Don Brown at Trenton, N.J., Summer 1963.

THE DEE BEE QUADRUPLEX

RCM tests Don Brown's proportional . . . a proven system, consistent in performance and reliability.

Several issues ago, when RCM began its discussion and examination of the various full-house proportional systems, we asked for letters of comment from individual owners of these systems. The response was immediate, frank, and to the point. In almost every instance, the "pros" and "cons" of a given rig were about equal. We say almost — for if it is possible for a manufacturer and his product to have a fan club, the honors go to Don Brown and the Dee Bee Quadruplex "21." From scattered points throughout the world, this one system not only received more letters than any other, but in each case the report was all on the plus side of the ledger. We wanted to know why.

The man behind Dee Bee Engineering is personable Don Brown. The son of a New Jersey dentist, Don started in free flight during his school years — along with racing hydroplanes, and dabbing in amateur photography. His introduction to radio control came in 1952 in the form of an original, home-brew ship complete with hard tube receiver, escapement, and Cub .074 engine — all of which parted company with its owner on a first flight flyaway. This was followed by another, and somewhat more successful model, this time employing the old two-tube RK61 receiver. A LiveWire Senior with escapement operated elevator, rudder, and motor control provided an entire season of flying in 1953.

Don's introduction to proportional control started with a home-brew mechanical pulser and Walt Good's Rudderbug. In 1955, this progressed to Galloping Ghost with which Don won top Intermediate class honors at the 1957 Nationals. This system was then replaced by Walt Goods' TTPW, and installed in an original shoulder wing design called the DB III. Its successor, the DB IV, carried Don Brown to third place at the 1961 Philadelphia Nationals and a berth on the U.S. Internat's team. During this time, Don, along with Carl Schwab of Huntington Station, N.Y., was developing the first prototype model of the present Dee Bee proportional system. It was this system, in an original design called the Ambassador, that carried Don to fifth place at the '63 Internationals.

Since that early prototype, Dee Bee Engineering has grown to include six full time and two part time employees, and has gained an enviable reputation in the field of proportional control. At the recent 1964 Dallas Nationals, Austin Leftwich flew to second place in

the Pylon event with the Dee Bee "21."

General Description

The Dee Bee Quadruplex "21" is a triple simultaneous, fully proportional pulse servo radio control system. The number "21" stands for the actual weight of the airborne equipment — 21 ounces including the superhet receiver, servos and amplifier board, and nicad pack. The model "21" is completely pre-wired with the receiver and servo board connected by a permanent cable. Elevator and rudder servos are mounted on the glass epoxy servo board. When RCM's Editor received his Quadruplex, we found out just how easy this matter of installation becomes — the servo board was simply fastened to a plywood cutout frame and solidly mounted in the fuselage. The receiver was loosely wrapped in foam and mounted on end just ahead of the servo tray. The four "C" size, 1.2 amp nicad cells were wrapped in foam and installed under the fuel tank area — the pre-wired battery pack simply plugging into place on the servo tray along with the aileron and throttel servos. This pre-wiring and cabling provides the utmost in installation flexibility, and reduces to an absolute minimum the possibility of installation error. No soldering was required.

The Quadruplex "21" provides completely independent proportional control of rudder, aileron, and elevator, plus trimmable throttle. Servo power is completely adequate for the full house competition models, while the airborne weight allows the use of the smaller .15-.19 size aircraft.

Transmitter

Three simpltaneously transmitted subcarrier channels are employed by the Quadruplex "21" — 2.2 KC for Rudder, 2.8 KC for aileron, and 3.4 KC for Elevator. Time ratio modulation of the subcarrier is employed for independent control of rudder, aileron, and elevator position. 0% and 100% time ratio of the rudder channel is reserved for trimmable throttle control.

A blocking oscillator is used to generate a sawtooth waveform at the desered repetition rate of approximately 10 CPS. This sawtooth wave is A.C. coupled into the sawtooth segment selector. Trim and main control potentiometers are connected in such a manner that any portion of the sawtooth waveform can be utilized to conrol the time ratio of the subcarrier clamps. Each subcarrier clamp in turn modulates its respective subcarrier oscillator.

The subcarrier oscillator is a Hartley configuration. When the subcarrier clamp is conducting, the Hartley oscillator is turned off. When the subcarrier clamp is cut off the Hartley oscillator runs at its assigned frequency.

The output of each subcarrier oscillator consists of time ratio modulated

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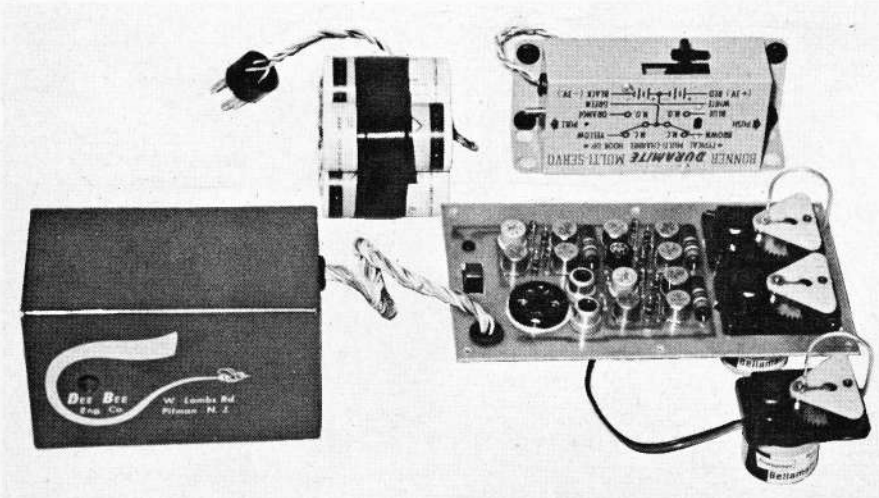
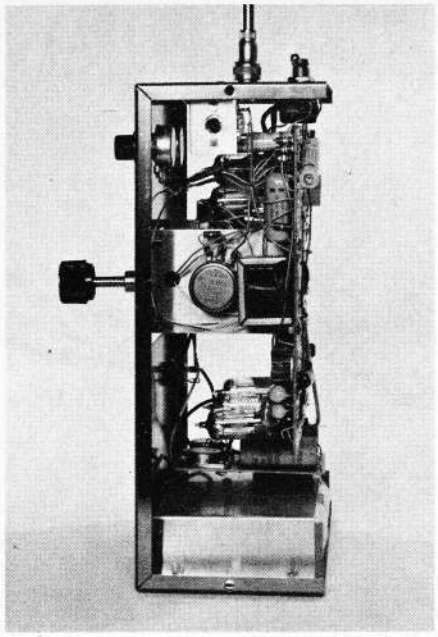


The airborne "21" system. Only change in RCM's test unit was an Annco on throttle.



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bursts of sine wave subcarrier frequency. All three subcarriers are simultaneously mixed in the mixer amplifier stage, and are used to grid modulate the RF output stage that operates as an RF frequency doubler. Throttle control buttons simply turn the rudder subcarrier full off or on for trimmable throttle progression.

The transmitter itself is housed in a red anodized case measuring 10½" high x 7" wide by 4" deep. The 4 amp hour nickel cadmium power supply is rechargable through a front panel jack designed to accommodate the Dee Bee charger which charges the "21" receiver and transmitter simultaneously. Eighteen hours of charge at the fixed charger rate assures over three hours of transmitter operation.

The "21" transmitter features a single control stick for rudder, aileron, and elevator. A red and a black button on top of the case advances or retards the trimmable throttle. Two small knobs above and to the right of the central control stick trim the aileron and elevator. The position of these trim knobs does not affect the full deflection position of the servos.

One additional feature on this particular model is a switch, located next to the throttle buttons, which allows the rudder and ailerons to be coupled for those maneuvers or portions of the pattern where such a feature would be advantageous.

Receiver

The superheterodyne receiver utilized in the airborne system is a two-deck, fully transisttorized unit with no pulsing relays. The upper printed circuit board comprises the superhet front end, consisting of RF mixer, local oscillator, IF amplifier, audio detector, and AGC, along with the motor control circuitry. The lower deck contains the subcarrier amplification, separation (filtering) and detection stages. After the second detector, the three simulaneously received subcarrier bursts are fed into a common subcarrier amplifier that is essentially flat in response over the frequency range of 2 to 4 KC. At this point, the subcarrier output is applied to three series connected filters with center frequencies of 2.2 KC, 2.8 KC, 3.4 KC. The output of these filters is the time ratio modulated bursts of sine wave subcarrier exactly as transmitted. We have now only to convert these into bursts of subcarrier detector current to be used in driving the individual servo amplifiers.

When 0% or 100% rudder subcarrier is applied through the use of the throttle control buttons, as mentioned, a pulse omission detector transfers the voltage that would normally be applied for rudder operation to the throttle servo.

Tuning the "21" receiver is a simple matter of removing the transmitter antenna, and while holding the ship four feet or more above the ground, peaking the RF slug for maximum range (about 10 to 20 feet). Throttle retard should be checked and fine tuning accomplished to make sure that this function operates at half the range mentioned.

All components associated with Dee Bee's subcarrier filtering system are permanently potted in epoxy for maximum protection — a practice that has resulted in an experience record of *no* filter failures. One of the features we noted was that no attempt was made to "cram" the smallest available components into the smallest available area in the "21" receiver. Workmanship and layout are excellent, and all circuitry is contained in a heavy gauge red anodized aluminum case measuring 2¼" x 1⅞" x 3⅜".

Servo System

The present Dee Bee Quadruplex is not a feedback proportional system, but rather, utilizes a pulse servo system of the most advanced design. When in operation, the slight quiver of the surfaces is barely noticeable, and when in flight, the difference between this form of pulse and that of

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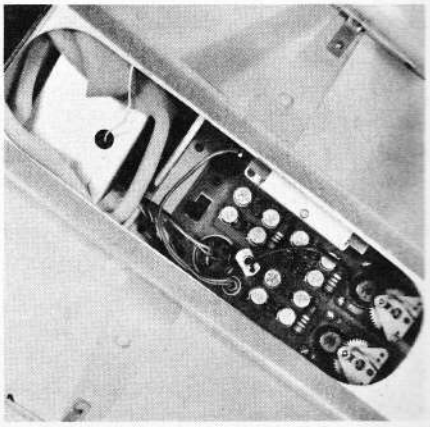
RCM Editor's Glasquire — yellow, white, black.

Inside the Glasquire, the "21"



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a closed loop system is not apparent.

Behind this particular system are several years of development, with the foundation of the servo system being the Micro Mo motor housed in the Graupner Bellamatic servo case. Beginning with this basic unit, Dee Bee replaces the centering system with a unique and extremely effective, torsion spring centering device. This modification is used on the elevator and aileron servos only, where extremely precise control is mandatory. The result is a centering action that is perfectly linear, and unmatched in fine resolution. As mentioned, the wiggle, or dither amplitude, is so infinitesimal, that in many installations it is not even visible.

The stock Bellamatic servo unit contains a slip clutch to prevent pinion damage in the event of extreme shock loads. This, too, undergoes further modification by Dee Bee, in order to deliver the higher power necessary for the high speed contest airplane. This modification, however, in no way nullifies the safety features of the original clutch design.

The rudder servo utilizes a scissor spring, rather than the torsion bar used on the elevator and aileron units, in order to maintain an absolutely solid neutral for the rudder and nose wheel in the absence of control command.

Elevator and rudder servos are mounted on a sturdy 2¾" x 5" fibreglass card that also carries the solid state servo amplifiers, off-on switch, and aileron and engine servos.

Flight Tests and Conclusion

Our Quadruplex "21" underwent its first flight tests in a Zeus-Taurus combination. Frank Justin, RCM Associate Editor, removed his ten-channel reed unit and installed the proportional system with little or no modifications. Although Frank had not flown proportional control prior to these attempts, no difficulty of any kind was experienced, and the Quadruplex performed perfectly, flight after flight.

The photographs included with this article illustrate the installation of the "21" in RCM Editor Don Dewey's GlasQuire — a fibreglass version of the Tri-Squire, as manufactured by SkiGlas. Here, the "21" has been adapted for Class II flying, simply by removing the rudder servo from the amplifier board and installing the aileron servo in its place. In this installation, trim function is available on both the rudder and elevator. The weight of the airborne system, 21 ounces, is the same as most six-channel installations.

When we completed flight testing the Dee Bee Quadruplex "21," we knew why the owners of this system were spontaneous, and in accord, with their praise of Don Brown's product — it works, consistently and reliably. It is a system that the beginner to multi-channel will find much easier to handle than reeds. It will perform when you want it to perform. It will not have to go back to the factory for service after each few flights. We have heard it said that the "21" is not as exotic, or complex, design-wise, as some of the feedback systems. It is our feeling that this is exactly why its performance and consistent reliability is on such a high plane.

We like it, we fly it — and we recommend it to the RC'er who wants proportional control at a reasonable price, and with the assurance that it will perform consistently day in and day out.

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Beloit, Wisconsin. They sure are beauties and present a fine challenge.

Here is an interesting note from our Japanese friends. From Ken Arikawa of the Tokyo Model Boat Club the picture showing Ken's boat running half speed on Lake Yamanaka. Ken said they held their 3rd Annual Long Distance Contest at Lake Asi-Hakone on May 12th and 13th. More than 30 boats from all parts of Japan joined in this competition. The course that is run is 12 kM. Ken did not state if this was an oval, triangular, or what type of course this is. Here are some of the classes and times involved.

Class "A" (up to 10 cc)
A. Sato — 31 M—27.7 S.
Class "B" (up to 37 cc)
T. Koyam — 20 M—19.1 S.
Class "C" (up to 50 cc)
H. Toriyama — 24 M—16.0 S.

The points of long run are endurance, reliability for R/C engine, and sailing of hull on rough open water surface. It sounds like an interesting time was had by all.
