

PA BELL

The little chopper that did

BY EDWARD G. TRIPP

Most people know the Bell 47 on sight, even if they do not know the name of the manufacturer or the model designation. To many people, it has been the helicopter personified in much the same way the Piper Cub represented general aviation to millions of people. Even little children watching *M*A*S*H* reruns know it.

The first version was built in 1945, and there are many flying yet today. Some are greatly modified, including those converted to turbine power.

A significant number of young men had their first helicopter ride in 47s, living out the scenes their children and grandchildren watch on television, as war casualties in Korea. Theirs was not the best introduction to rotary-wing flight, injured as they were in the gritty half-war that too few recognize as the prelude to Vietnam. But that ride decided life or death for thousands. A Bell spokesman has stated that 80 percent of front-line evacuations in Korea were flown by Bell H13 and HTL military versions of the Model 47.

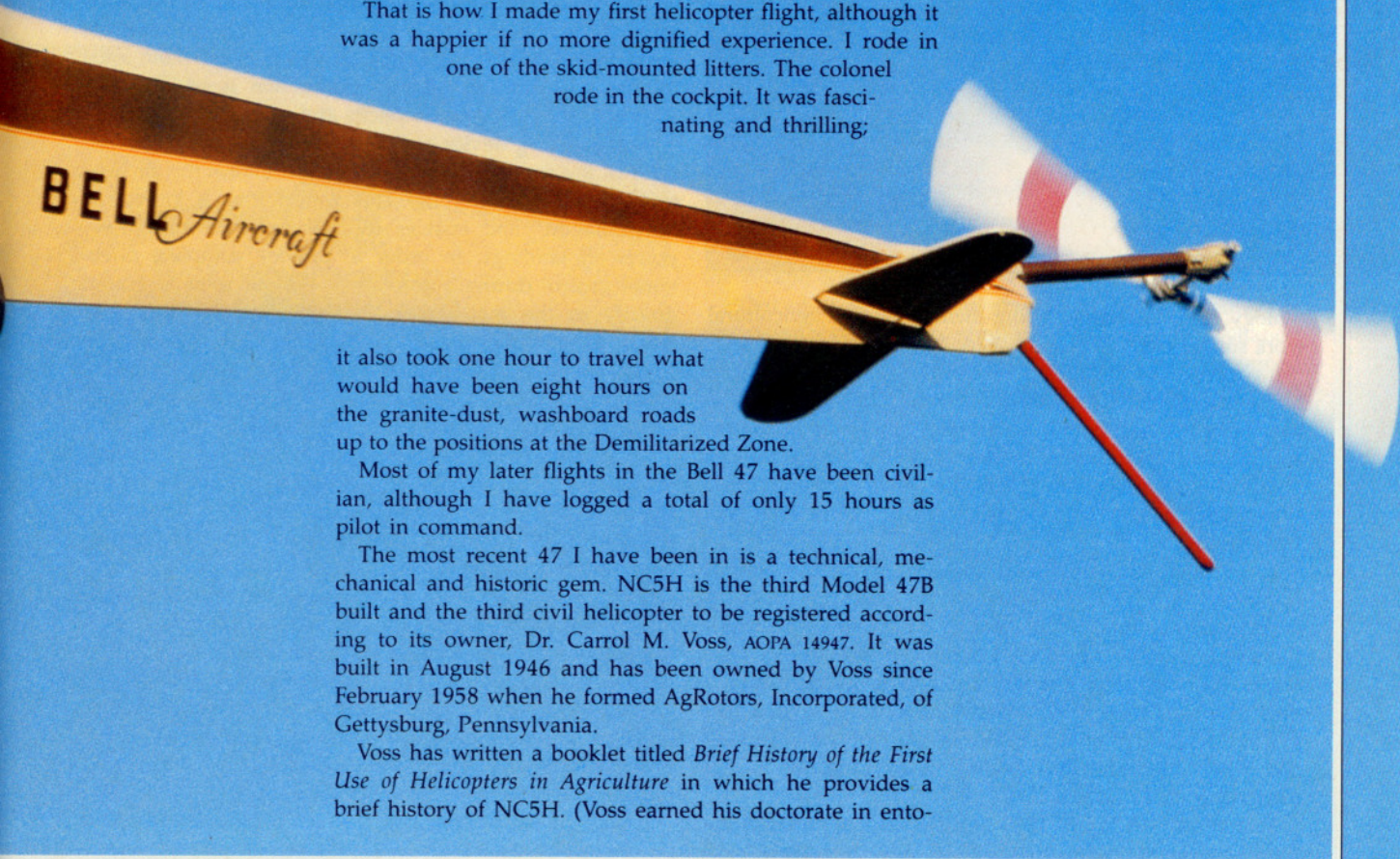
That is how I made my first helicopter flight, although it was a happier if no more dignified experience. I rode in one of the skid-mounted litters. The colonel rode in the cockpit. It was fascinating and thrilling;

it also took one hour to travel what would have been eight hours on the granite-dust, washboard roads up to the positions at the Demilitarized Zone.

Most of my later flights in the Bell 47 have been civilian, although I have logged a total of only 15 hours as pilot in command.

The most recent 47 I have been in is a technical, mechanical and historic gem. NC5H is the third Model 47B built and the third civil helicopter to be registered according to its owner, Dr. Carrol M. Voss, AOPA 14947. It was built in August 1946 and has been owned by Voss since February 1958 when he formed AgRotors, Incorporated, of Gettysburg, Pennsylvania.

Voss has written a booklet titled *Brief History of the First Use of Helicopters in Agriculture* in which he provides a brief history of NC5H. (Voss earned his doctorate in ento-



PA BELL



mology and has been flying helicopters in agricultural work since 1949.)

It was used by Bell as a demonstrator until April 1951; it had accumulated 504 hours at that time. Chicago Seaplane Base bought it and flew it for another 726 hours in charter and training applications. It then was sold to the Energy Equipment Company in Monticello, Iowa, in June 1957. When Voss bought it from that company, total time was 1,274 hours.

To be legal for agricultural uses, Voss had the aircraft converted to 47D-1 configuration. It spent the next 14 years in agricultural work, charter operations and flight training (AgRotors still does a significant amount of helicopter training, from primary to crop spraying, using a fleet that runs from a Robinson R22 through several Bell 47s and Hiller 12s to Hiller-Soloys—turbine conversion—and a Bell 206 JetRanger). During its working life, NC5H traveled as far as Liberia.

Voss retired NC5H in 1972 and decided to preserve the

helicopter and restore it to its original configuration as a "cabin class" Model 47B. The task was consigned to Versatile Helicopters, Incorporated, of Ardmore, Oklahoma, and was completed in late 1982.

One of the highlights of the restoration of NC5H was the visit paid to AgRotors by Joseph Mashman, one of helicopter aviation's true pioneers. Mashman joined the helicopter development team at Bell in 1945 after a stint as a fighter test pilot for Bell Aircraft. He flew NC5H during his visit, but his first flight in it was made when it rolled out of the factory.

Mashman was one of hundreds of pioneering helicopter pilots who visited the aircraft and its cousin, a 1947 Model 47D, N150B (serial number 70) that also is owned by Voss and restored to its original state, at the 1982 Helicopter Association International convention.

The guest book from that exhibit contains a who-was-who in helicopter operations in the early days.

N150B, which Voss purchased in 1981, has been loaned to the Mississippi Agriculture and Forestry Museum as part of a display of agricultural aircraft.

At first sight, NC5H looked like a cross between a cartoon character and a 1947 sedan. Legend has it that Lawrence D. Bell wanted the Model 47 to appeal to non-pilots and required a cabin configuration with doors large enough and cabin high enough to enable a gentleman to get in without having to remove his hat. Even a top hat.

The description of the aircraft that appears in the 1947 *Erection and Maintenance Instructions for Bell Model 47B Helicopter* is engaging:

"1-1. Description.

1-2. GENERAL. The model 47B is a two-place, single-engine helicopter with a two-blade rotor and an exclusive stabilizer bar. A two-blade controllable pitch tail rotor affords precise directional control and counteracts main rotor torque. Welded steel tubing construction is used in the body and tail boom for simplicity and ease of maintenance. A free-wheeling device in the transmission disengages the rotor in the event of engine failure and allows the air flow to keep the rotor turning. This windmilling is known as "autorotation" and enables the helicopter to make safe, power-off landings. In order to provide complete directional control during autorotation, the tail rotor is geared directly to the main rotor. A four-wheel landing gear, equipped with shock struts and low pressure tires, insures comfortable landings. Full swiveling front wheels facilitate ground handling. For protection in case of a tail-low landing, the tail rotor is protected by a tail skid.

"The attractively styled cabin is entered on either side through large hinged doors. It is equipped with two softly upholstered seats arranged side by side and fitted with safety belts. Windows in the doors are easily opened or closed to control ventilation. These features, combined with ample leg and head room, assure the utmost of comfort. As a result of unusually large areas of plexiglass, there is exceptionally good visibility in all directions. A quick-release mechanism on each door permits easy removal and also provides a means of emergency egress. For the storage of small articles, a glove compartment is located to the left of the instrument column. Adequate luggage space is provided aft of the engine compartment."

Except for the metallic paint, which we irreverently have



Restored and airworthy, NC5H is the sole surviving 47B in original form still flying; Pa Bell, indeed.



dubbed "Hudson Hornet Bronze," and slight variations to the original striping, NC5H looks much as it did when new. In fact, the least airworthy appearing equipment are the tires. According to Voss, they are hard to find. Suitable alternatives fit the rims, but do not look right.

Perhaps the biggest drawback to the 47B is the cosmetic touch of covering the airframe. It makes post and preflight inspections and normal maintenance a bit more work-intensive. For this reason and to increase useful load, most operators stripped off most of the panels and fairings.

The panel and cockpit arrangement are quite in keeping with more modern light helicopters, and visibility out of the cockpit is quite good.

What most surprised me about the aircraft when I was discussing a visit to photograph NC5H was Voss' invitation for a group of us to "come up and fly it." It is maintained in airworthy condition, the sole surviving early Bell, at least in original form.

I will not claim to have flown Voss' treasure. I merely followed him through. On engine start, the old six-cylinder Franklin roared just like a new air-cooled, opposed aircraft powerplant. All the pre-takeoff checks were quite similar to later variations of the 47 I have flown except for the hydraulic boost check. There is none on the B and subsequent models up to later versions of the G.

The hydraulic boost dampens out feedback through the controls, particularly the cyclic control. Flight without it heightens your appreciation for the skill and endurance of early helicopter pilots, particularly in lighter aircraft. Stories of pilots flying eight and nine hours a day in the earlier ships with undampened controls make them seem like supermen. When you add the noise and vibration and

the tight conditions in which so many operations were conducted, it convinces you they were supermen.

Insurance underwriters as recently as the early 1960s had a rule of thumb for approving pilots for commercial operations. They looked for at least 1,000 hours rotary-wing experience on the theory that if a helicopter pilot had survived that long, he had encountered practically every hazard, from tail rotor and engine failures to tail strikes and ground resonance and had figured his way out. (Ground resonance is the sympathetic vibration between the rotor blades and rotor wash off the ground during low hover or with one skid or wheel on the ground that could—and did—beat the machine to pieces in short order.)

Voss and I flew NC5H for just a few minutes. It was enough to leave me with a mixture of increased admiration for the men who figured the solutions to the many problems of making a helicopter work and those who flew them and proved the value of the concept, and recognition of how right the configuration of main rotor, stabilizer bar, tail rotor and controls that Young and Carlson and the rest of their team devised (see "Wright Was Wrong," p. 96). So much of it remains fundamentally unchanged to this day. Most of all, I was thrilled to make that brief flight in such a rare element of aviation history. □

WRIGHT WAS WRONG

But Sikorsky and Young were right.

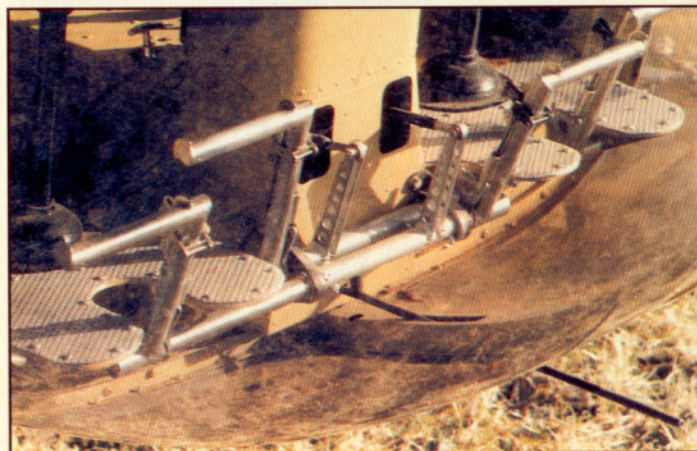
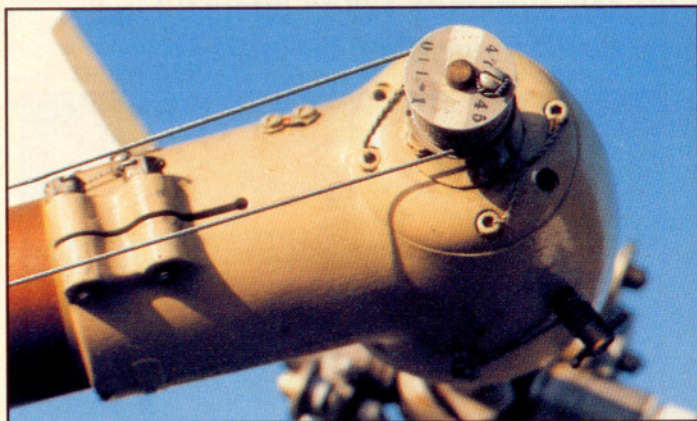
If you include the doodles of Leonardo da Vinci, dreamers and inventors have worked to solve the problems of vertical flight for more than 400 years. Less than 50 years ago, practical solutions were just being devised and tested.

The Wright brothers had played with helicopter toys as children, but Wilbur was quoted as saying that, despite the fact it was easier to design and build than a fixed-wing aircraft, the helicopter was worthless. This was the largest aeronautical error they made.

Events have proved that attitude wrong, but it took the thought, effort, money and failures of many people before the complex problems of vertical lift aircraft could be solved. As the solution was finally worked out and the several problems of stability and control were being resolved, the helicopter emerged as a competing collection of apparently mutually exclusive requirements. It is a machine of high complexity that needs to be of minimum empty weight to do any useful work, yet, because of the variety of moving parts, the need for durability and the high levels of vibration, demands weight.

Igor I. Sikorsky made the first successful flight of a helicopter in his VS-300 on September 14, 1939. A year before, a lecture he gave helped a young inventor to develop the line of thinking that resulted in the world's first commercial helicopter, the Bell 47B.

Arthur M. Young was still working on his own at that stage, methodically pursuing research and experiments begun 10 years earlier. When Young listened to Sikorsky's





The Bell paid for its capabilities in complexity, but it also proved that the benefits were worth the costs.



presentation at the first Rotary Wing Aircraft meeting in 1938, he was trying to simplify his approach to controllable rotary-wing flight. He readily accepted Sikorsky's ideas on the use of a vertically mounted tail rotor to counteract the torque effect of the main rotor.

Young was experimenting with hinged rotors to deal with unequal lift produced by the blades when in flight. Another problem he addressed in a series of test flights with models (the first flew in 1931) was stability. His final solution was a stabilizer bar mounted below and perpendicular to the main rotor. Young achieved hovering flight successfully for the first time in his many attempts (and many models) at the end of the decade.

His strategy was to prove his concepts, then look for backers. Young had noticed several failed attempts that he ascribed to designers who looked for funding for their ideas before they were proven, only to see the backing disappear at the first failure. He was aided by the fact that he had sufficient independent income to fund his experiments.

Despite his design progress and demonstrated accomplishments, he was unable to interest aircraft companies until a friend mentioned his flying model helicopter during a business meeting at Bell Aircraft Company in Buffalo, New York. The net result was a demonstration to a group of Bell engineers on September 3, 1941, followed by a meeting with Lawrence D. Bell, founder of the company and the visionary who enabled Young and a handful of colleagues to develop Young's design.

The Bell Helicopter Company started in earnest in the garage of an old Chrysler dealership in Gardenville, New

York, about 10 miles from the main plant. The initial work force of 15 included Bartram Kelley, who had started as Young's apprentice in 1931 and retired as senior vice president of engineering of Bell Helicopter Textron in 1974.

In December 1942, the first Model 30, christened *Genevieve*, was rolled out. Young made the first attempts at tethered flight behind the shop. High vibration was a problem, particularly in windy conditions. And then the aircraft was damaged by a Bell executive who insisted on trying to fly.

After that, Floyd W. Carlson, a Bell test pilot, joined the program and did the bulk of the flying from then on, including the first free flight on June 26, 1943. Carlson developed the profile for helicopter flying, including autorotation technique, as he learned.

Three Model 30s were built; the last was in effect the prototype for the Model 47 and the first to feature a blown-bubble canopy. It became a hero in two rescue missions flown by Carlson in 1945. In January, a Bell test pilot had to parachute from a damaged airplane. Injured, he made his way to an isolated farmhouse. Carlson took off in poor weather, landed on a road near Lockport to pick up a doctor and flew him to the farm to attend to the pilot. In March, Carlson rescued two fishermen stranded in Lake Erie when the ice began to break up. The ice was too thick

WRIGHT WAS WRONG

for a boat to get through yet too weak to be crossed by even a sled. Carlson made two trips, again in marginal weather, to get the men.

A small team was selected by Bell to pursue helicopter development and production rather than have part of its huge engineering staff take over. It moved to Bell's new main facility in Niagara Falls in June 1945 and began work on the Model 47.

Six months later—on December 8, 1945—the first aircraft was rolled out. The company committed to a production run of 10 units.

At the time, Bell was in a race with Sikorsky to win certification for the first production helicopter in the world. Bell won. The 47 received its certificate on March 8, 1946. Bell also started a flight-training school that year, and in April 1947, the Model 47 was approved for night flight.

In December 1946, the first civil delivery was made, at the same time that the first military sale occurred, to the U.S. Army. In April of the following year, 13 Model 47s were delivered to the Air Force and the Navy. Altogether, there were 2,600 civil and 2,400 military units sold during the Model 47's 27-year production run, which ended in 1973. Although there were 20 key variations of the model,

BELL 47B

List price \$25,000 (Includes Hallicrafter Corporation CA-2 Skyfone communications receiver/transmitter and dual controls)

Specifications

Powerplant Air-cooled Motors Franklin 6V4-178-B3, six cylinder, 335 cubic inches, 178 hp @ 3,000 rpm

Rotor systems

Main Two blade, 35 ft 1.5 in dia

Tail Two blade, 5 ft 8.13 in dia

Length 41 ft 2.57 in dia

Height 9 ft 4 in dia

Main rotor blade area 35.34 sq ft

disc area 965 sq ft

Tail rotor blade area 2.4 sq ft

disc area 25.31 sq ft

Power loading 12.36 lb/hp

Seats 2

Cabin length 2 ft 9.25 in

Cabin height 4 ft 4 in

Cabin width 4 ft 3 in

Empty weight as tested 1,501 lb

Gross weight 2,200 lb

Useful load 699 lb

Payload with full fuel 501 lb

Fuel capacity 198 lb/33 gal

Oil capacity 18 lb/3 gal

Baggage capacity 40 lb

Performance

Takeoff distance,

hover in ground effect 0 feet

Rate of climb, sea level 715 fpm (est)

Hover ceiling

In ground effect 4,800 (est)

Out of ground effect 2,000 (est)

Service ceiling 11,000 (est)

Max level speed, sea level 80 kt (est)

Cruise speed/Range, no reserve,

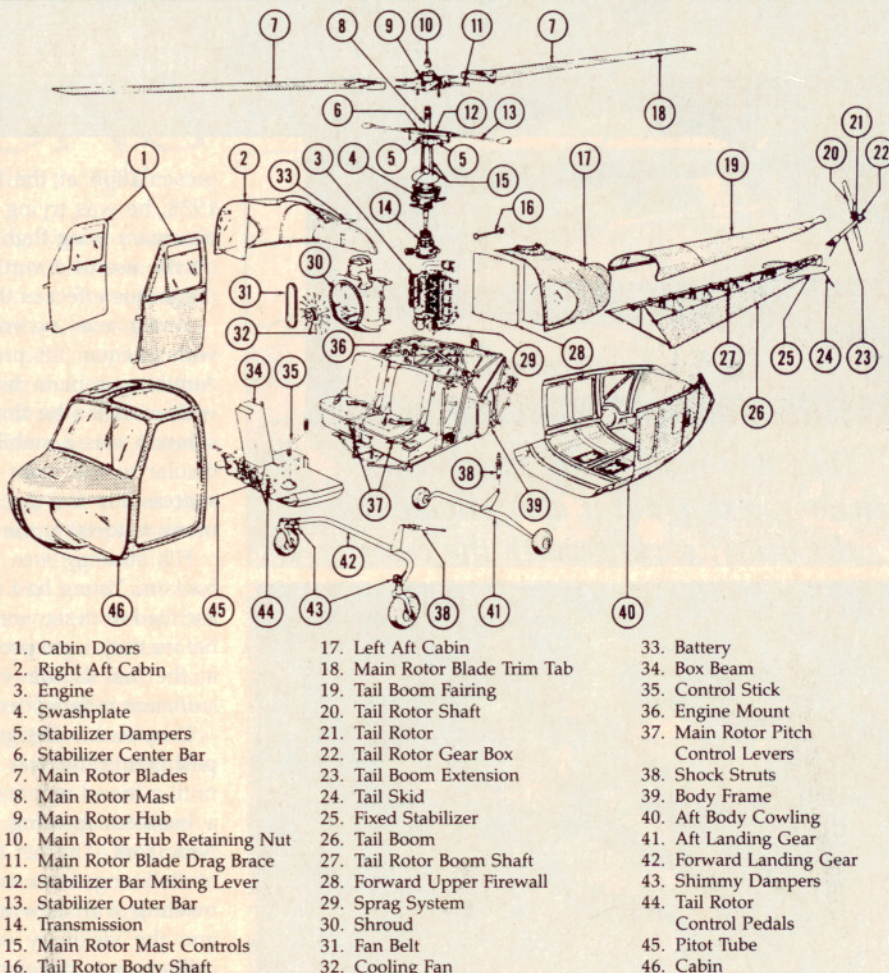
@ 75% power, sea level 74 kt/184 nm

All specifications are based on manufacturer's

calculations. All performance figures are based

on standard day, standard atmosphere, at sea

level and gross weight, unless otherwise noted.



The exploded view of the aircraft with labeled parts is shown as it appears in the 1947 *Erection and Maintenance Instructions for Bell Model 47B Helicopter*.

only two—the 47G-2 and the 47G-3B-1—had a production run of more than 300 units.

There were many milestones in the life of the Model 47. But the most significant fact of its long life is that it is the helicopter that made the dream a reality. It made rotary-wing aircraft a part of civil aviation around the world. And it proved the value of the concept in regular operations to the military.

In a report to the President's Air Policy Commission dated September 22, 1947, Lawrence Bell stated that further development of the helicopter needed government interest and support. By that time—nine months after the first delivery—the 47 fleet had logged more than 8,000 hours of operation.

By 1950, the relative trickle of commercial helicopters had demonstrated its unique capabilities, flying a variety of special missions that remain the most recognized strengths of rotary-wing aircraft to this day: power and pipeline patrol; law enforcement; a variety of agricultural and forestry missions from dusting and seeding to frost protection and fire fighting; movie camera platforms; news media and executive express; and daring rescue operations.

The almost total special-mission application of the helicopter was enforced by the combination of high capital and maintenance cost relative to fixed-wing aircraft, low payload capability, high noise and vibration and limited utility due to the inability to fly in bad weather.

But despite the quickly accumulated record of utility, the company's investment was returned slowly. By the end of 1950, only 175 aircraft had been sold. In the less than five

years between start of the program and certification, the company had invested \$5 million, more than one million manhours of engineering and labor and 4,000 hours of flight testing.

Commercial helicopter sales were depressed, but the fortunes of Bell Helicopter were improved greatly by the invasion of South Korea (the Republic of Korea) by North Korean forces on June 25, 1950. The military Model 47s principally operated for search and rescue by the Army and Marine Corps and for medical evacuation from the battlefield to Mobile Army Surgical Hospital (MASH) units. Helicopters are said to have rescued 25,000 soldiers and civilians during the Korean War. The recognition of the importance of time to saving lives was turned into a routine mission in Korea. And the lessons learned there led to the development of civil medical evacuation helicopter operations that are a significant factor in saving lives throughout the United States and other countries today.

The value of the light helicopter in the Korean War also led to development contracts that sped the development of larger aircraft and of turbine-power for helicopters.

In 1951, Bell moved the helicopter operation to Fort Worth, Texas, where more milestones were set. On April 10, 1953, the 1,000th Model 47 rolled off the line. On October 20, 1954, the XH-13F, the first turbine-engine helicopter flew. On August 11, 1955, the XV-3 convertiplane, forebear of the Bell XV-15, flew for the first time.

Lawrence D. Bell died on October 20, 1956. The company he founded continues as Bell Helicopter Textron, Incorporated. —EGT

BELL 47 SPOTTER'S GUIDE

The Experimental Model 30 was the proof-of-concept predecessor to the Model 47. Three aircraft were built.

The first, NX41867, was an open cockpit, single-seat helicopter powered by a vertically mounted, six-cylinder Franklin engine rated at 160 hp. This was the first full-scale, flying application of Arthur M. Young's stabilizer bar. NX41867 was rolled out in December 1942 and began a series of tethered flights. Floyd W. Carlson was the principal pilot. His experiences and recommendations led to the development of a vibration-reducing brace to the mast and the cyclic control. The first untethered flight was made on June 26, 1943.

The second aircraft closely resembled the Model 47B. NX41868 had a fully enclosed cabin and two seats. It was the first helicopter in the free world to fly indoors as a demonstration of controllability and stability.

The third Model 30, NX41860, was the first helicopter to feature the blown-bubble canopy and was basically the prototype Model 47. All three had conventionally arranged wheel landing gear.

The first Model 47 was rolled out on December 8, 1945. The two-place helicopter featured an enclosed cabin similar to that of the second Model 30, but had a four-wheel gear with fully swiveling, self-castering for-

ward wheels. The aft wheels were fixed. It was powered by a six-cylinder Franklin 6ALV-335 rated at 178 hp. It was granted the first civil helicopter license on March 8, 1946. All the early helicopters had wooden rotor blades with metal leading edges.

In late 1946, the 47B and 47B-3 models were introduced. The 47B was the first production version. A variant, Model 47A, was



The first of three experimental Model 30s, NX41867 was the first full-scale flying application of Arthur Young's stabilizer bar.

sold to the U.S. Army, the Air Force and the Navy early in 1947. Initial price was \$25,000. The B-3 had an open cockpit that could be converted to a full bubble and was the first helicopter approved for agricultural applications.

The 47D also featured a full bubble canopy, plus doors to enclose the cabin fully, particularly for crop dusting. It was introduced late in 1947. The next year the price was increased to \$39,500. Major overhaul periods were increased from 100 to 300 hours; by a major change in the transmission—the use of roller bearings—time between overhauls was increased from 50 to 1,000 hours.

The Model 47D-1 was introduced in 1950. It featured several improvements, including an optional 200-hp Franklin engine. The first skid gear was another option, and there was no fuselage covering to reduce weight and increase useful load. The company also announced a price reduction: The 178-hp version with skid gear listed for \$21,950.

A major improvement was made on Model 47G, which was introduced in 1953: A small elevator was added to permit an increase in permissible CG travel and to greatly improve stability by working in conjunction with the rotor tilt.

Experimental Model 47G-1, built in 1954,

was a four-seat, fully enclosed version of 47G and was powered by a 280-hp Turbomeca Artouste turbine engine. Only one was built, and the design never went into production.

A 1955 development of 47G, 47G-2 is also a three-seat utility model, but it is powered by a 260-hp Lycoming VO-435 engine. Introduced in 1955 as Bell's first executive helicopter, Model 47H Bellairus is the deluxe version of 47G. It has an enclosed cabin that accommodates a pilot and two passengers on an automobile-type cross seat. Special features on the Model 47H Bellairus include soundproofing, leather uphol-

stery and an enclosed baggage compartment.

Another 1955 development of 47G, Model 47J Ranger is a four-seat utility version. An enclosed cabin seats the pilot centrally in the front with three passengers on a cross bench aft. This model features a removable passenger seat to allow for two stretchers on a parallelogram rack or space for up to 650 pounds of cargo. It is powered by a 260-hp Lycoming VO-435 engine. Bell first offered metal rotor blades as an option with this model.

Model 47G-3 Trooper is a 1960 development of 47G-2 with outstanding high-altitude performance. It is powered by a 225-

hp Franklin 6VS-335 engine. This model was modified that same year to become Model 47G-3B, powered by a 260-hp Lycoming TVO-435 engine.

A more streamlined modification of 47J, 47J-2 was introduced in 1960 with a 305-hp Lycoming engine and metal rotor blades.

A three-seat utility model, 47G-2A, followed in 1961. It is distinguished by an extended tail boom and larger rotor system and is powered by a 240-hp Lycoming VO-435 engine. A 1961 development was the 47G-2A-1, modified with a widened cabin and increased fuel capacity.

The Model 47G-3-B became the 47G-3B-

BELL 47 SPOTTER'S GUIDE

Model 47 (1945)



47J Ranger (1955)



47B-3 (1946)



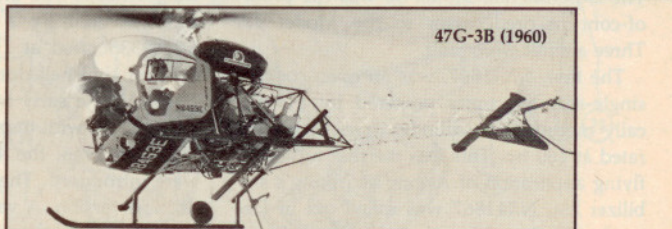
47G-3 Trooper (1960)



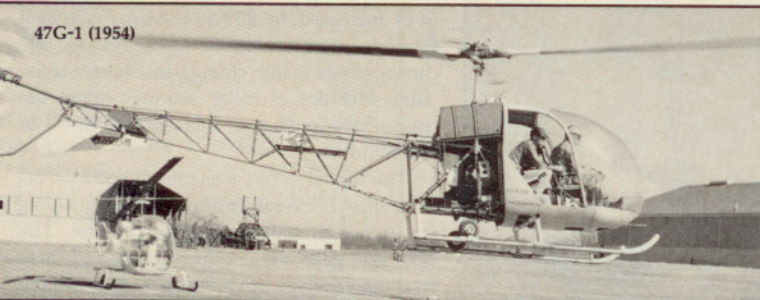
47D (1947)



47G-3B (1960)



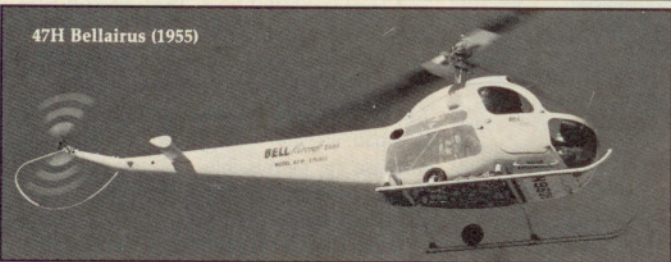
47G-1 (1954)



47J-2 (1960)



47H Bellairus (1955)



47G-2A (1961)



1, in 1963, with a 270-hp Lycoming TVO-435-B1A turbosupercharged engine, a wider cabin and increased fuel capacity.

Model 47G-4 Trooper is a 1964 version with a 305-hp Lycoming VO-540 engine. Model 47J-2A Ranger, introduced in 1965, is a four-seat version of 47G-4 offering utility or deluxe furnishings.

A low-cost, three-seat utility model, 47G-5, was introduced in 1965. Nonessential structures and components were eliminated in this model to reduce initial price and increase maximum useful load in much the same way as the 47D-1 of 1950. Model 47G-5 is powered by a 265-hp Lycoming

VO-435 engine. Model 47G-Ag-5 is a two-seat agricultural version of the 47G-5 and also was introduced in 1965.

In 1968, the 47G-3B-1 became the 47G-3B-2 and is powered by a 280-hp Lycoming TVO-435-B1A supercharged engine.

Many of the commercial models listed above were modified in various ways and given military designations. During the 27 years of production of the 47 series, 2,600 helicopters were manufactured for commercial use and 2,400 were delivered to the U.S. Army, Navy, Air Force and Marines, as well as to the armed forces of many foreign nations.

—Erin L. Harman

47G-2A-1 (1961)



47G-3B-1 (1963)



47G-4 Trooper (1964)



47J-2A Ranger (1965)



47G-Ag-5 (1965)



47G-3B-2 (1968)

