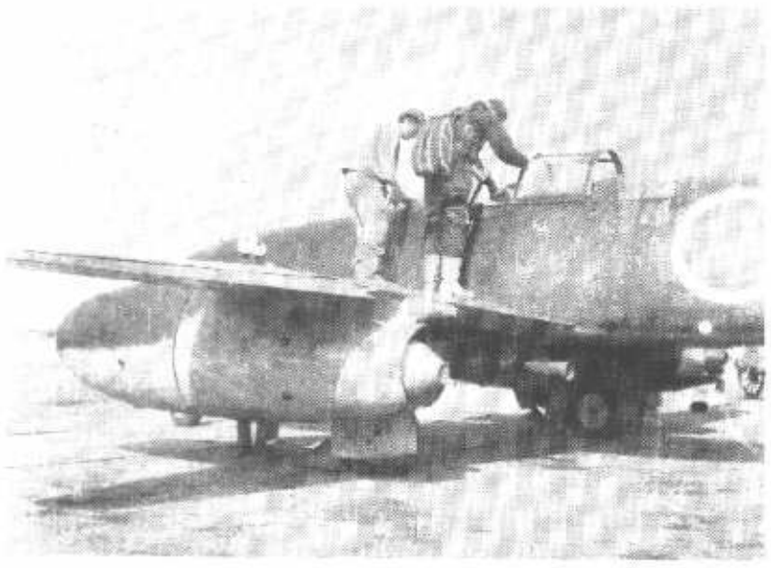
MONOGRAM

Close-Up 19

KIKKA



Pilot Takaoka boarding Kikka for its second, but aborted test flight.

Author Robert C. Mikesh has actively gathered information and background about Kikka for more than ten years, bringing him in contact with many who have contributed to a most definitive study on this historic airplane. Among these are Mr. Susumu Takaoka, Japan's first jet pilot, who told of his first hand accounts with Kikka and provided other factual information. Early in the preparation of this study, details on the development of Japan's jet engines were dramatically reconstructed by the late Dr. of Engineering, Tokiyasu Tanegashima, former IJN Captain. Dr. Osamu Nagano, Executive Vice-President of Ishikawajima-Harima Heavy Industries (IHI), noted for his early research in jet engine principles and who did much of the development work on the Ne 20, prepared many documents used for this CLOSE-UP, and reviewed the final manuscript for content. Others who contributed to the technical aspects of this book are former IJN First Lieutenant Ichiro Naito, previously with the Yokosuka Experimental Flight Wing during the development period of Kikka and an avid aviation historian and writer in post war years. Mr. Shorzoe Abe, formerly with Japan Defense Agency and an aviation historian, provided considerable information over the years to assist the author on this and many other Japanese subjects. Other technical assistance was received from Dr. Kaneichiro Imai, General Manager of IHI, Aero Engine & Space Development Group, and Messers Paul L. Dawson and I. W. Victor of General Electric Co. The enthusiastic help with extensive translations came from Atsushi Hirota, Toru Miyagi, Kazuo Ohyauchi, Osamu Tagaya, Hisako Naito and Chang-su Cho Houchins.

The drawings of Kikka which appear in this report are the most accurate yet published. Since the destruction of Japanese wartime drawings was almost total, all previously published illustrations were drawn against surviving photographs. The author was able to correct this shortcoming by working directly from the sole surviving example now in storage at Silver Hill, Maryland. Just before going to press, it has been learned that preliminary plans have been made for the full restoration of Kikka by the talented staff of the National Air and Space Museum.

The photographs in this report consist of virtually every known picture of Kikka previously published, plus many more appearing for the first time. Some of the many contributors deserving special thanks are Messers Hideya Ando, Peter M. Bowers, T. M. Emmert, R. S. Esposito, G. V. Henderson, Thomas H. Hitchcock, and last but by no means least, Mannosuke Toda. The superb centerspread created by Graham Wragg, adds immeasurably to our preception of Kikka's first flight.

- Drawing credits

All drawings are by the author except:
Robert D. Migliardi: 8, 9T
Graham Wragg: 14, 17, 18

- Back cover design: Nakajima Monogram

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KIKKA or KITSUKA *Two spellings for the name of this aircraft have been used, neither of which can be said to be incorrect. Simply stated, the name is Kitsuka, yet pronounced Kikka. The earliest record of the written name in English usage for this airplane is found in the many interrogations that were written immediately after the war. The spelling most frequently used was Kikka, a form that would have come from those Japanese assisting in documenting their technology in English. This spelling may have been selected for simplicity since it is as close as practical to being phonetically correct. Kitsuka would be the proper spelling of the two Japanese kanji characters that make up this word, however their joining brings about an improper pronunciation for English readers. Kikka has become the accepted spelling of this word and therefore is used in this form throughout this book.*

Like so many things of Japanese origin, there is a symbolism to the name Kitsuka--or Kikka. The story is told that Kitsuka as well as Ohka (or Baka Bomb as the Allies called it) received their names from trees in the courtyard of the Imperial Palace in Kyoto. This courtyard contains the present Shishiden, or main entrance to the Imperial suite, the site of the coronation ceremonies of Japan's wartime ruler, Emperor Hirohito. Lining the stairway on the left are cherry trees, and on the right, are wild orange trees. These sacred trees are considered guardians of the Emperor and are accordingly honored with imperial court ranks.

Therefore, the aircraft having the name Kitsuka, meaning wild orange blossom, and Ohka, which translates to cherry blossom, along with their pilots would serve as guardians of Imperial Japan, just as did their arboreal counterparts flanking the stairway at Shishinden. Both of these airplanes were conceived during the same time period with similar Special (suicide) Attack missions.

Although Kitsuka is the literal translation of the two kanji; Kitsu-ka, the natural pronunciation of "tsu" becomes too strong. Another phonetic spelling would be Kitska with less accent on the "ts," but Kikka has proven to be the safest spelling for a more accurate pronunciation. One author has translated this spelling of Kikka back into Japanese and found the word "Chrysanthemum," which is now associated with the Kikka Trophy (horse) Race. This however is an inaccurate translation of the original name.

One early historian of Japanese aircraft coined the J9Y1 designation of Kikka, to the point that other writers have expanded its use. As a jet interceptor version of Kikka, this designation would be a logical one, falling in what is believed to have been the proper sequence. However, there is no Japanese documentation that supports the official assigning of this designation, nor is there strong feeling among aviation historians in Japan that this assignment was ever made. Other designations found in similar postwar accounts about Kikka have been J8N1, MXN1, 19-shi Type B Homeland Weapon, all reasonable and logical, but none can be supported by Japanese military documentation. Kikka, like several other late war Japanese planes, though given names, were conspicuous in not having a type designation assigned.

KIKKA

By Robert C. Mikesh

"The climb out and level off at 600 m (2000 ft) altitude was more rapid than I had anticipated. Throughout my instrument cross-check and keeping a visual observance on the outside, my eyes could not help but momentarily become fixed on the air inlet of each jet engine nacelle. It was difficult to believe that there was no propeller pulling me. There had to be one on each side—turning so rapidly that I could not make out the usual blurred propeller disc. But it was true, these were pure jet engines, and they were propelling me with greater performance than I had ever experienced before."

This event was still quite vivid in Mr. Susumu Takaoka's mind and he recounted the story as though the event had just taken place. Takaoka, then a Lieutenant Commander in the Imperial Japanese Navy, became Japan's first jet pilot with that flight of the Nakajima built Kikka on that summer afternoon of August 7, 1945. The flight was made from the Naval Air Base at Kisarazu, on the east side of Tokyo Bay.

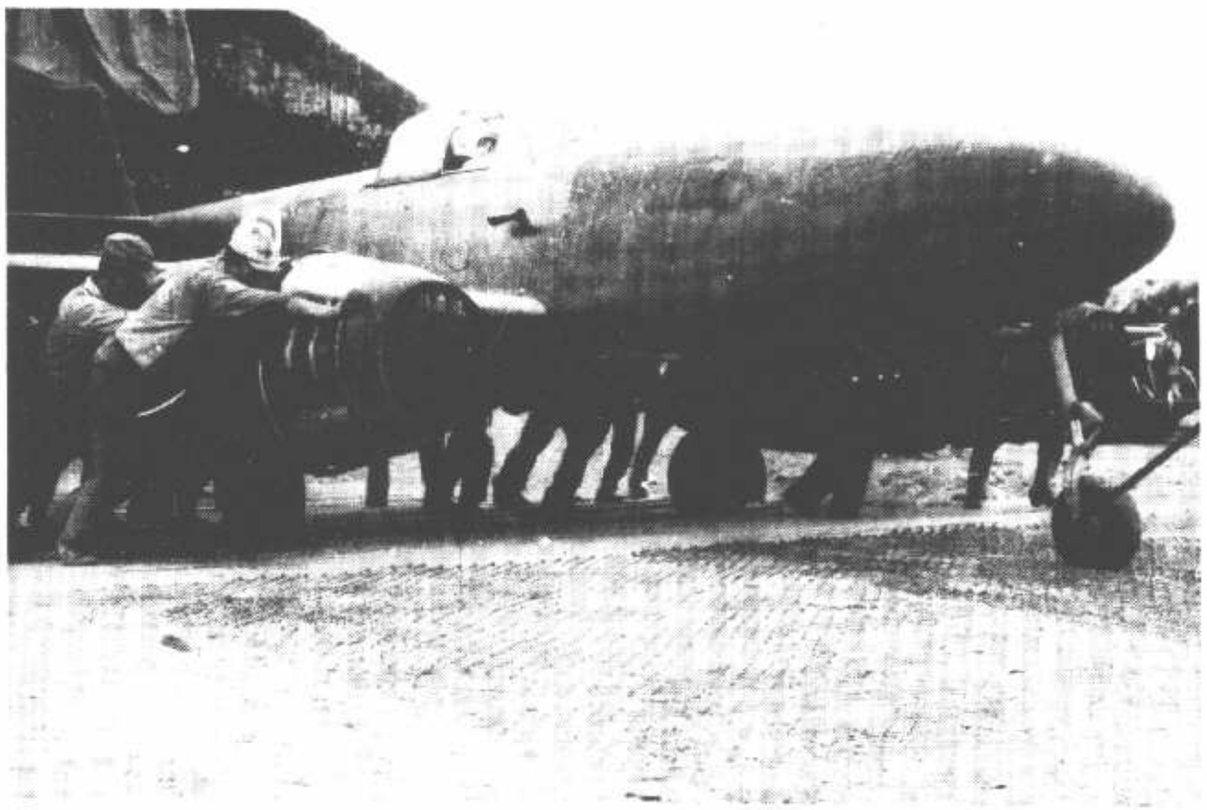
"The lack of noise and engine vibration was something that I was not prepared for," Takaoka continues. "This made me a bit apprehensive, for in testing other aircraft these two factors supplemented the readings of the instruments in telling me how the engines and the airplane were performing. Now there was only a very soft metallic high pitched noise, and a slight high frequency vibration that told me nothing more than that something was running. In a way, the sensation was like being in a glider—but not so after checking the airspeed indicator.

"I circled over Tokyo Bay, keeping the runway at Kisarazu in sight at all times for an immediate return in the event something might go wrong. The airspeed kept increasing and I was having to make frequent, yet cautious power reductions from the initial 11,000 rpm setting. The landing gear remained extended for this flight and I could not exceed the gear down speed of 170 knots. This flight had to be brief since I had a very light fuel load for about sixteen minutes, yet I had to learn as much as possible about Kikka on this first test flight.

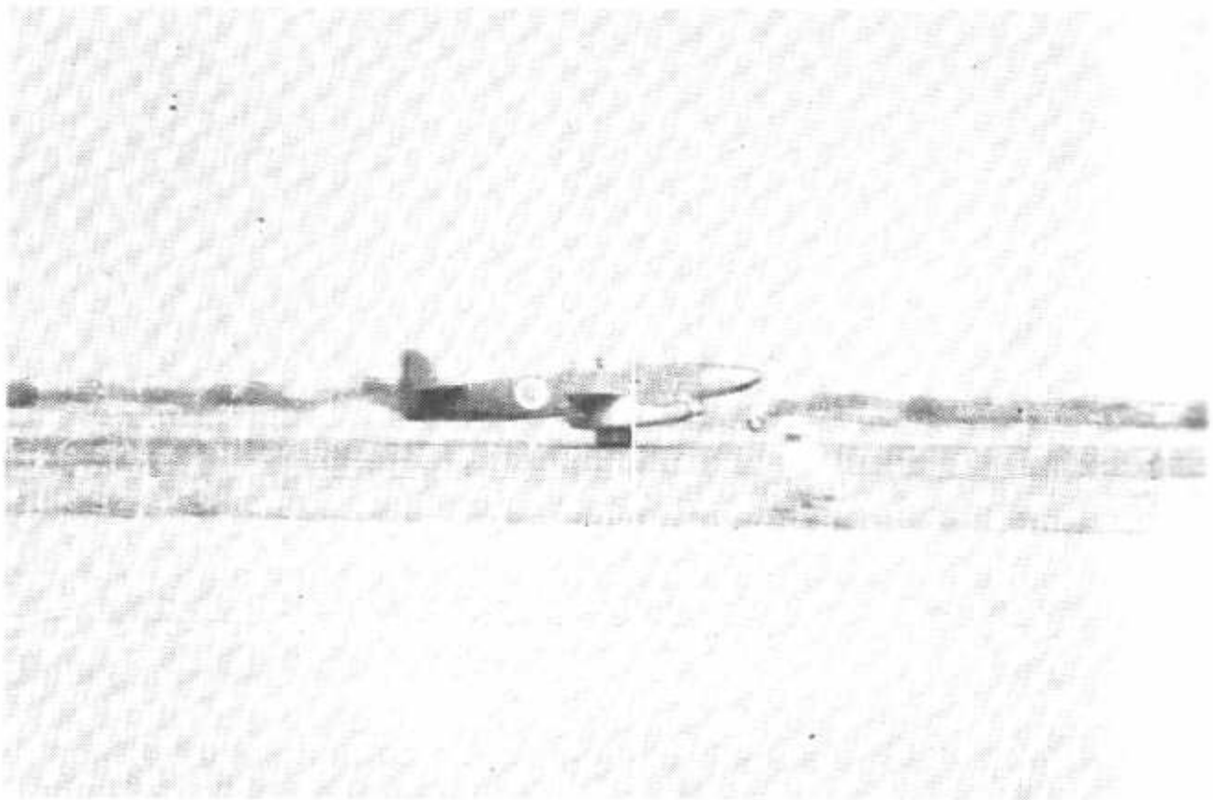
"A fast check of control sensitivity revealed that the elevators were a little overly responsive, ailerons—heavy but effective, and rudder seemed a little stiff. How these would react at normal cruising speed had yet to be learned.

"I was very careful in the handling of the throttles for I was aware that any rapid movement was likely to cause a flameout. This had a great effect on my planned approach back to the field for landing, for a low power setting below 6000 rpm may cause a flameout. Therefore, my letdown to the field was deliberately long and shallow,

The first Nakajima Kikka is ready for flight with IJN Lieutenant Commander Susumu Takaoka seated in the cockpit. Kikka had well balanced lines and was surprisingly much smaller than photos of it suggest.



Ground crewmen push Kikka from its concrete-domed protective hangar at the north end of Kisarazu for further ground testing. Japanese printing on air intake covers read: "Bo-jin-ban," meaning dust-proof plate. The venturi tube at the side of the cockpit is unusual for jet aircraft in having vacuum operated flight instruments. Since the landing gear was not to be retracted for the initial test flights, the nose wheel door was removed so as not to effect lateral stability.



The only known photo of Kikka in operation is this view taken during its first takeoff. Note that the nose wheel is already off the runway as it passes mid-field at Kisarazu Air Base.

setting up a very wide down-wind and base leg. When established on final, I put down 40 degrees of flaps, and maintained 7000 rpm for a power on approach to the runway. Crossing the fence with 15 knots more than my lift off speed, Kikka settled to the runway under good control all the way."

The rollout for the lightly loaded Kikka required only moderate braking, and Takaoka cleared the 1700 m (5500 ft) runway at the two-thirds point. "As I taxied to the ramp," he continues, "many people rushed out to meet me, waving their hands excitedly. The first flight which lasted eleven minutes had been successful, and I thought that Kikka might soon be ready for operational flight testing. This would allow the start of mass production earlier than we had expected."

In his debriefing report following the flight, Takaoka told his colleagues that they had nothing to fear from the new power plant. They appeared reliable throughout the flight. The engineers found nothing wrong with the engines when they removed the cowlings, so plans were made for a second flight. Takaoka had no recommendations to make for changes to the flight characteristics of the aircraft. No changes other than those absolutely necessary were to be considered due to the urgency of the war effort. Parts for twenty-five additional aircraft were already in production.

There was much rejoicing following this meaningful event, especially by those who had labored so long in Japan to achieve jet flight. Ever present in their minds had been the knowledge of success with jets by the Americans with the Bell P-59A Airacomet, which had made its first flight on October 1, 1942. The Gloster E.28/39 had been flying in England since May 1941, and the Messerschmitt Me 262's had made world headlines with their terrorizing attacks on U.S. bomber formations over Germany.

But success was now achieved by the Japanese, and the development of this special attack jet airplane had to be continued as rapidly as possible. The next flight for Kikka was set for August 10, three days later. Senior officers of the Army and Navy would witness what was to be Kikka's first official flight. This would differ mainly from the previous short hop in that a greater fuel load would be carried to allow a more complete flight check, and RATO (Rocket Assist Take-Off) would be used to assist

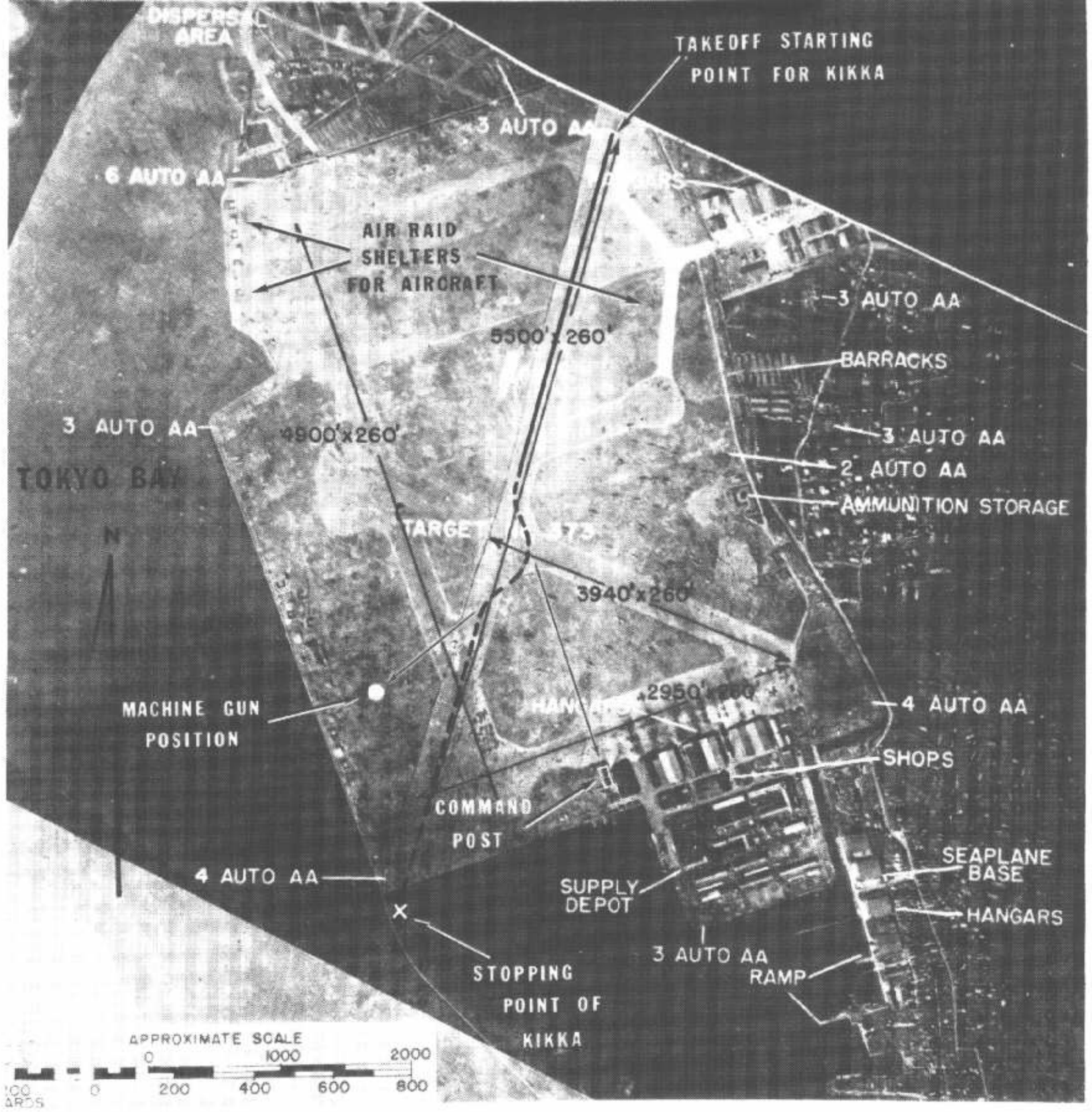
The lines of Kikka's airframe were revolutionary at the time of its appearance in Japan in July and August 1945. Aside from being jet powered, the tricycle landing gear was quite new for Japanese designs. Air raid shelter for Kikka at Kisarazu is at left.

Above: Kisarazu Air Base was the site of the first jet flight in Japan that was made by Kikka. This air picture of Kisarazu with Douglas RB-66's of the 12th TRS in the foreground was taken in the mid-1950's. It shows the resurfaced runways of the base on which Kikka made its takeoff. This end of the runway is where Kikka's second attempted flight ended, when it came to a sliding stop near the waters edge of Tokyo Bay.

Right: This postwar air surveillance picture of Kisarazu Air Base taken November 1, 1945, shows the field layout from which Kikka operated. A sea wall to the west and south of the field borders on Tokyo Bay. The dark triangle at upper right was a lightly populated area deleted from the published photo. Note Japanese aircraft clearly dispersed in the center of the field. This was an Occupation Forces requirement.

Lower Left: The Bell XP-59A Airacomet was the first U.S. jet aircraft, making its initial flight October 1, 1942. News of first flight events reached Japan long after they happened, but they did give encouragement to the engineering efforts they had underway.

Lower Right: This is England's first jet propelled aircraft: the Gloster E.28/39 which flew for the first time in May 1941. Its engine invented by Air Commodore Frank Whittle, was later manufactured in the United States and powered America's first jet aircraft.



the takeoff. Pilot Takaoka was uneasy about the angle at which the rocket tubes were set on the belly of the aircraft. To make a change would require considerable modification time, a commodity that could not be spared. As a compromise, each of the two rocket motors was reduced in thrust from 800 kg to only 400 kg.

When the appointed day of the second flight arrived, the air seemed filled with U.S. Navy task force aircraft making sweeps of the Kanto Plains area around Tokyo, and the flight had to be postponed for twenty-four hours. Few, if any of those in attendence were aware that on this very day, the Japanese Government had offered to surrender.

Flight test planning continued. A firsthand account of the second flight of Kikka continues as told by Mr. Takaoka, but his enthusiasm over the first successful flight is not in evidence with this second attempt.

"On the 11th, the August day was bright with only patchy clouds. The wind was from the southwest at 5 to 7 m/sec. (11 to 15 mph), giving me a crosswind from the right. This crosswind was not ideal, but the growing impatience of the assembled high ranking officials added a sense of urgency. In everyone's mind was the knowledge that any delays could slow the development of the airplane which was sorely needed to defend Japan against the impending invasion.

"I set the flaps at 20 degrees, checked the runway, and signaled with my right hand that I was ready for takeoff. Without hesitation, the signal officer gave me the flag, and

RATO tubes are in place under the wing of Kikka for its second flight. The stabilizer sat high on the fuselage, well away from the jet exhaust. Flight control surfaces were fabric and dope covered, an unusual arrangement for tail surfaces exposed to varying degrees of heat during engine ground operations.

Test pilot for Kikka was Susumu Takaoka, pictured here in 1970. He was a graduate of the Imperial Japanese Naval College in 1932, and during the war commanded a dive bomber squadron aboard the Soryu and one at Yokosuka Air Base. Later he became a test pilot and was responsible for initial and development testing of several new combat aircraft for the Japanese Navy. Takaoka achieved the rank of Commander by the end of the war. When the Japanese Air Self-Defense Force was formed in 1954, he rejoined and commanded the JASDF flight test wing. During that time he was the first to fly Japan's first postwar jet aircraft. Later he commanded the 4th Interceptor Wing, and retired in 1962 with the rank of General. He then became director of Mitsubishi's Komaki plant and chief test pilot for that company's MU-2 twin-turboprop general aviation aircraft. He is again retired and lives in Zushi City near Yokosuka.

I was cleared to go. Kikka began rolling forward. I began counting the lapse of time . . one-thousand . . two-thousand . . three-thousand. At four-thousand, I actuated the RATO ignition switch. This brought a sudden surge of acceleration with such force that the nose of the aircraft came up—blocking my forward view as the tail went down and skidded along the runway. I snapped the control stick forward in an effort to correct this unintentional pitch-up, but the elevators were not yet effective.

"The plane gained speed rapidly and I felt somewhat helpless in this uncorrectable nose up attitude. The nine second burning time of the RATO seemed endless. Finally as elevator control seemed to take effect, the nose wheel contacted the runway with such violent force that it could have blown the tire. Simultaneously the RATO burned out. Immediately there was a feeling of deceleration—most unexpected at this point, for both engines appeared to be functioning normally. The plane was at mid-field. Air speed was 90 knots. Another second passed and the feeling of deceleration persisted.

"At this point I elected to abort the takeoff and cut the power. Precomputations indicated that from this point I would have sufficient runway remaining in which to stop. I applied both brakes to their maximum. There was little effect. The runway check points sped by, and the overrun was approaching rapidly. In desperation, I attempted a ground loop by holding the left brake. The nose came around about ten degrees and headed me toward the operations building near the hangars. I forced the right brake to its fullest, bringing the nose around and now aligned it with a machine gun emplacement on that side of the runway.

"I straightened the airplane again with the runway and fought the brakes desperately. The end of the runway flashed by at an alarming speed and the plane continued across the 100 meter grass overrun. But this was far from enough stopping distance and the perimeter drainage ditch caught the three landing gear and Kikka slid on its belly, off the embankment and came to rest on the sand at the waters edge.

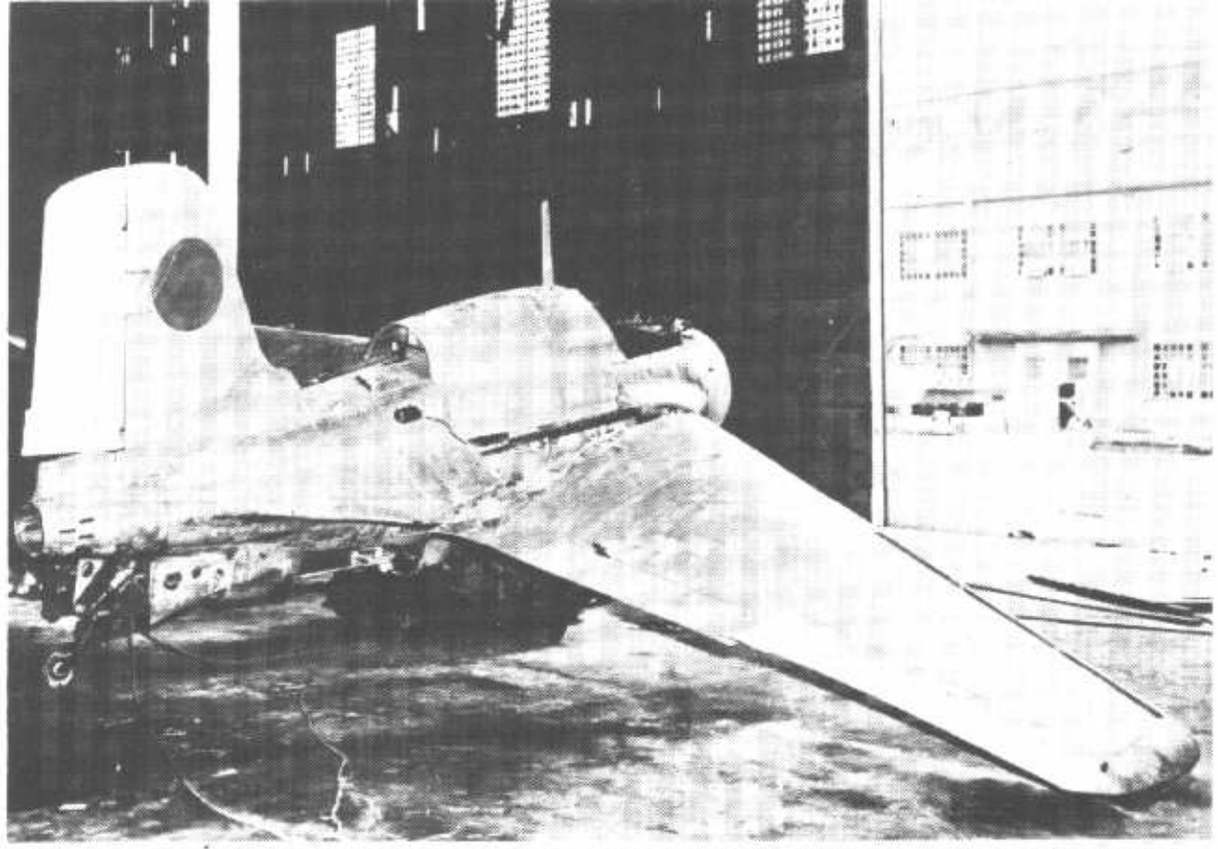
"After all was over, and had become quiet, an unreasonable loneliness and atrophy attacked me, rather than any feeling of relief. I did not know whether I had been responsible for the accident or not, but a priceless prototype had been damaged. It was clear that the accident would delay the test seriously.

"Groundcrewmen came over the bank and ran toward me, wondering in what condition they would find me. On the verge of tears, I climbed out of the cockpit and away from the airplane. No fire—no explosion followed, but it seemed certain that the airplane would not fly again. Without a landing gear, the engines may have been torn loose from their mounts as they appeared to be badly damaged.

"I had a strange sense of guilt over this disaster, but the real cause of the accident remained unexplained. What caused the deceleration? Perhaps it was only an illusion. When the RATO stopped burning, was I imagining trouble which did not exist? I had experience many takeoffs in other type aircraft with RATO, but none with sensations as this. Thinking back, the airplane could have been stopped safely with proper brakes rather than those used on the lighter weight Zero fighter. Four days later the war came to an end—and with it my association with Kikka also ended."

In retrospect, with the knowledge that has been gained about aircraft design and jet operations, several factors seem evident as the cause of this accident, none relating to faulty design of the aircraft. Kikka was among the first airplanes in Japan to utilize a tricycle landing gear. Since the RATO units were attached to the bottom of the aircraft, and below the center of mass, the acceleration force caused the nose to pitch up abruptly. Since this attitude could not be corrected at this slow speed by the pilot, the airplane remained behind the power curve during the entire length of the takeoff roll. What might have happened had the takeoff not been aborted is left to speculation, but this remains a gnawing question in the mind of Kikka's pilot, Susumu Takaoka.

The accident had a fortunate ending considering what might have happened. Navy Captain Ito, the former head of the Flight Test Section before Takaoka, watched the event and was fearful that Kikka may become airborne in this nose high attitude while the RATO was still burning in its last few seconds. Had this happened, the moment this power from the rockets ended, the flight of Kikka would have ended also, and it would have fallen uncontrolled to the ground. Motion pictures taken during the



The Japanese were interested in Germany's futuristic fighters such as this rocket powered Messerschmitt Me 163. Its potential appeared so promising to the Japanese that it overshadowed development of the Army's Ki.201 twin jet fighter and nearly cancelled the project.

Japan received manufacturing rights and production drawings from Germany for the Messerschmitt Me 163. Approximately four of these Mitsubishi J8M1 Shusui rocket fighters were built for the Navy, and one as the Ki.200 was for the Army. These were reasonable copies of the Me 163, but material substitutions had to be made in the airframe as well as the Walter rocket engine. A larger version known as the Ki.202 was in the planning stage.

takeoff were reviewed on the day of surrender. It remained questionable, but the aircraft could have been slightly airborne at the time the rockets ceased burning, and this could have accounted for the heavy impact of the nose gear on the runway. A feeling of deceleration would have been very likely under these circumstances.

This fateful story of Kikka came to an abrupt ending before it had the chance to fully prove its airworthiness capability. Its evaluation by the Occupation Forces in Japan was a limited one, for Allied jet technology was far more advanced. This first flight of a turbojet aircraft in Japan was a milestone that put Japan in the jet age, and the story of how this was achieved is a fascinating one.

GERMAN TECHNICAL AID TO JAPAN

As a prelude to the direct development of Kikka by the Japanese, it is interesting to first evaluate to what extent the Germans were an influencing factor. A document prepared by the U.S. Military Intelligence Service, dated 13 August 1945, entitled *German Technical Aid to Japan,* gives some insight into this relationship between Japan and Germany during the war years. At the time this document was prepared, Germany had surrendered, and this study was to give the Allies an idea of what technology and equipment might have been passed on to Japan and which they might have to face in combat.

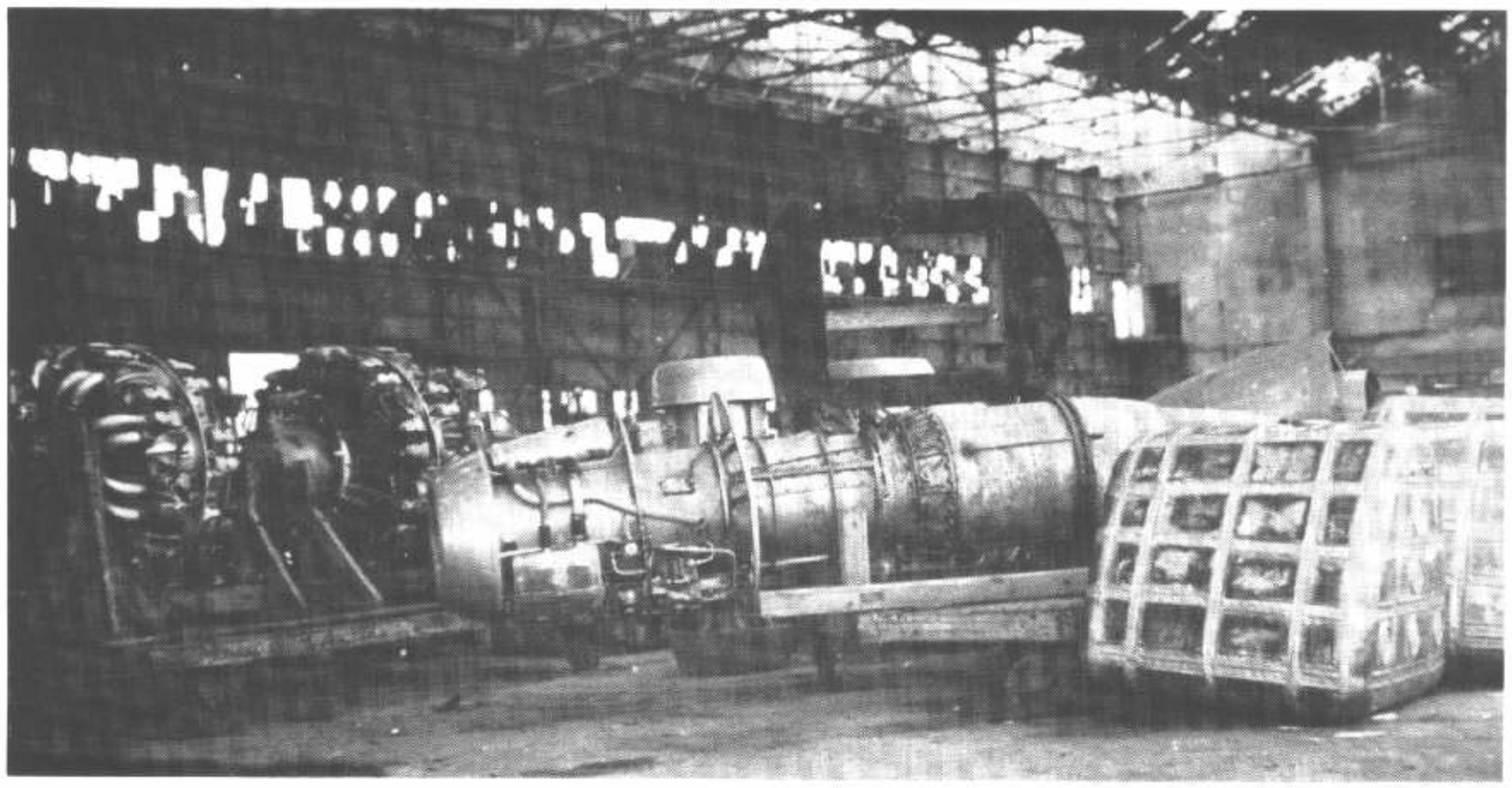
This section, taken from the formerly secret document, is made up of passages which relate primarily to jet powered aircraft for Japan. The reader is reminded that this material not only relates to German influence in Japan's development of Kikka, and Shusui—a close copy of the Me 163, but also the Army's Ki 201—with similar lines to the Me 262 that followed Kikka, and is described on page 28. Selected parts of this document follow:

Reciprocal technical liaison between Germany and Japan took place under the German-Japanese Economic Agreement of January 1943. The agreement was in general terms and provided for the mutual exchange of raw materials, military equipment, manufactured goods, technical assistance and drawings, an exchange which had been in practice for some time.

At the beginning of 1944, the German Air Force High Command first revealed to the Japanese in Berlin, the secret jet and rocket-propelled fighters. The Japanese lost no time in availing themselves of this willingness on the part of the Germans to divulge information on jet and rocket aircraft. An official request for information was made by Japanese representatives in Berlin, and in March 1944, Hitler and Field Marshal Hermann Göring, Luftwaffe Chief of Staff, decided that the information should be made available to Japan.

According to a letter from Field Marshal Erhard Milch, Head of Luftwaffe production, to Göring, dated 1 April 1944, discussion between Japanese and German representatives led to the formulation of Japanese requests for (i) Messerschmitt jet technicians to be sent to Japan, (ii) the training of Japanese technicians in Germany, and (iii) the purchase by Japan of manufacturing rights for the construction under license of the Me 163 B-1a and Me 262 A-1a. In making these requests the Japanese were availing themselves of the terms of a Hitler order that Japan must be

Negotiations began in 1944 for the Japanese to obtain manufacturing rights from Germany for the Me 262. Though approved, the drawings for the aircraft failed to reach Japan and they were forced to design their own jet aircraft using only the arrangement concept of the Me 262.



This Ne 20 jet engine on a dolly is ready for installation on Kikka. At right are the fuel tanks that fit into the fuselage. In background at left are two Nakajima Homare 18-cylinder, 2000 hp engines to power Renzans that were on the production line nearby.

given extensive information concerning future German developments, and of the fact that, in the preceding January, Göring had expressed agreement in principle with the idea of close Japanese-German collaboration as regards the latest types of German aircraft.

Around April 1944 negotiations were under way to allow the Japanese to purchase manufacturing rights for the Walter propulsion unit, the Me 163 fuselage, the turbojet propulsion unit, presumably the Junkers Jumo 004, along with the BMW 003. In addition to two complete Me 163 aircraft, the negotiations also were to provide the Japanese with all the results of testing and experience of the German manufacturing companies. In May the Germans agreed to release manufacturing rights of the Me 262 fuselage, but at that time negotiations were not successfully concluded, possibly because considerable modifications of the Me 262 were necessary as a result of flight tests.

It was not until July 1944 that orders were issued for the preparation and handing over to the Japanese representatives in Germany of sets of blueprints and drawings for the manufacture of the aircraft, propulsion units and chemical fuels. The sets of blueprints and drawings were to be sent to Japan as individual sets on different U-boats. On 22 July 1944, Göring approved the granting of licenses to Japan for the delivery of one Me 163 and one Me 262 as sample aircraft.

By late September, the OKL (Oberkommando der Luftwaffe/High Command of the Air Force) had decided that in view of the limited transport space available, deliveries of sample aircraft to Japan would have to be dropped, but that necessary plans and sample power units, together with some of the individual parts of the power units which were especially difficult to manufacture, should be released for transportation to the Far East, probably during October 1944. By this time, however, transportation was no longer possible and it seems fairly clear that sample equipment of the aircraft and their power units never reached the Far East.

One of Messerschmitt's principal planning engineers has stated that he and four other Messerschmitt employees were the only ones who knew of a plan to transmit to Japan complete technical and production plans for the Me 262. Plans were delivered in October 1944 to Dr. Thun—head of Messerschmitt's foreign export branch—at Jettingen; a Japanese representative was present on that occasion. This suggests that the only drawings to reach Japan concerning the Me 262 were the preliminary survey sketches and illustrations of the A-1 sub-type which may have arrived in the fall of 1944.

It became clear during the negotiations that the Japanese could not build the Me 163 and Me 262 without compulsory modifications; they therefore required specialists who would supervise manufacture in accordance with those modifications. The modifications were necessary because of Japanese inexperience with German production methods, because of a lack of skilled workers, and because of a lack in Japan of certain special materials, among which thin sheet steel was outstanding. That material was used for the nose of the Me 262. Since Japanese sheet steel manufacturing processes were incapable of producing sheet steel of the necessary thinness and resilience, the nose of the Japanese produced Me 262 was to be made of duralumin. The reason for Japanese limitations in the field of thin sheet steel was not a lack of raw materials, but limited experience of production methods and a lack of skilled supervisory personnel.

In late October 1944 the Japanese in Berlin advised the Germans that only the Army was planning production of te Me 262, and requested investigation for the Army of two production plans (work sequence schedules) for the aircraft: one of 100 aircraft a month, the other for 500. At that time it appears that the Army was putting the greatest emphasis on the improvement of the Me 262 fuselage and the Jumo 004 propulsion unit. Nevertheless, first of all, attempts were being made rapidly to perfect the Me 163, principally as a means of high altitude defense.

Bringewald, a Messerschmitt civilian technician, who was to direct the manufacture of the Me 262, and Ruf, a Messerschmitt expert on procurement of industrial machinery, left for Japan in the U 234[1] and were captured when that U-boat surrendered to Allied forces. (Surrender was off Newfoundland, 16 May 1945, eight days after Germany surrendered.)[2] They carried with them blueprints and plans necessary for the setting up in Japan of factories adequate for the production of 500 Me 262s a month. It was the opinion of Bringewald and Ruf that the Japanese were not capable of building the Me 262 without receiving complete specifications and technical supervision from German specialists.

The impressions of the Messerschmitt officials with regard to the negotiations with Japan can be summarized as follows:

a. It was obvious that the Japanese intended production of the Me 262, after several major changes in construction had been effected;

b. Production was intended on a limited scale only;

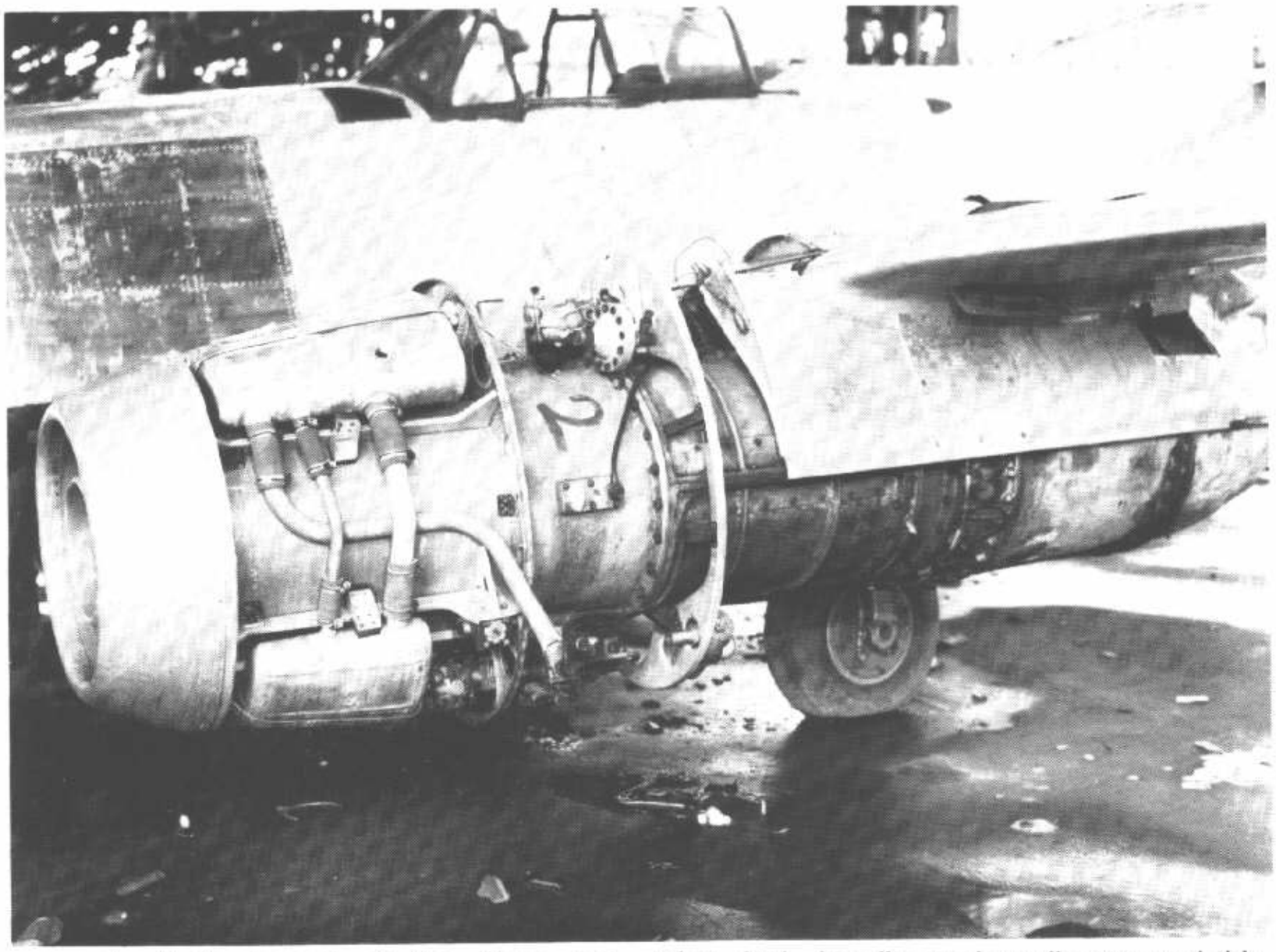
c. The Japanese apparently did not intend to build the Me 163, relevant documents being needed for study purposes only;

d. The intensity with which the Japanese demanded a license for the plywood process indicated the importance which they placed on plywood development;

e. Under the most favorable conditions, the earliest date for mass production of the Me 262 must be estimated at one and a half years after arrival of necessary documents in the Far East. (Author's note: Only fragmentary knowledge carried by IJN Commander Iwaya reached Japan by July 1945. From this the Navy's Kikka actually flew thirteen months later. Production delivery time for the Army's version of the Me 262 (the Ki. 201) was scheduled for twenty months after the German estimate.)

1 U 234 was a large ocean-going minelayer of the Type XB class built by Germania Werft of Kiel late in 1943. It measured nearly 295 feet and displaced 2,177 tons.

2 The precise point of surrender remains in doubt. Some sources list Portsmouth, New Hampshire on May 16, 1945. After a brief tour as an U.S.N. experimental vessel, it was expended off Cape Cod, Massachusetts in November 1946.



Close-up picture of the Ne 20 jet engine installed on Kikka. This axial flow engine developed about 500 kg (1,050 lb) of thrust.

In conclusion, from the Japanese point of view, the opening up to Japan of modern German war equipment and manufacturing techniques unfortunately coincided with severe restrictions in blockade running between Europe and the Far East. Japan's knowledge of late war German developments generally were restricted to descriptive information, supplemented in some cases by manufacturing drawings and blueprints. As a result, Japan was not adequately able to benefit from Germany's more open attitude toward negotiations.

Thus, with this concluding statement ends the intelligence report on what the Allies might expect of Japan's jet and rocket aircraft development at this time soon after Germany's surrender. Facts conveyed here serve as a starting point for telling of Japan's first jet aircraft development. However, many of the assumptions made in this report underestimated the potential of technical development and production of the Japanese. The reader will discover this as the stroy of Kikka unfolds. Had the war continued a few months longer, U.S. Forces may well have been totally unprepared to face rocket and jet aircraft over Japan.

ENGINE DEVELOPMENT FOR KIKKA

The focal point in this story about Kikka must be centered around the development and background of the jet engine in Japan. The airframe of Kikka merely provided a means to utilize this advanced power system. Although overshadowed by the fact that the other major warring nations had developed jet powered airplanes, U.S. Occupation Forces at the end of the war had not anticipated the degree of success that Japan had achieved. An interesting analysis of this progress is recorded in a U.S. Navy report dated November 1945 which describes the effectiveness of the engine used in Kikka:

In all, the Ne 20 appears to be a fairly well and simply designed turbojet. The BMW 003 was probably the best of the smaller German turbojets and the Japanese apparently didn't sacrifice any of the 003's good features. It should be noted that a Japanese plane with two Ne 20's would have equivalent performance to a German plane with two 003's (as did some Me 262's)due to the light construction employed by the Japanese in their aircraft.

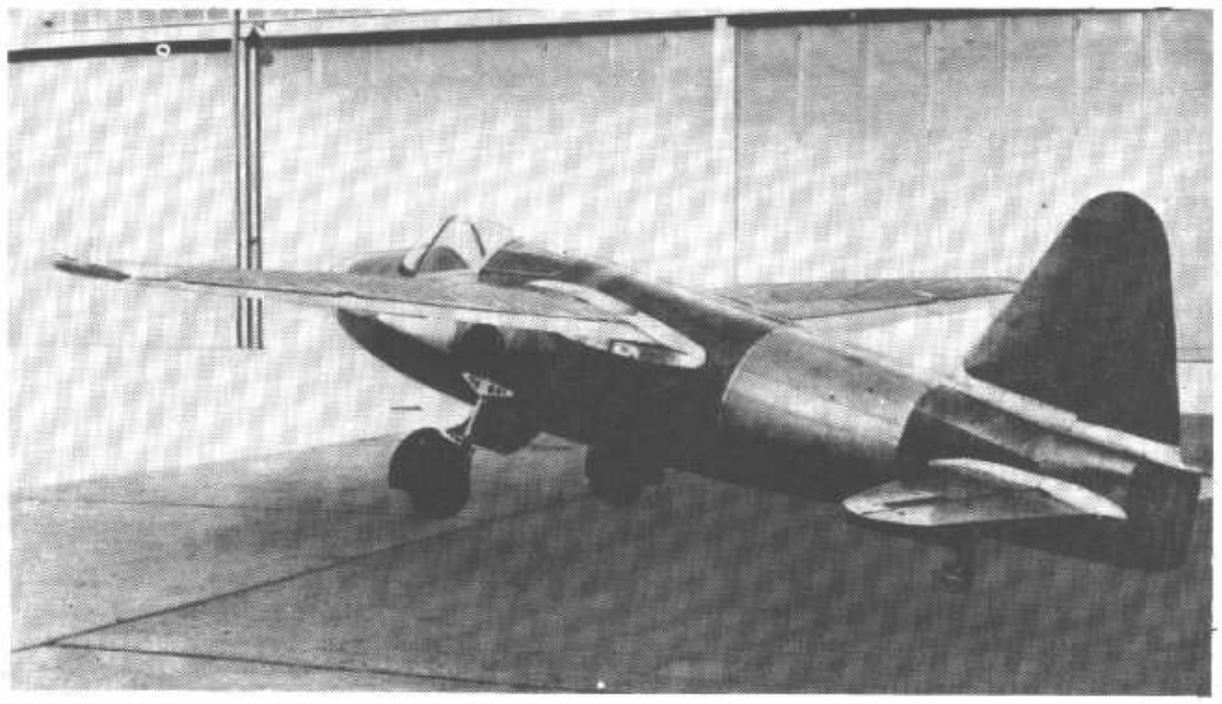
As with other nations of the world, the development of the jet engine in Japan did not happen in a short period of time. As early as 1920, Rear Admiral Kohichi Hanajima, who later headed the engine division of the Naval Air Arsenal at Yokosuka, saw the potential of the jet engine propulsion concept. A lieutenant at the time, he brought back from France, ten turbo superchargers that had been designed by Rateau for the Hispano Suiza engine. The potential of the supercharger failed to awaken any general interest in Japan and development along these lines was put aside.

Around 1937, with patent applications of Campini and Whittle, along with articles by Goddard, Hanajima's interest was again aroused. With the aid of Tokyo Imperial University, and Mitsubishi Heavy Industries, Ltd., he directed studies toward this futuristic form of aircraft propulsion. Rocket experiments were conducted, along with those of air breathing jets—particularly ram jets. Data was gathered but there seemed little interest outside the sphere of Hanajima's staff to continue an aggressive program for jet propulsion.

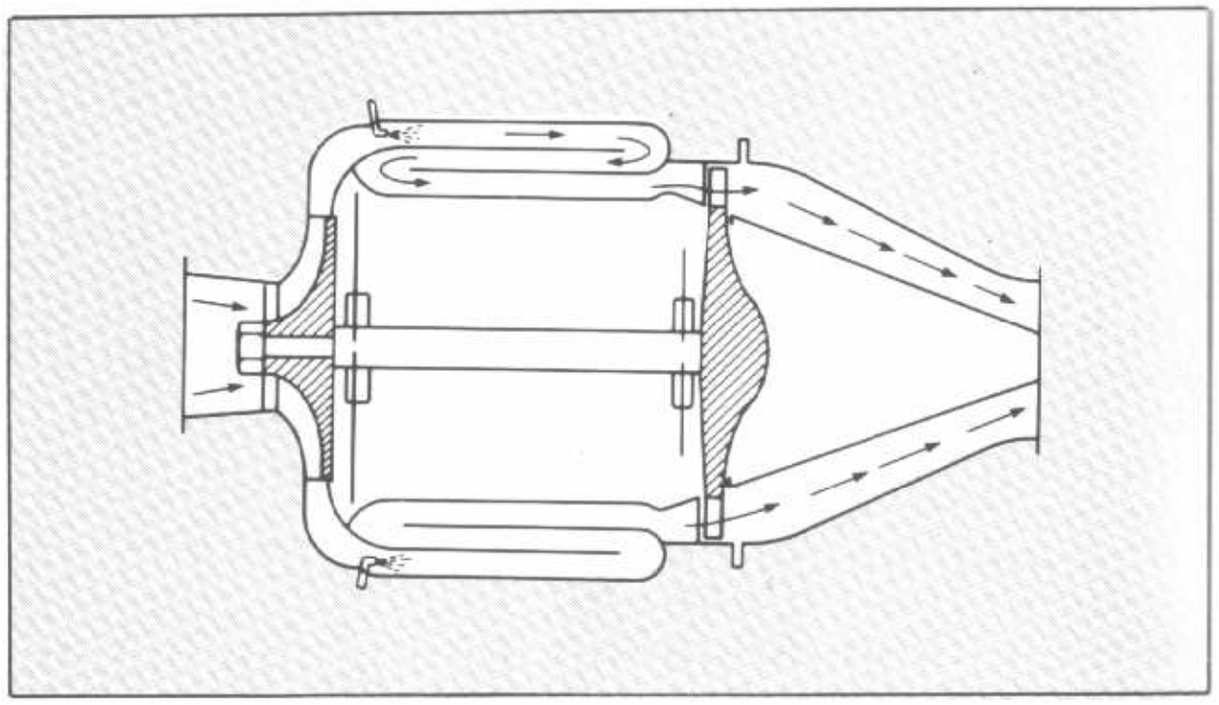
A new cycle of experiments began in 1938 when Captain Tokiyasu Tanegashima was assigned as Chief of the Engine Test and Field Support Shop at the KAIGUN KOKUSHO (or acronym KUGISHO for Naval Air Arsenal) at Yokosuka. While interest in jet power remained low within the Navy, Tanegashima's enthusiasm won him permission to spend some time and a little money on jet experimentation. His main effort was initially directed to the study and component testing of the G.T.P.R. (Gas Turbine Propeller Rocket) which is now called a turboprop.

While these tests were underway, Tanegashima, with the aid of Professor Fukusaburo Numachi—who was regarded as one of Japan's leading specialists for axial compressor theory, explored other concepts of propulsion. They persuaded the Ishikawajima-Shibaura Turbine Company, and the Ebara Manufacturing Co., Ltd. to under-

Dr. Osamu Nagano was instrumental in the development of the Ne 20 jet engine that powered Kikka. While holding the rank of Commander in the Japanese Navy, he became Technical Manager of jet engine development at KUGISHO. Being one of Japan's most knowledgeable engineers of jet engines in Japan, Nagano was photographed here as guest lecturer for the Jet Pioneers Association on May 20, 1977, held at Salem, Massachusetts. Since the war, Dr. Nagano has held high engineering and managerial positions with Ishikawajima-Harima Heavy Industries Co., Ltd., Japan's leading manufacturer of jet engines.



The Germans were the first to design and build a turbojet powered airplane. This was the He 178 that flew for the first time on August 27, 1939. News of this success reached Japan in 1942 and gave new encouragement to Japanese engineers to continue their investigation of jet type aero propulsion systems.



The TR-10 was an early centrifugal compressor concept of a jet engine being developed by the Japanese Navy.

take the design and construction of various experimental models of compressors and gas turbines of which the G.T.P.R. was a part. Development of this type propulsion was thoroughly explored but yielded little success.

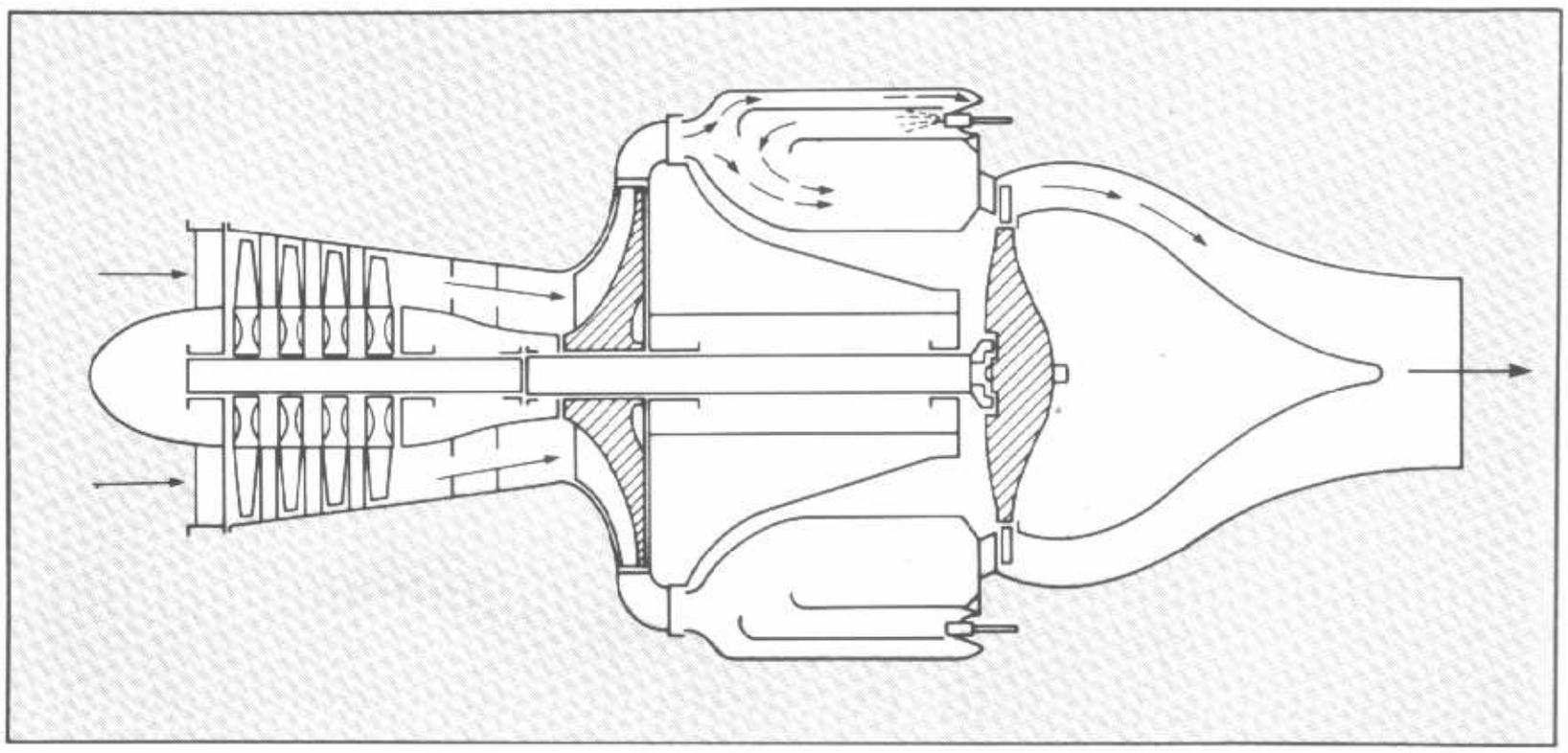
Professor Stodola of the University of Zurich advocated the free piston compressor for gas turbines, and Tanegashima attempted to develop this type compressor for the Navy. With the aid of the Mitsui Seiki Kogyo Co., Ltd., in early 1940, a free piston compressor on the principle of the Junkers type was designed and constructed. The attempt was unsuccessful for the purpose intended, but many were produced as compressors for portable oxygen producing plants. That same year, Lieutenant Commander Osamu Nagano of the Aircraft Engine Division at KUGISHO, aided by Mr. Masanori Miyata, Chief of the Electric Parts Shop, engineered the building of a small model gas turbine with a free piston gas generator. For demonstration purposes, this unit drove a small magneto to light a small lamp, developing 1/10 hp at 12,000 RPM.

The success of this demonstration aroused only slight interest, and Captain Tanegashima realized that Japanese industry was not then capable of manufacturing an effective free piston engine. Instead he became convinced that an axial compressor plus combustion chamber would be more feasible, and experiments continued for the Navy along this theory.

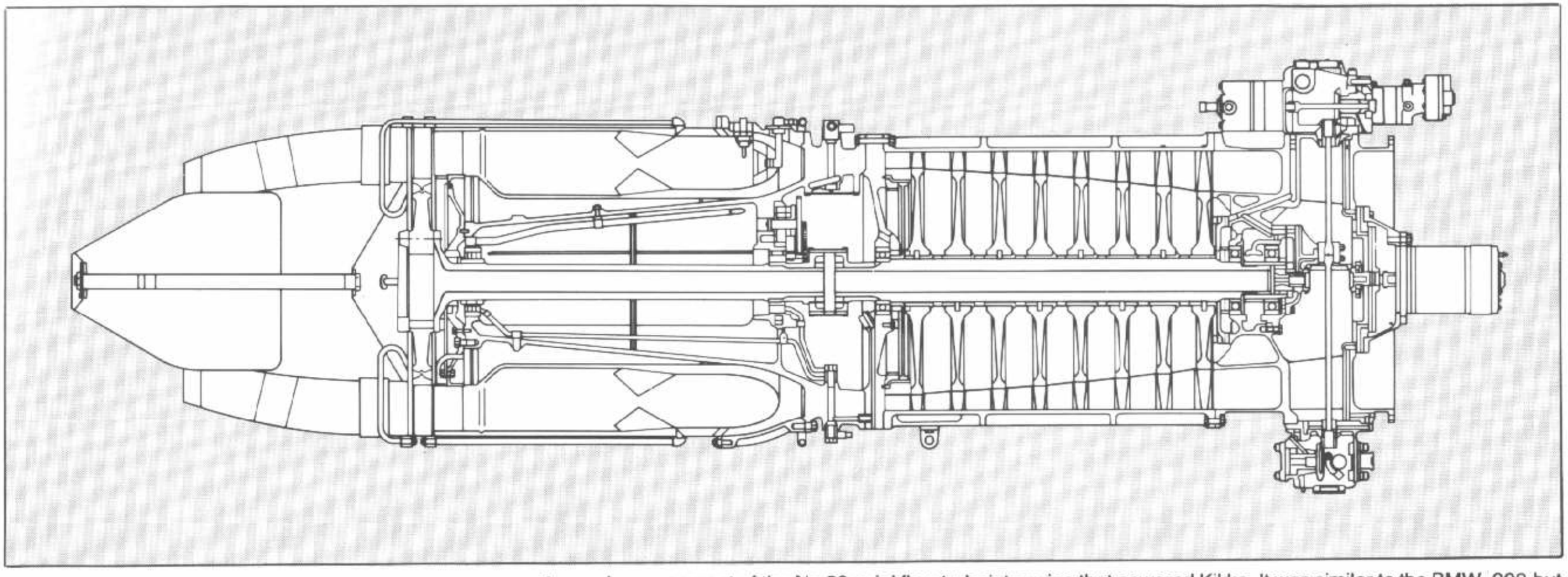
About 1942 the word spread among Japanese engineers that Germany had flown the He 178 as early as 1939, proving the theory that jet engines could be efficient and practical. This caused a number of projects to be restudied in Japan. Among these was the Campini type engine which utilized an internal combustion engine to turn the compressor. Japan's development for this concept was the TSU-11 that eventually powered an advanced model of the Ohka piloted suicide bomb. It was the pure jet that showed the most promise, and Vice Admiral Misao Wada, Chief of KUGISHO directed further development of this concept. The first of this type was designated TR-10, the letters meaning Turbo-Rocket. This engine consisted of a single stage centrifugal compressor with a single stage turbine, built by the Ebara Manufacturing Co., Ltd. The centrifugal compressor concept was used since it was converted from an experimental large turbosupercharger. The unit was first tested in the summer of 1943, but its efficiency results were disappointing.

To further develop the TR-10, now redesignated Ne 10 ("Ne" meaning "Nensho Rocketto" or burning rocket), it was necessary to reduce engine RPM and obtain more thrust. To achieve this, four axial stages were added to the inlet to ease the load of the centrifugal compressor, thus following a compressor development pattern similar to the German Heinkel-Hirth engines. This became the Ne 12, which was far too heavy for the work intended. The model Ne 12B evolved as a lighter weight version weighing 770 pounds. Forty of these engines were built before the type was fully developed. These were to power Kikka, an aircraft design already underway in anticipation that these jet engines would be satisfactory and meet airframe production schedules.

Prior to this serious planning of Kikka and putting the Ne 12B into production, a major turn of events took place in mid-July 1944, when Technical Commander Eiichi Iwaya returned to Japan on July 17 from Germany on the last of the submarine blockade runners. To expediate his return he left the submarine during the stopover at Singapore after eighty-seven days at sea and flew the last leg to Japan leaving on board the submarine the many detailed blueprints of German jet engine technology. Before the submarine I-29 reached Japan from Singapore, it was sunk west of Manila with all its holdings. All that remained of German jet engine technology was a photocopy that Iwaya had with him of the general design layout of the BMW 003A. Wasting no time, the Japanese were quick to discover that their design principle followed closely those of the Germans. Instead of using a centrifugal compressor, the BMW 003A had an eight stage axial flow compressor, and lower RPM, giving less strain on the turbine blades.



This TR-12B jet engine had a four-stage axial flow compressor in front of the centrifugal compressor. The early design phase of Kikka was to use this engine.



General arrangement of the Ne 20 axial flow turbojet engine that powered Kikka. It was similar to the BMW-003 but about three-fourths the size.

Based upon this new technical information, a general conference of the Army/Navy advisory group decided that a Japanese version of the German engine showed more potential than any of the jet or rocket developments then underway in Japan. Several companies were given the available information on the BMW 003A and instructed to develop their individual versions. The resulting projects were: Ne 130 by Ishikawajima-Shibaura Turbine, modified from the G.T.P.R., Ne 230 by Nakajima Aeroplane Co., Ltd., together with Hitachi, Ltd., and the Ne 330 by Mitsubishi Heavy Industries, Ltd. In the meantime the Naval Air Technical Arsenal, KUGISHO, developed its own version, namely the Ne 20.

By using the fragmentary cross-section conceptual drawing of the BMW 003A, Navy designers laid out the axial flow compressor design for the Ne 20. This engine was roughly three-fourths the size of the 003, and considerable substitutions had to be made in materials. The combustion chamber remained like that of the BMW type, which was annular in design. In scaling down the BMW, the Ne 20 used the same size burners, but instead of sixteen, it used only twelve, thus eliminating additional experimentation by retaining the same flame length, airflow characteristics, etc.

By the end of January 1945, the design phase was completed and fabrication of test models began at once. About 400 machine tools were used day and night in the Aero Engine Division of KUGISHO. The first test model soon emerged and was run for the first time on March 26, 1945, in a crude test cell in a cave on the side of a cliff at Yokosuka. It was the success of this test run that led to the decision that the Ne 20s would be the power for Kikka in place of the Ne 12B.

Much investigation and improvement was required and this persisted to the end of the war. Preliminary trouble with blade cracking had been eliminated. However, the control problem had received little attention and there was little technical knowledge available about tail cone positioning. Starting problems were not difficult. An electric starter mounted within the compressor spinner was capable of turning the engine rotor at 2250 rpm, although starting was usually obtained at rotor speeds of 1500 rpm. (Starter reduction was 4:1 which is 6000 rpm starter speed). Maximum RPM was reached in ten to fifteen seconds of starter operation. Starting was accomplished on gasoline fuel. During acceleration the fuel supply was switched to pine root distillate fuel containing from 20 to 30 percent gasoline.

While Commander Nagano, who headed the development of the Ne 20, and his staff worked continually to further refine the new engine, Captain Tanegashima joined in the task and all but directed his full attention to this project. Reflecting on those trying days as the air war intensified over the home islands of Japan and the need for the jet engine became more urgent, Tanegashima describes the situation in this manner:

"I decided it would be wise to move our jet-engine group and vital equipment to a calmer location where the fear of air strikes would be diminished. We borrowed several warehouses at a tobacco factory in Hadano at the southern edge of the Tanzawa mountains in southwestern Kanagawa Prefecture, about three hours by truck from our Yokosuka location.

"There we assembled our equipment for constructing test models of the Ne 20, and we installed two bench test stands in a nearby farm, camouflaged by bamboo thickets. We soon resumed testing to remove several flaws. The first problem was the lower pressure ration of the axial compressor. Nagano proposed that the camber of the stators, which were in the Clark Y section, were insufficient, so he bent the stators on the anvil to give them more curve. These make-shift cambers were tested on the second Ne 20 engine."

The staff at Hadano included roughly ten officers and 200 workmen. The officers rented a small but sturdy building from a bank in central Hadano, and refitted it as their quarters and club. "Hadano was so pleasant," Tanegashima recalls, "that we occasionally forgot about the severity of the war. Hadano was a wide valley on the southern side of Mt. Oyama (4078 ft.) surrounded on the other three sides by beautiful hills.

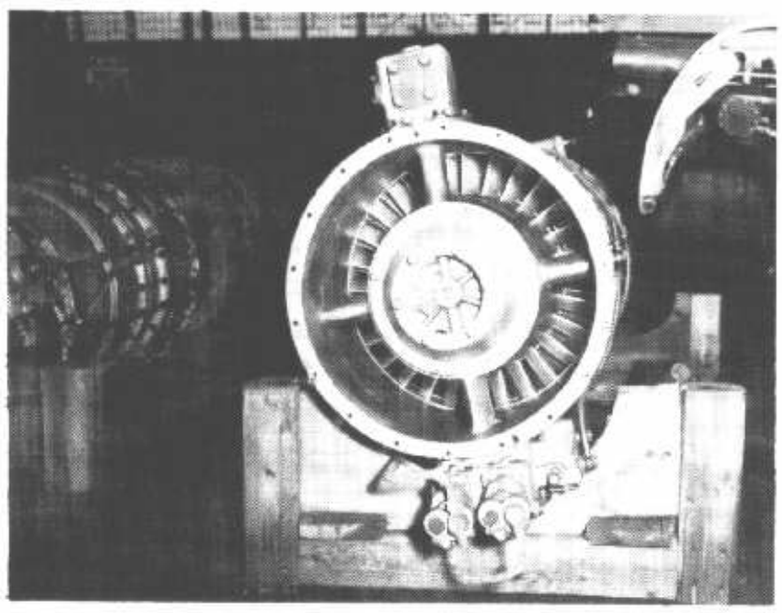
"Food there was plentiful, and the area was especially known for peanuts, sweet potatoes, land rice, and wheat. There was also a good amount of tobacco grown, making it a paradise for smokers. Milk was also in abundance. We were thus well off for food.

Map showing key locations within central Japan that relate to the development of Kikka.

I was afraid that our diets would be deficient in protein, so I ordered the men to try eating some common harmless snakes, frogs, and snails, but these proved hard to find. One day a piece of snake was served for dinner—and I ate it courageously—but it was very bony and hard."

These glimpses of Hadano, its beauty, and the problems, brought vivid memories to this jet engine developer. He continued with his accounts of the final efforts to perfect a producible engine.

"Now that the Ne 20 engine's axial compressor had been successfully tested, I ordered that such compressors be installed on all succeeding engines. The next problem confronting us was the the thrust bearing of the axial compressor burning out frequently. Nagano applied himself to this problem, reconstructing Michel type thrust bearings for this point. Finally he found a way to use several series of ring-shape springs between two deep grooved ball bearing rings. To equalize turbine and compressor pressures, a balance piston was used.



This front view of the Ne 20 engine shows clearly the stator and compressor blades of the engine. The 4:1 electric starter motor attaches in the center. Two gear type fuel pumps are at lower front. These were later changed to plunger type pumps. Servo oil pump drive is at top and behind fuel pump.

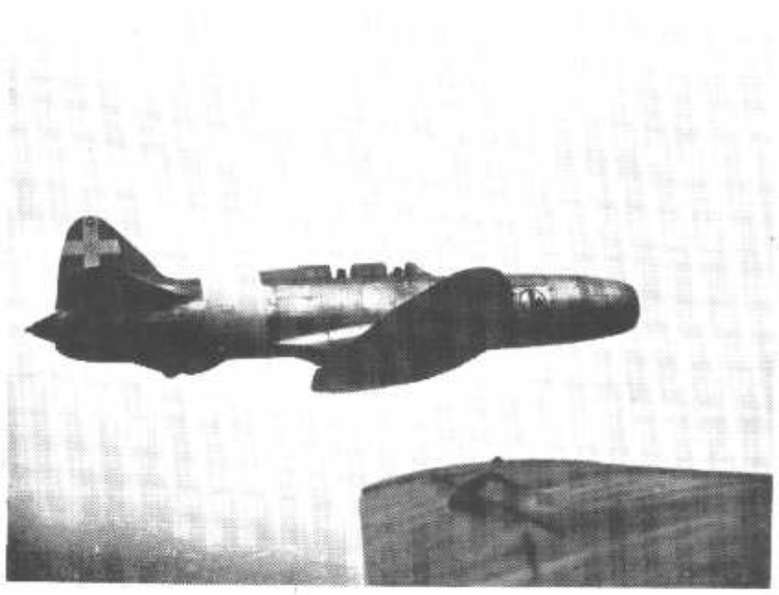
"Due to the lack of nickel, our turbine blades were made of manganese-chromium-vanadium steel alloy, yet the blade-cracks at the roots did not disappear. After one or two hours running, cracks could almost be found on several blade roots. At first, the blades were made with a reasonable profile, but later it was changed to a thicker silhouette, and the number of blades reduced, forcing us to sacrifice efficiency. Had we known the present technique of setting the blades loosely in a Christmas tree shape slot while cool, we could have solved this problem more easily. But at that time every blade was firmly welded to the disk. Finally we managed to get good results for test runs of four to five hours, but beyond this we could not guarantee safety.

"It was now mid-June 1945," Tanegashima goes on. "We still had to mass produce the 10 Ne 20 and conduct flight tests of the Kikka. But we were in the midst of a very unfavorable war situation, and while many civilian manufacturers cooperated, they were very slow in producing the engine and plane. I had hoped" he concludes, "that at the very end of the war, we Naval personnel could complete this project largely on our own, since we had such a well-developed Naval Institute. I had hoped that we could set a good example for civilian manufacturers of new technological development."

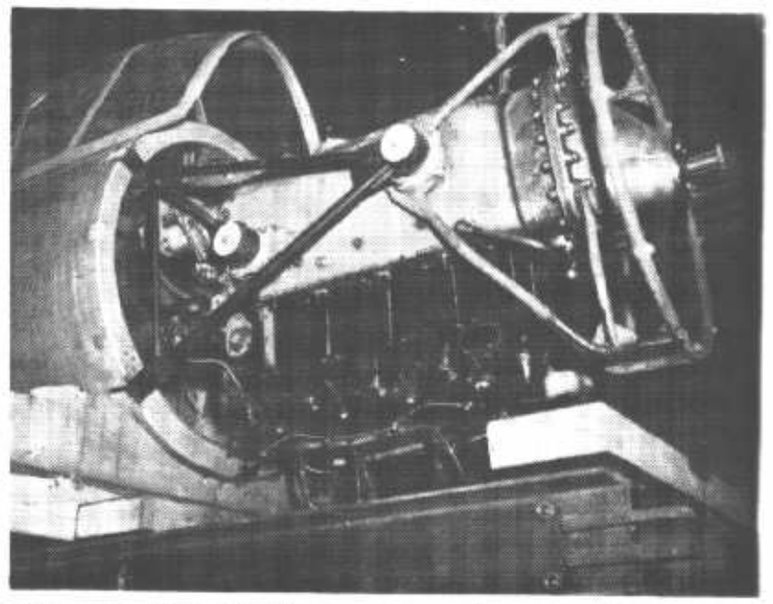
In Mr. Tanegashima's reflections on those devastating war years, he marveled over the quick development of the Ne 20 in only one year. Had development begun two years earlier, the war might have been expanded and bitterly contested with higher casualties on both sides. "It was well that it stopped when it did," was Tanegashima's final comment of this highly technical triumph that took place under adverse circumstances.

By the end of the war according to the U.S. Strategic Bombing Survey, KUGISHO, redesignated DIA-ICHI-GIJUTSU-SHO from February 1945 (meaning the First Technical Arsenal) had built nine engines. Yokosuka Naval Yard had built twelve engines, making the sum total manufactured, twenty-one. The latter were considered by the Japanese to be poor in quality largely because of lack of experience on the part of the naval ship yard in aircraft engine construction. Their quota was to have been forty-five Ne 20s a month, while Kure-Hiro and Maizuru, each were to produce twenty per month, and Sasebo, fifteen per month. These capacities were later to be increased by Hitachi and Mitsubishi facilities.

(Note: Through wartime mobilization, Ishikawajima became part of the Navy ship yard and the building of these jet engines. Today, Ishikawajima-Harima Heavy Industries Co., Ltd. (IHI) is the largest manufacture of jet engines in Japan.)



The Italians also influenced the Japanese to develop jet propulsion with news of their Caproni Campini jet flight made in 1940. A reciprocating engine turned a compressor which created a ducted-fan type of thrust that could be increased with fuel combustion similar to an afterburner.



The Hitachi TSU-11 was at one time considered to power Kikka until the turbojet engine could be perfected. The TSU-11 powered the jet version of Ohka (Baka Bomb) pictured here. Instead of having a turbine to drive the compressor, a 4-cylinder inverted inline engine was used. The compressor wheel, not installed here, was normally attached directly on the drive shaft at the rear.

EARLY CONCEPT OF KIKKA

Japan became an industrious and imaginative nation long before World War II. It is natural then, that their technology trends paralleled those of other industrialized countries throughout the world, and that jet powered aircraft would certainly have been developed during the early 1940's within the same time frame as other nations. The development of such an airplane was totally dependent on perfecting a suitable jet propulsion unit.

Preliminary study on jet aircraft design in Japan centered around the TSU-11 engine (a Hitachi "Hatsukaze" 4-cylinder inverted inline engine of 160 hp driving a ducted fan compressor) that generated 230 kg (500 lb) thrust. This concept was first demonstrated by the Italians with the Caproni Campini in 1940, and Japan's TSU-11 adaption of this principle eventually powered the Ohka 22, an advanced model of what is generally called *Baka Bomb*. Since this engine was of relatively low power, serious thoughts could not be put into advanced aircraft designs until there was promise of higher thrust engines.

This conservative thinking changed, however, when the war took a drastic turn for the worse for Japan in mid 1944, and the Mariannas Islands came under Allied control. This placed U.S. land-based B-29's in easy striking range of the Japanese home islands, and before long Japan would be faced with having to defend its home shores against a massive invading force. To prepare for that day, a change in strategy and air weaponry was made. In late August 1944 an air weapons planning study was held at the KAIGUN KOKU HOMBU (Naval Air Headquarters) with aircraft designers from Nakajima and Kawanishi present. These two companies would have a major part in executing this proposed plan.

This view of the final assembly line of Kikka was taken on November 6, 1945, at Nakajima's Koizumi plant, nearly three months after the war. In the background are three fuselages and wing sections of unfinished 4-engine Renzan Navy bombers. Production on these aircraft terminated so that efforts and material could be concentrated on Kikka.

Three categories of new air weaponry called KOKOKU HEIKI were given close study. (There are various literal translations of this name including; *Empire Weapon, Weapon of the Empire, Up-rating for our Country, Emperor's Country's Weapon, etc.*) The first category for weapons was of an immediate nature. This called for remodeling existing aircraft such as Raiden (JACK), Shiden (GEORGE) and Suisei (JUDY) to carry a 800 kg (1760 lb) bomb. This heavy weapon exceeded the design load for these aircraft, but they would carry the weight, with RATO assist, for their one way flight to plunge into enemy ships.

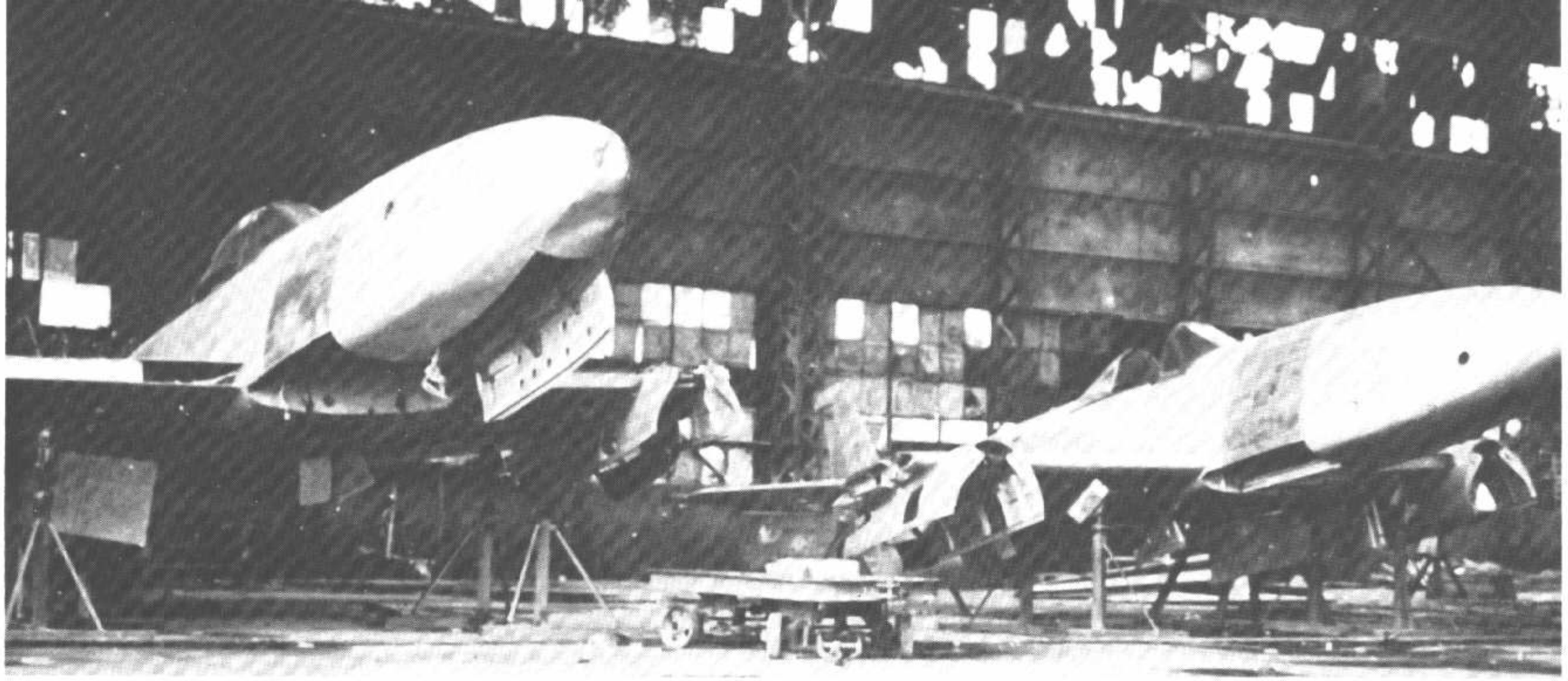
The second weapon system to be developed was a new jet powered aircraft using two TSU-11 engines initially for design purposes, and to be replaced by the higher thrust TR-12 turbojet engine if the forecast development of this new engine became a reality. This was the first glimmer of what would become Kikka.

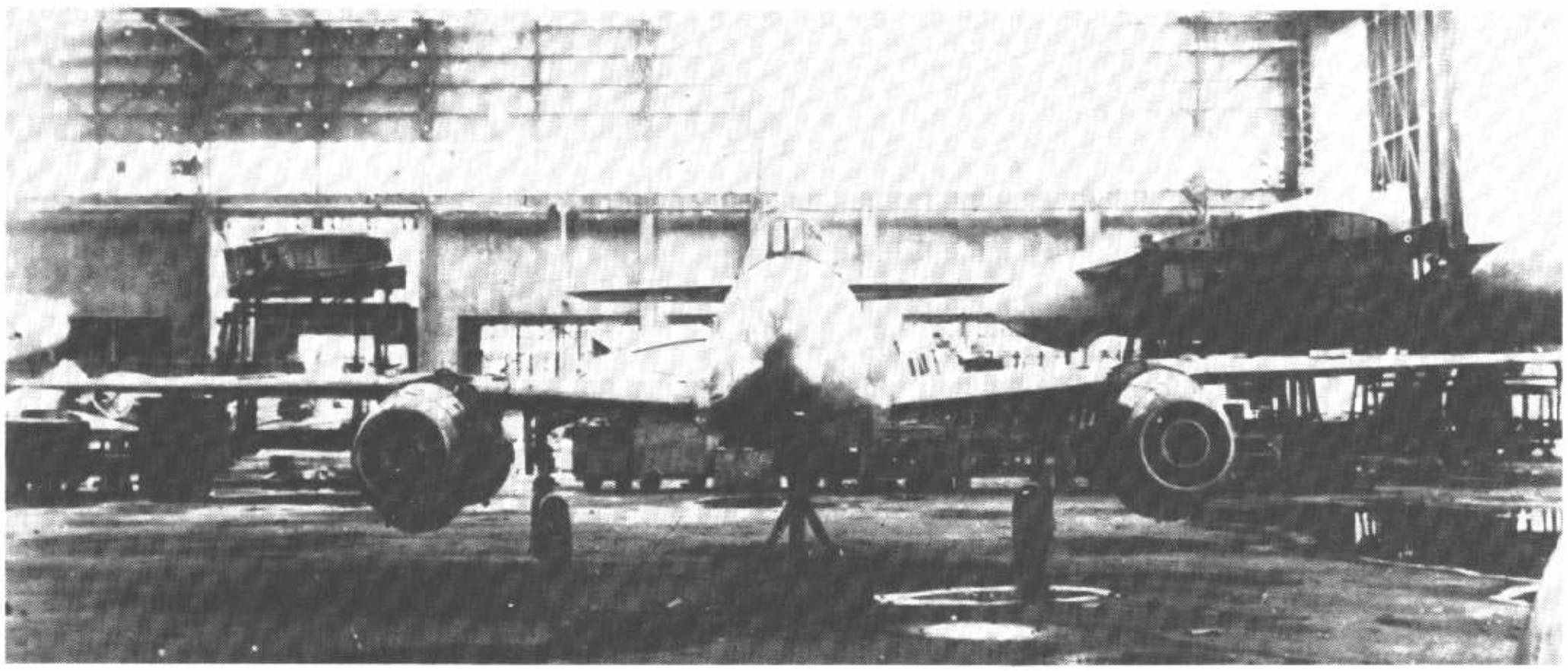
KOKOKI HEIKI No. 3 was a special attack plane called Tokko-ki which was to be designed and built by Kawanishi. This was a conventional propeller driven aircraft powered by a Mitsubishi Kinsei, 14-cylinder radial engine of 1280 hp, one of Japan's most dependable engines. The mission of this plane was also suidical attacks against assault ships. This final portion of the plan by the Navy was not developed, however, for reasons unknown. (It should be noted that Nakajima produced 104 Ki.115 Tsurugi Special Attack aircraft for the Army, similar to the Tokko-ki, to meet this mission requirement.)

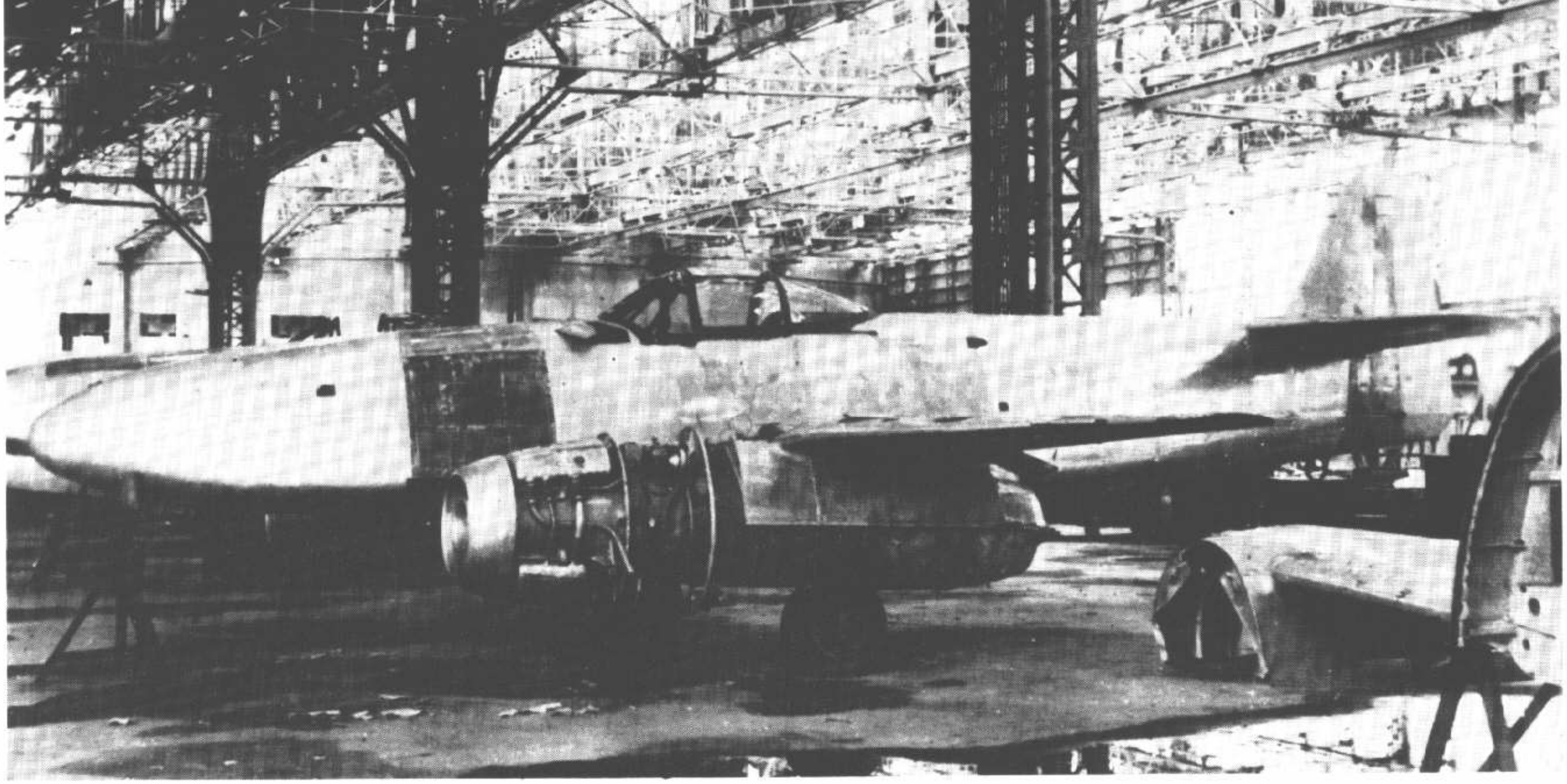
This planning conference left much to the imagination of the aircraft designers in attendance. Soon after this August meeting Chief designer for Nakajima, Ken-ichi Matsumura, who was in attendance, had preliminary sketches made of what he proposed should be the new jet aircraft design. At a meeting held on September 14, 1944, this new jet airplane was discussed with company and Navy planners at Nakajima's main plant at Koizumi, and this KOKOKI HEIKI No. 2 design was accepted. Matsumura's previous designs included the 4-engine Renzan (RITA) and Carrier Attack Bomber Tenzan (JILL). Aided by Engineer Kazuo Ohno, also of Nakajima, the two men had only vague information on which to base this new design that was generated from the Navy requirements.

The design layout was generated from reports given to the design team by Technical Commander Eiichi Iwaya when he returned to Japan the previous July after studying the Me 262 in Germany. Since the drawings for this airplane, as well as the BMW 003 jet engine drawings were lost on the blockade running submarine, the airplane had to be designed from basic concepts only. With the success in combat that Germany was having with the Me 262, there was little wonder that the Japanese version would resemble that airplane. All other similarities ended there, for the structure was totally Japanese in design.

It seems probable that top level planners may not have understood the potential of jet powered airplane at this point of development. The mission for this new plane was that of Special Attack, which generally refers to suicide crash-dive missions, and there was no mention of using it as an air







Page 12, Above Left: Two Kikkas on the assembly line at Koizumi show the nose cavity in which the fuel tank was carried. Sheet sheel was used as a substitute material to skin over this area which accounts for the different color. Page 12, Center: This front view of Kikka taken at the Nakajima factory shows the gull-wing effect with its break just outboard of the engine nacelles. The wing folds at this point. An inboard engine nacelle of Renzan, 1 4-engine bomber, is in the right rear background. Page 12, Below: When the war ended, the first run of 25 Kikkas was well underway. Production was planned for reaching 135 per month collectively from four aircraft manufacturing sites. All these factory pictures were taken at Nakajima's Koizumi plant. Two airframes were also under construction at the Kyushu Hikoki by the end of the war. Page 13, Below: Sub-assembly units of Kikka were manufactured at dispersed sites in Gumma Prefecture utilizing silkworm factory buildings. The finished components were transported to Koizumi where they are shown here in readiness for final fitting and assembly.

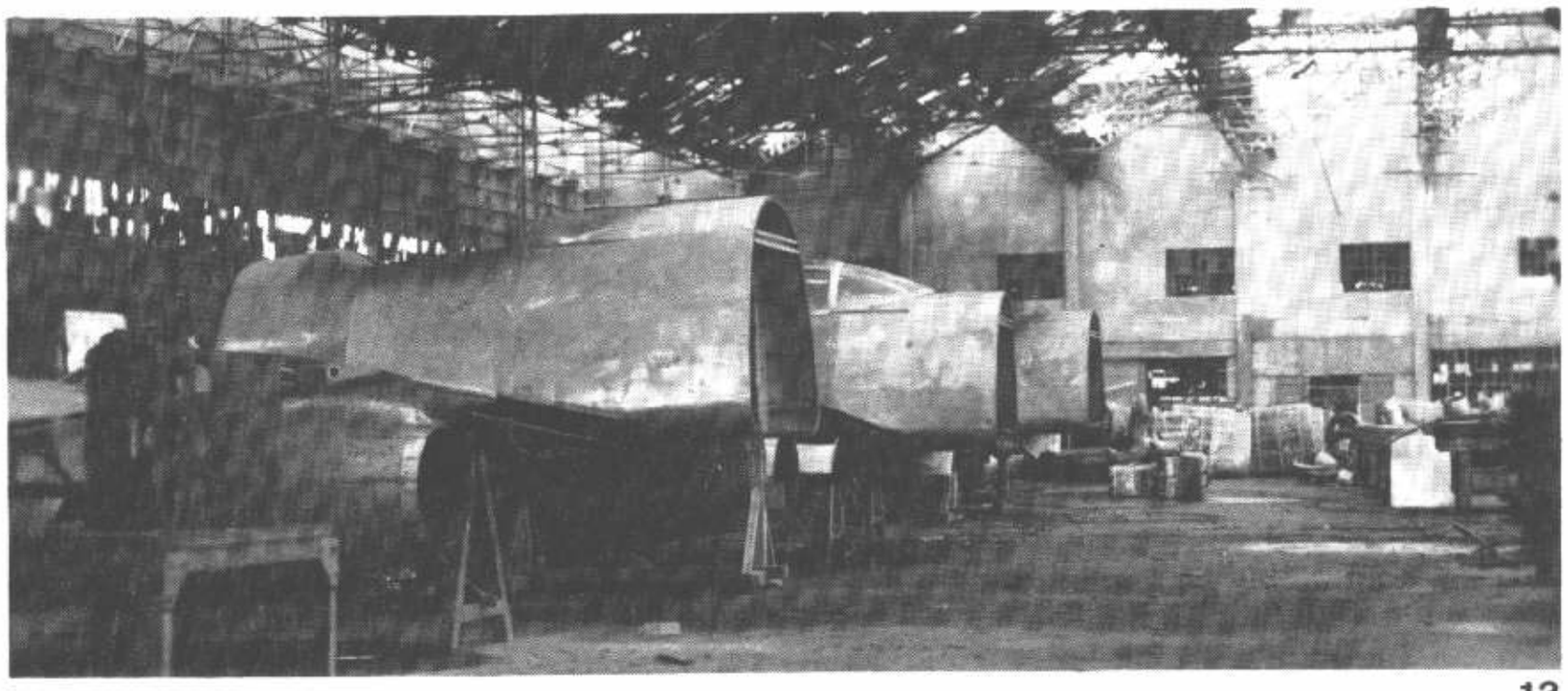
defense fighter or recoverable bomber. Consequently, in the early plans the landing gear was deleted, and takeoffs for these one way flights would be by catapult with RATO assist. Aircraft range requirements were only 110 miles, calling for a twenty-seven minute duration. Perhaps this short-range requirement was due to the reputation of existing test models of the TR-12 engine, which was then the planned power system, of having excessive fuel consumption. Maximum speed at sea level was to be 345 knots.

Programming an aircraft for development is normally planned in increments of months, but by necessity the schedule for this aircraft was compressed into a matter of weeks. On October 8, the Plant Chief for Nakajima, Kazuo Yoshida, was directed by KUGISHO to have a wooden mock-up available for inspection within the month. By the end of October, the basic structural drawings were to be completed so that fabrication on the first aircraft could begin. The engineering staff at Nakajima worked day and night to achieve these unrealistic demands. The Navy promised that the TR-12 engine would be flight-tested in November, attached to the underside of a Navy Type 1 Attack Bomber (BETTY). With great optimism they anticipated that delivery of production engines would begin soon after. Expecting to have engines in hand, Nakajima was to produce thirty jet planes by the end of December 1944.

Every effort was made by Nakajima to achieve these goals, but the project floundered for one reason or another. Uncertainty about the engine was the greatest concern at the Nakajima plant, and there were continual set backs in other phases of its development and production, In the design of the airframe, it was necessary to make substitutions for critical materials wherever possible, which further complicated production. In essence, the entire design of the new plane remained quite fluid through this time period.

PLAN FOR KIKKA STABILIZES

Information from a Navy Research and Development conference that took place on December 9, 1944, brought about another perspective for the KOKOKU HEIKI No. 2 project. Production schedules were adjusted for delays and mention was made of production ship number "0" to be completed by the end of February 1945, and to be used as a static test model. Obviously, at some point prior to this time, the airplane had taken on greater meaning to the Navy and its mission was changed as well. Surprisingly, pilot and aircraft survival measures were included. No longer was it intended for Special Attack—Kamikaze—missions, but it was now able to release its bomb and be used in the close air support bomber role. A new specification was is-



The first prototype thunders down the runway moments before the underfuselage RATO units forced the nosewheel off the ground prematurely rendering pilot Takaoka's attempts to control, and finally to abort the second takeoff, futile.

Had the RATO unit been better positioned, the second attempted flight would probably have been a success.

sued for Japan's first turbojet aircraft, and in it the name Kikka was mentioned for the first time. (See Table I.)

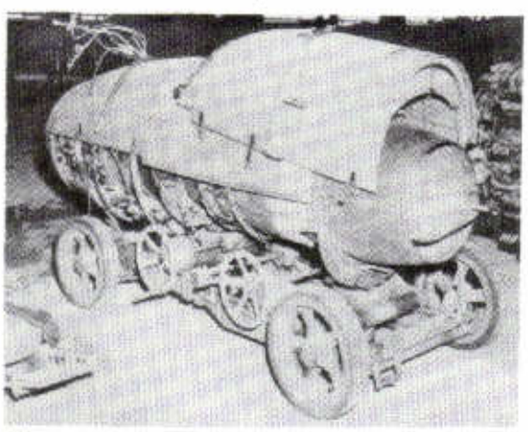
The turn of the new year 1945 was not a happy event for the Japanese in light of the deteriorating war situation, but it would be the year that the first jet would be built and flown in Japan. Perhaps many had doubts, for there was one setback after another in the development of the Ne 12 as a suitable propulsion unit. In a conference on January 4, the Kikka designers discussed the possible use of the more powerful Ne 20, an engine even further away in the development stage. For the present, however, they planned to use the Ne 12, which seemed closer at hand.

Because of the continuing changes and uncertainty, the full scale wooden mockup of Kikka was not available for inspection at the Koizumi plant until January 28. Admiral Misao Wada, Chief of KUGISHO, and his staff made their evaluation of this new plane, with designers Matsumura and Ohno pointing out the various features. Simplicity in detail was the keynote so that production could be rapid. The manhours required to build the Zero fighter, for instance, were estimated at 15,000, while the manufacture of Kikka was hoped to be held to only 5,000 manhours—a reduction to one-third the time. Final estimates in manhours, however, escalated to 7,500 per Kikka. In a further attempt to expedite production of Kikka, the J5N1 Tenrai, twin-engine fighter by Nakajima was discontinued (only six prototypes were built) and standby plans were made to curtail or terminate production of the four-engine Renzan (RITA).

The only change that was generated at the mockup evaluation meeting was to improve forward visibility by incorporating a flat panel in place of the curved windshield. This suggests that a fighter configuration of Kikka may have been considered as early as this time, for a reflector type gunsight is affected in sight alignment by distortion of curved windshields with changes in temperature and air pressure. The cockpit canopy was modified to slide to the rear rather than hinge from the side.

PRODUCTION BEGINS

A second inspection of the mockup was held on February 10 and approval was given for production. Those in attendance at this gathering were Commander Iwaya, who had seen the Me 262 in Germany, and had conveyed the details of that airplane to



This is the intake end of the cowled Ne 20 engine. This engine was patterned after the BMW-003 and was approximately three-fourths the size. Japanese engineers had only a sideview cutaway drawing of the German engine from which to develop this axial flow turbojet.

Rear view of the same engine showing the tail cone and pipe. The greatest difficulty in the manufacture of the Ne 20 other than substitution of scarce material was in keeping turbine blades from cracking at welded attachment points to the turbine disc. Consequently, engine life was approximately 5-hours running time.

Nakajima designers. Also, the name of Lieutenant Commander Susumu Takaoka appears for the first time with this project, for it is he that will fly Kikka for its one and only flight.

Although mass production began without flight testing, the first examples off the line were to be treated as prototypes. Airplanes No. 1 and No. 2 were to have "no armament at all," according to the plan, presumably meaning that bomb attachment fittings and linkages were eliminated. Airframes No. 1 through No. 5 were to be without armor plate and leak-proof fuel tanks.

The tempo of air raids increased over Japan and its industrial heartland, and on February 17, 1945, the engineering staff of Kikka moved from Koizumi—26 miles north of Tokyo, to a site further to the east at Sano City. Production was also to be dispersed. Wings, center and aft fuselage sections, and empennage were to be constructed by KUGISHO at Yokosuka, while smaller components production remained at Nakajima's Koizumi plant. Air attacks soon changed this and parts manufacture were dispensed through Gumma Prefecture in central Honshu, northwest of Tokyo, utilizing silkworm factory buildings and facilities. Ironically, Japan, known the world over for its fine silks, had its first jet plane take shape under the thatched roof of one of these silkworm factory buildings.

The results of the successful test run of the Ne 20 engine on March 26, 1945, fostered the decision that Kikka would be powered with this more promising axial flow engine, replacing the Ne 12 centrifugal flow jet engine. Fabrication had not reached engine installation at this point, but this engineering change did cause another delay in the production of Kikka. The advantages to be gained with this higher thrust Ne 20 engine were expected to outweigh the loss of production time. By March 31, all production drawings for the airplane were completed and were now stabilized after many, many changes. With the new engine, modifications were in order for the specifications pertaining to Kikka. (See Table II.)

GENERAL DESCRIPTION OF AIRFRAME

The Me 262 was used as the inspiration for Kikka, however, the Japanese model was smaller than the German design, and its smaller engines developed less power. With this resultant light weight due to reduced size, Kikka's performance would have been comparable to the Me 262. Structural contours between the two crafts differed considerably, and Kikka was totally Japanese in design.

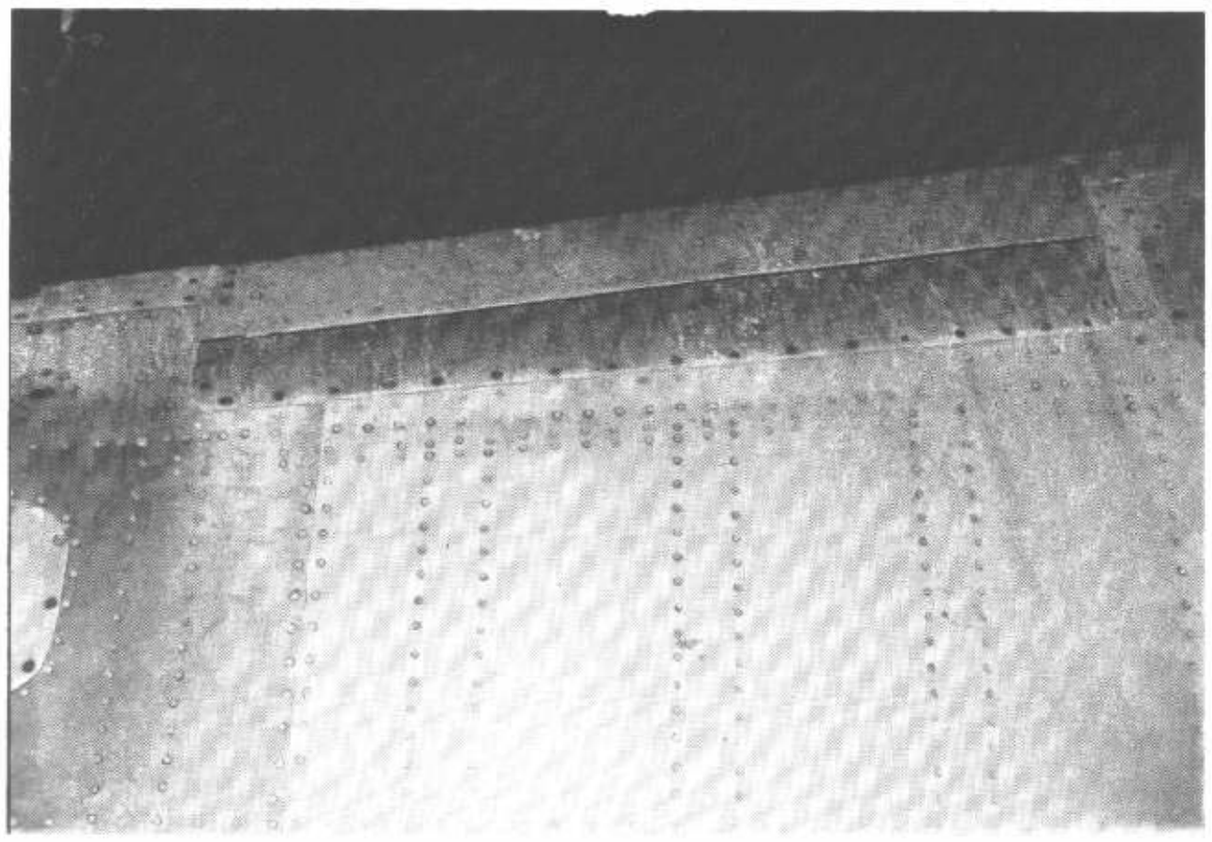
Main Wing: Tapered in design, its leading edge had a 13° sweepback, and 9° at the aerodynamic center line. Wind tunnel tests showed that the wing had a tip stall tendency due to the wings sharp taper ratio and sweepback angle. This could be detected at about 160 kts. To compensate for this, a

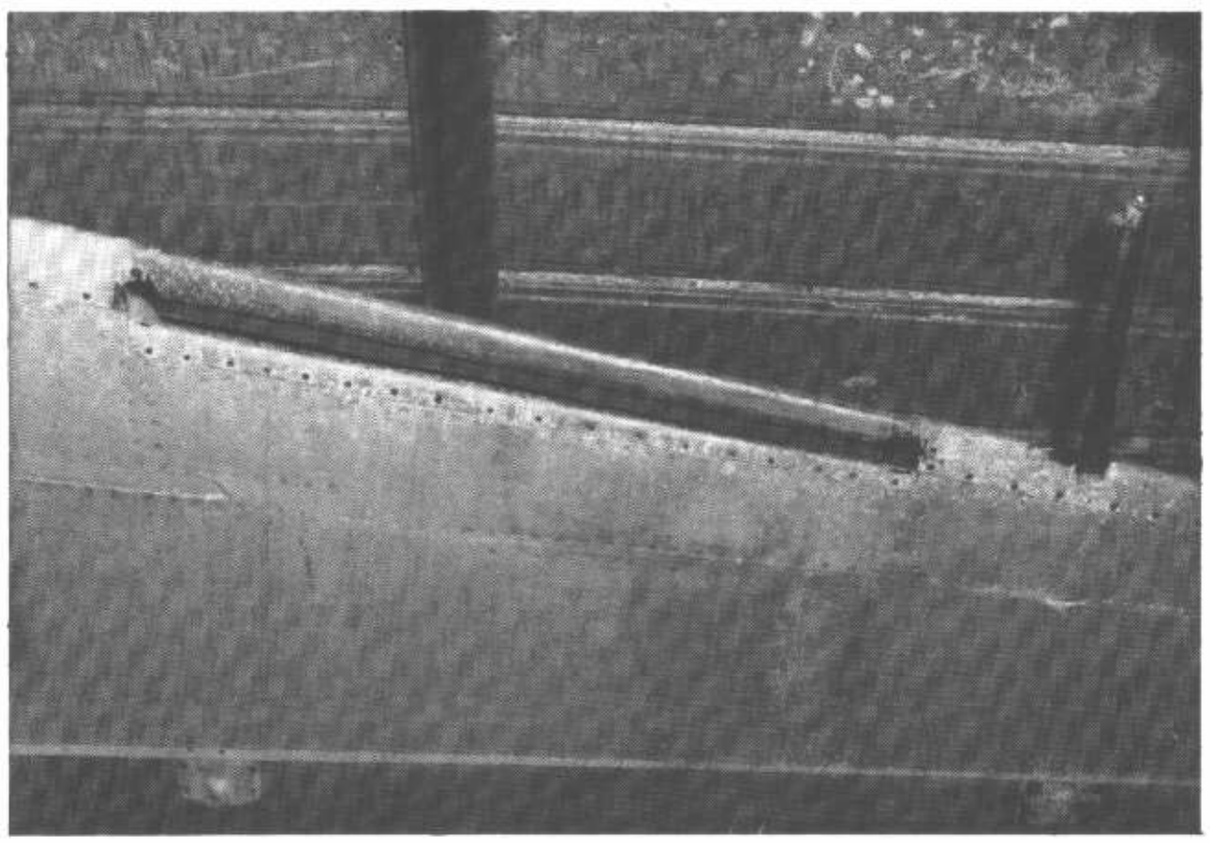
Continued on p. 18

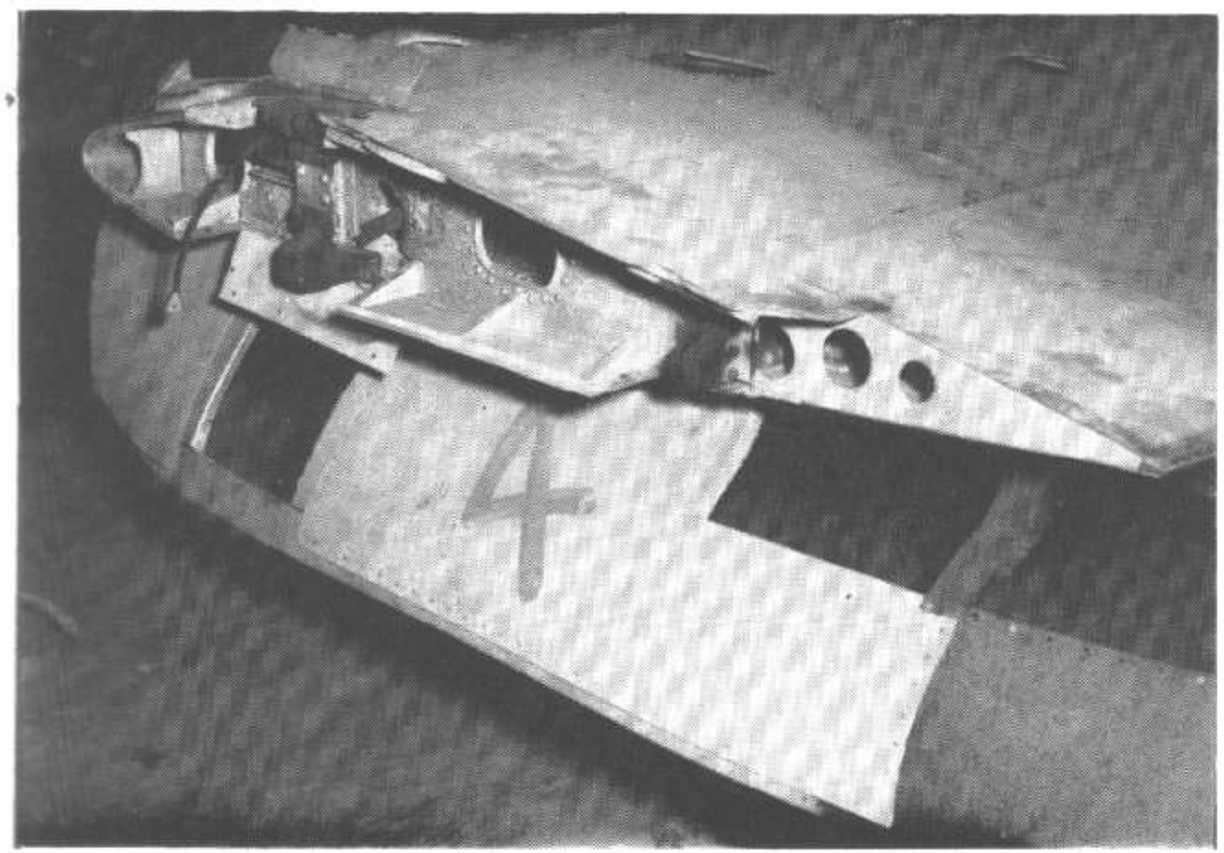
Below Left and Right: Wing slot openings, top and bottom.

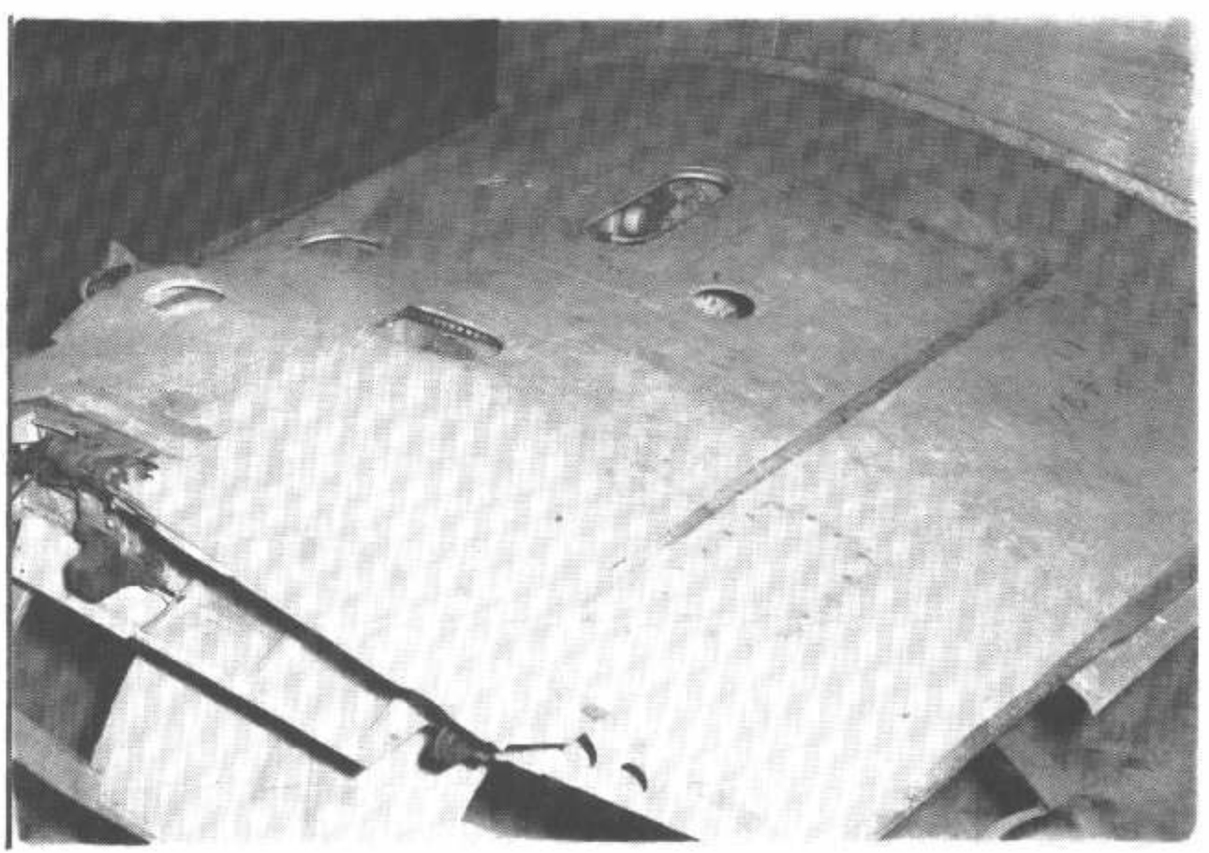
Bottom: This is the hinge point for the left outer wing panel of Kikka. After the wing is pin-locked in position, hinge point openings are covered by fairings hinged to the wing. When the wings are folded, they are supported by rods that fit into slots near the wing tip and on sides of the fuselage. Folding operation is done manually.

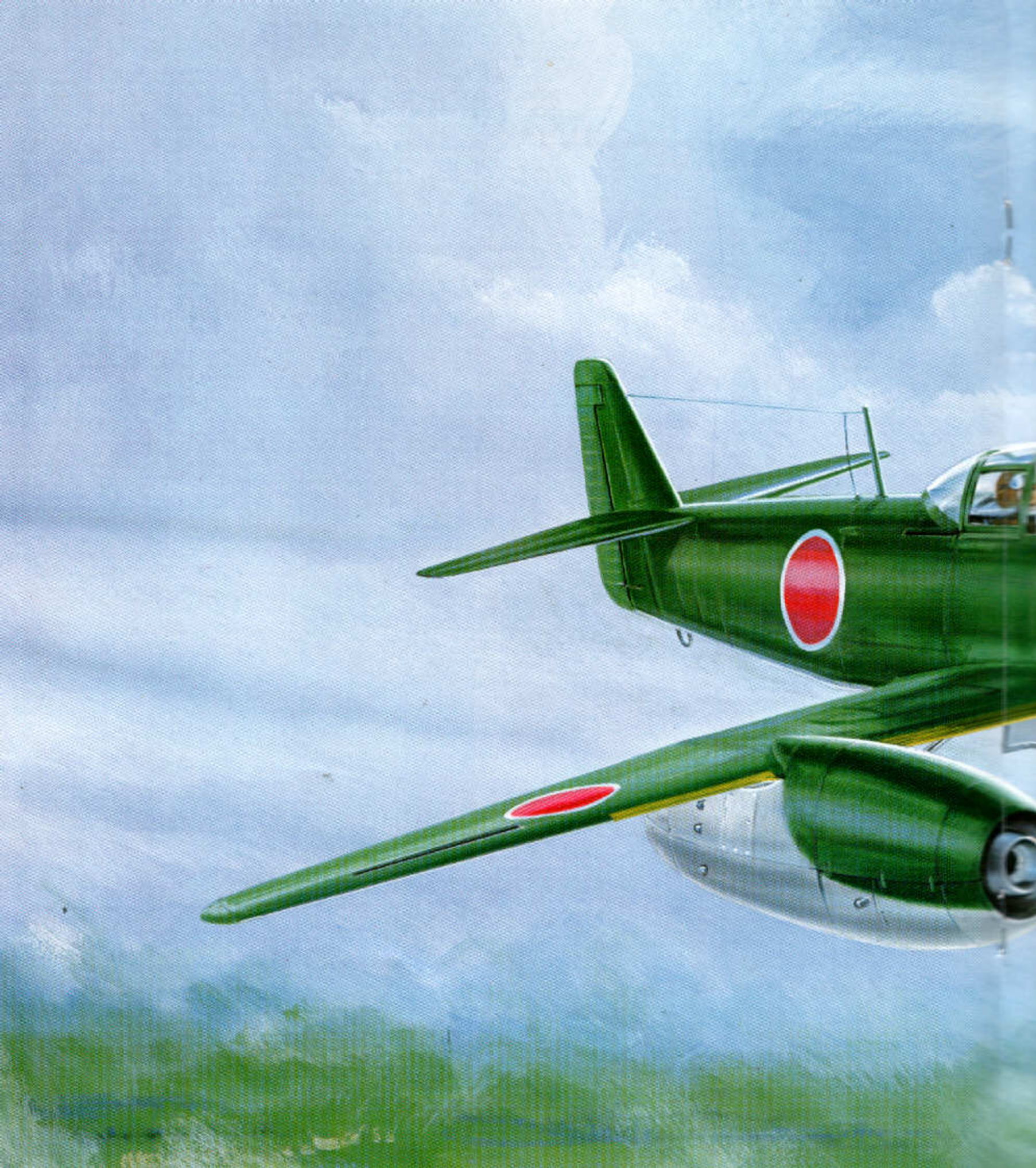
Bottom: Center section of left wing shows the many access openings on the upper surface. The trailing edge has a jog near the flap end, a detail often exaggerated in early drawings of this aircraft. Line above flap area is painted red.











washout of 2° at the tip was tried without success, and the adaptation of a wing tip slot resolved the problem. A number of high-lift devices were contemplated to adjust for the heavy wing loading at low speeds. The simplest form of split type flaps were adapted, along with droop ailerons. Air foils were Nakajima series K, a laminar flow design used on Saiun (MYRT), Renzan (RITA), and others. The K 125 airfoil section was used at the wing root, changing to K 309 at the wing tip.

The wing had a double spar with sheet

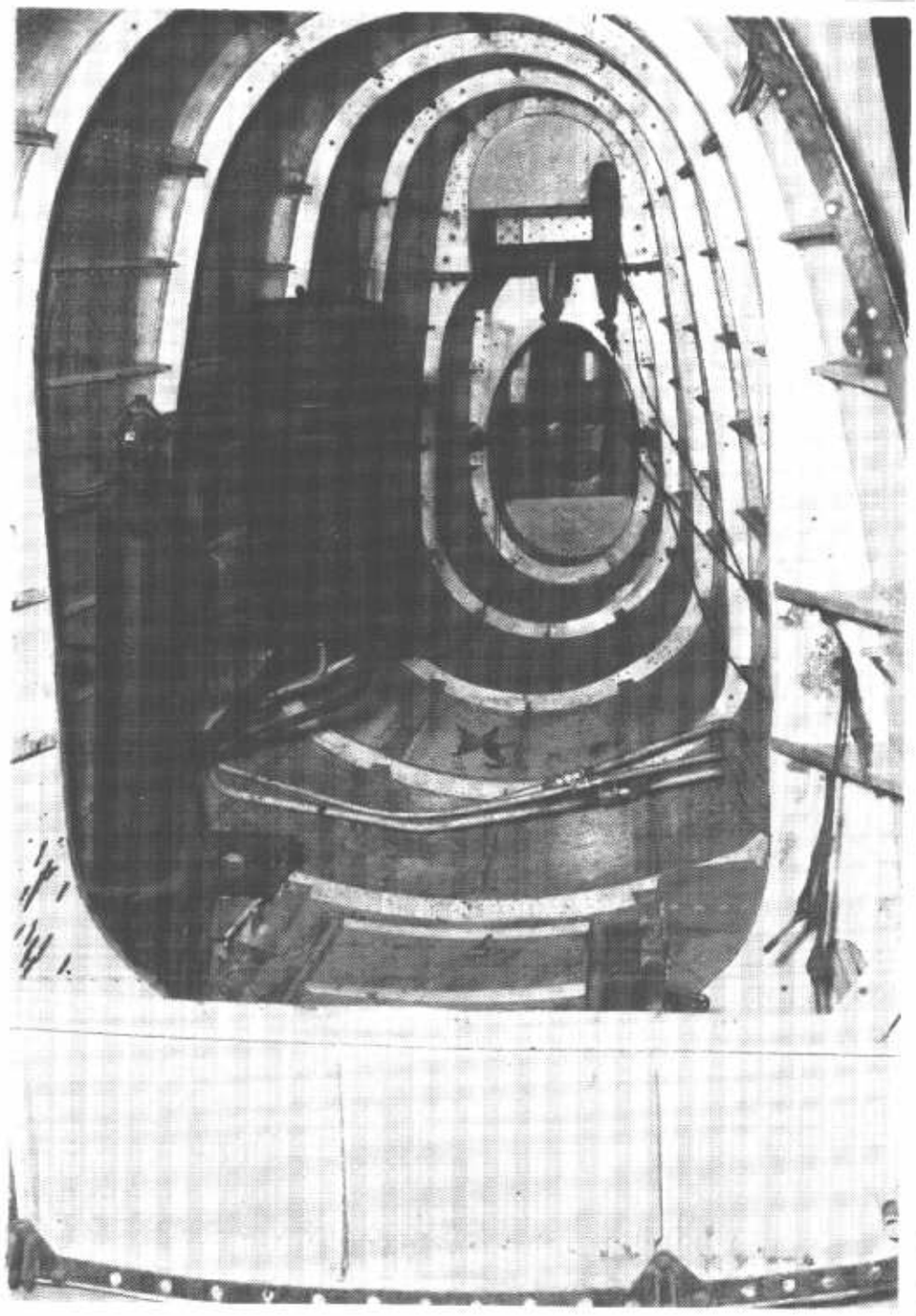
Continued on p. 20

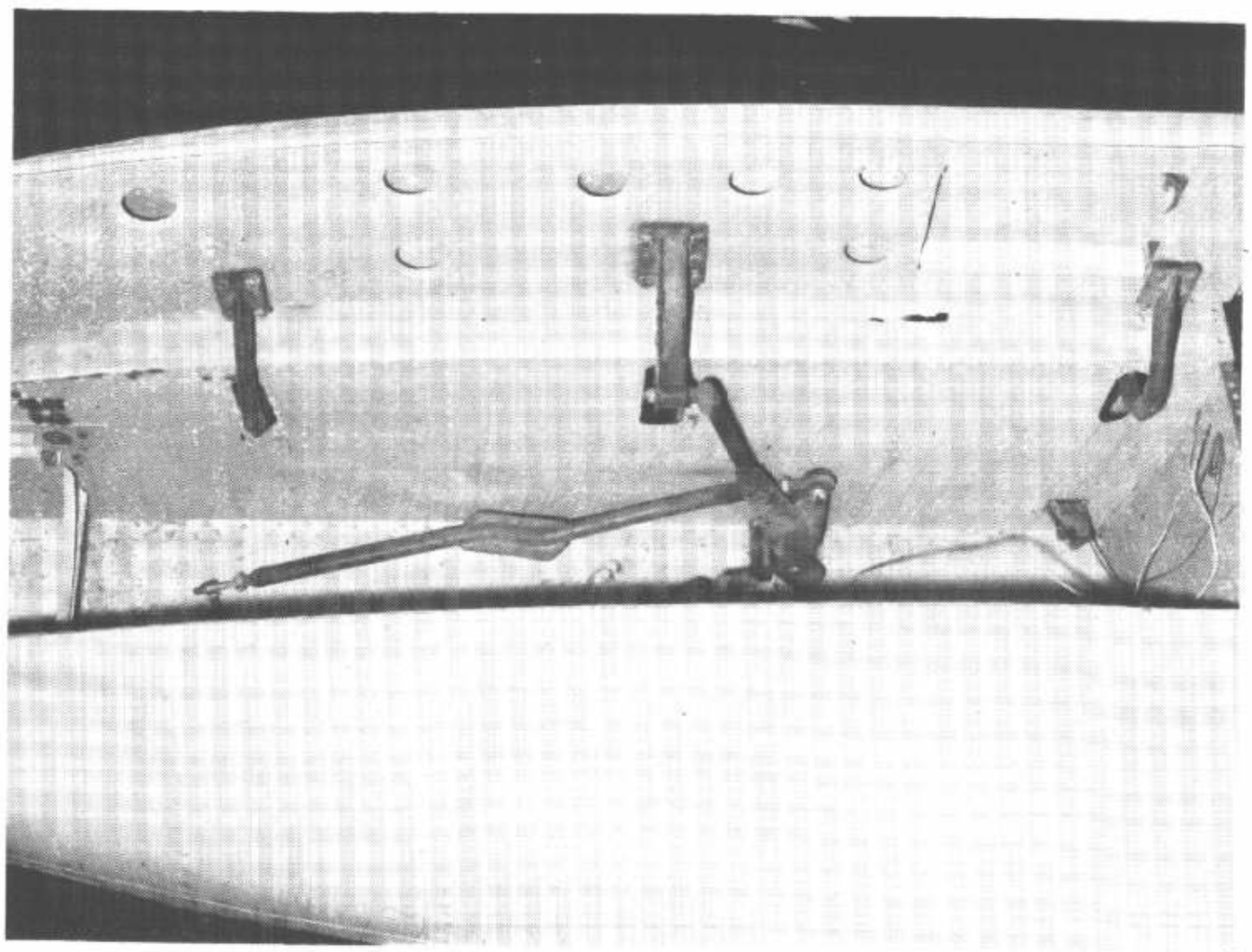
Below Left: Interior of aft fuselage section of Kikka. Tank at rear left is hydraulic reservoir. Kikka had a fire detection and supression system in the area of the fuselage fuel tanks. Pressure bottle at left contained CO2 for this purpose. Access door to this compartment is in the floor. Control cables are along the side.

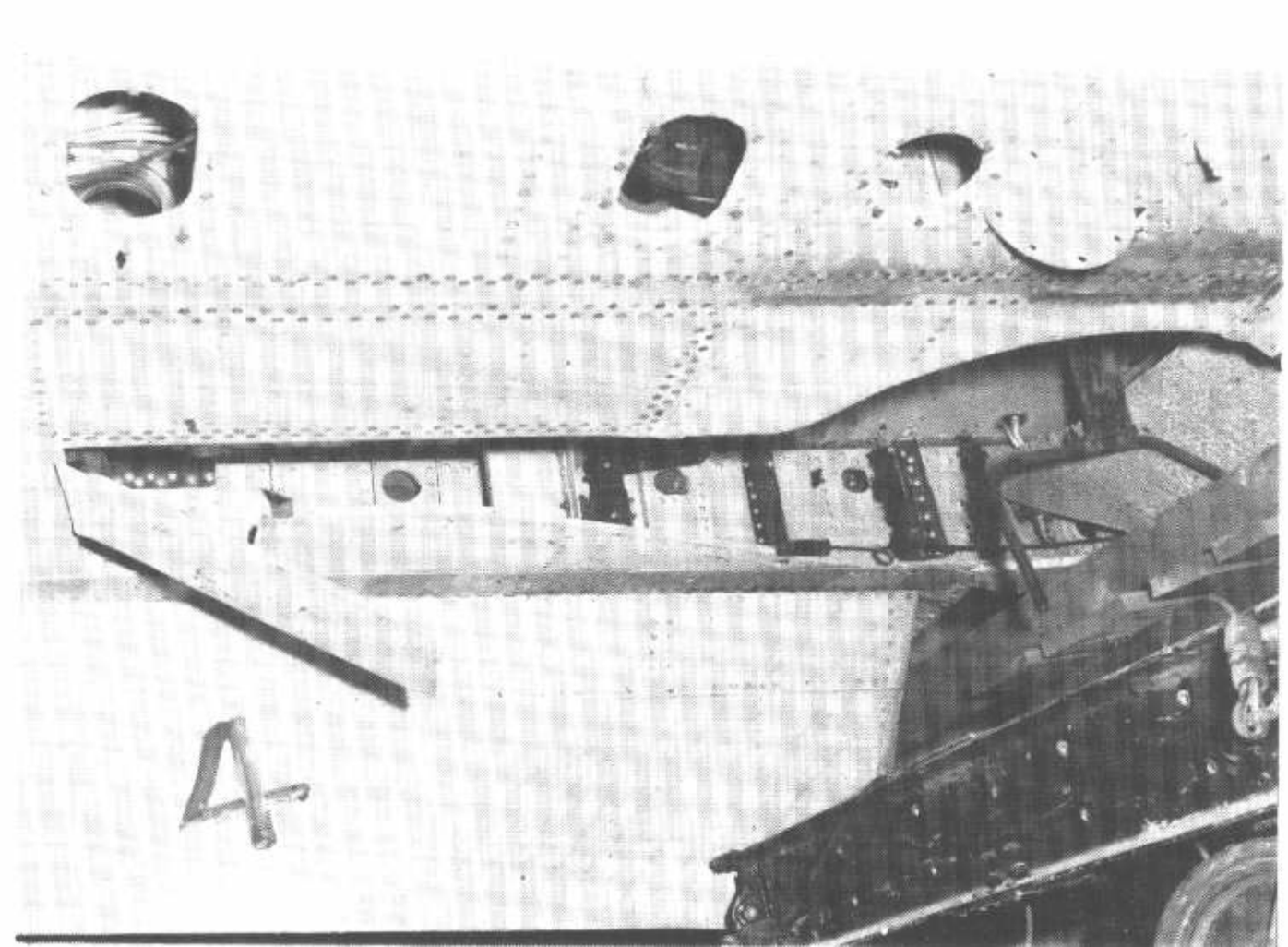
Below Right: Nose gear wheel well with door open. The attachment pivot point for the nose gear strut is the hole on the wall at the right.

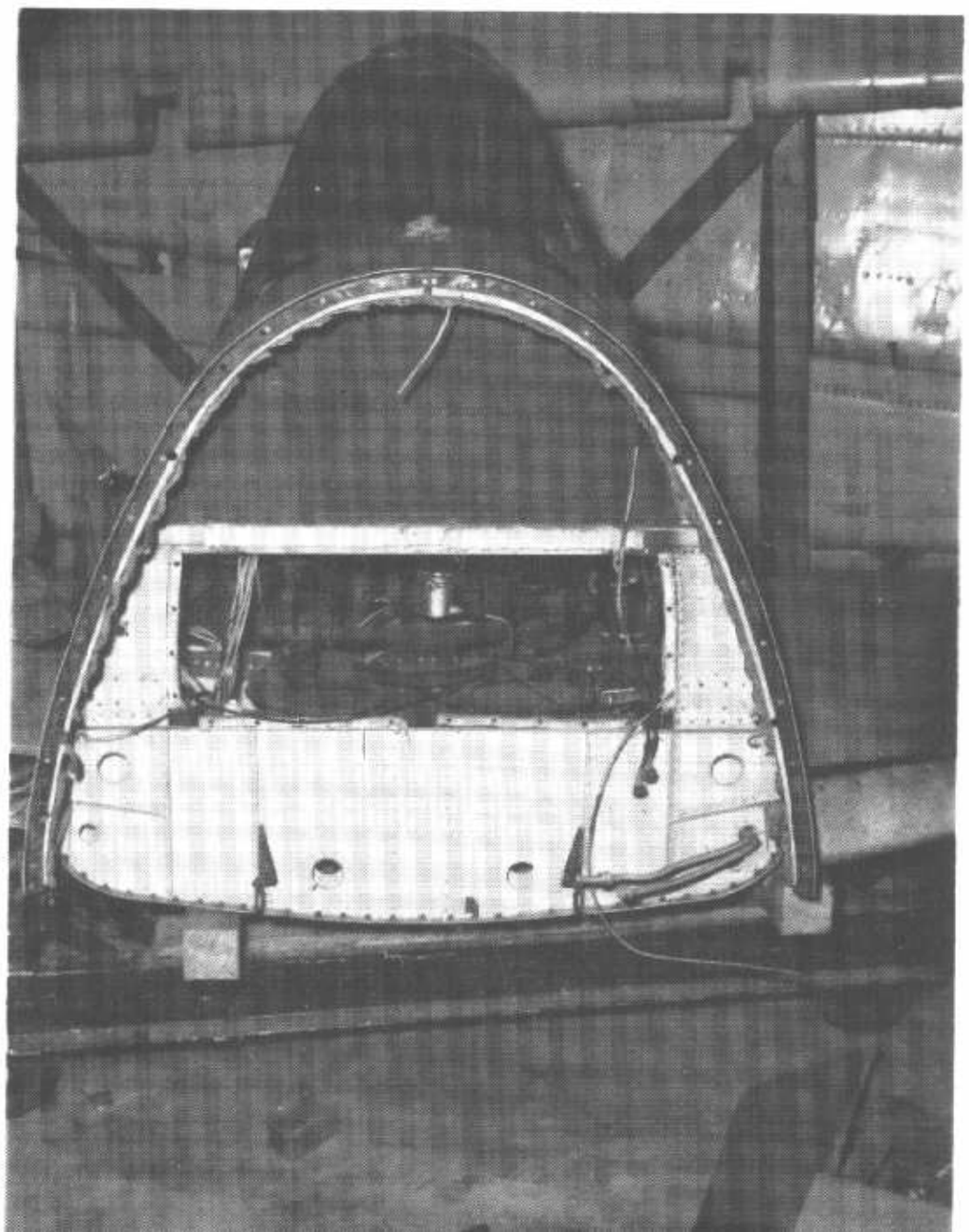
Bottom Left: Looking aft at right main landing gear wheel well. The forked device at right activates the fairing door that is hinged to the fuselage. Note the flap in the extended position.

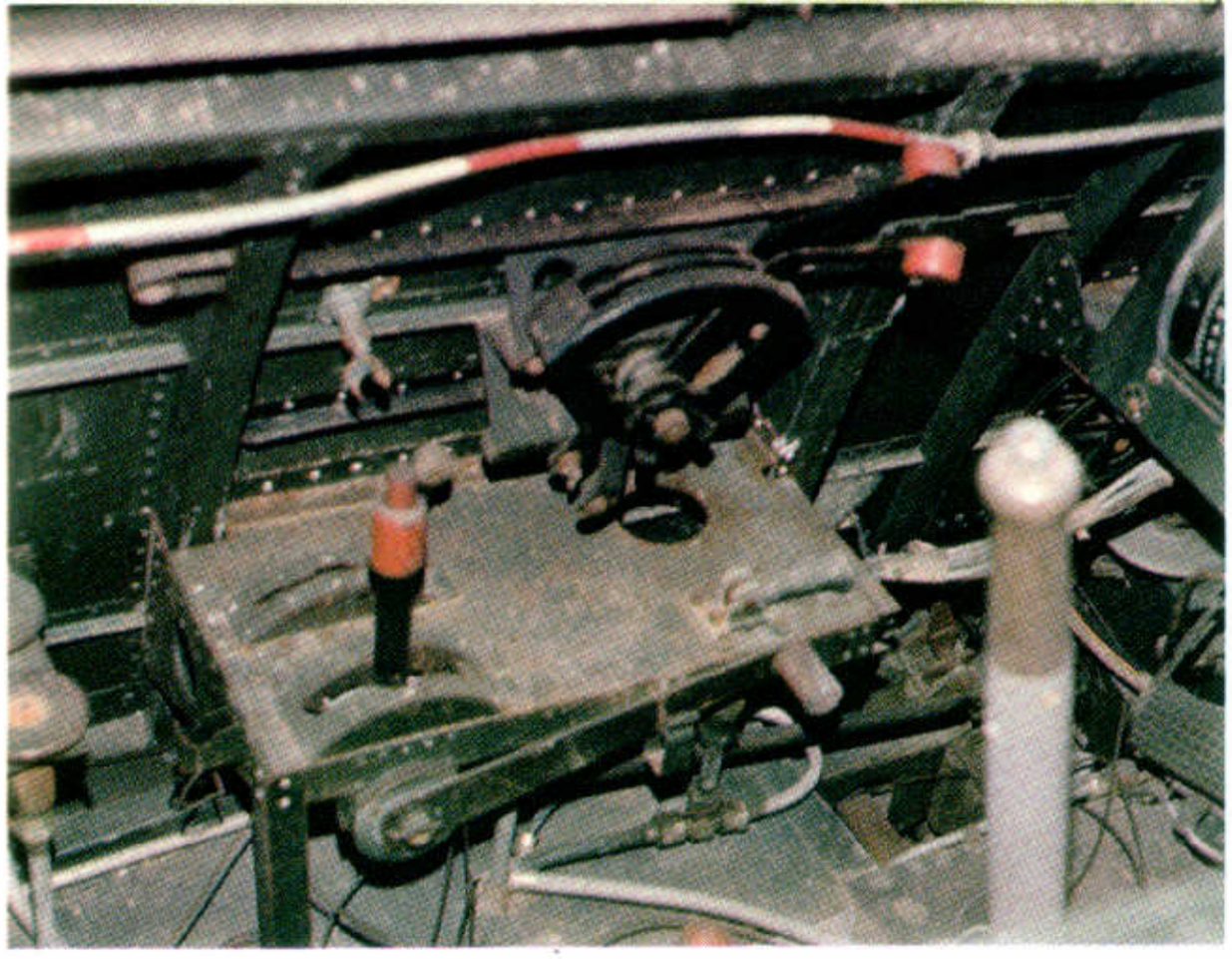
Bottom Right: Front view of nose center section shows the unusual flat lower surface of the fuselage. This view is at the nose separation point. The rudder pedals and bar are visible through the bulkhead opening. Brake system is unique in that the master brake cylinders operate directly at the pedal which eliminates considerable linkage. Fluid reservoir is off center on the rudder bar.

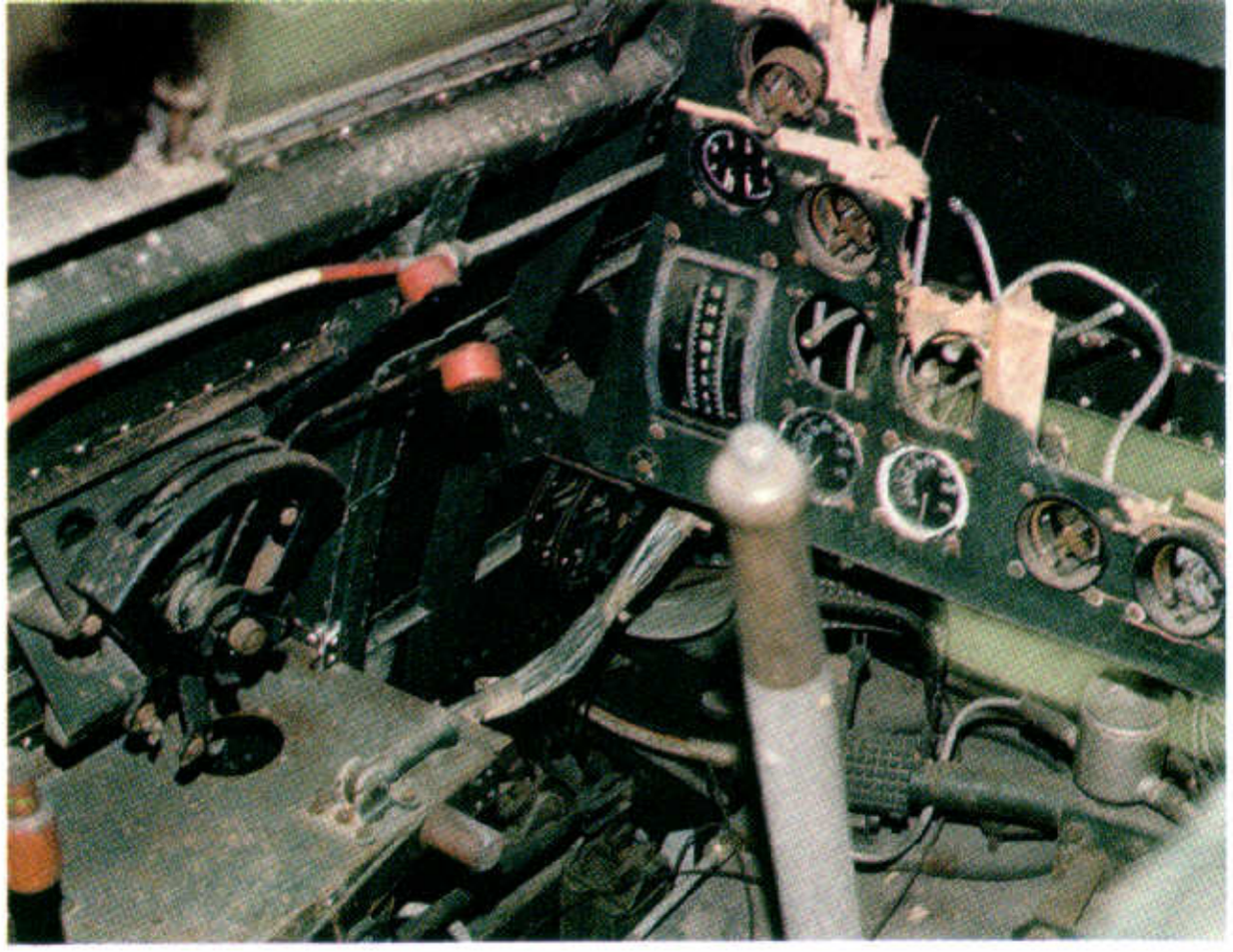












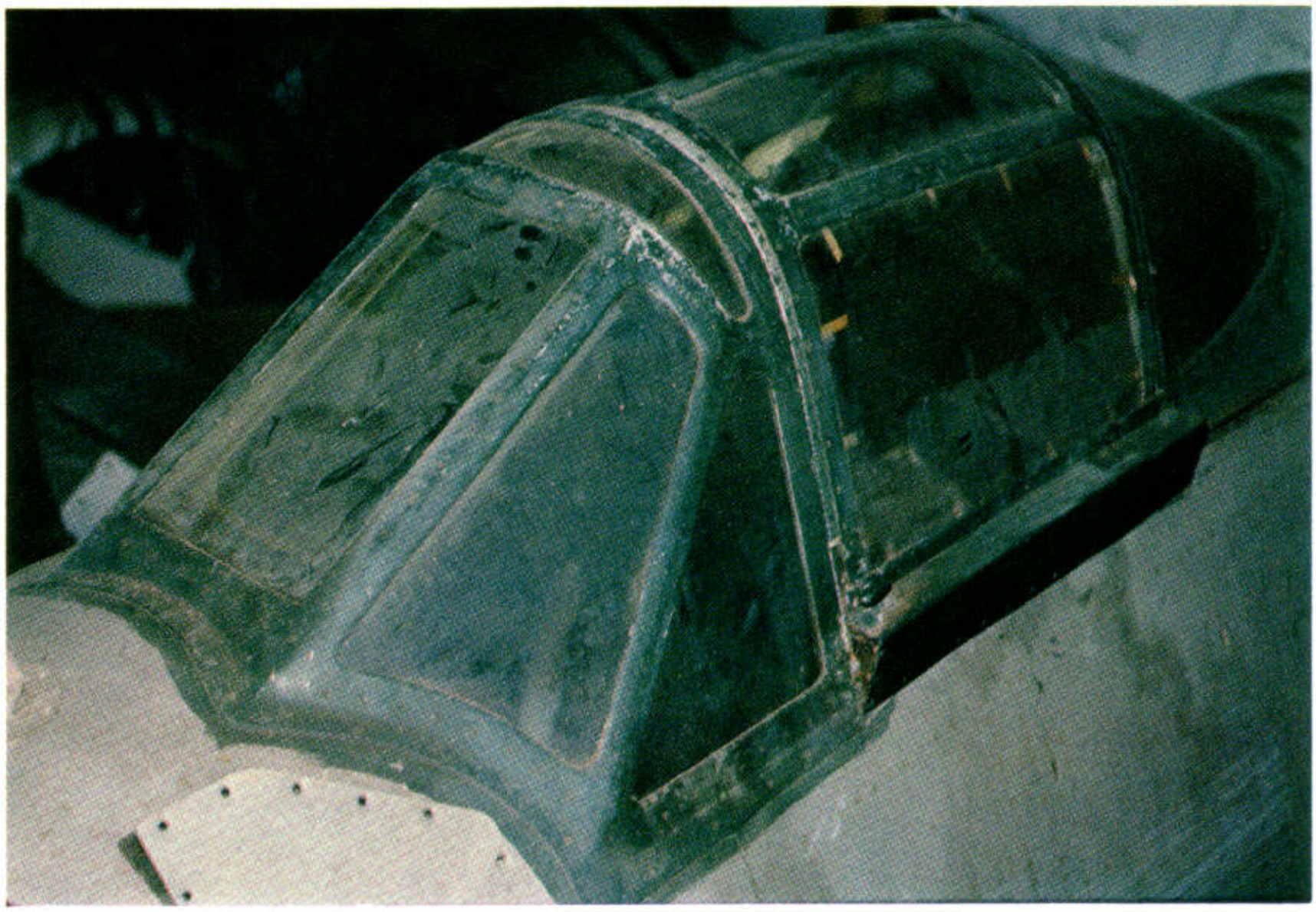
Upper Left: Left side of the cockpit contained the throttles in their usual location: upper center in this picture. The red handle is for the landing gear and the one behind it is for the flaps having three positions: up, 20° and 40°. The hand crack appearing handle manually unlocks the landing gear up-locks.

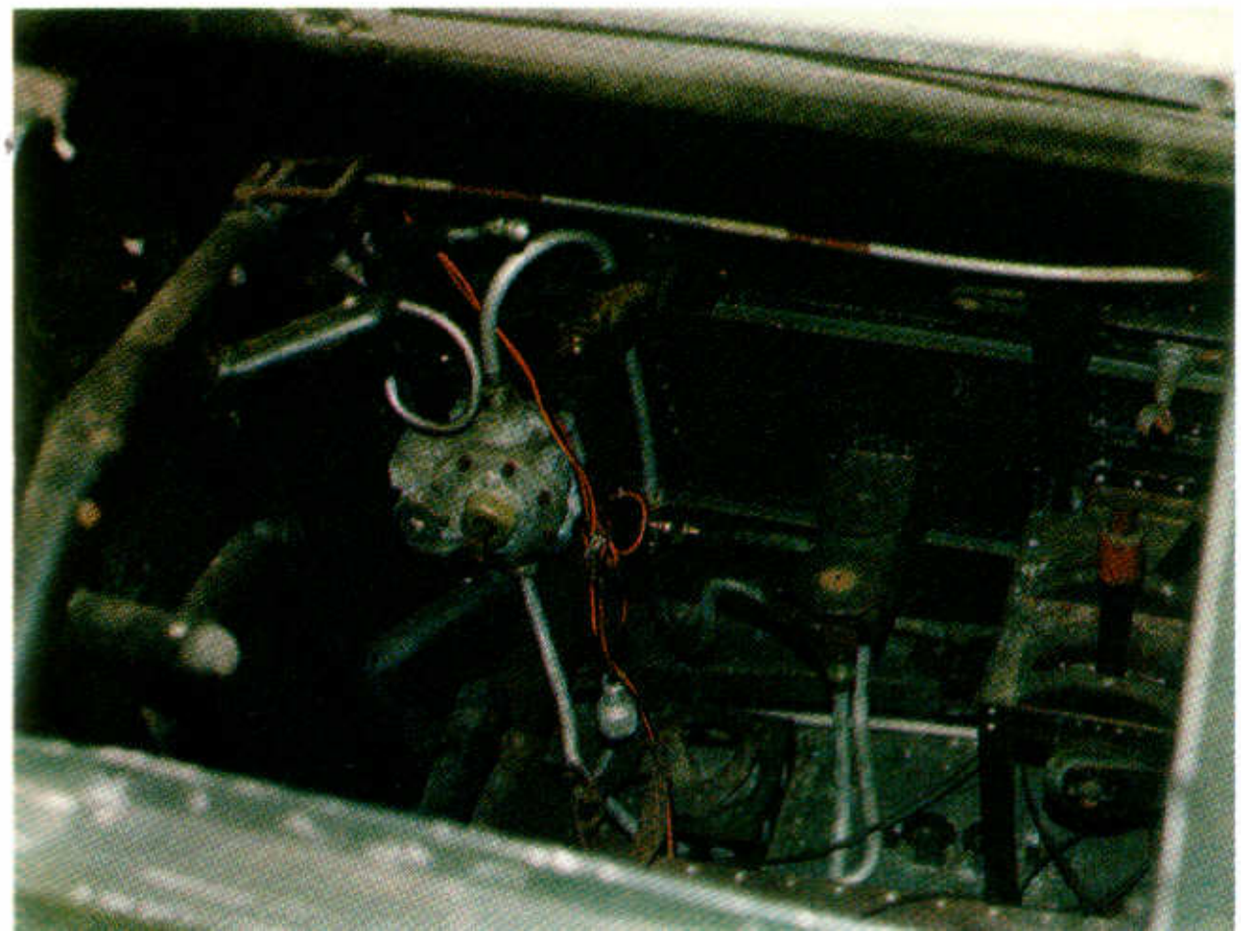
Above Right: Forward left view of the cockpit prominently shows the vertical-reading engine tachometers. Light green color is caused by artificial outside lighting.

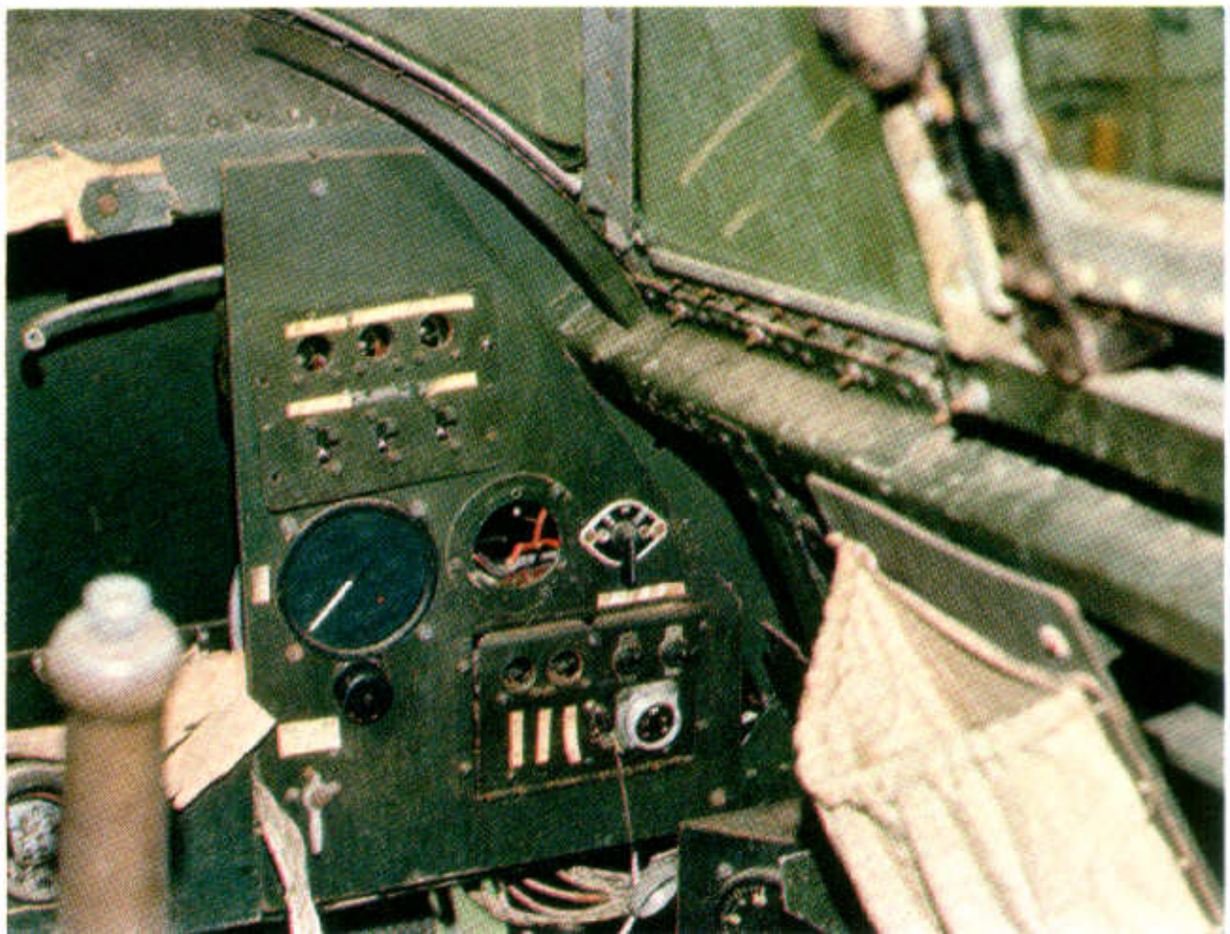
Right: The windscreen of Kikka closely resembles that of the Zero fighter, also manufactured by Nakajima.

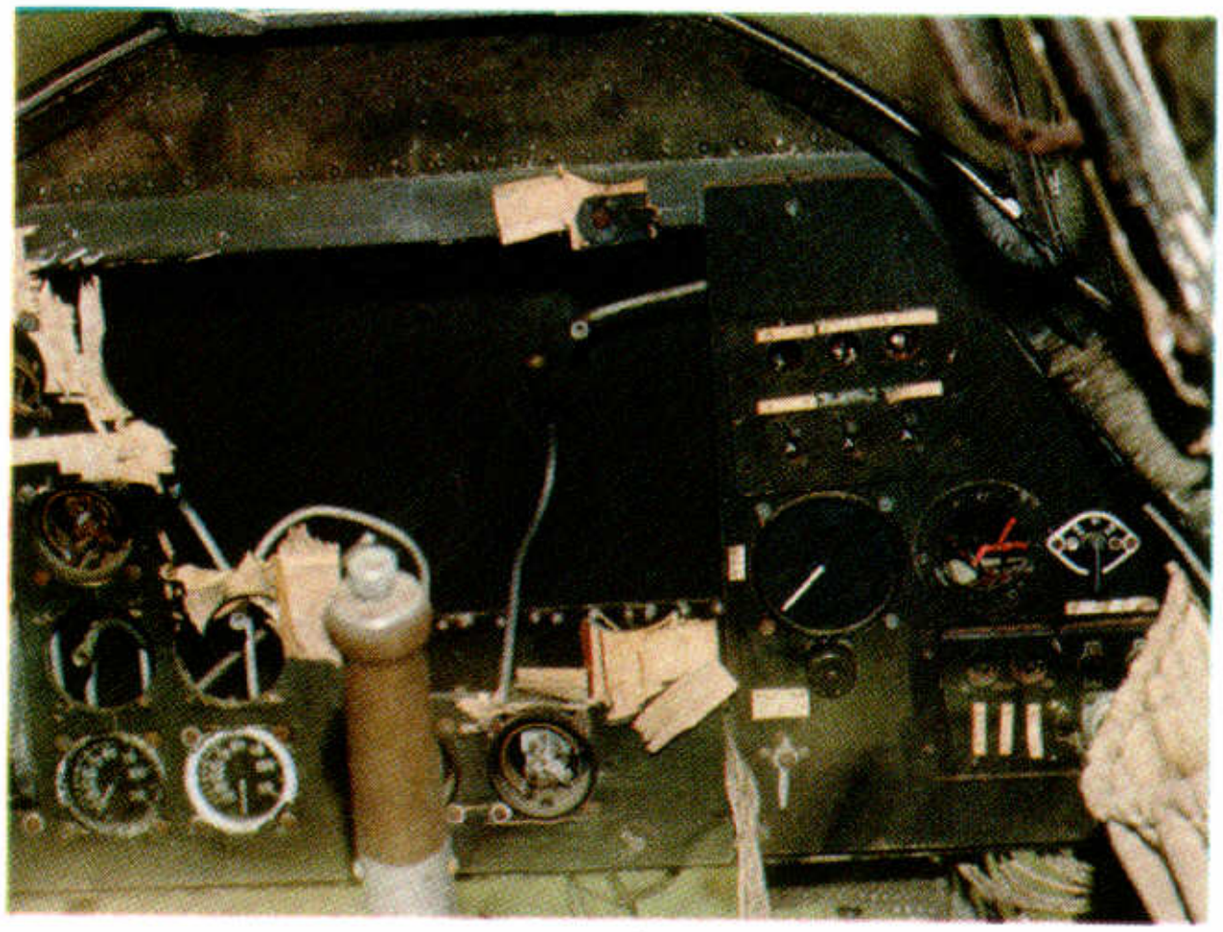
Below Left: Looking down into the cockpit, the unusual seat-back frame is to the left. The top bar has been bent up, but the side protruding fingers that center the parachute pack are the interesting feature.

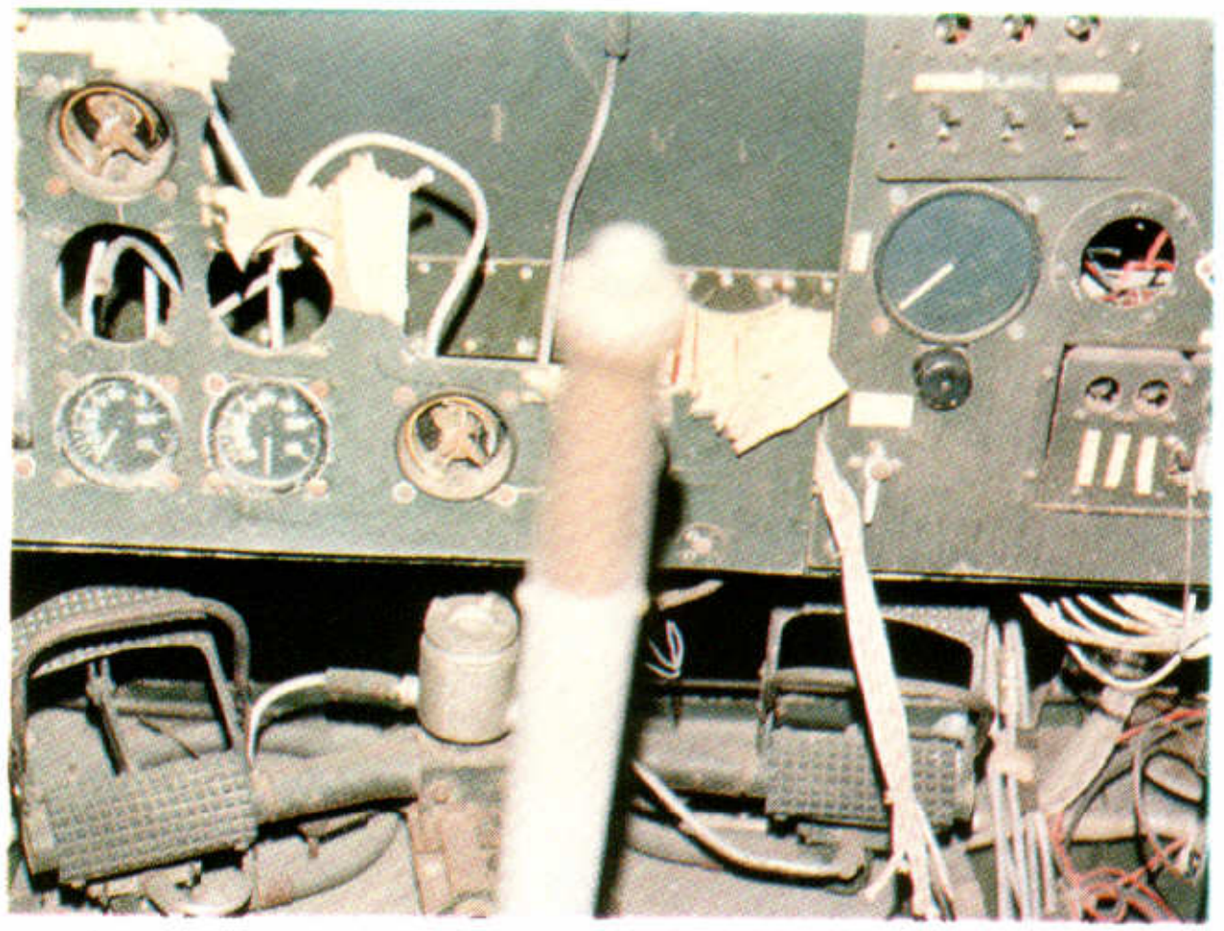
Below Right: Front right of cockpit. Accessory bag is handy for various objects.











steel and duralumin skin, forming a monocoque structure. There were nine main support ribs at needed points between the front and rear spar of the center section. The flap at the wing trailing edge utilized Zero fighter hinges. Outer panels were conventional with the exception of the wing tips which were made of wood and sheet steel.

Although the 10 m (32 ft - 9 11/16 in) wingspan was considered relatively small, the outer panels folded upward, bringing the tips over and nearly resting on the top of the fuselage. This was to reduce its size for storing as many aircraft as possible in the grotto type underground shelters. The centersection span was 5 m with 5° dihedral, while the outer panels had 2° dihedral, giving Kikka a gull type wing form.

Fuselage: Conventional in appearance, its cross-section was unusual in having a triangular form, although not as pronounced as that of the Me 262. Fuselage width was 1.200 m, height, including canopy, 1.430 m. Typical of many Japanese aircraft, this fuselage separates into three major parts: nose, aft, and main center section which has the wing section built into it as an integral part. Considerable sheet steel was utilized in this section due to the shortage of duralumin. The all metal monocoque structure was conspicuously simple in design to aid production. It contained twenty-four bulkheads, which were double at joining locations where they were secured together with bolts. One fuselage fuel tank was forward, and one was aft of the cockpit.

Empennage: Though quite different in shape from that of the Me 262 which had a distinctive fin and rudder, the empennage lines of Kikka matched no other aircraft. The aft fuselage lines were kept high for mounting the stabilizer so that it would avoid the jet wash without needing dihedral.

Landing Gear: This was Nakajima's first small aircraft to use a tricycle landing gear, proceeded only by the four-engine Renzan (RITA). The main gear was adapted from the Zero fighter and retracted inward and was concealed in the wing. The nose wheel was the same as the tail wheel used on Ginga (FRANCES) and retracted to the rear into the nose section. The wheel carried a 400×140 tire, while the main tires were 600×172.

KIKKA TAKES SHAPE

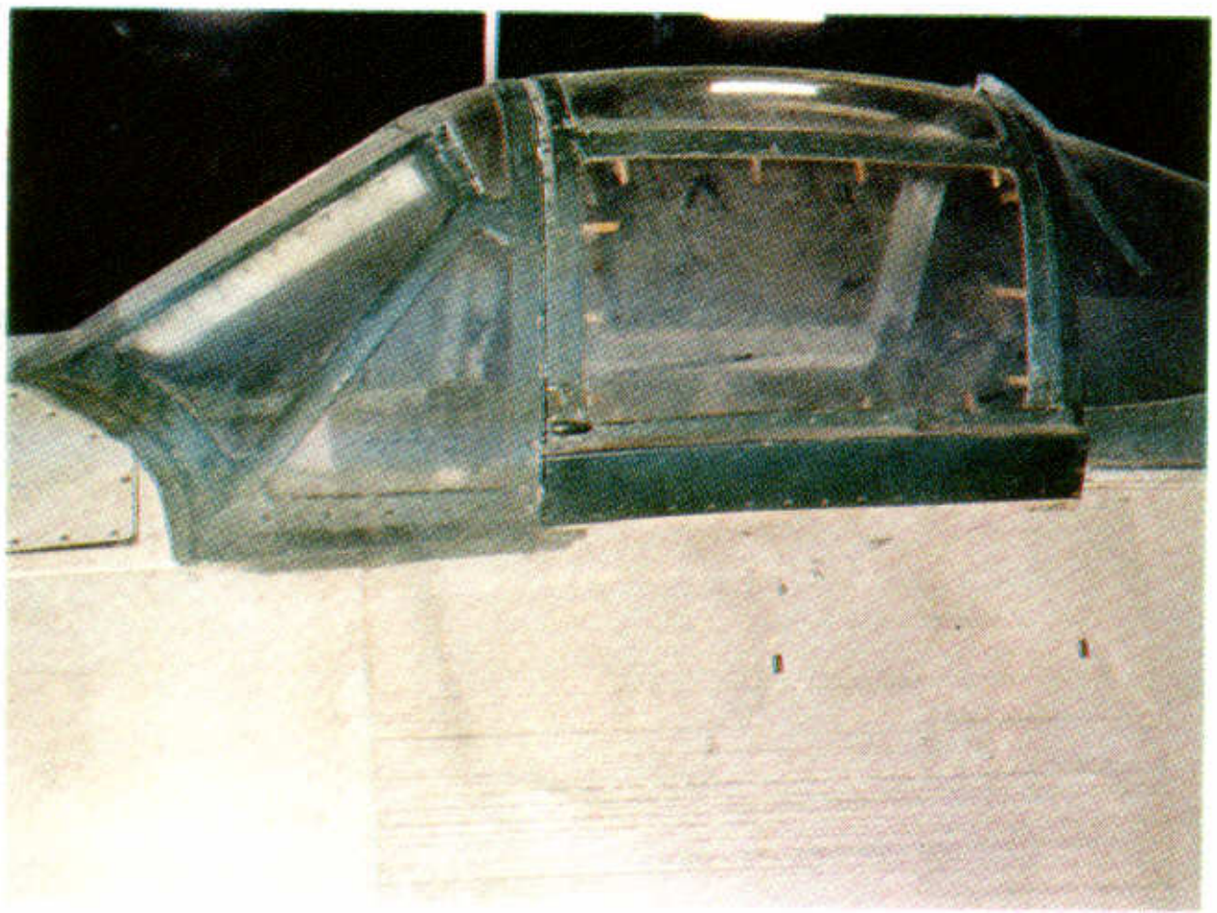
Delay after delay hindered the timely com-

Above Left: Front-on view of instrument panel shows the portion broken out many years ago. Interior cockpit color is also dark green (Munsell, 10G 3/2) which is exterior camouflage color.

Above Right: Details of the rudder pedals are noteworthy in this forward view of the cockpit.

Below Left: This Kikka canopy was hand painted with standard IJN dark green (Munsell equivalent 10G 3/2) to avoid tedious time consuming masking before spray painting the aircraft after assembly. This was a common practice with Nakajima late in the war.

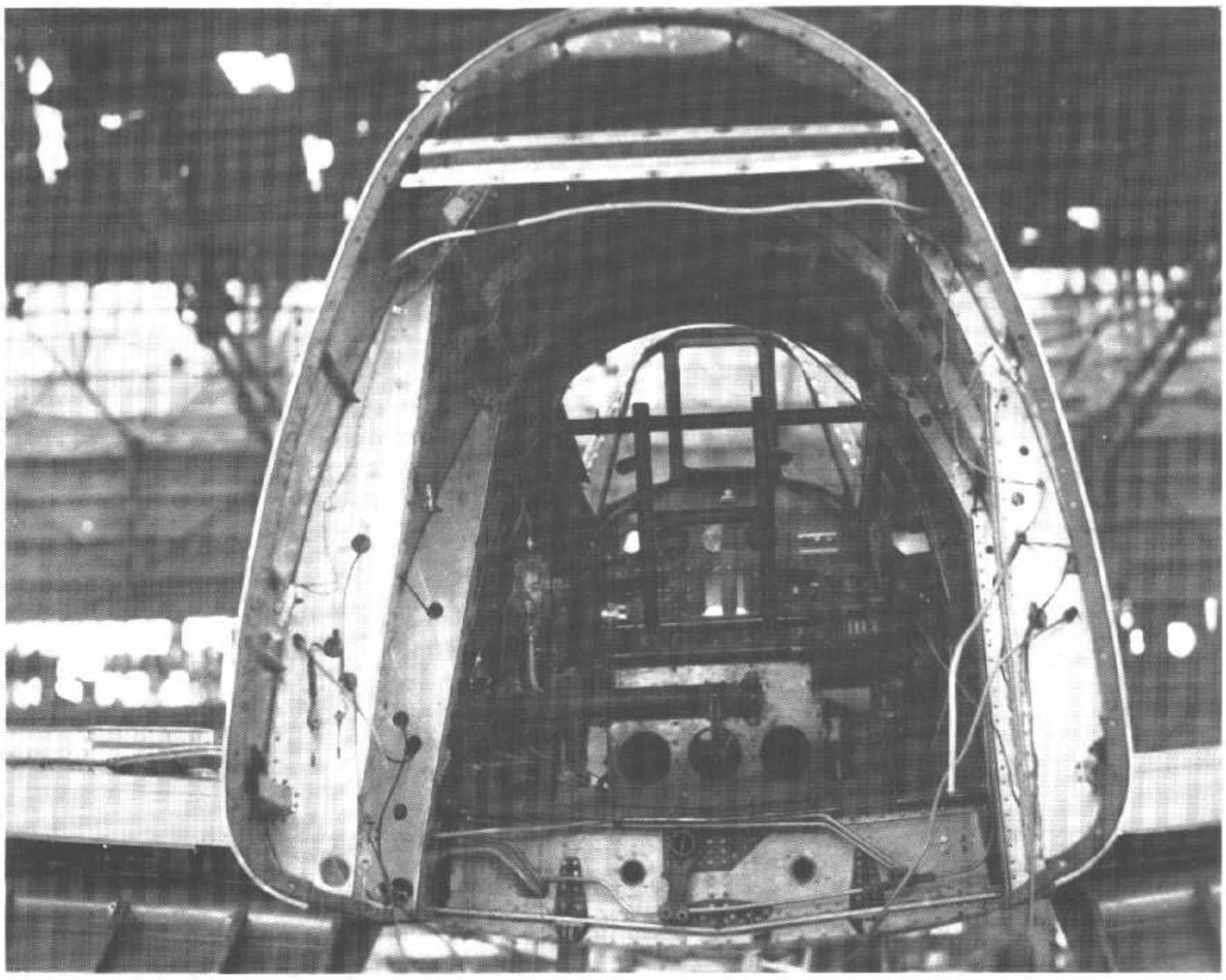
Below Right: Rear details of canopy. The protrusion at the base of the canopy for sliding mechanism is unusual in design. Rear tank filler cap is at rear of enclosure.



pletion of the first Kikka. On May 20 the first of the structural tests began, centering on the vertical tail of the first airplane. Apparently this was now the static test aircraft, but not one to be stressed to the point of destruction. The production run of twenty-five aircraft was taking shape. With six operational engines now on hand, prospects of continued production looked favorable and schedules became more stable. Table III shows the production plan for 1945, recorded by the U.S. Strategic Bombing Survey. Commander Eiichi Iwaya reported a similar schedule for Nakajima, but with forty fewer aircraft through September.

This optimism in production was unfounded, however, and the lack of critical materials was becoming apparent to all those involved with war production. At a conference on June 13 at Nakajima's main plant at Ota, Admiral Misao Wada, Chief of KUGISHO, made a number of points very clear.

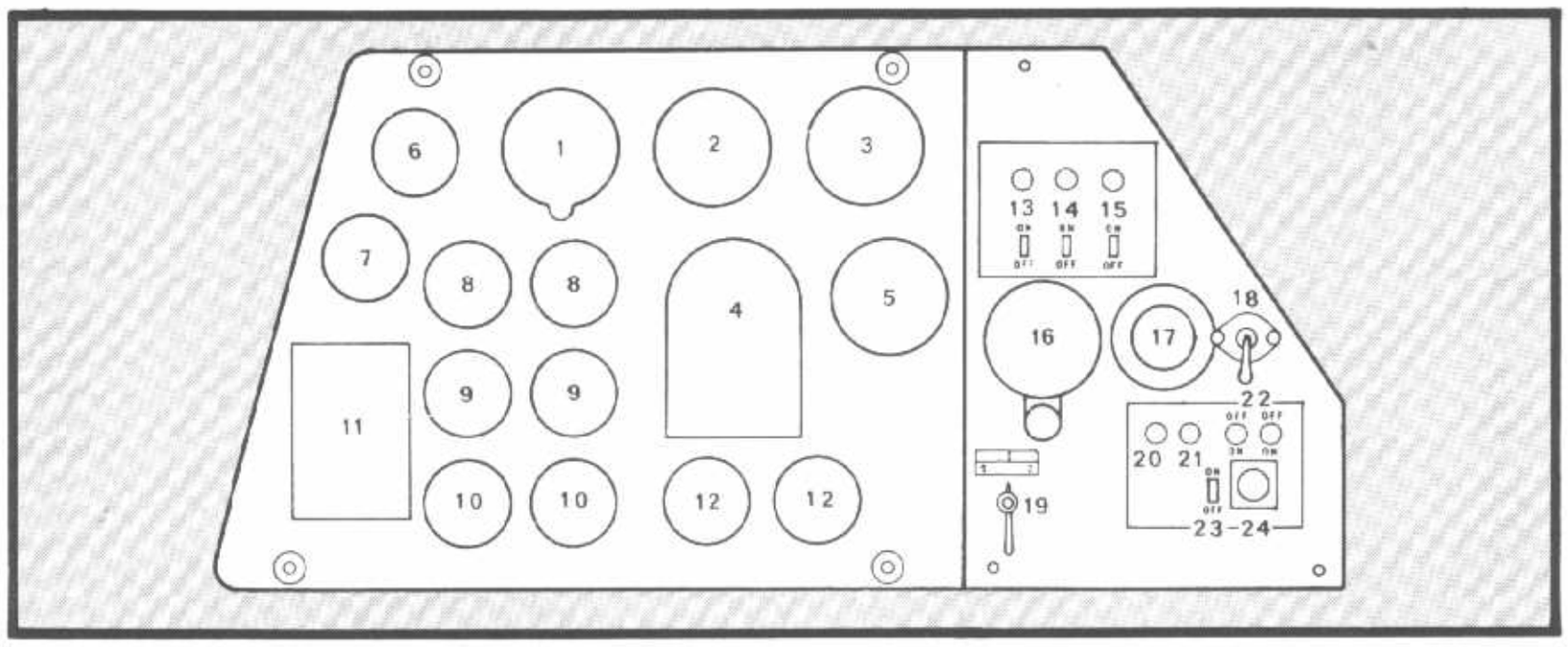
"We must terminate the manufacture of Renzan. This will allow us to divert these ef-

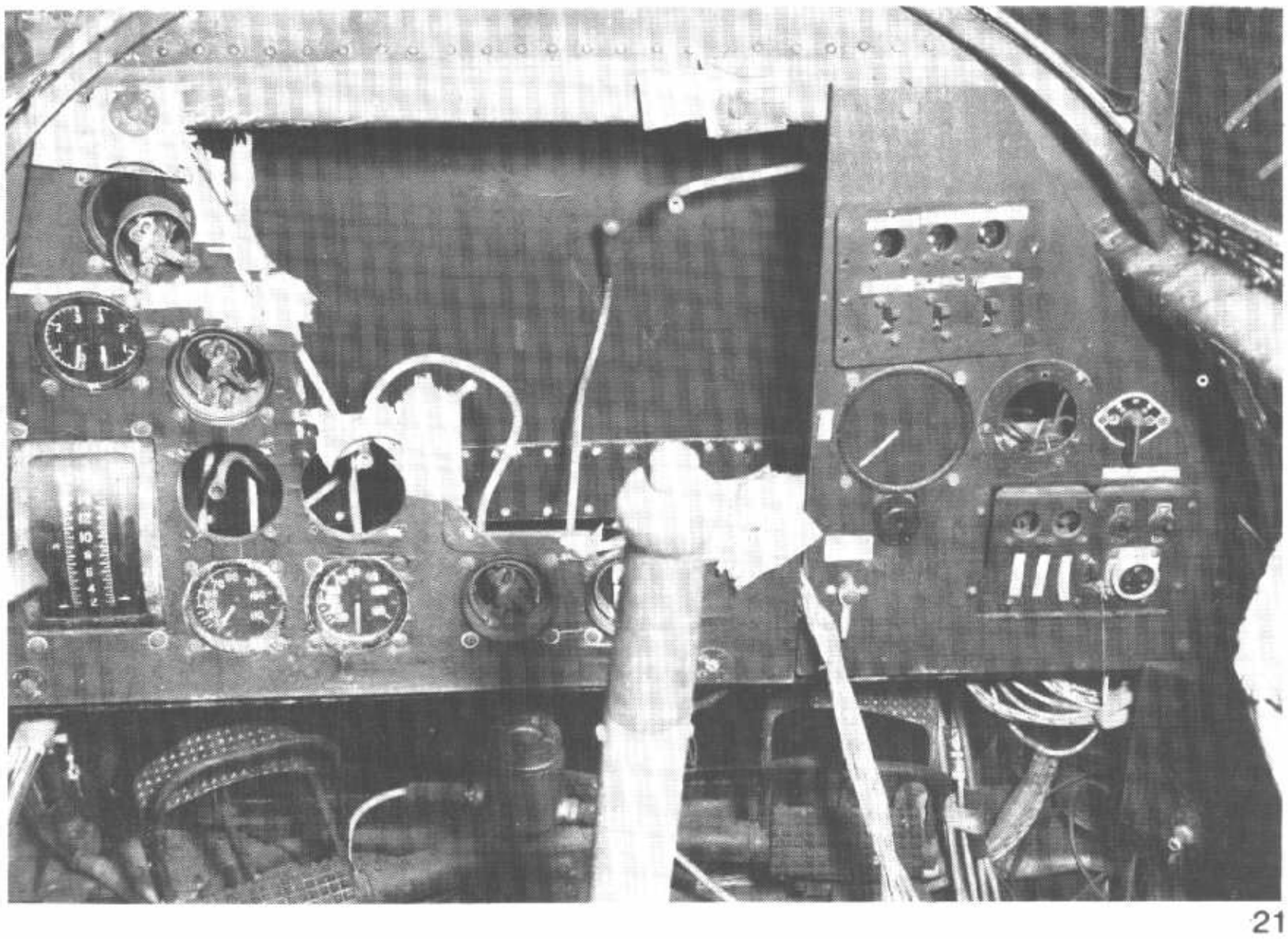


KEY TO INSTRUMENT PANEL

1. Artificial Horizon
2. Airspeed Indicator, Model 3, Tanaka Keiki Seisakusho
3. Turn and Bank Indicator
4. Compass, Navy Model 2, Type 92, Yokogawa Denki Seisakusho
5. Altimeter
6. Pressure Gauge
7. Dual Methanol type Pressure Gauge
8. Pressure Gauge
9. Pressure Gauge
10. Oil Pressure Gauge
11. Dual Vertical Tachometer
12. Pressure Gauge
13. Bomb Arming Switch and light
14. Left Rocket Switch and light
15. Right Rocket Switch and light
16. Fuel Quantity Gauge, Hydro-Static, Tanaka Keiki Seisakusho
17. Volt-Ammeter Gauge
18. Volt-Ammeter Selector
19. Fuel Tank Quantity Selector Switch
20. Oxygen Light
21. Lighting
22. Switches (Unknown)
23. Radio
24. Aux. Electrical Power Plug

Note: 14 & 15. Rocket may refer to turbojet, not necessarily RATO units.





Center: Instrument panel layout for Kikka.

Right: Close-up of the only remaining instrument panel of Kikka which has been vandalized. Wood was used for instrument panels on many Japanese aircraft as a metal saving measure.

Mechanics work on the uncowled Ne 20 engine of Kikka in preparation for flight. with his hand on the top of the engine is Commander Osamu Nagano, who was very instrumental in developing this engine.

forts to Kikka as a special attack plane as well as an interceptor. (This is the first mention of any follow-on mission for Kikka.) Aviation fuel is extremely critical," the Admiral declared, "and must be conserved for exclusive use for the high powered 'Homare' series engines. All other engines must use a lower form of fuel of which our turbojet engine is well suited."

Moreover, it was learned at this conference that aluminum stock would be exhausted in September at the present rate of consumption, or by the end of 1945 at a reduced rate. From then on, only steel and wood would be available. The overall picture of faltering production, the deteriorating war effort, made defeat for Japan a certainty—it was merely a matter of time. Continuing with the development and production of Kikka as a war machine seemed useless at this late date, but it now became a matter of pride for those working with the airplane. Effort never let up to attain, at the earliest possible date, a turbojet propelled aircraft for Japan.

On June 25 the first Kikka was completed in its thatched roof assembly building among rolling hills, miles away from any runway. It was disassembled and trucked to Nakajima's Koizumi plant where it was reassembled and fitted for the first time with two Ne 20 engines on the 27th. Weight and balance checks were verified and by the 29th, Kikka was declared complete and ready for testing. A strange sound echoed on the flying field at Koizumi on June 30, when the two engines of Kikka burst forth with a new voice, in Japan, for an airplane.

Due to runway approach restrictions around the Koizumi airfield of Nakajima and a runway length that was probably insufficient for this untried airplane, flight tests were first planned to be conducted at Misawa Air Base, in northern Honshu. This base had unrestricted approaches and little harassment by attacking airplanes. Due to the time required for land transportation of the Kikka all that distance, Kisarazu Air Base, a closer facility of the Air Arsenal, was selected. Kikka was again disassembled and moved by truck to this airfield adjacent to Tokyo Bay.

As chance would have it, all that seemed going well at this point, came to a sudden halt. During run-up at Kisarazu on the 14th, a stray nut found its way into the air scoop of the engine and shredded the blades of one of the compressors. Hopes of an early flight faded quickly, for this made a complete engine change necessary. Several ground checks had to be repeated with the new engine, and all were aware that time was running out. The frequent air attacks continually hampered the work.

When Kikka was once again assembled and ready for testing, taxi checks were started on July 27 by Lieutenant Wada. Then came the high speed taxi runs conducted by Lieutenant Commander Takaoka, who had been appointed Kikka's test pilot as early as the fall of 1944. During one test on July 29, Takaoka accelerated the craft to 70 knots to check the brakes for stopping ability. Results were not good, but not to such a degree that tests were discontinued. Caution had to be exercised, however.

After Kikka's last ground checks of the day, on August 6, rumors spread among the technicians that a tremendous explosion, suspected to have been an atomic bomb, had totally destroyed Hiroshima. Information was sketchy, yet it underscored the urgency to complete the task at hand as quickly as possible.

On the next day, the aircraft was ready for flight with very favorable weather. The wind was from the southwest at 7 m/sec. (15 mph), which was a slight crosswind from the right for takeoff on runway 20. The 1700 m (5500 ft) runway was free of departure obstacles as only Tokyo Bay lay ahead. For

Saddle type oil tanks are mounted on top and bottom of the compressor section and supply oil to lubricate the four rotor shaft bearings. The screen covering the air intakes were removed for flight. Electric starter was contained in center inside housing of the air intake.

the first flight, Kikka carried only a partial fuel load to deliberately keep the weight down to 3150 kg. (6945 lbs). RATO was not used for this flight so that takeoff characteristics could be checked.

Takaoka signaled for engine start. Anxiety heightened as the engines came to life with their high pitched whine. Taxiing into position at the extreme edge of the runway, twenty degrees of flaps were extended in preparation for the takeoff. All was in readiness and Takaoka eased the throttles forward so as not to induce a compressor stall which was so prevalent with early jet engines. As both engines reached 11,000 rpm, the brakes were released and Kikka began rolling. Unlike the quick response of a propeller driven airplane, acceleration was very slow at first. Speed multipled as Kikka moved past the runway markers. At 725 meters (2378 ft) and twenty-five seconds after brake release, Kikka lifted into the air.

Japan was in the jet age, and it took less than one year form the time Kikka was first conceived. The untimely damage during the attempted second takeoff, however, made this the only flight of Kikka. Although the operational life of this airplane ended abruptly, success had been achieved—a historical milestone for Japan, marking the beginning of a new phase of industry in jet technology. Kikka and its engines were an original design, aided in *concept* only, by building on outside influence in advanced technology, a practice that is common the world over.

In tne post war years, involvement with jet aircraft continued in Japan through the manufacture of American designs, holding together the nucleus of Japan's wartime jet engine and airframe technicians and engineers. As this industry gained momentum, many of these talents stemming from Kikka, brought forth a second—totally Japanese jet aircraft design—the Fuji T1F2 jet trainer. Its first flight took place on January 19, 1958, thirteen years following the successful flight of Kikka. At the controls of this new jet, seemingly in an attempt to erase the stigma of Kikka's aborted takeoff, was again—Susumu Takaoka, by then a General in Japan's new Air Self Defense Force.

THE UNCERTAIN FATE OF KIKKA

After the extensive damage caused to Kikka on its aborted second takeoff, attention was quickly turned to preparing the second airplane for continued testing. What happened to that first Kikka that came to rest at the edge of Tokyo Bay has never been determined. Its pilot, Takaoka, reports never having seen the airplane again after leaving the scene of the mishap. The war ended at this point and consequently the development of Japan's jet airplane cease.

Inspection reports made by postwar Occupation Forces personnel treated somewhat lightly the fact that Japan had jet aircraft in production. Since none were in evidence as being ready for flight, this may have been the cause of the low interest level of Japan's eleventh-hour technology.

In postwar interviews with Admiral Wada concerning the Kikka program, it was learned that two-seat trainer models were among those being assembled—five in all. Also in the program was a two-seat reconnaissance version to be followed by a

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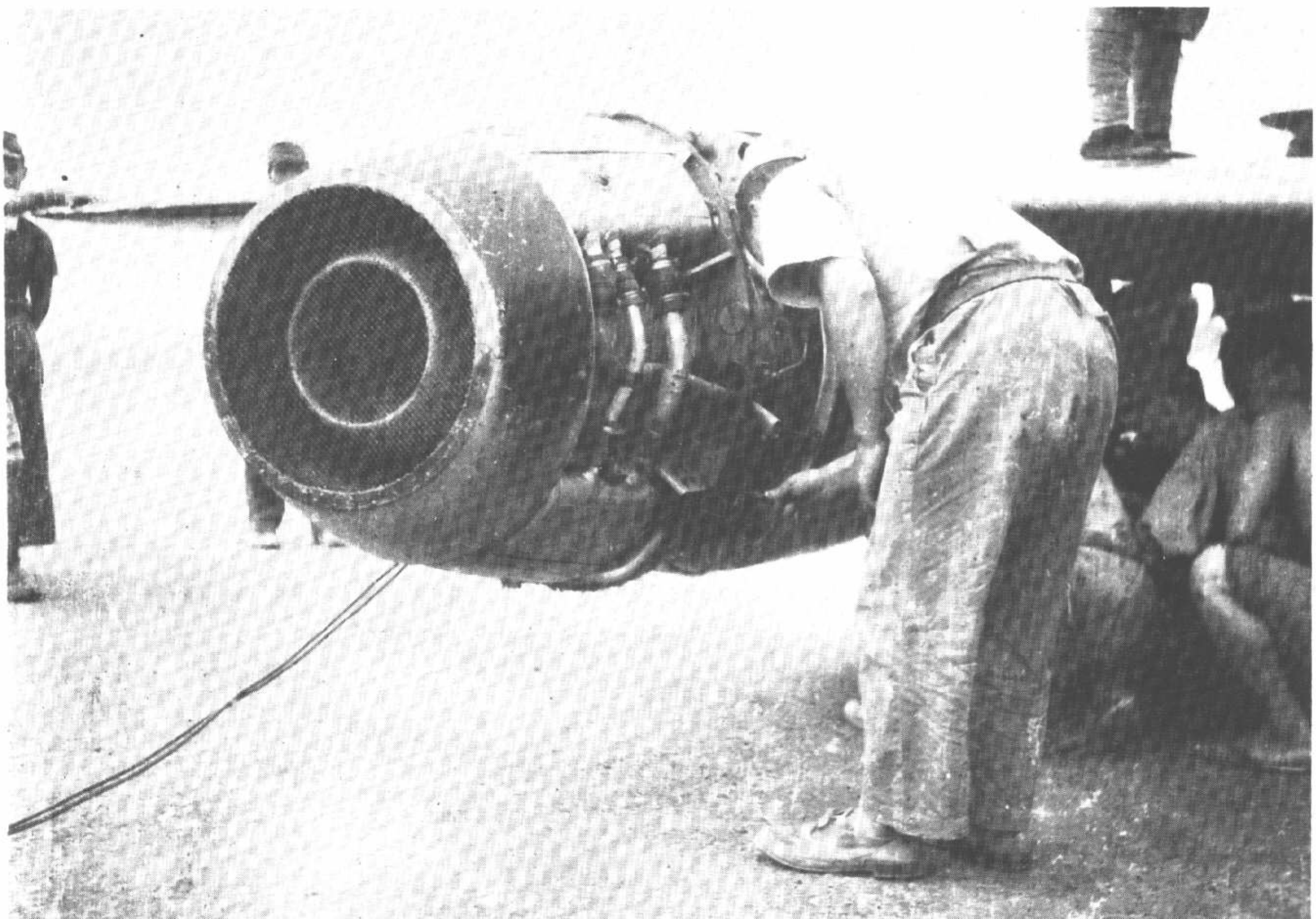
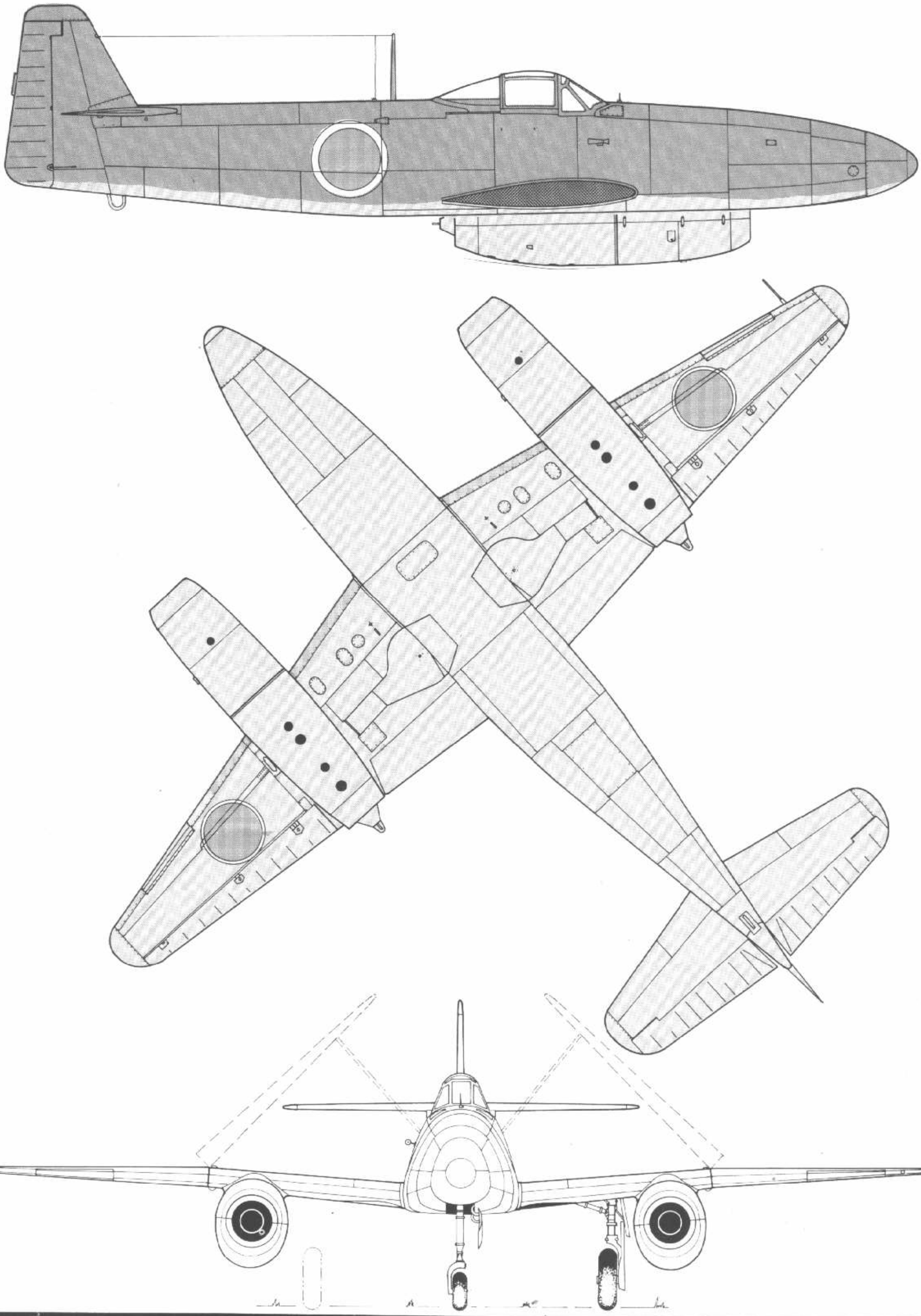
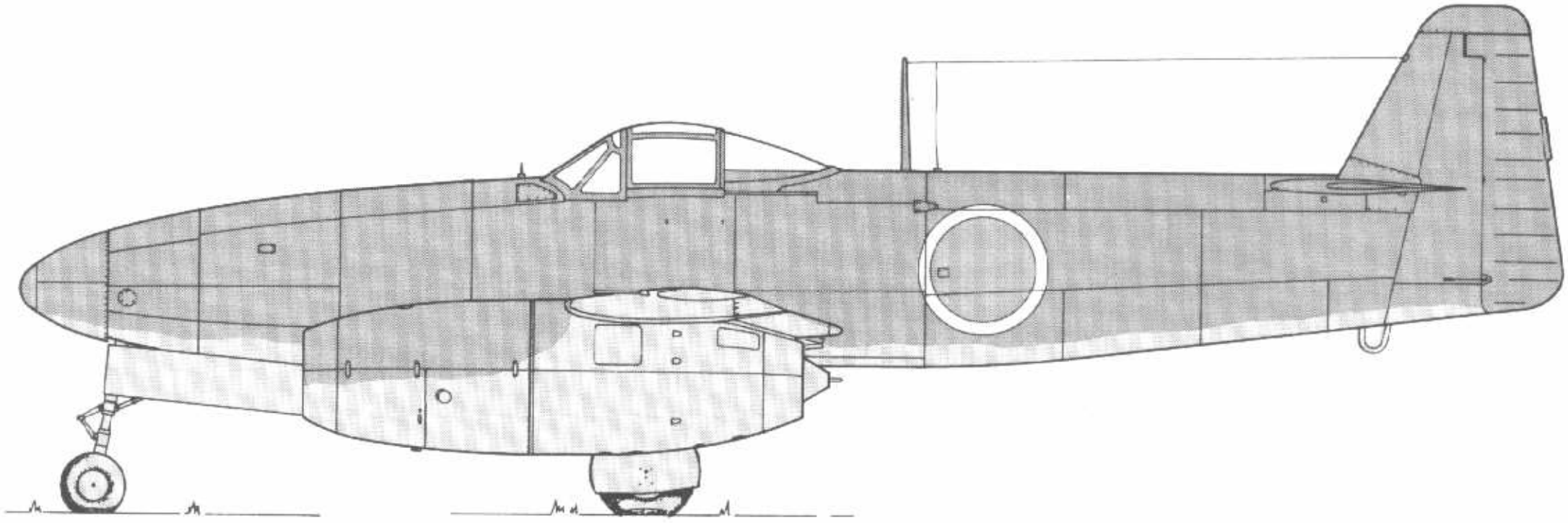
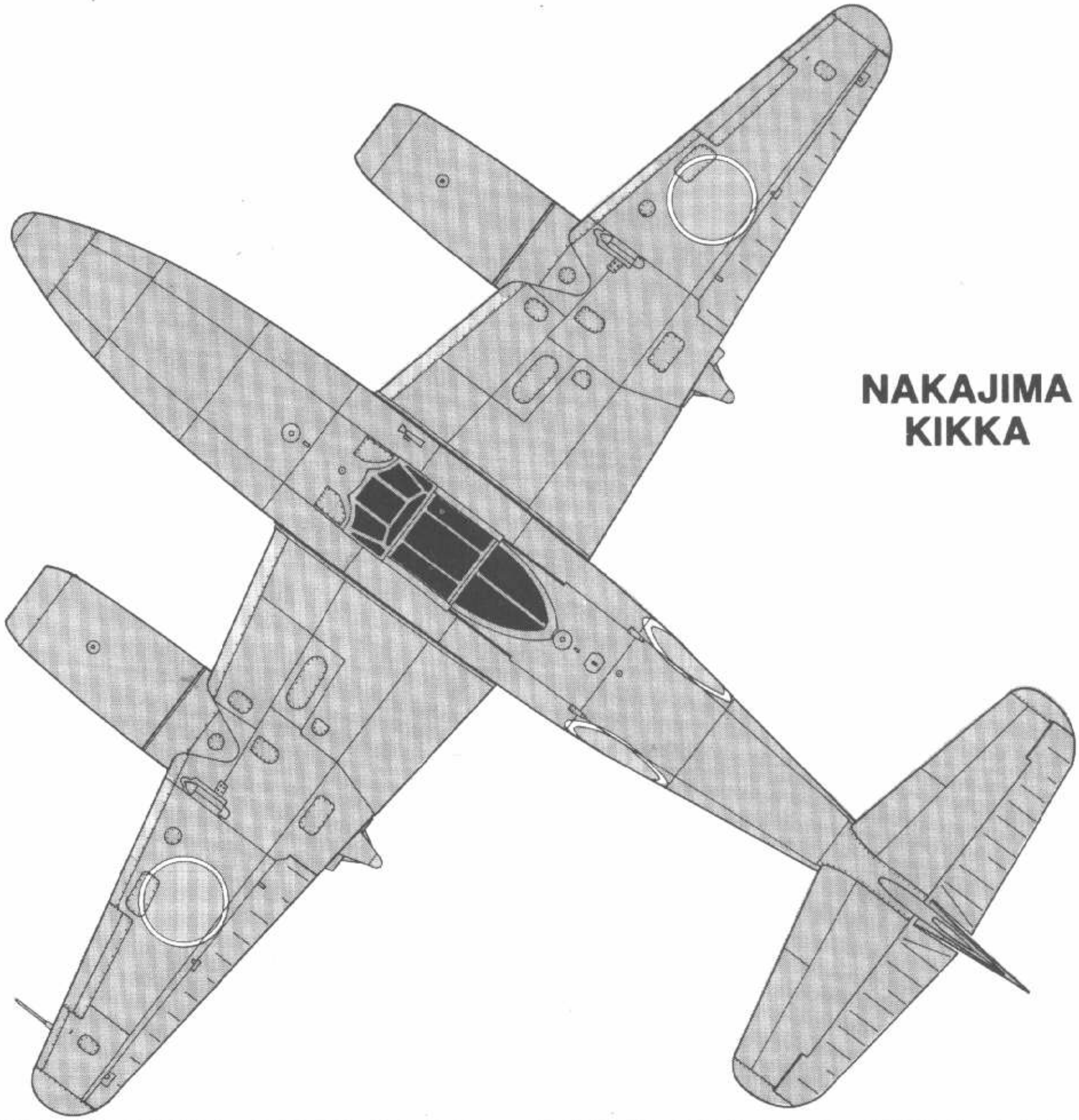








NAKAJIMA KIKKA

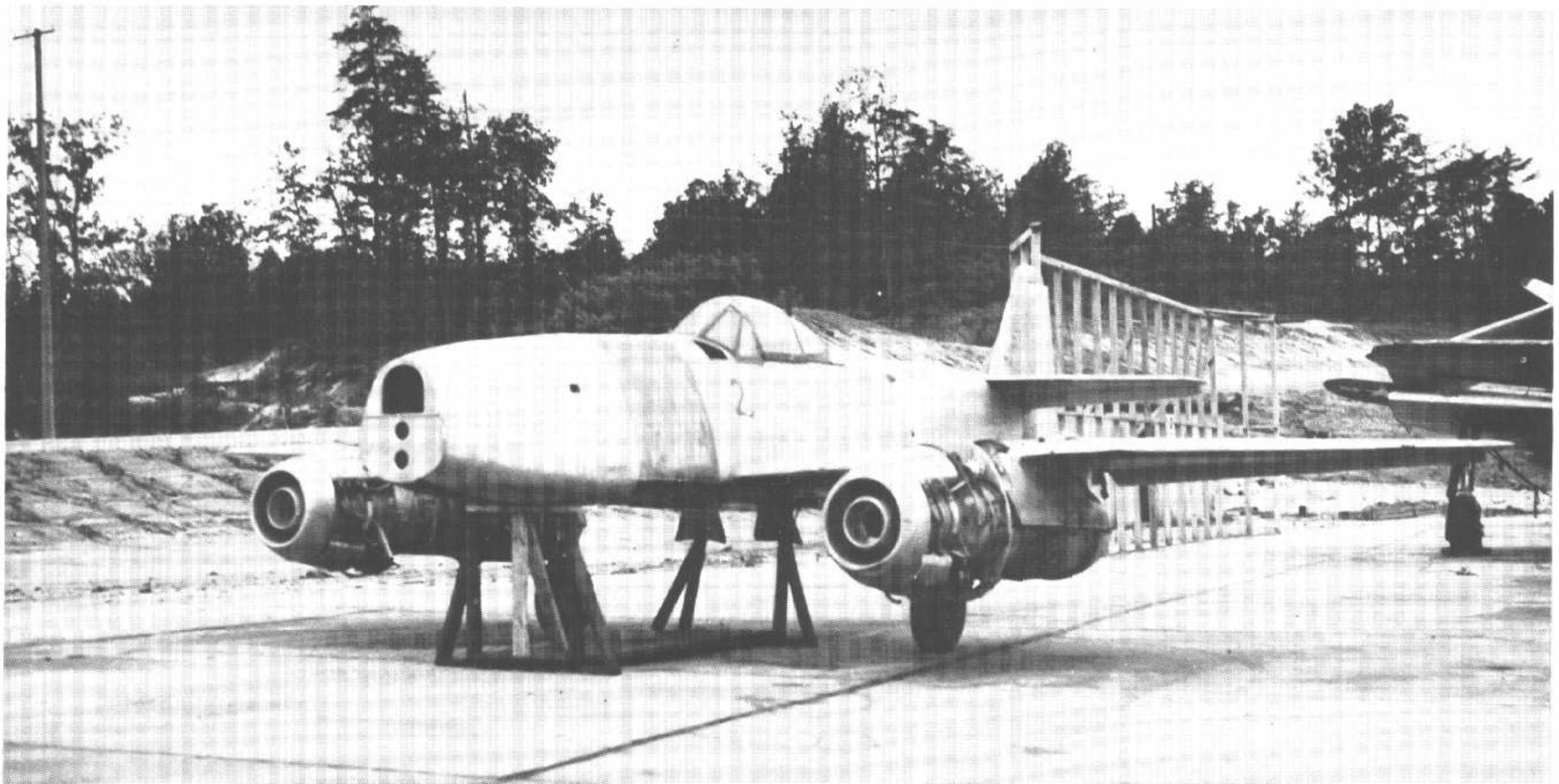
Dark Green 10G 3/2	**White** N 9.5	**Red** 5 R 4/12
Light Gray N 7.5	**Yellow** 10 YR 7/14	Cockpit interior color was identical to the external Dark Green.

single-seat fighter version armed with two 30 mm cannons in the nose. This indicates that the potential of this jet plane had become apparent to the planners. Kikka could have been a formidable weapon in air attacks against B-29s had Japan's jet program begun a bit sooner.

To study Japan's aeronautical technology after the war, approximately 145 aircraft of every type, with several duplicates of each, were taken to the United States. Some were eventually flight evaluated. Seemingly there was little technical attention given to Kikkas that were brought to the United States, for it was quite evident that U.S. technology was more advanced. None were prepared for flight due to their semi-finished conditions. Exactly how many of these jet planes were brought to the U.S. cannot be positively determined as only fragmentary inventories were made of foreign equipment.

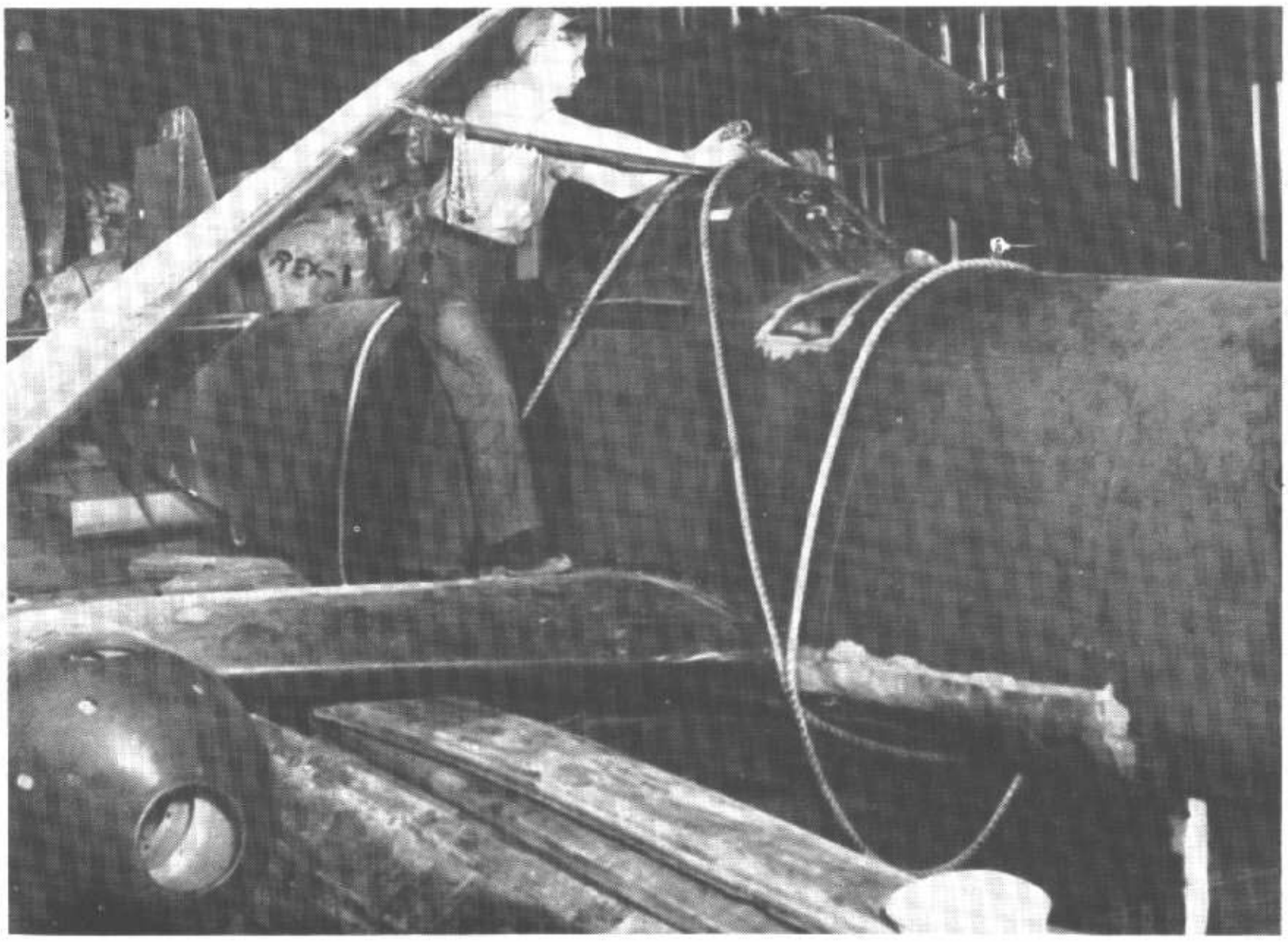
The view of Kikka above, and the Messerschmitt Me 262 to the right, give photographic comparisons of the two airplanes. Their similarities were not by coincidence since Technical Commander Eiichi Iwaya studied the Me 262 with intentions of producing the plane in Japan. The plans did not reach Japan, and design had to be based on technical recollections only. Both aircraft photos were taken in the U.S.

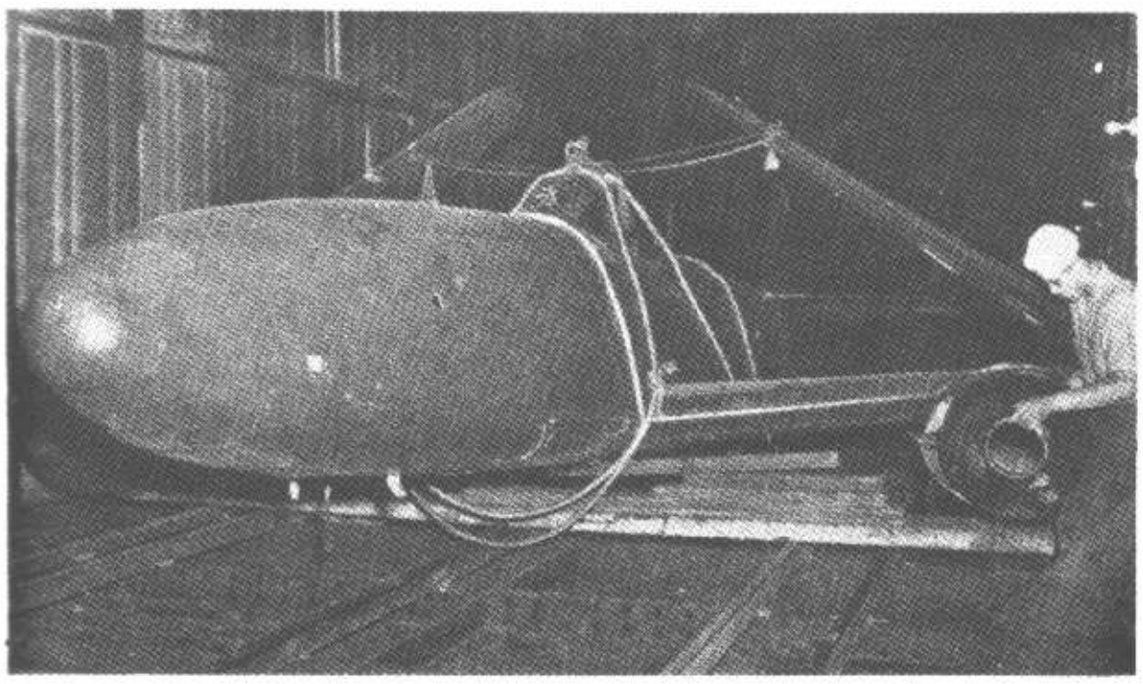
Below: This Kikka is perhaps the number-two airframe althought it is likely that the number "2" was added by the U.S. Occupation Forces. The number "2" also appears on the engine of pictures taken at the Koizumi plant and the two aircraft could be the same. These Stateside pictures are presumed taken at the Naval Air Test Center, Patuxent River, Maryland, after the Americans added the Hinomaru.



One report in 1950 made by the 11th Naval District at San Diego, listed an "Eilka No. 103" in its possession; a "Kikka" at the Naval Air Test Center, Patuxent River; and a "Twin-jet Japanese Fighter" at NAS Norfolk. It was learned that the name "Eilka" was a typographical error perpetuated in inventory reports of foreign equipment. Recently, through cross reference to another record showing tail numbers, the author identified "A-103" as being a "Kikka".

As interest in foreign equipment lessened in the postwar years, a cleanup of excess equipment at military bases was undertaken. Priority for transfer of this material was first given to the National Air Museum, but the quantity was overwhelming for the limited storage space available. The Advisory Board of the National Air Museum developed a limiting policy that read in part that only "Military types allied with or opposed to American aircraft in warfare" would be retained. Names like "Eilka" and "Kikka" were not within this category, much less was the board aware of what they were, sight unseen. Fortunately however, the descriptively named "Twin-jet Japanese Fighter" and parts of another were set aside and stored at Norfolk for eventual shipment to the museum.



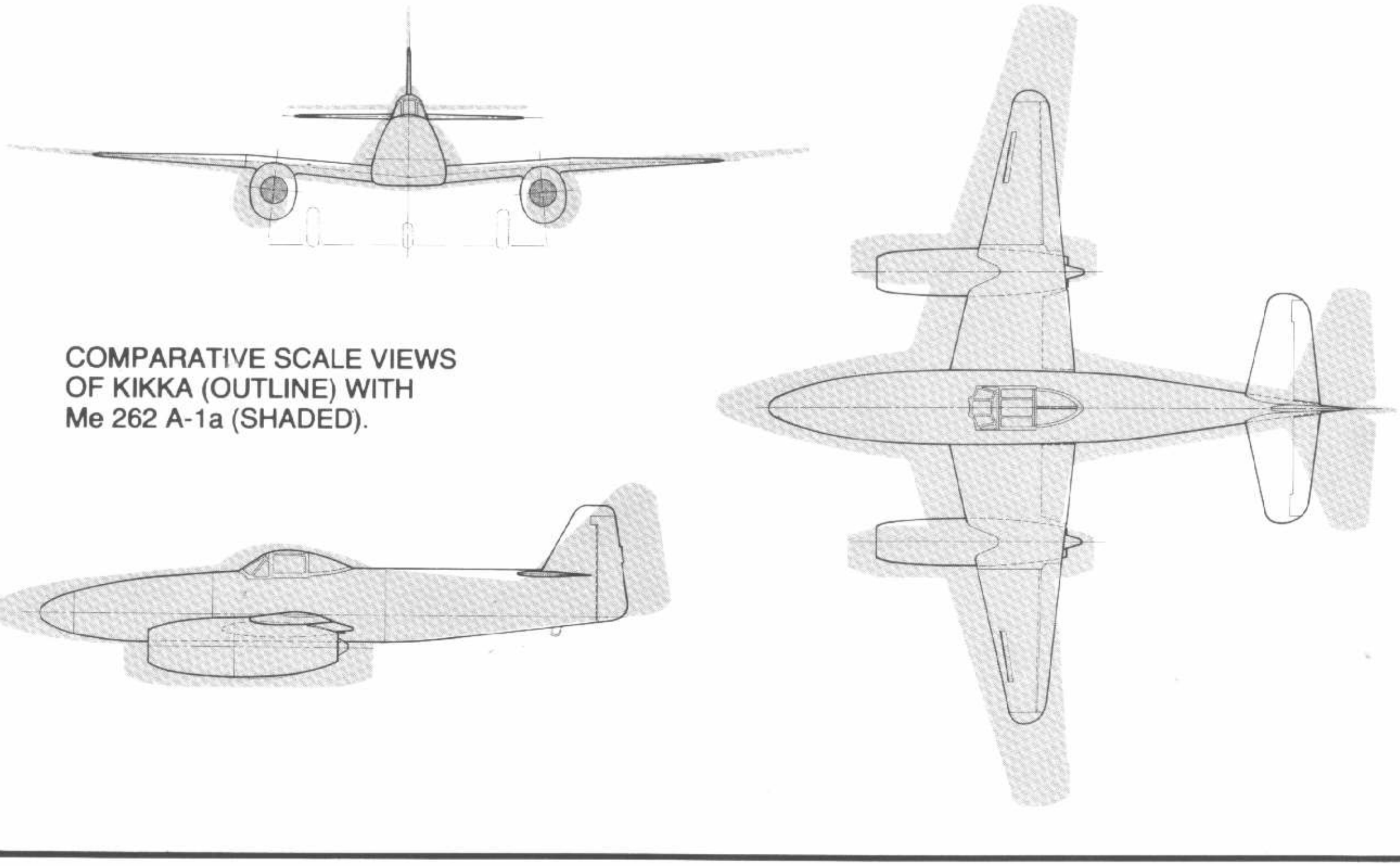


For a number of years, the only surviving Kikka remained in an aircraft storage container at NAS Norfolk, Virginia. These pictures show a seaman checking Kikka during periodic inspections. The ability of its wings to fold, to facilitate storage in Japanese underground grotto type hangars, eased storage problems in this instance also.

For the trip by barge from Norfolk to the storage facility at the National Air and Space Museum in 1960 at Silver Hill, Maryland, all the openings of Kikka were covered and sealed against salt air and moisture. It remained in outdoor storage for several years until warehouse buildings could be built to house this and other aircraft of the museum collection.

For many years it has been speculated that the one surviving Kikka that was moved from Norfolk to the museum's storage facility in 1960 is the Kikka that flew. For this publication, the author inspected the wheel wells for possible signs of damage caused by the landing gear being sheared off as was the case with the first Kikka. There is no sign of this damage. Furthermore, it is possible that a landing gear was never installed in this partially completed Kikka as these wheel wells remain empty of landing gear and attachment fittings. This sole remaining airframe of Kikka is historically significant, however, for it is representative of Japan's first turbojet airplane.

Only Kikka No. 1 was painted in standard Japanese camouflage by the Japanese. When Kikka is restored by the National Air



COMPARATIVE SCALE VIEWS
OF KIKKA (OUTLINE) WITH
Me 262 A-1a (SHADED).

and Space Museum at some future date, an analysis will be made to determine if the first layers of paint are of Japanese or American material. This will further confirm or deny the identity of this Kikka. Until that time, it is this author's opinion that this airplane and the other two that were shipped to the U.S., were ship numbers 3, 4 and 5. The remaining Kikka and the extra center section, match reports describing these numbered airframes as being fairly complete but without landing gear and engines. Two Ne 20 engines are on hand for this restoration. No identifying serial numbers can be found inside or on the airframe, but these may be discovered during the structural teardown for the restoration. Until that restoration begins, the history of Kikka comes to a close.

NAKAJIMA Ki.201 KARYU

The Japanese Army's adaptation of the Me 262 plan form as the Ki.201, is often confused with the Navy's Kikka, and deserves inclusion here. As brought out in the German technical aid section of this coverage, the Japanese Army was equally as interested in the Me 262 design. It is possible that the Army was more interested in matching the Messerschmitt design than was the Navy. Surprisingly, the Army's

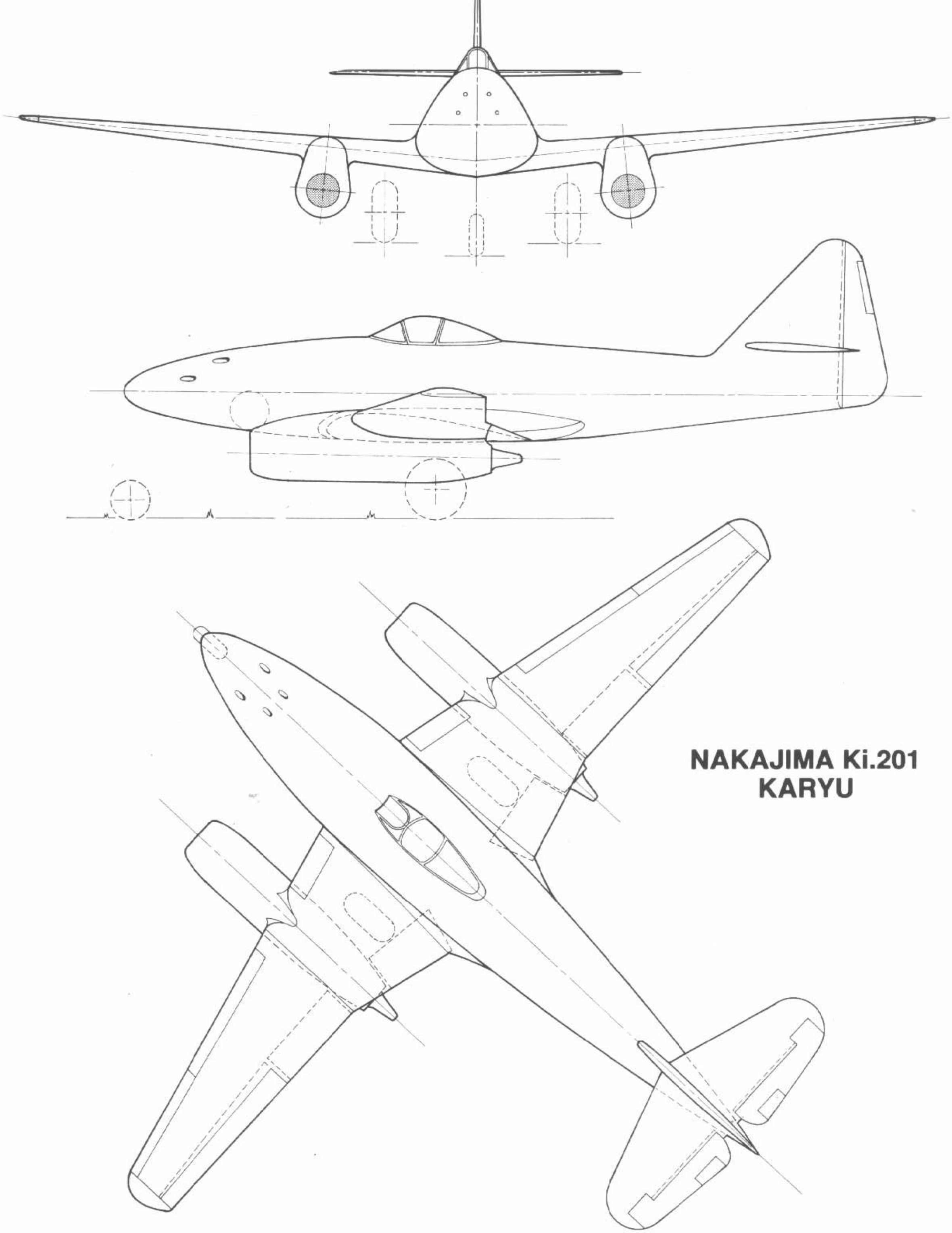
version of the Me 262 resulted in a larger aircraft.

The Ki.201 was initiated on January 12, 1945, five months after the start of Kikka. Despite the later start, it is doubtful that the Japanese Army had more German technology to work with than did the Navy. Structural design led by Nakajima Engineer Iwao Shibuya, was to be completed by December 1945, and the first eighteen aircraft to be delivered by March 1946. Engines were two Ne 230s with 885 kg thrust each, to be replaced with Ne 130s with 905 kg thrust, should they become available.

The initial concept of the Ki.201 for the Army was quite different than that of the Kikka for the Navy. From the very start, the Ki.201 was to be an attack fighter with performance equal to or better than contemporary jet fighters. It was to be equipped with two 20 mm and two 30 mm cannon in the nose and able to carry a 500 kg or 800 kg bomb. Of further interest, it was also to have the TaKi-15 airborne intercept radar, to be used in conjunction with the TaChi-13, which was a ground control radar unit for directing air intercepts. Operational range of the two units working in unison was about 95 mile radius.

Although Nakajima engineered both Kikka and the Ki.201, this is little indication that there was any appreciable cross-tell of information, as Army and Navy projects were seldom coordinated. The Mitaka plant on the west edge of Tokyo was to construct the prototype, even though this was the Engine Research Works for Nakajima. Production was to take place at the newly established Kurosawajiri Research Works No. 21 near Kitakami, in Iwate Prefecture, north-central Honshu.

This 3-view drawing of the Ki.201 was developed from a Technical Air Document, T-2, Hq. AMC, prepared by Nakajima Aeroplane Co., October 15, 1945, for U.S. Intelligence. A Ne 130 engine notation was on this drawing. This layout differs from other published drawings of the Ki.201, but concept and specifications of the two versions are basically the same. The source of the other design is not certain, therefore an assessment cannot be made in this report as to which of the two is most correct for the design which was only 50% completed by the end of the war. Aircraft comparison data table reflects the specifications for the Ki.201 as they appeared in this Technical Air Document.



NAKAJIMA Ki.201
KARYU

Specification for KOKOKU HEIKI No. 2 (Kikka).

1. Mission: Land-based attacker suitable for attacking enemy warships and vessels off the coast of Japan, and to be suitable for mass production.
2. Type: Twin turbojet-powered monoplane.
3. Dimensions: Smallest possible. 5.3 m or less with wings folded. 9.5 m or less in length, and 3.1 m or less in height.
4. Powerplant: Two TR-12's.
5. Crew: One.
6. Performance:
   A. Flight data (with 500 kg bomb unless otherwise specified).
      (1) Maximum Speed: 275 kt (510 km/h) at sea level.
      (2) Range: (Full power at sea level):
         a. With 500 kg bomb: 110 nm (204 km).
         b. With 250 kg bomb: 150 nm (278 km).
      (3) Rate of climb: Not specified, but should be adequate with gear down after takeoff.
      (4) Takeoff distance: Less than 350 m with RATO, no wind
      (5) Landing speed: Less than 80 kts (148 km/h) at normal landing weight.
   B. Stability and Control: To be highly maneuverable with a short turning radius, capable of basic aerobatics. Must be stable at high speed and able to maintain a steady course for target tracking.
7. Structural strength: Category IV.
8. Armament: Capable of carrying 250 kg and 500 kg bomb.
9. Armor: Shatter proof glass, with 70 mm bullet proof glass in windscreen; 12 mm steel armor plate below and in back of pilot. Fuel cell to be 22 mm sandwich-type tank.
10. Instruments: Tachometer, tail pipe temperature gauge, fuel pressure gauge, oil pressure gauge, oil temperature gauge, airspeed indicator, pitot tube electric heater, altimeter, artificial horizon, Model O Type 1 flux gate compass, and others to be determined at inspection of mockup.
11. General equipment: Type O parachute, automatic fire extinguisher, Type 3 dry battery, Type 3 radio receiver, Type 1 life raft, reserve weight of 30 kg.
12. In the event performance can meet the above requirements any improvements should be directed toward aircraft range.

Revised specifications for KOKOKI HEIKI No. 2 (Kikka).

(Only changes in specifications carried in Table I are shown.)

4. Powerplant: Two Ne 20.
6. Performance:
   A. Flight data (with 500 kg bomb unless otherwise specified)
      (1) Maximum Speed: 335 kt (620 km/h) at sea level.
      (2) Range: (Full power at sea level): 190 nm.
      (3) Takeoff distance: Less than 500 m with RATO, no wind
      (4) Landing speed: Less than 50 kts (93 km/h) at normal landing weight.
      (5) To achieve the above performance, special lift devices and speed brakes can be incorporated.
8. Armament and Equipment: Normal bomb load 500 kg with capability of carrying 800 kg bomb, utilizing a Type 3 bomb rack for the latter. Radio transmitter and receiver, Type 3, Model 1.
9. Armor: Shatter proof glass, with 50 mm bullet proof glass in windscreen, 12 mm steel armor plate in front, behind, and in back of pilot. Fuel cells are to have automatic fire surpressor equipment.

PRODUCTION STATUS OF KIKKA BY THE END OF THE WAR

Airframe Number	Status
Test Fuselage:	Completed April 25, 1945.
No. 1:	Completed June 31, 1945. First ground taxiing July 21. First flight August 7, 1945.
Test Fuselage:	Completed July 5, 1945.
No. 2:	Near complettion, but lacking landing gear and other fittings.
No. 3 - 5:	Approximately as above.
No. 6 - 7:	As above. Fuselages sent to Ist Naval Technical Arsenal July 8, 1945, for conversion to 2-seat trainer.
No. 8 - 10:	Fuselage complete.
No. 11 - 16:	Fuselage and wings completed but airframe not assembled.
No. 17 - 25:	Fuselage completed, wings under construction.

Planned schedule of Kikka production thru Dec. 1945.								
	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
NAKAJIMA								
Planned	1	24		20	45	50	40	20
Actual		1		22*				
KYUSHU HIKOKI								
Planned			5	15	25	30	30	30
Actual			2*					
SASEBO ARSENEL					10	35	35	35
Ist AIRCRAFT ARSENEL (Kasumigaura)						20	30	30

(Note *: Under construction only.)

Presently the sole surviving Kikka is suspended from the ceiling of one of the National Air and Space Museum's warehouses awaiting restoration. Since only one Kikka was completed before the end of the war, it is likely that this Kikka was one of the partially assembled airframes on the production line. There are few system accessories in the aircraft.

KIKKA AIRFRAME DATA

Span:	Extended:	10.00 m
	Folded:	5.26 m
Length:		9.25 m
Height:		3.05 m
Wing area:		13.20 m
Wing cord:	Root:	2.15 m
	Tip:	0.05 m
M.A.C.*	Length:	1.480 m
	Location:	1.870 m from C/L
Aspect ratio:		7.57
Taper ratio:		0.234
Dihedral:	Center section:	5°
	Outer panels:	2°
Wing incidence:		2°
Washout:		2°
Airfoil:	Root:	K 125
	Tip:	K 309
Stabilizer area:		2.21 m2
Elevator area:		1.02 m2
Fin area:	0.62 m2	0.62 m2
Rudder area:		0.75 m2
Landing gear tread:		3.018 m

*Mean Aerodynamic Chord

KIKKA WEIGHTS

Basic weight:	2300 kg.
Normal weight:	3550 kg.
Maximum weight:	4312 kg.
Useful load:	1249 kg.
Wing loading:	269 kg./m2
Power loading:	3.7 kg/kg. s.t.
Normal fuel quantity:	725 liters
Maximum fuel quantity, (with drop tanks):	1450 liters
Normal oil quantity:	30 liters
Maximum oil quantity:	60 liters
RATO:	
9 seconds burning:	2 - 800 kg. s.t.
Armament:	1 - 500 kg. bomb or 1 - 800 kg. bomb

KIKKA PERFORMANCE

Maximum speed (clean):	
Sea level:	336 kt
6,000 m:	367 kt
10,000 m:	376 kt
Maximum speed (500 kg bomb):	
Sea level:	275 kt
Rate of climb to:	
6,000 m:	12 min - 16 sec
10,000 m:	32 min - 42 sec
Service ceiling:	10,700 m
Absolute ceiling:	12,000 m
Range at:	
6,000 m:	315 nm
10,000 m:	480 nm
with 500 kg bomb:	110 nm
with 250 kg bomb:	300 nm
Cruising range:	512 nm
Takeoff data:	
0 wind with RATO, weighing 4,200 kg:	504 m/65.2 sec
0 wind without RATO, weighing 3,950 kg:	1363 m
Takoff speed at 3,950 kg:	80 kts
Landing speed at 2,570 kg:	86 kts

AIRCRAFT COMPARISON DATA

	Kikka	Me 262	Ki.201
Span:	39 ft - 9 11/16 in	40 ft - 11 1/2 in	44 ft - 11 3/8 in
Length:	26 ft - 7 7/8 in	34 ft - 9 1/2 in	36 ft - 5 in
Height:	10 ft - 0 in	12 ft - 7 in	13 ft - 3 in
Wing area:	142.082 Sq ft	234 Sq ft	269.1 Sq ft
Engines:	Ne 20, 475 kg. s.t.	Jumo 004B, 900 kg. s.t.	Ne 230, 885 kg. s.t.
Weight:	5071 - 8995 lbs	9741 - 14,101 lbs	9843 - 18,671 lbs
Max. Speed:	376 kt/32,810 ft	467 kt/29,560 ft	440 kt/32,810 ft

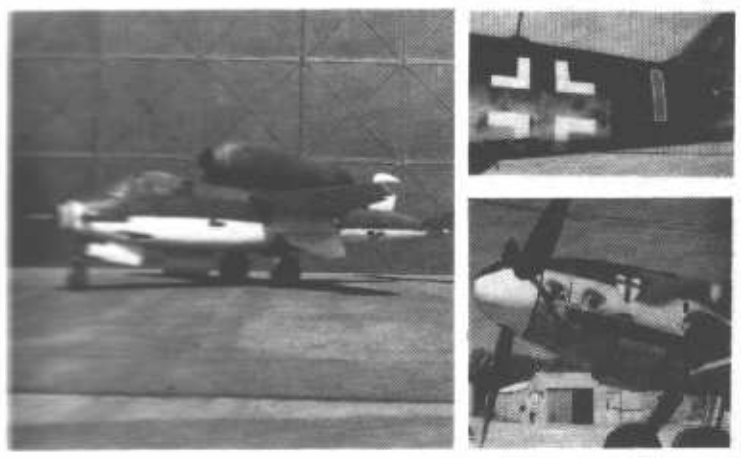
Ne 20 JET ENGINE SPECIFICATIONS

Combustion chamber:	
Annular combustion chamber length:	700 mm
Annular velocity:	275 m/sec
Ignition plugs:	2
Number of flame nozzels:	24
Number of fuel injection nozzels:	12
Turbine section:	
Single stage turbine	
Turbine diameter:	475 mm
Number of blades:	66
Blade:	
Length:	88 mm
Tip cord	28 mm
Root cord	32 mm
Turbine reaction at tip:	7%
Turbine efficiency:	70% estimated
Gas temp in primary chamber:	1000 - 2000°C
Turbine inlet temperature:	700 - 750°C
Tail pipe temperature:	549 - 582°C

General data:	
Length:	2750 mm
Diameter:	620 mm
Vertical across accesories:	813 mm
Weight:	450 kg
Thrust:	475 - 500 kg
Fuel consumption:	1.4 - 1.5 kg/kg thrust hr 730 to 740 kg/hr
Compressor:	
Eight-stage axial compressor.	
Compressor tip diameter:	480 mm
Hub diameter, first stage:	330 mm
Hub diameter, eighth stage:	424 mm
Rotational speed:	11,000 rpm
Relative tip Mach number:	0.85
Axial inlet air velocity:	130 m/sec
Pressure ratio:	3.4:1
Air flow:	14 kg/sec
Compressor efficiency:	80 - 83% estimated

Source: Air Technical Intelligence Review, No. F-IR-57-RE, 26 June 1946. Interview of Commander Osamu Nagano, IJN.

THE OFFICIAL MONOGRAM PAINTING GUIDE TO GERMAN AIRCRAFT 1935 — 1945



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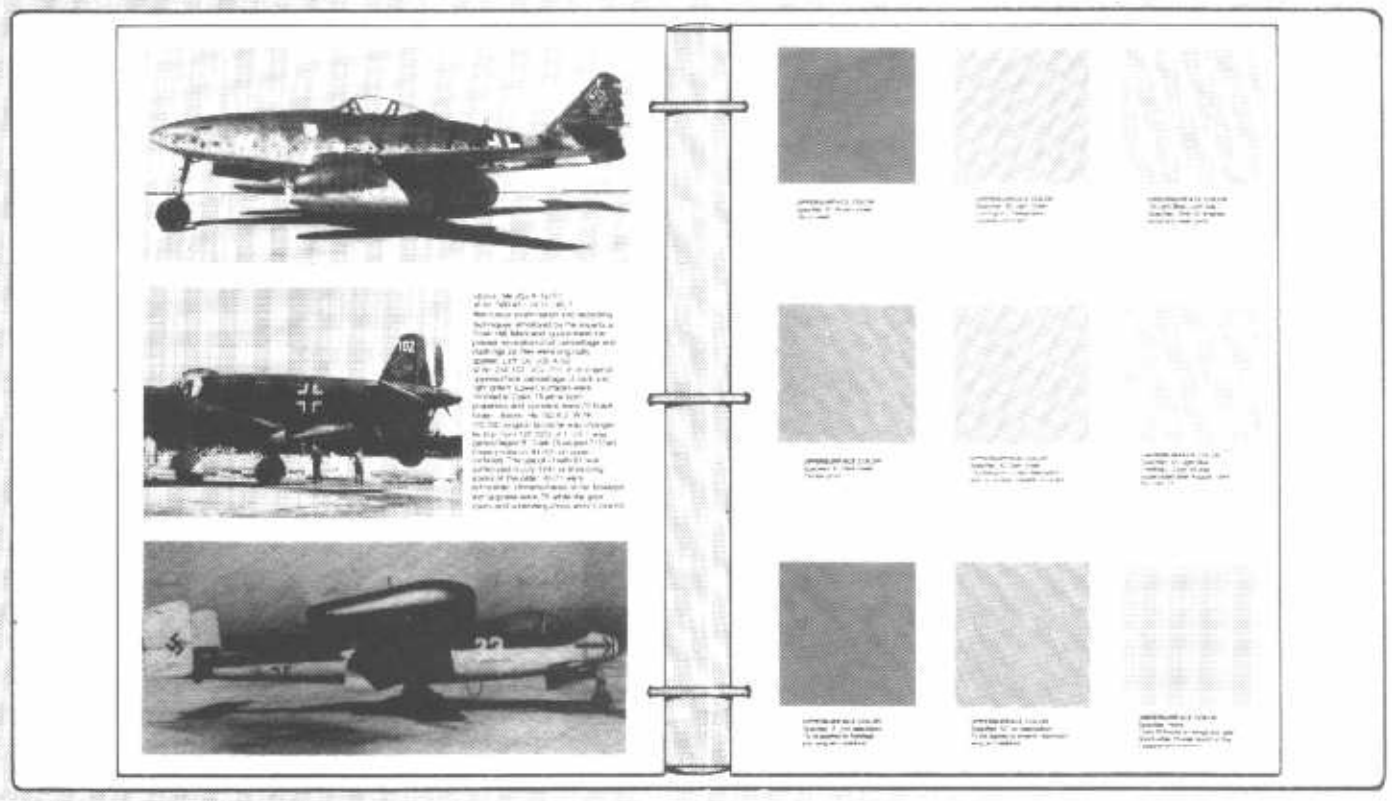

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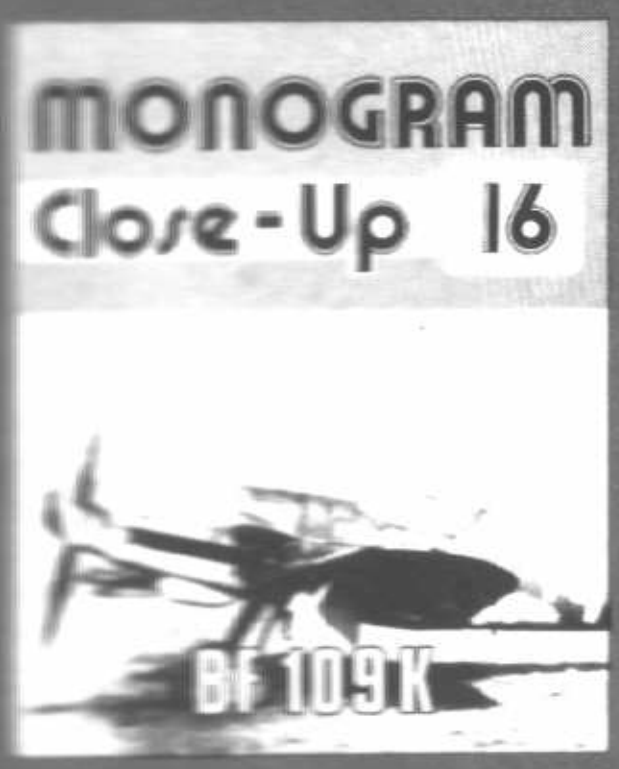

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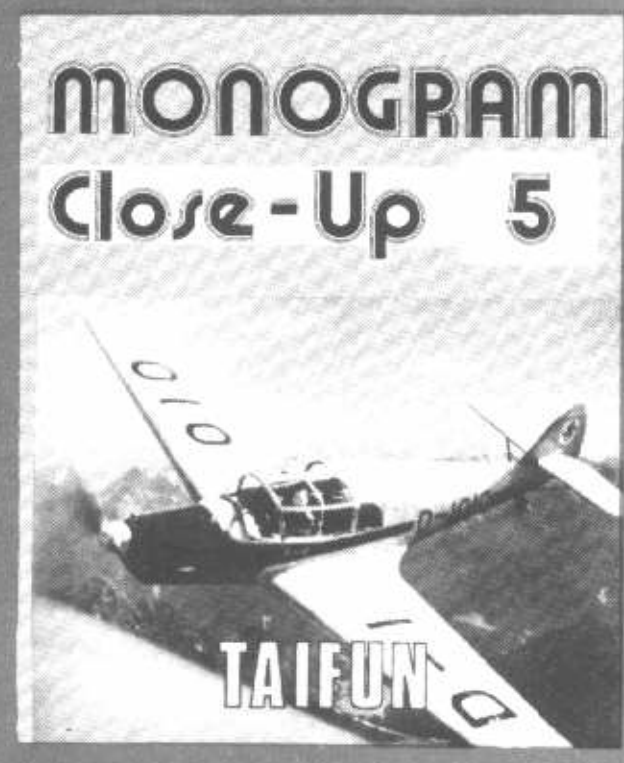

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