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Design and Fabrication of TLIM(Tabular Linear Induction Motor)

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ABSTRACT

A general framework for the analysis and design of a class of Tubular Linear Induction Motor (TLIM) is described. This project describes the design, construction and evaluation of a prototype modified tubular linear synchronous motor. The properties of this motor, with its high speed and low moving mass, make it attractive to use as a servo motor for linear mechanical movements. The design of the rotor section has been optimized to produce the greatest possible thrust force while reducing the effects of the cogging forces. Rotor design is used to enhance flux density in air gap, and thus to improve output performance of linear machines. This motor is designed for the pick & place application in the manufacturing and packaging industries. Calculated results are validated by the practical measurements of the motor. A prototype with induced part has been designed and built. Finally some experimental result on electrical and mechanical variables, when the machines are used as motor.

Keywords: Tubular Linear Induction Motor (TLIM), tubular linear synchronous motor.

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I. INTRODUCTION

In order to tackle the increasing electricity demand, a number of solutions for efficient energy consumption, generation of energy from renewable sources, and new power distribution business models for active energy control have been considered and some of them have been even pushed via regulations in national and European level.

In this paper the design of a tubular linear induction machine is presented because from this theory the dual generator machines can be in a simple way developed .In tubular linear machine the magnetic flux flows, from pole to pole, along the direction of the motion, crossing the air-gap in radial direction. The cross-section of a tubular machine is not always circular, but can have the shape of regular polygon (square, hexagon, etc.) .The most used configurations are those in which the cross-section is square or circular; in this case the machine is called cylindrical. The most used structure has a short inductor which is fixed to a basement, while the induced part, usually longer than the inductor, is the moving one.

The lamination of the inductor can be either longitudinal or transversal with respect to the direction of motion. In case of transversal lamination the magnetic core of the inductor is composed of one block in which each sheet has a crown shape or of more blocks in which each sheet has the shape of a crown sector. The main disadvantage of longitudinal lamination is the difficulty to align the sheets of each core with precision, because of their length.

II. LITERATURE SURVEY

Vincenzo di dio etc. & al [1] describes a mathematical model of tubular linear induction machines (TLIM) with hollowed induced part is recalled. Moreover the design criteria of a TLIM with hollowed iron induced part are presented as well as the technological processes to be adopted and the choice of materials to construct the various parts. The methodologies for mechanical assembling and electric wiring are considered too. A prototype with bimetallic induced part has been designed and built. Finally some experimental results on electrical and mechanical variables, when the machines are used as motors, are shown.

R. g. hoft, life fellow ieee [2] explains an axis symmetric model of the magnetic field of the tubular linear induction motor (TLIM) for application to hydraulic capsule pipelines is developed using finite element method (FEM) analysis. The FEM model is used to analyze a specific TLlM design at standstill for a given supply current. The finite element formulation of the field equations is discussed and the magnetic field contours at different instants of time are presented. FEM computation of the thrust compares.

Filippo Milanesi [3]explains The demand for linear electric machine, specially for controlled motion, has registered a continuous growth in recent years, since its integration in industrial applications leads to important advantages . Furthermore, the tubular structure seems to be attractive for industrial purposes due to both its closed form and the inherently absence of attractive force between the stator and the mover. In this chapter the fundamental characteristics of the linear machines will be illustrated in order to highline their main advantages and drawbacks. Particular attention will be paid to the technologic developments in soft and hard magnetic materials, which enable the industrial realization of motor with high force density, improved dynamic behaviour within a relatively low cost. Finally the attention will be focused on permanent magnet (PM) tubular linear motor.

III.BLOCK DIAGRAM

A linear machine stems from the idea of cutting open a rotary motor and lying it out flat. With this simple conversion from rotary to linear motion, many applications are possible. This conversion can be seen in Figure1.

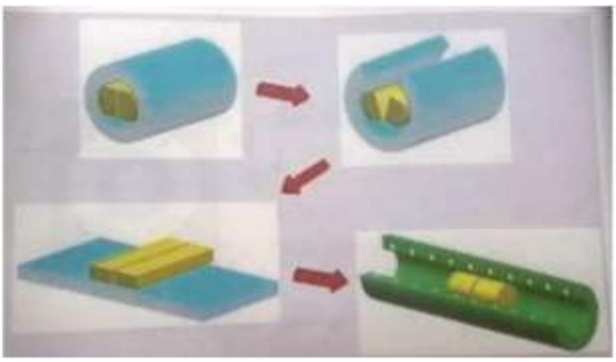


Fig.3.1 :The Conversion from rotary Tubular Linear Motor

Wheatstone designed the first linear motor in 1841, just 10 years after Faraday's discovery of the Laws of Induction. Since then, until the 1960's, there has been relatively little development in the field of linear motors compared to that of the rotary motor. This was mainly due to the perception of engineers, that rotar motion was the most efficient way to convert electrical energy to mechanical energy or vice versa. Also, linear motors generally aren't able to achieve the same power factors and efficiencies that the equivalent rotary motors can achieve. With the increased interest of linear motors in the latter half of this century, linear induction motors (LIM) found more applications Linear motors can eliminate the need for gears, ball screw drives or belts connected to a rotary motor for particular applications, as direct linear motion could be used. An example is an industrial printer. Instead of belts connected to rotary motors positioning the ink cartridges, the linear motor can be used to position them. Thus, the convenience of direct linear motion, in some applications, can make up for the reduction in performance compared to the rotary motor. With advances in magnet technology in the 1990's, TLIM's are becoming more pop-ular. Along with improved performance, there is an ever increasing number of applications for TLIM's. TLIM applications vary in size from large requirements like a Maglev transportation system, to small precise applications like point to point sample testing in biomedical equipment. Linear motors are also utilised for positioning with incremental changes in the order of nanometres. For this project, it was decided that a TLIM be chosen, as it produces a better efficiency and power factor compared with that of a LIM. Additionally, with the advances in rare earth magnet technology, magnets are now more powerful and can produce higher forces, compared with magnets 10 years ago. With the objective of attempting to produce the greatest force possible with a certain input power, the synchronous motor option was selected. Thirdly, an added advantage of using the synchronous motor, instead of an induction motor, is the inherent ability to allow for dynamic braking should there be an electrical power failure. This gives enhanced safety features to the linear motor. There are two basic configurations of a linear machine

- A long stator or primary section and a short rotor or secondary section. Or the converse of the first, with a short primary section and a long secondary.

Each of these configurations have two options in that either the primary or the secondary. The two basic linear motor configurations:

(a) Long primary and short secondary.

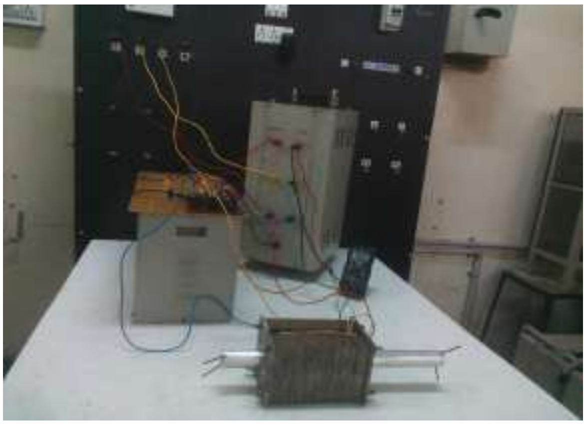
(b) Short primary and long secondary.

Secondary can be fixed, with the other being the mobile section. The stator windings are usually associated with the primary section. In the case of a LIM, an aluminium or copper plate forms the secondary. For this project, a long stationary primary and a short mobile secondary with permanent magnets was used. There are three different linear motor topologies, namely

- Single-sided. This consists of one primary section and one secondary section.
- Double-sided. Usually, consists of two primary sections, which are positioned on both sides the secondary.
- A tubular linear motor is formed by rolling up a flat linear motor around the longitudinal axis. In general, the primary completely encircles the secondary.

IV. RESULT

Description



Tubular Linear Induction Motor : A TLIM is a type of linear motor with a forcer consisting of a series of tubular coils wrapped around a rod that contains a number of strong cylindrical permanent magnets aligned in alternating and opposing directions. It can be also said the advanced version of the linear motors. The Tubular Linear Motor is gaining importance in the mechanical automated structures.
The tubular Linear Motor is suitably used for Servo Applications.
Linear motors have earned a reputation as highly precise & efficient alternative to other types of motor.

Control Circuit: Control circuit use for controlling the TLIM. It is main function of reversing the phase sequence.

Autotransformer : use for input supply.

Tubular shape advantage : All magnetic lines interacts with current carrying conductors at right angles. Magnetic attraction between forcer and the thrust rod is eliminated. Heat generated is dissipated quickly. Thus thermal losses minimizes. Thus tubular shape proven to be much efficient produces fewer eddy currents & eliminating cogging issues.

Application: Press Machines, Solenoid Valves, Robot Linear Axles, Electric Switches, Alternative Compressor, Liquid Metal Pump, Hammers.

V. CONCLUSION/ FUTURE SCOPE

Presently the Tubular linear motor is being employed in power system for linear movements such as Actuators, Solenoid, Relays, Circuit Breakers, etc. As this motor has a high start up thrust, it can replace the hydraulic press cutting machines and pneumatic machines.

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