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The Design of a Layered High Phase Order AC Electrical Cable

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Background

Alternating current (AC) has been a basis of electrical power systems since the inception of electric power use. Most energy input applications use a three phase configuration of AC circuits. Three-phase configuration of the AC circuits provides high levels of power transfer from generator to the point of end use. However, some applications require an output with more than three phases. It is conceptually possible to extend the concept of three phase designs to poly-phase designs using more than three phases. High phase order AC systems have certain advantages relating to the enhanced mutual reactance between phases, resulting in reliability and efficiency improvements. Unfortunately, a realistic method of incorporating high order phases within electrical cables is yet to enter the energy market.

Invention Description

Researchers at Arizona State University have invented a high phase order electrical cable conductor capable of high or low power level operation. The design consists of a polyphaser AC electric power cable suitable for transmission, sub-transmission, and distribution. The essence of the design is a multilayer configuration in which the placement of the polyphaser conductors are such that desirable line impedance characteristics are attained. Electrical phase conductors are placed in specific locations so the cable impedance can be set to a desired level. Enhancing mutual coupling between the phases reduces the positive sequence impedance, which enhances the power transfer capability.

Potential Applications

- Wind farm power generation
- Energy transmission
- Energy sub-transmission
- Energy generation

Benefits and Advantages

- **Energy Efficiency** – Removes the need for phase manipulation through combining/splitting multiple three-phase components, reducing energy losses.
- **Reliability** – Circuits are able to operate with one or more phases removed from service, eliminating a major cause of blackouts and grid failures.
- **Lower Costs** – Lower voltage phase to phase allows for less insulation between phases, cutting manufacturing costs.
- **Capacity** – Use of higher phase orders increases the power capacity of the cable and allows for more compact and higher power density cable.