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Conceptual Design of an Aircraft with Maglev Landing System

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***Abstract*—**The accelerated growth in aircraft industries desire effectual schemes, programs, innovative designs of advanced systems to accomplishing the augmenting need for home-free air transportation. In this paper, a contemporary conceptual design of an airplane has been proposed without landing gear systems in order to reducing accidents, time consumption, and to eliminating drawbacks by using superconducting levitation phenomenon. This invention of an airplane with superconductive material coating, on the solar plexus region assist to reduce weight by approximately 4% of the total take-off weight, and cost effective. Moreover, we conjectured that superconductor landing system reduces ground friction, mission fuel, total drag, take-off and landing distance.

***Keywords*—**Aircraft landing system, Magnetic levitation, Superconductors, Take-off and landing.

I. Introduction

THE Landing gear system in an aircraft remains a problem for a continued period all over the world; Records shows that approximately 50% of aircraft accidents occur during landing [1]. For today's fast-paced society, there is a pressure on every aeronautical engineer in improvising air transportation that could revolutionize transportation, the way maglev trains did in the 21th century.

Maglev is a method of propulsion that uses magnetic levitation to propel vehicles [2]. The maglev trains use superconducting magnets which allow for a larger gap and repulsive/attractive-type electrodynamics suspension [2]-[3]. Superconductivity is a phenomenon occurring in certain materials at very low temperatures, characterized by the complete absence of electrical resistance and the damping of the interior magnetic field (*Meissner effect*) [5]-[6], if superconducting magnets are used above a track made out of a permanent magnet, then the train would be locked into its lateral position, it can move linearly along the track, but not off the track [7]. Due to the complexity and ramification in current aircraft landing system, there are some limitations. Fog season consumes passenger's time; aircraft are forced to divert their flight paths. Due to unpredictable climatic changes, the invisibility of the runway creates inconvenience to both passengers and crew members. This level of disruption costs airlines huge amounts of money and it also causes passengers a great deal of inconvenience through missed connections and the extra time spent in the aircraft after a long flight [8]. Research is going on for the developments and improvisation in aircraft landing systems which could hold the key to travel delays.

As a result, various aviation authorities have been working on the next generation of all-weather aircraft landing systems. Initially, a Microwave Landing System (MLS) started to come into use at major airports but airlines were slow to adopt it because of the expense. Then, Global Positioning System (GPS) has led to the next evolutionary stage in landing systems [8]. Despite of the advantages there are also some disadvantages. It potentially has a single point of failure in that interference with or failure of the GPS system would disable it completely. The major disadvantage is accuracy [9]. Airports are working with the aviation industry to maximize operations in low-visibility conditions and have upgraded facilities by installing transmissometers to provide pilots with more accurate electronically derived visibility information. This will maximize opportunities for departures in fog as well as assisting landings. Further upgrades are being coordinated with the aviation industry.

The present invention resides in an advanced and improved landing system which requires less maintenance, low fuel consumption, reduced amount of harmful greenhouse gases (CO_2, nitrogen oxides, O_3, SO_2, and methane) released. In its most basic form, the landing system of the present invention utilizes the maglev tracks, reduces the amount of collisions and accidents during take-off and landing.

The magnetized coil running along the track, called a maglev tracks, repels the large magnets on the airplane's undercarriage, allowing the body to levitate [10]. Take-off and landing in maglev airplanes are much faster, because they float over the runway eliminating rolling resistance and potentially improving the power efficiency. Fig.1 represents a side-view of an airplane with magnetic pole arrangement in the belly region.

II. Working Principle

Aircraft maglev landing system relies on magnets for both levitation and propulsion. Airplanes underbody is made up of superconducting magnets. During landing, superconducting magnets on top of the runway get oriented accordingly to repel

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similar poles in the basement of the airplane to levitate the body upward in a hovering position.

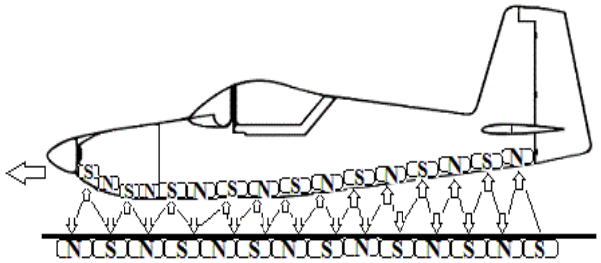


Fig. 1 A drawing of Maglev airplane

During take-off, the airplane is propelled by the changing in magnetic fields, the whole runway is cabled with electromagnets that can be switched rapidly to push the airplane. Once the body is levitated, power is supplied to the coils within the maglev tracks to create a unique system of magnetic fields that pull and push the airplanes along the guideway. The electric current supplied to the coils in the maglev tracks is constantly alternating to change the polarity of the magnetized coils. This change in polarity assists to pull the vehicle forward.

Maglev airplane floats on a cushion of air, eliminating friction. This lack of friction and the planes' aerodynamic designs allow these airplanes to reach unprecedented ground speeds during landing and take-off. Fig.2 (a) clearly shows the front-view of the magnetic levitation airplane with superconductive magnetic coating on the abdomen region. Moreover, airplanes use the most fuel, and produce the most harmful emissions such as CO_2, nitrogen oxides, O_3, SO_2, and methane, during takeoff. Around 25% of the total fuel consumed is used during takeoff. However with the help of maglev landing system, emission of harmful greenhouse gases get reduced and large amount of fuel get consumed.

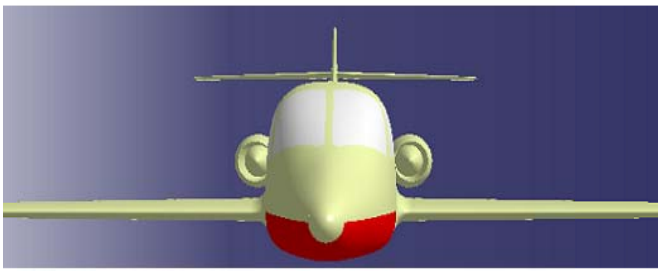


Fig. 2 (a) A Front-view of a maglev aircraft without landing system

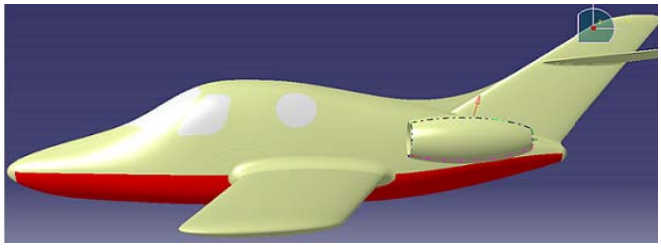


Fig. 2 (b) A side-view of a maglev aircraft without landing system

Each magnet in the belly area of an airplane has an electronic switch, controlled by the computer to accelerate or decelerate the airplane's body. Once attained cruise, the airplanes belly superconductor magnets acts as a normal material. Aluminum is chosen to play both the role of normal material and superconducting magnetic material when cooled to 1.2K (Kelvin). Fig. 2 (b) represents the side-view of the magnetic levitation airplane with superconductive magnetic coating on the stomach region.

The minimum material coating of around 20% of the total aircraft's surface area is adequate due to the *magnetic locking*. By this technique, as soon the aircraft reaches the runway, it gets locked in the field and travels with the same orientation throughout the landing, changed only by applying external forces. Fig.3 represents the three dimensional view of the magnetic levitation airplane without landing system.

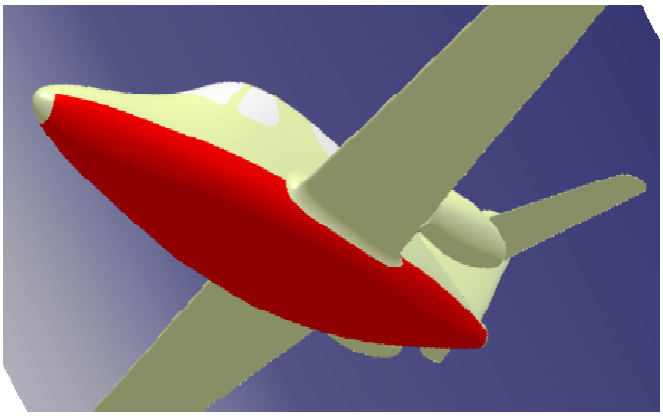


Fig. 3 A 3D view of a maglev aircraft without landing system

III. Conclusion

Thus, maglev airplane has no landing system and therefore need much less maintenance. They run on superconducting magnets and don't require all of the fuel that current aircraft do and reduce the amount of CO_2 released. Maglev airplanes are less expensive to build in comparison to conventional airplanes. The maglev tracks, reduces the amount of collisions and accidents. Take-off and landing in maglev airplanes are much faster, because they float over the runway eliminating rolling resistance and potentially improving the power efficiency.

Acknowledgment

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