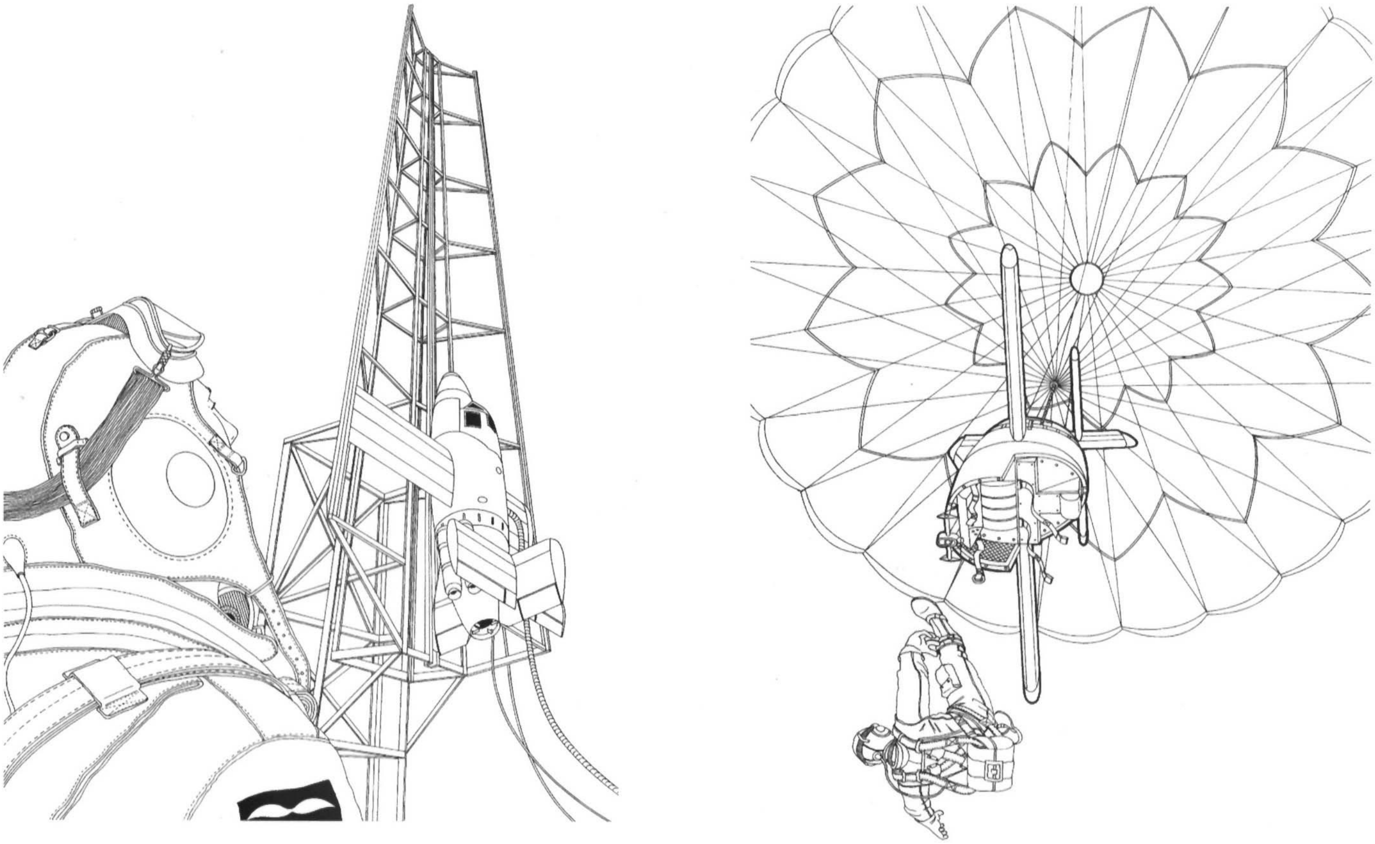
State of Development:	Manned research aircraft		
Construction:	Wood		
Propulsion:	One Walther HWK 109-509 A-1 rocket motor producing 1 600 kg of thrust. C-Stoff as fuel, T-Stoff as igniter and a mixture of T-Stoff and Z-Stoff as energizer. Four Schmidding 109-533 solid-fuel rockets as takeoff boosters, each producing 1 000 kg of thrust.		
Fuel Tanks:	One 365-liter tank for T-Stoff in the fuselage above the wing spar and a 165-liter tank for the C-Stoff under the spar.		
Armament:	None		
Length:	6.26 m	Wingspan:	3.60 m
Wing area:	3.6 m2	Height:	2.52 m
Maximum speed:	1 000 kph at 5 000 m	Takeoff weight:	2 065 kg (with four Schmidding 533)
Range:	14 to 80 km	Cruising speed:	800 kph at 5 000 m
Service ceiling:	16 000 m	Endurance:	5 minutes

Technical Data Bachem Ba 349 A/A-1

State of Development:	Operational aircraft		
Construction:	Wood		
Propulsion:	One Walther HWK 109-509 A-1 rocket motor producing 1 600 kg of thrust. C-Stoff as fuel, T-Stoff as igniter and a mixture of T-Stoff and Z-Stoff as energizer. Four Schmidding 109-533 solid-fuel rockets as takeoff boosters, each producing 1 000 kg of thrust.		
Fuel Tanks:	One 365-liter tank for T-Stoff in the fuselage above the wing spar and a 165-liter tank for the C-Stoff under the spar.		
Armament:	One aircraft was equipped with the "Grosse Rohrbatterie 108" with 32 tubes housing 30-mm shells. Standard armament consisted of 24 Hs 217 "Föhn" 73-mm unguided air-to-air rockets.		
Wingspan:	3.60 m (A-2: 4 m)	Length:	6.40 m
Height:	2.20 m	Wing area:	3.60 m2 (A-1: 4.70 m2)
Takeoff weight:	2 050 kg	Maximum speed:	1 000 kph at 5 000 m
Cruising speed:	800 kph at 5 000 m	Climb speed:	15 000 m in 76 sec.
Range:	45 to 70 km	Endurance:	5.15 min.
Service ceiling:	16 000 m	Climb angle:	60 degrees

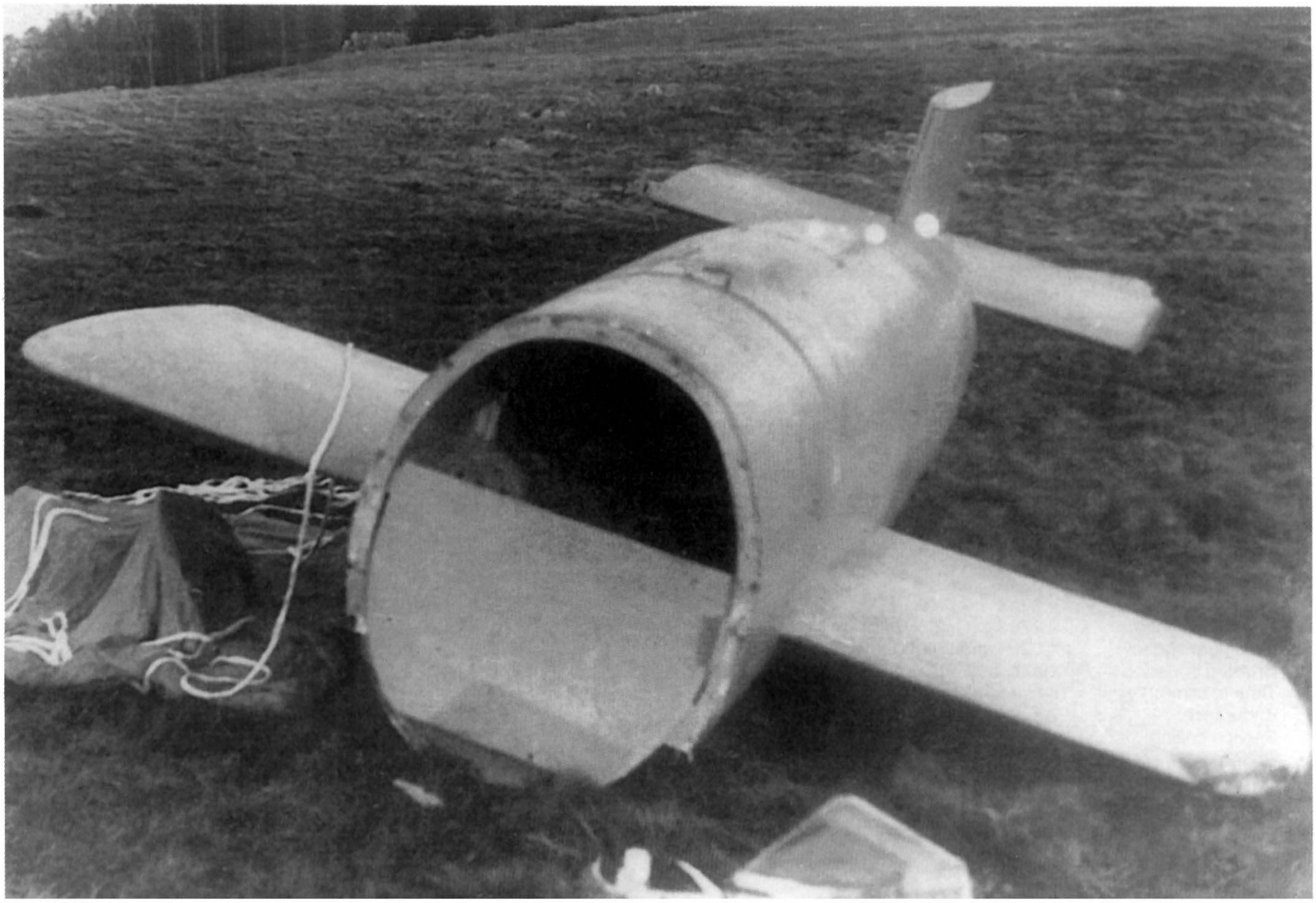


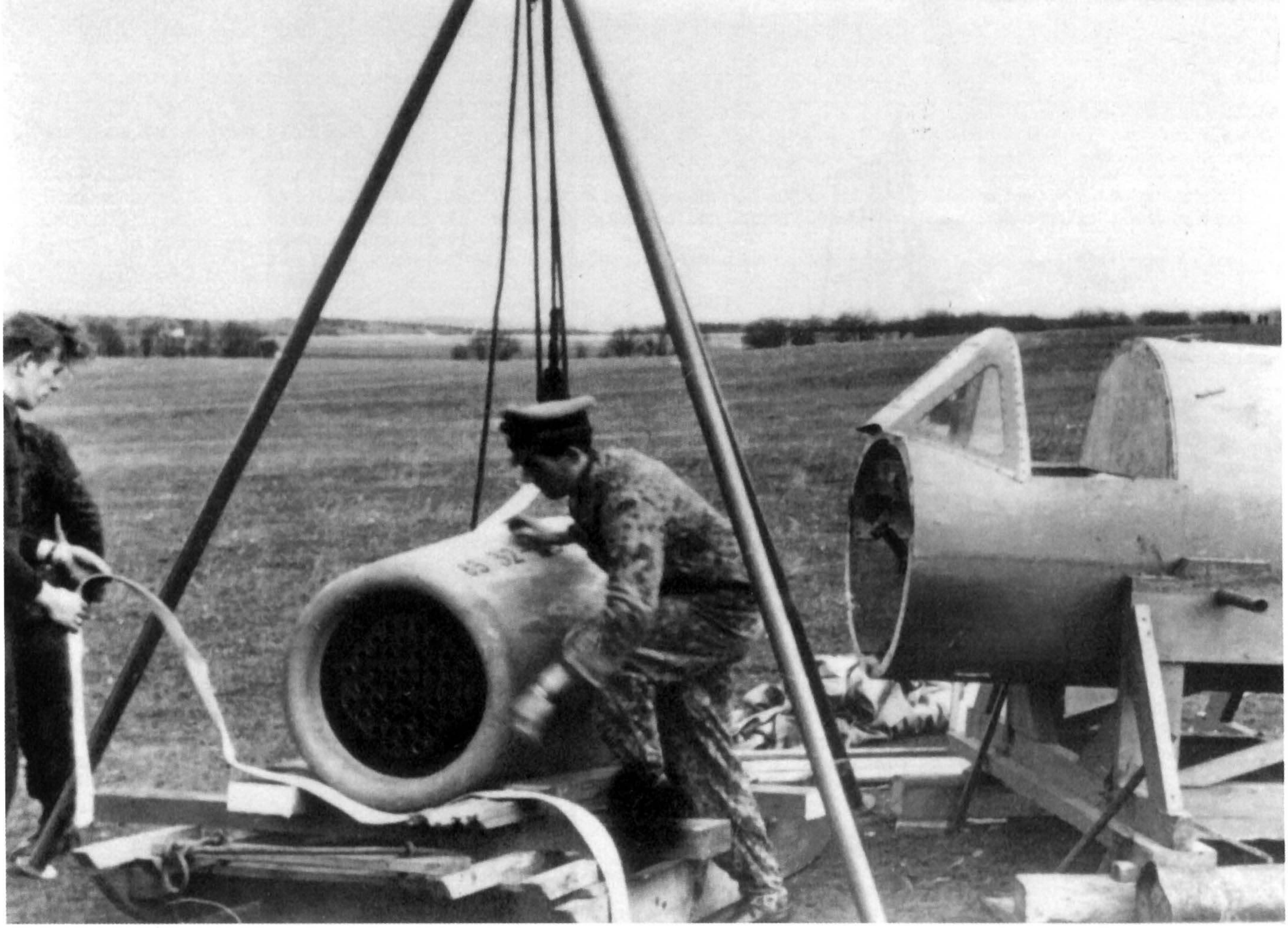
The Bachem Natter was by far the most advanced of all the rocket interceptor projects and was nearing the point of service introduction when the war ended. Here a photo of one of the many production sites.



Artist's impression of the launch tower and the pilot-seat separation sequence.

Natter aft section after separation of the nose and cockpit sections and return to earth by parachute.





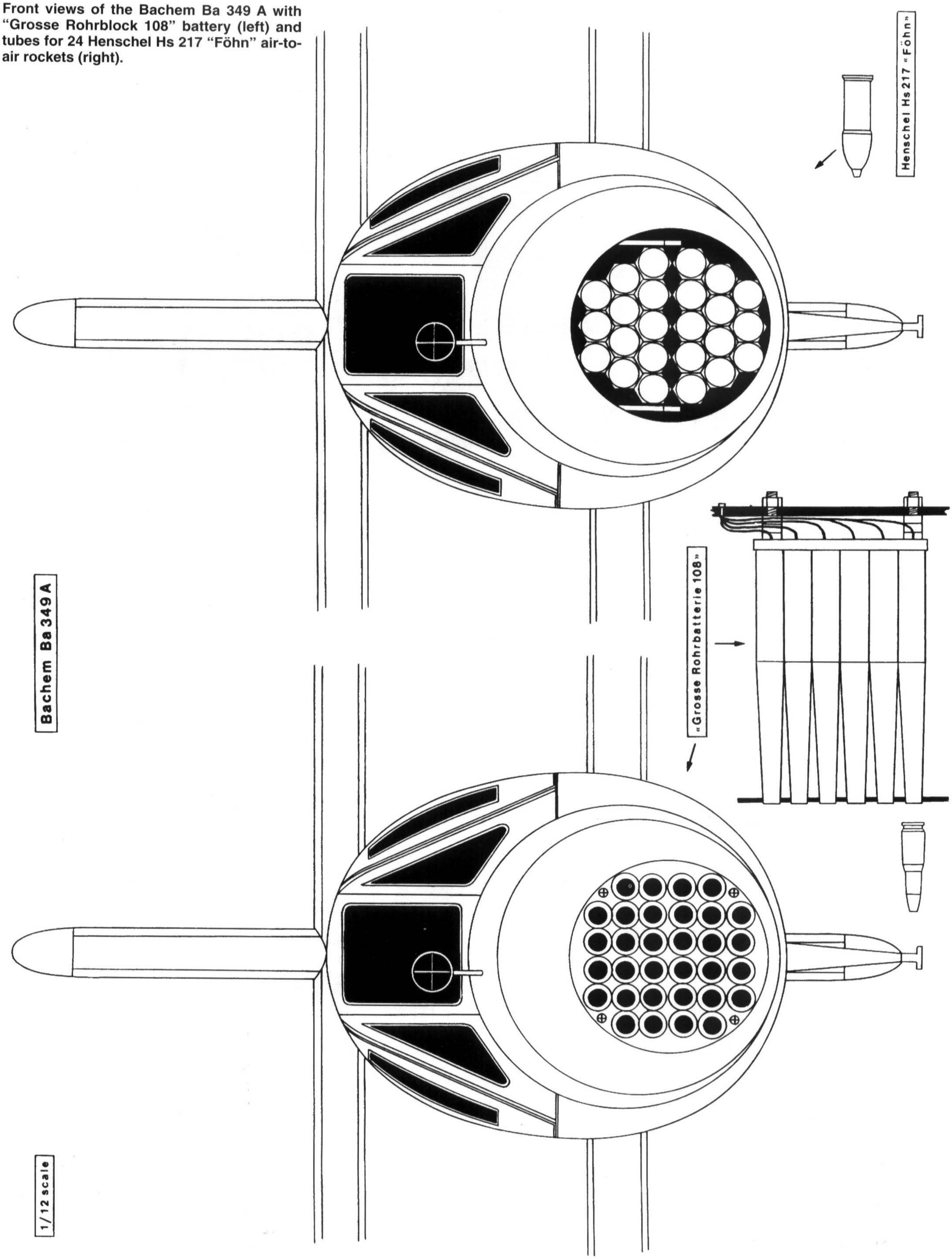
Installation of the Rohrbatterie 108 at the Heuberg troop training grounds. Firing tests with this system were carried out from 23 to 27 January 1945.

Technical Data Bachem Ba 349 B/C

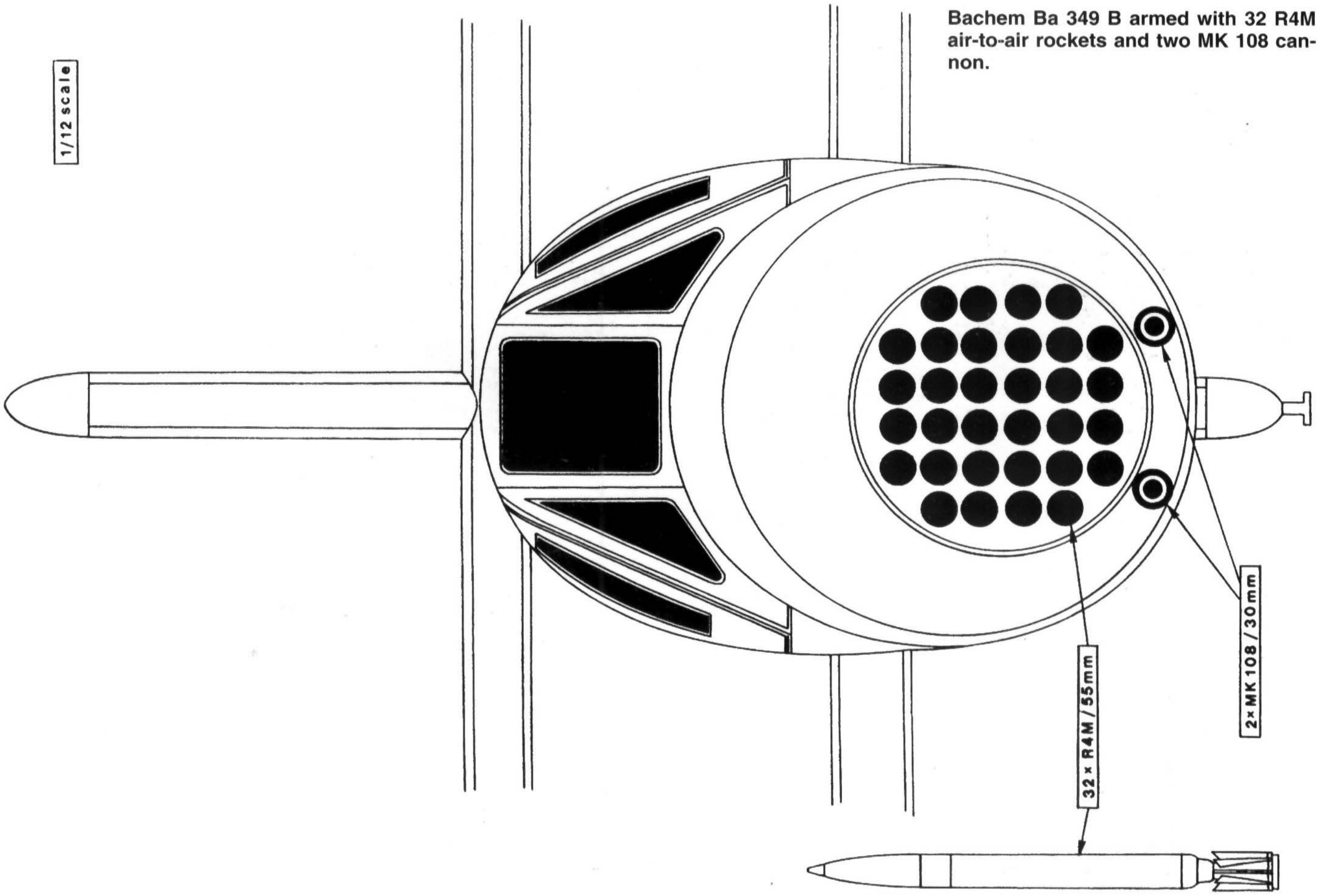
State of Development:	B: prototype C: in design stage
Construction:	Wood
Propulsion:	One Walther HWK 109-509 A-1 rocket motor producing 1 600 kg of thrust. C-Stoff as fuel, T-Stoff as igniter and a mixture of T-Stoff and Z-Stoff as energizer. Four Schmidding 109-533 solid-fuel rockets as take off boosters, each producing 1 000 kg of thrust.
Fuel tanks:	One 400-liter tank (450 liters in the Ba 349 C) for the T-Stoff in the fuselage above the wing spar and a 190-liter tanks (250 liters in the Ba 349 C) for the C-Stoff under the spar.
Armament:	Thirty-two R4M 55-mm unguided air-to-air rockets. Two MK 108 30-mm cannon beneath the pilot's seat, each with 30 rounds of ammunition.
Wingspan:	4.0 m
Length:	6.6 m
Height:	2.37 m
Wing area:	4.7 m2
Takeoff weight:	2 270 kg (C: 2 050 kg)
Maximum speed:	1 000 kph at 5 000 m
Cruising speed:	790 kph at 5 000 m
Time to climb:	84 seconds to 15 000 meters
Endurance:	7.8 minutes (C: 6.1 min.)
Service ceiling:	16 000 m
Range:	59 to 81 km (C: 41 to 73 km)
Climb angle:	60 degrees (C: 54 degrees)

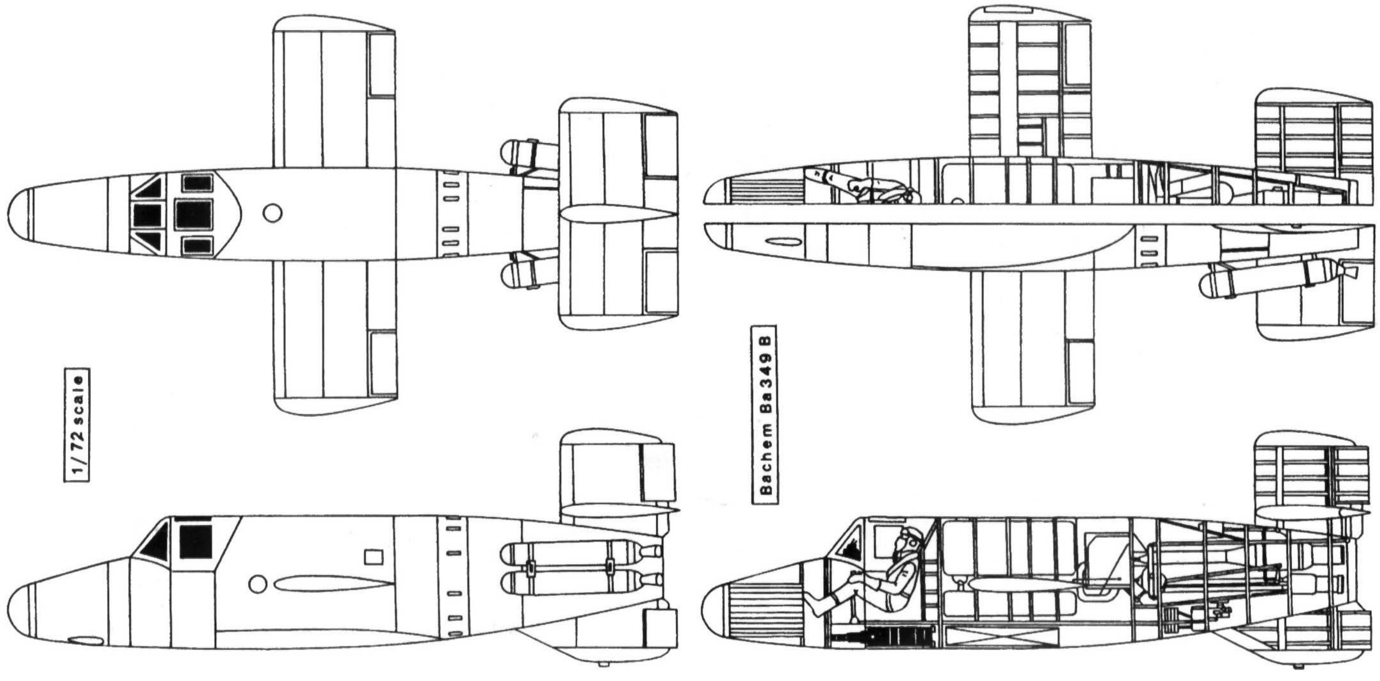
Production Ba 349 A Natter discovered by American forces in the Alpine region of Germany. The aircraft is equipped with launch tubes for 24 Hs 217 air-to-air rockets.

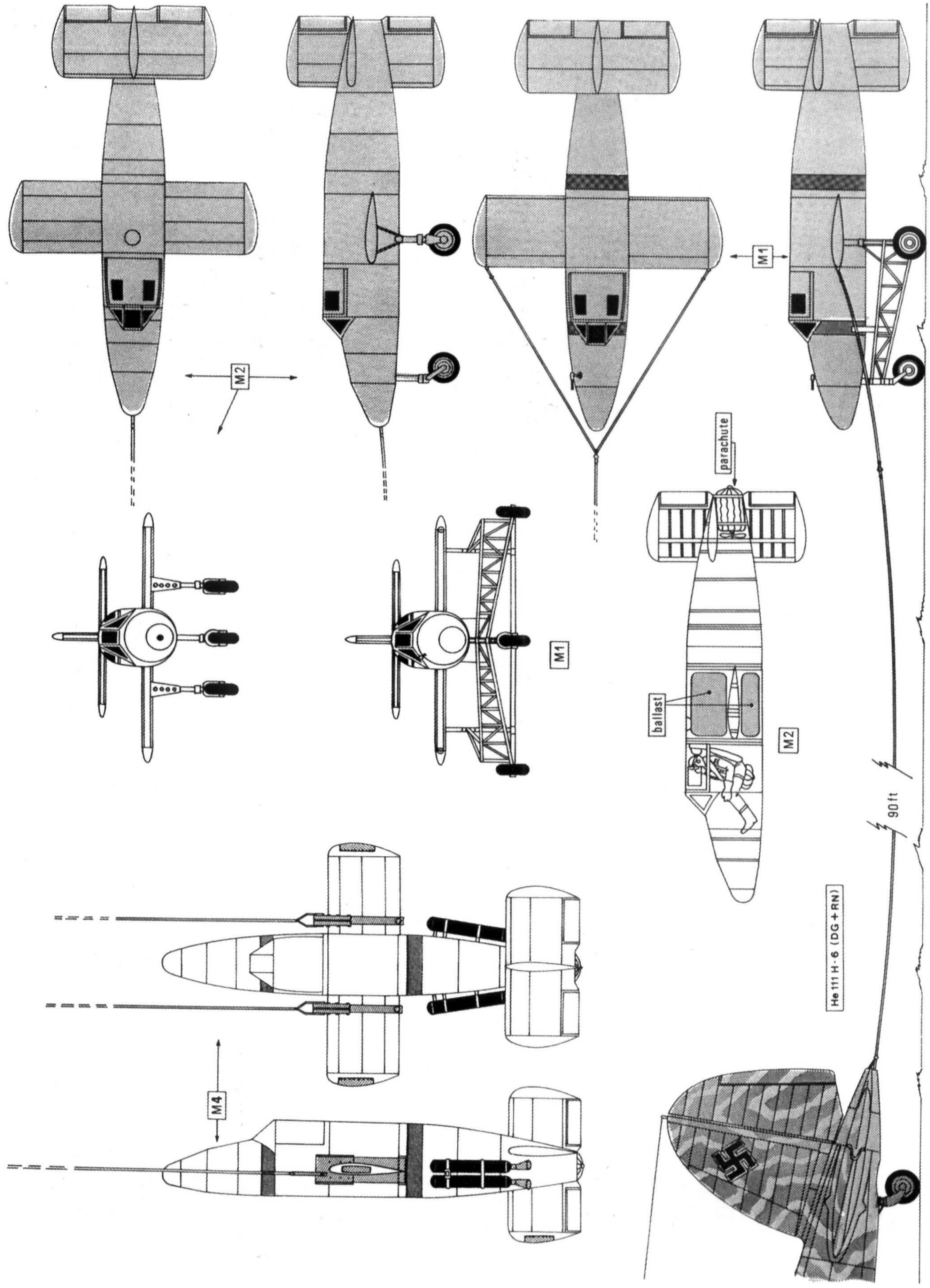
Front views of the Bachem Ba 349 A with "Grosse Rohrblock 108" battery (left) and tubes for 24 Henschel Hs 217 "Föhn" air-to-air rockets (right).



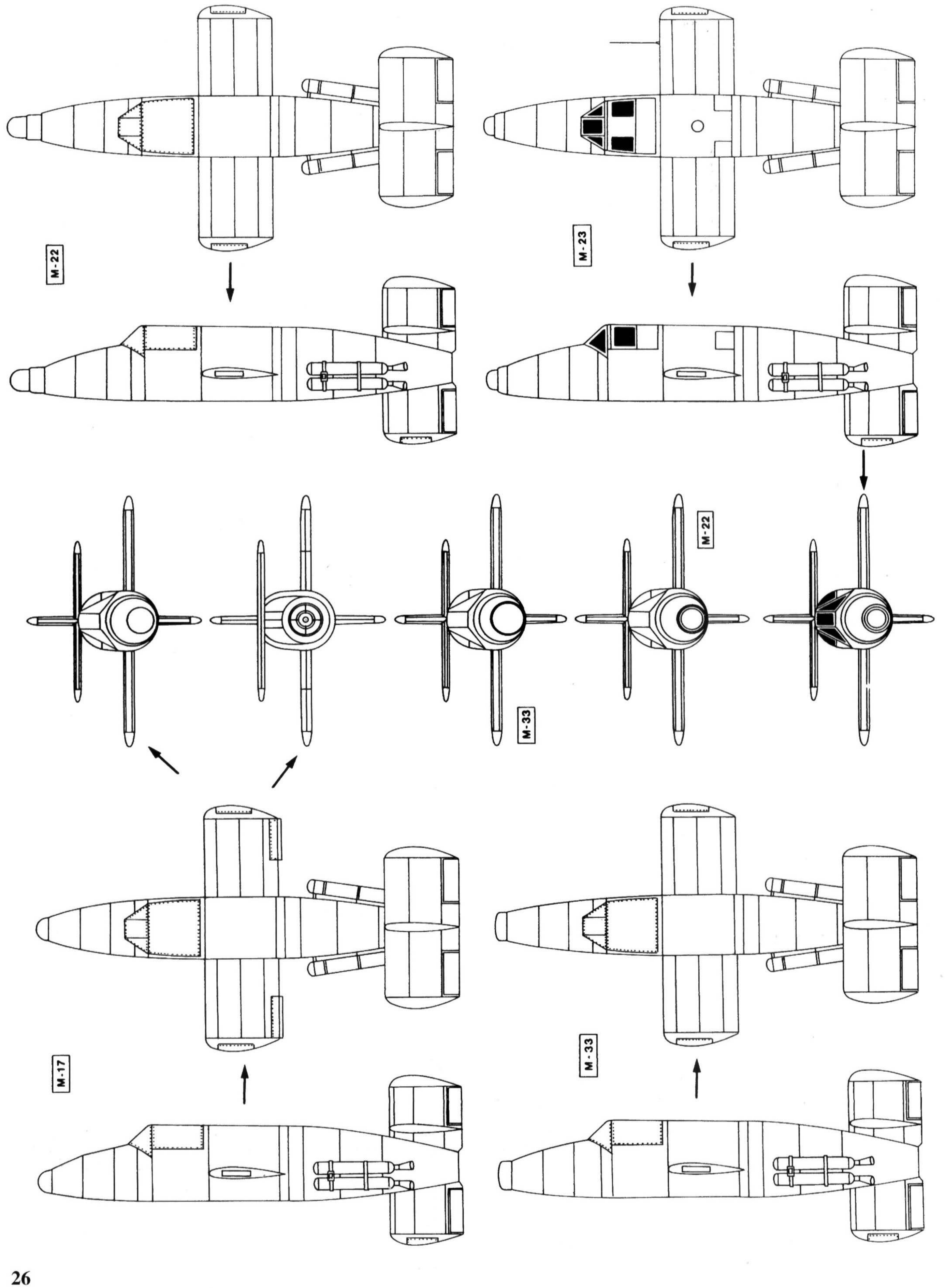
Bachem Ba 349 B armed with 32 R4M air-to-air rockets and two MK 108 cannon.



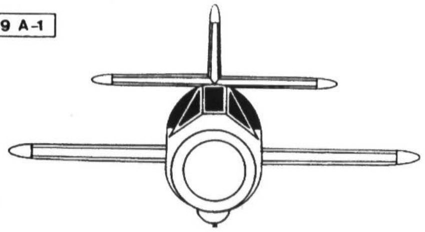




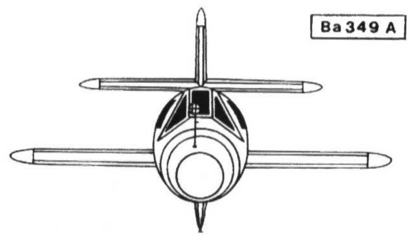
M2
M1
M1
parachute
ballast
M2
90 ft
He 111 H-6 (DG+RN)
M4

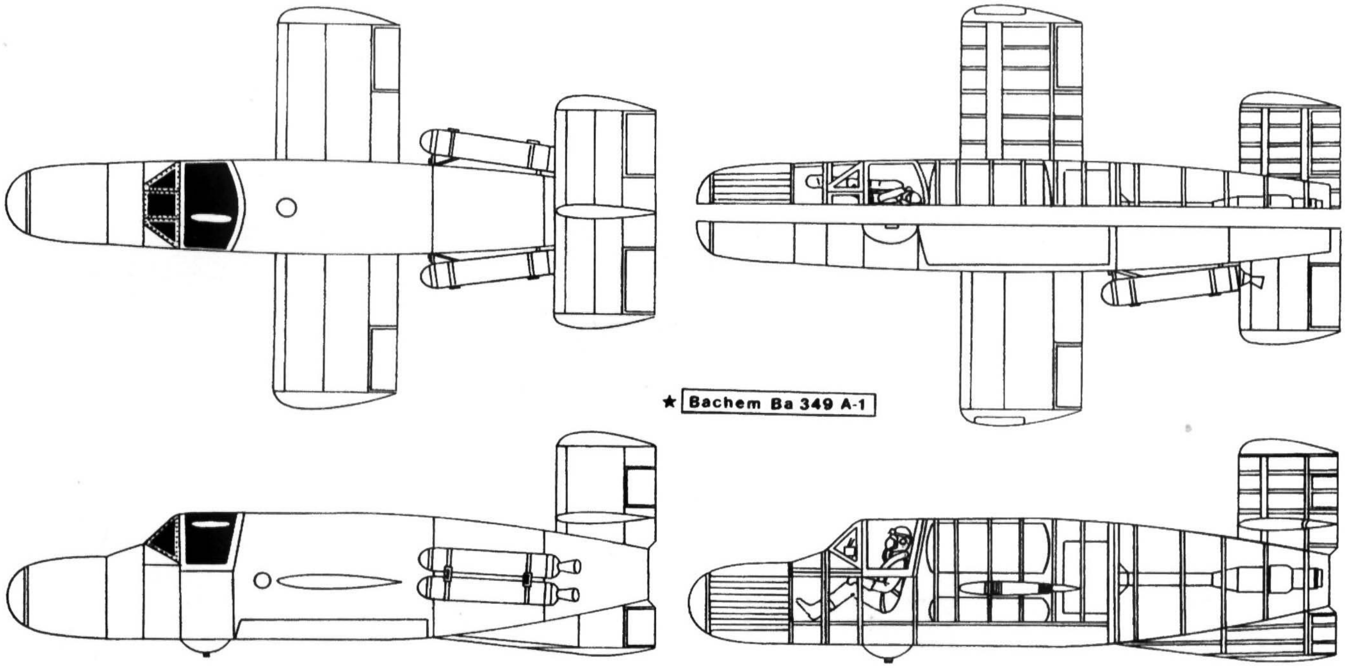

M-22
M-23
M-22
M-33
M-17
M-33

★ Ba 349 A-1



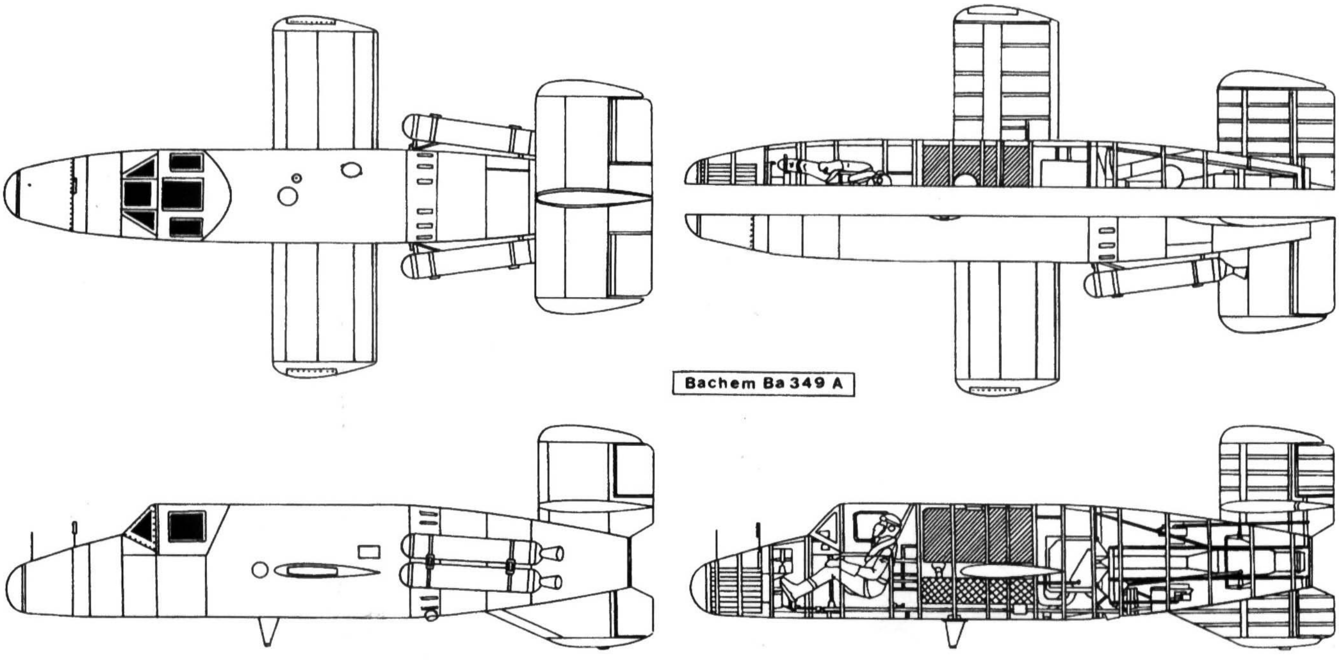
Ba 349 A



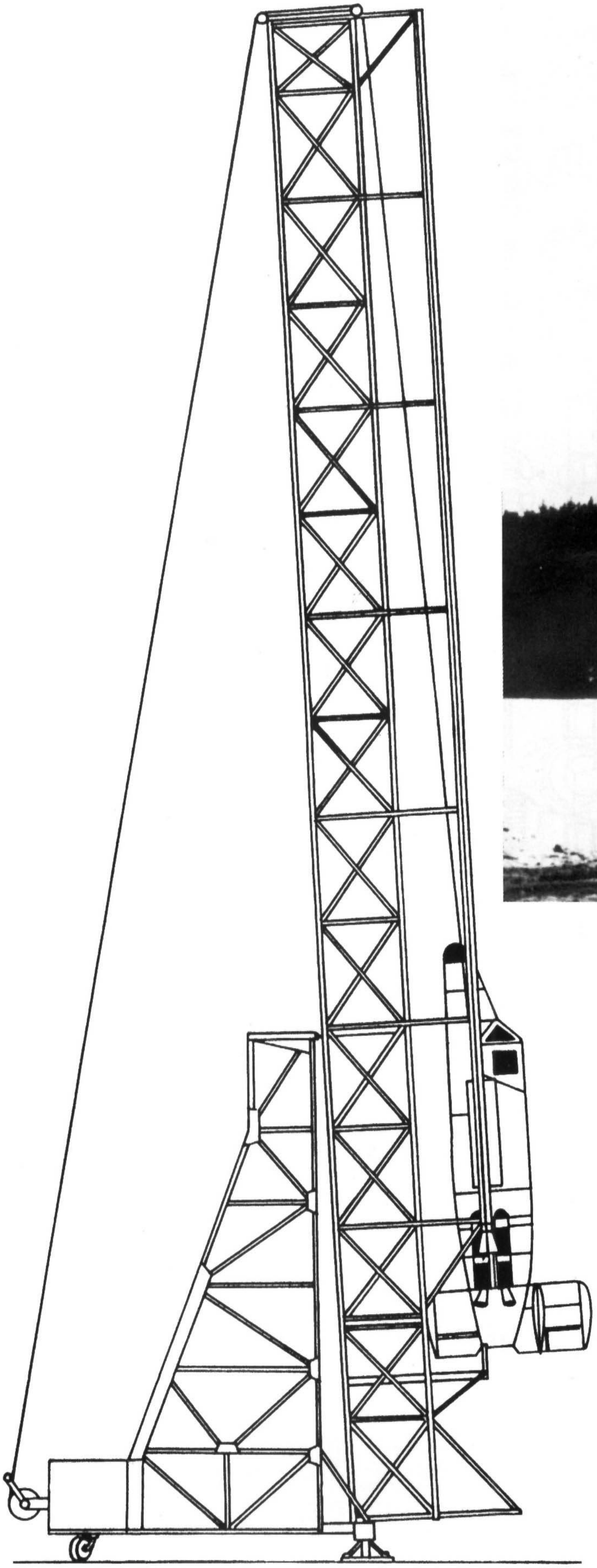


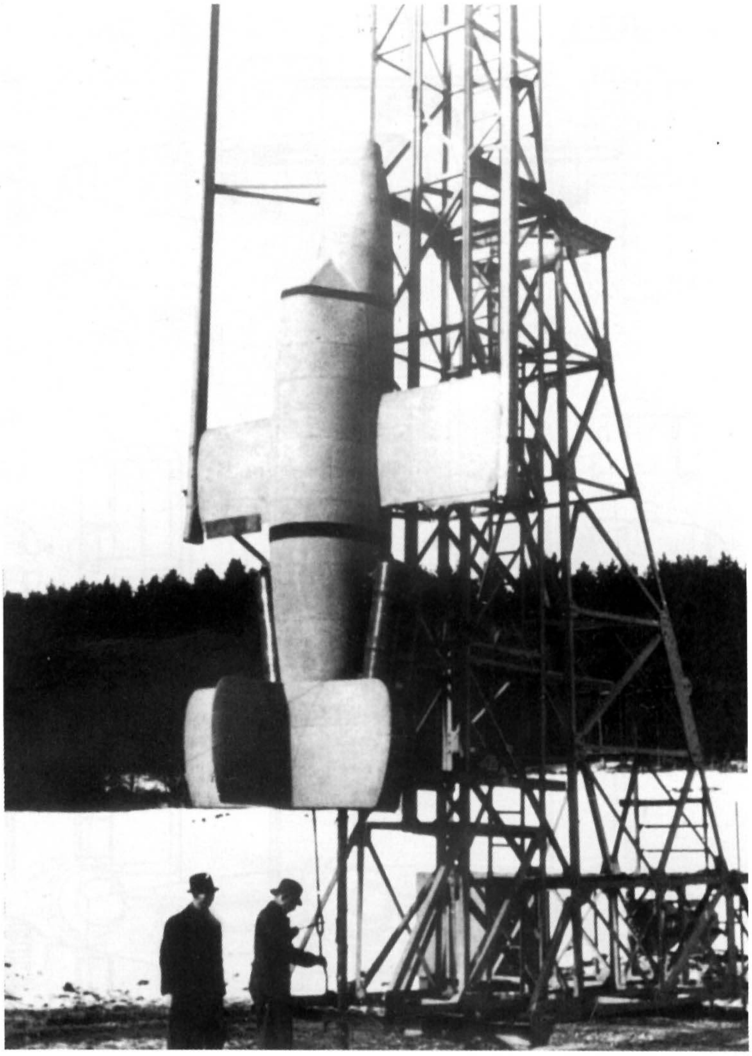
★ Bachem Ba 349 A-1

1/72 scale

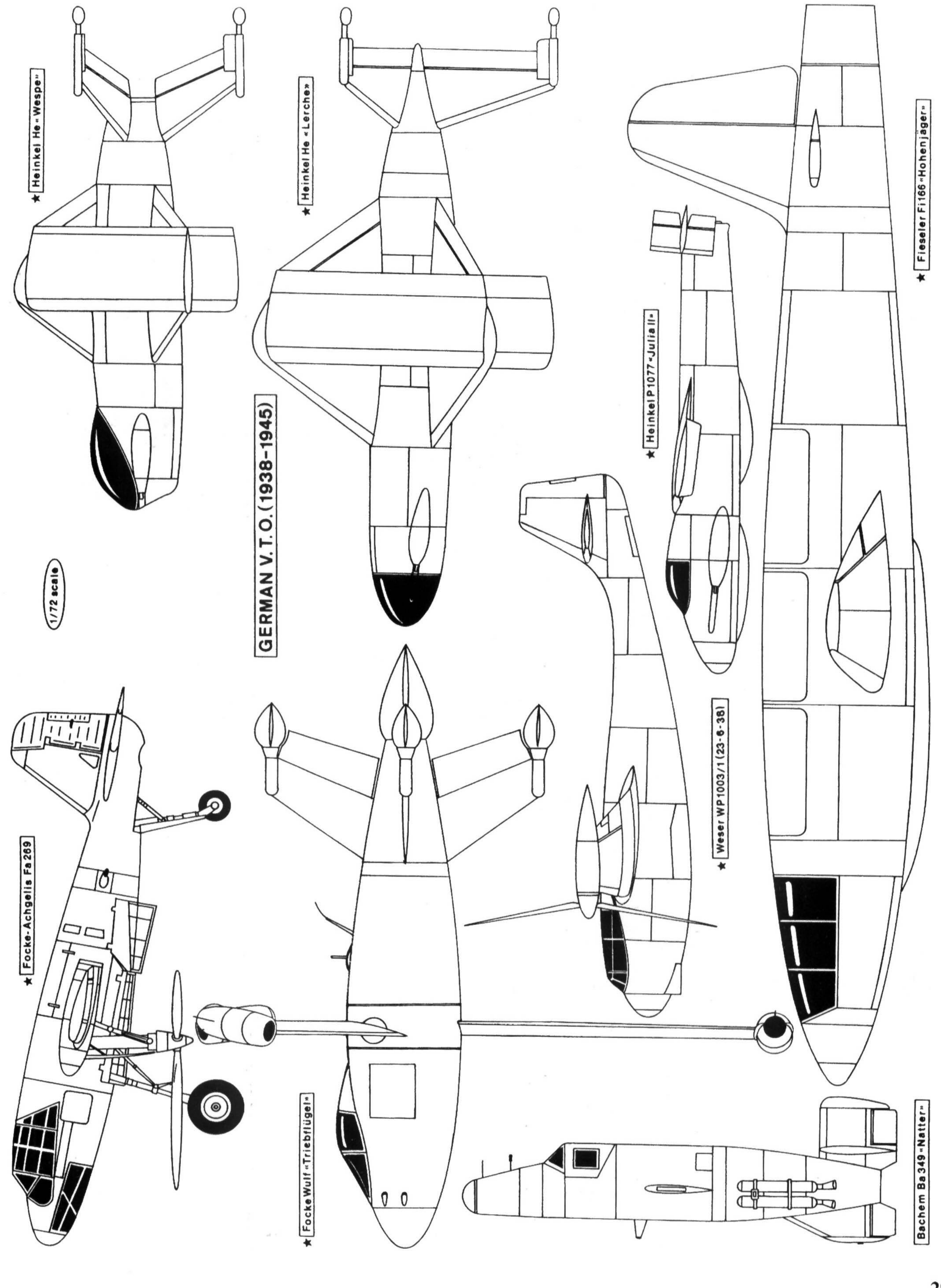


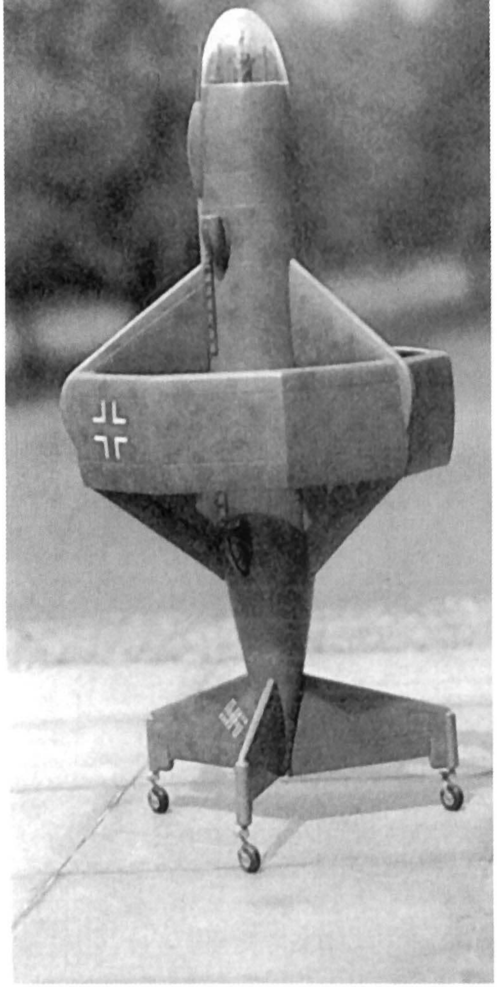
Bachem Ba 349 A

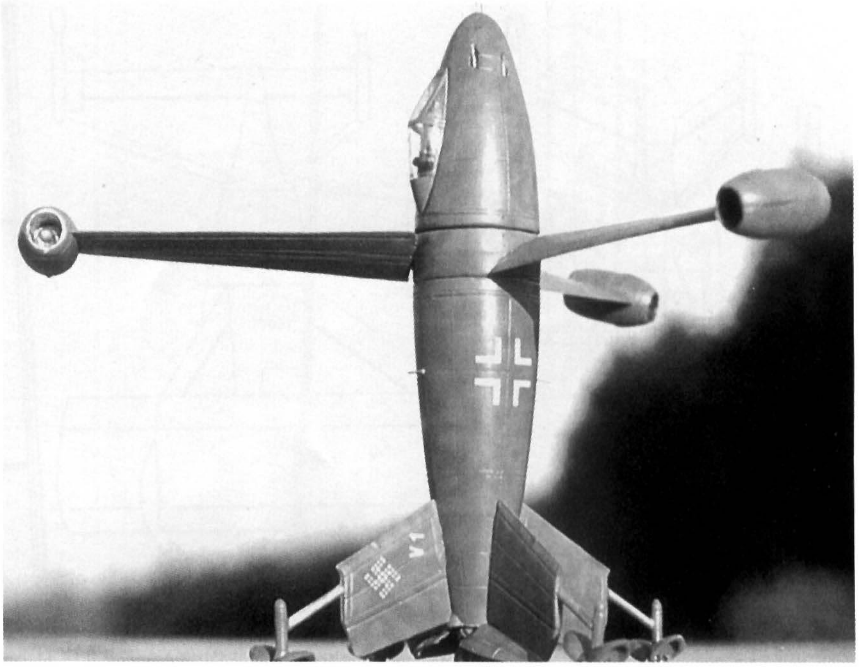




Drawing of the production version of the Bachem Natter launch tower.

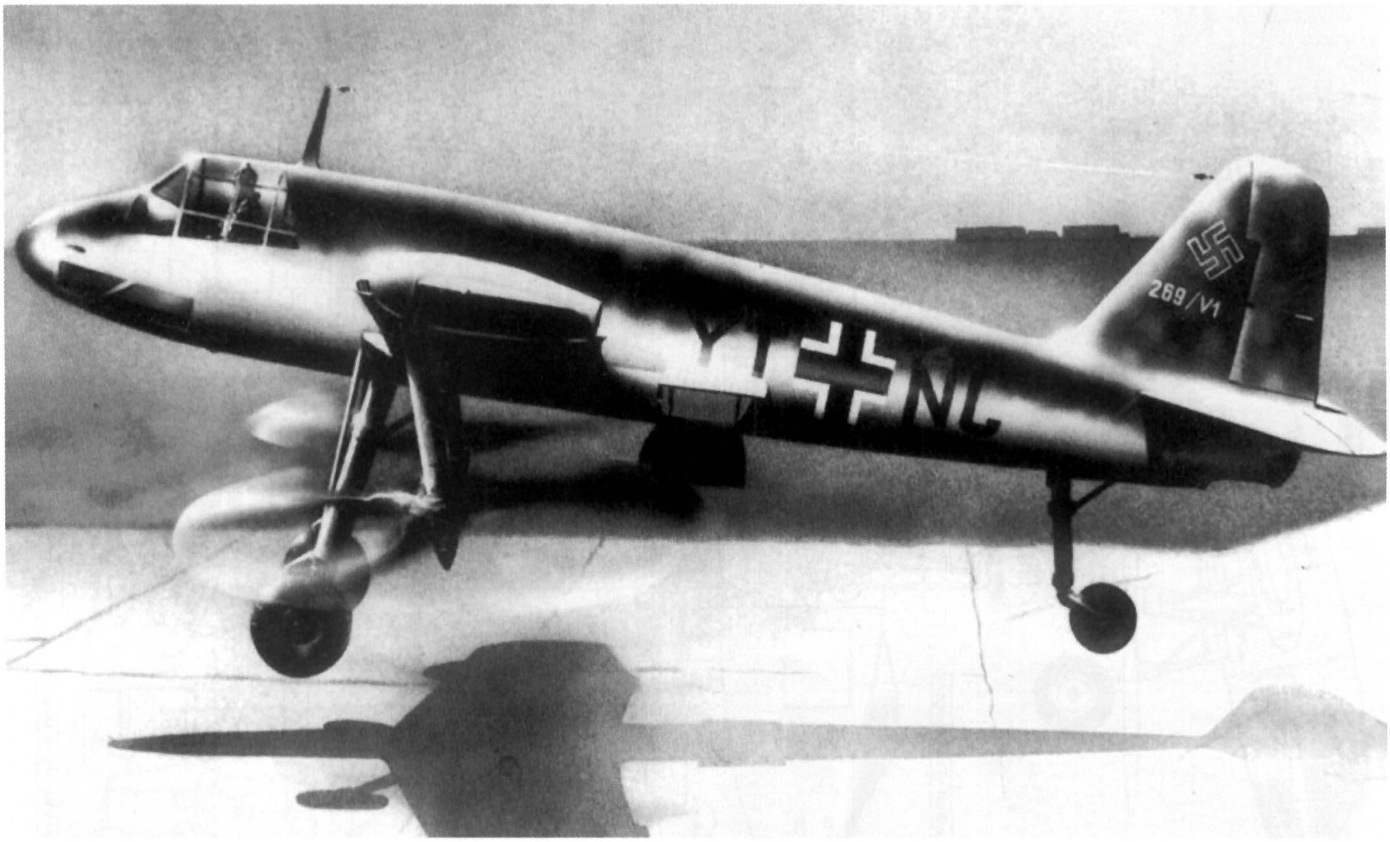

GERMAN V.T.O. (1938-1945)
1/72 scale
★ Heinkel He «Wespe»
★ Heinkel He «Lerche»
★ Fieseler Fi166 «Hohenjäger»
★ Heinkel P1077 «Julia II»
★ Weser WP1003/1 (23-6-38)
★ Focke-Achgelis Fa 269
★ Focke Wulf «Triebflügel»
Bachem Ba 349 «Natter»



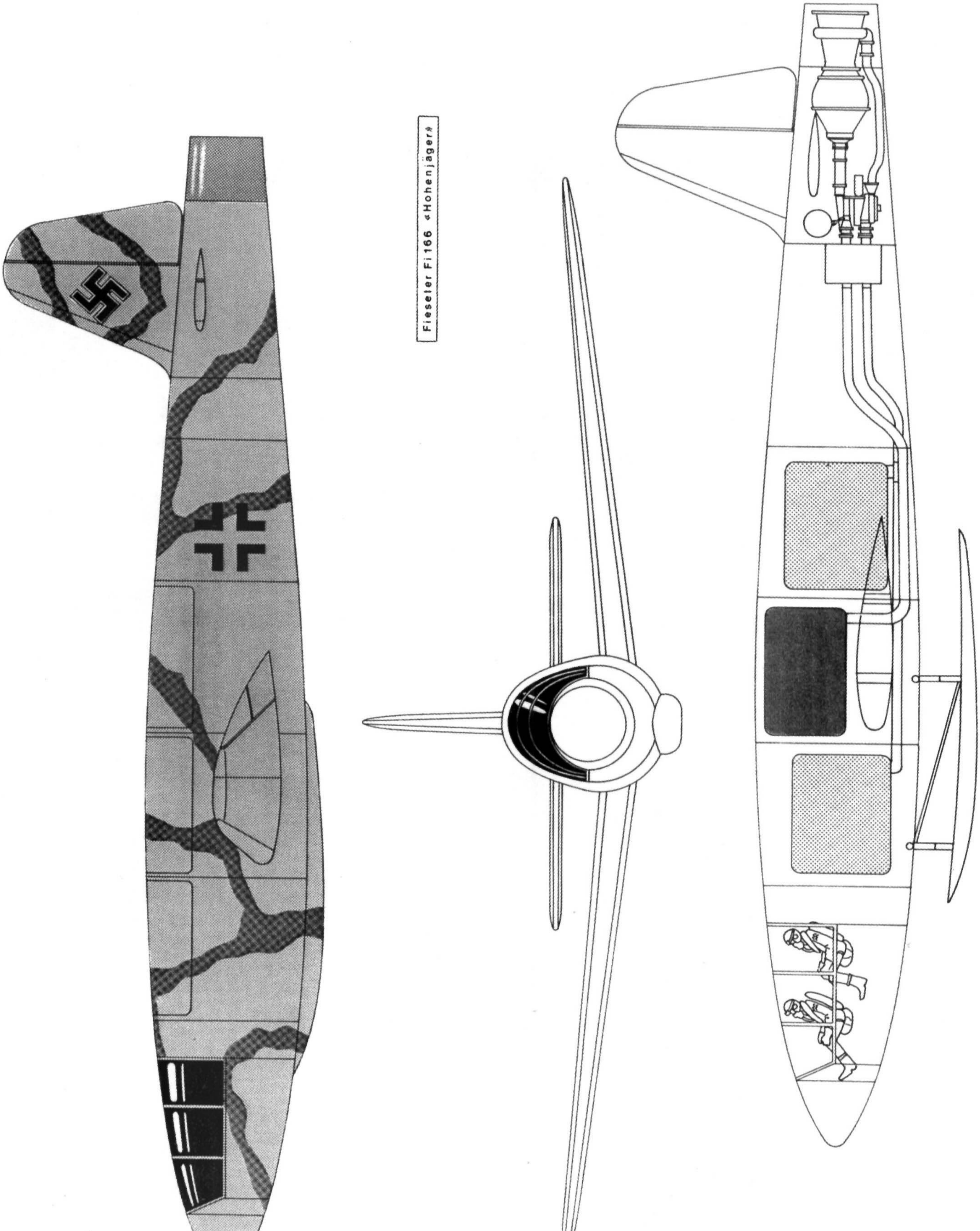


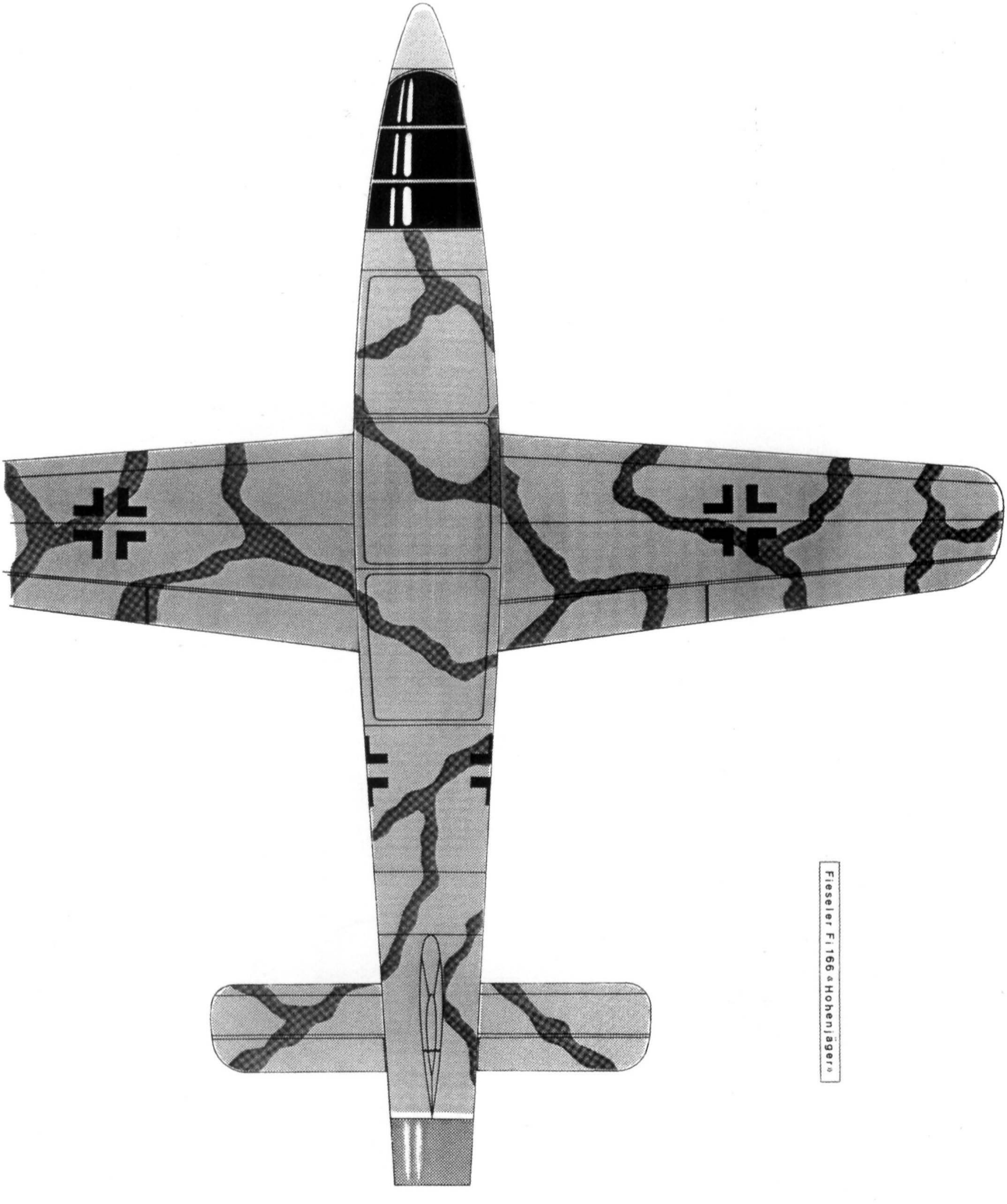
The Focke-Wulf "Triebflügel" project was for an interceptor with turbojet-powered wing-rotors. The wings rotated in a manner similar to the rotor blades of helicopters. The project was still in the development stage when the war ended.

The Heinkel "Lerche" ring-wing project also failed to proceed past the design study stage.



In response to the RLM's call for a vertical-takeoff fighter, the Focke-Achgelis company designed the Fa 269 with variable-position propellers. Fortunately this company drawing has survived. In the 1960s this concept was investigated by the Dornier company using the Do 29.

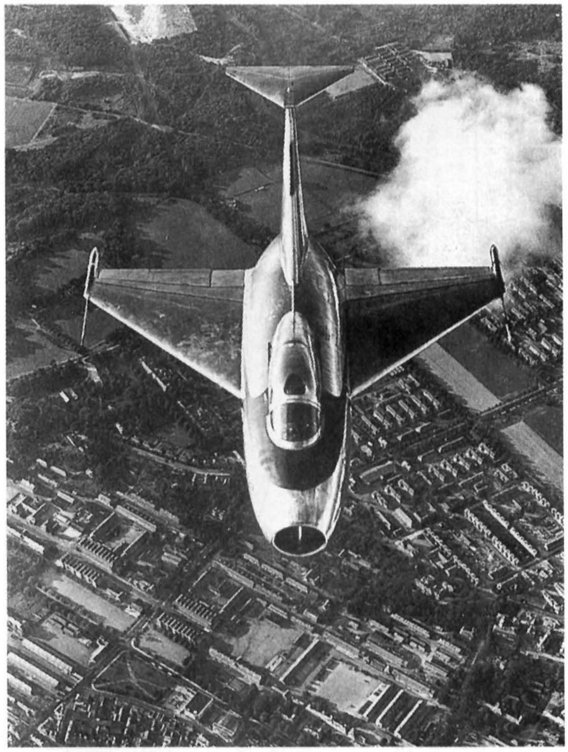

Fieseler Fi166 «Hohenjäger»



Fieseler Fi 166 »Hohenjäger«

Post-War Vertical-Takeoff Fighter Developments

1



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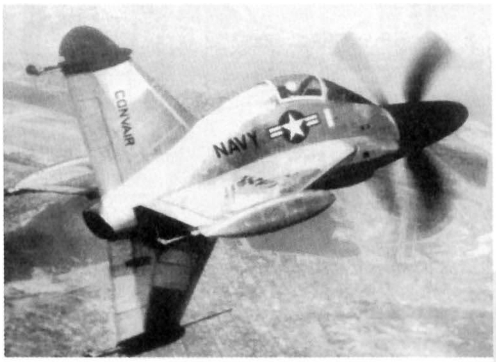
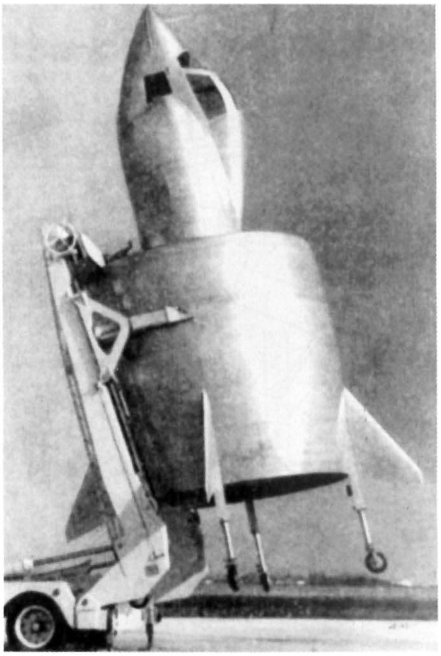


3

1 Lockheed XFV-1 Salmon
2 Fairey Delta 1
3 Convair XFV-1 Pogo
4 SNECMA C. 450.01 Coleopter
5 Ryan X-13 Vertijet



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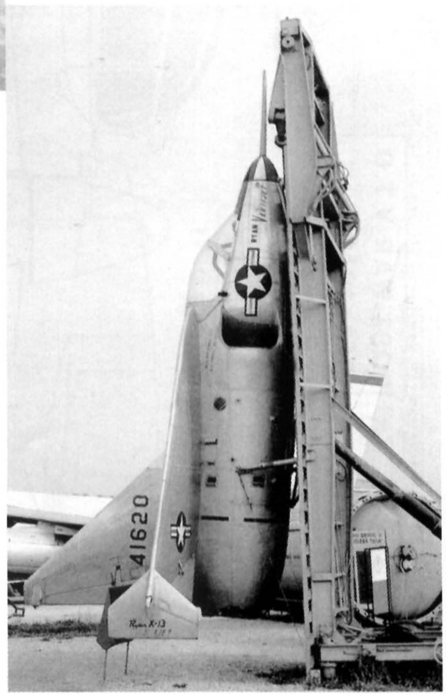

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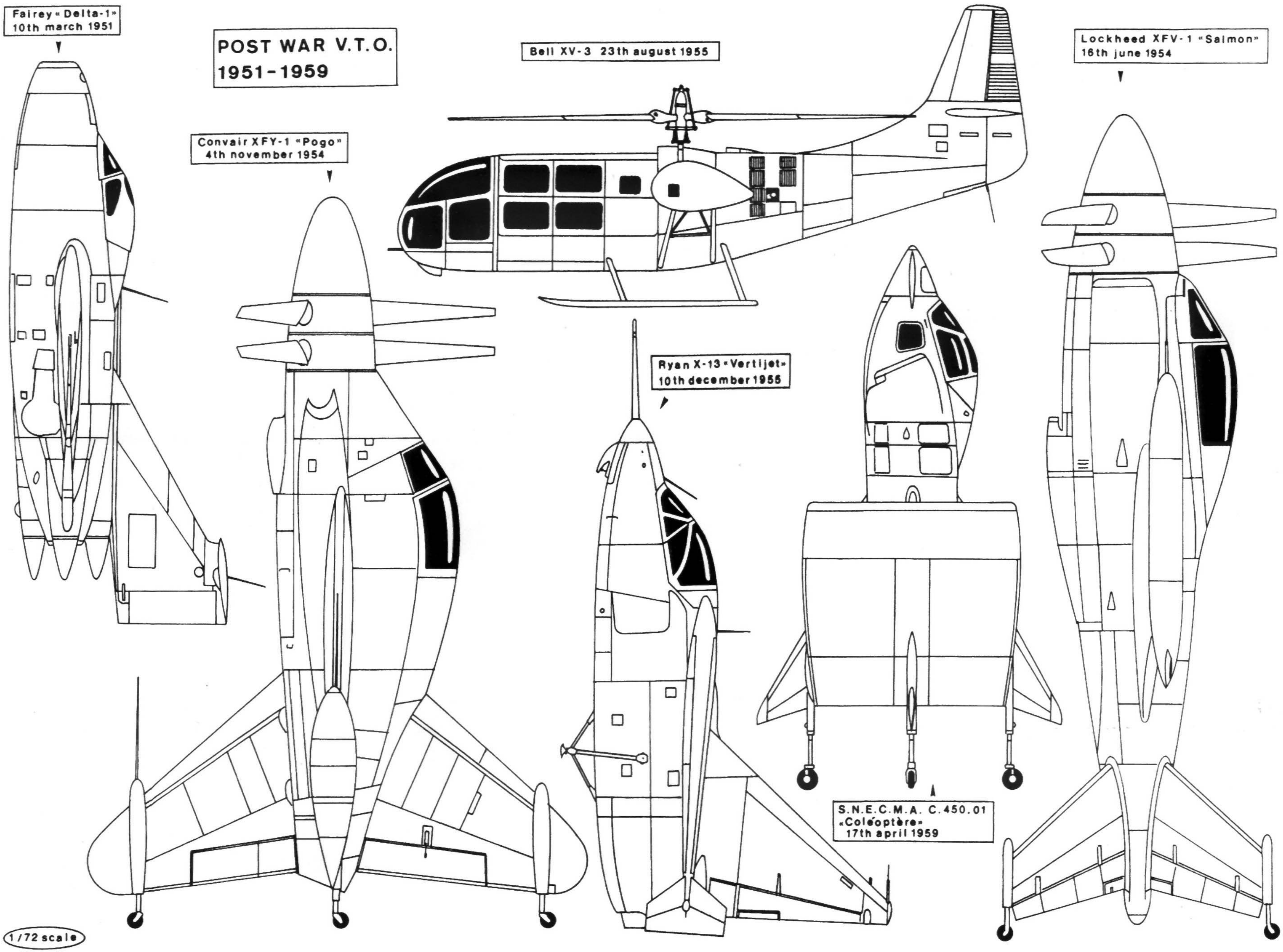
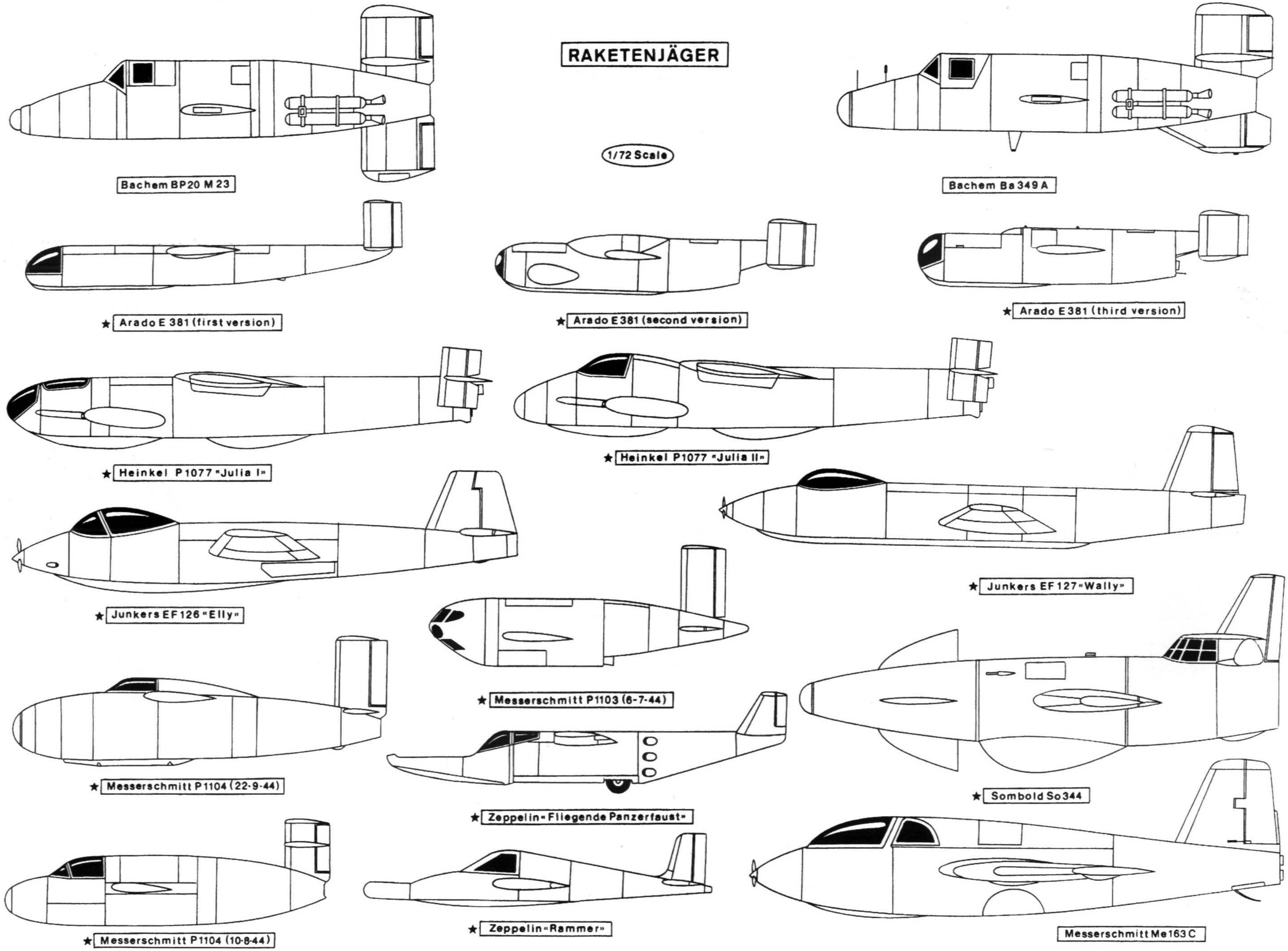
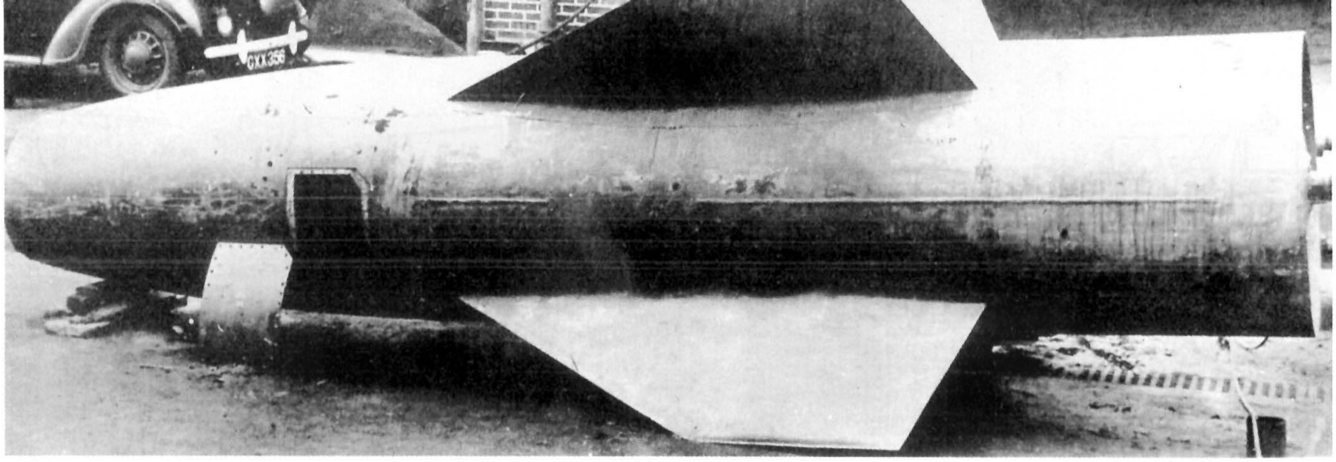


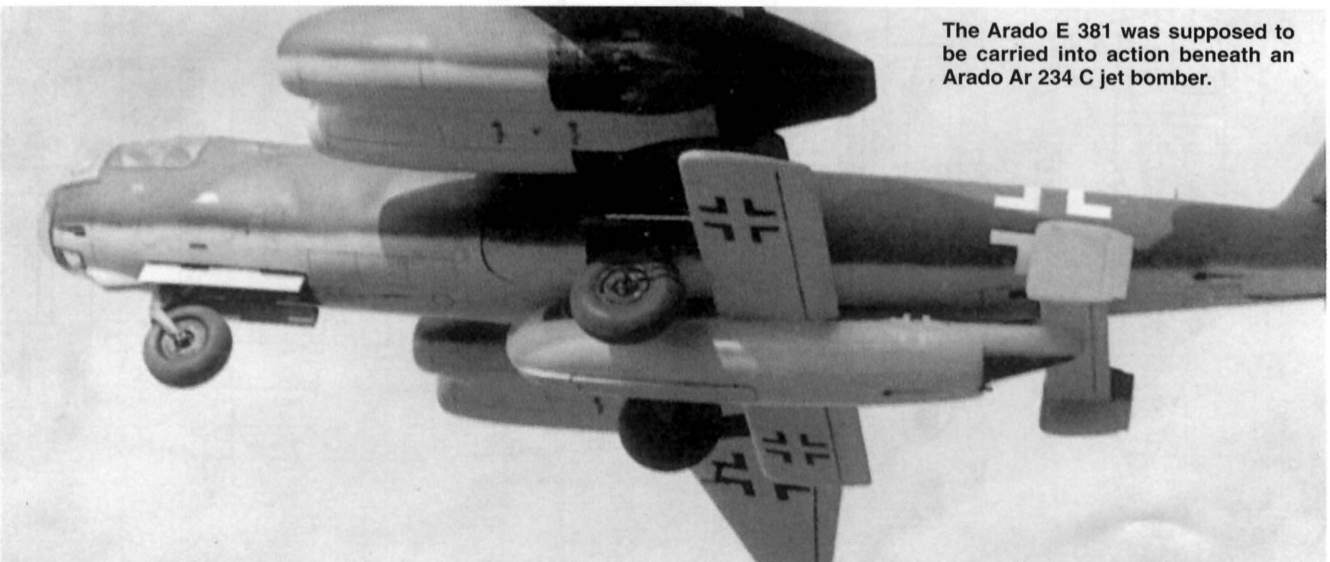
POST WAR V.T.O.
1951-1959
Fairey «Delta-1»
10th march 1951
Convair XFY-1 «Pogo»
4th november 1954
Bell XV-3 23th august 1955
Ryan X-13 «Vertijet»
10th december 1955
S.N.E.C.M.A. C.450.01
«Coléoptère»
17th april 1959
Lockheed XFV-1 «Salmon»
16th june 1954
1/72 scale


RAKETENJÄGER
1/72 Scale
Bachem BP20 M 23
Bachem Ba 349 A
★ Arado E 381 (first version)
★ Arado E 381 (second version)
★ Arado E 381 (third version)
★ Heinkel P1077 «Julia I»
★ Heinkel P1077 «Julia II»
★ Junkers EF 126 «Elly»
★ Junkers EF 127 «Wally»
★ Messerschmitt P1103 (6-7-44)
★ Messerschmitt P1104 (22-9-44)
★ Zeppelin «Fliegende Panzerfaust»
★ Sombold So 344
★ Messerschmitt P1104 (10-8-44)
★ Zeppelin «Rammer»
Messerschmitt Me 163 C



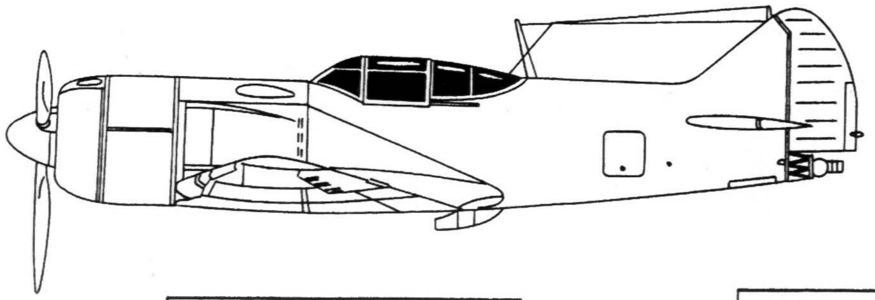
The only photo of the "Sombold Rammer" is this one, depicting the warhead section in the forward fuselage.

Of the numerous Soviet rocket interceptor projects, only this example of the Bereznyak-Isaev BI-1 survives, in the Monino Museum in Moscow.

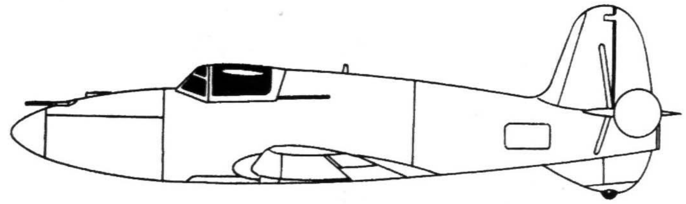


The Arado E 381 was supposed to be carried into action beneath an Arado Ar 234 C jet bomber.

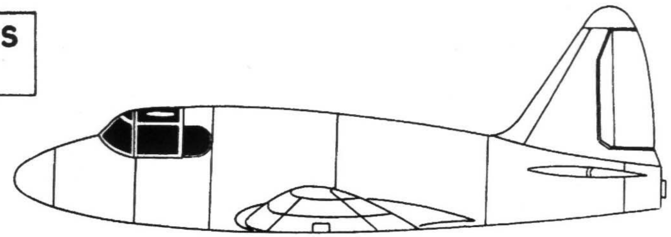
ALLIED ROCKET PLANES 1936-1944



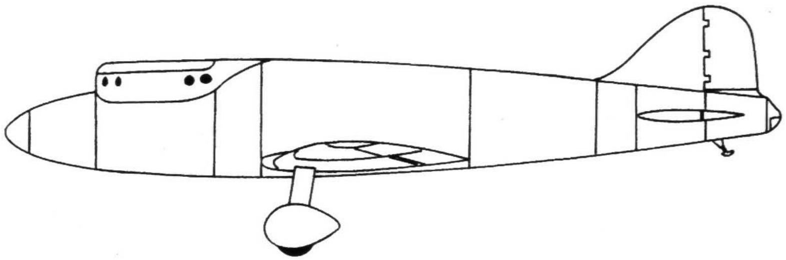
Lavochkin La-7R october 1944



Bereznyak-Isaev BI-1 may 1942

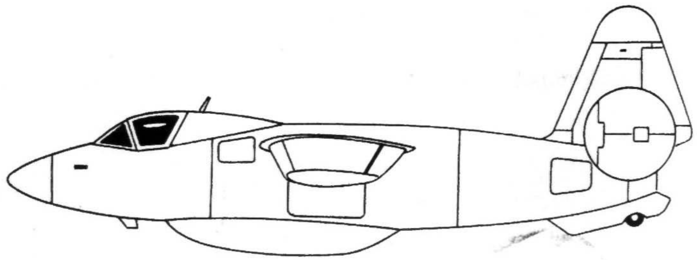


Polikarpov «Malyutka» 1944

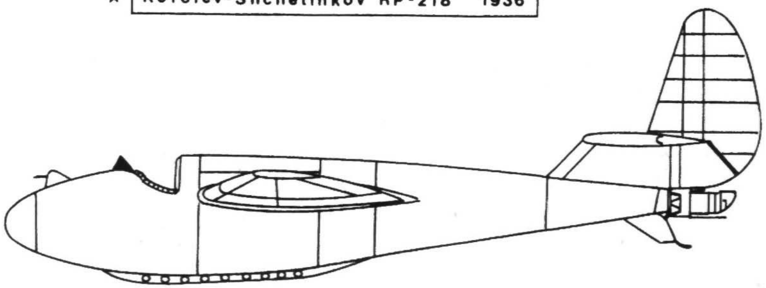


★ Korolev-Shchetinkov RP-218 1936

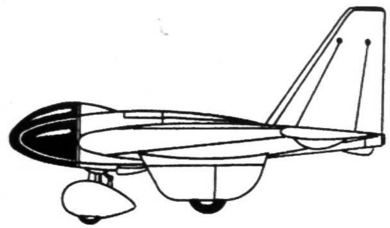
1/72 scale



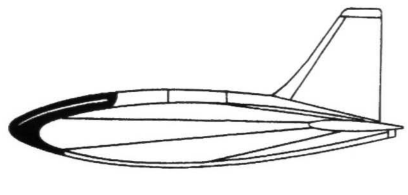
Florov N.4302 1944



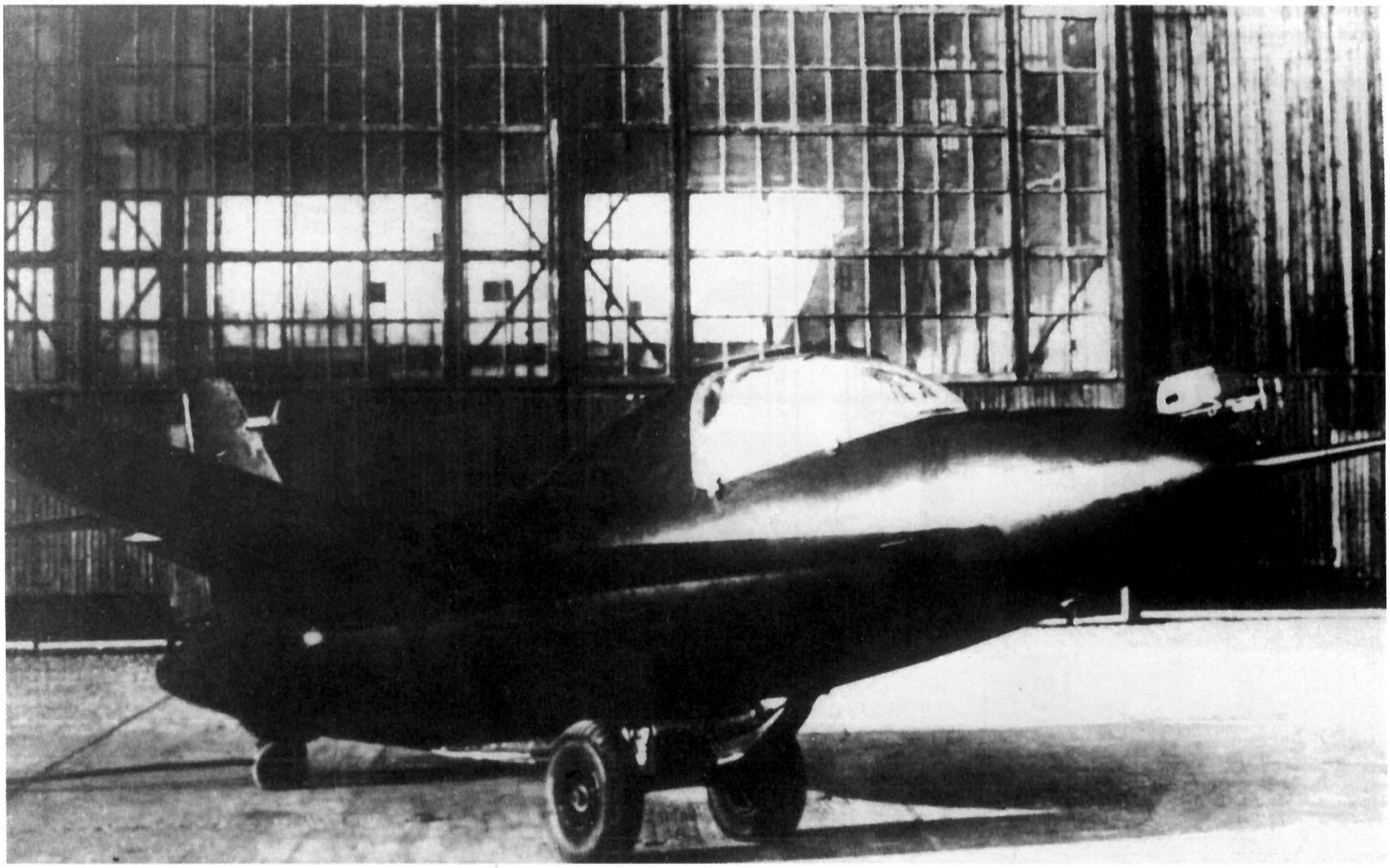
Korolev RP-318 28th february 1940



Northrop MX-324 2nd october 1943



★ Northrop XP-79

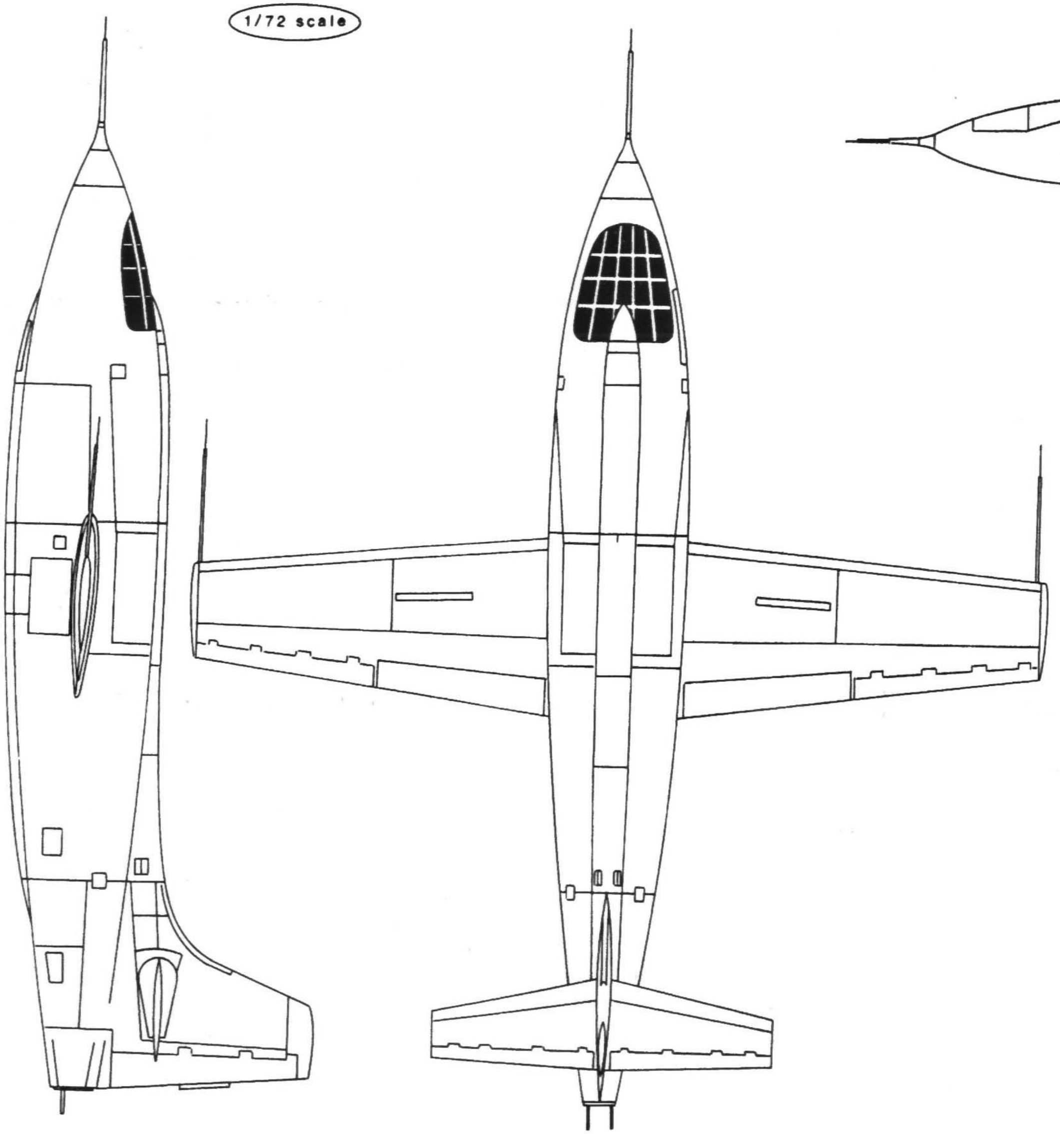


In contrast to the Tsybin LL-1 (see drawing on facing page), the LL-2 was fitted with a negatively-swept wing and was used for high-speed trials with the Ju 287 wing. This rocket-powered aircraft completed more than 100 test flights.

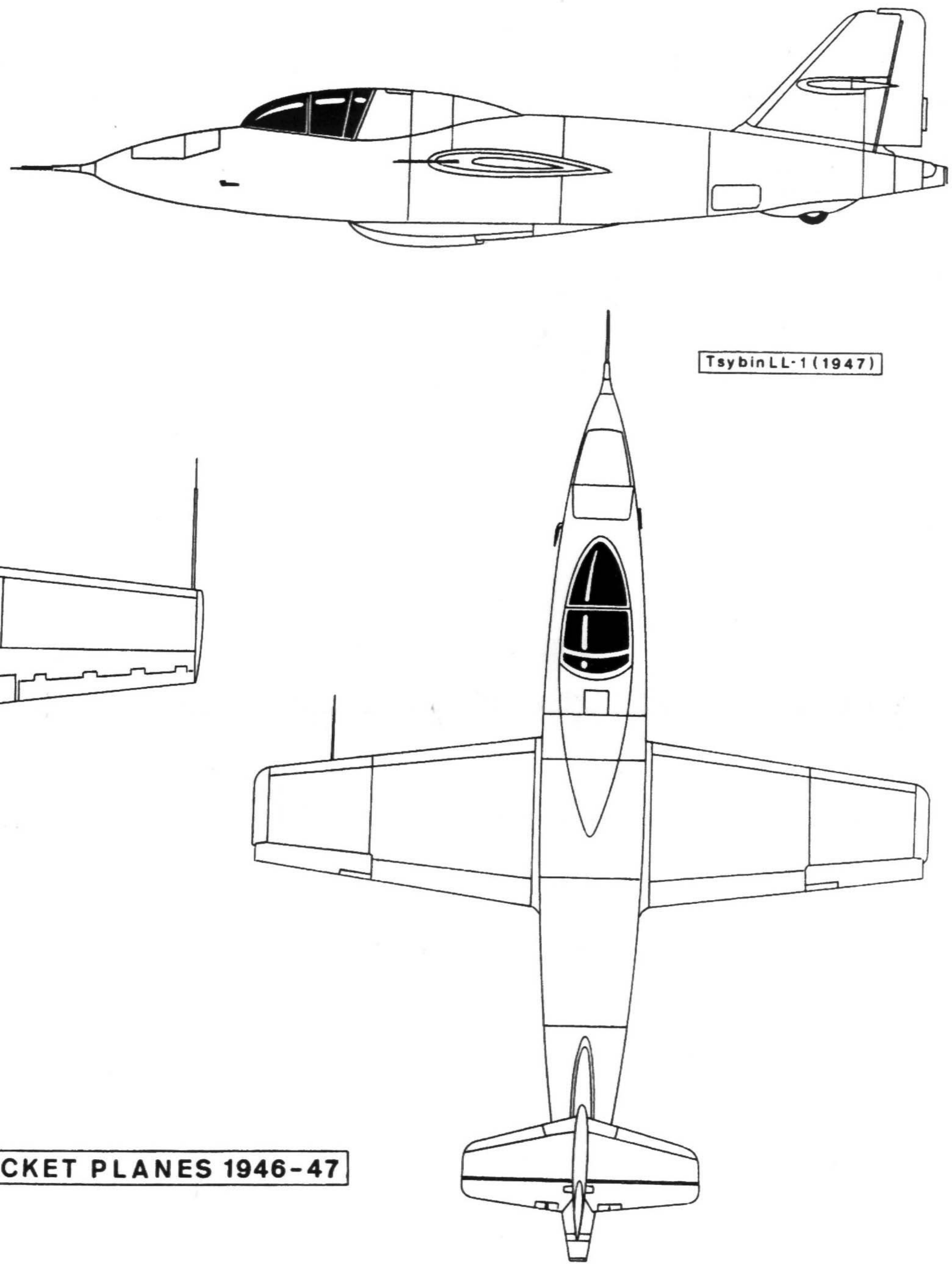
The Bell X-1 launched a new age when it broke the sound barrier. Although not an interceptor fighter, it did set the scale for all subsequent rocket interceptor developments.

ROCKET PLANES 1946-47

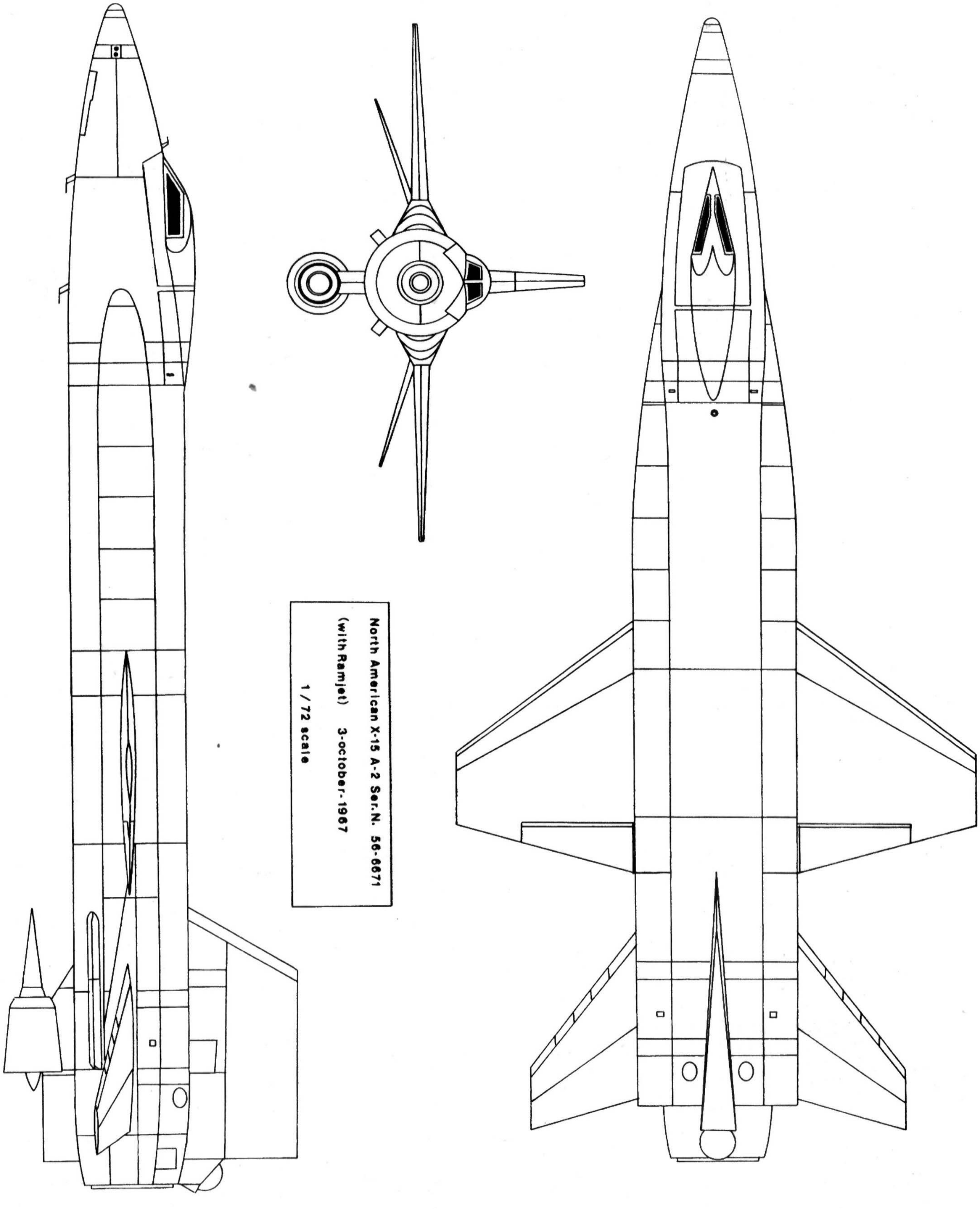
1/72 scale



Bell X-1 (9th december 1946)



Tsybin LL-1 (1947)



North American X-15 A-2 Ser.N. 56-6671
(with Ramjet) 3-october-1967
1 / 72 scale

Color photographs of the two competing designs for an American vertical-takeoff fighter, the Convair XFY-1 Pogo (left) and the Lockheed XFV-1 Salmon (right).

To date the X-15 represents the apex of rocket aircraft development, having achieved speeds on the order of Mach 6.7.

Miranda/Mercado LUFTWAFFE PROFILE SERIES NO.17 • Vertical Takeoff Fighter Aircraft •

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