The Hoverwing Technology

Bridge between WIG and ACV
Internet Preview

Prepared for the EAGES 2001 International Ground Effect Symposium
Toulouse, France
June 2001

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ABSTRACT

Wingships (WIG, Wing In Ground) utilise water as runways to reach their lift-off speed, which is determined by the wing loading. High Wing Loadings are desirable for high cruising speeds with inherent height and Longitudinal stability.

To build up the necessary dynamic air pressure under the wings, they need roughly 3 times more power to overcome the hydrodynamic hump-drag compared to the drag during ground effect flight. So it is necessary to develop suitable devices as Lift-off-aids in order to reduce the recommended power. With support of the German Ministry for R&D (BMB & F) Fischer-Flugmechanik (FF) has developed the *"Hoverwing - Technology"* in order to further reduce the necessary lift-off power. The principle of this technology, for which FF has patent rights, is the building up of static air pressure between the catamaran float. After lift-off the dynamic pressure will replace the static pressure and the craft operates as a WIG with high lift to drag ratios.

FF is developing the *"Hoverwing 80"*, with the target to transport 80 passengers at 100 kts. Some test results with a scaled down two Seater will be demonstrated by video extracts.

ABOUT THE AUTHOR

Ing.Hanno Fischer was the Technical Director to Rhein- Flugzeugbau GmbH (RFB)in Germany. He has developed around 12 different aircraft like Fantrainer, Fanliner, RW 3 and the military used WIG X113, X114 and X114 H (X114 with hydrofoils) .They were designed as aircraft to fulfil the military requirement with free flight capability. The concepts were based on the works of Dr. Lippisch.

After retiring from RFB he founded the company Fischer - Flugmechanik together with his partner Klaus Matjasic. Their target is to develop the ground effect technology towards commercial application.

Based on their patents, they successfully designed the first generation of WIGs for civil use- the Airfisch 1, to Airfish 3, for which they granted a production licence to RFB.

In order to achieve a higher economical efficiency, they have developed the Hoverwing technology, which can be considered to be a basis for the second generation of WIGs. Their works are government sponsored from the German Ministry of R&D.

Last design is the Airfisch 8 called now Flightship 8, a 8 seater which has made the maiden flight in February 2001 and is delivered to Australia after successful flight demonstration.
Author of many articles and papers in the field of ground effects, for instance in Australia 1996.

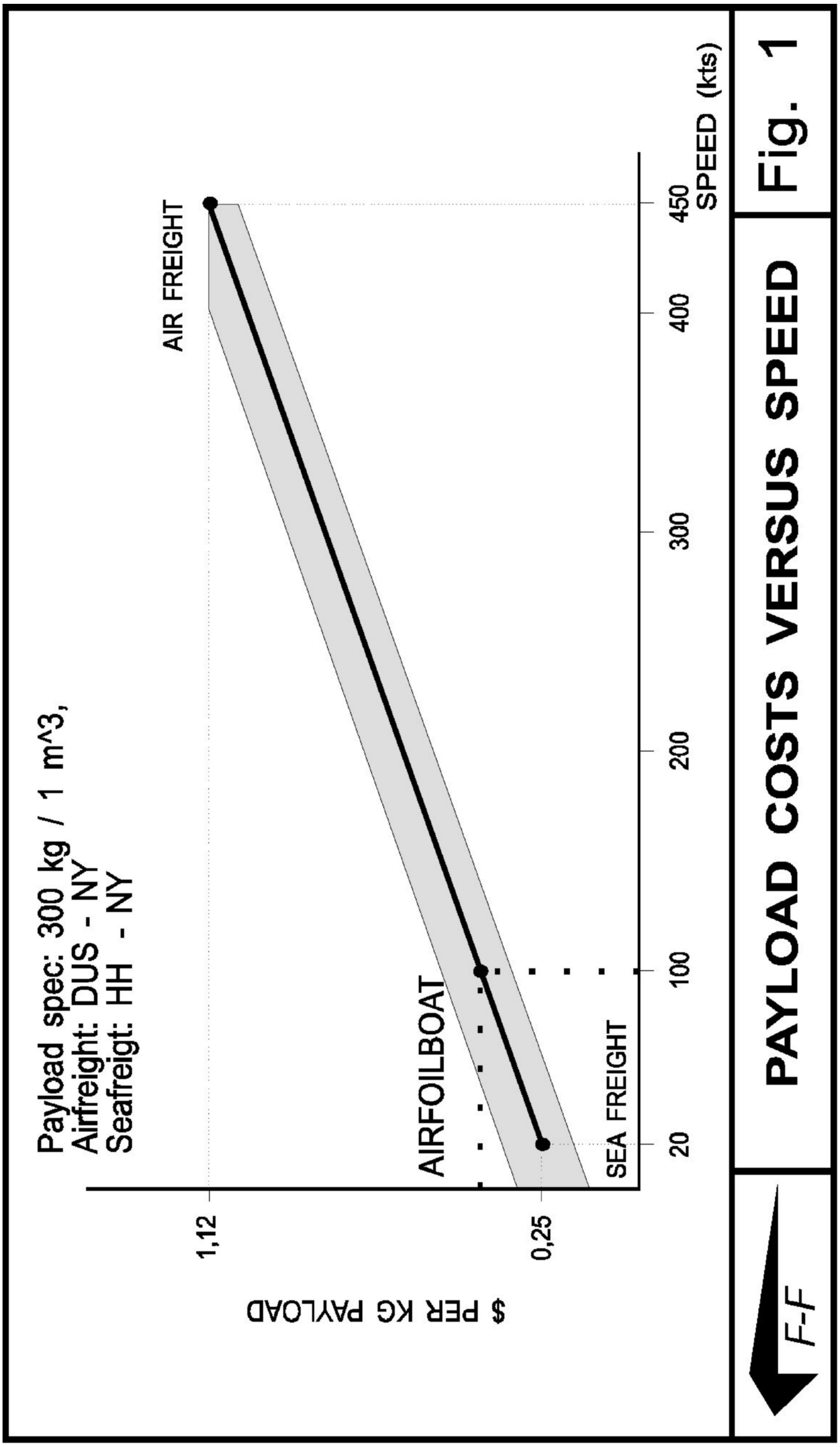
INTRODUCTION

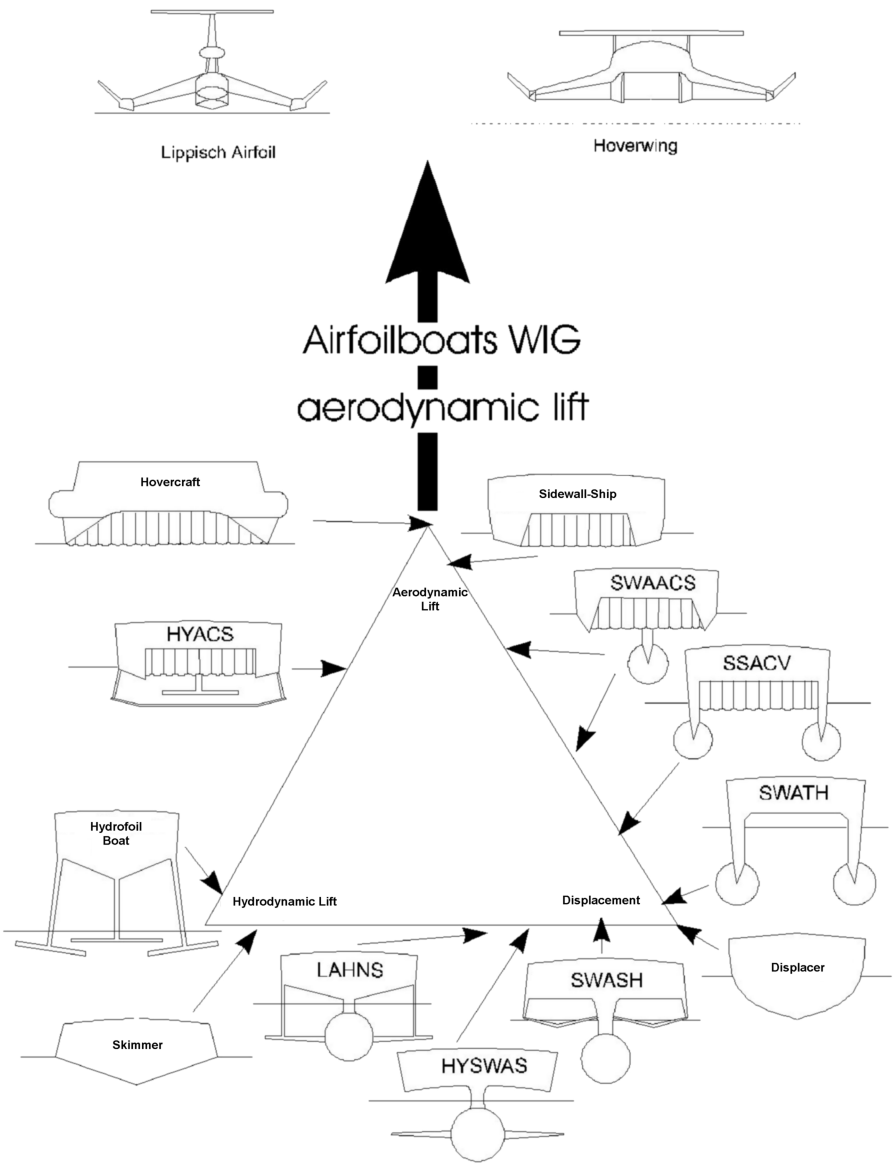
The transport velocity of passengers and goods is well above 100 km/h during surface transport. Changing from surface to water transport, the speed is reduced by as much as 20 % because of the low speed of waterborne vessels, thus increasing the tendency to switch over to fast but expansive air transport. Utilizing the so called ground effect, the gap between slow and inexpensive ships and fast but expensive aircraft can be filled. Fig.1 As WIGs lift of from the water during cruise, they avoid the high drag from the high density of the water. In order to achieve the necessary aerodynamic lifting forces for taking off, it is also necessary to overcome the hydrodynamic drag, which can be extremely high on a conventional WIG and determines the engine power to be installed. Contrary to aircraft, this excessive installed power cannot be used to increase the cruise speed. The economic efficiency of WIGs, therefore, relies on the drag being overcome during take-off.

The Hoverwing technology uses a small portion of the propeller slip stream to create a static air cushion between the floats, which are designed, as catamarans. Thus the displacement of the vessel's floats is reduced by 80 %. This results in a reduction of the wetted surfaces, that enables a drastic reduction of installed engine power.

TAKE-OFF AIDS REDUCE THE ENGINE POWER TO BE INSTALLED

The attempts to reduce the hydrodynamic drag in order to achieve higher speeds led to numerous different designs. Figure 2 Morphologic Triangle shows the different systems known today, which are supported by static air cushions at increasing speed but which cannot avoid water contact completely. By using a static air cushion during take-off, which at take-off speed is replaced by a dynamic air cushion, the Hoverwing can lift of from the water completely, and reaches glide ratios which are significantly higher than those of today's vessels. Figure 3 Weight to Thrust Ratio gives an impression of the different thrust requirements of different vehicles. A seaplane or flying boat has a very high thrust, as it is able to use this excessive power for cruise. WIGs, having the disadvantage compared with water-planes in that they cannot change the angle of attack during a take-off run in order to maintain the best lift to drag ratios.They must have an improved float design, allowing them to take-off with a constant angle of attack. Tested WIGs show a thrust-to-weight ratio of about 1 : 4. The optimized float design of the Airfisch-3 increased that number to 1 : 5.2 and with the manned Hoverwing Testbed we reached already 6.5 and we expect to come to 1 : 8 with our current optimisation programm.


Payload spec: 300 kg / 1 m^3,
Airfreight: DUS - NY
Seafreigt: HH - NY
AIR FREIGHT
AIRFOILBOAT
SEA FREIGHT
$ PER KG PAYLOAD
1,12
0,25
20
100
200
300
400
450
SPEED (kts)
F-F
PAYLOAD COSTS VERSUS SPEED
Fig. 1



SWAACS = Small Waterplane Area Cushion Ship
SSACV = Semi Submerged Air Cushion Vehicle
SWATH = Small Waterlane Area Twin Hull
SWASH = Small Waterplane Single Hull
HYSWAS = Hydrofoil Small Waterplaner Area Shi
LAHNS = Large Hydrofoil Hybrid Ship
HYACS = Hydrofoil Air Cushion Ship

F-F

Morphologic Triangle for "Hybrid - Waterborne - Craft"

Fig.2