MANUAL MOONEY

Manual flap, gear and turbocharging add performance to the low-maintenance systems of an older Mooney.

BY MARK TWOMBLY

You can tell when a pilot has not yet mastered a Mooney manually operated landing gear: After takeoff, the wheels will start to retract, then hang in trail while the pilot tries to wrestle the handle down to the floor. As the struggle in the cockpit unfolds, the airplane begins to porpoise because the pilot unconsciously hauls back and forth on the control yoke for leverage. You can tell when a pilot has perfected the technique: The gear disappears into the wheel wells in an instant. In experienced hands, the Mooney manual gear may be the fastest there is.

The manual gear was last used on the M20E Super 21, a model that bridged the simplicty of first-generation Mooneys and the all-electric, higher-horsepower sophistication of later versions. The maturing process that has seen the four-place Mooney M20 evolve from wooden to metal wings, from 150 horsepower to 210 turbocharged horsepower and from a short cabin to a stretched fuselage also claimed the simple, rugged Mooney manual landing gear system.

The Super 21, introduced in 1964 and withdrawn just three years later, was the first Mooney to have a 200-hp, fuel-injected engine and the last to incorporate manually operated retractable landing gear and a mechanical/hydraulic flap system. The original four-place M20 Mooney, which appeared in 1955, was powered by a 150-hp Lycoming O-320. Mooney switched to a 180-hp Lycoming O-360 in 1958 with the introduction of the M20A, and continued to offer 180-hp models through 1978. An electrically actuated landing gear was first offered as an option in 1965 and became standard in 1969. That year, electrically actuated flaps replaced the hand-pumped hydraulic flap extension system.

There were 1,264 Super 21s produced

PHOTOGRAPHY BY ART DAVIS

from 1964 through 1967. Sales dropped off drastically in 1967, the first full year of production for the M20F Executive. The Executive had the same Lycoming IO-360-A1A engine as the Super 21, but was 10 inches longer, held more fuel and had a higher gross weight. Mooney did not build any Super 21s in 1968, but in 1969 the M20E was reintroduced with electric gear and flaps, a new instrument panel and power quadrant and a new name: the Chaparral. The short-cabin Chaparral and long-cabin Executive were co-produced until the Chaparral was retired in 1975. Mooney undertook an extensive aerodynamic clean-up of the Executive during 1976, and the following year introduced the model M20J, or 201. With no more horsepower than the Executive, the 201 was 19 knots faster and much more attractive. The last of the Executives was sold in 1977.

Although not difficult to operate, the Super 21's manual gear does require some effort on the part of the pilot. It also takes up all of the space between the two front seats, and space is a valuable commodity in Mooneys. The system uses a direct mechanical linkage between the long handle in the cockpit and the welded steel-tube gear legs. To raise the gear, the pilot depresses a safety latch at the base of the instrument panel, slides the gear handle grip down to free the bar from its down-lock, and pivots the handle down between the seats until it locks into place.

Mechanically raising and lowering the gear does take a lot more effort than flipping an electrical switch. The secret to operating the gear is to rotate the handle in one brisk, uninterrupted motion. Springs in the wings and fuselage take most of the aerodynamic loads and weight off the gear handle. Once the handle has moved through about half its arc, the springs take over and the rest is easy. With a little practice, the gear can be retracted or lowered in less than two seconds. Proponents of the manual gear say it is difficult to forget to lower the gear because the handle is so prominent.

Extending the flaps is a two-step operation. First, the pilot pushes down on an airfoil-shaped flap-position switch on the panel to close off the flap hydraulic system. Next, a stainless steel flap handle, located just to the right of the gear handle, is pumped (twice for the takeoff setting of 15 degrees, and four-and-a-half times for full flaps). Pumping the handle moves a cylinder that pressurizes the hydraulic system and forces the flaps

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Pump the flaps down, muscle the gear up—operating the system takes a lot of work.

to extend. When the position switch is returned to Up, springs and air pressure slowly retract the flaps.

The manual labor required to operate the gear and flaps is more than offset by the reliability of the simple systems. Both systems have a reputation for inexpensive and infrequent maintenance, but overhaul kits for the flap system no longer are available. Mooney Aircraft has an electric retrofit kit for the manual flap system that costs $632 and takes an estimated 20 man-hours to install.

The Super 21 featured in these photographs was manufactured in June 1964 and initially was used by Mooney Aircraft as a model for publicity photographs and as an experimental prototype to test changes that were officially introduced in the 1965 model year. It was the first Mooney equipped with a new squared-off window and a Brittain Industries, Incorporated, wing-leveling device called Positive Control (PC).

Pneumatic pressure supplied by the engine-driven vacuum pump powers servos linked to the ailerons and rudder. The single-axis (roll) autopilot is engaged as long as the engine is running, but the pilot can momentarily override the wing-leveler by depressing a button on the control yoke. PC was standard equipment on the Super 21 beginning in 1965. Some pilots found the PC annoying when maneuvering and devised ways to disconnect it. The system also had to be well maintained, since pinhole leaks in the pneumatic servos would cause sluggish performance.

Dr. Paul M. Straub, AOPA 467411, of Rolling Hills, California, bought N300MD in 1970. (Straub changed the original registration number from N7121U to N300MD.) When the Mooney's engine was overhauled in 1975, Straub had a Rajay turbocharger kit installed. The turbocharger enables the Lycoming IO-360-A1A engine to develop maximum continuous power to 20,000 feet, according to Century Aircraft Corporation (Post Office Box 31026, Amarillo, Texas 79120), which manufactures and markets Roto-Master, Incorporated, (formerly Rajay) turbocharger kits for a variety of piston singles and twins. The wastegate valve is adjusted manually with a large vernier control partially hidden between the bottom of the instrument panel and the top of the nosewheel well.

There are a few caveats that must be heeded to avoid overboosting the engine. The aircraft is placarded against operating the turbocharger below 3,500 feet. From 3,500 to 12,000 feet, there is a three-minute limit on use of takeoff power, which is 28.5-inches manifold pressure and 2,700 rpm. Maximum continuous power to 20,000 feet is 27 inches and 2,500 rpm, and from 20,000 to 25,000 feet the limits are 25 inches and 2,500 rpm. The pilot must apply full throttle before engaging the turbocharger and open the wastegate during descent to prevent overboosting as the air becomes more dense.

The flight manual supplement for N300MD does not contain performance charts for altitudes above 15,000 feet, where the turbocharger is most productive. Specifications published by Century Aircraft Corporation claim that a turbocharged Mooney M20E has a critical altitude of 16,500 feet, a service ceiling in excess of 30,000 feet and will cruise at 195 knots at 20,000 feet and 75-percent power. At 12,000 feet and 75-percent power, it should cruise at 174 knots, and, at 10,000 feet, 168 knots, according to Century.

We did not have the opportunity to test the high-altitude performance claims, but at lower altitudes, from 6,500 to 14,500 feet, true airspeeds fell short of

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Mechanical systems blended with 200 hp-performance made the short-body Super 21 a simple sophisticate.

the pilot operating handbook figures and Century's figures by about eight to 10 knots. Although the turbocharger had recently been overhauled, Straub suspected there were leaks in the system that caused a loss in power.

Despite having a reputation as a high-maintenance item, the turbocharger has held up well in N300MD. The overhaul is the only major service the system has required since it was installed, according to Straub. However, the turbocharger is shoehorned into an already tight engine compartment in the Super 21, which makes it that much more difficult to work on the engine.

The Century turbocharger kit costs $7,590 uninstalled and adds 16.5 pounds to the empty weight of the aircraft. The only external change required on the aircraft is the addition of a louvered panel on the right side of the engine cowling. An aftermarket turbocharger modification may or may not add to the value of a 20-year-old Mooney. A pilot looking for high performance on a budget would do well to consider a turbocharged Super 21. On the other hand, the long-time owner of a Mooney sales and service center in the northeastern United States said he has known several customers who overboosted their turbocharged engines and suffered the repair consequences. In his opinion, a turbocharger does not increase the price of an older Moone,. Normally aspirated Super 21s are worth from $20,000 to about $22,500, according to the latest *Aircraft Bluebook Price Digest*, but the condition of the avionics, paint, interior and engine have a significant effect on the value.

When it was new, the turbocharger gave Straub's Super 21 additional speed and high-altitude capability, but he rarely used it on his many long-distance flights. If maximum range was the objective, Straub would cruise at between 12,000 and 14,000 feet with the power set at 16 inches and 2,400 rpm. He found adventure and relaxation in long trips, and the longer, the better.

Straub traded up to the Super 21 from a Piper Tripacer. The Mooney's greater speed and range made it far more adept at tackling the Friday-night-to-Sunday-night flights Straub regularly made from his home in Johnstown, Pennsylvania, to the Bahamas. With the Mooney, he began to plan more ambitious flights to Haiti, Jamaica, the Virgin Islands and into South America. In December 1970, Straub flew from Pittsburgh to Caracas, Venezuela, to climb Angel Falls in the jungles of southeast Venezuela. The 3,282-foot-high waterfall is reputed to be the highest in the world. The successful expedition was chronicled in a book, *Angels Four*, written by David Nott, one of the four climbers (Prentice-Hall, Incorporated, Englewood Cliffs, New Jersey, 1972).

In 1975, Straub replaced the Mooney's rear seats with a 55-gallon drum and lashed a second auxiliary fuel tank to the right front seat. He planned to fly nonstop from Gander, Newfoundland, to the European continent, but after reaching Gander the flight plan had to be changed because of a low-pressure system that had stalled over the Atlantic Ocean. He flew south, instead, to the Azores, and then on to Portugal, Spain and Western Europe. The last leg of the return trip to the United States was a 21-hour nonstop flight from Reykjavik, Iceland, to John F. Kennedy International in New York City. Straub then flew to the Reading Air Show in Reading, Pennsylvania, where N300MD was named the best production single-engine retractable of the show.

The following year, Straub made a second flight to and around Europe. In the summer of 1977, he flew around the world. The trip began in Wichita, where a larger rear-seat auxiliary fuel tank was installed, giving the Mooney a total fuel capacity of 199 gallons. Survival gear was squeezed between the front tank and the instrument panel, and the pilot's seat could be reached only by wiggling between the top of the tank and the cabin roof.

When all of the tanks were filled, 15 pounds of lead shot had to be placed in the engine compartment to keep the center of gravity within limits. The engine was fresh from a major overhaul, and the cockpit had been outfitted with dual automatic direction finders (ADFs), a high-frequency communications radio, three-axis autopilot, an oil-pressure warning horn and a rented Loran-A receiver. Fully loaded, N300MD was 25 percent over gross weight, which the FAA approved under a waiver.

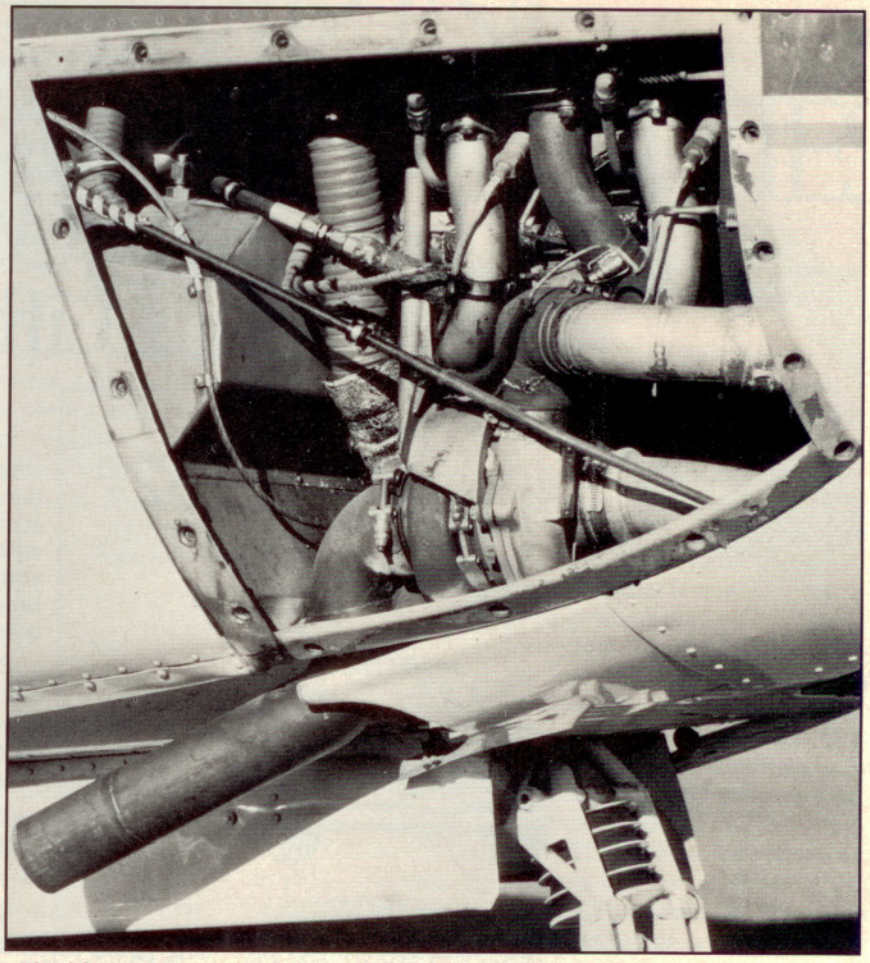
Straub departed Wichita for Gander

with the tanks partially full, then flew nonstop to Karlsruhe, West Germany, and on to Athens, Greece; Ankara, Turkey; Teheran, Iran; Karachi, Pakistan; Calcutta, India; Bangkok, Thailand; and Singapore. He had planned to spend two months on the flight, but in Singapore he learned of an illness in his family and rushed through the rest of his itinerary. After stopping at several Australian cities, Straub flew to Fiji and Pago Pago in West Samoa. The next leg was the longest overwater segment of the trip: 2,171-nm to Honolulu. All of the fuel tanks were topped for the first time since leaving Wichita, and Straub waited until evening and cooler temperatures to take off from Pago Pago. The Mooney broke ground in less than a third of the length of the 9,000-foot runway, and Straub reached Hawaii without having to draw from the main tanks.

With the tanks full once again, Straub departed Honolulu for the continental United States. He overflew San Francisco and reached Salt Lake City before switching to the main tanks. The intended destination was Cedar Rapids, Iowa, but the weather there was below minimums. Straub elected to land at Des Moines, 27 hours two minutes after leaving Hawaii, with two hours fuel still in the tanks.

Six months after completing the trip, Straub and his wife, Toni, flew N300MD to Europe and back. That was the Mooney's last ocean crossing and one of its final long flights. Following a trip to the Bahamas, the airplane was left in Florida for repairs, including an overhaul of the turbocharger system. Meanwhile, Straub, a specialist in hair transplantation, moved his practice from Johnstown to Los Angeles. The Mooney remained behind in Florida and for several years was flown very little.

A year ago, Straub retrieved the airplane, had it repainted and now bases it at the Torrance Municipal Airport in Torrance, California, near his home and offices. The oil-pressure warning horn and aging ADFs are the only reminders of the global travels of a decade ago. Straub and his wife and young son take occasional overnight flights, but they have not yet ventured far from Torrance. The urge to prowl the world in a light aircraft has been held in check by the demands of a successful medical practice and a young family, but Straub has not ruled out a long-distance flight or two in the future. The auxiliary fuel tanks still are stored in his garage. □



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The tight quarters underneath the cowling were made even tighter when the turbocharger was installed. The modification includes changes to the intake and exhaust systems.

Mooney M20E Super 21
Specifications

Powerplant	Lycoming IO-360-A1A with Rajay RJO326-1 turbocharger, 200 hp @ 2,700 rpm
Recommended TBO	1,800 hr
Propeller	Hartzell HC-C2YK-1A/ 7666A-2 74-inch diameter
Length	23 ft 2 in
Height	8 ft 4 in
Wingspan	35 ft
Wing area	167 sq ft
Wing loading	15.4 lb/sq ft
Power loading	12.9 lb/hp
Seats	4
Cabin length	8 ft 8 in
Cabin width	3 ft 4.5 in
Cabin height	3 ft 8.5 in
Empty weight	1,642 lb
Gross weight	2,575 lb
Useful load	933 lb
Payload w/full fuel	621 lb
Fuel capacity, std	312 lb (312 lb usable) 52 gal (52 gal usable)
Oil capacity	8 qt
Baggage capacity	120 lb (plus 10 lb in hat rack)

Performance

Takeoff distance, ground roll	760 ft
Takeoff distance over 50-ft obst	1,300 ft
Rate of climb, sea level	1,120 fpm
Max level speed, 2,500 ft	171 kt
Max level speed, 20,000 ft	195 kt
Cruise speed/Range w/no rsv, std fuel (fuel consumption)	
@ 75% power, best economy	
5,000 ft	158 kt/771 nm (64 pph/10.6 gph)
@ 65% power, best economy	
7,500 ft	152 kt/ 844 nm (56 pph/9.4 gph)
@ 55% power, best economy	
10,000 ft	142 kt/897 nm (50 pph/8.3 gph)
Max operating altitude	30,000 ft
Landing distance over 50-ft obst	1,550 ft
Landing distance, ground roll	595 ft

Limiting and Recommended Airspeeds

Vx (Best angle of climb)	80 KIAS
Vy (Best rate of climb)	98 KIAS
Va (Design maneuvering)	115 KIAS
Vfe (Max flap extended)	87 KIAS
Vle (Max gear extended)	104 KIAS
Vlo (Max gear operating)	
Extend	104 KIAS
Retract	104 KIAS
Vno (Max structural cruising)	130 KIAS
Vne (Never exceed)	164 KIAS
Vs1 (Stall clean)	58 KIAS
Vso (Stall in landing configuration)	50 KIAS

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.