Mohawk and Intruder

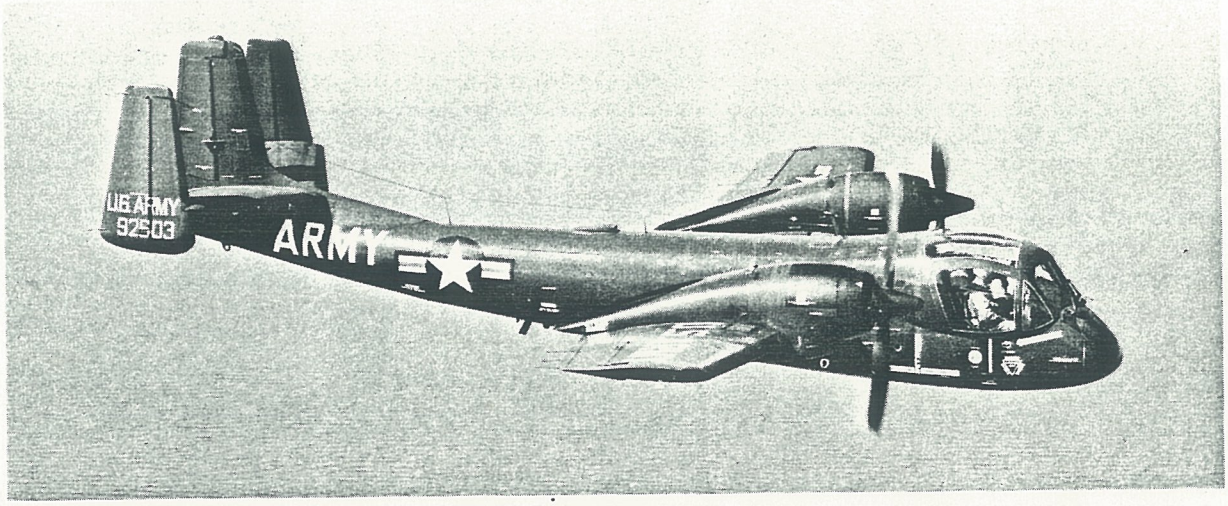
During 1956 military requirements were formulated which led to two of Grumman's most distinctive looking aeroplanes, the OV-1 Mohawk battlefield surveillance aircraft for the US Army and the A2F-1 Intruder attack bomber for the Navy. Neither would have won any prizes for elegance or good looks, but each reflected in its appearance the specialized and demanding specifications it had to meet. The Grumman G-134, as the Mohawk was designated, was the company's first design for the US Army – and the latter's first turboprop aeroplane – and was conceived to meet joint Army and Marine Corps requirements. These called for exceptional STOL performance with good low-speed control characteristics, and the ability to operate from rough forward airstrips, whilst carrying a wide range of electronic surveillance equipment for a variety of tactical observation roles.

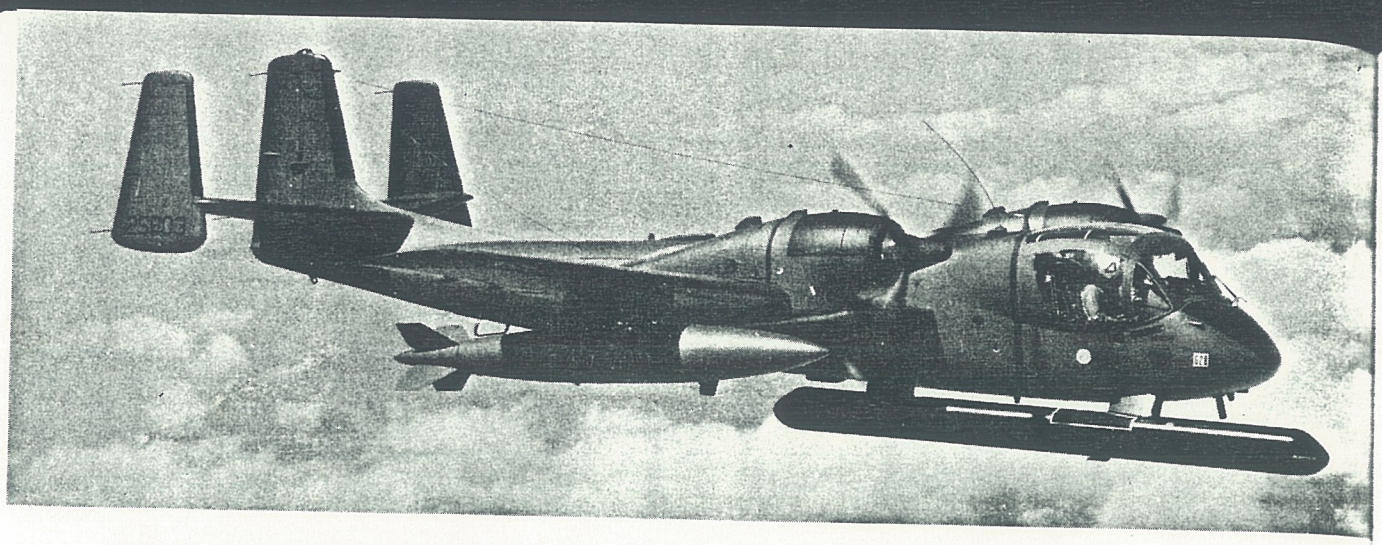
The OV-1 Mohawk

The result was an unusual aeroplane with a performance approximately midway between that of light AOP types such as the Piper L-18 Super Cub and Cessna L-19 Bird Dog and that of jet fighters. The Mohawk's crew of pilot and observer were seated side by side on Martin-Baker J5 ejection seats in a cockpit giving a very good all-round view. Triple fins and rudders and full-span leading edge slats gave good low-speed control, and, unlike the S2F Tracker and the later jet fighters, the Mohawk had conventional-size ailerons and flaps instead of spoilers for lateral control. There were forward-opening air brakes on each side of the fuselage aft of the wing.

Power was at first provided by two 1,008eshp Lycoming T53-L-3 turboprops driving Hamilton Standard three-blade, reversible-pitch propellers. Turboprops were chosen not only because this type of engine had a higher power-to-weight ratio than a piston engine and was cheaper, more reliable and simpler to maintain – very important for an aircraft operating from forward airstrips – but also because the high-octane aviation fuel required for piston engines, especially in forward battle areas, constituted a greater fire risk. Moreover, the Lycoming T53 was in widespread use in the US Army's many hundreds of Bell UH-1 Huey heli-

Below: The OV-1 Mohawk battlefield surveillance aircraft for the US Army has side-by-side seating for the crew of two, triple fins and rudders for good low speed control and Lycoming T53 turboprops, and carries cameras and surveillance equipment. This is the first production OV-1A. (Grumman)





Above: The OV-1B was equipped with APS-94 SLAR (side-looking airborne radar) in a long, torpedo-like radome under the starboard side of the forward fuselage which could produce a permanent radar photographic map of the terrain below. The wing span was increased by 6ft on this model. (Grumman)

copters. From 1962 Mohawks of all versions were equipped, both on the production line and by retrofit, with 1,150eshp Lycoming T53-L-7 or T53-L-15 engines. A fuel tank in the fuselage over the wing had a capacity of 297 US gallons, and a 150 US gallon Aero 1C drop tank could be carried under each wing.

For better downward visibility, the sides of the Mohawk's cockpit canopy were bulged. Dual controls were fitted, except when electronic surveillance equipment was carried, while removable flak curtains could be installed on the forward and after cockpit bulkheads. The main wheels retracted outwards from the wing roots into the engine nacelles, instead of inwards from the nacelles, and the nosewheel retracted backwards into the fuselage. An alternative wheel-ski landing gear was also designed for the Mohawk.

Nine YAO-1A-GR Mohawks were ordered for service tests in 1957, these being redesignated YOV-1A-GR under the 1962 tri-service arrangements. The first, 57-6463, made its maiden flight on 14 April 1959, all nine test aircraft being completed by the end of that year. The US Navy acted as the Mohawk programme manager for the Army and Marine Corps, but the Marines withdrew from the project before the first test aircraft flew and their projected OF-1 version, which would have had additional fuel tankage and provision for underwing armament, and for which four YOF-1s had been ordered, was abandoned. The nine service test aircraft each had two underwing pylons for drop tanks or up to 2,700lb of external stores, and were equipped with a KA-30 high-resolution camera system in the fuselage, together with extensive radio equipment, IFF and VOR/tacan. The production AO-1A-GR (later OV-1A-GR), of which 64 were built, was the basic visual photographic variant, with the same KA-30 or (later) KS-61 camera system in the fuselage for horizon-to-horizon coverage, and provision for a nose camera; two additional underwing pylons could be fitted. The first 18 OV-1As had a Collins FD-105 integrated flight system and some changes in radio and navaids over the YOV-1As, with provision for fitting a radar altimeter, ILS system, autopilot, doppler and other radio equipment and navaids that were installed in the nineteenth and later OV-1As. All versions of the Mohawk can carry 52 flares for night photography in each of two removable, upward-firing pods mounted above the wing roots. Two OV-1As were later modified to OV-1B standard, one of these going to the US Navy.

The OV-1A entered operational service in 1961 with units of the US Seventh Army in Germany, and started operations in Vietnam with the 23rd Special Warfare Aviation Detachment in July 1962. Two years later President Johnson's signing of the Gulf of Tonkin Resolution marked the beginning of a growing and irrevocable US commitment to the Vietnam War, and in 1964 some armed Mohawks, designated JOV-1A-GR, were operated by the 11th Air Assault Division in South-East Asia, being handed over to the 73rd Aerial Surveillance Company in 1965. Mohawks were usually unarmed, but these few JOV-1As were modified to

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have four additional underwing pylons (making six in all) for carrying light bombs, 12.7mm machine gun pods or 2.75in rocket projectiles. OV-1As, -Bs and -Cs in Vietnam were also fitted with grenade launchers, Minigun pods or small guided missiles under the wings. Yet the Mohawk played only a limited part in the Vietnam conflict, partly because its basic concept was overshadowed by the development of helicopter gunships such as the Bell UH-1 Huey family, and also because of the widespread use of ADSIDs (Air-Delivered Seismic Intruder Devices) dropped in planned patterns by F-4 Phantoms along the Ho Chi Minh Trail. These transmitted seismic information by remote control to listening aircraft for onward relaying on Viet Cong movements of men and supplies down this Trail. RPVs (remotely piloted vehicles, or small pilotless aircraft) were also used in Vietnam for battlefield surveillance.

The OV-1B-GR Mohawk, of which 100 were built, was distinguished by having APS-94 SLAR (side-looking airborne radar) in a long, torpedo-like container under the forward fuselage on the starboard side. Wing span was increased by 6ft, the fuselage air brakes were deleted, and there was no provision for dual controls. The APS-94 SLAR could produce a permanent radar photographic map of the terrain on either side of the aircraft's flight path, on either 4in×5in cut film or 70mm film strip, and an in-flight film processor enabled the observer to see a developed photographic image within seconds of the film being exposed. The -B's other radio equipment, electronics and navaids were very similar to those of the later production OV-1As. At least two OV-1Bs were transferred to the US Navy.

The OV-1C-GR, of which 129 were built, was also very similar to the later production OV-1A, but had UAS-4 infra-red surveillance sensor equipment in the underside of the rear fuselage, and single instead of dual controls; a forward-looking panoramic camera was also fitted. A number of OV-1Cs were fitted with updated electronics during 1966–67, and at the same time the wing leading-edge slats were deactivated.

Four OV-1C airframes were assigned to completion in 1967 as YOV-1D-GR service test aircraft. The OV-1D-GR, of which 37 were built, incorporated three photographic systems, a KA-60C 180-degree vertical panoramic camera, a similar KA-60C forward-looking panoramic camera and a KA-76 vertical camera. The OV-1D could also be converted from an infra-red to a SLAR surveillance capability (or *vice versa*) in an hour, by fitting the AN/AAS-24 infra-red surveillance system or the AN/APS-94D SLAR. The OV-1D thus combined in one airframe the operational capabilities of the OV-1A, -B and -C, but it also had more extensive radio equipment and navaids than earlier versions, and could carry ECM pods, flare or chaff dispensers or an LS-59A photoflash unit on the underwing pylons; furthermore, it had a strengthened landing gear, was fitted with underwing hardpoints for 'stores', and was equipped with an inertial navigation system (INS). Finally, more powerful Lycoming T53-L-701 turboprops of 1,400shp were fitted to the OV-1D, the last of which was completed in December 1970. Many OV-1Bs and OV-1Cs were converted to OV-1D standard at Grumman's Stuart plant near Miami from 1981, and a total of 110 such conversions were planned, 80 being completed during

Below: This OV-1C, 61-2706, was one of several Mohawks that carried armament on six underwing pylons; the JOV-1A was a very similar armed variant, whilst some OV-1As, -Bs and -Cs in Vietnam also carried underwing ordnance. (Grumman)

1981–82. A dozen OV-1Bs were also modified to become RV-1D-GR tactical reconnaissance variants for 'elint' (electronic intelligence gathering).

The OV-1E-GR was a projected version of the OV-1A Mohawk with a modified forward fuselage to accommodate a large cabin aft of, and integral with, the cockpit, for advanced electronic surveillance duties, crew proficiency training or cargo transport; SLAR radar or infrared surveillance equipment could have been fitted, but the OV-1E was not built. Sixteen OV-1Bs were in fact converted for 'elint' duties as EV-1E-GRs, with AN/ALQ-133 'Quick Look II' surveillance radar, a ventral radome and wing-tip radar pods, plus various equipment changes. Early in 1976 two EV-1Es were supplied to the Israeli Defence Force/Air Force for the 'elint' and battlefield surveillance roles, equipped with SLAR pods.

The A-6 Intruder

In 1956 the Navy issued a requirement for a low level, long-range, carrier-based attack aircraft able to deliver nuclear or conventional weapons on to small targets completely obscured by weather or darkness. This requirement reflected Korean War experience and called for a high subsonic performance, at tree-top height so as to fly under the enemy's radar, and a heavy weapons load. The design contest, which lasted from May to December 1957, involved eleven submissions from eight companies, and on 31 December that year Grumman's G-128 proposal, to be known as the A2F-1 Intruder, was judged the best. It became the subject of the Navy's first 'cost plus incentive fee' contract in March 1959 when four of eight YA2F-1 (later YA-6A and A-6A) development aircraft were ordered. The first of these made its maiden flight on 19 April 1960, quickly followed into flight status by the remaining seven YA2F-1s.

The high/mid-wing Intruder was designed around two 8,500lb s.t. Pratt & Whitney J52-P-6 'straight' turbojets mounted side by side in the fuselage, the jetpipes of which were arranged to be swivelled downwards hydraulically through 23 degrees on the first four YA2F-1s, to shorten the take-off run by deflected jet thrust. The other four YA2F-1s had the jetpipes fixed and angled downwards, although there was provision for swivelling them, and production Intruders had them permanently angled downwards at 7 degrees. The fuselage was area-ruled, although the aircraft was designed to be subsonic, and an unusual feature in a machine of this category was that there was no internal weapons bay. Nevertheless, up to 15,000lb of external stores could be carried under five weapons attachment points, four under the wings and one under the fuselage, each of these points having a load capacity of 3,600lb. Up to thirty 500lb bombs could be carried in clusters of three, or four Martin AGM-12B Bullpup air-to-surface missiles, or two Bullpups and three 2,000lb bombs.

The absence of a weapons bay made possible a slim, tapering fuselage and a very compact airframe. The Intruder's wing span is actually 1ft less than the Avenger's but the maximum take-off weight of the A-6E – 60,400lb – is much more than twice its own empty weight and nearly four times the maximum weight of the TBF-1 Avenger. Unlike the Royal Navy's similarly sized Blackburn Buccaneer, the Intruder does not use supercirculation or flap-blowing techniques to make possible a smaller wing. The crew of two, pilot and bombardier/navigator, are seated side by side on Martin-Baker GRU5 ejection seats under a rearward-sliding canopy. The seats can be reclined to reduce fatigue during low-level operations, and the bombardier/navigator (B/N) is seated to starboard slightly behind and below the pilot. He controls the very comprehensive navigation, radar and attack systems which are integrated into the DIANE (Digital Integrated Attack Navigation Equipment) system, and an integrated display enables the pilot to 'see' the target and geographical features at night or in bad weather by means of two viewing screens in the cockpit.

The wings are swept back 25 degrees at the quarter-chord line, and feature almost full-span leading-edge slats and trailing-edge flaps to give excellent slow-flying qualities. Instead of ailerons for lateral control there are inset spoilers (or