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MAGNETO BOOSTER BICYCLE

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***ABSTRACT* - In this paper, we present our high performance new innovative bicycle by the application of magnetic transmission and propulsion. In order to overcome the pollution and demand of fuel in our day today life we humans are seeking for an alternative way of transportations like e-bike and maglev train. Our magneto booster bicycle integrates the magnetic force, pedalling force and the electric forces to make performance of bicycle to an next level.**

INTRODUCTION

The Ordinary bicycle is propelled only by the force of pedalling but our concept is based on the use of available forces between two magnets to reduce the pedalling effort of human. Magnetism is a mysterious force. We can neither see nor feel it. During pedalling the forward of pedal is assisted with the repulsive force where the retraction of pedal to forward is achieved by magnetic attraction. Magnets exert forces and torques on each other due to the complex rules of electromagnetism. The forces of attraction field of magnets are due to microscopic currents of electrically charged electrons orbiting nuclei and the intrinsic magnetism of fundamental particles (such as electrons) that make up the material. Both of these are modeled quite well as tiny loops of current called magnetic dipoles that produce their own magnetic field and are affected by external magnetic fields. The most elementary force between magnets, therefore, is the magnetic dipole–dipole interaction. If all of the magnetic dipoles that make up two magnets are known then the net force on both magnets can be determined by summing up all these interactions between the dipoles of the first magnet and that of the second.

On the other hand for triggering the speed of pedalling an electric motor which is coupled magnetically in order to reduce the frictional losses in the conventional transmission system. The new magnetic gear will have a high torque density1 relationship –high efficiency and are maintenance free.

LITERATURE REVIEW

Force Detection of Nuclear Magnetic Resonance

D. Rugar, O. Züger, S. Hoen, C. S. Yannoni, H.-M. Vieth, R. D. Kendrick

IBM Research Division, Almaden Research Center, 650 Harry Road, San Jose, CA 95120, USA.

Micromechanical sensing of magnetic force was used to detect nuclear magnetic resonance with exceptional sensitivity and spatial resolution. With a 900 angstrom thick silicon nitride cantilever capable of detecting subfemtonewton forces, a single shot sensitivity of 1.6×10^{13} protons was achieved for an ammonium nitrate sample mounted on the cantilever. A nearby millimeter-size iron particle produced a 600 tesla per meter magnetic field gradient, resulting in a spatial resolution of 2.6 micrometers in one dimension. These results suggest that magnetic force sensing is a viable approach for enhancing the sensitivity and spatial resolution of nuclear magnetic resonance microimaging.

Magnetic force microscopy: General principles and application to longitudinal recording media

Rugar, D.
IBM Research Division, Almaden Research Center, 650 Harry Road, San Jose, California 95120-6099
Mamin, H.J.; Guethner, P.; Lambert, S.E.; Stern, J.E.; McFadyen, I.; Yogi, T.

This paper discusses the principles of magnetic force microscopy (MFM) and its application to magnetic recording studies. We use the ac detection method which senses the force gradient acting on a small magnetic tip due to fields emanating from the domain structure in the sample. Tip fabrication procedures are described for two types of magnetic tips: etched tungsten wires with a sputter-deposited magnetic coating and etched nickel wires. The etched nickel wires are shown to have an apex radius on the order of 30 nm and a taper half-angle of approximately 3°. Lorentz-mode transmission electron microscopy of the nickel tips reveals that the final 20 µm is essentially

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single domain with magnetization approximately parallel with the tip axis. Images of written bit transitions are presented for several types of magnetic media, including CoPtCr, CoSm, and CoCr thin films, as well as γ-Fe2O3 particulate media. In general, the written magnetization patterns are seen with high contrast and with resolution better than 100 nm.

Observation of Single Vortices Condensed into a Vortex-Glass Phase by Magnetic Force Microscopy

P. Chaudhari
IBM Watson Research Center, Yorktown Heights, New York

A low temperature magnetic force microscope has been applied to spatially resolve single vortices in an epitaxially grown YBa2Cu3 O7-δ thin film at 77 K. A disordered vortex arrangement is observed, and the vortices are strongly pinned. The observed phase is expected to be truly superconducting due to strong pinning.

Mechanical detection of magnetic resonance

D. Rugar, C. S. Yannoni & J. A. Sidles
Conventional techniques for measuring magnetic resonance involve the detection of electromagnetic signals induced in a coil or microwave cavity by the collective precession of magnetic moments (from nuclei or electrons) excited by an alternating magnetic field. In a different approach[1], isolated electron spins have been detected by scanning tunnelling microscopy, with the spin precession inducing a radiofrequency modulation in the tunnelling current.

CONCEPT

The Magneto Booster Bicycle is based on the principle of magnetic repulsion during the forward movement of pedal whereas magnetic attraction during the retraction of pedal to the top dead centre of sprocket. On the other hand electric motor is used to further boost up the bicycle with the new way of transmission called magnetic coupling with high efficiency and free maintance.

PERMANENT MAGNET:

A magnet is a material or object that produces a magnetic field. This magnetic field is invisible but is responsible for the most notable property of a magnet: a force that pulls on other ferromagnetic materials, such as iron, and attracts or repels other magnets.

A permanent magnet is an object made from a material that is magnetized and creates its own persistent magnetic field. An everyday example is a refrigerator magnet used to hold notes on a refrigerator door. Materials that can be magnetized, which are also the ones that are strongly attracted to a magnet, are called ferromagnetic (or ferrimagnetic). These include iron, nickel, cobalt, some alloys of rare earth metals, and some naturally occurring minerals such as lodestone. Although ferromagnetic (and ferrimagnetic) materials are the only ones attracted to a magnet strongly enough to be commonly considered magnetic, all other substances respond weakly to a magnetic field, by one of several other types of magnetism.

Ferromagnetic materials can be divided into magnetically "soft" materials like annealed iron, which can be magnetized but do not tend to stay magnetized, and magnetically "hard" materials, which do. Permanent magnets are made from "hard" ferromagnetic materials such as alnico and ferrite that are subjected to special processing in a powerful magnetic field during manufacture, to align their internal microcrystalline structure, making them very hard to demagnetize. To demagnetize a saturated magnet, a certain magnetic field must be applied, and this threshold depends on coercivity of the respective material. "Hard" materials have high coercivity, whereas "soft" materials have low coercivity.

An electromagnet is made from a coil of wire that acts as a magnet when an electric current passes through it but stops being a magnet when the current stops. Often, the coil is wrapped around a core of "soft" ferromagnetic material such as steel, which greatly enhances the magnetic field produced by the coil.

The overall strength of a magnet is measured by its magnetic moment or, alternatively, the total magnetic flux it produces. The local strength of magnetism in a material is measured by its magnetization.

Classification

Permanent Magnets can further be classified into four types based on their composition: 1. Neodymium Iron Boron (NdFeB or NIB) 2. Samarium Cobalt (SmCo) 3. Alnico 4. Ceramic or Ferrite

NIB and SmCo are the strongest types of magnets and are very difficult to demagnetize. They are also known as rare earth magnets since their compounds come from the rare earth or Lathanoid series of elements in the periodic table. The 1970s and 80s saw the development of these magnets.

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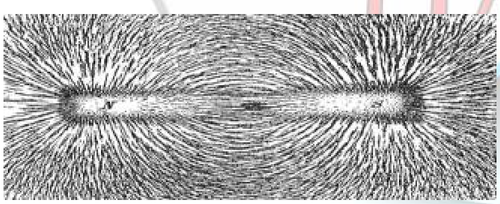
Alnico is a compound made of ALuminium, NIckel and CObalt. Alnico magnets are commonly used magnets and first became popular around the 1940s. Alnico magnets are not as strong as NIB and SmCo and can be easily demagnetized. This magnet is however, least affected by temperature. This is also the reason why bar magnets and horseshoes have to be taken care of to prevent them from loosing their magnetic properties.

The last type of permanent magnets, Ceramic or Ferrite magnets are the most popular today. They were first developed in the 1960s. These are fairly strong magnets but their magnetic strength varies greatly with variations in temperature.

Permanent Magnets can also be classified into Injection Moulded and Flexible magnets. Injection molded magnets are a composite of various types of resin and magnetic powders, allowing parts of complex shapes to be manufactured by injection molding. The physical and magnetic properties of the product depend on the raw materials, but are generally lower in magnetic strength and resemble plastics in their physical properties. Flexible magnets are similar to injection molded magnets, using a flexible resin or binder such as vinyl, and produced in flat strips or sheets. These magnets are lower in magnetic strength but can be very flexible, depending on the binder used.



Magnetic field produced by a bar magnet

Shape & Configuration

Permanent magnets can be made into any shape imaginable. They can be made into round bars, rectangles, horseshoes, donuts, rings, disks and other custom shapes. While the shape of the magnet is important aesthetically and sometimes for experimentation, how the magnet is magnetized is equally important. For example: A ring magnet can be magnetized S on the inside and N on the outside, or N on one edge and S on the other, or N on the top side and S on the bottom. Depending on the end usage, the shape and configuration vary.

Demagnetization

Permanent magnets can be demagnetized in the following ways: - Heat - Heating a magnet until it is red hot makes it loose its magnetic properties. - Contact with another magnet - Stroking one magnet with another in a random fashion, will demagnetize the magnet being stroked. - Hammering or jarring will loosen the magnet's atoms from their magnetic attraction.

Calculating the magnetic force

Calculating the attractive or repulsive force between two magnets is, in the general case, an extremely complex operation, as it depends on the shape, magnetization, orientation and separation of the magnets. The Gilbert model does depend on some knowledge of how the 'magnetic charge' is distributed over the magnetic poles. It is only truly useful for simple configurations even then. Fortunately, this restriction covers many useful cases.

Force between two magnetic poles

If both poles are small enough to be represented as single points then they can be considered to be point magnetic charges.

Classically, the force between two magnetic poles is given by:

F= $_1$ $_2$/4□ ^{2}

where

F is force (SI unit: newton)

*qm*1 and *qm*2 are the magnitudes of magnetic poles (SI unit: ampere- meter)

μ is the permeability of the intervening medium (SI unit: tesla meter per ampere, henry per meter or newton per ampere squared)

r is the separation (SI unit: meter).

The pole description is useful to practicing magneticians who design real-world magnets, but real magnets have a pole distribution more complex than a single north and south. Therefore, implementation of the pole idea is not simple. In some cases, one of the more complex formulas given below will be more useful.

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Force between two nearby magnetized surfaces of area *A*

The mechanical force between two nearby magnetized surfaces can be calculated with the following equation. The equation is valid only for cases in which the effect of fringing is negligible and the volume of the air gap is much smaller than that of the magnetized material:

$$F=\ _{0}\ ^{2}\ /2$$

where:

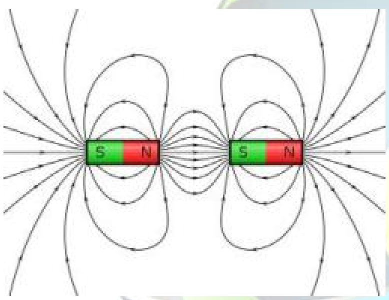
A is the area of each surface, in m^2

H is their magnetizing field, in A/m.

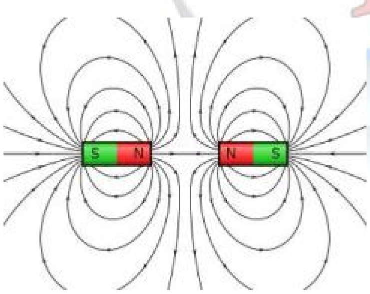
$\mu0$ is the permeability of space, which equals $4\pi\times10^{-7}$ T·m/A

B is the flux density, in T

Force between two bar magnets



Field of two attracting cylindrical bar magnets



Field of two repelling cylindrical bar magnets

The force between two identical cylindrical bar magnets placed end to end is approximately:

$$F=\left[\frac{\ ^{2}\ \ ^{2}(\ ^{2}+\ ^{2})\ _{0}}{2}\right][1/\ ^{2}+\frac{1}{\ ^{2}}-$$

$$2/(\ +\ )^{2}]\ \square\ _{0}\qquad(\ +2\ )$$

where

B0 is the magnetic flux density very close to each pole, in T,

A is the area of each pole, in m^2,

L is the length of each magnet, in m,

R is the radius of each magnet, in m, and

x is the separation between the two magnets, in m

ENERGY STORED IN MAGNETIC FIELD

Energy is needed to generate a magnetic field both to work against the electric field that a changing magnetic field creates and to change the magnetization of any material within the magnetic field. For non-dispersive materials this same energy is released when the magnetic field is destroyed so that this energy can be modeled as being stored in the magnetic field.

For linear, non-dispersive, materials (such that B = μH where μ is frequency-independent), the energy density is:

u=B.H/2=B.B/2 =H .H/2

If there are no magnetic materials around then μ can be replaced by $\mu0$. The above equation cannot be used for nonlinear materials, though; a more general expression given below must be used.

In general, the incremental amount of work per unit volume δW needed to cause a small change of magnetic field $\delta\mathbf{B}$ is:

W=H. B

Once the relationship between H and B is known this equation is used to determine the work needed to reach a given magnetic state. For hysteretic materials such as ferromagnets and superconductors, the work needed also depends on how the magnetic field is created. For linear non-dispersive materials, though, the general equation leads directly to the simpler energy density equation given above.

Magnetic gear

All cogs of each gear component of magnetic gears act as a constant magnet with periodic alternation of opposite magnetic poles on mating

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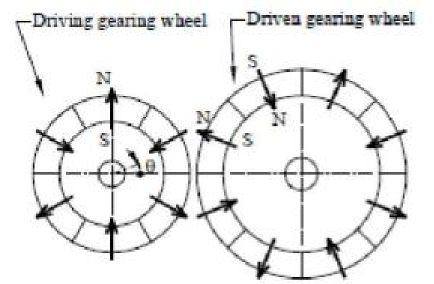
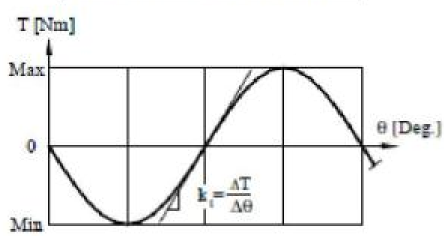
surfaces. Gear components are mounted with a backlash capability similar to other mechanical gearings. Although they cannot exert as much force as a traditional gear, such gears work without touching and so are immune to wear, have very low noise and can slip without damage making them very reliable. They can be used in configurations that are not possible for gears that must be physically touching and can operate with a non-metallic barrier completely separating the driving force from the load. The magnetic coupling can transmit force into a hermetically sealed enclosure without using aradial shaft seal, which may leak.

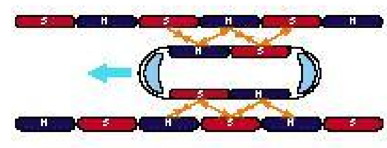


Torque transfered to the driven wheel



MAGNETIC PROPULSION:

A repulsive force and attractive force are used to propel the vehicle in magnetic propulsion system. due to the noncontact property of magnetic levitation technology, a resulting system possesses many advantages, such as no friction, no contamination, long life, high speed, low noise and so on. According to Hollis et al. the system creates a stable state without any mechanical contact when the gravitational force is solely counterbalanced by magnetic forces.



COMPONENTS USED

1. Bicycle
2. Neodymium magnet
3. Epoxy resin
4. Aluminium shaft
5. Bearings
6. Electric motor
7. Disc plate
8. Speed controller feed back circuit

Bicycle:

The bicycle's invention has had an enormous effect on society, both in terms of culture and of advancing modern industrial methods. They are the principal means of transportation in many regions.

NEODYMIUM MAGNET:

A neodymium magnet (also known as NdFeB, NIB, or Neo magnet), the most widely used type of rare-earth magnet, is a permanent magnet made from an alloy of neodymium, iron, and boron to form the Nd2Fe14B tetragonal crystalline structure. Developed in1982 by General Motors and Sumitomo Special Metals, neodymium magnets are the strongest type of permanent magnet made. They have replaced other types of magnet in the many applications in modern products that require strong permanent magnets, such as motors in cordless tools, hard disk drives, and magnetic fasteners. Neodymium magnets are powerful permanent magnets composed of the elements neodymium, boron and iron. These magnets have the highest known energy product for their mass. They consist of an intermetallic phase in a tertragonal crystal structure and their normal chemical composition is Nd2Fe14B. One of the most appealing characteristics of neodymium magnets is their relatively low cost. Neodymium is the third most abundant rare-earth element, and is far more prevalent than samarium.

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EPOXY RESIN IS IDEAL:

Where superior adhesion is necessary; Evercoat epoxies will bond permanently to wood, fiberglass, metal, concrete, glass, and many plastics. So to bind magnet over aluminium piston and head, epoxy is right choice to replace more strengthening.

Used epoxy grade are EP-416

Hardener EH-153

Both epoxy and hardener are mixed in the ratio of 100:80gms by weight.

Aluminium shafts:

Aluminium shafts are the most preferred one for the manual magnet polarization. And it was also less weight and high strength.

Bearings:

A bearing is a machine element that constrains relative motion to only the desired motion, and reduces friction between moving parts. The design of the bearing may, for example, provide for free linear movement of the moving part or for free rotation around a fixed axis; or, it may *prevent* a motion by controlling the vectors of normal forces that bear on the moving parts. Many bearings also *facilitate* the desired motion as much as possible, such as by minimizing friction.

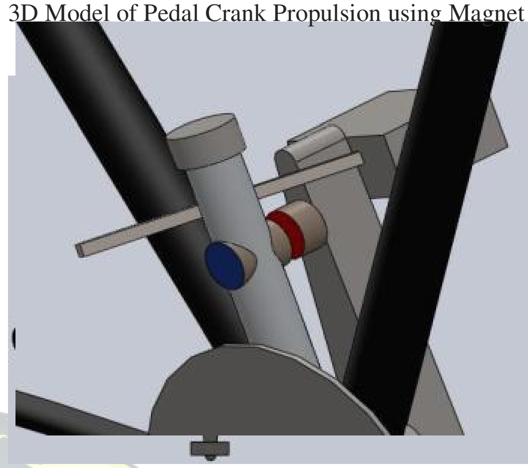
Electric Motor:

An electric motor is an electrical machine that converts electrical energy into mechanical energy. For boosting our bicycle we used 90watt dc motor of 1.65kg with an torque of 2N.m.

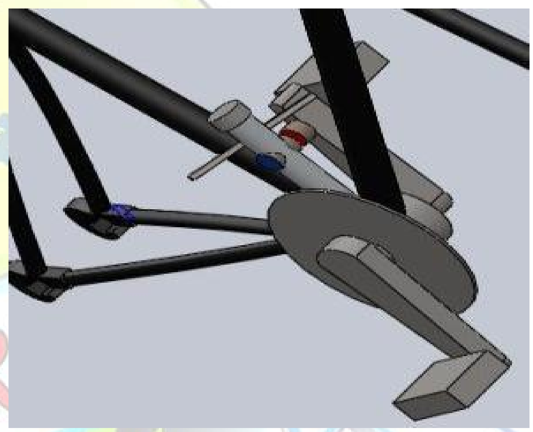
Speed controller feedback circuit:

An Intelligent Motor Controller (IMC) uses a microprocessor to control power electronic devices used for motor control. IMCs monitor the load on a motor and accordingly match motor torque to motor load. This is accomplished by reducing the voltage to the AC terminals and at the same time lowering current and voltage. This can provide a measure of energy efficiency improvement for motors that run under light load for a large part of the time, resulting in less heat, noise, and vibrations generated by the motor.

3D Model of Pedal Crank Propulsion using Magnet



3D Model of Magnetic Power Transmission



CONCLUSION:

Thus magneto booster bicycle reduces the effort of pedalling with the assistance of magnets. So our magneto booster bicycle pays new way of innovation for conventional bicycle.

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