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Electromagnetic conveyor

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Abstract:*This Levited transporter is known as "ELECTROMAGNETIC CONVEYOR". This conveyor is different from other more conventional, industrial conveyor in that it requires surface contact for traction and it is able to move freely over a variety of surface while supported continuously on a self-generated levitation of air. Though the concept is different, the rate of development of Levied conveyor has been outstandingly faster than that of any other mode of conveying. We thought on the lines of improving his design from the aspect of reducing the Vibration and frictional resistances encountered by a conveyor moving on the guide rails. We struck upon the idea of using magnets in steps on the track, which would help to guide the material more gradually without any shock and vibration. To reduce jerks and uneven movement the magnetic affect must increase and vice versa. Most normal designs are a compromise between the two. We imagined that if we could introduce a coil between the two separated guide rails a great magnetic field can be created and by the control system the problem of conveying from start to end can be effectively minimized.*

Keywords:*levitation, less friction,electromagnet, lessjerk, elevator*

I. INTRODUCTION

The fast industrialization and rapid urbanization have generated a high demand of material transportation. There is always a need of fast supply of material as the demand of consumer is ever increasing daily. So for basic material handling process used till date are experiencing many drawbacks like time consuming conveying system is there. In addition, there has to be a requirement of skilled operators to handle it properly. The material handling system used are noisy in operation and the maintenance of the system is more now a days. Therefore, for overcoming these drawbacks our main objective is to provide a noiseless maintenance free conveying system. This magnetic conveying system can be used in every industrial application where there is a requirement of transportation of material between two sections or segments. This type of structure provides a compact and efficient conveying guarantee with quick and fast operation. The wear and tear problems are reduced at a low level in this system giving a very smooth and gradual flow of materials.

II. RESEARCH PAPERS REFERRED

This paper proposes an adaptive robust nonlinear controller for position tracking problem of a magnetic levitation system, which is governed by an SISO second-order nonlinear differential equation. The controller is designed in a backstopping manner based on the nonlinear system model in the presence of parameter uncertainties. The combined adaptive and robust approach helps to overcome some well-known practical problems such as high-gain feedback of the robust controller, and poor transient performance of the adaptive controller, so that better control performance can be achieved compared to the case where either is employed alone. [1]

A relatively new magnetic-levitation device is discussed. This levitation device uses an electromagnet which is the inductive part of a resonance circuit and the paper seeks an explanation of the principal properties of the system. Some of the properties are analyzed by the use of steady-state impedances. The dynamic instability is interpreted by comparison with electromechanical parametric machines. The results of the experiments described are in agreement with the theory. The paper concludes with a brief mention of an analogy between this levitation system and a device where levitation is obtained by induction. [2]

It is well known that sliding mode control (SMC) is capable of tackling systems with uncertainties. However, the discontinuous control signal causes a significant problem of chattering. In this paper, a new and simple approach to chattering free SMC methodology is proposed. The main purpose is to eliminate the chattering phenomenon. As a result, the chattering is eliminated and error performance of sliding mode control is improved. The reduction of the chattering of sliding mode control is achieved by using a distance function which measure the distance between the trajectory of state errors and the sliding surface as the corrective control term instead of discontinuous sign function.[3]

A power-saving electromagnetic suspension system has been developed in which electromagnets with permanent magnets are used to suspend the vehicle. The electromagnets are controlled to maintain air gap length so that the attractive force by the permanent magnet always balances the total weight of the vehicle and its loads, based on modern control theory. This technology realizes a significantly power-saving system in which the electromagnetic coil current required to keep a vehicle levitating was extremely small, ideally zero. The 8-kg weight test vehicle with 4-kg load could be levitated continuously over 8 h, without recharging the on-board 1300-mAh batteries. [4]

The term "Levitation" refers to a class of technologies that uses magnetic levitation to propel vehicles with magnets rather than with wheels, axles and bearings. Maglev (derived from magnetic levitation) uses magnetic levitation to propel vehicles. With maglev, a vehicle is levitated a short distance away from a "guide way" using magnets to create both lift and thrust. High-speed maglev trains promise dramatic improvements for human travel widespread adoption occurs. Maglev trains move more smoothly and somewhat more quietly than wheeled mass transit systems. Their no reliance on friction means that acceleration and deceleration can surpass that of wheeled transports, and they are unaffected by weather. The power needed for levitation is typically not a large percentage of the overall energy consumption. Most of the power is used to overcome air resistance (drag). Although conventional wheeled transportation can go very fast, maglev allows routine use of higher top speeds than conventional rail, and this type holds the speed record for rail transportation. Vacuum tube train systems might hypothetically allow maglev trains to attain speeds in a different order of magnitude, but no such tracks have ever been built. Compared to conventional wheeled trains, differences in construction affect the economics of maglev trains. [5]

Analysis of electromagnetic field distribution created by multi-turn coil used as propulsion mean for conveying of materials by electromagnetic field is presented. Use of different coil materials and coil dimensions is evaluated. It is evident that coil's geometry plays an important role in conveying model. The maximum of force is achieved at the entrance of coil wound or in the first half of coil's height. [6]

III. WORKING PRINCIPLE

The magnetic air conveyor works on the principle of LEVITATION. When current is passed through a coil a magnetic field is generated around it. So when a magnet is placed around this fields it creates repulsion and this repulsive force is used to give a contactless transporting of materials

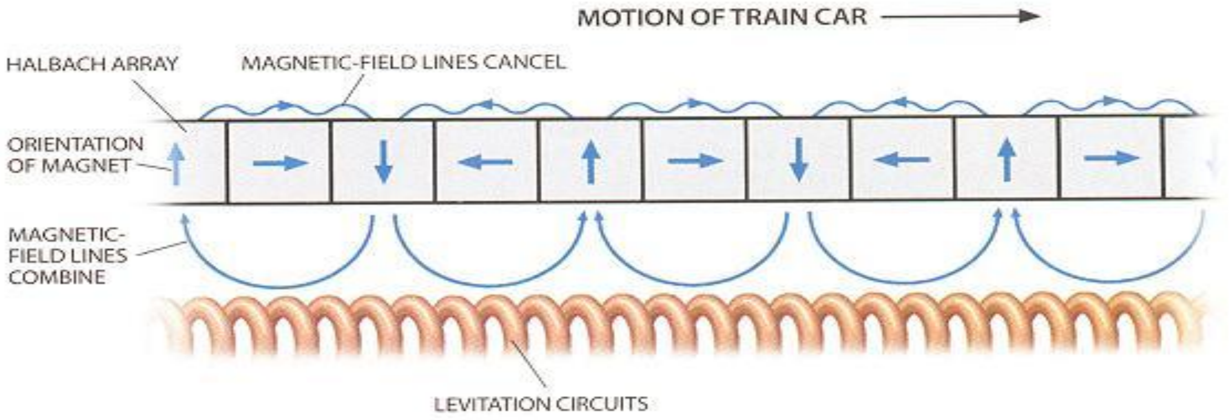

Figure 1. Principal of Levitation

As shown in figureconveyingthemechanismworks.Herecontinuouslythecurrentflowsin thecoilshownitSo THATDEVELOPSamagneticfieldaroundthesystem. AnarrayofmagneticPlacedaboveisit soThatitopposestothemagneticfield andlevitationisdevelopedin theSpace Betweenthemrelative. ThislevitationisHelpfulin themotionof themagneticmaterialsPlacedabovethearrayandthistechniqueisused toconveythematerialsfromoneplace toanotherandcanbeapplicabletoalsoreplaceourconventionalConveyingsystems.

IV. HOW TO LEVITED?

When a current is supplied from the circuit to a coil a magnetic field is developed. This activates the repulsive action of the bar magnet and so the whole carriage is lifted by a definite amount. So this proves easier to place a load on it and convey it from one end to another. Thus this is the main concept behind this magnetic air conveyor. In construction it is alike as the rail, but just the difference is that here in between the two guide ways a copper coil is to be installed. There are two guide ways separated by a distance made of Aluminum or M.S. On this guide ways carriage is suspended freely to navigate from one end to other. A bar magnet is placed beneath the carriage which comes above the coil. Two magnetic tapes are also flattened along the length of guide ways which keeps the repel action on sideways.A Copper coil is fitted in between two guides which is supplied by a power supply. A control MCB is to be installed before the coil for having a safe transfer of current and have a protective environment.

V. DESIGN CALCULATION

When the magnet energizes, it will tend to lift the ferromagnetic material around its pole. The gravitational force is given by: F = mg in this case-study the maximum mass of the object to be lifted is 500grams. Therefore, the gravitational force is 500g x 9.81m/s^2 = 4.90N.

The lifting force should be greater than 4.90N.

The pole area is given by $A=\pi d^2/4$,

$A=\pi x\ (15x10^{-2})^2/4 = 1.767x10^{-4}m^2$

$\mu_o=4\pi x10\text{-}7$

m=500g,

$g=9.81m/s^2$ substituting this in equation we have:-

$F = B^2A/2\mu_O$

$4.90 = B^2*1.767*10^{-4} /2*4*\pi*10^{-7}$

From which B is calculated as 0.0696 wb/m^2

This is the flux density in the air gap and is the same as the flux density in the core for a very small air-gap; the total flux in the core is:

$\Phi = BxA$

Where A is the core area, since the magnet acts like a closed cylinder; the area is given by:

$A = 2\pi rl+2\pi r^2$

Where r is the half diameter of the core and l is the length of the former.

Since r=7mm and l=20mm

The area is computed to be A=1.1875m2

Hence the total flux from equation is obtained to be Φ = 0.08265 Wb.

This total flux in the core, is the same as the flux in the air-gap.

The magnetizing force (H) in the air-gap is given by

$H = B/\mu o$

$= 0.0696/4*\pi*10^{-7}$

= 55385.9 AT/m

For the air-gap of 40 mm the magneto-motive force (mmf) is given by

mmf= HxL = 55385.9x30x10-3 = 1661.57AT

L is the length of air-gap specified as 30mm

This magneto-motive force is the product of the current that will go round the magnet and the number of turns of the wire that make up the magnet. If one of the variable is chosen the other variable can be calculated, thus if the number of turns is chosen to be 300, then the current in the electromagnet is given by;

I = mmf/N

= 1661.57/300

Therefore the current is computed to be **5.54A**.

Finally the lifting power or force of the magnet is computed using equation as

$F = B^2A/2\mu_0$

$= 0.0696*1.1875/2*4*\pi*10^{-7}$

= **5.88N**

VI. ADVANTAGES

Speedy: The time required to transport is less in this system as this is fast and quick in operation and there is no surface contact or friction to slow them down.

Effort Less: Among the many conveyor system used till date this gives an effortless environment to work upon.

Safe Environment: Magnetic air conveyor is safe to handle and convey the material with great safety without any damage and less susceptible to congestion and weather conditions.

Low Maintenance: This has low maintenance cost compared to other systems as it is contactless and does not have any motion relative to other object in contact.

Reduced Air and Noise Pollution: Magnetic conveyor has no effect on the surrounding as it is noise free and no obstacle is breaking its path. Less noise helps in working more efficiently for workers also. Less polluting as a result of being electrically powered. Emissions can be controlled more effectively at the source of electric power generation than at many points of consumption,

Less Skilled Workers: There is no need of having skilled workers as less skilled workers can also do the work effectively .This ultimately reduces the cost on training and development.

One time Investment: This project need to be installed only once so the cost for operation is reduced and no need to spend money in future.

VII. APPLICATION

- Coal Mining Industries
- Automobile Industries
- Food Processing
- Airport Luggage Carrier
- Pharmaceutical Industries
- Bottling Industries

VIII. CONCLUSION

It is conclude that, the Electromagnetic Conveyor has been started and operated indoors without creating pollution. The Magnetic Air Conveyor is eco-friendly, which does not produce harmful emissions. However, we believe that there is still much work to be done in optimizing the conveyor for various different designs, determining the effect of variation in power, adapting it to various changing parameters and developing other uses. For that reason we are publishing our preliminary results here and hope that others will help adapt these principles to improve the material handling processes and energy conservation.

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