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Application of Efficiency Technology in EV Drive Systems and Regenerative Braking

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Abstract: - Technology originally designed for efficiency and greenhouse gas emission reduction in commercial power generation being utilized as an assist in efficiency in an electric vehicle. A mechanism, consisting of a driving shaft composed of a non-ferrous alloy, with planar magnetically charged beams, reacting with a set of stationary magnets. Originally for installation within the drive of a power plant, it facilitates the rotation of the primary generators with greater torque and ease of operation and may now be utilized in gaining efficiency in electric vehicle power systems.

Keywords:- *Driveshafts, Drives, Electric generators and motors, Electric Power production, Electric Vehicle, Regenerative braking.*

I. INTRODUCTION

The consequences of the proliferation of Carbon Dioxide and Sulphur Dioxide emissions in the earth's atmosphere have been of major concern for decades, as early as the 1960's.[1] Automotive manufacturers are now committed to achieving sustainability, not only in their products but also in how they are manufactured. [4] This poses even greater challenges in technological development, in how to produce world class, highly advanced products while minimizing harm to the environment,. This is especially challenging for any manufacturer, as while technological advancement can move quickly, implementation within existing infrastructure is often difficult, if not totally economically impracticable. While a gradual shift is much more manageable, the rate of change currently desired, and even stressed by governments and environmental concerns is far more drastic to implement.

In 2007 a Project was created to gain efficiency and reduce emissions in traditional means of electric power generation, and aid in the eventual transition from fossil fuels to alternative forms of energy production, specifically in the generation of electricity by fossil fuel. A magnetically assisted generator shaft was designed to function as a link, specifically at the point where the generated torque is delivered from the turbine drive to the main series of generators within a power plant. (Figure 1) This providing an estimated 15 to 25% gain in efficiency with a likewise percentage in emissions reduction. In turn, this also lowers the production cost of each kilowatt per hour to the producer.

The device is applied within established means of electric energy production, installed with an absolute minimum of cost in exchange for the benefits received. This is especially helpful in areas serviced by relatively modern power plants, as the rapid construction of entirely new facilities is often beyond the immediate available funding of many utility providers.

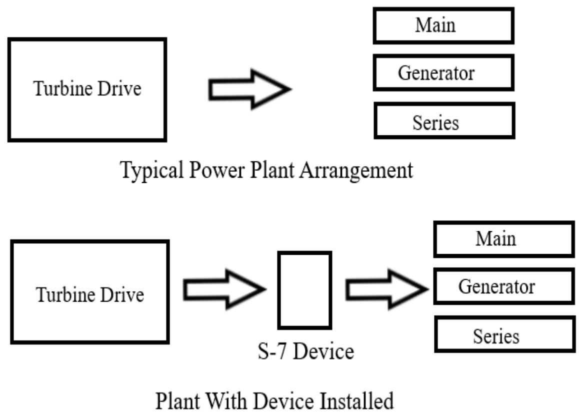

Fig. 1: Point of device installation within power plant

Although originally conceived for use in fossil fuel and nuclear power plants, the concept may also be applied in any method of electrical power production which employs rotation to generate an electrical field.

II. DESIGN AND OPERATION

It consists of a tubular driving shaft, (Figure 2) forged of 304 stainless steel (S30400) or other non-ferrous alloy. Over the center of the shaft are two elongated wheel sections, each containing a series of sixteen (16) vanes. The vanes form the channels into which are installed a series of eight (8) magnetized strips. The strips are in themselves essentially bar magnets, each having a north and south polar end accordingly and are installed in alternating order around the perimeter of the shaft. Each strip is shaped with a dovetail configuration which both assists in stability as well as functionality within their respective channels, creating the equilibrium necessary for rotation at high speeds. Near the poles of each strip are eight (8) stationary magnets which react with the shaft. At any given moment during.operation. The strips are being attracted by one of the stationary magnets, yet also repelled by half of the force of each of the surrounding two strips on either side (figure 3) They are rated at the same charge or pull load and flux density as those on the shaft, creating a necessary balance of constant magnetic attractions and reactions.

It is this assistance that enables the ease of the rotation as the reactions of the stationary magnets with the magnetized strips produce the effect of a virtual "cradle" or balance of forces for the shaft to rotate within, similar to the action of a magnetic bearing. The device, in pseudo-levitation by mechanical constraint, regardless of its size

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and weight is now enabled to move in a far more weightless state with extremely low friction. Hence, this allows the entire assembly to be moved with greatly increased moment of force than would normally be possible. Although Earnshaw's theorem does not allow for a static configuration of permanent magnets to stably levitate another permanent magnet or materials that are paramagnetic or ferromagnetic against gravity,[7] the theorem does not apply to the non-static nature of the device.

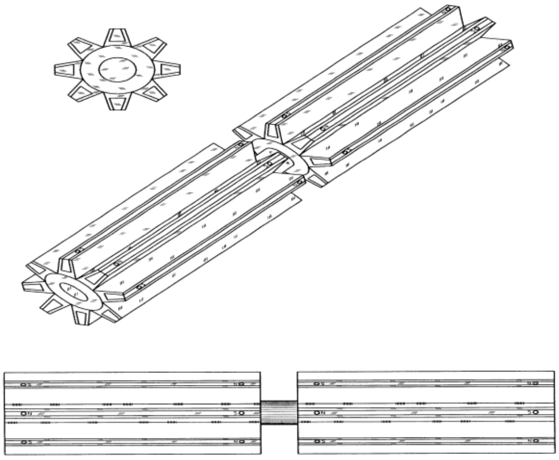
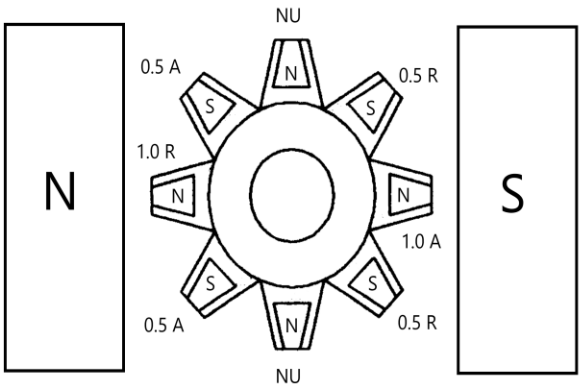


Fig. 2: Configuration of driving shaft

For our illustration we will take a plant operating at 50% production rate. To operate at this level, a given amount of fuel must be burned to produce enough steam to rotate the turbine at the desired rate. The speed of the turbine is determined by the quantity of fuel burned, which of course directly or indirectly regulates the speed of operation of the generators. Installation of this device enables this plant to operate at the previous rate, yet with improved productivity. A plant running at a normal 50% rate will now produce the amount of electricity as if operating previously at a 65% to 70% rate. This is made possible by the reduction in drag between the primary turbine drive and the generators. As the mass of the shaft is now free to operate within the field created by the reaction of the magnetized strips with the stationary magnets. Thus, the mass of the shaft may drive the generators with far less resistance and greater torque, resulting in greater efficiency.



A= Attraction R= Repultion NU = Neutral Position
Fig. 3: Shaft at given moment during operation

In addition to these attributes, implementation of the device results in another benefit. In operation, the action produced by the shaft itself may also be employed as a means of electrical power generation. As a commercial generator typically contains a powerful magnet which produces an electric field, in operation, a series of wires are rotated through this field which produces electrical current. The magnetized strips reacting with the stationary magnets produce the same kind of reciprocation as in the commercial generator with very similar end results. In this case, the shaft during rotation also produces a magnetic field in a method like that of the stator within the typical commercial generator. While the magnet within the generator is stationary with wires rotating through the field, the magnetized strips in rotation produce a magnetic field surrounding the shaft during operation. It is this field which may be additionally utilized in the production of electricity.

A series of cage-type structures composed of conductive wires will employ this added source of electrical current. When installed surrounding the device while in operation, the stationary wires will assimilate current produced by their reaction with the magnetic field produced by the shaft. This energy may then be stored or used immediately for whatever purpose desired. The additional current may even be deployed to partially facilitate the rotation of the shaft itself. This may be achieved through an electric assist mechanism, such as a series of motors. Thus, in essence, the energy produced by the shaft can also become a partial energy source to power it, resulting in even greater operating efficiency.

The Project was accepted to Clean Energy, NM, (Now the New Mexico Renewable Energy Transmission Authority), by the New Mexico State Governor’s Office. The original technical proposal StahlCon 7: Magnetically Assisted Generator Shaft for Use in Fossil Fuel and Nuclear Energy Production. was published on July 7, 2007, and shared with the governments of both Canada and Great Britain, and the Alliance to Save Energy in Washington D.C. [2] [6]

III. CONCLUSION

The basic concept of this technology could be utilized by automobile manufacturers in two ways. It could be employed as originally designed in increasing efficiency and reducing operational emissions at plants where practical, especially at operations where facilities may produce, supplement, or store some of their own power.

There is also a definite possibility that this concept could also have automotive applications, functioning as an assist to a main power source in an electric vehicle, and/or being utilized in its regenerative braking system. Since an electric vehicle’s motor can reverse itself to function as a generator during deceleration, the controllers on most electric vehicles also have a system, whereby some of the kinetic energy normally absorbed by the brakes and turned into heat is converted to electricity by the motor/controller and is used to re-charge the batteries. A miniaturized version of this basic type of shaft could function as a component of an axle or drive assembly in an EV. While weight displacement would not be as primary a concern in an electric automotive application as it would in an internal combustion vehicle, or even within commercial power generation with this concept, the efficiency of the braking system to generate electrical energy during deceleration could be greatly improved. Regenerative braking generally not only increases the range of an electric vehicle by 5 - 10%, but also decreases brake wear and reduces maintenance cost. [3]

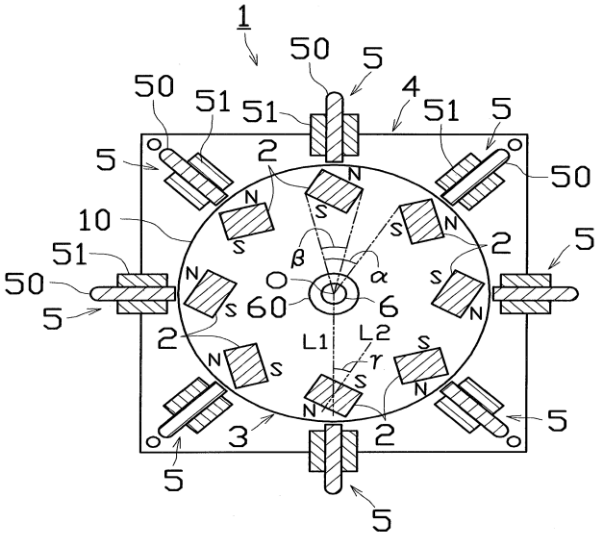


Fig. 4: Magnetic Rotation Device

The shaft's main design resulted in US Patent D539,739 *Magnetically assisted generator shaft,*.[8] which was issued on April 3, 2007.Japanese Patent JP5540411B2 *Magnetic Rotation Device* granted in 2010 and International Application WO 2011114982A1 (Figure 4) filed in 2011[5] disclose a later, very similar concept in which alternating current flowed briefly through electromagnets to assist in the rotation of the device, essentially resulting in an electronic process called pulse width modulation. All patents foreign and domestic have expired, and the technology described herein is now available for use in the public domain.

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