= Sticky bomb =

The Grenade , Hand , Anti @-@ Tank No. 74 , commonly known as the S.T. Grenade or sticky bomb , was a British hand grenade designed and produced during the Second World War . The grenade was one of a number of anti @-@ tank weapons developed for use by the British Army and Home Guard as an ad hoc solution to a lack of sufficient anti @-@ tank guns in the aftermath of the Dunkirk evacuation . Designed by a team from MIR (c) including Major Millis Jefferis and Stuart Macrae , the grenade consisted of a glass sphere containing an explosive made of nitroglycerin and additives (this added stability to the mix , as well as giving it its squash @-@ head @-@ like effect) covered in a powerful adhesive , and surrounded by a sheet @-@ metal casing . When the user pulled a pin on the handle of the grenade , the casing would fall away and expose the sphere ; another pin would activate the firing mechanism , and the user would then attempt to attach the grenade to an enemy tank or other vehicle , ideally with enough force to break the glass ball . After it was attached , releasing the lever on the handle would activate a five @-@ second fuse , which would then detonate the nitroglycerin .

The grenade had several faults with its design . In tests , it failed to adhere to dusty or muddy tanks and , if the user was not careful after freeing the grenade from its casing , it could easily stick to his uniform . The Ordnance Board of the War Department did not approve the grenade for use by the British Army , but personal intervention by the Prime Minister , Winston Churchill , led to the grenade going into production . Between 1940 and 1943 , approximately 2 @.@ 5 million were produced . It was primarily issued to the Home Guard , but was also used by British and Commonwealth forces in North Africa , accounting for six German tanks ; used by Allied Forces on the Anzio Beachhead , including the First Special Service Force ; as well as by Australian Army units during the New Guinea campaign . The French Resistance were also issued a quantity of the grenades .

= = Development = =

Since at least 1938 , Jefferis had been toying with the idea of a demolition or anti @-@ tank weapon that would be ideal for irregular warfare . It would work by having an explosive charge deform so that it has a substantial area of intimate contact with the surface of the target . Then , when detonated , the effect of the explosion would be focused on a small area and would rupture an armoured plate much thicker than would otherwise be the case . Sappers call such a device a " poultice " or " squash head " charge . Jefferis enlisted Drs Bauer and Schulman of the Colloid Science Department of Cambridge University , they had experimented with lengths of bicycle inner tube filled with plasticine to represent the explosive . These were fitted with wooden handles and dipped in rubber solution to make them sticky . In experiments , these prototypes proved difficult to aim and only by chance did any stick to the metal bins used to represent tanks .

With the end of the Battle of France and the evacuation of the British Expeditionary Force from the port of Dunkirk between 26 May and 4 June 1940 , a German invasion of Great Britain seemed likely . However , the British Army was not well equipped to defend the country in such an event ; in the weeks after the Dunkirk evacuation it could only field twenty @-@ seven divisions . The Army was particularly short of anti @-@ tank guns , 840 of which had been left behind in France and only 167 were available in Britain ; ammunition was so scarce for the remaining guns that regulations forbade even a single round being used for training purposes .

Under the circumstances , Jefferis considered that his idea might have more general application for the British Army and the Home Guard . Jefferis was in charge of a department known as MIR (c) , which had been created to develop and deliver weapons for use by guerilla and resistance groups in Occupied Europe . MIR (c) was now charged with the development of the Sticky Bomb .

The problem of designing a sticky bomb had been delegated to the enthusiastic genius of Robert Stuart Macrae . Clearly , some sort of flexible bag was required to contain an explosive gel so that it did not matter how the bomb landed on the target . However , a flexible bag is hard to throw and trials had not been at all satisfactory .

Discussions of the problem in Macrae 's office were overheard by Gordon Norwood , a master

printer who Macrae had recruited from his former magazine publishing employer , but he was not directly working on the weapon . Norwood suggested that what was needed was a frangible container and to the annoyance of the War Office store keeper he obtained a 150 W light bulb with which to demonstrate his point : a spherical glass flask inside a sock of woven wool is rigid when thrown , but on contact the glass breaks and the bomb deforms to the required shape . Experiments with glass flasks filled with cold porridge confirmed that this was the way to go . The grenade needed a delay for the thrower to get clear , so the woollen sock was covered in a sticky substance ensuring that the bomb stayed in place for a few seconds before detonating . Having covered the bomb in glue , a non @-@ sticky handle was required ; in the handle , a delay fuse ignited by releasing a sprung lever so that a five second time delay starts as the grenade leaves the thrower 's hand (just like the levers found on a conventional Mills bomb type hand grenade) .

Meanwhile , finding a suitable adhesive was a significant problem . After unsuccessful experiments with a variety of candidates , somebody suggested birdlime ? a viscous sticky compound used since ancient times to trap birds by spreading it on tree branches and waiting for birds to get stuck . Birdlime performed better than anything previously tested , but it was still not good enough . Macrae 's tin of birdlime was labelled with a large letter ' K ' and an indication that tin came from Stockport but with no more clues as to the manufacturer . Macrae got on a train to Stockport and there found a helpful taxi driver who took him to Kay Brothers Ltd . The company 's Chief Chemist was soon working on the problem of a suitable adhesive and within a matter of weeks the problem was solved to Macrae 's satisfaction .

The filling for the bomb was developed by ICI . It was nitroglycerin @-@ based with a variety of additives to make it more stable and viscous . The glass flask containing the main charge held about 1 1 ? 2 pounds (680 g) of this explosive that was described as having the consistency of Vaseline .

The adhesive surface was protected by a light metal case which was released by pulling a safety pin : the case fell away as two hemispheres connected by a sprung hinge . The inside of the case was fitted with a number of rubber spikes that kept it clear of the glued surface of the grenade . Early models also had a strip of adhesive tape round the neck of the casing .

Development continued , but there were problems with service regulations that were not written with such an unconventional weapon in mind . The sticky bomb was inevitably rather fragile and even a specially designed box could not fully meet the army 's demanding requirements for withstanding rough handling without damage . It seemed there were problems at every turn . The Prime Minister , Winston Churchill , who was concerned with the state of the country 's anti @-@ tank defences , learnt about the grenade and urged its development . The Ordnance Board of the War Office did not approve the grenade to be used by the Army . However , Churchill ordered further tests to be conducted in July , and after personally viewing a demonstration of the grenade ordered that it immediately be put into production . His memo of October 1940 simply read " Sticky bomb . Make one million " . A couple of days later , Anthony Eden , then Secretary of State for War , added a scribbled note to a cabinet minute that recorded the order to go ahead with the bomb :

Anti @-@ Tank (& indeed anti @-@ enemy generally) bombs for Home Defence are vitally urgent and should be available in very large quantities . I don 't mind where they come from as long as we get them , home or abroad . [emphasis as in original]

In spite of top level pressure , the arguments rumbled on . Trials were disappointing , it was not possible to get the bomb to adhere to any surface that was wet or covered with even the thinnest film of dried mud " a customary condition of tanks " as Major @-@ General Ismay , on 27 June , could not resist pointing out .

Churchill was not amused :

General Ismay , I understand that the trials were not entirely successful and the bomb failed to stick on tanks which were covered in dust and mud . No doubt some more sticky mixture can be devised and Major Jefferis should persevere . Any chortling by officials who have been slothful in pushing this bomb , over the fact that at present it has not succeeded will be viewed with great disfavour by me .

Macrae , Ismay and Churchill all saw fit to record these arguments over the technical issue of

stickiness . As Eden had pointed out , there was a lot at stake . The British infantry and Home Guard had little with which to put up a fight against tanks and to any who had witnessed trials of Molotov Cocktails and SIP grenades it was evident that they could do little to a modern tank other than to provide a blinding pall of smoke . What was needed was a hand weapon to deliver a coup de grâce by punching through the armoured plate . The sticky bomb could do the job and little else was available .

In his memoirs , Ismay recalled that he never solved the puzzle of how to convey his very genuine concerns of the time to the right people . A thrown sticky bomb simply would not reliably stick to a vertical surface . However , the bomb would stick if it was thrown onto the top of a tank where the plates were more or less horizontal ? and thinner ? but this reduced the throwing range to twenty yards at the most ? getting that close would only be possible in an ambush or in street fighting .

Churchill considered any obstruction , however well @-@ meaning , as singularly lacking in imagination . In the event of invasion , he foresaw a desperate fight to the last and after the war , he wrote about how he envisaged the use of the sticky bomb : " We had the picture in mind that devoted soldiers or civilians would run close up to the tank and even thrust the bomb upon it , though its explosion cost them their lives . There were undoubtedly many who would have done it [Italics added for emphasis] . " He also later recorded how he intended to use the slogan : " You can always take one with you . "

Arguments rumbled on and there were endless delays . Early versions of the sticky bomb were prone to leaks as well as breakage in transport . There were understandable concerns over the explosive charge : pure nitroglycerin is notoriously susceptible to the slightest knock , but the mixture developed by ICI proved to be very safe even if it should get into the hinges of the storage boxes . By December 1940 , fewer than 66 @,@ 000 had been produced and the rate of production was disappointing at five to ten thousand per week . Further , it was suggested that the original order of one million be reduced to 200 @,@ 000 . Minor improvements to the design were made , of which the most significant was to replace the glass flask with plastic . Finally , after passing all the required tests , the sticky bomb ? now the No 74 Grenade Mk II ? was accepted by the Ordnance Board ; it was put into full @-@ scale production and it became a service issue .

On 14 May 1941 , Lieutenant @-@ General Sir Ian Jacob reflected :

The most extraordinary feature of the whole business , however , was the fact that the Secretary of State for War , in a Minute addressed to the Prime Minister on 25 November 1940 , said that the Director of Artillery and the Ordnance Board had only just been able to obtain from ICI the details of the explosive contained in the bomb . Seeing that the bomb was demonstrated in June 1940 , this statement can hardly hold water . The War Office seems to be to blame in that , up to the end of April , 1941 , no sticky bombs had been issued to any unit , nor had any dummies been provided for training . In view of our acute shortage of anti @-@ tank weapons , the whole story is discreditable .

Between 1940 and 1943 approximately 2 @.@ 5 million were produced .

= = Design = =

The Grenade , Hand , Anti @-@ Tank No. 74 consisted of a glass sphere in which was contained approximately 1 @.@ 25 pounds (0 @.@ 57 kg) of semi @-@ liquid nitroglycerin devised by ICI . The sphere was covered in stockinette which was coated with a liberal amount of birdlime , an extremely adhesive substance from which the nickname ' sticky bomb ' was derived . A casing made out of thin sheet @-@ metal , and formed of two halves , was then placed around the sphere and held in place by a wooden handle , inside which was a five @-@ second fuse . The handle also contained two pins and a lever ; the first pin was pulled out to make the casing fall away , and the second to activate the firing mechanism in the grenade . This primed the grenade , with the lever being held down to ensure the fuse was not triggered ; then the user would run up to the tank and stick the grenade to its hull , using as much force as possible to break the sphere and spread the nitroglycerin onto the hull in a thick paste . Another alternative was for the user to throw it at the tank from a distance . Either way , the lever would be released and the fuse activated , and the grenade would then detonate .

The grenade did possess several problems with its design . Users were urged to actually run up to the tank and place it by hand , rather than throw it , thus the adhesive could very easily stick to their uniform in the process ; the user would then be placed in the unenviable situation of attempting to pry the grenade loose whilst still holding onto the lever . It was also discovered that as time passed the nitroglycerin began to deteriorate and become unstable , which made it even more difficult to use . As the grenade was a short @-@ range weapon , users were trained to hide in a trench or other place of concealment until the tank went past them , and then to stick the grenade to the rear of the tank , where its armour was thinnest . Users were relatively safe from a few yards away , as long as they were not in line with the handle when it detonated . The Mark II design used a plastic casing instead of glass , and a detonator instead of a cap .

= = Operational use = =

According to a War Office training pamphlet dated 29 August 1940 , the sticky bomb should be regarded as a portable demolition device which can be " quickly and easily applied " . It was reckoned to be effective against armour of up to one inch (25 mm) thickness and was suitable for use against " baby " tanks , armoured cars and the vulnerable points on medium and heavy tanks . The safest and easiest application was simply to drop it from an upstairs window ; otherwise , it could be used in an ambush of mobile tanks moving along a narrow road or in an attack on tanks parked up for the night . The sticky bomb could be either thrown or slapped in place by hand , in the latter case , the advice was to use sufficient force to break the glass thereby creating a greater area of contact resulting in a more effective explosion . Finally , there was also the option of placing the bomb first and then pulling out the pin at a safe distance by means of a length of string .

Macrae credits the Australian army with developing the technique of slapping a sticky bomb directly onto a tank instead of throwing it from a relatively safe distance . Since the bomb used a blast effect , it was safe to do this and walk away provided only that the bomb 's handle was pointing away from the bomber ? the handle would be shot away from the explosion " like a bullet . " Macrae gives no date for the development of this tactic . Macrae confirmed that placing the bomb rather than throwing it gives better adhesion and allows thicker plates to be penetrated .

The potential of the sticky bomb for physical humour has frequently proved too tempting to be neglected , a good example being David Niven 's novel Go Slowly , Come Back Quickly . The unfortunate officer Stanni , while attempting to demolish a smelly privy , loses his dignity and a large section of trouser fabric to such an incident . The sticky bomb also featured in the British television comedy series Dad 's Army . In the episode Fallen Idol Lance @-@ Corporal Jack Jones sticks his grenade to an improvised target and retires as instructed but keeps a hold of the grenade which is now primed and stuck to an old dustbin lid .

However , the dangers inherent in the weapon were real enough , if the bomb became inadvertently stuck in mid @-@ throw , it could easily be pulled from a soldier 's hand triggering the firing mechanism and putting him in mortal danger . There were tragic accidents during training .

By July 1941 , 215 @,@ 000 sticky bombs had been produced . Of these , nearly 90 @,@ 000 had been sent abroad to North and South Africa , the Middle East and to Greece where it did useful service . The remainder were stored at Ordnance Depots or distributed to army and Home Guard units . There were many calls for the total production to be cut back and it is not clear how many were manufactured by the end of the war , but it was probably not much more than 250 @,@ 000 .

The grenade was first issued in 1940 to Home Guard units , who appeared to have taken a liking to it despite its flaws . Although the Ordnance Board had not approved the grenade to be used by Regular Army units , a quantity were provided for training purposes . However , a number of sticky bombs did find their way to British and Commonwealth units participating in the campaign in North Africa , and were used as anti @-@ tank weapons . During the Afrika Korps advance towards the town of Thala in February 1943 , they accounted for six German tanks . They were also issued to units of the Australian Army , who used them during the Battle of Wau and the Battle of Milne Bay . They were used by various allied units on the Anzio Beachhead , namely the First Special Service Force , who obtained them from the British . A large number were also supplied to the French

Resistance .

= = Recognition = =

In 1947 , the Royal Commission on Awards to Inventors considered claims from Macrae and from the managing director of Kay Brothers . Macrae 's legal representative was Edward Terrell ? himself a wartime inventor . At the time the crown opposed granting an award ; when Macrae was asked what elements of the sticky bomb he claimed to have invented , he replied " I am claiming no invention ; I merely claim the development of the bomb , which was my job . " However , in 1951 , the commission recommended that Macrae should receive an ex @-@ gratia payment of £ 500 [about £ 14 @,@ 200 in 2016] and Norwood received £ 250 [£ 7 @,@ 100] for his contribution .

= = Users = =

Users of the grenade included :
Australia
Free French Forces
United Kingdom