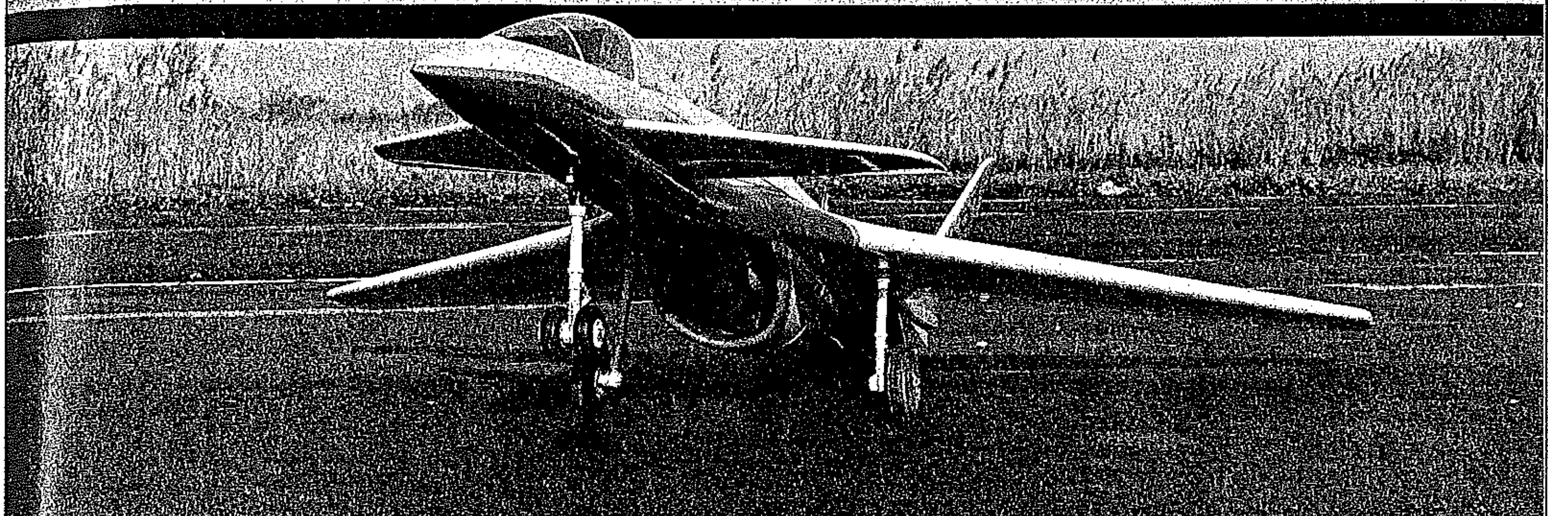
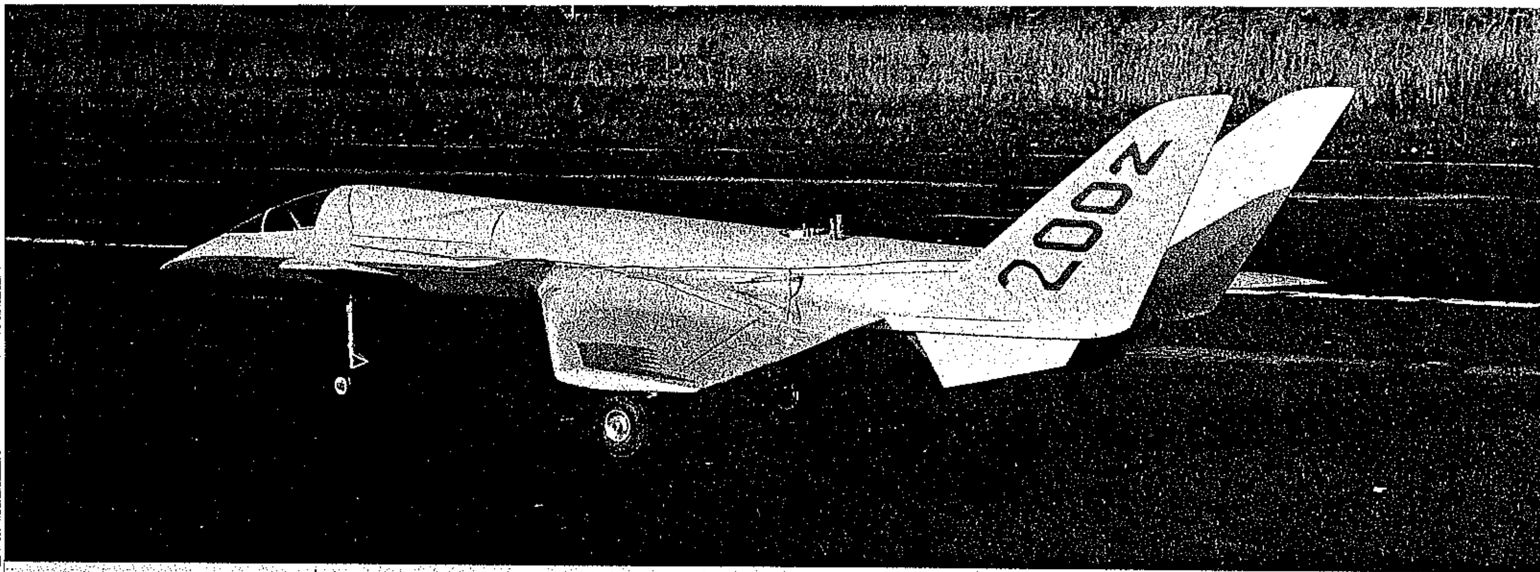
Hi-Tech 2002



Top: Rotation to a tail-strike position shows off the air inlet and new forebody. Below: The Hi-Tech 2002 on the runway at Cedar Creek Park Aerodrome, L.I., NY. Above: Pictured during a three-quarter-throttle go-round during an aborted landing, the angle of climb should give you a good idea of how much thrust this fan unit is capable of producing.

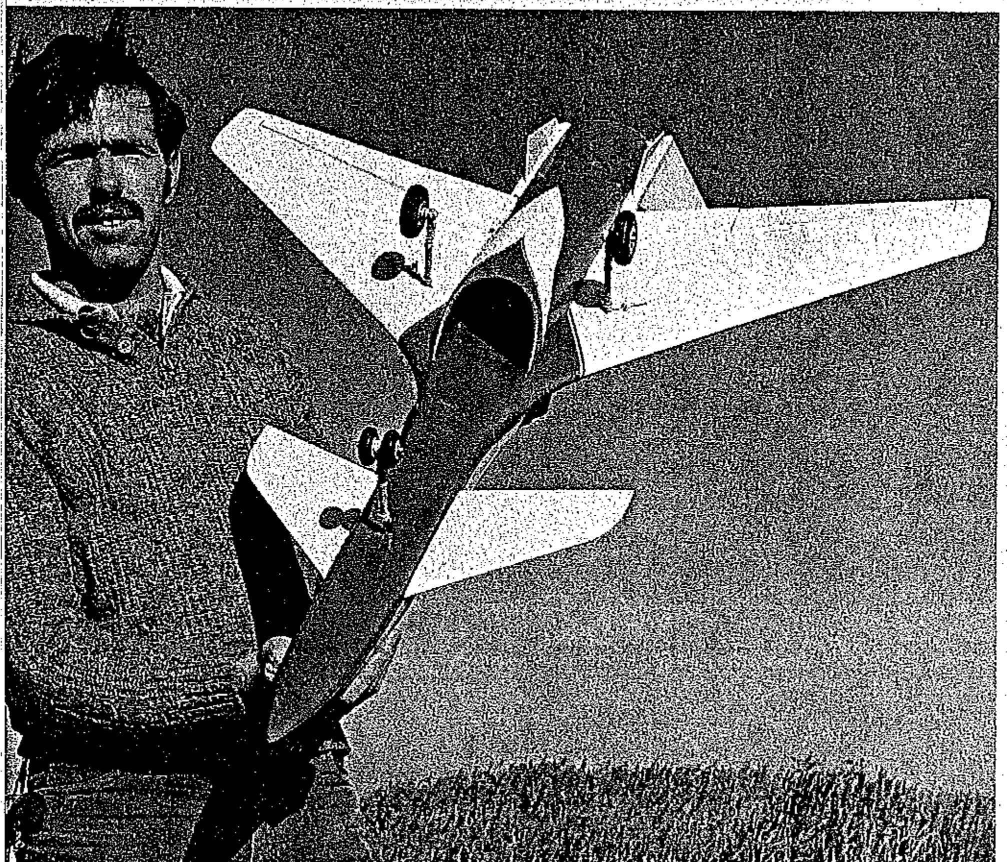
The third generation of this RC ducted-fan canard model takes advantage of the new RK-740 fan unit for a thrust-to-weight ratio that spells v-e-r-t-i-c-a-l. For a four-channel radio and one of the .45 cu. in. ducted-fan engines. ■Tom Hunt

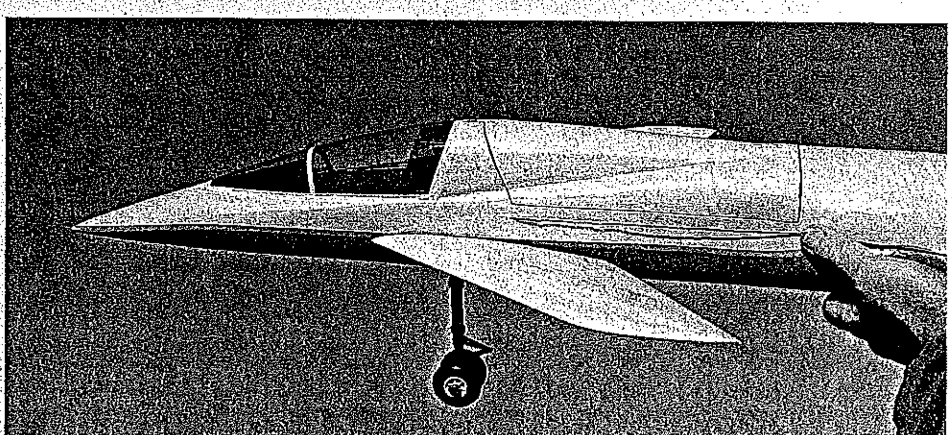


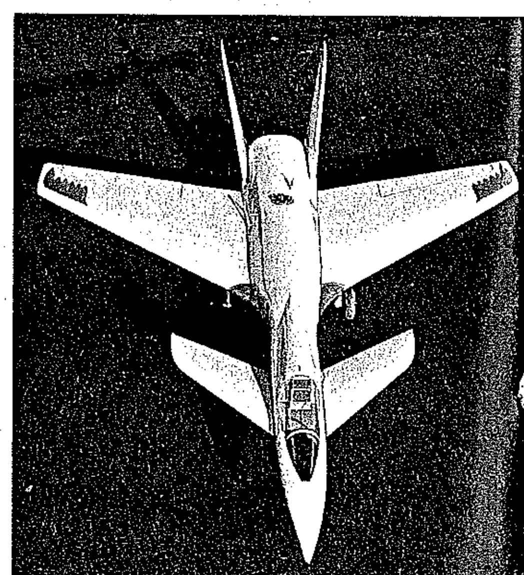
Latest new Hi-Tech model sports a new exterior and new paint scheme. Mods for new fan are simple since its diameter matches the RK-20.

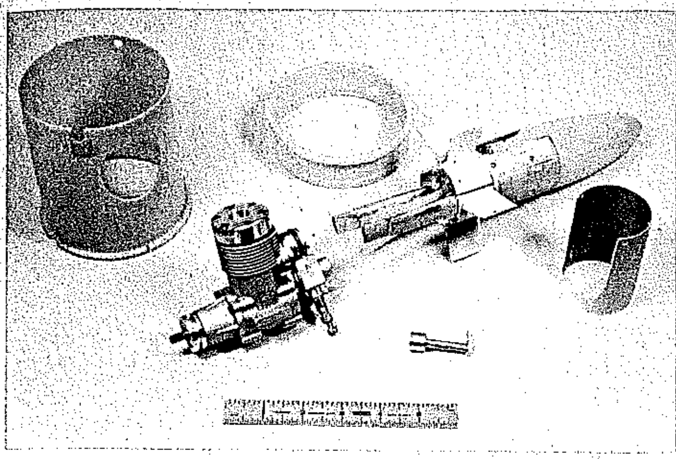
POWER TO SPARE! Do you put .10 engines on ½A airplanes, .40s on .20-size airplanes, and .60s on .40s because you really want a "hot" model? If you do, you aren't performing any great feats of magic when your airplane climbs up to the stratosphere in a matter of seconds. However, when you create an airframe/power plant package in the form of a ducted-fan aircraft that takes off from paved runways in 50 to 80 feet, climbs vertically as long as there is air to breathe, yet slows down to land just like a trainer, that's an accomplishment to be proud of! And that's the Hi-Tech 2002 and RK-740 combination; it burns up the sky!

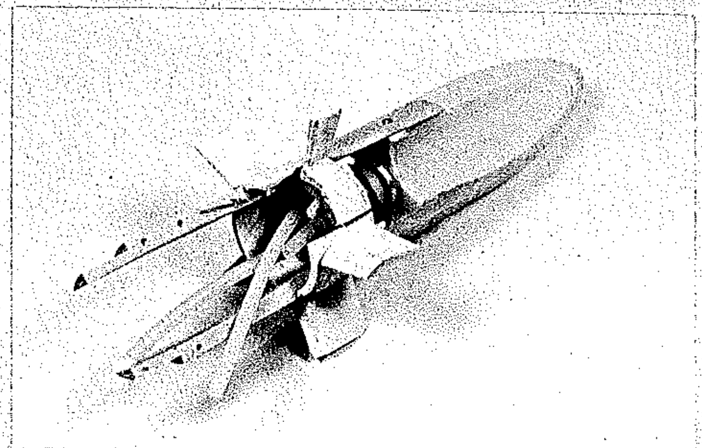
If you've been avoiding ducted fans because you feel they're underpowered sport models or that the ones that do fly well are too large and expensive to fit your car or your bank account, Hi-Tech 2002 may be the aircraft for you. A repeat performance of the 2001, which was originally published in the October 1984 issue of *Model Aviation*, the 2002 is an easy conversion from HT-2001, and it just might be the perfect aircraft for those of you who want to get your feet wet in "real" jet flight.


Our author holds up the 2002 in a stiff breeze to give us a view of the bottom surfaces.


Canopy is the rear portion of a Sig 12-in. bubble unit. Though not obvious here, the canard is 1 in. forward of where it was on the earlier 2001 version (to improve power-out control).


Star Wars fighter or the fighter of the 21st century? It could easily pass for either one.



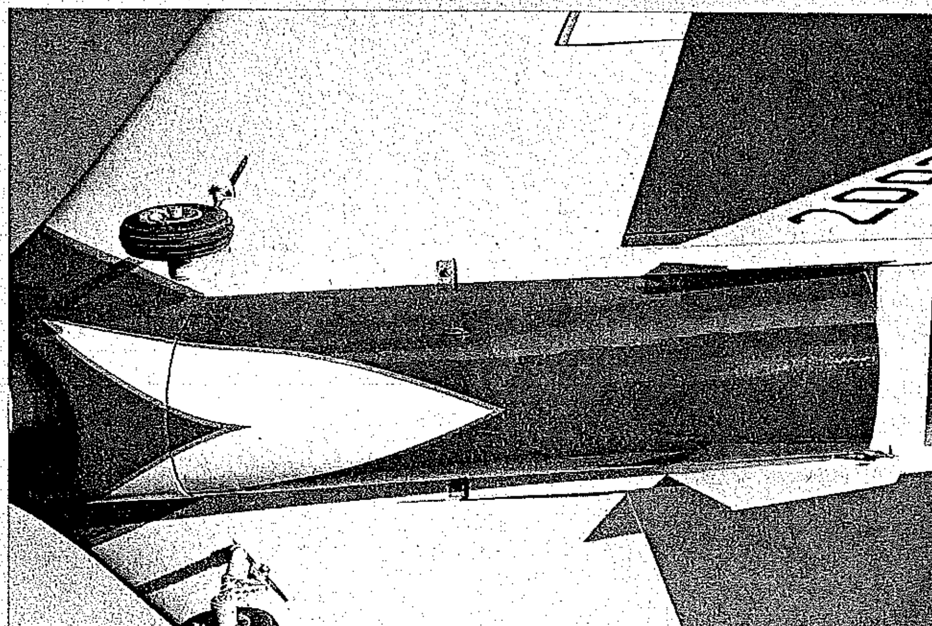


Left: RK-740 fan and O.S. Max .46 VR DF engine. Foreground (L to R), engine and carb with slightly modified throttle extension. Engine shroud also requires slight mods according to engine selected. Background (L to R), forward shell (taken from RK-20 fan unit) and modified rear shell (also from RK-20). Right: Top right stator has been shortened to make room for the throttle extension, and its base has been cleared to allow for the tuned pipe. Also, a small notch must be filed on the right-hand engine mount beam to clear the carb adjustment screw.

The HT-2001, powered by an RK-20 fan unit with an O.S. Max .25 VR, ducted fan engine, flew well at 4.5 lb., but it did not have jet-like performance. HT-2002 is much improved, not only in the power plant, but also in the new forebody.

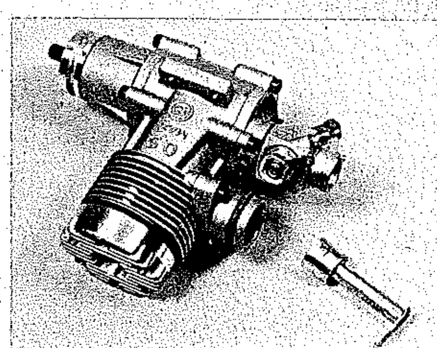
HT-2002 development. Though they might not be so obvious at first glance, a few structural and aerodynamic changes have been incorporated to improve durability and flight performance. Dual ventral fins mounted below the twin vertical tails increase the yaw stability of the aircraft at high angle of attack. HT-2001 showed a slight Dutch roll tendency when the nose was held too high during final approach (i.e. a roll and yaw rocking that appears to make the rear of the aircraft wag like a happy puppy dog's tail). This problem in HT-2001 was more of an annoyance than a danger to the aircraft (severe Dutch roll tendencies can make an aircraft spin out of control). HT-2002, with the ventral fins added, showed no signs of this phenomenon. The canard and canard pivot were moved forward 1 in. on the new forebody to improve power-out pitch control. Remember, the thrust-vectoring vane supplements pitch control only while the engine is running.

Structural changes include epoxy/fiberglassing of all the internal duct walls, removal of the top centerline internal 1/16 sheeting in the aft section, the inclusion of a rubberband fan unit hold-down, and the removal of the vertical cross brace just forward of the thrust-vectoring vane. Fur-

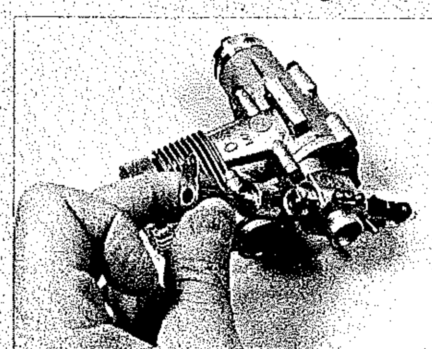


The two aluminum flanges and screws retain the lower hatch (but they don't support the weight of the fan unit). Note needle valve extension protruding from lower nacelle hatch.

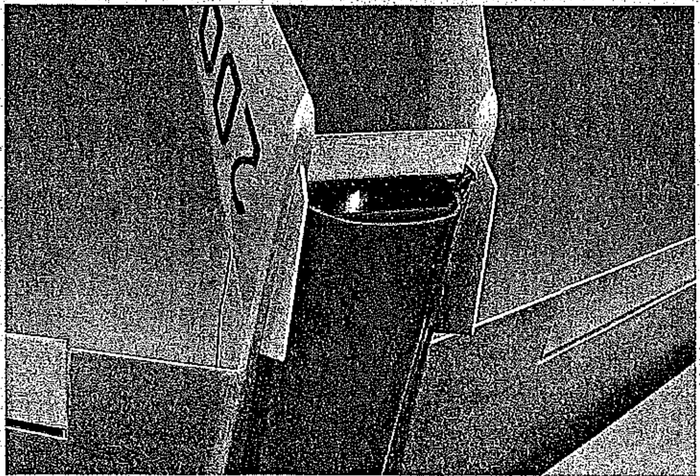
Fan shell cutouts required for the RK-740. Small piece has cutouts for throttle extension and fill and pressure lines. Large hole in the forward fan shell is for the cylinder head. Throttle extension hole is on the right, needle exit on the left. Cut a centering notch in the stiffener ring. Cut/grind another notch in the stiffener for the throttle pushrod.

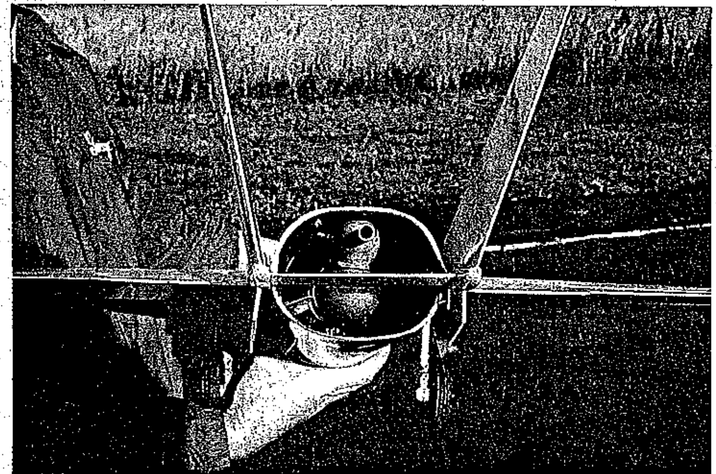


Carb on O.S. engine modified to accept the brass tube and sheet throttle extension.



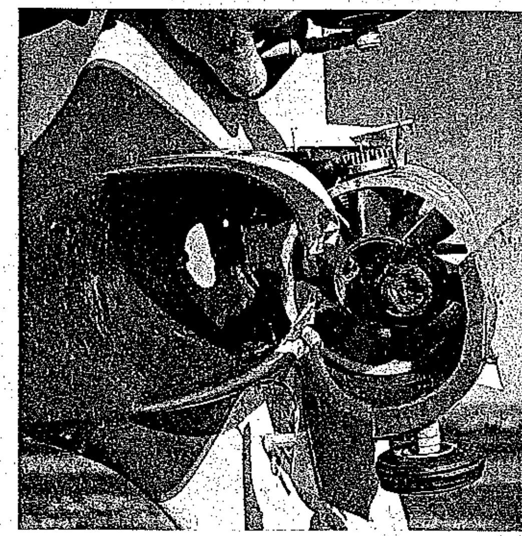
The notch cut into the brass tubing not only indexes it over the old bellcrank arm, but keeps it from slipping over the drum. There is also a notch for clearing the setscrew which locks the carb bellcrank to the drum.





Left: The 2002, compared with the 2001, includes new ventral fins and a one-piece lower hatch. Note the single horizontal spreader beam (cross brace) in the duct. Right: The tuned pipe and fuel tank take up about 25% of the fan diameter area; however, it does not seem to hurt performance. They probably even help to recover some of the whirl energy created by the fan blades (that's actually the stators' job).

The spinner cone just inside the inlet. Note the white spinner stripe (actually there are two, set 180° apart). These are for taching the fan on the ground. Photocell-type tachometers can read the difference between light and dark the way it reads the prop blade and void.



Without the rubberband mounts for the fan unit, the hatch screws failed 20 sec. into the first flight. The melted spinner (from friction) caused outrageous vibration. Water droplets were from a large puddle the author conveniently ran the model through to reduce its landing speed for a safe recovery.

ther, the lower nacelle hatch has been extended all the way to the end of the aircraft, and the wire size of the aileron torque rod has been increased to ⅛-in. diameter (previously 3/32-in.). Finally, the Nyrod aileron pushrods have been replaced by large Goldenrod cables.

The glassing of the internal walls was

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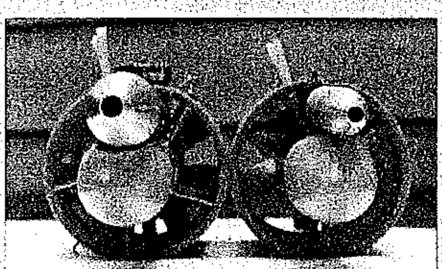
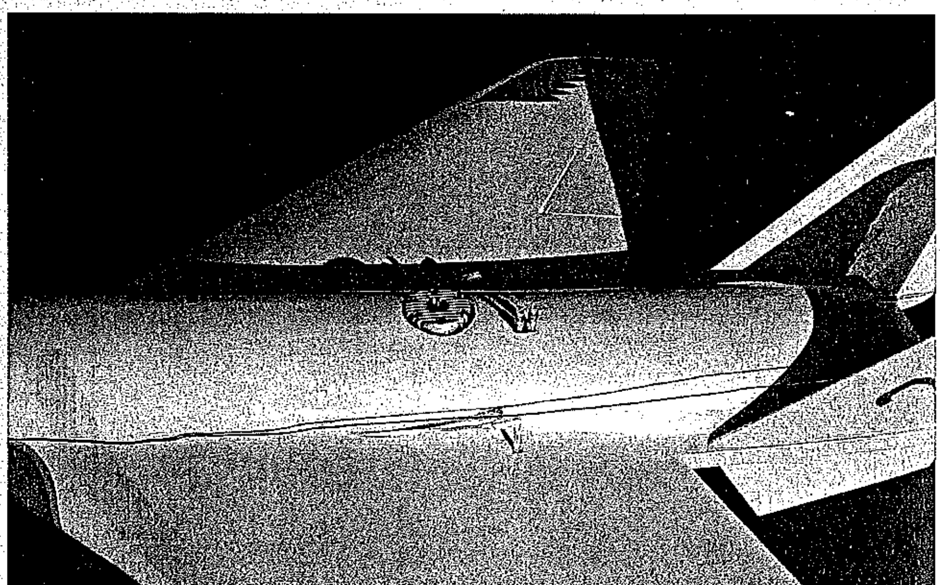
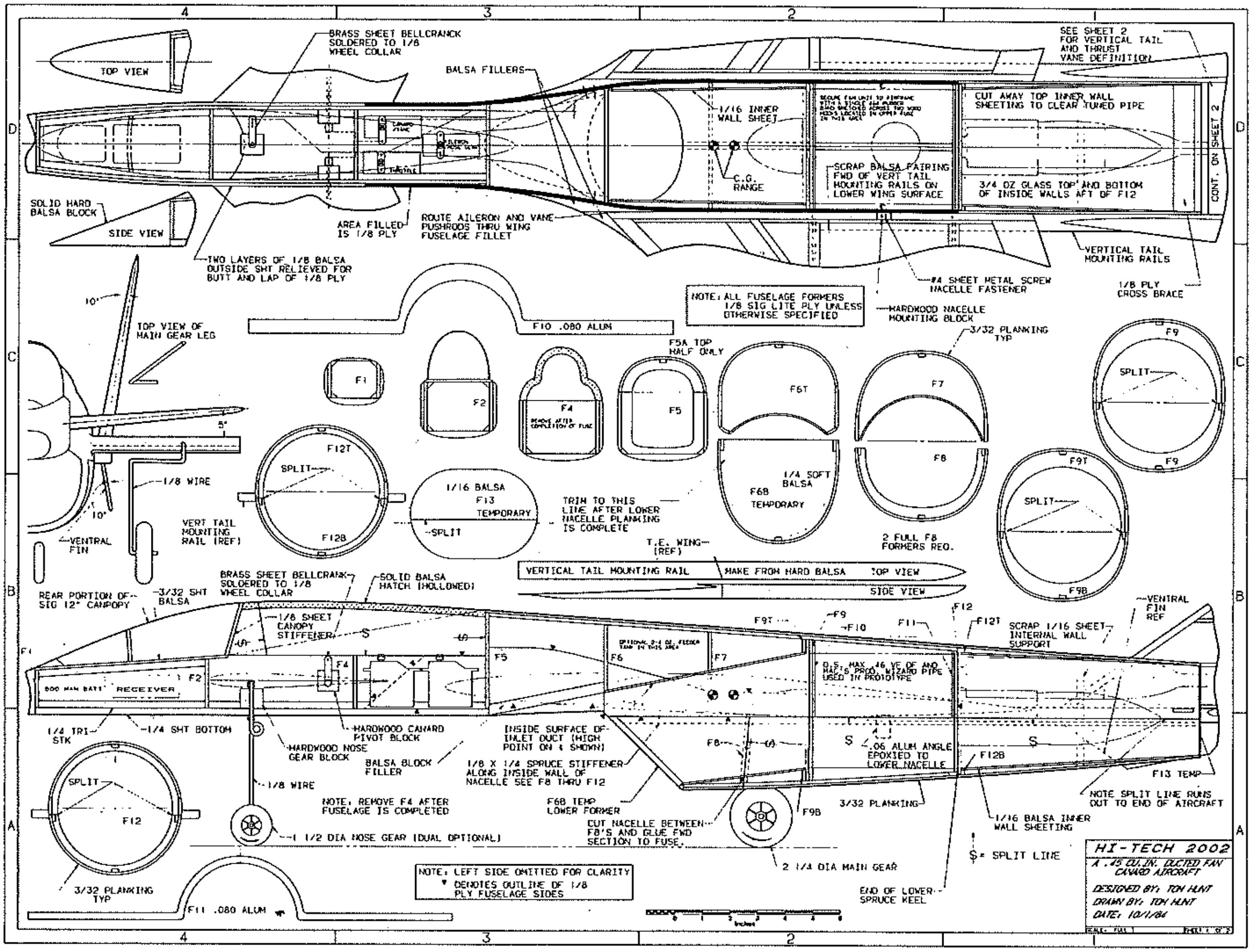


Shot from the rear shows the dished bulb fuel tank and the larger Macs Products' Wizzard tuned pipe on the RK-740 on the left. The RK-740 also has two rows of five stators vs. two rows of three on the RK-20.



The cylinder head protrudes out the top of the fuselage. Text contains cautions about overheating that can occur with this arrangement. Note the fill and vent lines that are plugged after being filled to allow the tank(s) to be pressurized from the tuned pipe.

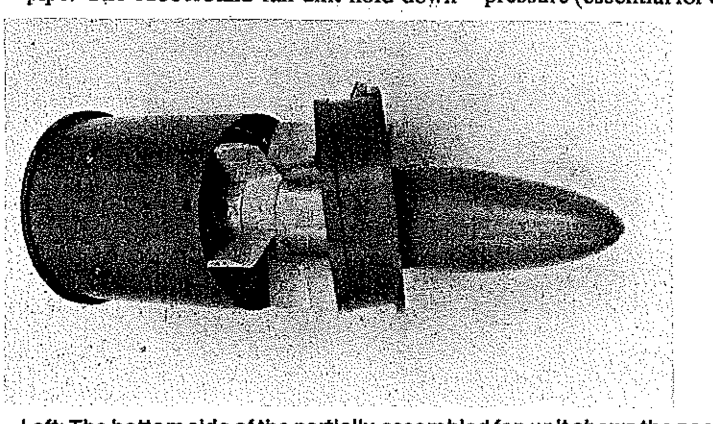
Full-Size Plans Available . . . See Page 170

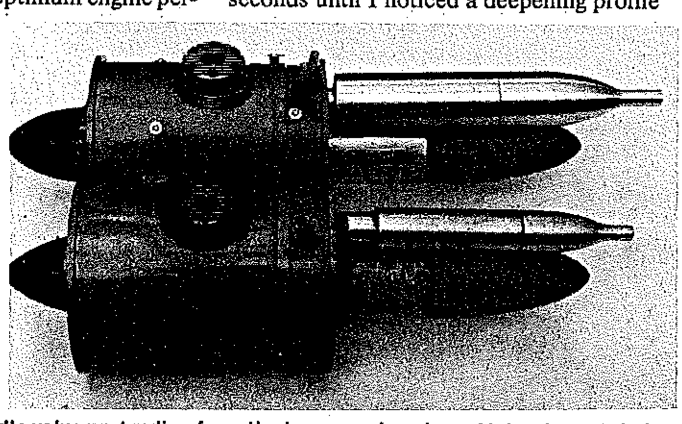


found to be necessary when the starter cone, which engages slightly off center, began rattling around the inlet uncontrollably and fractured the 1/16 sheet balsa internal wall in a number of places. The exhaust duct was glassed in order to stiffen the entire aft fuselage in torsion. A small section of the top centerline of the exhaust duct had to be removed to accommodate the larger tuned pipe used with the RK-740, and the vertical cross brace was removed for the same reason. The lower nacelle hatch was extended to facilitate the removal of the fan unit with its longer tuned pipe. The rubberband fan-unit-hold-down is absolutely necessary if you intend to keep the fan unit inside the aircraft during the entire flight. (More about that in a moment.) The increase in aileron wire size and replacement of the Nyrods with cables was required to eliminate an aileron flutter problem.

Flight testing. Anticipations of exceptional flight performance were high after briefly experimenting with a modified HT-2001 aircraft (the gray aircraft with the new forebody). First flights of this aircraft, with engine not yet broken in and no pipe pressure (essential for optimum engine performance), showed an exceptional climb rate at ¾-throttle position and a go-round response generally found only in propeller-driven aircraft. Unfortunately, testing was curtailed by a dead-stick landing in terrain that resembled the face of the moon!

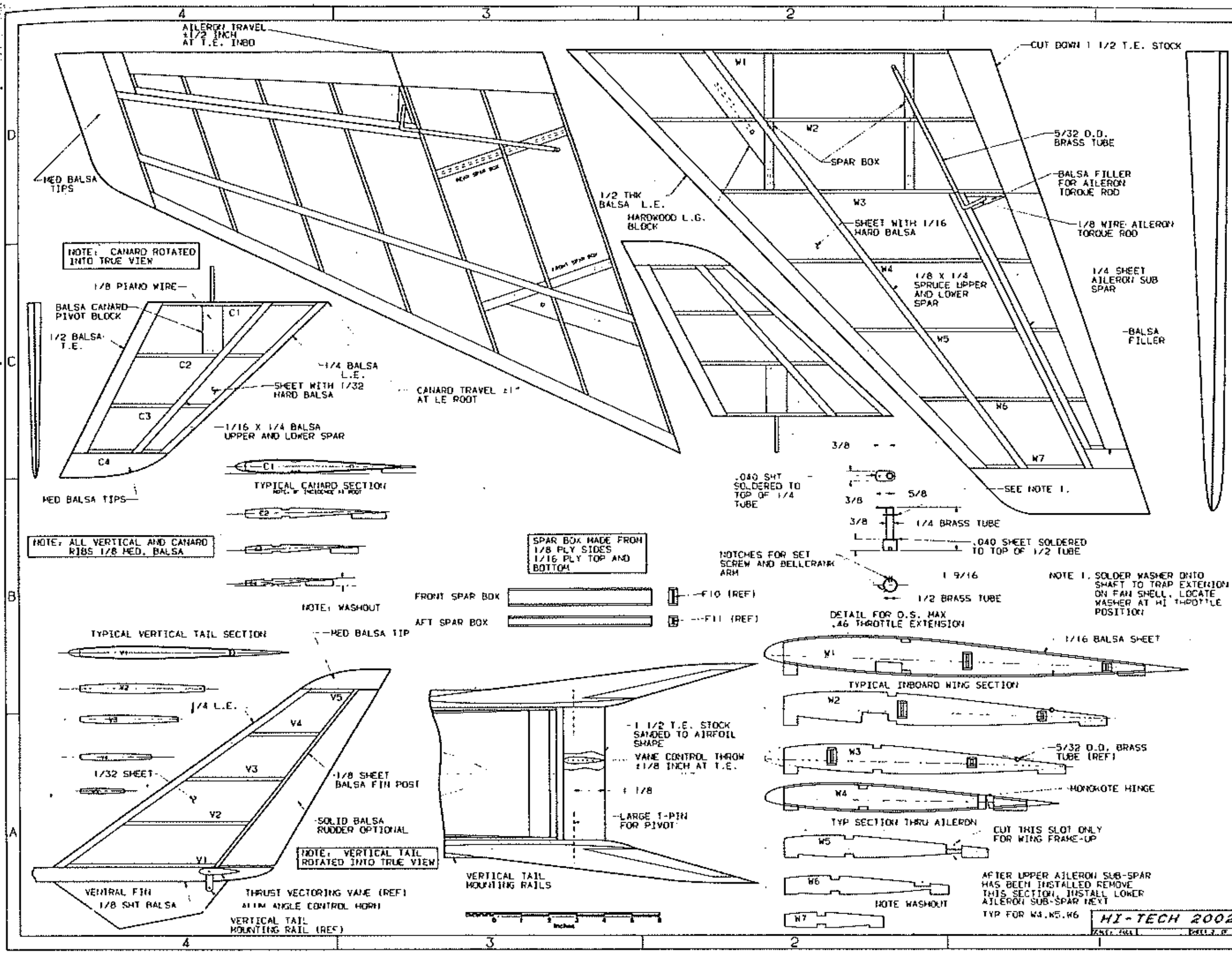
In stepped HT-2002 with all the aforementioned refinements, except a strengthened nacelle hatch hold-down attachment. Twenty seconds into the flight and at full throttle, I heard a severe airframe vibration. Did it throw a blade? Did I pick up some sort of foreign matter on the runway? I continued to fly the aircraft for a few more seconds until I noticed a deepening profile





Left: The bottom side of the partially-assembled fan unit shows the needle valve protruding from the inner engine shroud (aluminum tube). The needle valve is extended from this point with a small Allen wrench or a piece of 1/16 music wire bent to an L shape—and held in place by an Allen setscrew located at the top of the stock needle valve. Right: The RK-20 (foreground) and RK-740 are nearly identical in size. Slight differences between them pose no problem in making a direct substitution of the RK-740 into planes previously equipped with the RK-20.

Full-Size Plans Available . . . See Page 170



on the lower part of the aircraft. I surmised that the fan unit was just about to part company with its mount. I throttled back and immediately headed for the tarmac, still under complete control. Even the throttle, which was slowly leaving the airplane along with the fan, was responding. Just 58 seconds after lift-off (no, I'm not Mr. Spock; George Myers was timing the event with his video camera), HT-2002 was safely on the runway, the lower nacelle and fan unit scraping on the ground.

Inspection of the model showed that the port-side nacelle hold-down screw was missing, and the right-side bracket was broken off from the nacelle. MonoKote was the only material bridging the gap, barely holding the front of the nacelle and the fan unit onto the aircraft. The only other reason the fan did not exit completely was that the tuned pipe, which extends slightly past the end of the nacelle, was hung up on the horizontal cross brace. The difference in weight between the RK-740 fan and the RK-20 was probably too much for the two screws securing the nacelle, causing the fan to leave the aircraft on a high-G turn.

The solution to this problem was the aforementioned rubberband hold-down. This takes the load off the two #4 sheet metal screws which now only secure the lower nacelle—not the fan. The fan unit was finally secured to the airframe, and HT-2002 returned to the field for more flight testing.

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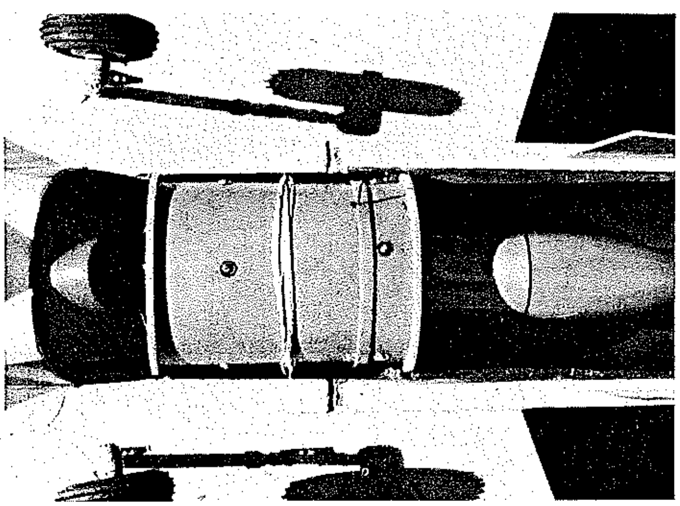

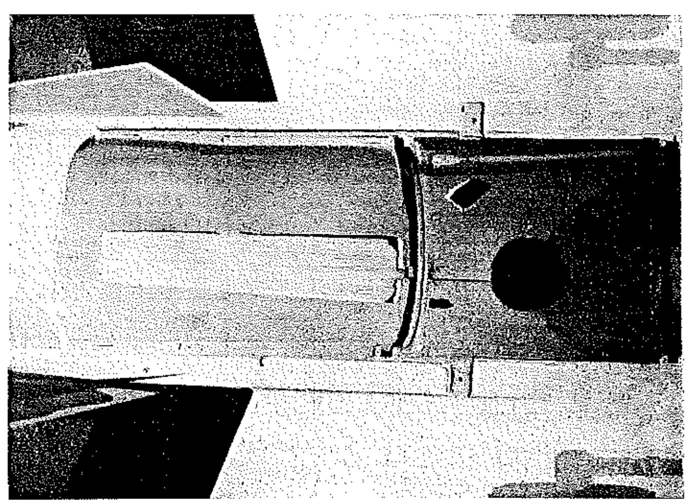

Left: Rubberbands through screw hooks have held the fan in place since the first flight. Right: Retrofitting the RK-740 into a previously-built HT-2001 requires only a bit of minor surgery to the aft internal duct. Top centerline inner wall was removed to allow for the larger tuned pipe.

um gray with dark green camouflage on the top. The fin and spinner are Curtiss blue. The lettering and trim are made from MonoKote. The roundels are red, the numbers white. Make the canopy from thin plastic; epoxy-glue to the fuselage. Outline the canopy with thin strips of MonoKote. The aileron and flap outlines are black MonoKote.

Final assembly. Glue the wing to the fuselage. Pass the lead-out wires through the wing tip line guide, and tie them. Attach the nylon control horn to the elevator, and hook up the pushrod. Attach 3-in. wheels to the main gear and a 1½-in. wheel to the tail gear. Attach an 11-6 prop and a 2¾-in. spinner to the engine.

Your airplane is now complete. Be sure to balance the model at the point shown on the plans.

RC Hi-Tech 2002/Hunt

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The next flight proceeded uneventfully until I dived the aircraft to maximum speed for a high-speed flyby for the camera. At just about the point when the aircraft pitched downward, I heard a loud buzzing sound above the engine/pipe noise. After landing, I inspected the aircraft and found nothing unusual—no nicked blades, nothing obviously loose on the fan unit itself. Since the noise had started when the aircraft was pitched nose down, I reasoned that the fan blades might have stalled. The theory seemed to have merit, the argument being that the fan inlet (below the fuselage) was being shielded by the canard and wing, obstructing the airflow to the fan and causing the blades to stall at high rpm. Another observation strengthened this theory: as soon as the noise occurred, the aircraft slowed like it had hit a brick wall. With the nose well down, one would expect a rapid descent, but if the blades had stalled, thrust and forward speed would be significantly reduced.

Returning home, expecting to cut a cheater hole (Eee Gads!) in the top of the fuselage, I found the real problem. Inspecting the MonoKote aileron hinge, I found that it was either torn or completely separated from the wing at both left and right aileron tips. Assuming that only a severe aileron flutter could cause this, I proceeded to stiffen the entire aileron control system. This included, as previously mentioned, the replacement of the ³⁄₃₂ wire torque rod with ⅛-in. wire and replacement of the Nyrods with cable. Subsequent flights showed that this modification alleviated the flutter problem.

Now that all these problems have been remedied, how does it fly? Fast, smooth, and slow (with power). Takeoffs and go-rounds rival most overpowered sport ships. Unfortunately, with the wing loading approaching 30 oz./sq. ft., this aircraft must be handled gingerly during dead-stick landings. It will not stall a wing tip and spin in like a heavy Scale model, but you will notice a loss of pitch authority. I have found, during the few dead-stick landings that I have had to perform, that the nose is not hard to keep up if it is already slightly up. It may seem strange and against conventional flying practices, but you must keep the nose level or slightly high during approach in order to perform a flared, dead-stick landing with this aircraft.

The only other condition you should be aware of is that the engine can overheat if left at any throttle position while sitting motionless on the ground. Since the cylinder head is entirely out of the wake of the fan, forward motion is your only friend. (If you have flown a pusher-type aircraft, you have very likely experienced this problem yourself.)

Construction/modifications Construction of the HT-2002 is almost identical to that of the HT-2001, so I will describe only the changes. I will also spend some time describing the construction of the RK-740 fan unit peculiar to the engine used (O.S. Max .46 VR DF) and its installation in HT-2002.

The new forebody is constructed with ⅛-in. and ¼-in. sheet as well as solid block balsa. Cut out two inboard and two outboard ⅛-in. sheet balsa fuselage sides and laminate with gap-filling cyanoacrylate (CyA). The inboard sheet is full length to F5; the outboard sheet is foreshortened as per the plan. Cut out the fuselage bottom from ¼-in. sheet hard balsa to the exact shape and length shown in the top view. Glue the ¼-in. triangle stock to the laminated side walls. Lay the bottom sheet over the plan, then cut out and glue F1 through F4 to the bottom sheet, making sure to center each former across the width of the bottom sheet.

Glue the fuselage side walls to the formers and to the bottom sheet making sure that the shorter ⅛-in. wall sheet is to the outside. (This is for the lap joint to the existing ⅛-in. Lite Ply fuselage on HT-2001). If you are building a brand new HT-2002, make the outside fuselage wall full length from ⅛-in. Lite Ply, lapping a ⅛-in. sheet balsa inside wall to this ⅛-in. ply outside fuselage wall. At this point, add the 3/32 sheet balsa canopy floor to the forward top ¼-in. triangle stock glued to the fuselage walls.

Next, block up the nose and hatch pieces from sheet balsa or solid block and glue in place. Cut the HT-2001 nose off at the old F4 bulkhead. Be sure to remove your radio first! Cut the ⅛-in. Lite Ply fuselage wall to the shape shown on the plans, and remove any balsa planking from the fuselage up to F5. Secure the new nose onto the HT-2001, and the HT-2002 will begin to emerge from its cocoon!

For those of you building HT-2002 from scratch, this forebody assembly is created in conjunction with the rest of the fuselage above the nacelle/fuselage split line. Carve and sand the forebody to match the existing contour of HT-2001 at F5. When the shape is satisfactory, cut away the radio hatch from the fuselage walls, leaving a small angled portion just behind the end of the canopy. F2 can now be hollowed to fit your radio into the nose, and F4 can be removed entirely if it gets in your way while you're installing the radio.

Add the hardwood canard and nose gear pivot blocks at this point. I secured the radio hatch with a 1/16-in.-dia. pin in the aft section that protrudes into F5, and a sliding pin mounted on the fixed piece just behind the canopy. The sliding pin slides out every now and then while the engine is running, so it must be secured with a small piece of tape before flying.

The canopy is taken from the rear portion of a 12- or 13-in. Sig bubble canopy—available at just about any hobby shop or direct from Sig. I do not glue my canopies on; rather, I cut and trim them for a very close fit to their mating surfaces and then use a matching color of trim MonoKote to secure them. I heat the trim MonoKote with an iron for a better seal with both the acetate and the underlying MonoKote.

The forebody enhances the illusion that this is a model of a future Air Force fighter. It's not, but we can all dream, can't we?

The small ventral fins are cut from hard ⅛-in. sheet balsa and secured to the bottom center of the vertical tail-mounting rails with CyA. Angle the ventrals out about 10° from the lower nacelle (the same as the vertical tails). This is done to improve ground clearance and to improve the airflow over the inboard side.

No changes were made to the wings except for the deletion of the wing-tip sidewinders (I kept breaking off the fins in the rough at each end of the runway), but removing these appeared to make no difference in flight performance.

The vertical tails and canard also remain the same, but the aft fuselage must be slightly modified to accept the new fan unit. Cut a larger hole in the top deck for the cylinder head; cut out an area in the inside upper inner wall for the tuned pipe (see plans and photographs); remove the vertical support brace, and depending on the engine used, either shorten or lengthen the throttle pushrod. All this can be accomplished in a few hours.

The RK-740 fan unit is an amazing engineering achievement. Mr. Kress of Kress Technology, active in the fan design field since its infancy, has designed a fan which is much smaller in diameter than its competitors yet offers the same thrust output (approximately 7 lb.). The primary intent behind the design was to maintain the same size as the RK-20. Except for the necessary addition of a longer and larger-diameter tuned pipe, this constraint has been met. The RK-740 can be retrofitted with very few modifications into any aircraft designed for an RK-20. The instructions for assembling this fan are quite explicit, but these photos and descriptions should help to explain the assembly with the O.S. Max 46 VR DF engine as power plant choice.

At the time of this writing, only three engine choices are possible without further modification: the K&B front and rear rotor 7.5cc and the O.S. Max .46 VRDF. When ordering, be sure to specify the engine intended.

Assuming you choose the O.S., as I did, here is what needs to be done: In assembling the engine/carburetor to the engine mount, you will notice that the right-hand beam must be ground away in a semicircle shape for the idle-stop screw on the carburetor. You must grind about 3/32-in. deep with a ⅜-in.-dia. grinding tool to successfully install the engine on the beams. The beams also must be chamfered on the top slightly (as per instructions) to fit the slightly greater width of the O.S. versus the K&B. Washers under the engine bolts must be filed flush with the beams to ensure that they do not interfere with the aluminum shroud of the engine body.

If the dished fuel tank is also chosen (necessary with the use of Mac's Products' Wizzard tuned pipe), some method of getting the vent/pressure line to the top of the tank is required. I solved this problem with a piece of curved 3/32-in. O.D. brass tubing inserted into one of the tank nipples and positioned so that it reached the top crease of the dished tank. It was then Hot-Stuffed into place from the inside. (Note: This tank has an approximately 6-oz. capacity; not very much fuel for a .46 cu. in. high-rpm fan engine. I am currently getting three minutes of high-speed flight with very little fuel reserve, and would suggest that a 2- to 4-oz. feeder tank be installed in the aft radio section to supplement the integral tank. Pipe pressure is adequate, I am told, to feed the main tank from this auxiliary tank, but I have yet to try it.

A throttle extension shaft must be made to get the bellcrank outside the fan shell. This is easily fabricated from brass tubing and sheet brass in about an hour's time. Details are on the plans. Remember, a hole must be provided to gain access to the low-speed carburetor adjustment screw located on the bellcrank side of the carburetor. To fit the throttle extension onto the carb, the stock, black steel bellcrank rim must be filed to the same diameter as the drum. When this is accomplished, the two notches on the brass extension for the bellcrank and the drum setscrew can be filed . Take care to position the brass external bellcrank correctly for proper throttle actuation. When assembly is complete, you will notice that the top right aft stator must be shortened in chord from the leading edge to accommodate the throttle extension shaft.

In order to make the retrofit into HT-2001 a little easier, I chose to use a gutted RK-20 fan shell for the RK-740 instead of the aluminum wrap provided in the kit. If you cannot get a fan shell from Midwest or Kress Technology, use the stock shell and position plywood rings onto the front and aft ends to simulate the RK-20.

A hole and setscrew in the needle valve are conveniently provided for extending the needle valve outside the fan shell and nacelle with a suitable piece of piano wire or Allen wrench. A 1/16-in.-dia., length to suit, L-shaped wire does the trick, or if you can spare a 1/16-in. Allen wrench, use it! It already has a flat on it for the setscrew on the top of the stock needle valve.

Holes for the cylinder head, needle valve, fuel lines, and throttle extension must all be located and drilled or enlarged for final assembly. Notches in the fan shell for the throttle pushrod and the notch in the forward stiffener ring for alignment in the fuselage can be cut away at this time. If all necessary modifications to the fuselage have been made, it is time to trial fit the fan assembly into the aircraft. Locate a hole in the lower nacelle half for the needle valve, and trial fit it.

Charge the batteries, truck to the field, fuel it, fire it up, set it on the threshold, push the throttle to the firewall, pull the stick into your chest, and watch it point its nose towards the heavens.

Till next sortie. . . . Again I would like to thank George Myers, Bob Kress, Bob Aberle, and especially my wife (proofreader and moral support) for their help in making this project a pleasant and painless success.

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Golden Age/Berliner

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non-flying reproductions. Given the basic information, the true modeler should be able to take it the rest of the way.

The first of the classic series of trophies for pylon racing was the James Gordon Bennett, which began at Reims, France in 1909. The airplanes participating in these races were extremely fragile. Few of them lasted more than weeks after a race, so one can expect to find little from this era. The Musee de l'Air at Le Bourget Airport north of Paris has a 1910 Baby Wright Racer and a marvelous 1913 Deperdussin monocoque. The Ford Museum in Dearborn, MI has the remarkably advanced 1920 Dayton Wright Racer which, though it never won anything, pioneered the retractable landing gear and had very modern streamlining.

Beginning at the same time as the Gordon Bennett, but lasting until 1931, was the great Schneider Trophy Race series for seaplanes. It led to some truly significant advances in engines and aerodynamics. Of the many great craft flown in these races, the Supermarine Sea Lion I from the 1919 race still survives (well, the hull does, at least) in the Science Museum in London. Of far greater interest, and housed in the same building, is the Supermarine S.6B, winner of the final race and the first flying machine to top 400 mph. An earlier type, the S.6A is in the Hall of Aviation at Southampton, England.

Europe hosted some pretty interesting racing during the 1930s, though hardly on the scale of Cleveland. The big meet was the Coupe Deutsch in France, run for many laps of a long course and stressing durability as well as speed. The sleek, dark blue Caudron racers completely dominated the series, and while the only one extant may actually be a sophisticated mock-up built for a movie sometime after the war, it is an accurate depiction of the Caudron 336. Right next to it in the Musee de l'Air is a Potez 53, presumably the winner of the 1933 race, and also on display is another great Caudron, the C.714R, which might have broken the world speed record had it not been for the war.

In the U.S.A. the only surviving Schneider racer is the Curtiss R3C-2 that Jimmy Doolittle flew to victory in 1925. It's on display at the National Air & Space Museum in Washington, DC. There are two Italian racing seaplanes left from this era. One is the Macchi M.39 from the 1926 race; the other, the spectacular Macchi-Castoldi MC.72 with its tandem engines and dual props, turned 441 mph in 1934 for a record that still stands. Both are in semiprivate collections in Italy.

The Pulitzer Trophy Races from 1920 to 1925, while purely a military event, produced some of the most colorful of the early racers—the Curtiss Army and Navy biplanes with the screaming V-12 engines and classy lines. Sadly, all that's left is a wing panel from a Curtiss R-6 (in the U.S.