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CONCORDE-2: AN OVERVIEW

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Abstract: Since last few decades, airoplanes have become the most prominent way of transportation even within countries. The most advanced form of these planes was Concorde which has given people an experience of travelling at a speed of sound in 1969, which lasted till 2003. Plane titled Concorde-2 was patented in USA by an airbus group company, which had claimed plane's speed to be four times speed of sound. This next version of plane seems to double that experience & excitement too. Concorde-2 will take people to an ultimate speed ever attained by an aircraft hence called as 'Ultra Sonic Airplane'. This Ultrasonic speed has made Journey from New York to London possible in just an Hour! This Significant reduction in time have also costed in reduction of passengers from 100 to 20 as compared to previous Concorde. Now whole world is excited to travel at this speed with Concorde-2 & most awaited for flying at a speed four times that of sound.

Keywords: Concorde, Fuselage, Mach, Ultrasonic.

I. INTRODUCTION

Concorde was a Supersonic airliner which travelled at a speed of two times that of sound from 1969 to 2003. This airliner is now termed as concorde-1. Concorde-1 completed dreams of many people in 20th century by cruising at sonic speed across the world. But now the Concorde-2 is expected to soon start its flights and that too at an ultra sonic speed of Mach 4. The construction of this aircraft also seems to be fascinating. The Concorde-2 is expected to reach speed as high as Mach 4.5 i.e. four & half times the speed of sound which is more than double of it's previous version. This Supersonic Airbus plane produces very small Sonic boom whereas passenger carrying capacity of Concorde-2 has decreased significantly from 100 to 20. The retired Concorde took three & half hours to travel from New York to London which is expected now to be just an hour with new Concorde. Another Extraordinary example of hypersonic air bus is to complete the trip like Paris to San Francisco or Tokyo to Los angeles in just 3 hours.

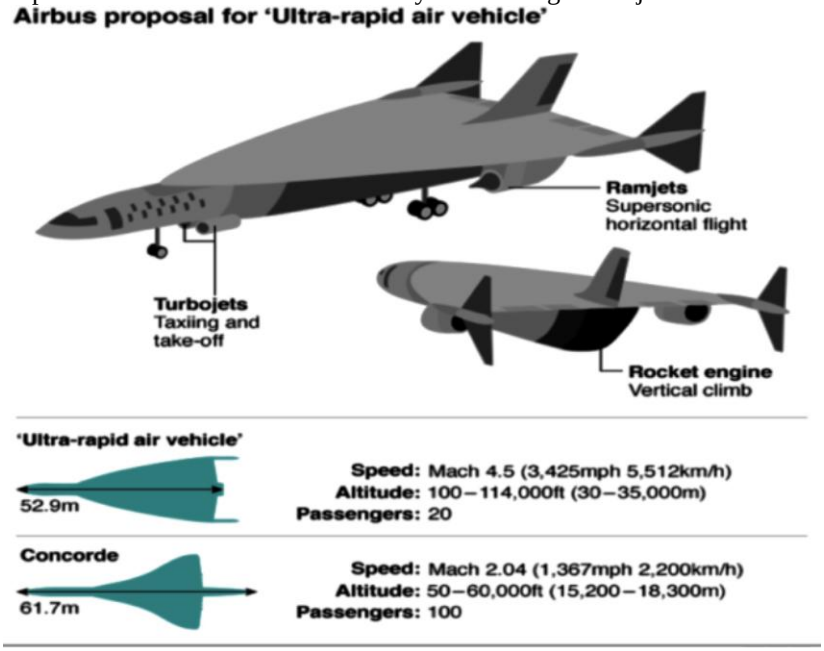

Fig. 1 Concorde-2 design

II. HISTORY

The Concorde was a joint venture between Airbus's two predecessors, France's Aerospatiale and British Aerospace. It's after burning Rolls-Royce Olympus engines powered it to a top speed of Mach 2.04 – twice the speed of sound or about 1,350 mph at an altitude of up to 60,000 ft while carrying up to 100 passengers. It began scheduled services in 1976, though only 14 ever went into service. A super fast plane then known as Concorde-1 was the fastest airplane travelling at a speed of sound.

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TABLE I :Comparison of Concorde-1 & 2

Model	Comparison of Traditional& Modern Concorde		
	Altitude	Speed	Passengers
Concorde-1	18,300 meters	2200 km/hr	100
Concorde-2	35,000 meters	5512 km/hr	20

This plane was built jointly by Britain & French government due to its high construction & Manufacturing cost. This project fetched a profit of £500m of net profit in its service. But the crash of AF4590 in Paris which Killed 109 people on board & four on ground proved to be major setback for Concorde-1, which ultimately closed the service of Concorde-1.

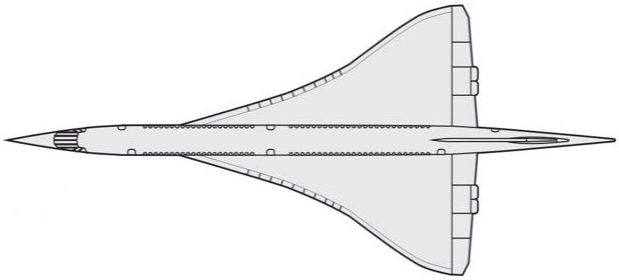

Fig. 2 Traditional Concorde Design

III. CONSTRUCTION

Concorde-2 is equipped with two Ramjets under its delta wings, a pair of Turbojets under the front part of the fuselage and rocket engine at the rear end of the fuselage.

Ramjet

Ramjet is a form of air breathing jet engine that uses the forward motion to compress incoming air without an axial compressor. Ramjet is efficient only when speed is more than MACH -3. Thrust is produced by forcing the external air into the combustion chamber using forward motion of the Concorde. The working fluid & hot air is brought in contact with fuel and then required thrust is generated.

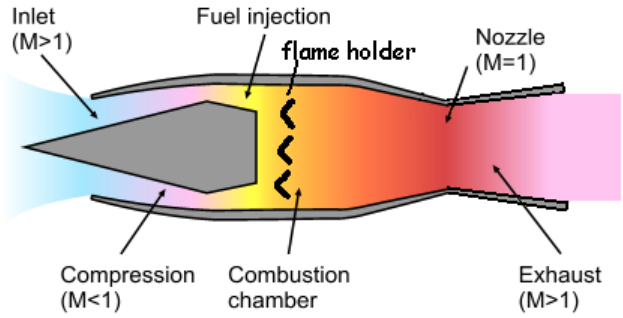

Fig 3 Ram Jet

At stationary condition or static state, engine cannot produce the thrust. At speed more than MACH- 5 air entering must be slowed down to subsonic speed and the dynamic pressure due to low velocity is converted into higher static pressure. Shock waves at inlet cause reduction in performance. To overcome this loss, pre-burner is provided so that first compressed air is mixed with fuel through the Fuel Injector and then combustion takes place.

Turbojet

Turbojet is another propulsion system which is used in Concorde-2. This is also called as Gas Turbine Engine. The compressed air from the compressor is heated by the fuel in the combustion chamber and then allowed to expand through the turbine. The turbine exhaust is then expanded in the propelling nozzle where it is accelerated to high speed to provide thrust. The turbine engine gets the oxygen from atmosphere. In space there is no oxygen so we cannot operate Gas Turbine in it.

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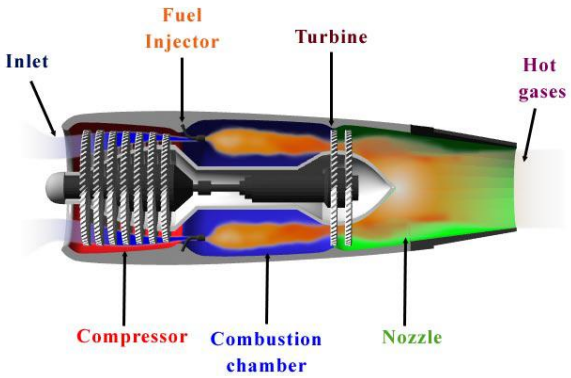

Fig.4 Turbo Jet

Turbojets consists of following Sections

- Air intake
- Compressor
- Combustion chamber
- Turbine
- Nozzle

Rocket Engine

The vertical motion of the rocket to reach the altitude of more than 100,000 feet requires a speed of MACH 4.5. This Rocket engine gives a vertical trajectory to the Aircraft which is the most important stage of the flight after completion of the Turbojet stage. This Rocket Engine is expected to generate a thrust of 15,000 Lb. This thrust would take the aircraft to an altitude of 100,000 feet in just 500 sec. The best estimation for a rocket engine is the solid propulsion system which uses solid fuels for this great thrust production.

IV. WORKING

The three main component of Concorde-2 are Turbojet, Rocket Engine & Ramjet. The turbojets are used for propelling the aircraft during Taxing and Take-off. Once the aircraft reaches to the required altitude, the turbojets are retracted into the Fuselage and Rocket engine is ignited at full power causing the aircraft to travel vertically like a rocket at supersonic speeds. Because of this vertical trajectory, the energy of the supersonic boom is dissipated in all horizontal radial directions and it does not encounter the ground. At speeds less than Mach-1, fins provided on the Delta wings are oriented horizontally. However once the speed exceeds the Mach- 1 the fins are oriented vertically. This maintains center pressure at the same point and thus provides greater stability after reaching at very high altitude. After the aircraft has attained a suitable altitude, it get a horizontal trajectory at which the rocket engine is powered off and closed by a door to make it streamlined. Here after the ramjets are ignited and the aircraft is projected in horizontal direction at supersonic speed of 4.5 MACH. While the Concorde follows all these sequences the passengers and the crewmembers are placed in hammock seats which improves comfort & keeps them unaware of all the transitions phases from which the aircraft pass through.

Delta Wings

The delta wing is a wing shape structure in the form of a triangle. The tailless delta is favoured design for high-speed use. In hypersonic Air plane "Gothic" delta wings are used so called because if its resemblance to cathedral, with a leading edge sweep of 70 to 75 deg. To slow down and descend, the vehicle's ramjets/s are shut down, split flaps are deployed and trapezoid-shaped fins on the outer edge of each wing's tailing edge are repositioned perpendicular to the delta wings after speed drops below MACH-1.

Supersonic Boom

As the plane would be travelling vertically while achieving supersonic speeds, the resulting boom would be minimized. At high supersonic speeds the shock cone from the leading edge root lies along the wing surface behind the leading edge. It is no longer possible for the sideways flow to occur and the aerodynamic characteristics change considerably.

Carbon Nano tubes coating

Usually one expects to have ceramic tiles to protect the aircraft's tip from thermal damage. In space shuttles as well as entry vehicles, ceramic tiles are used. However, the Ultrasonic Liner uses carbon nanotubes as the ultimate thermal

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protection. Carbon nanotubes have amazing tolerance to heat with them being able to withstand temperatures in the region of 2800 degrees Celsius in vacuum and about 750 degrees Celsius in air. Thus, carbon nanotube coatings are used at the thermally more vulnerable spots such as the tip of the nose and the tips of the wings. This diagram shows where the carbon nanotubes coating are put to use.

To curb the dangers to the environment due to high altitude emissions, a very effective and efficient method has been used for the SonicLiner. The engines have fitted filters to the end when the exhausts are released. This simply works like a sieve where the pollutants can be simply separated out so that they do not cause harm in the upper reach of the Earth's atmosphere.

However, it was noted that the exhausts would be travelling at a huge speed and under high pressure and high temperature. Moreover, the filters have to be effective so that their main purpose is not defeated. Thus, it was concluded that the most suitable materials for the filters would be carbon nanotubes. This is due to their unique molecular structures as shown in the Fig. 5.

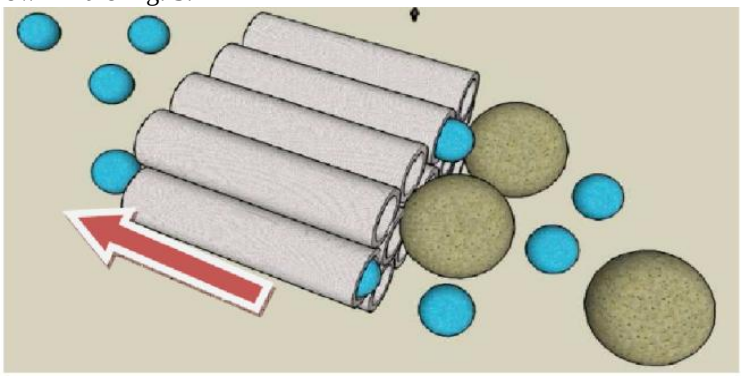

Fig. 5. Carbon Nanotube filters

Moreover use of carbon nano tube filters has the following added benefits:

- They are heat resistant and can withstand temperatures much higher than that of exhausts.
- They are quite cheap to manufacture and more effective as compared to other filters.
- They can be easily cleaned through processes like autoclaving, ultra sonication using mild oxygen plasmas and laser cleaning.
- They are environmentally friendly and pose no threat to the environment unlike other non-biodegradable filters.

V. SUMMARY

The era of Ultra Sonic vehicles seems to be ahead in a decade for its passengers. Life at this speed surely will prove to be a boom for travelling on this planet for the generations ahead. The Ultra Sonic Liner has novel and innovative approaches for increasing efficiency and performance of supersonic aircrafts. However, it should be noted that due to limitations of capital and access to cutting-edge research facilities and wind tunnels, analysis & testing is required to be done on the designs of the Ultra Sonic Liner.

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