MARTIN MARAUDER B-26

PART I

BY BOB PARCEL AND LEON SHULMAN
WITH ADDITIONAL INFORMATION FROM THE ARCHIVES OF CHALLENGE PUBLICATIONS, ASSEMBLED BY NORM GOYER

NOW THAT HOBBY MANUFACTURERS HAVE BROUGHT US SOPHISTICATED RADIOS AND RELIABLE ENGINES, MORE B-26 MODELS ARE BEING BUILT, AND FLOWN SUCCESSFULLY, TOO


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Bob Parcel's version of the Martin B-26 Marauder fighter/bomber of World War II. Watch for full construction article in next month's *Scale R/C Modeler*.

Bob's B-26 was a sensation at Byron Originals' EXPO 88 last summer, where it was seen (and admired) by over 40,000 people.

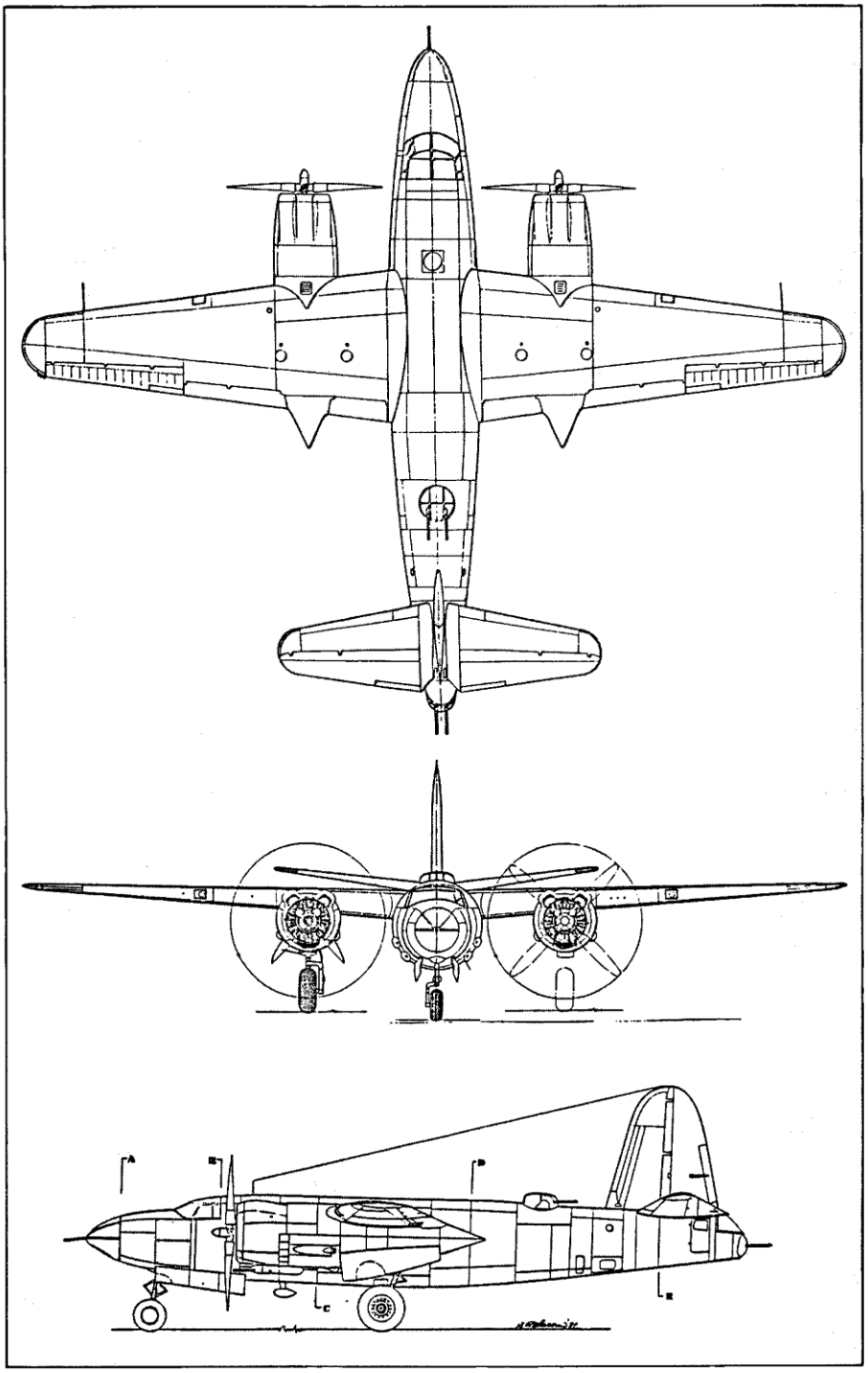
There were over 40,000 visitors to Byron Originals' EXPO 88 last year at Ida Grove, Iowa, and I think that every one of those visitors paused to admire Bob Parcel's new Martin B-26 Marauder on display there.

The Martin was the first military aircraft which did not have the wing loading specified in the initial contract bid. At that time, the War Department wanted aircraft with speed, and they were willing to get it at any price. They already had a fleet of B-25s, B-17s and B-24s, but what they *really* needed was a very fast, well-armed, light attack bomber. Martin won the bid, and construction was started on one of the best-looking and fine-performing twin engine fighter-bombers in the service of any country during World War II.

Aesthetically a very attractive aircraft, the B-26 Marauder was, in fact, a rather tricky airplane to fly, and early in its career, it earned an unenviable reputation as a deathtrap from its crews. The reason for this was its high wing-loading, a consequence of the stringent USAAC requirement which the design had to meet. In January 1939, the Army issued a requirement for a new medium bomber of very high performance. Realizing that the performance needed at the upper end of the operating range could not be met by an aircraft with a low wing-loading, the USAAC deliberately omitted any reference to landing and stalling speeds, thereby tacitly admitting that what had previously

B-26

Portrait of a handsome young World War II bomber "jock." Sure is tough to grow old, isn't it, Leon? (But not so bad when you consider the alternative.)

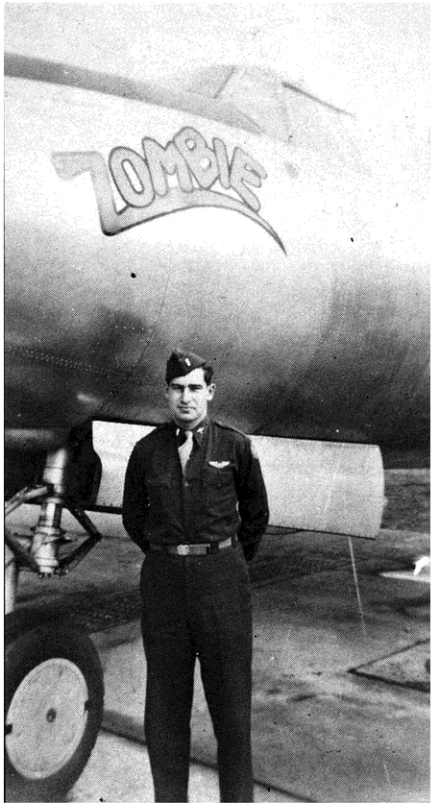


been unacceptable speeds for these two factors would now be accepted.

Martin replied to the requirement with a beautifully streamlined aircraft with very small flying surfaces and two large engines. So pressing was the need for the new design that the army ordered over 1000 examples into immediate production in September 1939, waiving the normal procedure of X and Y prototype and pre-production models for testing. This was perhaps an unwise step, as Peyton M. Magruder's design had the highest wing-loading to date of any US aircraft. The first B-26, powered by a pair of 1850-hp Pratt & Whitney R-2800 Double Wasp radials and armed with one 0.30-inch machine-gun each in nose and tail positions, and two 0.50-inch guns in the turret, made its maiden flight in November 1940. The first few aircraft were reserved for testing and evaluation, and full-scale production got underway in 1941.

The designation B-26 was applied to the first 201 aircraft built. These had R-2800-5 engines, and were capable of carrying a bomb load of 5800 lbs. Top speed, the highest of the whole series at a gross weight of just over 30,000 lbs. was 315 mph. Conversion to the new aircraft was, of necessity, a lengthy process, and the first Marauder unit did not become operational until December 1941. Operational conversions were further delayed by the introduction of the heavier (32,200-lb) B-26A in the second half of 1941. The increased weight came from the extra fuel tanks in the bomb bay, a change from 0.30- to 0.50-inch caliber guns in the nose and tail positions, and the provision of shackles for a 22-inch torpedo under the fuselage. Production of the B-26A, which was powered by R-2800-9 or R-2800-39 radials, reached 139; the B-26B entered production in May 1942.

Several sub-marks of the B-26B were built, corresponding to the various



Lt. Leon Shulman at Westover Air Force Base, Chicopee, Massachusetts, during the war years. Note double scissors on nose gear and shape of nose gear covers. Also note *Leon's* shape back then. Is this the Leon Shulman we all know and love?

batches of aircraft built. The first batch had R-2800-5 radials of 1850 hp each, and an increased weight of 36,500 lbs.; this latter was occasioned by an increase in armor protection for the crew, the addition of a ventral gun in a "tunnel," and the doubling of the armament in the tail position to two 0.50-inch guns. The second batch had 1920-hp R-2800-41 or -43 radials, two 0.50-inch machine guns for beam defense in place of the first batch's ventral 0.30-inch gun, and a lengthened leg for the nosewheel, to increase the incidence of the wing and improve takeoff performance.

A more radical change was made in another batch. In an effort to reduce the wing-loading, and therefore the problems of handling the aircraft at low speeds, the span of the wing was increased by six feet to 71 feet, thereby adding another 56 square feet to the area of the wing. This should have helped matters considerably, but it was negated by a further increase in weight to 38,200 lbs. due to the addition of a second gun to the nose armament, and the location of four new guns, all fixed, two on each side of the nose. At the same time, a Martin-Bell tail turret replaced the older position, and the size of the vertical tail surfaces was increased. Production of this sub-model amounted to 2477 aircraft.

The sole XB-26D and XB-26E were experimental aircraft; the first to test thermal de-icing equipment, and the second to assess the effects of moving the dorsal turret forward. Neither was put into production, and the next major model therefore became the B-26F, of which 300 were built in 1943. In a further effort to improve the type's takeoff and landing characteristics, the incidence of the wing was increased by 3 1/2 degrees. Other, detailed modifications were also included. The final combat model of the Marauder was the B-26G, which only slightly differed from the B-26F. Before production of the type terminated in March 1945, 893 B-26Gs and 57 TB-26Gs had been built, the latter as trainers and target tugs. The final Marauder model was the XB-26H, which was used to test a four-wheel bicycle undercarriage under the fuselage, similar to that finally used on the Boeing B-47 jet bomber. Total B-26 production came to 5157. The Marauder was also used by the Royal Air Force: 52 Marauder I (B-26A), 19 Marauder 1A (B-26B), 100 Marauder II (B-26C), and 350 Marauder III (B-26F and G). The B-26B and C were also converted into target tugs in the United States as they were withdrawn from front-line service under the designation AT-23, 208B and 350 C models being converted.

Although the service introduction of the Marauder had been far from smooth, and considerable difficulty had been experienced at first in combat, the Marauder came into its own in the closing stages of the war, when its high speed and heavy armament turned it into a formidable tactical support aircraft. Its high wing-loading was always a problem, but as pilots became more experienced, as the war progressed, they learned how to cope with this, and losses of B-26s became proportionally the lowest of any US combat type. And so ends the history of this revered aircraft? Not yet.

While at Ida Grove, I spotted a familiar face admiring Bob Parcel's B-26, and immediately recognized a gentleman I had become acquainted with at a free flight meet in Westfield, Massachusetts, just before World War II, *over fifty years ago*. Here's the story:

When I was about fourteen years old, I had heard that the noted free flight designer, builder and flyer, Leon Shulman (who was only a few years older than I) was going to be at a meet, fifteen miles away from my home, and would be competing in Free Flight with a Banshee, powered with a Bantam 19 engine. Not having any other means of transportation, I rode my bicycle all the way there, and spent one of the most wonderful afternoons of my life (up to that point, anyway), watching the expert flyer and his beautiful aircraft. It was an experience I never forgot. I had not seen Leon Shulman since then.

Now, forty-seven years later, there was Leon Shulman, himself, standing there, asking Bob Parcel questions about his B-26. I introduced myself, told him how I remembered him, and we chatted briefly. To my surprise, he remembered flying at Westfield that day so long ago, and even mentioned the seven tobacco barns at the edge of the flying field. What a memory — what a man!

It seems that, during World War II, Leon was assigned to a B-26 Squadron, and had flown B-26s on many assignments. In fact, he named one of his B-26s "The Zombie," after one of his very famous award-winning free flight aircraft. Leon told me I'd be hearing from him, and sure enough, a short time later, I received a letter and a package of photographs of him with various B-26s he had flown.

Leon had also designed and built a very nice B-26 controlline model, which was published in one of the early issues of *Air Trails*. We are happy to re-print this plan, along with Mike Beaulieu's great giant scale plan to give our readers a choice of aircraft. Somebody might want to scratchbuild a small version of the B-26, possibly even an *electric scale* Martin. Are you listening, Tony Nacarrato?

We're taking the liberty of sharing parts of Leon Shulman's letter, as well as his photographs with our lucky readers. Here it is:

Dear Norm:

It was nice meeting you at the Byron Fly In. Attached are photographs of one of the B-26 bombers I flew while at Westover Air Force Base, near Springfield, Massachusetts, where I was stationed in 1944. This particular aircraft, the "Zombie" which I named after my model "Zomby," was one of the *later* versions — new pilot — new aircraft! This particular version, designated the AT-23, was a stripped-down model with larger wing, and the wing set at a higher angle of incidence with the latest Pratt & Whitney 2800 engines and Curtiss *Electric* 4-Bladed propellers. These aircraft were slightly faster, and flew with the fuselage level with the horizon because of the increased angle of incidence in the wing. The earlier versions, without this incidence change and shorter wing span, flew in a nose-high attitude and were slower because of the increased drag. These new "babies" really hauled! The particular model I flew "AT-23" was used as an aerial tow. We flew out of Westover, towing targets for B-24 groups which

Landing speed of the B-26 was 135 mph; high by World War II standards, but slow, compared to the speeds of current jet fighters. Once pilots learned how to fly the bird, it became one of the country's top fighting aircraft, and the one with the least number of losses.

were being sent over to Europe to the air war which was going on over Germany at that time. These B-26s (AT-23) being lighter and faster, were easily able to climb to 20,000 feet, to rendezvous with squadrons of B-24s off the Atlantic coast, where we would trail the target sleeve behind us, and the B-24 gunners would have a go at it. There were several incidents, however, where my aircraft came back with many holes in it from these 50-caliber machine guns. Who said "1000 yards of steel cable, towing a sleeve behind you is long enough'"? I had to make several emergency landings from such damage, with one incident of my right engine being shot at and smoking!

You might notice that the spelling of "Zombie" was different from that of my model, which was spelled "Zomby." The commanding officer of the base overrode my specific request to spell it like my model, claiming *it* was incorrect and saying, "After all, rank has its privileges."

If there's any further information you may desire, please contact me. By the way, in going through my old magazines, I found that your Spring 1980 issue of *Air Trails Classic Flying Models* had the article and advertising for my Zomby on Pages 12 through 21. Also, in an issue of the same magazine, Winter 1979, you had my article on "The Flipper," which was the beginning of a series I had started to develop for youngsters just getting into models, but at that point, the war came along, and I was off to Air Cadet Pilot Training.

Please keep me posted.

Sincerely,
Leon Shulman

We suggest that you contact Mike Beaulieu for full-size plans of Bob Parcel's B-26 at: M.C. Beaulieu Plan Service, 84 University St., Presque Isle, ME 04769. Pre-formed parts and accessories which are listed on the plans are also available. *Scale R/C Modeler* is happy to allow any modeler wishing to do so, permission to reproduce or copy our controlline plan, for any purpose other than commercial use.

EDITOR'S NOTE:

Watch for Part II of Martin B-26 Marauder coming next month. We'll have Bob Parcel's information on designing and building the model. If you're planning to build this project, we suggest you get a head start on it by getting your plans now, so you'll have them on hand when next month's issue of *Scale R/C Modeler* comes out.

See you right here next month. ●

B-26 MARTIN MARAUDER

PART II
WHAT EVERY MODELER SHOULD KNOW ABOUT BUILDING AND FLYING THE MARTIN

BY BOB PARCELL

Author/designer Bob Parcell, with his B-26 Martin Marauder.

Several years ago, I designed and built the Douglas B-26/A-26, and thoroughly enjoyed the special design challenges of building a multi-engine Warbird. I then planned to build a North American B-25, but John Lockwood had already built a beautiful one several years before, and I wanted to build something unique, so I searched for a different aircraft — and found the Martin.

When I first considered building it, though, I wasn't very impressed with its looks; in fact, I didn't think it was a very attractive aircraft at all, but after spending some time studying pictures of it while gathering my documentation, the sleek lines of the vintage fighter/bomber started to grow on me, and those models which attracted me the most were the ones which were "weathered" and showed signs of having been in battle.

I starting checking the three-views I'd received from Bob Banka of Scale Model Research, and some photo packs of the Martin he'd photographed at the Air Force Museum in Dayton, Ohio.

With the documentation, three-views and photos in hand, I started to lay out my project. It wasn't long after getting started that I realized the landing gear was going to be a nightmare. I quickly figured out that this difficulty must be the reason why the aircraft hadn't been modeled more often — because the landing gear was so complex. Having already decided to go ahead with the project, anyway, I put all thoughts about the gear behind me and started building the airframe.

Soon it was time to start on the gear, and I knew I had a difficult problem to solve. I tackled the problem by building a dummy landing gear from wood, and turning over the mock-up *and* the problem to a man who used to design landing gears before he retired. He listened carefully and couldn't resist the challenge. Six months later, we came up with a working landing gear.

To make the aircraft easier to build, I turned the rights of the design over to Mike Beaulieu of Mike Beaulieu Plan Service, and he agreed to supply plans and the finished gear to modelers at an attractive price. Because of its double-knee action, the gear is quite complex, so in the interest of saving time and trouble, I do recommend that modelers *purchase* the finished gear, rather than try to build one themselves.

I talked to two pilots who'd already flown the aircraft, and both of them told me it was a sweet-flying model — that is, after they'd found the reason for a number of crashes (the props reversed on takeoff), which was a problem encountered by electric props during their first years of use. The other difficulty I found was the unaccustomed way in which a *high* wing-loading airplane had to be flown. This was true of the full-scale aircraft as well, because one pilot who flew one told me an old saying he'd heard about the hazards of flying the Martin in Florida, "One a day in Tampa Bay." (So it wasn't just me.) Once these pilot education and equipment problems were sorted out, the Martin had a better than average war record.

We first flew our Martin model out at Las Vegas with Frank Keller doing the pilot duties. We installed Como 90 engines in the aircraft, without any pre-flight running or setting up; we just bolted them in and went out to fly. On takeoff, the Martin tracked straight as a die, took off realistically, and wasn't that fast, probably because we had decided not to retract the gear on its first test flight. (The wheels have five-inch tires, with large doors hanging out in the breeze.) The aircraft flew rock solid stable, and the tail was at the right attitude, not hanging as it would have, had the plane been just *plowing* sluggishly through the sky.

Halfway through the flight, one of the engines started to sag badly, so Frank brought it in at reduced throttles. It was amazing to us that this 23-pound plane

Parcell also designed a very successful Douglas A-26 Invader featured in *Scale R/C Modeler* several years ago.

would still float in ground effects. This aircraft was light. I used no spars in the wing, but carbon fibers instead.

I'm sorry to have to report that I made the mistake of not having proper photos taken of the aircraft *before* its test flights, and, worse yet, I failed to have a competent photographer *during* its test flights. As a result, we don't have any permanent record of the test flight operations.

What makes this so hard to take is that, on the Martin's *second* flight, we lost an engine, and then the aircraft. At the Martin's "post mortem," we deduced that one of the reasons for the crash was a tip stall at about 20 feet off the runway. The pilot just started to level out, and over she went into the ground. We believe this was due to the lack of wash-out in the wing.

The *new* aircraft and plans call for this essential wash-out to be incorporated in the design. It should effectively prevent slow-speed roll-overs.

Another possible contributing cause was originally using an airfoil which was far too thin. We now build the wing with a scale airfoil which is a full inch thicker at the root.

I believe that these changes (the scale airfoil and the wash-out) will greatly improve the flight characteristics at critical airspeeds.

In the full-scale aircraft, there are two versions of the B-26; the earlier one with a shorter wing and a shorter rudder, then the later one with the larger wing and larger rudder. It was the *first* production run of B-26s with which their pilots had problems; after modifications were made (a larger rudder prevented those "walking" problems to which the earlier ones were prone), flight characteristics were much improved.

The wing loading of our model was low, because it only weighed about 23 pounds, with a wing area of 1200 square inches; numbers which are okay for a finished Warbird twin. The new design will weigh about one pound less than the first Martin, and the lower weight will further reduce its wing loading.

Another change which was made to the wing was flattening the bottom of the airfoil at the wingtip for increased lift, which I estimated would be needed at slow speeds. Therefore, this flattening of the lower wingtip airfoil, coupled with an increase in the thickness of the wing, tapering to a semi-flat bottom, with washout at the tip — was calculated to correct the Martin's problems and prevent a repetition of the previous situation.

On its test flight, the aircraft was flown hands off. It required no trim, and appeared to have no bad habits, with the exception of the low-speed problem, aggravated by an unequal engine thrust.

I wish I could remember more about the Martin's first flight, but I was so nervous I really can't recall too much about it. Most came from analyzing the tape.

The Martin prototype was built of wood, but the upcoming kit will have a fiberglass fuselage. The nacelles were also wood with foam wings. Because I'm a lazy builder, I like to build as fast as I can so I don't care for built-up ribs, formers, etc. I prefer to use the best of the *new* building procedures.

Mike Beaulieu has shown the foam wing, but also the built-up wing for the craftsmen out there. I built the tail surfaces from wood, but in the future I'll build with foam because it's a lot lighter. I also used Hy Johnson's double-sided tape to attach the wood to the foam because I don't like messing around with contact cement.

Another challenging item on the Martin is its large glass nose area into which you can look — right down to the pilot's feet. I did detail the complete interior, but because I didn't use light enough material, I probably gained another 1/2 pound of unnecessary weight. I actually had to add tail weight to this model, can you believe that? The aircraft needs that front

(Continued on page 80)

end detailing, but it doesn't need the extra weight from the poor choice of materials. My next one is going to be lighter.

I'm really fortunate in that, at Chino Airport, not far from where I live, there's a full-size, almost complete Martin, parked where I can measure it and take notes. There's nothing like having a full-size aircraft handy when you're modeling an R/C model of one.

The B-26 was designed with two types of bomb-bay doors on each airplane; the front one folded open, and the rear one had clamshell-type doors which just opened.

My first Martin model was equipped with landing lights which came on when the landing flaps came down. For correct scale, I found a krypton bulb (from inside a mini flashlight I'd bought at K-Mart) which is many times brighter than a regular bulb of the same size.

Because I don't want to mess with glow plug igniters, I equipped my Martin with on-board ignition. In fact, with a scale twin, I feel it's practically a *must*.

The fuselage contains a crutch, made with a mixture of lite ply and balsa, which gives the model its strength. I did this because the body is cut into by the wing platform and the bomb bay doors, and I was concerned about the body breaking in half. I used all lite ply, with the exception of the hard ply I used for the landing gear-attach points.

Mike did change the planking strips from the larger width ones I had used into smaller ones because of the difficulty I'd had with them. When I made the molds for the new model, I used Mike's method of planking, and I had to agree with Mike that not only did it did work much better, it was also much stronger.

The fuselage is typical crutch, formers and a side-shaping member. When these are assembled, the rest is planked. I would get the shape using F2, F3, and F4, and then remove them if you're planning on doing a full cockpit.

The plans which were published in Part I of this article last month showed another method of attaching the wing; but the new plans which will be printed will have the wing coming off *after* a hatch between F6 and F8 has been removed.

For the center beam which goes across the fuselage for the bomb bays, use a nice hard piece of balsa. With the bays and the wing opening, there are only a few inches of fuselage holding the tail on, and a hard landing could crack the fuselage (just as it happened in the full-scale one), so be sure that piece of balsa is very solid, hard and sturdy. Also, don't make the mistake of using anything flimsy in the control system, from the servo arms, to the pushrods, to the control horns, because the model cannot tolerate flexing of any kind.

The plans show built-up tail surfaces, so if you use this method, instead of foam, cover them with 1/16 balsa to keep the weight down. Personally, I prefer foam tail surfaces (they're lighter).

The wing shows a spar; but I opted for carbon graphite, then planked it with 1/16 balsa and made a good butt joint at the center section. This made it so strong that you could pick the 23-pound plane right up, with the wing flexing just a little.

Mike also shows a leading and trailing edge which is heavier than the size I built with, but use your own judgment. I prefer a lighter aircraft.

The ailerons on the plan are built up with a torque tube for control. The wing tips are from a balsa block, with the inside carved out for lightness. The flaps are foam, covered with very light balsa. I also used a torque tube with bushings for the flaps, a method I've used on several models because I found that it worked very well. The full-size aircraft had Fowler flaps on the later models, but there was *no way* I was going to attempt that.

The kit will have foam core wings and tail surfaces, with fiberglass fuselage, nacelles and cowls. The landing gear on the plans is exactly the way they were designed. I actually used the Rhom-Air cylinders used in the landing gear, which are shown on the plans, and they worked great.

The plans show formers in the rear nacelles with planking over them. I made the original model somewhat differently: I used the formers to shape a piece of foam, then, from N3 forward to the firewall, I built that section onto the wing. The tail end of the nacelle from N3 back, I shaped from foam, and covered it with 3/32 balsa. After that, I covered the wood with 1-ounce fiberglass cloth, using K & B epoxy and, when it was dry, I sanded it and popped it off the foam core. The reason why I did this was that the landing gear was so large, I didn't want any problems working around formers. This way there aren't any. This method also made cutting the landing gear doors easy because they were simply cut from the formed fiberglass.

On the engine mounts, I used Como or Super Tigre 90s because, with this size engine, you must cock them a little sideways to allow the head to fit up into one of the cowl scoops; otherwise you'll never get it in there.

I also used brass tubing to run the exhaust out to a scale position, and this location is clean-running because it dumps the residue out behind the wings. I also sealed off the firewall with high-temp silicone to keep fuel from seeping back into the nacelle.

The plans show the cowl flaps closed, but you can buy cowl flaps that are open from T&D, and I feel that it's a necessity in this area to allow the air to flow through the cowl. The plans which were printed last month are now undergoing minor revisions, so the plans you'll receive will differ in a few small areas from those which were published.

The plane flew very well, and in the right hands, could definitely be a contest winner. Because the B-26 went on to be carried in the inventory of countries around the world, when it comes time to detail *your* aircraft, there are many different, well-documented paint schemes to choose from, from tow-target tugs to fighter/bombers and many variations in between. And don't let the Martin's nickname "The Widow Maker" fool you — it's a great-looking, fine-flying authentic Warbird.

You have no way of knowing this but, as you read this article, it's been transcribed from what I'm saying into a Sony mini tape recorder. As I speak into the mike, I'm very carefully going over the plans, and I can't see anything about this airplane that a reasonably experienced builder would have any trouble with whatever.

To sum up the B-26 story so far, *plans for this model are available from the Mike Beaulieu Plan Service, 84 University Street, Presque Isle, Maine, 04769, and the B-26 Kit* will be available from me in the near future. (*Scale R/C Modeler* will let you know when.)

Next month, *Scale R/C Modeler* will feature Part III of this B-26 article which, in part, will explain in detail just how I weathered the aircraft. ●

MARTIN B-26

PART III

AUTHOR BOB PARCELL GIVES MODELERS SOME USEFUL HINTS ON HOW TO "WEATHER" AN AIRCRAFT

BY BOB PARCELL

When it comes to finishing World War II aircraft, Bob Parcell has got to be one of the most expert craftsmen I've ever met. His background in the painting industry provided him with the background needed to approach the problems with an understanding of both the chemistry and the mechanics involved.

Full-size plans for both the A-26 Douglas Invader and the Martin B-26 Marauder may be obtained from: Mike Beaulieu Plans Service, 84 University Street, Presque Isle, Maine 04769. Prefabricated parts and landing gears are also available. See Scale R/C Modeler *August and September 1988 for more information on these great World War II aircraft.*

— NG

In Part I of this article, we brought you plans for the Martin Marauder, along with the history of one of the most attractive bombers of World War II. Then in Part II we included some of the problems and solutions I had encountered while building, flying, and finishing the aircraft.

Here, in Part III, I'll attempt to pass on the techniques of weathering I've evolved during the many years I've been involved in the paint and painting business. It may look, and even sound difficult, but don't worry, it really isn't.

I used to work in a paint factory, and from talking with a great number of fellow modelers all over the country, I've come to the conclusion that many of them just don't understand the theory of weathering. Some of them even try to match the weathered "look" by mixing several colors of paint. I'll admit that I've tried that too, but I was never successful at doing it this way, and realistically, I don't believe it *can* be accomplished by that method, because the very chemistry of paint just won't allow the pigments to break down, even by pre-mixing, to produce that sought-after weathered color or look.

Paint is made up of a base of clear resin, with minute particles of pigment added to it to give it color. The pigment starts out as *small* particles, which are put into a milling machine to break them down into *minute* particles, the size necessary to adequately *cover* the object you're painting with the *color* of the pigment.

One of the problems is that, in certain colors (reds, blues and yellows), those particles of pigment do not break down easily, so more pigment must be added. Now, if you have an olive drab color, it not only contains browns and greens, but it also has yellow in it. Like red, blue and green, any color with yellow in it requires more pigment, and this increases the percentage of pigment in the mix, resulting in a paint with less resin and more pigment.

Now, in the actual weathering process, the ultraviolet rays of the sun *break down the resin* which, in turn, exposes the pigment at the top of the surface. Thereafter, the pigment colors which predominated in the paint will be those which will appear most prominently at the top of the surface. As an example, in an airplane which has been painted olive drab, the first color to come to the surface will be a lot of yellow.

Another feature which affects the way our weathered paint looks is that, to make a *flat* paint, manufacturers add a talcum powder ingredient to the resin (just as we do with our models), so if the aircraft had been painted, like many military aircraft were, with a *flat* olive drab, after it's been out in the weather for some time, you'll see the white of the talcum powder, as well as the yellows and blues of the highly pigmented portion of the paint formula.

On the aircraft which were painted in the later desert/tan camo designs, you can expect to see the red and white pigments surfacing. So, planes which started out a pretty flat tan, will weather to show a pinkish/whitish color, with just a hint of yellow. And, when yellow oxidizes, you'll notice a lot of white coming to the surface, because of the talcum powder used to make the flat paint.

Now, blacks (which contain pigments of all colors) oxidize quite rapidly, and

(Continued on page 54)

MARTIN B-26

(Continued from page 26)

when they do, you'll notice a purple sheen, since purple is composed of red and blue pigments, and because of the heavy pigmentation needed to create these colors (leaving less percentage of resin), these pigments will come to the surface sooner.

So, how can you duplicate these weathering effects *without* letting your plane sit out in the sun for ten years?

Here's how I do it:

After spraying on your basic colors, you add the weathering colors in a light wash coating over the top of the basic color. You can use a flattener or add a white wash to the basic coat. If your aircraft is going to be tan, you'd add a white, pink, and yellow wash over that basic tan. This process produces a pretty realistic weathered tan.

If you're finishing your aircraft, or a portion of it, in red, you need to add a white wash, because when red oxidizes, it assumes a white, bleached-out look.

Here's the technique I used in weathering my Marauder, but first, a little history:

During World War II, because it wasn't very high on the list of priorities for the ground crews *to clean* fighting aircraft, they got really filthy, especially on the bottom, and of course, all that dirt on the bottom of these planes wasn't sprayed on, it simply accumulated — from engine exhaust, dripping oils, dirty runways and parking stands.

These aircraft were flown on missions in all kinds of weather — rain, mist, snow and sunshine — and getting them right back into the air as soon as possible was of primary importance, so when those planes finally *did* get washed, crews could only hit the high spots. If another mission were scheduled the next morning, there was only time to clean the leading edge of the wings and stabilizers, and often, complete surfaces were left dirty. Sometimes crews simply depended on a morning rain to wash off the top of the plane, and that would streak the dirt back under the belly and the wings.

So just think about all this for a while, and let your imagination run free, as you visualize all the weathering which occurred from those flights. That's what I did.

To re-create those effects, on the bottom of my model, which is usually the dirtiest portion of any aircraft, I used powdered charcoal. This can be brushed on with a very light (makeup-type) brush, and then you can use the same brush to remove as much of the charcoal as you want. This method provides a nice clean look, and duplicates the effect you're trying to get, without leaving any brush marks or noticeable rag wipes.

You can practice this, using the powdered charcoal and soft brush, as many times as you want. If you don't like the way it looks the first time, wipe it off and try again. And don't be afraid to keep on doing it until you're satisfied with the results.

Don't forget this important step: Once you've achieved the desired effect, you then *spray-paint a coat of clear over the top of it to make it permanent*.

Now, about panel lines. I've occasionally seen modelers try to make their panel lines look "dirty" by spraying them with a darker paint, but, personally, I've never seen the resulting look on a *real* airplane. What I *have* noticed on the full-scale birds is a build-up of exhaust, oil and/or dirt on those panel lines, and when the aircraft is cleaned, the only dirty portion left is a slight smudge, usually right on the panel line.

This effect can be duplicated in this way: Smear full-strength, water-based black acrylic (you can find this at most any art store) around the panel lines and rivets. Let it set, from 30 to 45 *seconds*, then wipe it off with an alcohol-drenched rag. This will leave the desired nice "dirty" mark around the panel or rivet lines. Use this procedure on all your lighter surfaces.

When working on a really *dark* surface, however, you'll need to *reverse* the process, and use a white (water-based acrylic) instead, because, when the darker colors oxidize, the white talcum powder comes to the surface. You see, back when those ground crews cleaned the full-scale planes, they didn't (or couldn't) get into all those nooks and crannies, so there was always some white oxidation left on those darker colors.

Weathering your model isn't that difficult, once you know and understand the guidelines I've explained above. They're the same ones I've been using for years to give my World War II aircraft that "authentic" weathered appearance, and so far, everybody seems to like the way they look.

So, you see, understanding the chemistry of paint composition is really just good, common sense. That, and a little knowledge about colors, will produce the desired, "realistic" look.

Good luck with *your* weathering. I think you'll enjoy giving your Warbirds this added dimension. Who knows, it might even earn your aircraft some additional static points at the next scale contest you enter. ●