Agricultural aircraft

The Antonov An-2 was the first purpose-built agricultural arcraft to be mass-produced.

An **agricultural aircraft** is an aircraft that has been built or converted for agricultural use -- usually aerial application of pesticides (crop dusting) or fertiliser (aerial topdressing); in this role they are referred to as "top dressers" or "crop dusters." Agricultural aircraft are also used for hydroseeding.

The most common agricultural aircraft are fixed-wing, such as the Grumman Ag Cat, PAC Fletcher, or Rockwell Thrush Commander but helicopters are also used. Autogyros have been tested for aerial application as well.

Crop dusting with insecticides began in the 1920s in the United States. The first widely used agricultural aircraft were converted war surplus biplanes, such as the De Havilland Tiger Moth and Stearman. After more effective insecticides and fungicides were developed in the 1940s, and aerial topdressing was developed by government research in New Zealand, a large number of purpose-built agricultural fixed-wing aircraft appeared. In the US and Europe they are typically small, simple, and rugged. Many have spraying systems built into their wings, and pumps are usually driven by wind turbines. In places where farms are larger, such as New Zealand, Australia, the former Warsaw pact nations and parts of the developing world, larger and more powerful aircraft have been used, including turboprop powered aircraft PAC Cresco, twin engined types, Lockheed Lodestar and varying from the versatile and utilitarian Antonov An-2 biplane to the bizarre turbofan powered biplane, the WSK-Mielec M-15 Belphegor- all however tend to be of simple rugged STOL design. In places where dedicated use as an agricultural aircraft is uneconomic, utility types such as the De Havillland Canada DHC2 Beaver have been used.

In the case of helicopters, tanks are placed on or outside the body of the aircraft, while a spray rig, extending outward to the sides, is attached well below the main rotor blades. Hydroseeding is often done by helicopters using tanks and drop systems much like those used for aerial firefighting.

See also

- Category:agricultural aircraft.
- Crop dusting
- Aerial topdressing

Anti-submarine weapon

A Hedgehog depth charge launcher.

An **anti-submarine weapon** is any weapon system designed for **anti-submarine warfare (ASW)**, that is to attack and destroy enemy submarines and other underwater devices.

Development

World War I marked the first earnest conflict involving significant use of submarines and consequently marked the beginning of major efforts to counter that threat. In particular, Britain was desperate to defeat the German U-Boat threat against British merchant shipping. It began equipping its destroyers with simple **depth charges** which could be dropped into the water around a suspected submarine's location. Before the war ended, the need for forward-throwing weapons had been recognized and trials began. Also, aircraft and airships had flown with depth bombs (depth charges). In addition, the specialist hunter-killer submarine had appeared, HMS *R-1*.

By the time of World War II, anti-submarine weapons had been developed somewhat, but during that war, there was a renewal of all-out submarine warfare by Germany as well as widespread use of submarines by most of the other combatants. Consequently, a host of new anti-submarine weapons were developed. **Anti-submarine mortars** were developed which created entire patterns of explosions underwater around a potential enemy. Additionally, new weapons were designed for use by aircraft, rapidly increasing their importance in fighting submarines.

Post-war developments

The Cold War brought a new kind of conflict to submarine warfare. This war of development had both the United States and Soviet Union racing to develop better, stealthier and more potent submarines while consequently developing better and more accurate anti-submarine weapons.

Attack submarines (SSKs and SSNs) were developed to include faster, longer range and more discriminating torpedoes. This, coupled with improvements to sonar systems, made ballistic missile submarines more vulnerable to attack submarines and also increased the anti-surface warfare (ASuW) capabilites of attack subs. SSBNs themselves as well as cruise-missile submarines (SSGNs) were fitted with increasingly more accurate and longer range missiles and received the greatest noise reduction technology.

To counter this increasing threat **torpedoes** were honed to target submarines more effectively and new anti-submarine missiles and rockets were developed to give ships a longer-range anti-submarine capability. Ships, submarines and Maritime Patrol Aircraft (MPA) also received increasingly effective technology for locating submarines, e.g. Magnetic Anomaly Detectors (MAD) and improved sonar.

Types

Many concepts have been tried to come up with ways of attacking submarines, but the main effective methods are:

Depth charge

A U.S. Navy depth charge, used in WWII.

The simplest of the anti-submarine weapons, the depth charge is a large canister or 'bomb' filled with explosives and set to explode at a determined depth. The concussive effects of the explosion could damage a submarine from a distance, although in reality it

still must be very close to break the submarine's hull. Depth charges are typically used in a barrage manner in order to cause significant damage through continually battering the submarine with concussive blasts. In many cases destruction was not achieved, but the submarine was none-the-less forced to retire for repairs.

Early depth charges were designed to be rolled into the water off of the stern of a fast ship. The ship had to be moving fast enough to avoid the concussion of the depth charge blast. Later designs allowed the depth charge to be hurled some distance from the ship, allowing slower ships to operate them and for larger areas to be covered. Depth charges can also be dropped by aircraft and even carried by missiles to their target areas.

Anti-submarine mortar

With the discovery that depth charges rarely scored a kill by hitting a submarine, but instead were most effective in barrages, it was found that similar or better effects could be obtained by larger numbers of smaller explosions. The anti-submarine mortar is actually an array of spigot mortars, designed to fire off a number of small explosives simultaneously and create an array of explosions around a submarine's position. These were often called *Hedgehogs* after the name given a World War II British design.

Torpedo

Not originally designed with submarines in mind, the torpedo was instead a weapon to target surface ships with. However, it was quickly determined that torpedoes could be improved to be able to target submarines, particularly once they were equipped with their own guidance systems, allowing them to track and home in on moving submarines. Torpedoes have become one of the main anti-submarine weapons. They can be launched by submarines, surface ships, or aircraft, and can also be delivered practically on top of the enemy submarine by an anti-submarine missile, like ASROC.

Mine

Similar to those designed to defeat surface ships, mines can be laid to wait for an enemy submarine to pass by and then explode to cause concussive damage to the submarine. Some are mobile and upon detection they can move towards the submarine until within lethal range. There has even been development of mines that have the ability to launch an encapsulated torpedo at a detected submarine. Mines can be laid by submarines, ships, or aircraft.

Anti-submarine Rocket

One of the latest anti-submarine weapons, Anti-Submarine ROCkets (ASROCs) differ from other types of missiles in that instead of having a warhead which the missiles delivers to the target directly and explodes, they carry another anti-submarine weapon to a point of the surface where that weapon is dropped in the water to complete the

attack. The missile itself launches from its platform and travels to the designated delivery point.

The major advantages of a missile are range and speed of attack. Torpedoes are not very fast compared to a missile, and are much easier for a submarine to detect. The missile allows the torpedo to enter the water practically on top of the submarine's position, minimizing the submarine's ability to detect and evade the attack. Missiles are also more rapid and accurate in many cases than helicopters or aircraft for dropping torpedoes and depth charges.

Vertical stabilizer

The **vertical stabilizer** or **fin** of an aircraft is found on its tail, generally pointing straight upward. It is also known as the vertical tail, and is part of an aircraft's empennage. The trailing end of the stabilizer is typically movable, and called the rudder; this allows the aircraft to yaw. Often navigational radios have their antennas placed on or in the vertical tail. In some aircraft, the vertical stabilizer houses the engine; the Lockheed L-1011, McDonnell Douglas DC-10, McDonnell Douglas MD-11, Boeing 727, Tupolev Tu-154, and the Yakovlev Yak-40 are all examples of this arrangement.

Types of vertical stabilizers

Conventional tail

The tail is configured vertically, and the horizontal stabilizer is directly to the empennage.

T-tail

The horizontal stabilizer is mounted at the top of the tail. In this case, the vertical must accommodate the controls and motors for pitch and trim.

Cruciform tail

Arranged like a cross, the horizontal stabilizer intersects the vertical tail somewhere near the middle.

Twin tail

Rather than a single vertical stabilizer, there are two. These are vertically arranged, and intersect or are mounted to the ends of the horizontal stabilizer.

V-tail

A V-tail has no distinct vertical or horizontal stabilizers. Rather, they are merged into control surfaces known as ruddervators which control both pitch and yaw. The arrangement looks like a V, and is also known as a *butterfly tail*.