



**Royal Aeronautical Society
TOULOUSE BRANCH**

15th December 2015

“The Fathers of the Turbojet Engine”

Ian WHITTLE
son of Sir Frank WHITTLE
and
Wolfgang BRIX
former Engine Expert Airbus Deutschland

Download their Presentations from: www.Dibley.eu.com.



**Ian Whittle & Wolfgang Brix with their
RAeS Toulouse Branch Speakers' Tankards.
Download their Presentations from: www.Dibley.eu.com.**



Ian WHITTLE

Son of Sir Frank WHITTLE

Learned fly at school aged 17 through Government Flying Scholarship

5 years in Royal Air Force flying Meteor & Hunter jet fighter aircraft

1958 Kuwait Airways based in Bierut on B707 & Hawker Siddeley Trident

1969 Cathay Pacific in Hong Kong on Convair 880, TriStar & B747

After active flying instructed for Cathay on the B747 Flight Simulator

Fellow of the RAeS, Master Pilot of the Honorable Company of Air Pilots

Still flies his own light aircraft Piper Archer from the UK to France

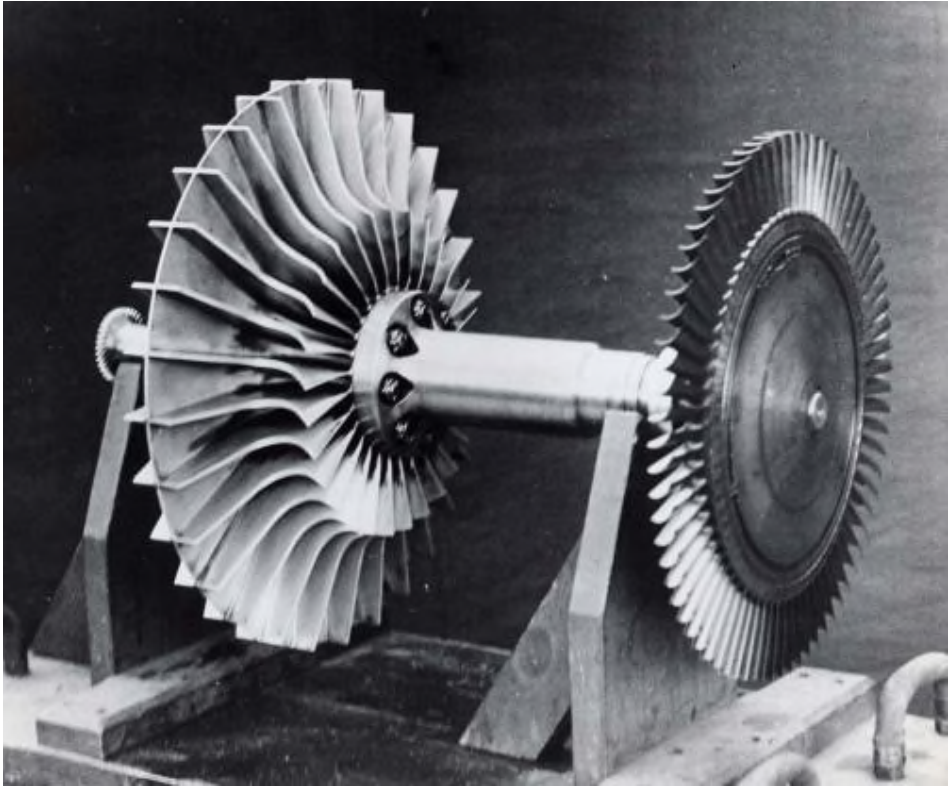
Genesis of the Turbojet



Rolls-Royce Trent 1000









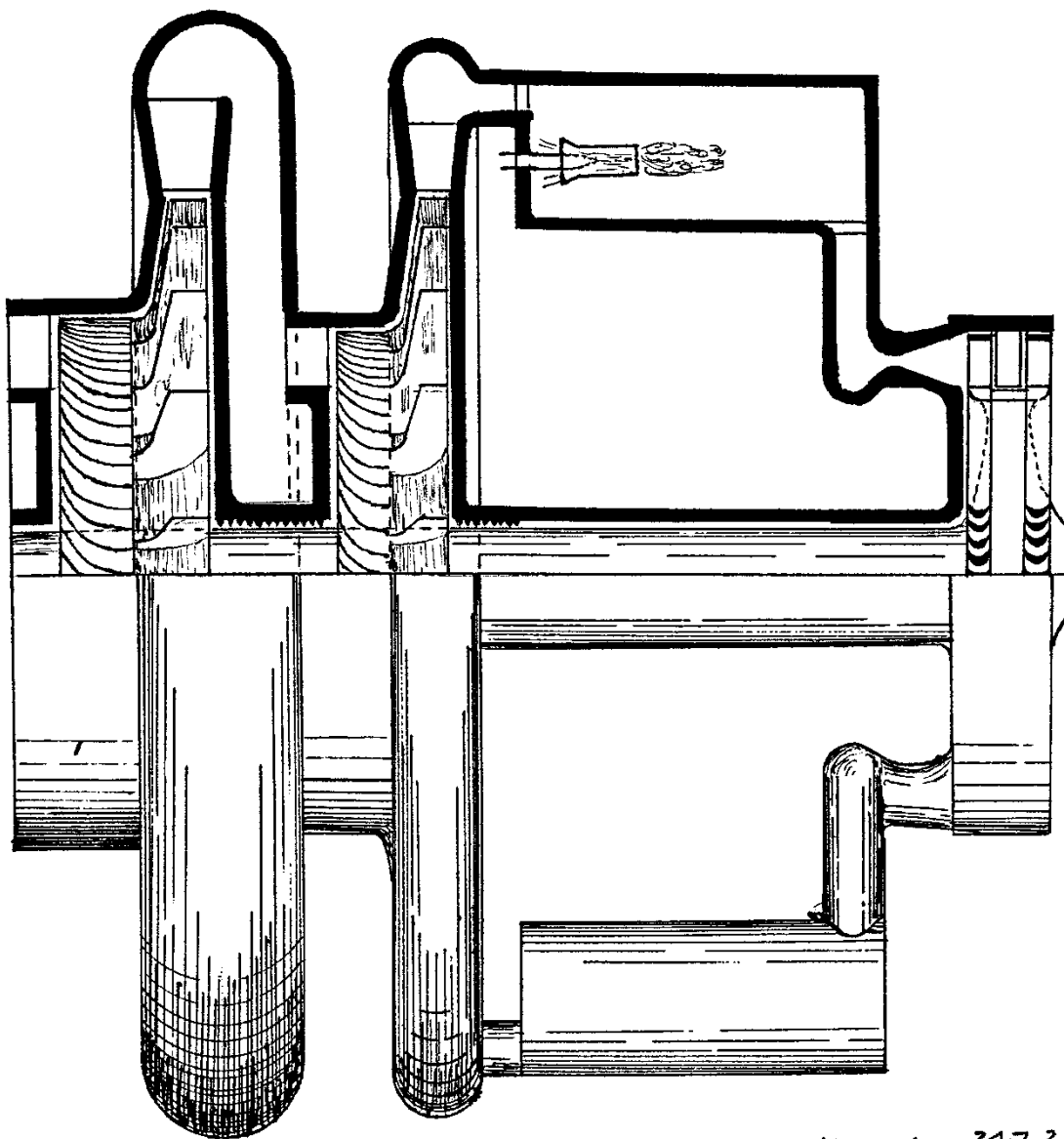
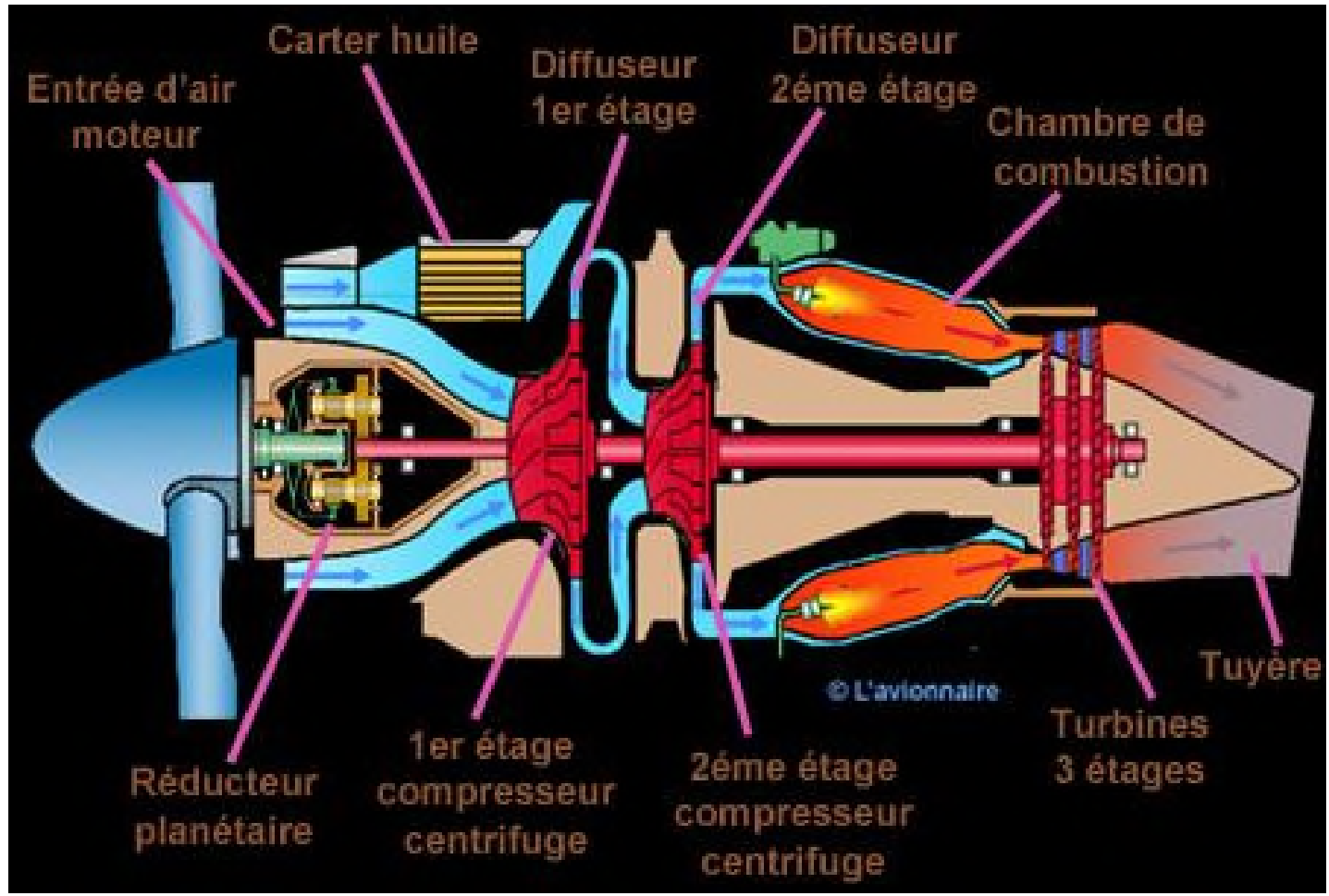


Illustration Patent Application 347,206
16 Jan 1930



Dr Griffith (RAE) advises
Air Ministry that idea has
insufficient merit to
warrant further research



1930/31

- Turbojet patent
- Air Ministry remain disinterested and fail to apply secrecy
- Aero gas turbine work at RAE ceases

1931/32 Turbojet enters the public domain



1930 - 34



Turbofan



Reheat



1934 - 1936 F.W. at Cambridge (Peterhouse)

**May 1935 - turbojet rescued from
oblivion**



Col Tinling & Rolf Williams c1936

1936 - back into the fray

Power Jets Ltd.

Royal Aircraft Establishment



1935-1936

Germany



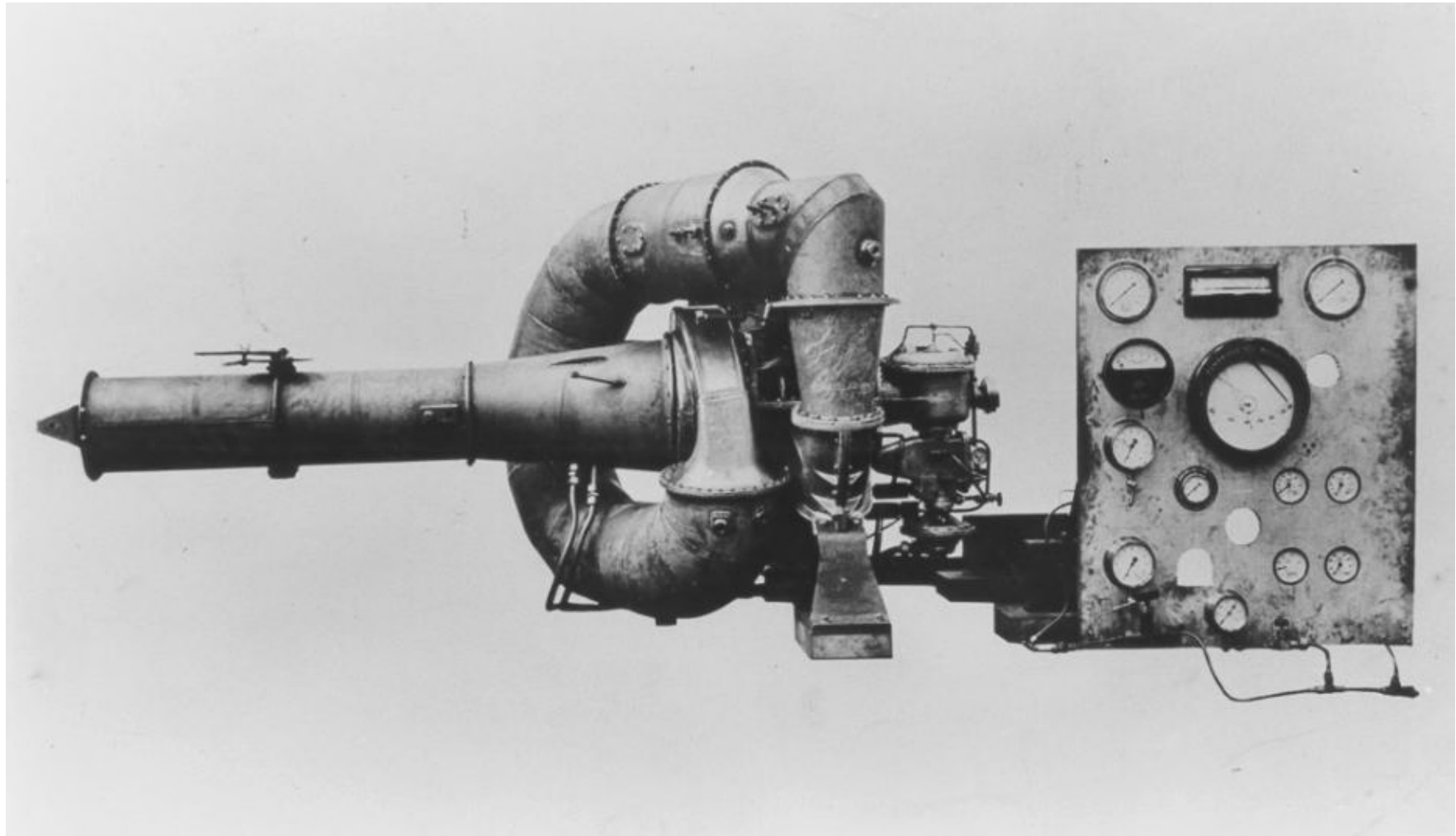
Hans von
Ohain

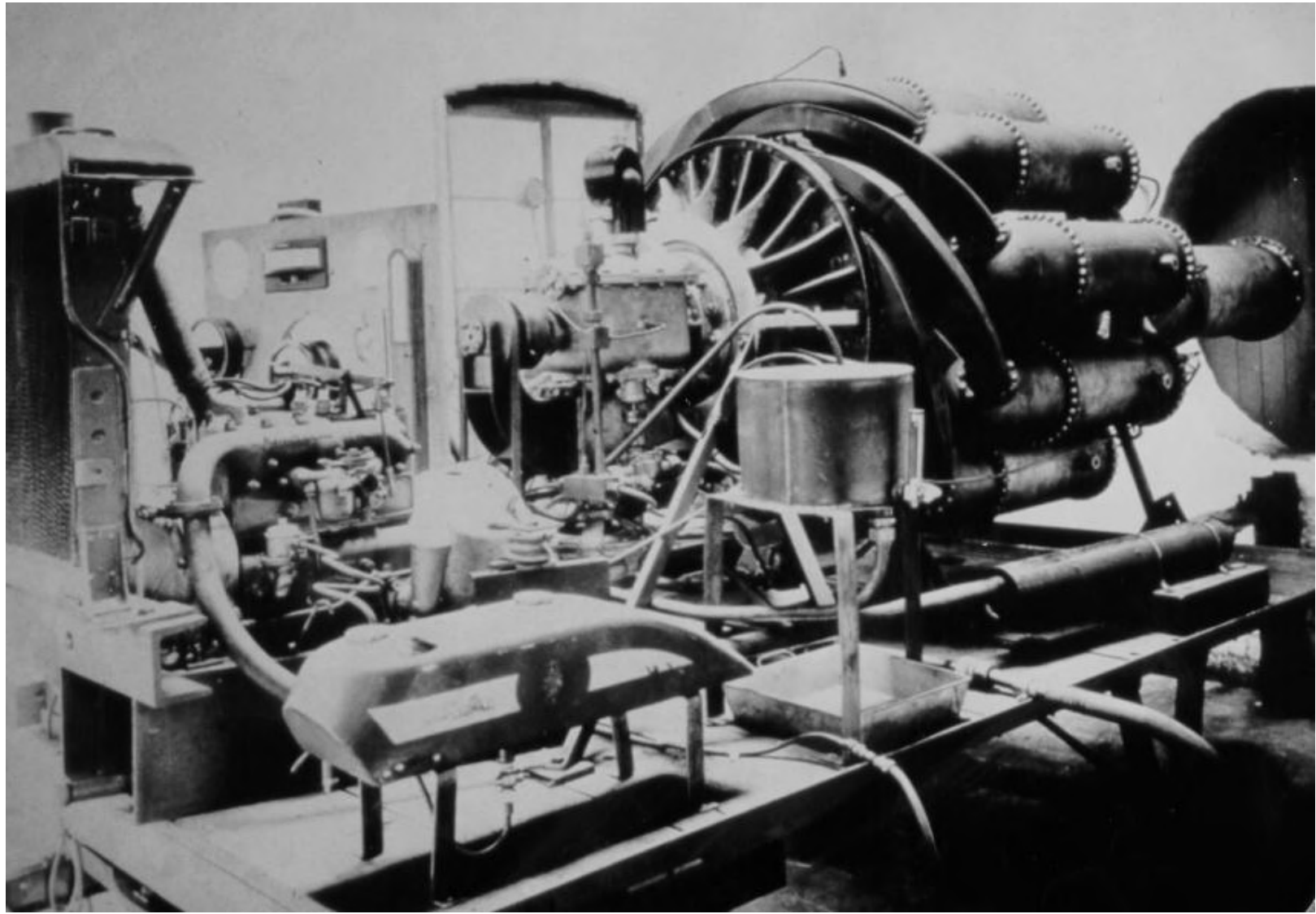


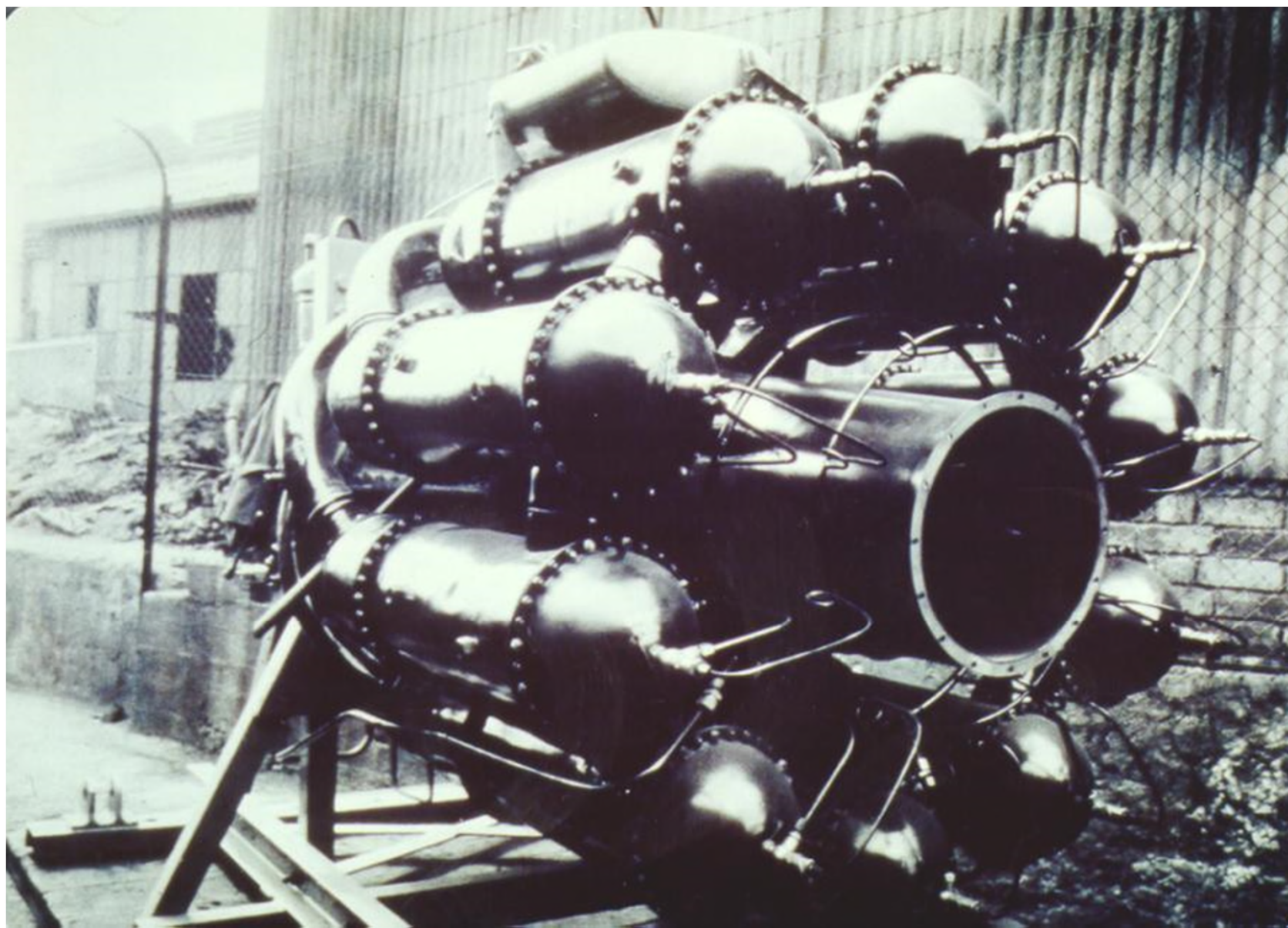
Herbert Wagner





Hermann Oestrich









1939 - Germany

First Flight of a Turbojet aircraft - He.178

Rocket • Turboprop • Turbojet •
Ducted Fan • Pulsejet • Ram Jet

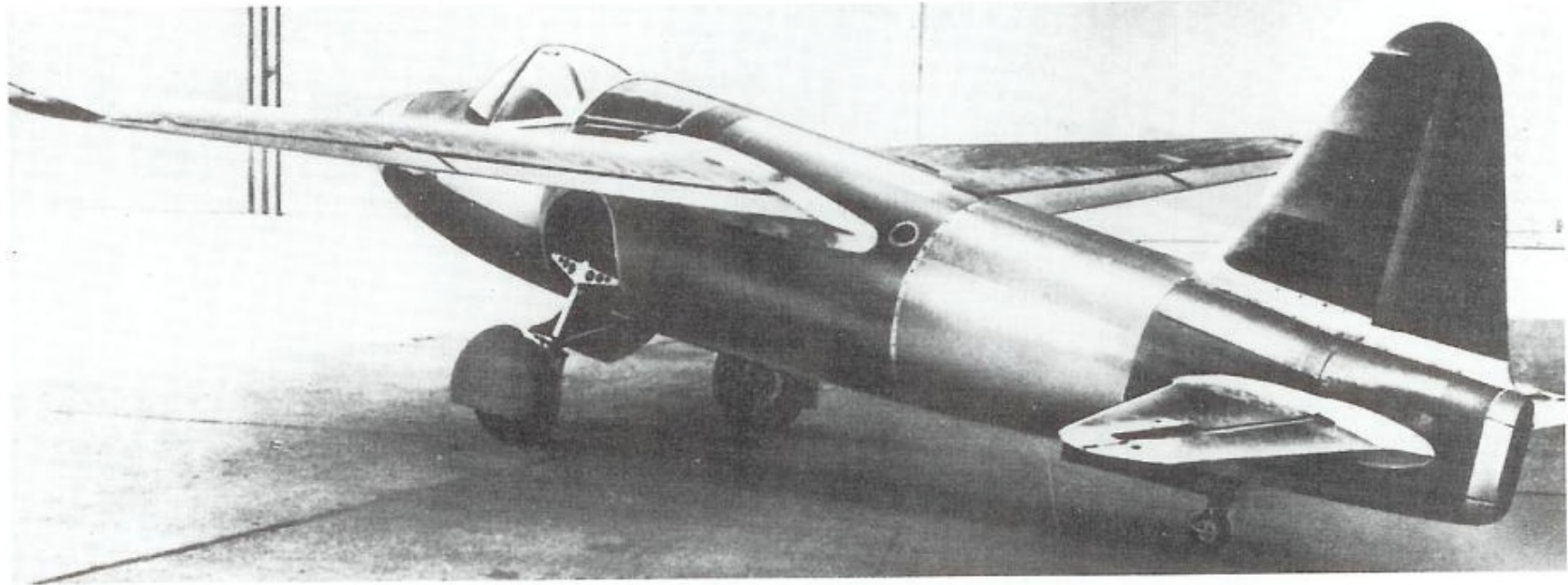


Fig 2.5A Heinkel He 178, the world's first turbojet-powered aircraft.

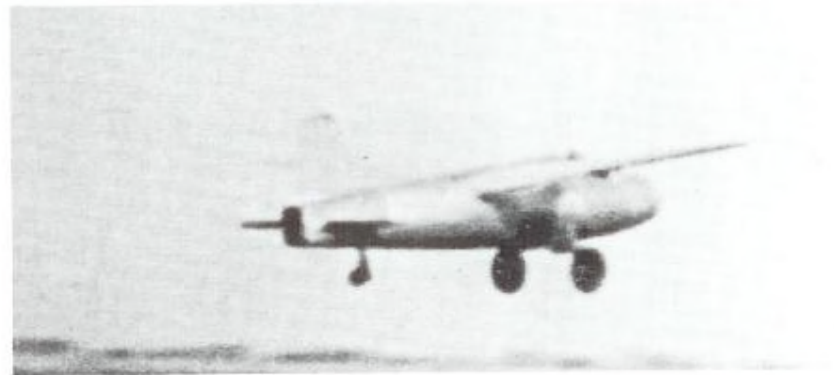


Fig 2.5B, C He178 taking off.





May 15th 1941

First Flight of the Gloster E28/39

Flight duration: 17 minutes

**Cleared for 10 hours of flight test
before engine inspection**



Gloster E28/39







1941 - The W1 sent to the USA

**(In 1940, the NAS had condemned
the Gas Turbine Engine as unsuitable
for aeronautical applications!)**







Wolfgang BRIX

Engine expert in Bremen for VFW-Fokker / Airbus Deutschland 36 years

Studied & made calculations for all Airbus engines –

Visited Toulouse more than 70 times

2005 Retired - made an archive of all his material,

2008 Wrote about all the engines in his life.

Presented in 1989 München Symposium “50 Years of Turbojet flight” 1989.

The fathers of the turbo jet engine



**A presentation by
Wolfgang Brix (Germany), Engine expert Airbus Deutschland
and
Ian Whittle (Great Britain), Son of Sir Frank Whittle**

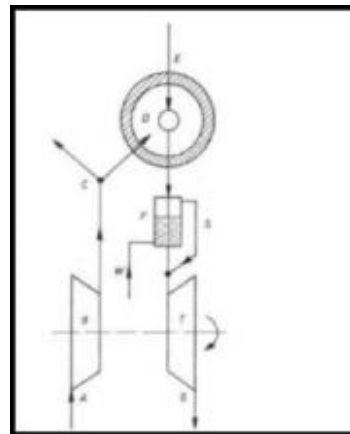
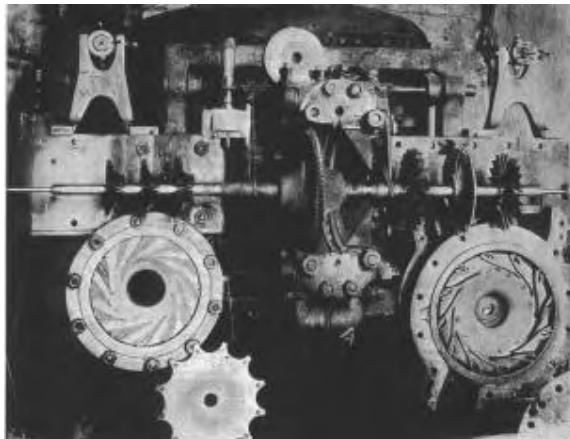


1 The first gasturbine of Aegidius Elling



On June 27th, 1903 the Norwegian Aegidius Elling writes in his diary :

„I have made the worlds first gas turbine which has given positive (excess) power.“

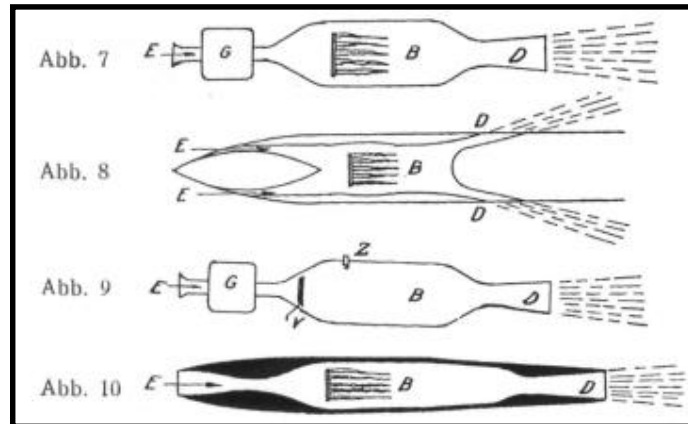


Ellings gas turbine from 1903 :
Temperature at turbine entry : 400°C
Power : 11 hp

The test installation can still be seen in the Norwegian Technical Museum in Oslo



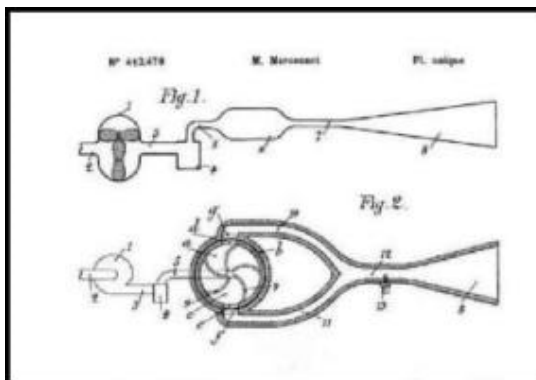
2 The first jet engine ideas



1913 Patents by Frenchman René Lorin



René Lorin (1877–1933)

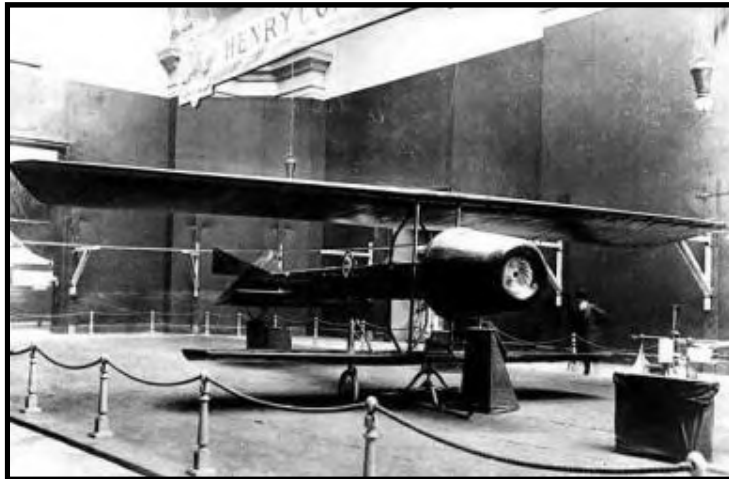


1909 Patents by Frenchman M. George Marconnet

**All patents have in common:
They do not show the power
unit to drive the compressor.**

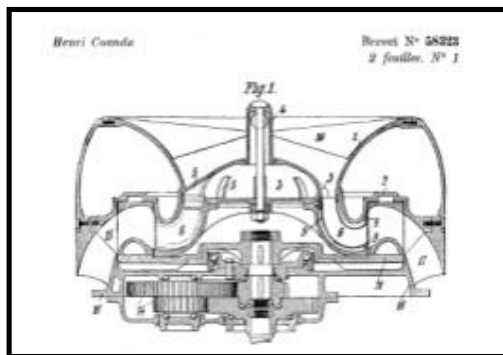


3 The first jet flight of Henri Coanda



1910 Air Exposition in Paris
The Romanian Henri Coanda shows an aircraft without propeller.

Below: on the table a part of the engine, inscription: Turbine Propulsive 50 hp.



1911 : Coanda gets a patent for a „Propulseur“.





3 The first jet flight of Henri Coanda



Henri Coanda (1886-1972)



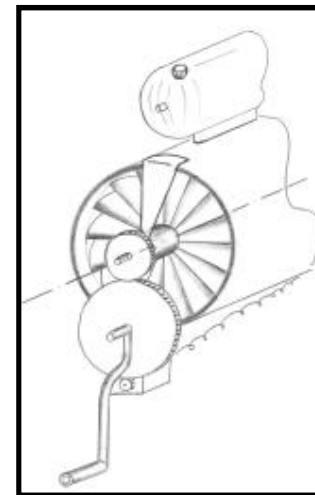
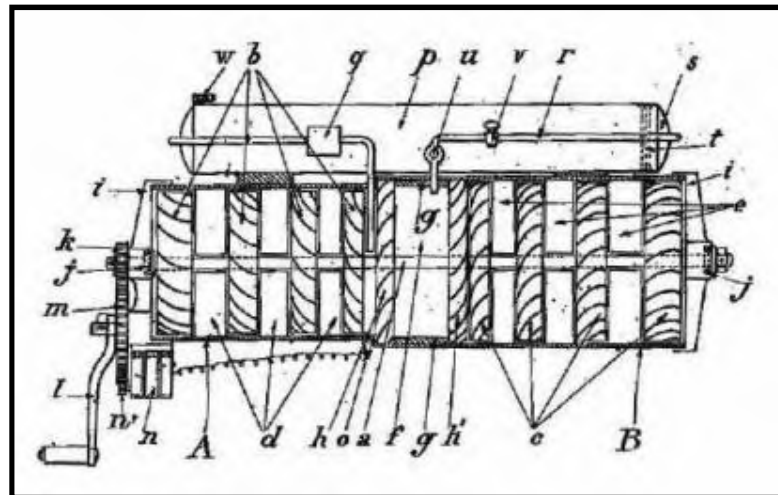
"It was on 16 December 1910. I had no intention of flying on that day. My plan was to check the engine on the groundI did not realize that the aircraft was rapidly gaining speed. Then I looked up and saw the walls of Paris approaching rapidly. I decided to fly instead.....The aeroplane seemed to make a sudden steep climb and then landed with a bump. First the left wing hit the ground and then the aircraft crumpled up. I was not strapped in and so was fortunately thrown clear of the burning machine".

This was the first jet flight in history !



4 The patent of Maxime Guillaume

1922 A first impression of a turbo jet engine is given by patent No 534.801 of Frenchman Maxime Guillaume, filed on 3rd May 1921, granted on 13th January 1922. The title was „Propulseur par reaction sur l'air“ = „Propulsion by reaction on air“.



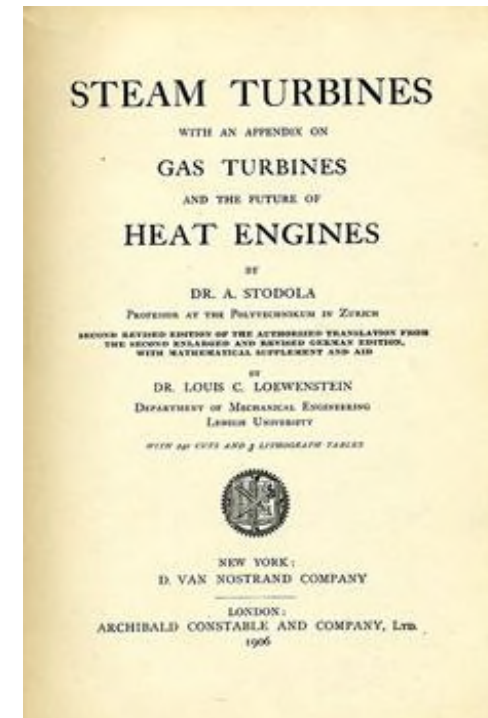
Guillaumes engine is not complete, inlet and nozzle are missing and he cannot describe exactly how it works. He does not know the words **nozzle**, **jet**, **jet velocity**, **mass flow**, **gross thrust**, **ram drag**, **net thrust**.



6 The book of Aurel Stodola



Prof. Aurel Boreoslav Stodola
born 10.5.1859 in the Slowakei,
died 25.12. 1942 in Zürich



This is Stodolas book about Steam+Gas Turbines. It is published from 1905 to 1927 in 6 editions and in 5 languages, this 1000-pages book becomes the bible of all steam and gas turbine engineers.

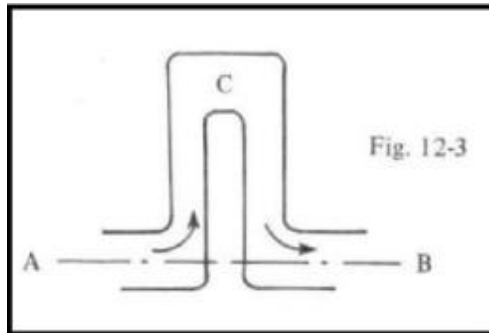


6 The book of Aurel Stodola

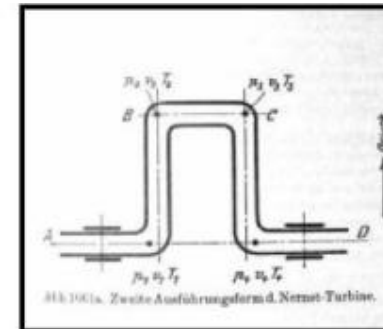
Sir Frank Whittle knows and owns the Stodola book. The Nernst Turbine appears even in Whittles book “Gas Turbine Aero Thermodynamics” .

Dr. Hans von Ohain knows the Stodola book, as here he finds the Nernst Turbine, which becomes the starting point of his inventions.

Sir Stanley Hooker, later chief of Rolls-Royce and Bristol Engines, starts his career with the study of Stodolas book.



The Nernst turbine
in Whittles book, left
and in Stodolas book, right



These 3 men found their inspiration in this book of Stodola



7 Alf Lysholm



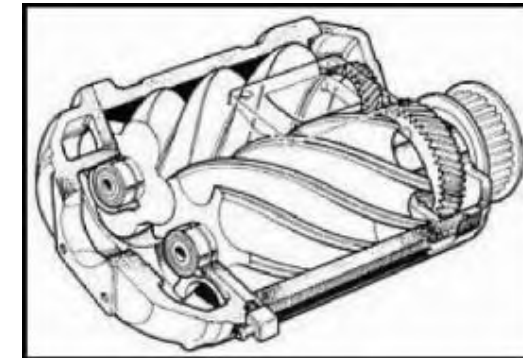
Lysholm's vita :

1893 December 14 born in Stockholm

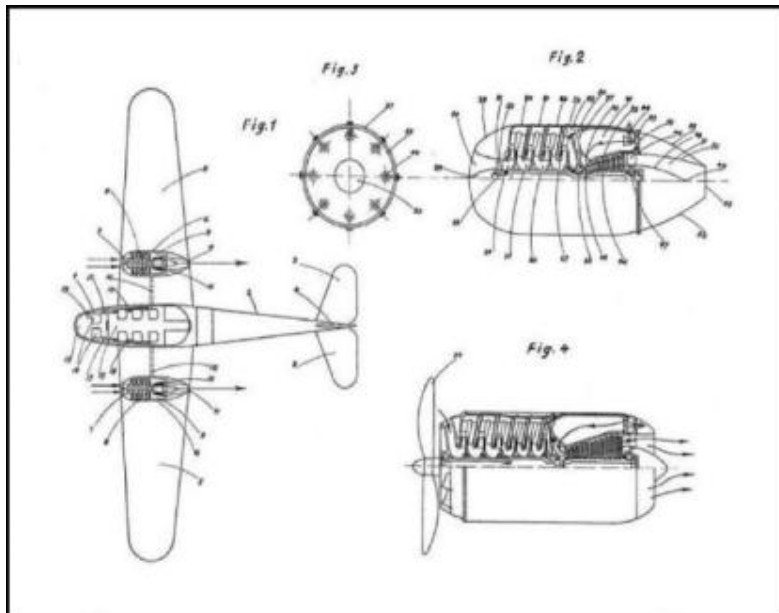
1917 Employed by Ljungström

1928 Chief engineer

Main work on screw compressors



Pressure ratio up to 4



Lysholm's German patent DE 710,082 from 1933. It covers a version with propeller and a version with pure jet. None of Lysholm's ideas has ever been built.



8 Herbert Wagner and team



Herbert Wagner
1900-1980



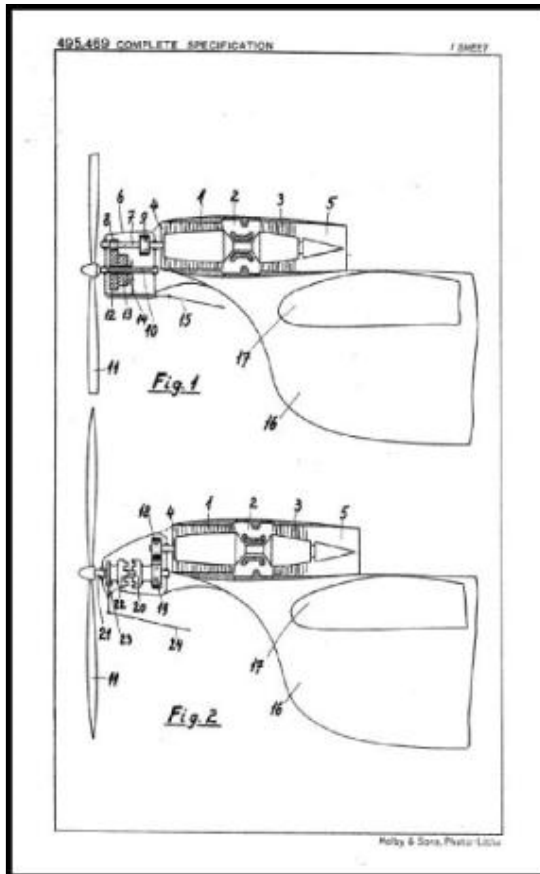
Max Adolf Müller
1901 - 1962

Wagner's vita :

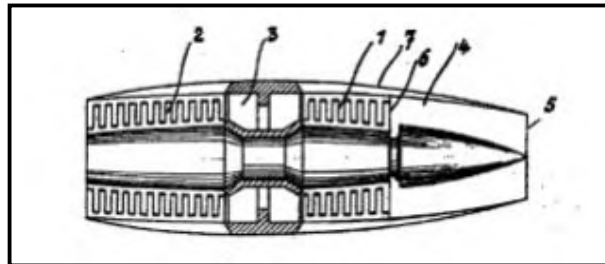
- 1900 Born in Graz/Austria
- 1934 First idea of a turbo prop engine
- 1935 At Junkers : Chief of airframe development, work on long range aircraft
- 1936 1.April : Wagner presents first idea of a turboprop engine to: Max Adolf Müller and other engineers
- 1938 Design and construction of a pure turbo jet engine, but the Junkers engine department is not informed
- 1938 Wagner needs better materials (alloyed steels), he contacts the RLM, Göring and his team are surprised and upset, they demand the work must be done in the Junkers engine department . Wagner + team refuse They know that Prof Mader is against jet engines
- 1938 End of the year the team splits : Wagner + some go back to Berlin, Max Adolf Müller turns to Heinkel, who hires him and 15 other members of the team. They start in October 1939 in Rostock the department of axial engines and produce the He S 011 with 1333 kp (2939 lb) thrust. This was the highest thrust of all German engines, but only a prototype.



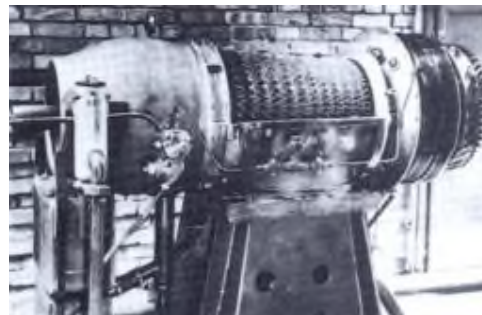
8 Herbert Wagner and team



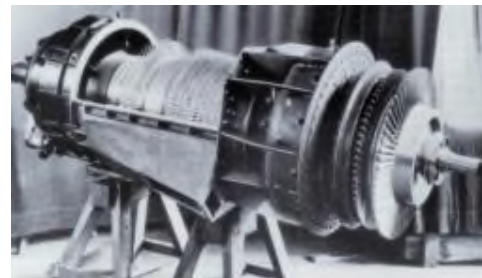
Patent GB 495,469
British application 8.Feb 1937
German application was 1935



Patent DE-724091
Patented 14.Aug 1938



The RT0
14-stage axial compressor, annular
combustion chamber, 2-stage turbine
No independent run



The RTI 12-stage axial
compressor, annular combustion
chamber, 2-stage turbine,
reached only 6500 rpm instead
of projected 12900 rpm

Both engines disappear 1939
without trace in history



9 Hans Joachim Pabst von Ohain



**Dr. Hans Joachim
Pabst von Ohain
1911-1998**

Von Ohain's vita :

14.12.1911 Born in Dessau
1924 Studies In Berlin

1934/35 Doctor thesis with Prof Pohl as doctor father :
„An interference Light Relay for White Light“

3.6.1934 First Patent , sold to Siemens for 3500 Mark

9.11.1935 Second patent: a turbo jet engine





9 Hans Joachim Pabst von Ohain

The idea for elegant flight

1931 Hans von Ohain makes a flight with a Ju52 from Köln to Berlin

His comment:

„The propellers made a horrendous noise. The airplane rattled because it had piston engines. ... So I said, „Well, gee, that isn't good“. As an physicist you can come up with another process.“



The first idea: A process without moving machinery : after some deeper consideration finds it to be impossible.

The second idea: The Nernst turbine.

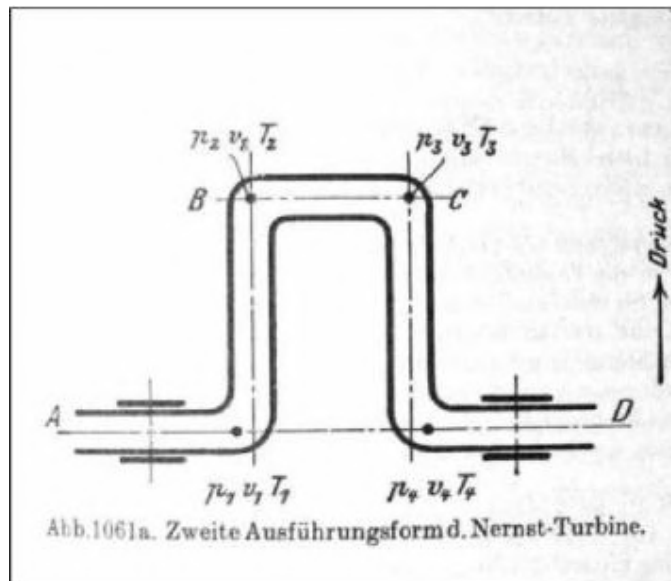
He describes the „modified“ Nernst turbine: having a radial compressor back to back with a radial turbine

“I was aware of employing axial flow compressors and turbines... but as too complex and expensive for the beginning. “

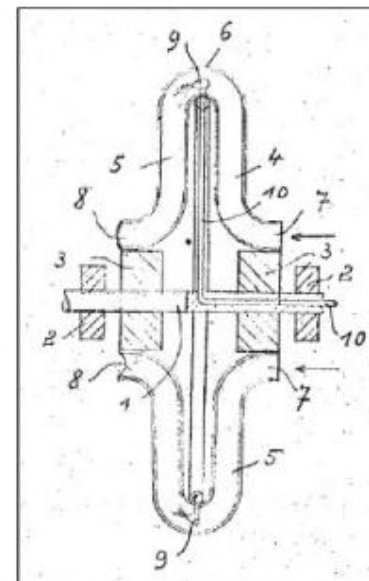


9 Hans Joachim Pabst von Ohain

The first patent (only an application)



The Nernst turbine from Stodolas book about Steam- and Gasturbines 1922

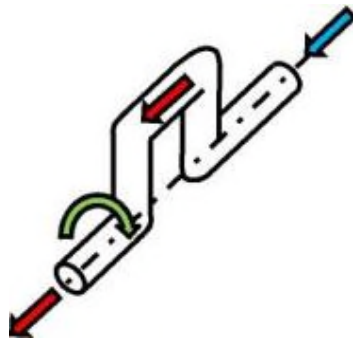


Patent No O. 21 822 XI/62b,
Filed 15.Mai 1935,
Never granted



9 Hans Joachim Pabst von Ohain

The way to the second patent



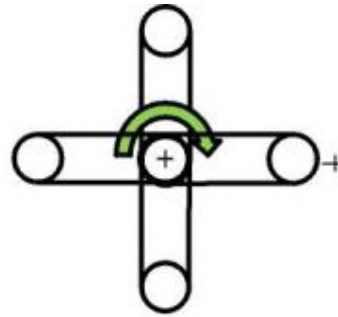
Nernst turbine



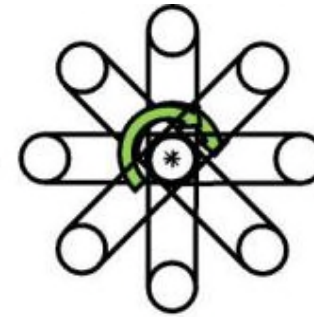
1 element



2 elements



4 elements



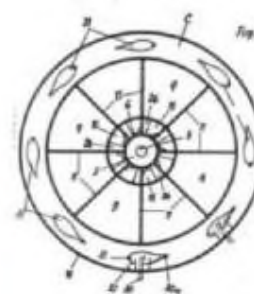
8 elements



8 elements



8 elements
combined into 1

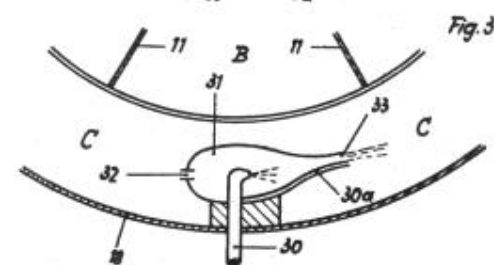
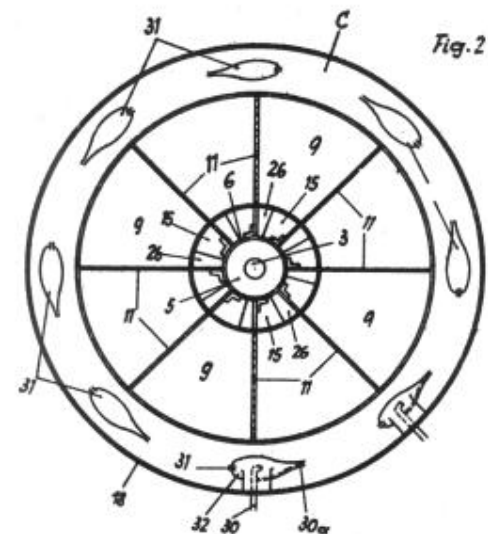
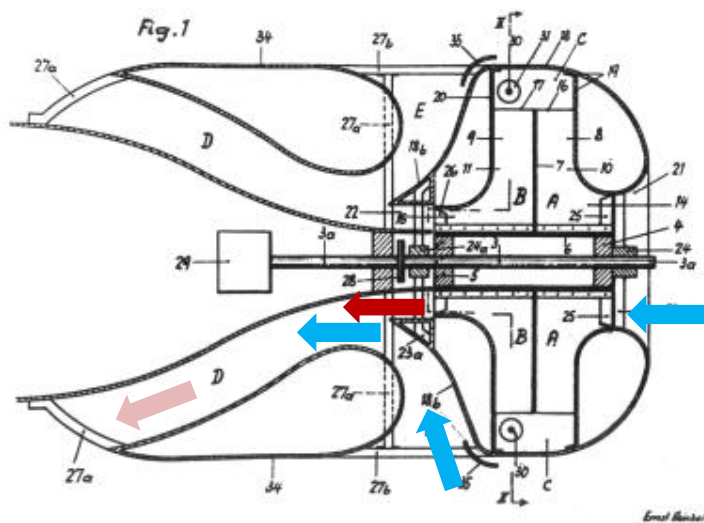


The turbo jet engine patent



9 Hans Joachim Pabst von Ohain

The second patent



Geheimes Reichspatent 317/38

Filed 9 November 1935

Patent 10 Nov 1935

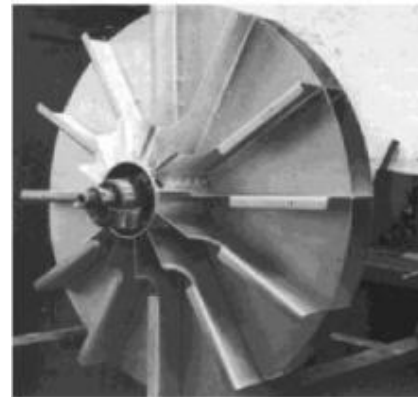


9 Hans Joachim Pabst von Ohain

The garage model

1935 Construction of a demonstration model in the garage of Bartels & Becker in Göttingen with the help of Max Hahn, no self sustained operation, Prof. Pohl helps with various equipment and checks the theory,

1936 When von Ohains money is spent, Pohl says: You need industrial support, Whom shall I write to ? Von Ohain decides: to Ernst Heinkel !



The compressor



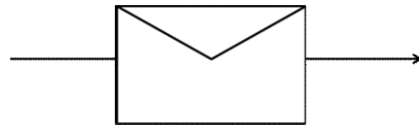
Max Hahn and the garage model



9 Hans Joachim Pabst von Ohain



The letter



3 March 1936
Prof. Pohl writes
to Prof. Heinkel



Heinkel invites von Ohain.
On 17th March 1936 they meet in Heinkels Villa in
Warnemünde at the beach of the Baltic Sea.



9 Hans Joachim Pabst von Ohain



Ernst Heinkel Siegfried Günter Walter Günter Kurt Matthaes Karl Schwärzler Heinrich Helmbold
Both twins - Project office Test Dept. Chief constructor Aerodynamicist

On the next day they meet again in the company with Heinkels technical team.
The reaction of the engineers:

„The idea of a turbojet is already known, but no one has produced a practical one. ..perhaps the time has come to have another try on it.“

After a second meeting Hans von Ohain gets a contract with a salary of 300 Mark/month.
Max Hahn is hired, too.

On 15th April 1936 they start working at Heinkel.

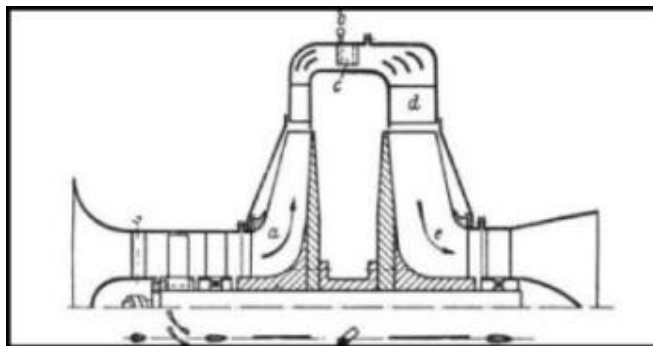


9 Hans Joachim Pabst von Ohain

The team (left to right):
Max Hahn, Hans von Ohain,
Wilhelm Gundermann – from Heinkel



- First they try again the garage model, again no self-sustained operation
- They build a copy of the garage model with the capabilities of the Heinkel company,
- again no self-sustained operation
- They gain the impression that they need 6-12 months to solve the combustion problem
- They decide to proceed in two directions:
 1. Build a hydrogen combustion facility and then a demonstration engine running with hydrogen
 2. Develop a combustion chamber running satisfactorily with fuel



The hydrogen model HeS-1,
built 1936/37,
first run Feb/March 1937,
thrust 250 lb = 113 kp at 10000 U/min



9 Hans Joachim Pabst von Ohain

The hydrogen model : when did it run first ?

Ernst Heinkel: In his memoirs „Stormy Life“ he mentions : “...in a September night 1937 “

Hans von Ohain : On many occasions he stated:
„ This date (September 1937) is definitely wrong. It was February/March 1937 “

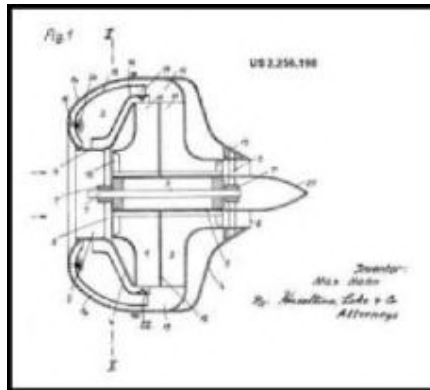
Ian Whittle: There are some serious doubts.....

My comment : We will never find out....

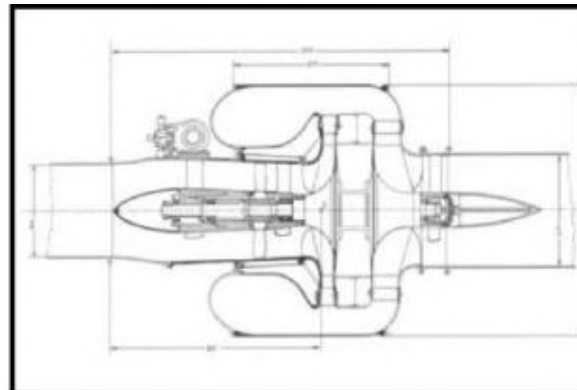


9 Hans Joachim Pabst von Ohain

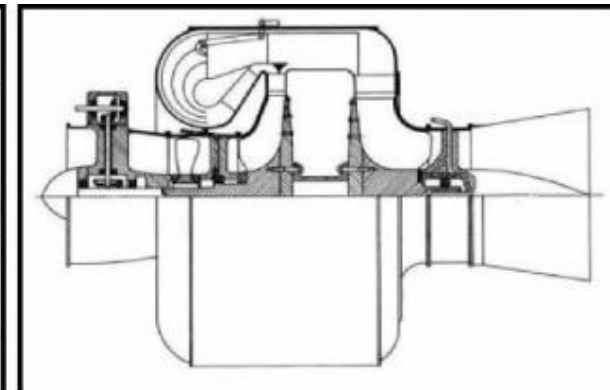
The Hahn patent and the HeS3B



Hahns patent



The first drawing of the flight engine



The final flight engine HeS3B

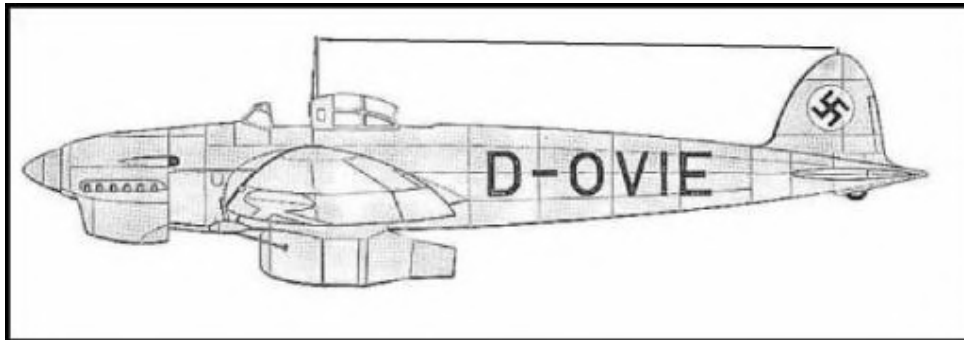
Hahn has the idea to increase the size of the combustion chamber and locate it in the large unused space in front of the radial flow compressor. Advantage: the diameter of the engine is kept small. Disadvantage: the flow must change direction twice.



9 Hans Joachim Pabst von Ohain

The flight engine HeS3B

First the flight engine HeS3B was built 1938/39, first run was around March 1939
Initial thrust was 350 kp (772 lb), later 500 kp (1102 lb)

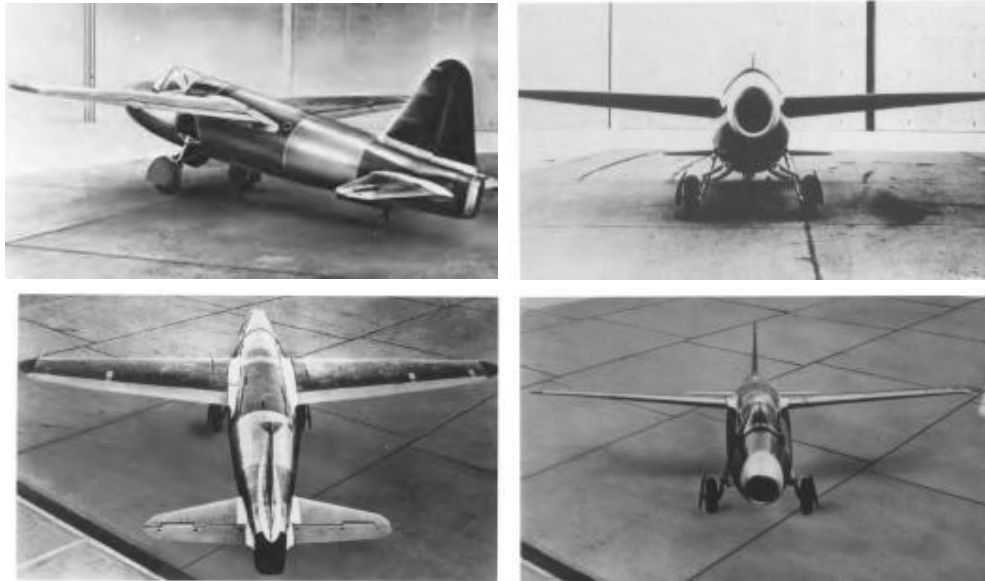


In May or July 1939 the first He3B was flight tested under a He118.

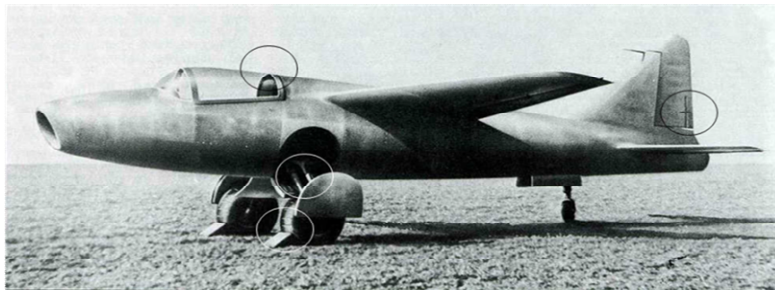
Because of a fuel leakage it burnt after a landing, destroying engine and aircraft. The pilots Warsitz and Künzel can escape unharmed.



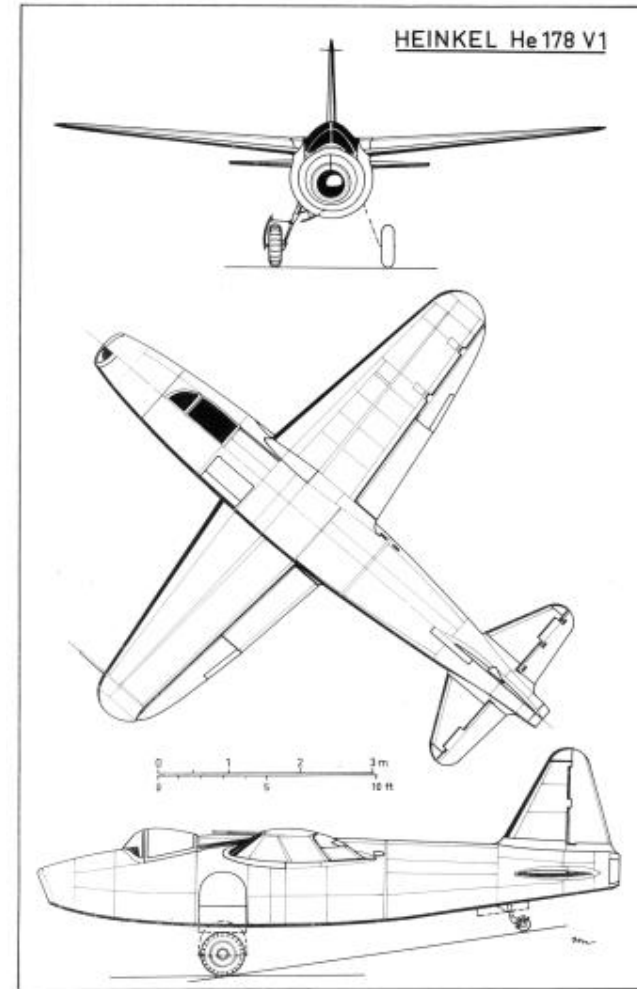
9 Hans Joachim Pabst von Ohain The He178



Above: photos of the second prototype V2 which never flew



Above: this photo is a fake, some details are wrong.





9 Hans Joachim Pabst von Ohain

The first flight of the He178



Date
Starting time
Start

Sunday, 27 August 1939
Around 6:00 (Sunrise 5:08)
300 m rolling
Max speed 600 km/h (?)
Erich Warsitz flies 2 rounds
Total flight time 6 minutes



Both Heinkel and Warsitz later reported that the raising of the landing gear was attempted, but in vain. This is nonsense, the landing gear was fixed, they knew it.

It was the first turbo jet flight in history



9 Hans Joachim Pabst von Ohain



Heinkel von Ohain



Warsitz Heinkel von Ohain

Short celebration after the first flight of the He178

The second flight of the He178 : 1 November 1939

High officials from Berlin come : Udet + entourage

During take off roll the fuel pump fails, Heinkel entertains the visitors with an opulent breakfast, after 2 hours a second successful take off is made and Warsitz flies for around 15 minutes.

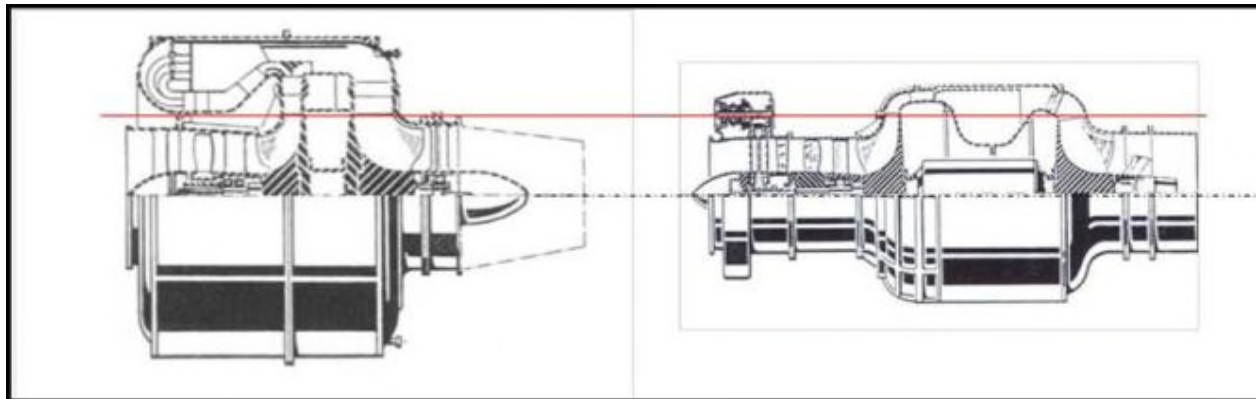
When leaving the visitors seem unimpressed.





9 Hans Joachim Pabst von Ohain

But around 2 months later Heinkel receives from the RLM the official assignment to develop a jet plane with 2 jet engines under the wing, the name is He280.



One potential engine for the He280 is the HeS8 (right) a derivative of the HeS3B (left) It has a straight flow through combustion chamber, a much longer rotor between compressor and turbine and thus a smaller diameter. The HeS8 never reaches more than 600 kp (1323 lb) thrust.



9 Hans Joachim Pabst von Ohain

First flight of the He280 is on 30th March 1941.
For safety reasons the engine cowls are not attached.
The second flight 6 days later is observed by Ernst Udet.
He is excited and allows Heinkel
to buy the Hirth Motoren Company, which means, he is
now an engine manufacturer and may continue with
his engine activities.



Ernst Udet
1896 - 1941

On the second flight the engine cowls are closed. On the right photo Udet makes a seating test.

End of the story: In March 1943 the He 280 is cancelled, the engines remain prototypes.



10 Anselm Franz



Dr. Anselm Franz
1900 - 1994

Franz's vita :

1900 1.January born in Schladming, Austria
1918-1924 Studies in Graz
1936 Working on superchargers at Junkers
1939 Chief engineer for the turbo engine development

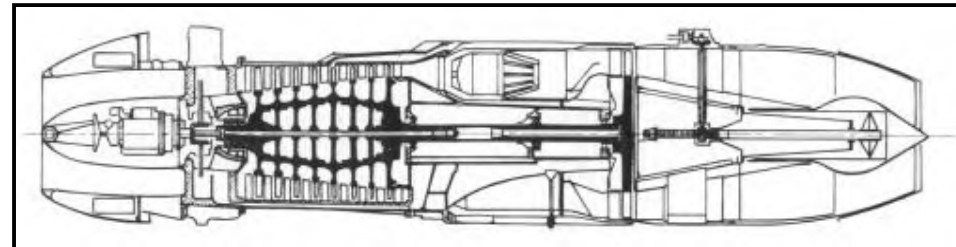
After 1945 Working for Lycoming



Dr. Anselm Franz
1989 in München



Me 262 First flight 18.7.1942
Top speed over 850 km/h
(1004 km/h in one case)
1368 aircraft built



Jumo 004 AB Serie for Me262

Thrust 910 kp (2006 lb)
Weight 850 kg
PR 3.1 with 8 stages
First run 6.8.1940
6000 units built



11 Hermann Östrich



Östrich's vita :

1903 30.December born in Duisburg

Studies in Hannover, Berlin

1926 Working for DVL

1935 BRAMO in Berlin

1939 Chief engineer for the turbo engine development

After 1945 Working for Snecma (Atar)

Dr.Hermann Östrich

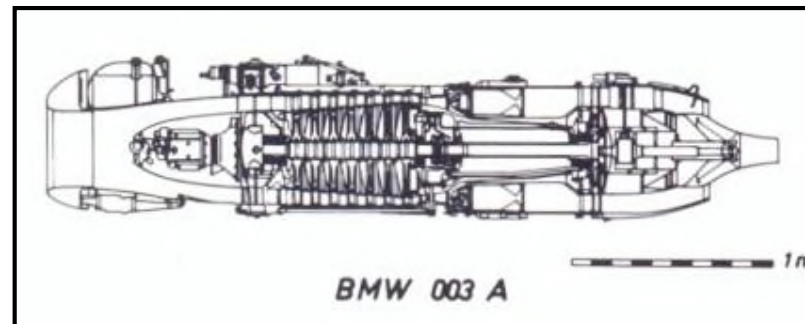
1903 - 1973



Arado Ar 234 V6 First flight 8.4.1944

Top speed of 234C 872 km/h

214 aircraft built



BMW 003 A Serie for Ar234, He162

Thrust 800 kp (1764 lb)

Weight 570 kg

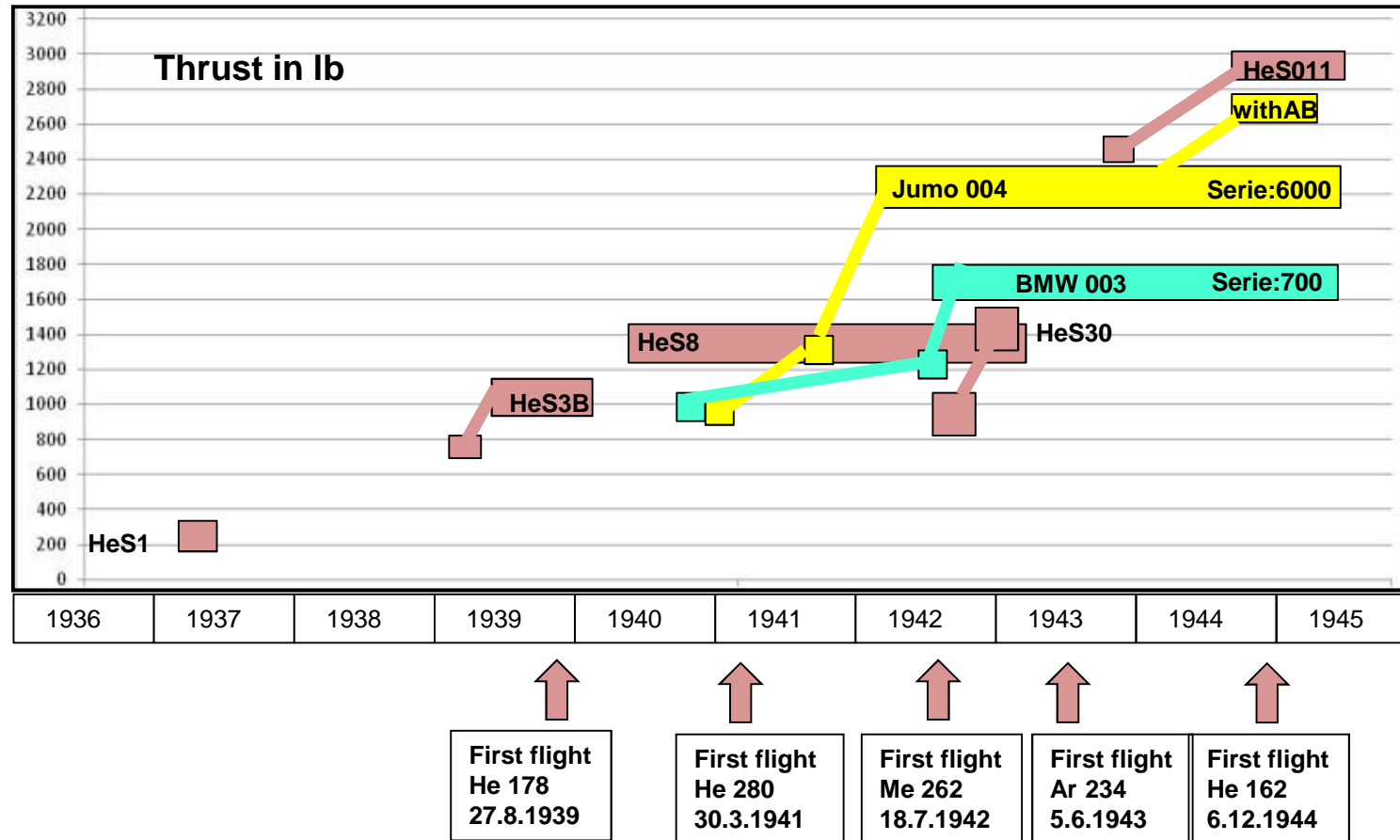
PR 3.1 with 7 stages

First run 20.2.1941

700 units built



12 The whole German Story



At the first day of war : 1 turbojet engine, at the last day : 6700 produced.



Ian WHITTLE
son of Sir Frank WHITTLE
and
Wolfgang BRIX
former Engine Expert Airbus Deutschland

Questions?



RAeS Toulouse Branch Lectures 2015 - 2016

- Tuesday
15th September
2015
18h30
"Corporate Jet Cabin Evolution"
David VELUPILLAI
Marketing Director
Symposium room, Building B01, Airbus Campus 1, Blagnac
- Tuesday
20th October
2015
18h00
Joint Lecture with 3AF Groupe Régional Midi-Pyrénées
"Commercial Spaceport Development –
Space Tourism and much much more"
Stuart McINTYRE
CEO Orbital Access Limited and Bid Leader, Prestwick Spaceport
Symposium room, Building B01, Airbus Campus 1, Blagnac
- Wednesday
18th November
2015
18h00
"Can We Fly Supersonic again in the 21st century?
and the SonicStar Project"
Bernard ROUSSET
CEO SonicStar Project
Symposium room, Building B01, Airbus Campus 1, Blagnac
- Tuesday
15th December
2015
18h00
"The Fathers of the Turbojet Engine"
Wolfgang BRIX & Ian WHITTLE
Former engine expert Airbus Deutschland & Son of Sir Frank Whittle
Symposium room, Building B01, Airbus Campus 1, Blagnac
- Tuesday
19th January
2016
18h00
24th Annual Gordon Corps Lecture
"Flight Testing Engines, Flying Spitfires & Vintage aircraft Safely"
Speakers Phil O'DELL & Mark LEWIS
Rolls-Royce Chief & Deputy Chief Test Pilot
Symposium room, Building B01, Airbus Campus 1, Blagnac
- Tuesday
16th February
2016
18h00
Rolls-Royce Mini-Lecture Competition *
20minute lectures by students from Toulouse aeronautical universities
"More Use of Electric Power in Aircraft"
Mark HUSBAND, Chief of R&T Electric Power, Rolls-Royce
Symposium room, Building B01, Airbus Campus 1, Blagnac

* Note: The competition is open to students under 25 years old.



RAeS Toulouse Branch Lectures 2015 - 2016

- Tuesday
22nd March
2016
18h00
"SonicStar - The Hypersonic Hybrid Mach 5.0 Business Jet"
Richard LUGG
Chairman & CEO HyperMach Aerospace Industries Inc
Symposium room, Building B01, Airbus Campus 1, Blagnac
- Tuesday
19th April
2016
18h00
"History and Future of easyJet"
Andrew MIDDLETON
Strategy Manager easyJet
Symposium room, Building B01, Airbus Campus 1, Blagnac
- Tuesday
24th May
2016
18h00
9th Annual ADS RAeS Toulouse Branch Lecture
"Space Weather"
Dr Gemma ATTRILL
Principal Scientist Future Sensing Technology Team, DSTL, UK
Symposium room, Building B01, Airbus Campus 1, Blagnac
The lecture will be preceded by the Branch AGM
- Friday
24th June
2016
Annual Dinner
Château de Larroque, 32200 Gimont
www.ChateauLarroque.fr

1. In order to make sure the Airbus Symposium room seating capacity is not exceeded ALL participants INCLUDING AIRBUS EMPLOYEES must REGISTER online for RAeS Toulouse Branch lectures at: <http://goo.gl/WbiKtV>, as soon as possible but by latest 10:00 two working days before the lecture and select if you require a temporary Airbus security pass. Attendees who require an Airbus pass must bring a photo ID eg a passport, to be exchanged by Airbus Security for a temporary pass whilst at Airbus.
2. Members who wish to join the speaker for dinner afterwards at le Ribouldingue, 1 bld Firmin Pons, Blagnac please contact Dinner@RAeS-Toulouse.org or 06 03 85 28 82, preferably 24 hours before the lecture.
3. Maps showing the location of Airbus Campus 1 are on our website www.RAeS-Toulouse.org



Frohes Fest und ein gutes Neues Jahr
Merry Christmas and Happy New Year
Bonnes Fêtes / Meilleurs Voeux
Feliz Navidad & Feliz Año Nuevo
God Jul och Gott Nytt År



Forthcoming Programme

For posters / any changes / updates

www.RAeS-Toulouse.org

www.Aerosociety.com

and links to



www.Academie-Air-Espace.com



AAAF-MP@sfr.fr