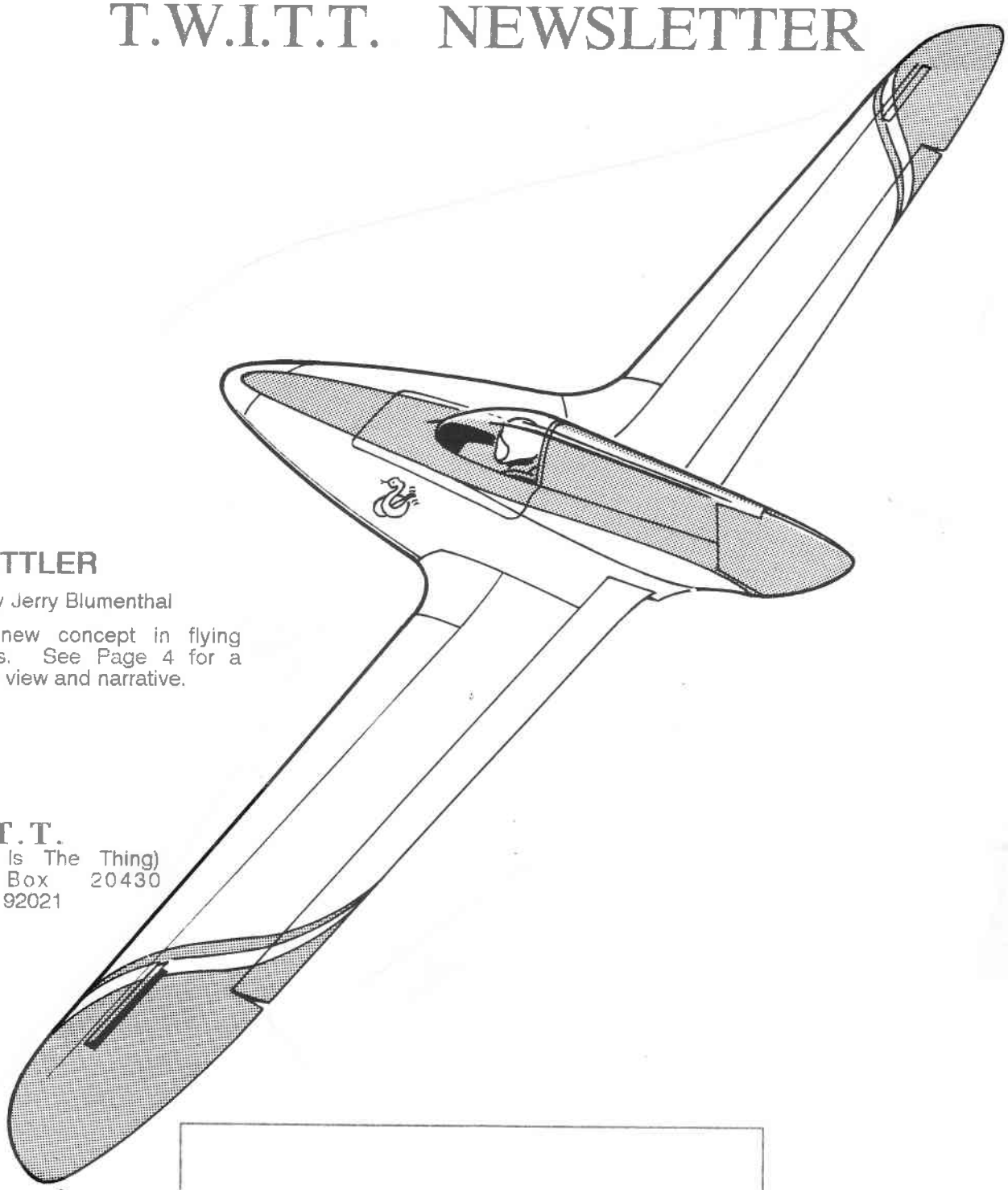
No. 63 SEPTEMBER 1991

T.W.I.T.T. NEWSLETTER



RATTLER

by Jerry Blumenthal

A new concept in flying wings. See Page 4 for a three view and narrative.

T.W.I.T.T.
(The Wing Is The Thing)
P. O. Box 20430
El Cajon, CA 92021

The number to the right of your name indicates the last issue of your current subscription, e.g., 9109 means this is your last issue unless renewed.

Next TWITT meeting: Saturday, September 21, 1991 beginning at 1330 hrs at hanger A-4, Gillespie Field, El Cajon, Calif. (First hanger row on Joe Crosson Drive - East side of Gillespie.).

THE WING IS THE THING
(T.W.I.T.T.)

T.W.I.T.T. is a non-profit organization whose membership seeks to promote the research and development of flying wings and other types of tailless aircraft by providing a forum for the exchange of ideas and experiences on an international basis. T.W.I.T.T. is an affiliate of The Hunsaker Foundation which is dedicated to furthering education and research in a variety of disciplines.

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Meetings are held on the third Saturday of each month, at 1:3Ø PM, at Hanger A-4, Gillespie Field, El Cajon, California (first row of hangers on the south end of Joe Crosson Drive, east side of Gillespie).

PRESIDENT'S CORNER

First, I would like to thank all of you who have been submitting logo designs. It is such a welcome change from several years ago when we tried this. Depending on the response between now and November as to who likes what, I will publish the clear favorites for a final runoff vote, and then we can look into how best to convert it into a decal and/or jacket patch.

In publishing the financial statements in last month's minutes, I neglected to comment on where the Net Income came from and how it is spent. The income is the result of cost savings in publishing the newsletter and from your donations. By keeping the newsletter costs under control, we have managed to go for five years without having to raise the subscription rate. If the current trends continue we don't anticipate them going up for another couple of years. We are trying to conserve on the spending side, using the extra money only for needed items, such as stationary supplies, etc.

I would like to apologize to Jim Loyd for not getting to his plans during this meeting. Between Danny Howell's presentation going a little longer than expected, and the added parts by Harald Buettner and Jerry Blumenthal, we called the meeting at about 4:45. Jim's plans will be carried over until next month, along with some comments by Bob Chase on high thrust lines.

I don't know about the rest of you, but I sure had a good time at the Tehachapi gathering. There several interesting projects, including a flying wing by Fred Blanton, the daily seminars seemed to be very successful, and the Saturday evening meeting was absolutely fantastic. Be sure to read the minutes from that meeting elsewhere in this issue.

Thanks go to Jerry Blumenthal for thinking ahead when he drew his RATTLER concept drawing. He specifically aligned and sized it to fit on the cover with a little unusual twist. We hope you enjoyed this way of presenting a new flying wing to the membership. Be sure you read all about it in the minutes.

I won't take any more room, since this newsletter is going to be packed.

Andy

SEPTEMBER PROGRAM

At long last we will be able to hear first hand, Phillip Burgers' account of his visit

with Dr. Horten in Argentina. You have heard a little about it from a previous newsletter announcing this event, so we won't redo it here. Phillip has a couple of new items that apparently have never been published before and he will be showing them during his presentation.

Also on the agenda will be a discussion of Jim Loyd's BOOMERANG concept drawings we were unable to cover last month. A few of the members had some comments, but we were unable to get enough details to publish them in the minutes.

Bob Chase will have his video tape of the Oshkosh airshow and has some comments about high thrust lines in some of the designs he has seen lately.

It all sounds like a good program with a variety of things that everyone should enjoy. With vacations at an end we are looking forward to a good turnout for this one, so don't let us down.

MINUTES OF THE AUGUST 17, 1991 MEETING

Andy opened the meeting by welcoming everyone to an interesting and packed program. He introduced Ken Hennessey, a TWITT member who had come all the way from Tempe, AZ to listen to Danny Howell's presentation on flying wing hang gliders, since that is his area of interest in belonging to TWITT.

The program began with a short video and talk by Harald Buettner on his involvement in a local high school's cross-country bike project. They came to Harald at the eleventh hour looking for help in building a composite framed high speed bicycle for a trek from the California-Oregon state line to the Mexican border. They gave him a concept drawing, and Harald went to work. By the time he finished they had a one-man, semi-prone bike that was streamlined with a lycra type material supported by carbon-fibre fishing rods.

The timing was so close that the boys only had a chance to ride the bike one time before they all, including Harald, left for northern California. The trip was anything but uneventful, and Harald had his hands full doing on the spot repairs when the bike would fall over and break the rods. This happened enough times he had to modify the structure since he was running short of rods.

Weather, political meetings and highway problems caused a number of delays which meant trailering the bike instead of riding it. But, after three days of hassles and multiple rider changes, the boys made it to the border with full TV coverage.

Supposedly they are going to try it again next year, but Harald has already told them they had better give him a lot more time to build a proper vehicle for the job.

Andy then introduced Danny Howell, who told the group about his latest flying wing hang-glider project. He began his presentation with a brief historical overview of hang-glider evolution and how it influenced his current design. He felt this was an important part of the project to ensure that some of the same errors others have made in the past are not made again. Some of you have had an opportunity to see the actual aircraft when Danny was doing the initial rigging in Bob's hanger last year.

Danny's company, Glider Sport International, has expended nearly $250,000 so far on perfecting the current design which will be going into production very soon. Much of this was provided by sponsors, and he has since joined forces with another company that has the experience in composite construction techniques.

Danny said that designing a hang glider has been one of the toughest projects he has ever undertaken. This is due, not to the aerodynamic concerns, but all the collateral issues demanded by the users, such as, transportability, ruggedness, simplicity, etc.

The modern day hang glider is now going through the same types of rigorous testing and certification that normal airframes do. They are fully loaded to determine g-load capability, and many are tested through the full range of operation with strain gages reading the results.

Danny talked about another project that has been completed which was an evolution of the Mitchell wing with three axis control and flaps. The designers were able to accomplish the delicate balance between flaps, sweep, and control mixing to come up with a good performing hang glider. He stuck his neck out by saying his new design would probably out perform this flapped wing, even without three axis controls.

An article out of Hang Glider Magazine showed that in order to optimize a wing's performance, the pilot must be fared in to reduce his contribution to the total amount of drag. Danny commented later that his wing would eventually offer a fairing for the pilot as an optional piece of equipment.

Danny showed us his initial CAD drawings of the wing where he first started validating the numbers and configuration. In this case he came up with a double spar arrangement with a D-tube leading edge, representing 40% of the airfoil. The rear 60% was aerolastic sail cloth supported by truss ribs. He has tried to remove the elasticity of the rear section through the truss design.

The airfoil he is using has not always received the best of press, but he has found that in this particular application it is working rather well. There are three different airfoil shapes over the span of the wing that were designed through an analysis of the pressure distributions.

He was able to optimize the airfoil quickly through the use of some high powered computer programs at Northrop with the aid of Irv Culver. He also analyzed the twist using Irv's somewhat proven theories of break points along the span *(this has been presented in other newsletters)*. This computer analysis saved weeks of manual computations, and allowed an interactive variation of the twist with immediate feedback on performance. Unfortunetly these type of programs are not available to everyone who wants to design an aircraft of this caliber.

At this point he had to make a decision as to how to proceed with the project. The final solution was to develop the front 40% tooling that would be used in the production aircraft. This meant any tweaking would have to done on the rear 60% which is not as easy a task. But he felt that all the analytical work was well founded and that this was the best way to keep the project moving ahead.

Danny wanted a 100% composite wing, but had to settle for 40%, with the remainder being flexible. The airfoil usually tripped at about 10%, but the smoother surface possible with composite tooling would enable him to get it back a little further.

The structural loads were to be taken by the two spar box, with the leading edge only providing a fairing for aerodynamics. It was constructed throughout with carbon fiber with a little Kevlar. Everything was designed around a central keel which would float between the wing halves in a set of saddles and transmit the pilot loads into the wing.

The main lug pins would be separate from the main spar pins to allow the keel to act as an energy absorbing device during crashes creating axial loads on the structure. The composite materials would only receive smaller secondary loads under these circumstances, and Danny said it has proved successful so far.

Construction used honey-comb sandwich for the skins instead of foam, but foam could be used later if the honey-comb doesn't work as planned. They use a film adhesive to attach the honey-comb to the skins to prevent the adhesive from flowing down into the cells. So far it has worked out fairly well, although it is a little tougher to work with.

The original plan was for the structural spar box construction to result in a wing weighing about 95 pounds. However, it came out a lot heavier, like 140 pounds, than this due to increases in hardware size, layers of composite, paint, etc. This came about because of his conservative attitude at this, knowing that he could trim it back at production time.

He constructed a test section of about ten feet to put it through the loading factors and determine the root hardware failure points. The wing took 140,000 in. lbs. of bending moment before there was a failure of a welded joint and not the composite area of the root fittings. This was well beyond what he had expected.

The root fittings are of removable metal, bolted through the composite spar structure. The bolts carry the load. He did it this way instead of building an integral fitting in order to make it easier to fix in the event of accidents.

The trailing edge sailcloth is attached to the hard surfaces with a heavy duty zipper. It has a mylar gap seal, like on modern sailplanes. This allows quick and easy breakdown, with the sailcloth being slipped out to the tip section without having to be fully removed. They have broken it down within 7 minutes with this system. Eventually a sail track type of attachment may be tried.

Before the initial test flights, the pilot asked Danny to increase the size of the tip rudders to ensure he could get a positive pitch-up for landing. A square foot was added, however, the production models will have this removed since it was found to be unnecessary.

The truck testing showed lifting forces of over 400 pounds which was more than enough to carry the planes 140 lbs. and that of the 200 lb. pilot. Even at this higher weight, it has been able to land in 5 mph winds with a one step landing.

The test pilot had only one comment on landing and that was maybe there was a need for a little more dihedral in order to prevent it slipping out in turns. This didn't need

to be done right away, but should be kept in mind. Right now it has 5 1/2 degrees, which Danny feels is quite adequate with the 14 degree quarter chord sweep and a 16 degree leading edge sweep. The wing has a taper ratio of about .47 with a 30" tip chord. Danny has optimized the tip airfoil to help improve the stall characteristics.

Danny closed out his talk by predicting that someday a high performance hang glider will be able to set records along the Bald Eagle Ridge line on the east coast. The flight from Pennsylvania to Tennessee will be possible with the increased glide ratios now coming into existence within the modern hang gliders. This will be an entire project in itself similar to the Daedelus flight between Greek islands.

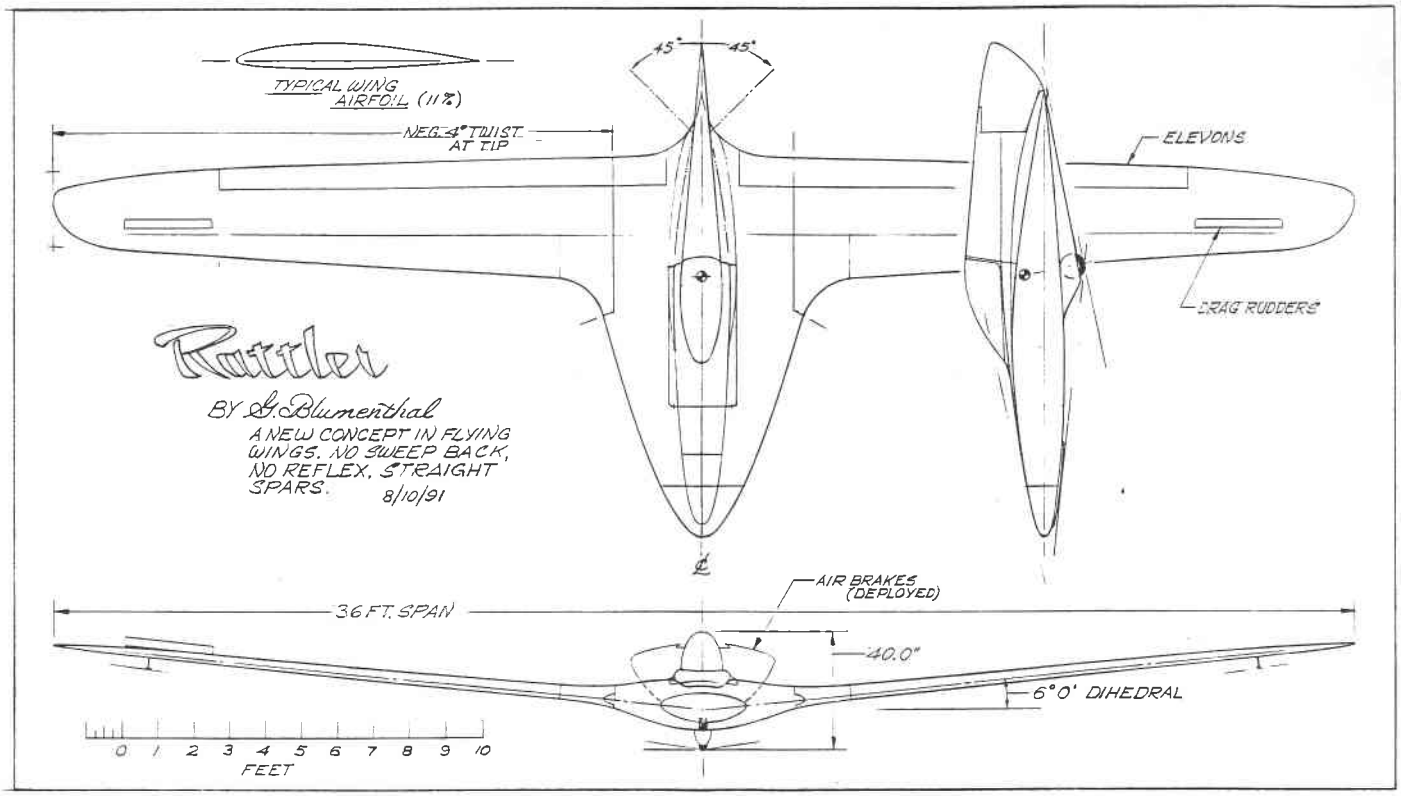
There was a great deal more said by Danny as he went through his slides and discussed a video he had of some flight testing. If this topic interests you, we can provide you with a copy of the tapes (about 2 hours worth) for $4.00 post paid in the U.S.

After a short beverage break, during which time Bob won the raffle prize of a T-shirt picture of his choice, Andy turned the floor over to Jerry Blumenthal. Jerry wanted to make sure he got in everything he wanted to say about the RATTLER, so read a short commentary, which is reproduced here.

"History - There has never been done anything quite like this design in the history of sailplanes. The nearest I can find are the experiments by Jack Northrop and Anthony Stadlman in 1929. Their craft was built as a wing with two light booms extending aft to support normal horizontal and vertical tail surfaces. Power included both tractor and pusher arrangements with buried engine.

"The work done by the late Mr. Norman Cross also deserves mention here, although his models were never intended as high performance sailplanes. These models were pusher engine powered and were basically deltas with extended tips. Mr. Cross always contended that his concepts were 'borrowed' by both Douglas Aircraft and Consolidated Vultee (Convair). Mr. Cross worked in the wind tunnel at Convair for many years.

"Concept - It has long been my contention that a wing could be made to 'fly' that had no sweep back, had an airfoil without the losses of a reflex trailing edge, and without vertical surfaces for yaw control. The first successful model that I built was the 'BULLSEYE' (TWITT Nov. '90). This model was quite stable but required upturned tips for directional stability. Also, the canopy for the prone pilot's head was destabilizing since it was ahead of the cg. I realize that 'flying



plank' designs have been flown but all of these needed at least reflex trailing edge airfoils for longitudinal stability and some form of vertical.

"I asked myself, could BULLSEYE be made to fly stably without upturned tips for directional stability? The answer was 'RATTLER' that I present here today. First I sat the pilot upright in a slightly reclined position to get rid of the forward canopy. Since he still needed a canopy, I extended a faring aft to incorporate airbrake flaps. The forward pilot body enclosure was designed to contribute lift to the entire configuration similar to what a canard does.

"The center of gravity now fell ahead of the basic wing. By adding 6 degrees of dihedral, the wing now became effective as rudder area. To test this, I flew the model without the canopy or faring. There was no sign of spiral instability. Dihedral was acting as rudder.

"RATTLER seems to answer all the requirements of a simple, straight forward flying wing with no compromises for lift, stability, or control! The design was sized to be no larger than 'LIL DOGIE' but could be faster and probably lighter. This concept could be massaged into a higher aspect ratio, higher performance machine that could compete against either conventional or flying wing aircraft. I contend that this design is a technological break through beyond Fauvel and Horten.

"I have said that we must never stop with what has been done. I respect the work of those who have gone before, but let us use their work to go on to new things. VIVE LA TWITT."

Jerry then demonstrated his model's flying capabilities for group. The airfoil has no reflex, with a twist of about 4 degrees. One of Jerry's goals is to keep the construction simple by using a straight spar instead of complex sweeps and angles. He feels it could easily be built out of wood, composites or metal since there are very few compound curves that need forming.

Jerry says he is not patenting any part of this design, and welcomes anyone to take his ideas presented here today and do with them what they may. He is also looking for comments about what may or may not be wrong with it, so here is another chance for the members to speak their minds on the subject of flying wing design.

Bob Chase pointed out that Jerry's previous design, the RASPBERRY, had a very high thrust line which could present problems at takeoff. Since the elevator is so close to the cg it may be difficult to overcome the pitch down effect of the high thrust line, plus the amount of elevator needed during climb would also cause a substantial amount of drag.

MINUTES OF THE AUGUST 31, 1991 MEETING AT TEHACHAPI

The meeting got underway after everyone had a chance to witness the auto-tow of a Carbon Dragon ultralight sailplane, and 2 delta wing hang gliders flown by Dan Armstrong and Floyd Fronius into the calm evening air, and finish their barbecue dinner. There were over 40 people present with some coming from as far away as Battleground, WA, St. Louis, MO, and College Station, TX. Obviously, SHA workshops are a good drawing card if you want to get a bunch of aero-nuts together.

Andy opened the meeting with a short explanation of what TWITT was currently doing in the arena of flying wings. He then asked all the TWITT members who were present to standup, and unfortunately there were not very many there to show our support of the flying wing movement. But, those of there had a really good time, so the rest of you missed a unique opportunity to mix with some of the people who are the history of soaring.

Andy then made a special presentation to Bruce Carmichael. Bob Fronius donated his raffle prize back to TWITT, which we turned into a set of T-shirts for Bruce and his wife Georgie. Each had their picture on it, an unfortunately, Georgie was not there to receive hers. The award was made to recognize the many contributions Bruce has made to TWITT over the years, and for Georgie's support in allowing us to have Bruce each month. Thank you Bruce for your efforts over the years, and we are looking forward to many more years of your talent to help TWITT grow and prosper.

The meetings first presentation was by Harald Buettner, who gave a brief explanation of his Flying Surfboard design which he had submitted to SHA's annual design contest. We won't go into details here since it has already been covered in a previous newsletter.

Harald then told the audience a little about his bicycle project covered in our regular minutes. He also went over some other material on Jerry Blumenthal's concept drawings and what he was planning on doing with his latest

design, RATTLER, which will be a 1/8 scale radio control model with a 54" wingspan.

The meeting was then turned over to Don Mitchell, our principle speaker for the evening. I am sure most flying wing buffs don't need a lengthy introduction to Don and his efforts in the flying wing industry. He has several successful hang gliders and powered flying wings to his credit, many of which have been used to set various records. He has been involved in flying wing development and design since before WWII, and worked for many years with Hawley Bowlus on conventional and flying wing designs.

Don began the his presentation with an overview of his historical background in aviation leading up to his present day activities in building his latest design, Stealth II, which was his entry in the SHA design contest this year.

Among one of his early successes with flying wings came when he obtained the flight test vehicle Bowlus was using to proof his design to the U.S. Government for a troop carrier. Don took the twin booms and, horizontal and vertical tails off of the CG-16 prototype model, added his now standard inverted airfoil control system and split tip drag rudders. The flight tests of this glider went very well with only slight wandering tendency noticed due to the lack of any vertical surfaces.

One of the advantages to using external surfaces aft of the tailing edge is that the entire wing now produces lift since no part of its surface is acting as a control. He is convinced this is one of the best ways to go, and his wings that use it are good flying, stable aircraft.

After proving his theory of inverted control surfaces worked, he contact Jack Northrop, who at that time was nearing completion of the YB-35 program. Northrop apparently liked the idea, but commented they were already committed to the current design and its control system.

One problem that plagued both Don and Northrop was the pitch sensitivity of short coupled aircraft. Northrop solved the problem with a complex adjustment system which allowed the pilot to change the ratio of control movements to the stick depending on speed. Don tried a similar device on his two place experimental wing, but found that it really wasn't necessary in that type of ship.

Don sort of stayed out of the flying wing area for a number of years after that initial success. He was then asked to design a hang glider, and that is when he produced the B-1Ø. This design has evolved into a number of variations, including power versions. Each has basically the same wing, but its what you hang underneath it that creates the different models. This design has won a number of prizes at the EAA fly-in at Oshkosh since it has very good flying characteristics and the owners have done outstanding jobs in finishing and flying the aircraft.

There was also the A-1Ø, which was an aluminum skinned version of the B-1Ø. Don doesn't like it very well because the skin is so thin, about .Ø12. that it is easily dented. It is placed over a foam core, but this still does not provide enough stiffness to prevent inadvertent dings. Repairing them is not easy and usually leaves a messy looking patch which detracts from the overall looks of the aircraft.

The B-1Ø has a control stick that comes out of the bottom of the wing into the pilot's hand. Don said he won't build anything with this type of stick configuration again since it causes some confusion with the more experienced pilots. Apparently, they have a tendency to push or pull the stick in the wrong direction until they get used to it. Novice pilots don't seem to have the same initial problem.

When Don got to a picture of the Victory Wing, he commented briefly on how the foam cores were cut. The exterior surface of the inner wing panel was hot wired to shape, and then the inside hollowed out with the hot wire rig. This inside section then becomes the outer wing panel which saves time and material. The break between the panels also makes for a convenient place to fold it in on itself for easier transportability.

The airfoils he used for the Victory Wing were of his own design. When he first got started with the U-2 he used a Wortman section that had a hook in the rear end but it turned out to be the wrong one. The initial flight of the U-2 with this airfoil resulted in the rear of the wing getting airborne before the nose. Ballasting finally took care of this, but he changed to a reflexed section which seemed to solve the problems aerodynamically. He wasn't sure what he really had for an airfoil on the Victory Wing, but he knows that it flies fairly well.

When viewing a picture of a Horten wing Don commented on how he feels the airframe should be kept simple with a single airfoil used throughout the wing span. He felt all these complicated airfoil changes that Horten used

were entirely unnecessary to accomplish acceptable flight characteristics. However, he does subscribe to Irv Culver's theory of wing twist and will be using it in the Stealth II.

Don commented that one of the biggest problems with building a pure flying wing is that you have to get a man into it. Unless you build one big enough, you can't get a man fully inside, and if you do then you have an aircraft with about a 1/2 lb/sq. ft. wing loading. If he lives long enough he would like to build a wing with about an 8Ø' span and make it a four place, since you would have the room.

At the current time Don is interested in ultra-lights, micro-lights, and multi-purpose aircraft like the Stealth II which can be flown from land, sea, and snow, and is self powered. He believes in keeping it simple, no laminar flow airfoils, so the average flier can have fun flying rather than spending time working on keeping up the performance.

As the ten o'clock bell began to chime, Don finished his excellent talk on flying wings, aviation history and Hawley Bowlus.

(If anyone is interested in hearing the entire presentation it takes approximately 2:15 of tape. The same offer as with the regular minutes applies, so send us $4.ØØ for tapes and postage.)

LETTERS TO THE EDITOR

7/26/91

TWITT:

Although late, I am sending you a sketch showing a possible logo for TWITT.

If I may, I would suggest that the logo should not include any particular tailless configuration, since advocates of other planforms might dislike it.

We should try to draw some idea from nature: the Zanonia seed would be ideal, but it is completely unknown to most people.

My sketch includes a bird: perhaps others can suggest something better.

As far as the name of the organization is concerned, I like very much TWITT: it's unique, it's original. Honestly, I don't see any reason for changing it: granted, at first glance it does not identify our activity, however, we are much better off if people ask us about our organization and scope.

Sincerely,
Ferdi Gale'

(Ed. Note: Thanks very much for the logo entry, which by the way is not late since we are still looking for good suggestions. Also, thanks for the comments on the name. TWITT seems to be the name of choice from what I can gather talking with others in the group, so obviously we will stay with it.)

7/29/91

TWITT:

Please find here enclosed a copy of the sketch attached to the Lippisch patent dated Oct. 24, 1933 (application filed on Nov. 12, 1931) based on an earlier application in Germany, dated Dec. 13, 1929: it has been sent to me by Dr. H.V. Borst, author of the book The Aerodynamics of the Unconventional Air Vehicles of A. Lippisch.

As it appears from the patent claims, this tailless with positive sweep has aerodynamic twist only, external Junkers type control surfaces, and airfoiled tip fins with rudder: these features are found in several early realizations by Lippisch, as well as in several free flight models which he used to establish his design philosophy.

One of these models is shown in the attached illustration 1.4, while illustration 2.12 shows a Russian tailless built much later which incorporates several of the Lippisch ideas.

Both illustrations are taken from the forthcoming book Tailless Tales, a low key approach to the tailless configuration.

Regards,
Ferdi Gale'

(Ed. Note: Thanks for the illustrations, which the members will find at the end of this newsletter. It should be noted that Don Mitchell commented briefly on Dr. Lippisch's external control surface designs during the SHA/TWITT meeting at Tehachapi, and that all great minds must work alike seems like an appropriate comment on the development work these two have done over the years.)

AVAILABLE PLANS/REFERENCE MATERIAL

Tailless Aircraft Bibliography
by Serge Krauss
Cost: $20
Order from: Serge Krauss
3114 Edgehill Road
Cleveland Hts., OH 44118

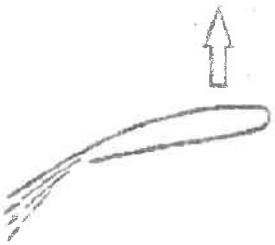
Horten H1c construction drawings with full size airfoil layout. 30 sheets 24" x 36" with specification manual. Price: $115.

Horten Newsletter
Cost: $5 per year for US/$7.50 foreign
Order from:
Flight Engineering and Developments
2453 Liberty Church Road
Temple, GA 30179
(404) 562-3512

FLYING WING SAILPLANE PLANS AND KITS: Two time-proven, 13m homebuilt designs suitable for the novice pilot. Build either the MONARCH "F" ULTRALIGHT (19 to 1), or the PIONEER II-D (35 to 1) sailplane.

Info packs $8 each, or $15 for both.

Marske Aircraft Corp.
130 Crestwood Drive
Michigan City, IN 46360



THE HIAM AIRPLANE
NEEDS YOUR HELP

For those of you who would be interested in assisting Budd Love with some aspect of his High Internal Air Mass (HIAM) project, he would be glad to hear from you. This concept has great potential for the future of air transportation.

Contact: AIRLOVE, LTD.
6423 Campina Place
La Jolla CA 92037
(619) 459-1489

MODEL WINGS

The cover of the July 1991 issue of RCModeler features a flying wing called the "Stealthbat" offered by Wing Manufacturer. There was no price listed, but they can be contacted at:
306 E. Simmons
Galesburg IL 61401
(309) 342-3009
Catalog: $4.00

Omni Models carries the Future Flight Klingberg Wing kit for $39.99 (item #FTF4000). They can be contacted at:
P.O. Box 1601
Bloomington IL 61702
1-800-747-6664 or (309) 663-5798
Shipping: $5.00

Oct. 24, 1933. A. LIPPISCH 1,931,928

AIRCRAFT AEROFOIL

Filed Nov. 12, 1931

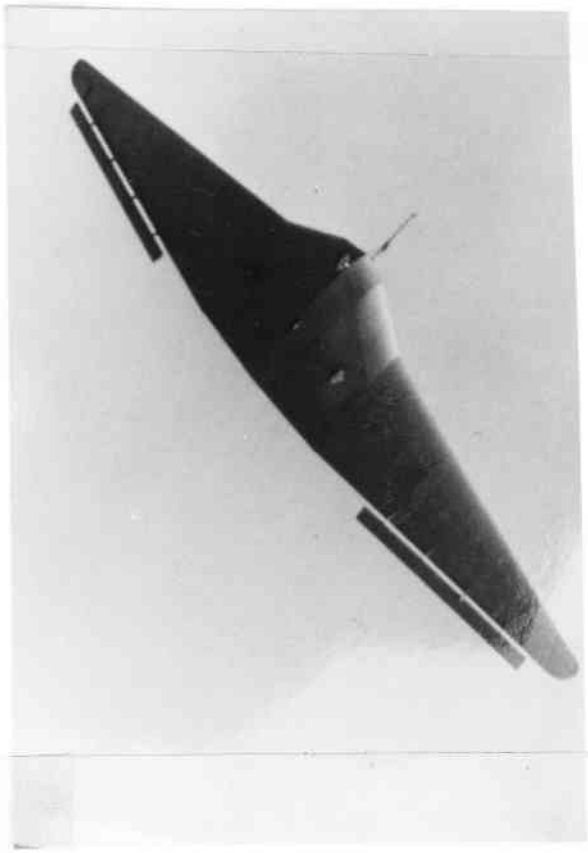


Fig. 1.

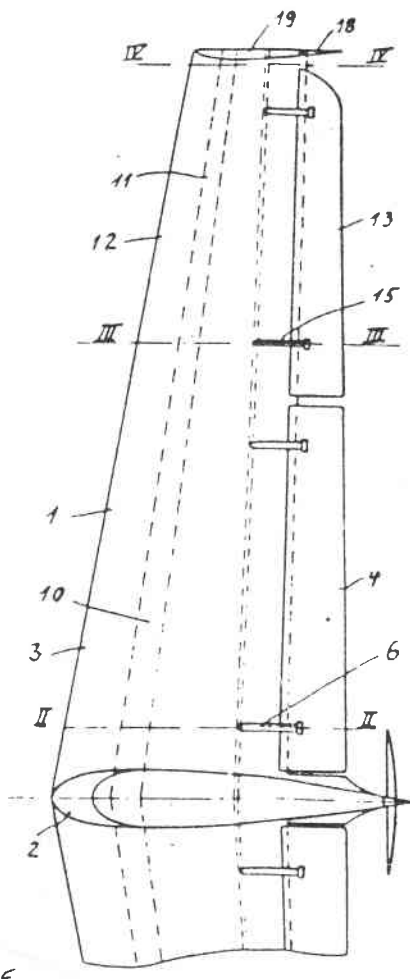


Fig. 4.

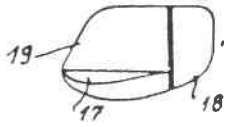


Fig 3.

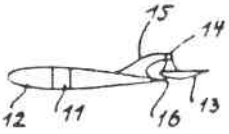
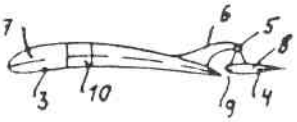
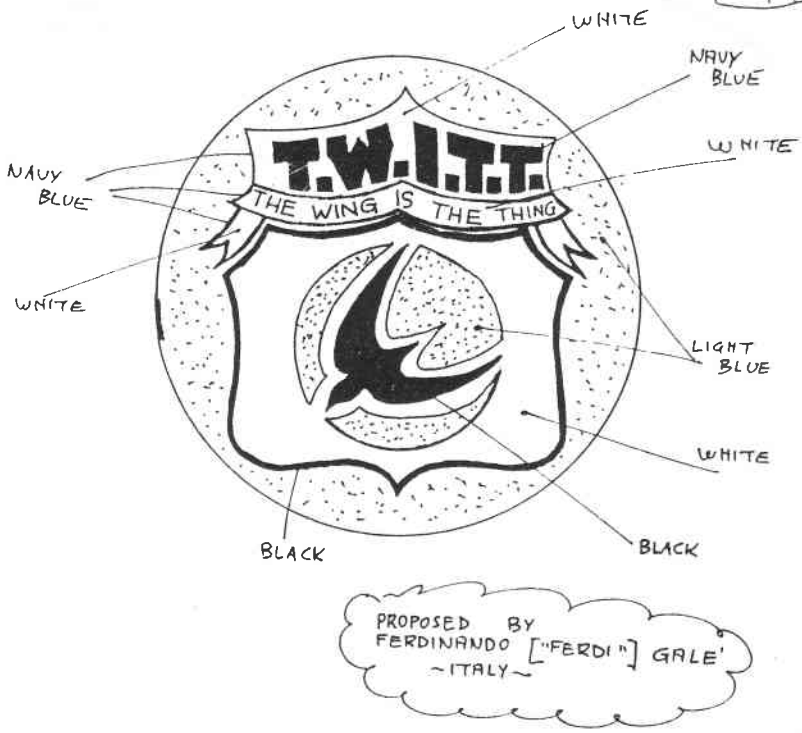


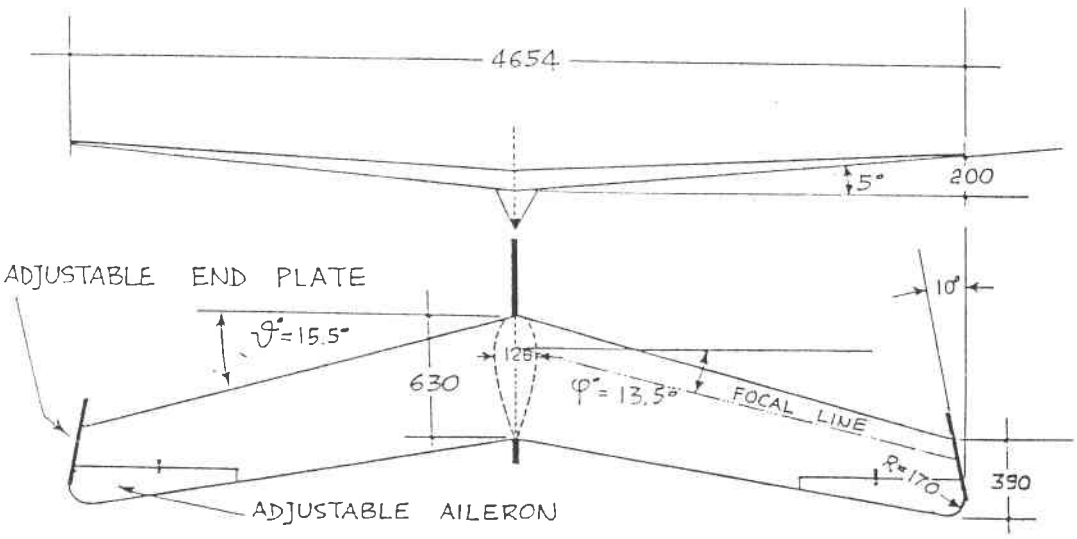
Fig. 2.



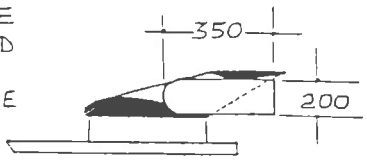


PROPOSED BY FERDINANDO ["FERDI"] GALE'
~ITALY~

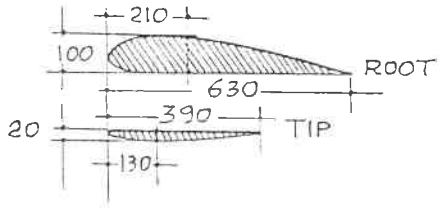
Inventor
Alexander Lippisch
By B Singer Atty



THIS SUCCESSFUL FREE FLIGHT MODEL PAVED THE WAY FOR THE DEVELOPMENT OF THE "STORCH" SERIES



MODEL N. 4 1926
BY ALEXANDER LIPPISCH
~DIMENSIONS IN mm



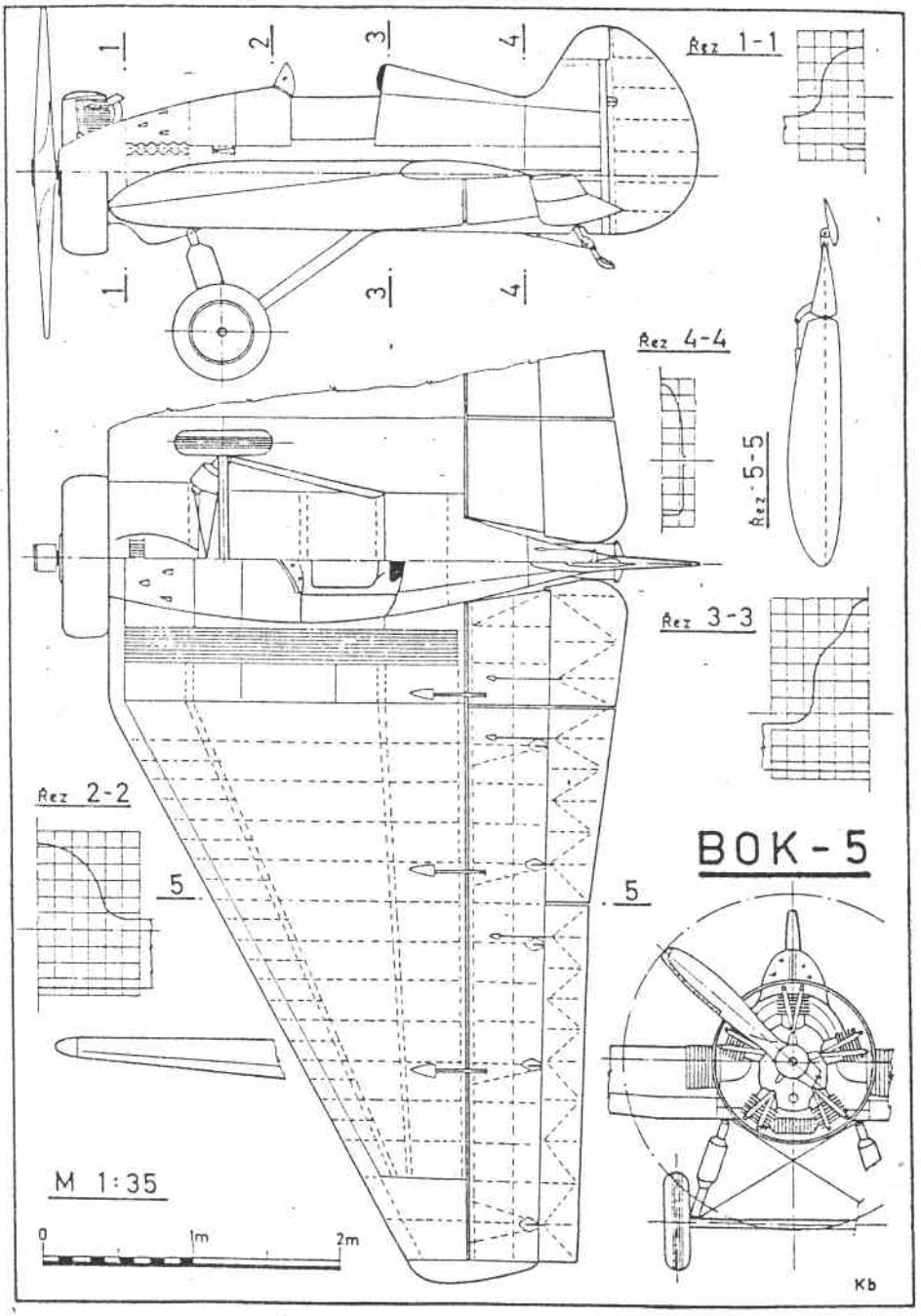
→ NO GEOMETRIC TWIST

→ AERODYNAMIC TWIST : AIRFOIL CHANGING GRADUALLY FROM ROOT FLAT BOTTOM [15.8%] TO TIP INVERTED FLAT BOTTOM [5%]

FIG.1.4

.....To fly models is a lot of fun, but be always aware that many achievements in large scale aviation made their way through aerodynamic childhood as models.....

Alexander Lippisch (from AIR TRAILS PICTORIAL, May 1950)



"BOK-5", a Russian powered tailless; note the external,Junkers type flap, with inverted airfoil (section 5-5).
Span b=9.86 m Length f=4.36 m Wing area S=18.9 sq:m.
Empty weight 596 kilos Take off weight 764 kilos
Top speed 174 Km/h Landing Speed 85 Km/h Climb rate 2.1 m/sec
Ceiling 4850 m Take off run 125 m Landing run 200 m
(from MODELAR, 2/1974)

FIG.2.12