Asian Journal of Applied Science and Technology (AJAST)
Volume 1, Issue 5, Pages 22-24, June 2017

Intelligent Airlock System for Hyperloop with Landing Wheels

E.Abin[1] and P.H.Varsha[2]

[1]*UG Student, Department of ECE, MVJ College of Engineering, Bangalore, India. Email: abinelamana@gmail.com*
[2]*Assistant Professor, Department of ECE, MVJ College of Engineering, Bangalore, India. Email: varsha.hotur@gmail.com*

Article Received: 14 May 2017 *Article Accepted: 03 June 2017* *Article Published: 05 June 2017*

ABSTRACT

Hyperloop is a new transportation technology which uses a capsule to travel from one place to another inside a tube. This paper presents an intelligent airlock system for the Hyperloop in order to maintain 100 pa pressure inside the tube. Also this paper deals with addition of wheels to capsule so that at the time of arrival, the capsule can enter inside the station from the airlock and the same can be used in emergency conditions also. The rest of the time when the capsule is moving the wheels will be hided similar to an aero plane landing wheels.

Keywords: Transportation technology, Hyperloop, Intelligent airlock system and Emergency landing wheels.

1. INTRODUCTION

Time is money perhaps that is the reason why people always complain about travel. We always think of getting transported from one place to other place faster and faster. We always dream to travel place from to place within a blink of an eye. This dream was the potential for idea behind the Hyperloop technology. The idea of Hyperloop is to transport people within capsule which moves through loops or tubes where there will be low pressure environment inside it and the capsule won't be touch because of the phenomenon of magnetic levitation caused by the linear induction motor. The atmosphere inside the tube with low air pressure is similar to an aero plane flying in high altitudes. The first ever concept of people transportation through a pod inside a closed tube was put forth by scientist G. Medhurust in a paper published in 1812 where concept was introduced to use power and velocity of air for travelling of passengers inside a tube. The concept was redeveloped by young entrepreneur Elon musk founder of Tesla motors and SpaceX. The principle idea behind the Hyperloop was simple and is just to reduce the friction and air drag so as to get higher velocity, just like maglev trains.

Understanding the concepts of Hyperloop

Even though the Hyperloop is a new technology, the idea behind it is perfectly feasible within our understanding of physics and also the implementation would not require any new technology. So the construction of Hyperloop is done through assembling the required things within our existing technologies. The major theoretical hurdle for Hyperloop is something called the Kantrowitz limit. It deals with the speed of an object moving inside a tube. A projectile in a tube has a minimum tube to projectile ratio in order to move at a high speed efficiently. This is because as a projectile start to move quickly in a tube it creates a large column of air in front of it. If the tube diameter is too small, the projectile will not only have to propel itself forward but also the entire column of air in front of it. This occurs because the air cannot move around the projectile if the diameter is too small. Furthermore, this situation would require an infeasible amount of power for a very little speed benefit, or in other words a horrible transportation system. The solution to this problem is to simply make a large tube, yet this too is inefficient for a largescale transportation system as material cost would be greatly increased.

In 2013, Elon Musk proposed [1] a solution to both these problems. If an electric compressor fan is placed on the nose of the pod it could actively transfer high pressure air from the front of the pod to the back. Moreover, this air could also be used to create a cushion for the train to glide on as it travels, known as an air bearing. The benefit to air bearings are that Hyperloop would not lose any energy to fighting friction. The movement of the capsule is as a result of the functioning of the linear induction motor. The linear induction motor speeds up the linear motion of the capsule inside the tube having aluminum track inside it. The aluminum track will act a s a stator for the linear induction motor and the rotors are fixed on the capsule thus the magnetic levitation is produced and the capsule moves inside the tube at a speed near to the speed of the sound.

2. EXISTING SYSTEM

Hyperloop is a proposed transportation system for traveling between Los Angeles, California, and San Francisco, California in 35 minutes. The Hyperloop consists of several distinct components, including:

1. Capsule

a. A capsule will be generally an air tightened or sealed transporting medium in which people are carried from one place to other place.
b. For the purpose safety, the capsules are separated from each other by approximately 37 km.
c. the capsules are lifted as a result of air bearing used for the purpose of creating an air cushion and magnetic levitation caused by the induction motor.

2. Tube

a. The tube is made up of steel. Two tubes will be welded together in a side-by-side configuration to allow the capsules to travel both directions.

b. Pylons or support pillars are placed every 30m to support the tube.
c. Solar panels are place throughout on the top of the tube in order to provide power to the system.

3. Propulsion

a. the thrust for the capsule is provided by the compressor which compresses the air in front of it a pushes through the back, which creates a thrust force for the capsule to move
b. Rotors are located on the capsules to provide magnetic levitation and thus will be moving along the aluminum tracks which are actually acting as stators.

Working of the capsule

So how exactly the capsule moves through the tube. The capsule will move through a steel tube with aluminium tracks inside it [3,5].

The capsule will be having a compressor fan which compresses the air in front of it and some of this air is passed to the air bearings for maintaining the capsule to be at the centre of the tube.

And the rest of air will be passed to the back of the capsule where it is pushed out to create a thrust for the capsule. The basic block diagram of a capsule is as shown below in figure 1.

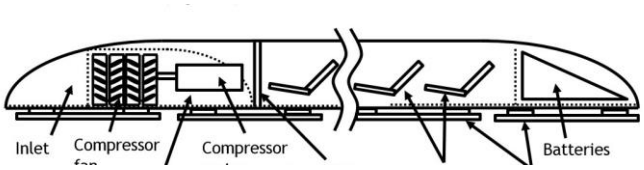

Figure 1: Basic block diagram of a capsule

The pods will be moving through frictionless track because of the use of a linear induction with magnetic levitation technology.

[2] Linear induction motor is nothing but, in this electric motor design, the force is produced by a linearly moving magnetic field acting on conductors in the field. Any conductor, be it a loop, a coil, or simply a piece of plate metal, that is placed in this field will have eddy currents induced in it thus creating an opposing magnetic field in accordance with Lenz's law. The two opposing fields will repel each other, creating motion as the magnetic field sweeps through the metal, this is shown in below figure 2.

For the braking purpose of the capsule, the regenerative braking system is used where the compressor motor will act as a generator at this time and will recharge the battery.

Self-powering capability

Hyperloop is fully powered by solar panels that are placed on the top of the tubes. So it doesn't need a separate space for the purpose of keeping the panels and doesn't need power from outside. The Hyperloop as a whole is projected to consume an average of 21 MW. A solar array covering the entire Hyperloop is large enough to provide an annual average of 76,000 hp (57 MW), significantly more than the Hyperloop requires. The Hyperloop tube has solar panels placed on it for the generation of power. So actually these solar panels can provide energy more than the system will be consuming and thus acting as a power generator.

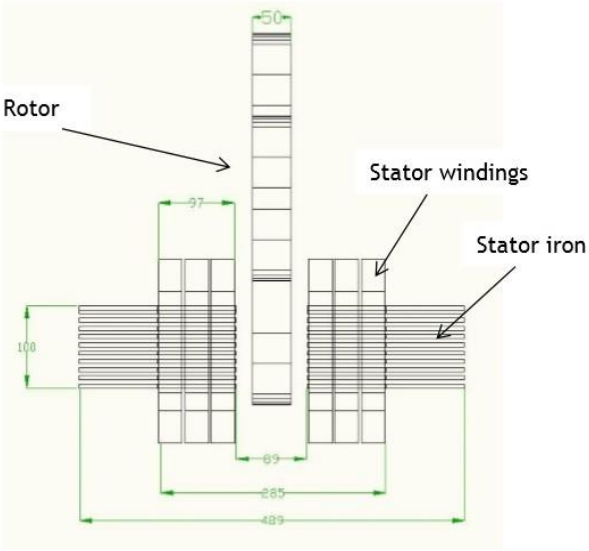

Figure 2: Linear induction motor

3. PROPOSED SYSTEM

The proposed system in this paper is an intelligent airlock system for the Hyperloop along with landing wheels. The Hyperloop technology at present faces a difficulty in stopping at the intermediate stations and this problem is not mainly caused in the first Hyperloop systems which are going to open in the world soon since as there are only two stations and intermediate stations are not considered in these projects.

So in future when Hyperloop is developing for transportation between two main places with different intermediate stations the difficulty in landing will be faced. So to avoid this landing wheels can be added to the Hyperloop system.

Also in the Hyperloop system there is need to maintain pressure throughout the tube over long distance and thus to make the process of maintaining this pressure easier automatic intelligent airlock systems can be added.

4. DESCRIPTION

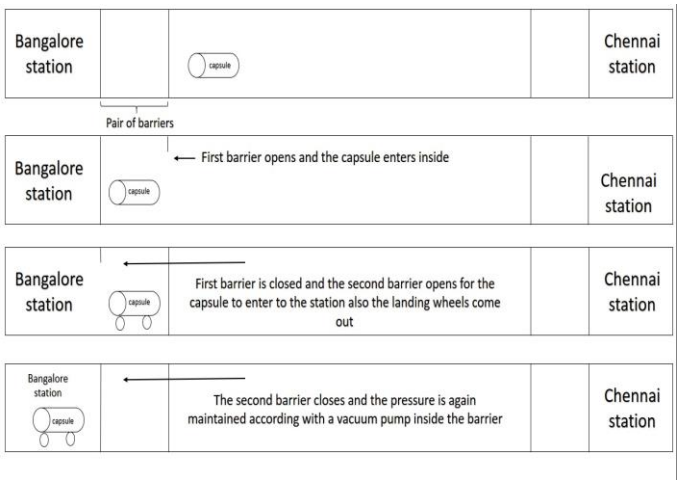

Figure 3: Working of air lock system

The tube has a lower pressure than the station. So in order to maintain the pressure, we need to employ airlocks. The airlocks are employed in the system in such a way that when we are considering between two stations almost the full distance will be considered as a full air lock and just at the entrance of each station a separate pair of airlock barriers are kept so that the capsule will fit inside these barriers perfectly. So initially these airlock barriers near the station will be closed and when the capsule is nearing the station, the first barrier opens so that the capsule enters inside the two barriers. After entering, once the barrier which was opened previously is closed, then the other barrier opens and the landing wheels comes out and the capsule moves to the station where normal atmospheric pressure exists. Once the capsule moves out of the two barriers, the last barrier closes immediately and an automatic vacuum pump will maintain the pressure required by the Hyperloop inside the two barriers and will get opened again and repeat the same procedure once the next capsule arrives.

The landing wheels which are used to move the capsule from the barrier to the station can be used in case of emergencies inside the loop. This is explained in the above figure3.

5. RESULT

Thus with the help of this intelligent airlock system there is lesser maintenance for maintaining the tube pressure and also the implementation landing wheels make the process easier and helps the Hyperloop system to add more intermediate stations and make the cost of stopping comparatively less.

Comparative results

The airlock system helps the loop to maintain a constant pressure inside it so that it resembles the atmosphere similar to that of an aero plane at high altitudes inside the tube.
The landing wheels will be useful at the time of moving to the station from the pair of barriers near the station as well as in case of some emergency.

The other advantages of Hyperloop over existing technologies are: -
Cost:

- The fastest mode of ground transport at present is Bullet trains and maglev trains
- So the proposed cost for the high speed rail network between San Francisco and Los Angeles was about 60 billion dollars.
- The proposed cost of Hyperloop for the same route is 6 billion dollars.
- So since the cost of making has decreased, the cost of tickets will be also reduced and thus will help more number of people.
- The cost per ticket of Hyperloop can be actually lower than the airline fare.

The estimated cost for Hyperloop between LA and SF is as shown in figure 4
SPEED:

- The maximum speed of a high speed train is 546 kmph whereas for Hyperloop is 1200 kmph
- So definitely Hyperloop is the best option

Component	Cost (million USD)
Capsule	**54** (40 capsules)
Capsule Structure & Doors	9.8
Interior & Seats	10.2
Compressor & Plumbing	11
Batteries & Electronics	6
Propulsion	5
Suspension & Air Bearings	8
Components Assembly	4
Tube	**5,410**
Tube Construction	650
Pylon Construction	2,550
Tunnel Construction	600
Propulsion	140
Solar Panels & Batteries	210
Station & Vacuum Pumps	260
Permits & Land	1,000
Cost Margin	536
Total	**6,000**

Figure 4: Approximate cost estimate of Hyperloop between LA and SF

6. CONCLUSION

So while comparing with all the aspects we can say that the Hyperloop is the best possible mode future transportation that helps people to travel between place at the speed of sound through the ground. The intelligent airlock system which is proposed in this paper helps to maintain specific air pressure inside the loop for smooth functioning of the Hyperloop also the landing wheels provide an extra safety feature for the Hyperloop as it can be used in emergency situations when the train can't move because of certain reasons. Thus the landing wheels are having multipurpose use in the Hyperloop system Because of all these tremendous features we can say that Hyperloop is the best solution for the fastest mode of transportation that can revolutionize the transportation field to undergo a massive change eco-friendly.

7. FUTURE SCOPE

To implement the revolutionary Hyperloop system in more places with more number of intermediate stations.

REFERENCES

[1] E. Musk, "Hyperloop Alpha." *Tesla. 08.12.2013. Accessed-10.26.2016. https://www.tesla.com/sites/default/ files/blog images/hyperl oop-alpha.pdf* .

[2] "Linear Induction Motor" *Wikipedia. https://en. wikipedia.org/wiki/Linear#induction#motor.*

[3] R. Palacin. "Hyperloop, the Electrification of Mobility, and the Future of Rail Travel." *IEEE Electrification Magazine.09.2016.https://www.researchgate.net/profile/Roberto_Palacin/publication/307867878_Hyperloop_the_Electrification_of_Mobility_and_the_Future_of_Rail_Travel_Viewpoint/links/5801f78008ae6c2449f7c30e.pdf.*

[4]*https://www.tesla.com/sites/default/files/blog_images/hyperloop-alpha.pdf.*

[5] Mohammed, M.A., 2015. Design and Implementing an Efficient Expert Assistance System for car evaluation via fuzzy logic controller. *International Journal of Computer Science and Software Engineering (IJCSSE)*, 4(3), pp.60-8.