No. 366 JANUARY 2017

T.W.I.T.T. NEWSLETTER

A common approach to generate yaw control moments without a vertical fin is to create asymmetric drag by means of differential flap deflections, that is, by deflecting two flaps on only one wing in opposite directions. In contrast to a conventional rudder deflection, the resulting yaw moment is not linearly dependent on the deflection angle. Furthermore, the efficiency of this technique depends substantially on the flight condition, notably the angle of attack. Source: https://www.ave.kth.se/avd/flight/control-of-tailless-aircraft-1.46621

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

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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 tailless aircraft by providing a forum for the exchange of ideas and experiences on an international basis. T.W.I.T.T. is affiliated with 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 every other month (beginning with January), at 1:30 PM, at Hanger A-4, Gillespie Field, El Cajon, California (first row of hangers on the south end of Joe Crosson Drive (#1720), east side of Gillespie or Skid Row for those flying in).

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PRESIDENT'S CORNER

In August 2011 I posted a letter from John Patten about a proposed circular wing design by Norman Heuvel along with his concept for a high-bypass ratio version of the radial flow engine. I was supposed to include the engine material in the September 2011 issue but other stuff took its place and I forgot about it in subsequent issues. It came to the surface again as I was looking for material in the archives to take with me on my move to Austin. So this issue will include some of the more interesting pieces provided to John by Norman in 2011. The included some more information on the engine that I will post next month to sort of put this concept to bed.

I do find it interesting that the concept had not had not been further considered in regards to how to bury the engine in a stealthy airframe. This is one of the issues faced by the F-117 and B-2 that were solved with grills or engine face set-back into the fuselage. Perhaps this is something still being played with at Area 51 that would explain supposedly flying saucer sightings over the years. I am not a conspiracy advocate, but if the design had potential according to the Air Force at the time, then I find it inconceivable they haven't been pursuing it under strict secrecy. Your opinions are welcome on this one since you usually know more about these things then myself.

Andy

LETTERS TO THE EDITOR

(ed. – The following article was contributed by Vittorio Pajino through the Experimental Soaring Association (ESA) but I thought it generic enough that everyone should have an opportunity to read it. If you have any comments on the subject, please forward them to me and I will be glad to pass them along to Vittorio for a possible response. It is obviously an abstract from a much more detailed report since there are references not included in this piece.)

The Spin

After having made the control analysis it is indispensable to know how to design a safe sailplane that will not enter in a dangerous spin

An answer to this question could be: about the spin. A lot of ink has been poured until today by competent people treating this matter but, despite the technical progress made in the past years and the flight test experience, we have not yet found a definitive and exhaustive answer to this question.

From a mathematical point of view it must be:

$$\frac{dCl}{d\alpha} \leq 0$$

and this in order to have a damping effect that avoid that the sailplane enter in a spin.

Apparently when it is verified the relation:

$$\frac{dCl}{d\alpha} \geq 0$$

the moment M_X shown below became so high that the sailplane - or a light airplane - enter in the spin. In other words the sailplane enter the spin because of the angle of attack increase and, in the expression of the moment M_X about the longitudinal axis shown below, as we can see, appear the derivative of the coefficient C_F, i.e. the slope of the C_F curve, but this is true only at low angle of attack.

The spin instead happens at relatively high angle of attack, therefore this hypothesis is not anymore valid. We have to introduce the component perpendicular to the rotation axis. This force can be expressed by the:

$$F = \frac{1}{2}\rho\, S\, V^2 \cdot \sqrt{Cl^2 + Cd^2}$$

and therefore the moment expression about the longitudinal axis is

$$M_X = \rho\, V\ p\ J_X \cdot \frac{dC_F}{d\alpha}$$

In order to analyze the spin is required to know the derivative of the aerodynamic force coefficient. If we intend to enter in this subject we must start calculating the polar extended up to an angle of 90.

If the area of the polar in which the value of the vector:

$$C_F = \sqrt{Cl^2 + Cd^2}$$

is always increasing, theoretically only, the spin is not possible. The so-called “normal” spin must be compared with a sailplane polar for which the spin is - only theoretically - impossible.

The above is related to a sailplane moving on a normal path and not on a deviated one by a gust. If the deviation is on one side of the sailplane plane of symmetry we have an anti-spin attitude, meanwhile if the deviation happens on the opposite side we have a pro-spin attitude.

These few lines have been written only with the purpose to show, very shortly, the basics of the phenomenon and the above do not give an answer to the initial question. Moreover we have to take into account that the considerations above made have been done only for one degree of freedom and in the plan, not in the space.

The sailplane instead, manoeuvring in the space, has six degrees of freedom.

To study the spin we must give to a mathematical model six degrees of freedom required for manoeuvres made in a three-dimension space.
This is a complex matter involving many variables.
After having prepared preliminary and complex calculations, only experience made in a special wind tunnel of the type shown in fig. 26, and especially from flight tests, we can get answers that complex calc-

ulation cannot give. All the above require to be analyzed by expert people not easy to find and at a high cost.

Only from flight tests will be derived a spin recovery procedure and this must be included in the flight manual. In the CS 22 rules are indicated the standard steps required for the spin exit . These are the base from which to start.

Tests made with “big” flying models must respect also the inertial characteristics of the sailplane and the model must be provided with adequate equipment capable to transmit the data from the model to the ground recorder.

Being the model chords shorter than the real one, the Reynolds Number will be different and the airfoil characteristics and behaviour will be different also.

A further complication in an already complex matter. A sailplane can enter in a spin because of a mistaken manoeuvre or because the pilot bringing deliberately the machine in the spin. The CS 22 indicate in the section Flight at the CS 22.221 to 22.223 sections the recommended procedures to follow in order to exit from the spin and these must be related to the sailplane behaviour and reported in the flight manual. Despite the above conclusions we suggest to research in the Universities libraries specialized literature dealing with the subject.

From the design point of view we suggest the use of the R. Ae. S. Data Sheet or American literature on this subject.

The spin manoeuvre involves a substantial fin masking because the horizontal tail is, probably, already stalled. A value of :

$$\left(\frac{\partial Cl}{\partial \alpha}\right)_{RUDDER} = 0.04/°$$

is necessary to help the sailplane to get out of the spin.

Using R. Ae. S. Data Sheets – Controls from 01.01.01 $\rightarrow 05$ and Wings 01.01.05, lead to a value of 0.035 / °, if the ratio between fin chord and rudder chord is = 0.4.

Therefore the value 0.04 / ° is acceptable in a theoretic way, but only flight tests can check if this value has been correctly estimated.
See also in the References the NACA reports about the spin. They are useful and valid even if not recent.

(ed. – Here is a reprint of parts of John Patten’s original letter that included the information provided to him by Norman Heuvel on his high-bypass ratio of the radial flow engine. Following the letter will be some of those documents.)

I am enclosing a packet on the flying platform. I sent you some information on this concept years ago saying I would follow through with more. I did not intend it to take <u>this</u> long.

This is a concept a student of mine put together back in the 80’s. Do not know whatever happened to him or the project. I hope you enjoy looking at it.

John Patten

February 8, 1986

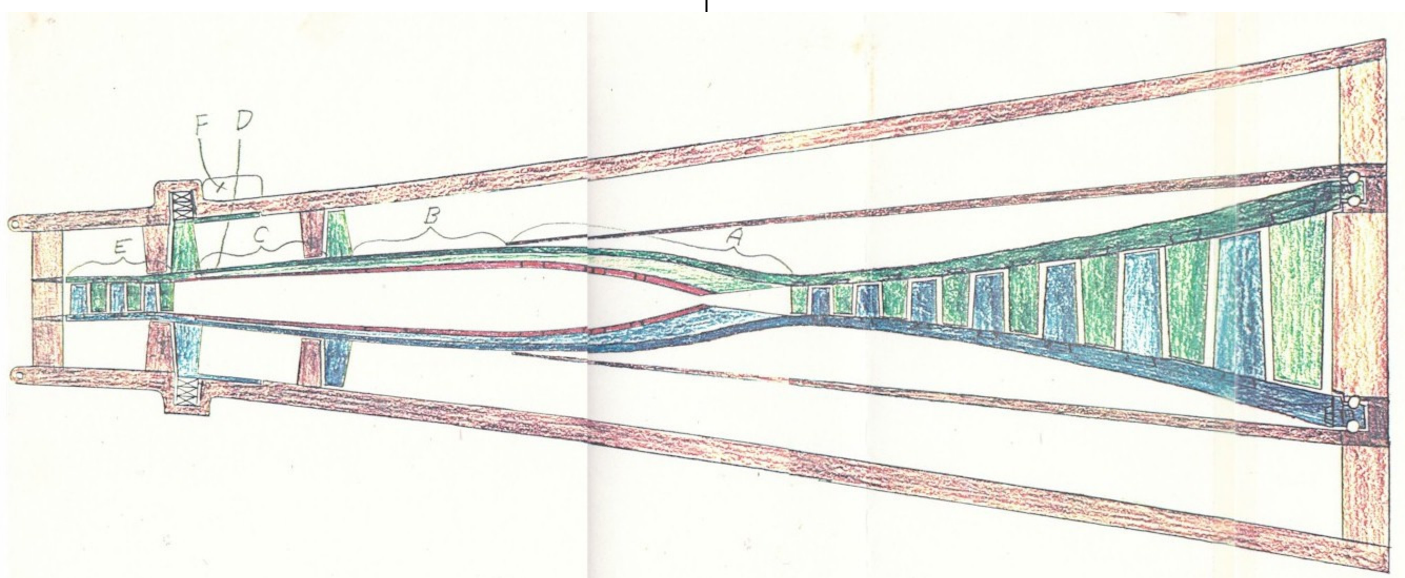
Please find attached two drawings of my concept of a high-bypass ratio version of the radial flow engine.

The first colored drawing depicts the original turbojet engine converted to fan operation and the use of what I call “speed-staged-bearings” instead of air bearings. The engine framing and bearings should be considered schematic only.

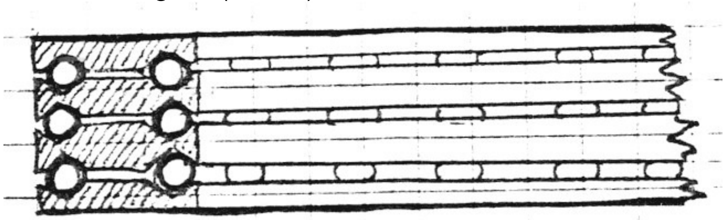
The location of the fan blades is to aid in cooling the engine rotors and the first two turbine stages. The portion of the rotor labeled “A” is cooled <u>internally</u> by air the discharge from the compressor as is “B” and “C”. The portion of the rotor labeled “B” and “C” is further cooled <u>externally</u> by the oncoming flow of ambient air and the air discharged by the first fan stage respectively. The first fan stage blading also serves as a heat sink or radiator for a portion of the rotor. Ideally, the first fan stage should be located along the rotor for maximum cooling effect. Final portion of rotor labeled “E” is cooled by second stage fan discharge air.

The second fan stage serves several functions to enhance engine performance. It should be noted that the leading edge of the second stage fan blade is located immediately above and adjacent to the end of the channel formed by the union of the rotor "turbulating valve" and combustion chamber zone walls. This is by design and is not arbitrary. Location "D" contains the highest-pressure air (because of centrifugal compression as discussed in the patent). However, this air is also very hot, caused by adiabatic heating as noted by consultant Bob Bullock. This air if used directly from location "D" would have minimal cooling effect on the turbine. I therefore propose tso route this "D" air through the second stage fan blades via drilled holes in the leading edge progressing to the trailing edge and there routed to the turbine blades for cooling in a conventional manner.

Another function of the second stage fan is the communication of the engine rotor with the outer peripheral "speed-stage-bearings." These thrust bearings are simply stacked one atop another as



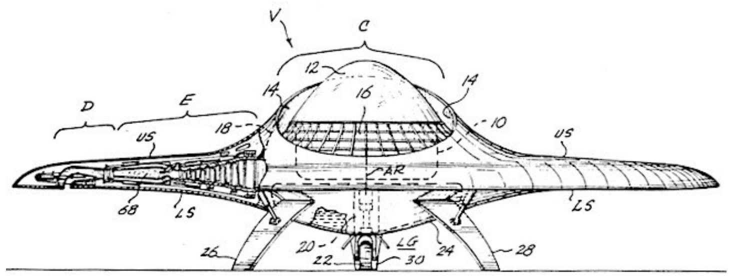
shown in Fig. 1. *(below)*



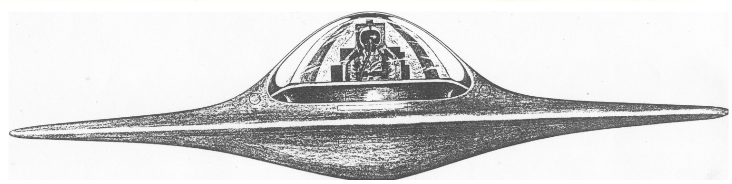
The theory is if the second stage fan is moving at 1500 ft/sec, no combination of balls and raceways will move faster than 1500/3 = 500 ft/sec for a 3 staged bearing. If this speed is excessive then say a 5 staged bearing would yield 300 ft/sec. There appears to be no limit to the number stacked.

The second fan stage is also shrouded, not so much to avoid tip losses but to provide an interface for the yaw control devices (at location "F") described in the patent.

The second black & white drawing shows how I envision the high bypass engine might be installed in the vehicle.



(ed. – This is from the patent document since there was not other drawing in my package that showed an engine mounted.)



(ed. – This is the only B&W drawing in the package but it doesn't show how the engine was mounted. It appears there would be several engines within the airframe providing balanced lift similar to a Harrier.)

Thank you very much for your time in reviewing this.

Very truly yours

Normal Heuvel

(ed. – This was Heuvel's letter to DARPA with his proposal a circular aircraft.)

January 20, 1987

Mr. Norman L. Heuvel
I4723 SE 263rd Street
Kent, WA 98042
Home (206) 631-0159

Mr. Robert Williams
c/o DARPA; Tactical Technology Office
1400 Wilson Blvd
Arlington, VA 22209-2308

Dear Mr. Williams,

I had the opportunity on December 11th and 12th to brief personnel of NASA AMES RESEARCH CENTER at Moffett Field, CA. on the circular aircraft and radial flow engine concept. These people were representatives of the Offices of Advanced projects and programs and Rotorcraft and Powered Lift Devices.

The developmental cost were discussed, as were the inherent high induced drag of low aspect ratio lifting surfaces and the probable pitch-up tendencies of circular plan forms. Although I had sent AMES virtually the same material as I sent you I had obviously failed to sufficiently emphasize the "pointing" or unconventional turning capability of the concept. The AMES evaluator, while giving me high marks in innovation, simply saw the vehicle as; "draggy first cousin to the Hawker-Sidley AV-8A! ". The "pointing" capability I refer to is the ability of the vehicle to make large heading changes in high speed flight of up to 180 degrees while maintaining a given flight track over the ground. The AMES evaluator asked, "Do you mean that if an aircraft is on my tail, all I have to do is to utilize my yaw control devices and spin 180 degrees and blow him away?" I said, "that's essentially correct, and little if any "G" forces are involved!" This certainly constitutes an aviation first!

Their are several requirements for this maneuver to be possible:

1. The general planform must be circular.

2. The planform may not employ a vertical stabilizer.

3. Any protuberances must be located at the center of the planform and thoroughly melded within.

4. Pitch and Roll controls should be locked out for large heading variances.

5. Full yaw control must come from an internal source, (in this concept from the inertial properties of the counter rotating engine rotors).

6. Heading changes of approximately 60 degrees to 180 degrees would probably require the engine at idle to prevent compressor stall. Blow-in doors in the inlet duct would probably be helpful.

7. External stores such as missiles, bombs or aux tanks must be expended or jettisoned prior to executing this maneuver to any extreme degree due to excessive aerodynamic side loading forces at elevated Mach numbers.

The ability to perform unheard of unconventional maneuvers is the main reason I am attempting to forward this concept. The time and "G" forces involved in a conventional 180 degree high speed tight turn to point or aim a weapon system are known to be quite high. The proposed concept is able to point in very little time with almost no change in "G" forces! This is an obvious tactical advantage.

This concept, in its present form, is admittedly very primitive in that the pilot has control of only the vertical or yaw axis when heading changes exceeds approximately 60 degrees from straight ahead. Refinement of controllability beyond this angle is an obvious next goal in development.

I have information from a reliable source that beam weaponry, i.e. lasers, rail guns, particle beams, etc., are due to be available for airborne platforms by the late 1990's. These systems cannot be programmed like a missile and, therefore, must be "pointed" or aimed like a gun. I'm sure by now you must see how this concept can utilize these beam systems to their maximum potential.

Further, the vehicle should be appreciated for its "stealth" qualities. There being no flat surfaces on the vehicle or the engine, the radar signature should be almost nil. Please refer to the large drawing (#8) to verify this.

Finally, while I concede that this planform is quite "draggy" in comparison to more conventional wings, the maneuverability I have described is utterly dependant on the use of a circular planform. As a design trade-off, "buy the drag and get the maneuver!".

In conclusion, just as the AMES evaluator did not see the possibility of this maneuver, I suspect it slipped by you as well. For this reason I am requesting that you reevaluate this concept in light of the foregoing information. To allow this new technology to go undeveloped by the United States would be a terrible missed opportunity. It took British Aerospace to develop the AV-8A, I hope I am not forced to take my case to them.

Thank you for your further time on this matter,

Signed – Norman Heuvel

(ed. – Heuvel sent a letter to the commander of the Aeronautical Systems Division at Wright-Patterson AFB with his proposal. Below are some of the points he tried on them vs. DARPA.)

General Thurman,

In the attached mail tube you will find material describing a circular aircraft powered by a radial flow gas turbine engine. This vehicle and engine is an extremely integrated concept which when acting in concert are capable very unconventional maneuver. The vehicle is capable of making extremely large heading changes in high speed flight of up to 180 degrees while maintaining a given flight track over the ground.

I know all branches of the Armed Forces are interested in highly maneuverable airborne weapon platforms and probably the Air Force, most of all. Because of this, I am submitting this concept to you and your technical staff for analysis and evaluation.

I have submitted this concept to DARPA in February, 1986, only to be told by the evaluator that, "the concept is not sufficiently unique to warrant DARPA funding". I am convinced the DARPA evaluator either missed the unconventional maneuver or does not realize the tactical importance of it. Please find enclosed a copy of my last correspondence with DARPA.

It might be advantageous if you treat this concept as a philosophy of control freedoms. If pitch, roll, and yaw are assigned equal values of controllability, then it follows that virtually every aircraft from the Wright Brothers to this day have been exploiting only 66.6 per cent of controllability in high speed flight. The present concept suggests 100 per cent controllability, which is why the vehicle/engine combination can execute such an unconventional maneuver as described in the first paragraph.

(ed. – Here is the Air Force response.)

DEPARTMENT OF THE AIR FORCE
AIR FORCE WRIGHT AERONAUTICAL LABORATORIES (AFSC)
WRIGHT.PATTERSON AIR FORCE BASE, OHIO 45433.6553
7 Oct 1987

REPLY TO ATTN OF: FIOP

SUBJECT: Unsolicited Proposal - Circular Aircraft Powered by a Radial Flow Gas Turbine Engine

TO: Mr. Norman L. Heuvel
14723 S . E. 263rd Street
Kent, WA 98042

1. The subject proposal was sent to the Flight Dynamics Laboratory, Technology Assessment 0ffice, for evaluation. Their report indicates that, the concept is considered to be technically feasible; however, a circular vehicle is not considered to be a particularly efficient aerodynamic configuration. The concept is a highly integrated engine and airframe configuration-one being dependent upon the other. As noted in the information provided, low aspect ratio plan forms have inherent high-induced drag (drag due to lift). The circular vehicle should possess excellent low radar observable characteristics with the proper edge treatment accomplished. The maneuver allowing large heading changes in forward flight is technically feasible. The performance efficiency of the vehicle and flight control aspects are dependent upon the effectiveness of the thrust deflection system.

2. However, the real issue with the concept is the development costs. The concept would require the development of a new and unique engine and a highly integrated airframe together with attendant systems, structural aspects, flight control laws, etc. A development task of this magnitude would require several hundreds of millions of dollars. In order to justify the expenditure of such a large amount of critical research and development funds, a definite need/requirement for the system must exist; and, the

effectiveness of the concept to satisfy the need/requirement would have to be soundly established. At the present time, there is no known Air Force need or requirement, which could embody the subject concept.

3. Your proposal covers a potentially important area of research and development. However, work in this particular area has not been assigned a sufficiently high priority to be undertaken at this time. Therefore, we are returning your proposal and drawing.

4. Thank you for extending to us the opportunity to examine your ideas.

Your interest 'in the United States Air Force is appreciated.

Signed FRANCES A. KNASIAK
Unsolicited Proposal Focal Point
Programs Branch
Flight Dynamics Laboratory

AVAILABLE PLANS & REFERENCE MATERIAL

Coming Soon: <u>Tailless Aircraft Bibliography</u>
Edition 1-g

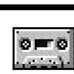
Edition 1-f, which is sold out, contained over 5600 annotated tailless aircraft and related listings: reports, papers, books, articles, patents, etc. of 1867 - present, listed chronologically and supported by introductory material, 3 Appendices, and other helpful information. Historical overview. Information on sources, location and acquisition of material. Alphabetical listing of 370 creators of tailless and related aircraft, including dates and configurations. More. Only a limited number printed. Not cross referenced: 342 pages. It was spiral bound in plain black vinyl. By far the largest ever of its kind - a unique source of hardcore information.

But don't despair, Edition 1-g is in the works and will be bigger and better than ever. It will also include a very extensive listing of the relevant U.S. patents, which may be the most comprehensive one ever put together. A publication date has not been set yet, so check back here once in a while.

Prices: To Be Announced

Serge Krauss, Jr. skrauss@earthlink.net
3114 Edgehill Road
Cleveland Hts., OH 44118 (216) 321-5743

VIDEOS AND AUDIO TAPES



(ed. – These videos are also now available on DVD, at the buyer's choice.)

VHS tape of Al Bowers' September 19, 1998 presentation on "The Horten H X Series: Ultra Light Flying Wing Sailplanes." The package includes Al's 20 pages of slides so you won't have to squint at the TV screen trying to read what he is explaining. This was an excellent presentation covering Horten history and an analysis of bell and elliptical lift distributions.

Cost: $10.00 postage paid
Add: $ 2.00 for foreign postage

VHS tape of July 15, 2000 presentation by Stefanie Brochocki on the design history of the BKB-1 (<u>B</u>rochocki,<u>K</u>asper,<u>B</u>odek) as related by her father Stefan. The second part of this program was conducted by Henry Jex on the design and flights of the radio controlled Quetzalcoatlus northropi (pterodactyl) used in the Smithsonian IMAX film. This was an Aerovironment project led by Dr. Paul MacCready.

Cost: $8.00 postage paid
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An Overview of Composite Design Properties, by Alex Kozloff, as presented at the TWITT Meeting 3/19/94. Includes pamphlet of charts and graphs on composite characteristics, and audio cassette tape of Alex's presentation explaining the material.

Cost: $5.00 postage paid
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VHS of Robert Hoey's presentation on November 20, 1999, covering his group's experimentation with radio controlled bird models being used to explore the control and performance parameters of birds. Tape comes with a complete set of the overhead slides used in the presentation.

Cost : $10.00 postage paid in US
$15.00 foreign orders

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BLUEPRINTS – Available for the Mitchell Wing Model U-2 Superwing Experimental motor glider and the B-10 Ultralight motor glider. These two aircraft were designed by Don Mitchell and are considered by many to be the finest flying wing airplanes available. The complete drawings, which include instructions, constructions photos and a flight manual cost $140, postage paid. Add $15 for foreign shipping.

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