THE CALCULATING MACHINE

NEWNES

PRACTICAL MECHANICS

9D.

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A BUSY SCENE AT LIVERPOOL DOCKS (See page 367)

Rocket Propulsion

Anti-shipping Missiles : the "Baka" Suicide 'Plane : German Aircraft Developments

By K. W. GATLAND

(*Continued from page 320, June issue*)

Fig. 73.—The "Bat." This was the first and only missile of the war to incorporate a radar "self-directing" scanner.

ALTHOUGH it must be admitted that many of America's guided missiles were based on German research, the Germans by no means had the monopoly of ideas in this development.

The "Bat" (Fig. 73), one of the rocket powered missiles, produced in quantity and used effectively against Japanese shipping, was actually *self-directing*. It had the appearance of a miniature high-wing monoplane, and contained within its blunt nosing a radar target-seeking device against which evasive action by the enemy was useless.

The aircraft chosen to operate the missile was the Naval PB4Y-2 Privateer, and priority modification was set in hand at Consolidated Aircraft to provide two special carriers, one beneath each wing.

A large number of Privateers equipped with "Bats" were ready before the final overthrow of Japan, and no time was lost in using them in action. The missiles were released, one at a time, from well outside the range of defensive fire, and were presumably directed to the vicinity of the target by radio-control. Instead, however, of depending upon the remote controller for final delivery, the "Bat" was able to search out its own target and to guide itself directly in to the vessel its sensitive radar "eye" had first located.

This 12ft. long missile was responsible for sinking many thousands of tons of shipping, being the only weapon of the war to be fitted with the radar-scanner "brain."

The Henschel 293

It was, of course, the Germans who first demonstrated the anti-shipping "glide-bomb." Their most successful missile in this class was undoubtedly the Henschel 293 (Fig. 74); it was, in fact, the first of all aerial missiles, being initially used against Allied shipping in the Bay of Biscay during the autumn of 1942. It later appeared in the Mediterranean, particularly near Anzio.

Certainly, the Hs. 293 was a unique weapon, coming as it did before the era of the "V" developments. In it were combined for the first time in any warcraft a bi-fuel rocket unit and a radio-controlling gear, the latter being operated by the crew of a parent aircraft.

The controlling aeroplane, usually a Dornier 217, remained out of range of defending fire, yet at a distance that permitted direct sighting of the target. A flare was fitted at the tail of the missile to assist the controller. Designed by Prof. H. Wagner, of Junkers, the Hs. 293 was about the same size as the American "Bat," 11ft. 8in. long and 9ft. 6in. in span. It had the appearance of a small mid-wing monoplane, with the tail-plane high on the rear fuselage and a single fin extending forwards along the centre-line.

A detonator projected from the nose, behind which was the 1,120lb. war-head. The radio directive gear was contained in the centre section, with the gyroscope, power generators and batteries at the rear. The propulsion unit was housed complete in an underslung nacelle.

The weapon weighed 1,730lb. when fully charged with 1,120lb. of propellant. It had a controlled range of 5½ miles and flew at a maximum speed of 375 m.p.h.

Propulsion was by the reaction of H_2O_2 and calcium or sodium permanganate in a modified version of the Walter 109-500 assisted take-off motor. In this system hydrogen peroxide and an aqueous solution of the permanganate are injected under pressure from air bottles into a single reaction chamber. The catalytic action of the permanganate decomposes the H_2O_2 to steam and oxygen at 480 to 500 degrees Centigrade, yielding an average thrust of 1,500lb. for twelve seconds.

There was also an alternative motor which burned gaseous oxygen and methonal.

The missiles scored a certain initial success until a satisfactory antidote was found in the development of a radio device for jamming the controlling signals.

Another Henschel development was the Hs. 294, an air-launched missile which entered the sea at approximately 275 m.p.h., to explode below the surface. It was guided to hit the water at 100 to 130ft. from the target vessel, shed its wings and motor, and penetrated beneath the ship, being detonated by a proximity fuse.

The "Baka" Suicide 'Plane

The "Baka" or Kamikaze 'planes were the Mikado's last desperate challenge to Allied sea-power in the Far Eastern waters. They were initially operated from the island of Okinawa against shipping in the Ryukya area, and several were found intact when the island was subsequently taken by U.S. forces.

A remarkably small 'plane to be piloted, the "Baka" was only 19ft. 10in. long. Its low aspect ratio wings were 16ft. 5in. in span, and the tail span 7ft. 1in.

The fuselage was well streamlined, and the pilot was accommodated about two-thirds from the nose. His cockpit embodied a clear-view hood, which appeared large in comparison with the rest of the machine, of all-metal construction, the body structure having a covering of thin gauge light alloy. In the nosing was a 1,200lb. charge of tri-nitro-anisol explosive, and behind the pilot three dry-fuel rocket units, which propelled the "Baka" in its final "death-dive" at a maximum speed of

This "Baka" 'plane was found on Yontan airfield, Okinawa. Its capture may have saved an Allied warship—certainly the life of a Jap.

630 miles per hour. Each unit weighed approximately 260lb., of which 97lb. comprised fuel and fired for about eight seconds. The maximum thrust developed by each propulsor was 1,760lb., and the jet velocity, therefore, a little more than 4,700ft. per second.

The all-wood, ply-covered wings were placed mid-depth of the fuselage, forward of the cabin, and the tail-plane was set high at the extreme rear, with square fins at the tips.

The "Baka" was equipped with a liberal array of instruments, comprising an air-speed indicator (served by a pitôt head, which protruded from the port wing), altimeter, compass, fore and aft level indicator, rocket ignition selector and ignition buttons, circuit test switch, and a base fuse arming handle.

The pilot was supplied with oxygen during his brief flight, and protection was afforded by two 5-16in. armour panels, one on the floor of the cockpit and the other at his back. Normal "stick" and foot controls worked the ailerons, elevators, and fin rudders.

It was a surprisingly well-built aeroplane considering the short period of its operation, and had a high-gloss finish. The colouring was dark green on the upper surfaces, light grey beneath.

The Betty 2-2, a development of the Betty 1-1, was the aircraft initially used to parent the "Baka." The standard version of this two-engined medium bomber was able to carry two torpedoes in lieu of bombs. It was powered by two Mitsubishi Kasei 21 air-cooled radials, each capable of 1,800 h.p. at sea-level, which gave the machine a top speed of about 330 m.p.h. and a maximum range of 2,700 miles. These figures naturally suffered slight reduction when the "Baka" was carried.

A special carrier was installed below the fuselage near the c.g. of the aircraft, which held the 'plane snugly above the depth of the lowered undercarriage, permitting normal take-off. The undercarriage and all services were fully operable, as also was the protective armament, three 7.7 mm. machine-guns and two 20 mm. cannon.

The cockpit projected into the bomb-bay, and the twin fins and rudders fitted alongside the bomber's fuselage. The Betty 2-2 was particularly ideal for the job, as bomb-bay doors were not normally fitted. Another bi-motor aircraft, the Peggy, was reported to be operating the "Baka" during the later stages of the war.

The Kamikaze Corps

The fanatics who kept the "Baka" 'planes hammering away at Allied carriers and capital ships from the early summer of 1944 were, of course, inspired to the "supreme sacrifice" by their peculiar religious cult. The Japanese had grown up to the philosophy that to commit suicide was to be assured of a place among the gods. Even their nursery stories reflected the apothesis: "The Forty Knights of Ronin" tells of a band of knights who set out to avenge the death of their leader, and, each having accomplished his particular deed of valour, rounded off the episode by committing "hari-kari" with the sanctified sword.

Large numbers of their warriors during the war died self-inflicted deaths rather than suffer the "disgrace" of capture; similarly, it was not uncommon for pilots of orthodox fighters to dive their 'planes headlong into Allied bombers in preference to returning unsuccessful.

The men of the Kamikaze Corps went to their deaths as a well-trained unit. Their initiation involved months of calm instruction in the handling of gliders, and they eventually flew in specially built "Baka" trainers which landed on skids. Few of the pilots were more than 20; the majority ended their lives at an earlier age, and there appears to have been no lack of volunteers.

Having completed their training and before being assigned to their missions, the pilots, their heads shaven, were consecrated in a priestly ceremony. This involved a kind of religious carnival in which the people joined, honouring their heroes with flowers as pilots and priests paraded through the streets of Tokyo.

Eventually the fateful day arrived, and, locked within their separate cockpits, with the emblem of their unit painted boldly on the nosings of their machines—a cherry

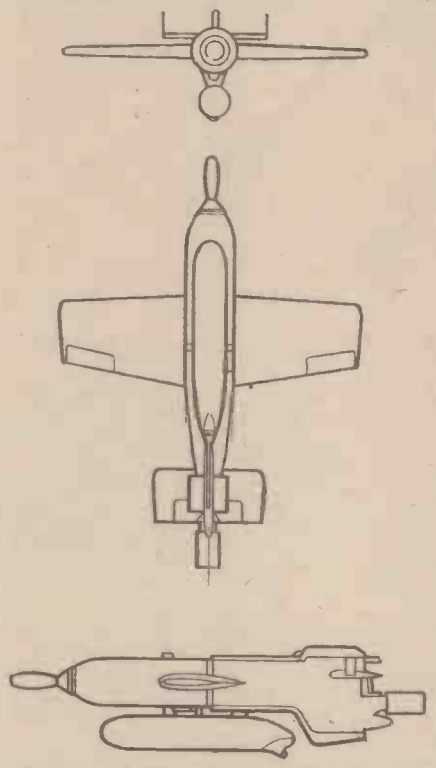


Fig. 74.—Three views of the Henschel 293, radio-controlled anti-shipping "glide-bomb." Its bi-fuel rocket unit was contained in a separate nacelle below the fuselage.

blossom, for instance, was the insignia of the Cherry Blossom Unit—the pilots were airborne on their last flight.

While the "Baka" and its parent 'plane were joined, the pilots were in radio contact, and it was the bomber pilot who decided upon the target and the time of release. Approaching the target area, the Kamikaze pilot was given his last instructions, and the 'plane cast loose from about 10,000ft.

The pilot did not use his rockets immediately, but glided in to his objective, bringing them into operation one at a time to increase speed for the final assault; then, weaving and diving to evade defensive "flak," he plunged headlong to his death.

Although the damage inflicted by suicide attacks was not as great as one might have expected, it is nevertheless true that a number of the "Baka" pilots succeeded in exploding their tiny aircraft on the decks of warships. The great majority, however, were either shot out of the air by the barrage of defensive fire or made to miss their targets completely, crashing harmlessly into the sea.

Whatever the outcome of the attack, the fate of the pilot was certain; the "Baka's" delicate fuses detonated on the water as easily as against the steel of a warship.

German Aircraft Developments

The turn of the air war in favour of the Allies brought an ending to heavy bomber production in Germany, and the entire industry was switched to the production of high-speed single and twin-engined interceptors. Only when the practicability of jet-propulsion was demonstrated did work again proceed with "heavies," and even then development was restricted to one or two firms. These aircraft were to have been operated from great heights, and in order to achieve bombing accuracy provision had been made in the original designs for guided missiles to be carried. The first of these new types to reach the prototype stage was the Junkers 287. This machine was said to have a range of 1,000 miles with a bomb load of 4 tons and a top speed in the region of 550 miles per hour.

Fighter Production

The production of fighters proceeded along the three distinct paths of power-plant development, (a) the conventional internal combustion engine, (b) the jet-propulsion unit, and (c) the bi-fuel rocket propulsor.

The most prominent in class (a) were, of course, the veteran Messerschmitt 109 and the Focke Wulf 190. At least three newer propeller fighters were in course of production.

In the jet-propulsion class were the Messerschmitt 262—the first jet machine to be used operationally—the Heinkel 162 or Volksjaeger (People's Fighter), the Arado 234, and a unique tail-less fighter designed by the Horton Brothers. A number of other jet interceptors were in project stage, while many prototypes of more advanced designs were still incomplete at the time of the surrender. Of particular interest is the fact that two of these projects were purely research aircraft intended to test various aerofoil sections and wing plan-forms at speeds in the region of M = 1. One of the research machines was designed for the fitment of alternate wings of 0 deg., 25 deg. and 35 deg. sweepback, and with these it was hoped to determine a degree of sweepback optimum for flight both at high and low speeds. The other was to have been a twin-boom aircraft with the space between the booms utilised to test high-speed wing profiles.

Compressor-less Jet Interceptors

Another machine in class (b) was one projected by Lippish—undoubtedly the most unorthodox jet aircraft that has yet undergone serious investigation. A flying-wing in the very essence of the word, its design was based on the phenomenal top speed of 1,500 m.p.h., "g" effects being reduced by the pilot occupying a prone position. The wings were swept back sharply, the air to be taken in through a duct in the nosing.

It was intended to accelerate the 'plane into flight with dry-fuel rockets, and compression of the air was to have been entirely due to the ram effect of the high speed and not the result of rotary compressors. There was, of course, no turbine, and whereas most jet systems employ a liquid hydrocarbon to raise the air temperature, this was to have been accomplished in the Lippish machine by the use of carbon blocks, pre-heated to incandescence and rapidly loaded into the expansion chamber just prior to flight. The A.T.O. rockets having imparted the initial speed, the high velocity air-draught would ensure that the heat of the carbon was maintained in much the same way as bellows inflame a fire. The air was thereafter heated by the glowing carbons and the effluent ejected from the rear through a long, narrow slit in the trailing edge.

This system was said to be capable of maintaining a useful thrust for three-quarters of an hour, and in the closing months of the war the German technicians had suc-

A corner of a hangar at the Yokosuka Naval Air Station, Japan, where the Kamikaze pilots underwent their training. The machines in this picture are all trainer versions of the notorious "Baka," having ballast in place of H.E., and fitted with landing skids.

ceeded in the development of an improved motor in which the effective life of the heating substance had been almost doubled, simply by incorporating liquid fuel sprays above the carbons. The fuel tank was to be built within the single vertical fin.

Other compressor-less jet projects were fighters to be powered by liquid-fuelled propulsive ducts, including a high-speed helicoptor of unorthodox layout, which was to embody a duct unit in each tip of its three rotors.

All jet systems which depend upon induced ram pressure and are not resonant operating (e.g., as the Argus Rohr 014, propulsion unit of the "V1") are termed "athodyd"—the abbreviation of "aero-thermodynamical-duct." The simplest of all thermodynamic engines, the working portion is simply a venturi-shaped tube, having no moving parts and fitted solely with fuel burners and means of ignition. The duct contour is, of course, based on the performance desired of the motor.

Operation of the Athodyd

When the duct moves forward under the thrust of assisting rockets, air commences to ram into the intake at high pressure. The fuel burners, placed about a third from the intake, heat and expand the air, and the resultant high velocity gases are ejected from the rear as the reactive jet.

The greater the speed of the athodyd, the higher is its efficiency. Its possibilities for operating aircraft at sonic and supersonic speeds are enormous, and small test units have already been operated in America within these speed ranges.

In aircraft, however, its use will always be in conjunction with an auxiliary motor, and an integral rocket unit has already been tried by the Germans and found highly effective. A simple athodyd unit was employed with the rocket motor placed in the mouth of the duct, and it was found that a 50 per cent. increase in thrust was registered without actual burning of the fuel in the duct. This was largely cancelled, however, by the increased drag.

The rocket and duct combined were then tested for maximum thrust conditions, and the duct only for cruise purposes. This brought about a 100 per cent. increase in the cruising endurance over that of the bi-fuel rocket motor used in the Me. 163, and it was, in fact, proposed to replace the cruising unit on rocket powered fighters by a composite motor of this type. The development, however, arrived too late for operational use.

(To be continued)

Notes and News

Gun-fire Control

NOW that peace prevails, naturally we do not expect so many war inventions to be contrived. But military devices are not absolutely in short supply. Here is one relating to machines and particularly to gun-fire controlling mechanism.

The inventor points out that in the case of machine-guns mounted on aircraft, economy in the use of ammunition is desirable in view of the difficulty of carrying great quantities on aeroplanes. This is especially so when machine-guns of large calibre fire, for example, explosive shells. It is therefore sometimes desirable to employ short bursts of fire. But, owing to the rapidity of the fire of modern machine-guns, the number of rounds fired should be limited. This is not possible without some means for stopping the fire after the desired number of rounds have been fired.

The new invention has for its principal object the provision of mechanism for limiting to any desired value the number of rounds fired upon one continued depression of the firing button or trigger.

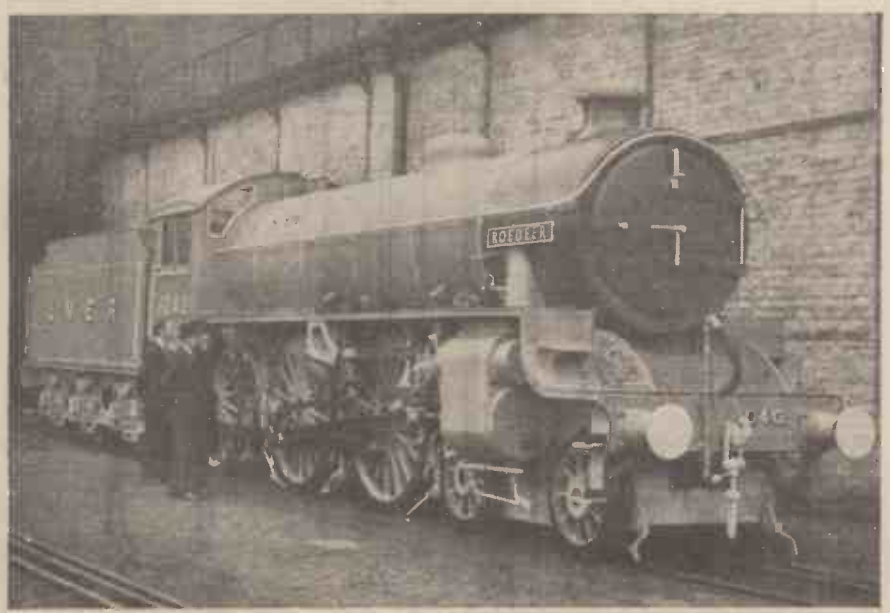
The device comprises electro-magnetic or electro-dynamic means for effecting directly, or through a relay, withdrawal of the gun sear, and an energising circuit for the electro-magnetic or electro-dynamic means, including a normally open firing switch, arranged to be closed by depression of the firing button. And there is a normally closed control switch arranged to be opened by a control member, when the latter has been moved forward a predetermined number of slips. This corresponds to the rounds fired by mechanism operated by the recoil of the gun or by the movement of a gun component during the firing cycle.

New High-speed Wind-tunnel

WITHOUT the modern wind-tunnel the task of the test pilot would be much more complicated and dangerous. At the Royal Aircraft Establishment at Farnborough, the new high-speed wind-tunnel is proving invaluable in testing aircraft models and component parts in varying atmospheric and wind conditions similar to those that might be experienced in any part of the world.

Work on the wind-tunnel was commenced in 1938, and over 1,000 tons of steel were used in its construction. The tunnel is 130ft. long and has a diameter of 37ft., while its 4,000-h.p. fan can produce a wind velocity of over 600 m.p.h. During tests a great heat is generated, and a brine circulation plant is used for cooling the shell of the wind-tunnel.

Full-size aircraft are not tested in the tunnel, but it is possible to use quarter-size models for making a close study of the characteristics of the airflow in relation to the aircraft's fuselage, nacelles, and controls.



A new British locomotive, "Roedeer," first of the "Antelope" class engines being built by an outside contractor at Polmadie, Glasgow, for the L.N.E.R.