

= Disney bomb =

The Disney Bomb , also known as the Disney Swish , officially the 4500 lb Concrete Piercing / Rocket Assisted bomb was a rocket @-@ assisted bunker buster bomb developed during the Second World War by the British Royal Navy to penetrate hardened concrete targets , such as submarine pens , that could resist conventional free @-@ fall bombs . Devised by Royal Navy Captain Edward Terrell , the bomb was fitted with solid @-@ fuel rockets to accelerate its descent , giving it an impact speed of 990 miles per hour (1 @,@ 590 km / h) ? substantially beyond the 750 miles per hour (1 @,@ 210 km / h) gravity @-@ propulsion impact velocity of the 5 tonne Tallboy munition for comparable purposes ? and hence the ability to penetrate 16 ft (4 @.@ 9 m) of solid concrete before detonating . The name is attributed to a propaganda film produced by the Walt Disney Studios , that provided the inspiration for the design .

The Disney bomb saw limited use by the United States Army Air Forces in Europe from February to April 1945 . Although technically successful , it initially lacked the pinpoint accuracy required for bunker targets . It was deployed late in the war and had little effect on the Allied bombing campaign against Germany .

= = Background = =

During the Second World War , Barnes Wallis developed two large " earthquake " bombs for the Royal Air Force : the five @-@ tonne Tallboy and the ten @-@ tonne Grand Slam , for use against targets too heavily protected to be affected by conventional high explosive bombs . These enormous weapons were designed to strike close by their target , to penetrate deeply into the earth , and to cause major structural damages , making repair uneconomic , by the shock waves transmitted through the ground . In practice , they proved capable of penetrating a significant thickness of concrete if they scored a direct hit despite not being designed for that purpose by Wallis , who had to work within the accuracy limitations of current bombsights and the resulting low accuracy of the bombings .

The Disney bomb , by contrast , was designed from the start to directly penetrate the thick concrete roofs of fortified bunkers . Whereas the earthquake bomb 's target was the bunker itself , the Disney bomb 's target was the bunker 's contents . To this end , the warhead was composed of an unusually thick steel shell , containing a comparatively small amount of explosive . It was shaped to be much slimmer than was usual for aircraft @-@ dropped bombs and a cluster of booster rockets accelerated the weapon as it fell , so it struck the target with a velocity much greater than its free @-@ fall , terminal velocity . These features accord with Newton 's approximation for impact depth , and the empirical design equation known as Young 's equation that state that the deepest target penetration is achieved by a projectile that is dense , long and thin (i.e. has a large sectional density) , and strikes with a high velocity .

= = Description = =

The CP / RA Disney bombs were 16 ft 6 in (5 @.@ 03 m) long and weighed 4 @,@ 500 pounds (2 @,@ 000 kg) . The diameter of the body of the bomb was 11 in (280 mm) , while the diameter at the tail was 17 in (430 mm) . They were composed of three sections . The forward section was the warhead ? an explosive charge of 500 pounds (230 kg) of shellite , contained within an armour @-@ piercing casing of thick steel and fitted with two British No.58 MK I tail Pistol fuzes at the base (i.e. furthest from the nose) . The second section was made up of nineteen rocket motors from the 3 inches (76 mm) Rocket Projectile - essentially metal tubes filled with cordite . In the third rear section , a tail cone contained the circuit that ignited the rockets . This was powered by a small generator with a vane spun by the airstream going past the falling bomb . Rocket ignition was controlled either by a time @-@ delay switch , or a barometric switch . There were six small fins at the rear of the bomb for its stabilisation . The bomb was suspended from the aircraft by two weight @-@ bearing lugs . Three arming wires also connected the bomb and the aircraft ; as the bomb

dropped , a brief tug from the wires would arm the warhead fuzes and the rocket @-@ ignition circuit , and unlock the electrical generator , allowing it to spin freely .

For accuracy , the bombs had to be dropped precisely from a pre @-@ determined height , usually 20 @,@ 000 feet (6 @,@ 100 m) . They would free @-@ fall for around 30 seconds until , at 5 @,@ 000 feet (1 @,@ 500 m) , the rockets were ignited , causing the tail section to be expelled . The rocket burn lasted for three seconds and added 300 feet per second (91 m / s) to the bomb 's speed , giving a final impact speed of 1 @,@ 450 feet per second (440 m / s) , equivalent to 990 miles per hour (1 @,@ 590 km / h) or approximately Mach 1 @.@ 29 . Post @-@ war tests demonstrated the bombs were able to penetrate a 14 @-@ foot @-@ 8 @-@ inch (4 @.@ 47 m) thick concrete roof , with the predicted (but untested) ability to penetrate 16 feet 8 inches (5 @.@ 08 m) of concrete .

= = Development and testing = =

According to an anecdote , the idea arose after a group of Royal Navy officers saw a similar , but fictional , bomb depicted in the 1943 Walt Disney animated propaganda film Victory Through Air Power , and the name Disney was consequently given to the weapon . The Royal Navy developed the bomb even though the Fleet Air Arm operated no aircraft capable of carrying it . The navy 's interest in a concrete penetrating weapon can be explained by the German navy 's extensive use of fortified submarine pens to protect their U @-@ boats and E @-@ boats from air attack while docked .

The Disney Bomb was devised by a British naval officer , Captain Edward Terrell of the Royal Naval Volunteer Reserve , who served in the Directorate of Miscellaneous Weapons Development . Before the war , he had been a lawyer and the Recorder of Newbury . However , he was also an enthusiastic inventor and had filed several patents pre @-@ war , including ones for a vegetable peeling knife and a bottle for fountain pen ink .

The bomb 's development began in September 1943 . Although there was support for the idea at the highest levels within the Admiralty , production of the weapon would have to come under the Ministry of Aircraft Production (MAP) . The Road Research Laboratory provided theoretical formula for penetration from US data on the performance of 15 @-@ inch (381 mm) shells against reinforced concrete and the Chief Engineer of Armament Development at Fort Halstead prepared a preliminary design to present to the MAP . In the face of opposition , the First Sea Lord prepared a memorandum for the Anti @-@ U @-@ Boat Committee of which Churchill was the Chairman . Terrell visited Churchill 's scientific adviser Lord Cherwell to convince him that it was feasible technically . Due to the Prime Minister 's absence through illness , it was not until January 1944 that Churchill expressed a desire that the bomb should be considered by the committee . Due to the number of departments involved there were meetings involving large numbers of technicians and scientists to confirm the technical feasibility .

Through the Air Technical Section of the USAAC , Terrell received support and was able to show the Admiralty a mockup under the wing of a Boeing B @-@ 17 Flying Fortress . The Air Ministry was still opposed to its development on several technical grounds and it took a meeting of the War Cabinet in May (which Terrell attended) to decide in its favour giving it " P plus " priority . A side effect of the meeting was it focused attention on the issue of the U @-@ boat shelters and the RAF were directed to make attacks on them ? dropping 26 Tallboys in August that year .

Despite being a British weapon , Disneys were used only by the United States Army Air Force , with the bombs becoming a joint project between the American Eighth Air Force and the British Royal Navy ; they were never used by RAF Bomber Command . The 92nd Bombardment Group was initially tasked with their use . The bombs would also be dropped by the 305th Bombardment Group and 306th Bombardment Group . The 94th Bombardment Group prepared to use the bombs , but flew no operations with them before the war in Europe ended . The B @-@ 17 Flying Fortresses operated by these units carried the bombs in pairs ; one was slung under each wing as they were too long to be carried in the B @-@ 17 's bomb bay . The Disneys were carried from the same external mounting that was used for the Aeronca GB @-@ 1 glide bomb . Cameras were also fitted

to the aircraft so the bombs' trajectory and effect could be recorded .

Testing of the Disney bombs began in early 1945 . Bombs were initially dropped on a bombing range near Southampton to photographically record their trajectory and calibrate bombsights . This was necessary as the flight @-@ path of a rocket @-@ accelerated bomb differed considerably from that of a free ? falling bomb . Test drops were then conducted on the Watten bunker , German codename Kraftwerk Nord West (now known as the Blockhaus d 'Éperlecques) , a large German concrete bunker near Watten in northern France . This was ideal for the purpose as the area had been captured by Allied forces in September 1944 , so damage to the structure could be inspected after bomb tests . Four bombs , carried by two B @-@ 17s , were used and two hits scored on the target . The resultant damage was considered satisfactory by Royal Navy observers on the ground .

= = Combat = =

The first Disney attack was against the port of IJmuiden , Netherlands . This was the site of two separate fortified pens used by the German navy to house their Schnellboote (fast torpedo boats , known to the Allies as " E @-@ boats ") and Biber midget submarines . The older structure , codename Schnellbootbunker AY (SBB1) , was protected by a 10 @-@ foot (3 @.@ 0 m) thick concrete roof . The newer one , codename Schnellbootbunker BY (SBB2) , had 10 ? 12 feet (3 @.@ 0 ? 3 @.@ 7 m) of concrete , with a further 2 ? 4 @-@ foot (0 @.@ 61 ? 1 @.@ 22 m) layer separated by an air ? gap .

The E @-@ boats laid up in the shelters during the day , safe from air ? attack , and put to sea under cover of night to attack Allied shipping . The pens were priority targets as the torpedo boats they protected were a considerable threat to the supply lines serving Allied forces in western Europe . Since August 1944 , the two bunkers had been attacked four times by No. 9 Squadron and No. 617 Squadron of the RAF , with a total of 53 of the five ? ton , Tallboy earthquake bombs . There had been numerous other attacks from bombers carrying smaller , conventional bombs .

Nine aircraft of the 92nd Bomb Group , carrying 18 Disneys , attacked Schnellbootbunker BY (SBB2) on 10 February 1945 . Royal Navy intelligence learned the concrete had been penetrated , but the pens had been empty at the time of the attack . The 92nd therefore carried out an attack on the SBB1 pen , again with nine aircraft , on 14 March .

On 30 March , 36 aircraft from the US Eighth Air Force , including 12 from the 92nd Bomb Group , attacked the Valentin submarine pens , a massive , bomb ? hardened concrete shelter under construction at the small port of Farge , near Bremen in Germany (location : 53 ° 13 ? 00 ? N 8 ° 30 ? 15 ? E) with Disney bombs . The shelter was nearing completion and was to be a factory for the assembly of Type XXI U @-@ boats . Construction had been under way since 1943 , using the forced labour of 10 @,@ 000 concentration ? camp prisoners , prisoners ? of ? war and foreign civilians (Fremdarbeiter) who suffered a high death rate because of the horrific conditions they worked under .

Valentin 's 4 @.@ 5 @-@ metre (15 ft) -thick roof had already been penetrated by two 10 @-@ ton Grand Slam bombs dropped by the RAF three days earlier , on 27 March . During the Eighth Air Force attack , more than sixty Disneys were launched but only one hit the target with little effect , although installations around the bunker received considerable damage . After the bombing , the Germans made limited attempts to carry out repairs before abandoning the complex ; the area was captured by the British Army four weeks later .

On 4 April 1945 , 24 B @-@ 17s attacked fortified targets in Hamburg . The target was obscured by cloud so radar guidance was used to launch the bombs . A further mission in May 1945 was cancelled . A total of 158 bombs were dropped before the end of the war . No aircraft or aircrew were lost during the four Disney combat missions .

= = Post @-@ war development = =

In June 1945 , the Air Council wrote to the Lords of the Admiralty expressing " their appreciation " of the work that had been done on the " rocket bomb " . The RAF initiated bombing tests of the Disney

in June 1945 , using the Watten bunker as a target . The actual bombing was carried by the US 8th Air Force on behalf of the RAF . However , Watten proved too small to be a satisfactory target , and the French objected to continued bombing of their territory in peace @-@ time .

Further testing took place as part of Project Ruby . This was a 1946 , joint Anglo @-@ American programme to test a range of concrete penetrating bombs against a wartime German bunker on the small island of Heligoland and the Valentin submarine pens . Bombs tested included the Tallboy and the Grand Slam (both British and US @-@ made versions) , the American 22 @,@ 000 @-@ pound (10 @,@ 000 kg) Amazon and 2 @,@ 000 @-@ pound (910 kg) M103 SAP bombs , and the Disney . The bombs dropped on Valentin were inert , as the objective was not to observe the effects of bomb explosions , but rather to test concrete penetration and the strength of the bomb casings . Also , with the resumption of peace , the safety of civilians living around Valentin had become a consideration .

Heligoland was uninhabited at the time as its small population had been evacuated during the war . It was the site of a U @-@ boat pen with a 10 @-@ foot (3 @.@ 0 m) thick roof . This was used to test bombs loaded with explosive (but with inert detonators) to make sure the explosives used were not shock sensitive and would not prematurely detonate upon impact with the target .

This peace @-@ time testing of the bomb was far more extensive than could be carried out prior to its wartime deployment . A total of 76 Disneys were dropped on Heligoland , loaded with a variety of explosive charges , composed of shellite , RDX , TNT or Picratol . Thirty @-@ four Disneys were dropped on Valentin , 12 with the rockets inactivated and 22 with the rockets firing . A further four had been previously dropped on a bomb range at Orford Ness to test their accuracy , and to make sure none would land outside the safety exclusion zone that was set up around Valentin during the trials .

The penetration performance (14 feet 8 inches (4 @.@ 47 m) of concrete) of the Disney was found to be satisfactory , with a predicted maximum penetration of 16 feet 8 inches (5 @.@ 08 m) . One of the bombs penetrated both Valentin 's concrete roof , and its 3 @-@ foot (0 @.@ 91 m) thick concrete floor , coming to rest completely buried in the sand under structure 's foundations . However , there were problems with the bombs . The reliability of the rocket booster ignition was considered unsatisfactory , with a failure rate of around 37 % during the trials . Also , some bombs broke up on impact with the target due to flaws in the steel casing and bombs struck at an angle , increasing the effective thickness of concrete they had to penetrate . Furthermore , it was noted that the warhead of the bomb was comparatively small so a very large bunker complex , such as Valentin , would have required many penetrating hits to be sure of destroying all the contents .

In comparison , the effective concrete penetration of the Tallboy and Grand Slams was similar to the Disney (around 14 feet) . However , these bombs directly penetrated only around seven feet of concrete , and the remaining thickness was blown in by the detonation of the bomb 's enormous explosive charge . The roof of Valentin had been penetrated by two Grand Slams before the war ended . But , as no detonation occurred inside the bunker , post @-@ war examination revealed little damage to the complex aside from the large holes in the roof ; installations inside the bunker remained comparatively unscathed . The conclusion of Project Ruby was that none of the bombs tested was completely suitable and the development of a new , concrete ? penetrating bomb was recommended . However , the Disney 's rocket @-@ assist was viewed as a worthwhile feature that should be incorporated into any new bomb designs , as target penetration increases with strike velocity , but it was found this only increases marginally if a bomb is dropped from higher than 20 @,@ 000 feet (6 @,@ 100 m) .

On 27 January 2009 , the body of an inactive Disney bomb , with its 500 @-@ pound (230 kg) explosive charge , was extracted from the roof of Watten bunker (by now a private museum) , where it had embedded itself during one of the 1945 test @-@ drops . The bomb was transferred to the ammunition depot at La Geule d 'Ours ? two kilometres from the centre of Vimy ? where recovered chemical ammunition and equipment from the First World War is processed .