A SYSTEM AND A METHOD FOR EXTENDING CONSTANT-POWER SPEED RANGE OF A 3-PHASE ELECTRICAL MACHINE

IITM Technology Available for Licensing

Problem Statement

- **Achieving a wide constant power speed range (CPSR) in electric machines**, particularly Permanent Magnet Synchronous Motors (PMSMs), is challenging due to limitations in torque capability and demagnetization of permanent magnets during field weakening operation.
- Designing 3-phase machines for higher base speeds by using low voltage and high current configurations can lead to difficulties in winding formation, overheating, and additional losses due to circulating currents.
- There is a need for technological solutions to overcome compromised torque capability, winding formation challenges, and overheating.

Intellectual Property

- IITM IDF Ref. **1891**
- **IN 498908 - Patent Granted**

Research Lab

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TRL (Technology Readiness Level)

TRL - 4: Technology validated in lab scale.

Technology Category/ Market

Category - Advanced Motor Control Systems
Applications- Electric Vehicles (EVs), Marine Propulsion, Aircraft Integrated Motor-Inverter Drives.
Industry- Automotive Manufacturing

Market - The electric drives market, valued at USD 24.5 billion in 2023, is projected to grow to USD 31.4 billion by 2028, with a **CAGR of 5.1%.**

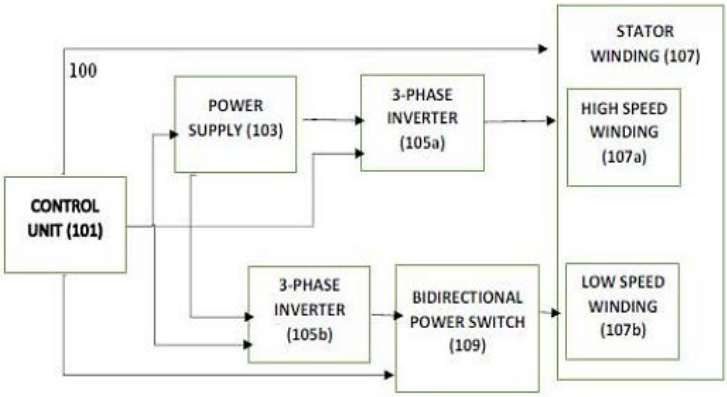

FIG. 1. illustrates a system 100 for controlling the constant power speed range of a 3-phase electrical machine.

Technology

The invention proposes a method to extend the constant power speed range of a 3-phase electrical machine by employing a stator winding with both high-speed (HS) and low-speed (LS) windings. These windings are connected to the power source via separate inverters, allowing for independent control.

The control unit calculates a turn ratio based on the number of turns in the HS and LS windings. This ratio is then used to determine the combined base speed of both windings and the individual base speed of the HS winding.

The control unit orchestrates the operation to extend the original constant power speed range by integrating the base speeds of the HS and LS windings, offering higher performance compared to conventional setups.

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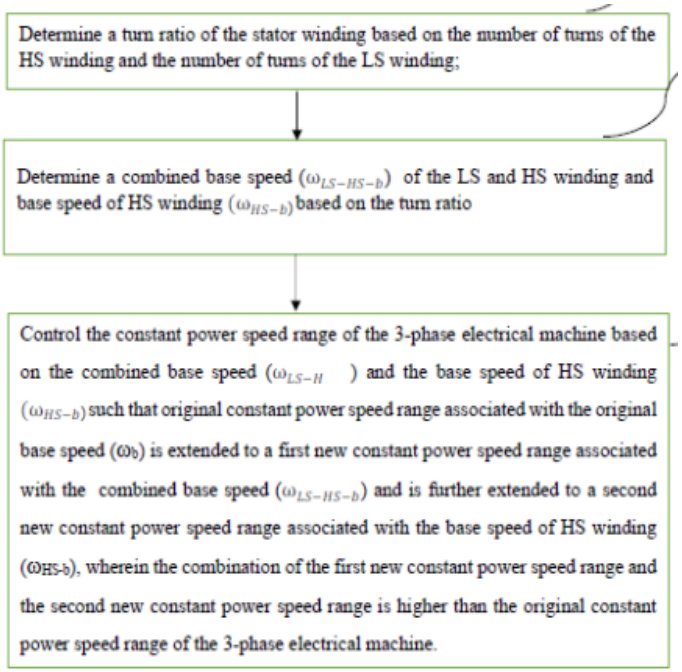

FIG. 2. illustrates a flowchart illustrating a method of controlling the constant power speed range of the 3-phase electrical machine.

Key Features / Value Proposition

1. Enhanced Constant Power Speed Range:

- Extends original speed range, enabling superior performance in diverse applications like electric vehicles and marine propulsion.

2. Dual Stator Winding Configuration:

- Utilizes high-speed and low-speed windings for optimized control and increased flexibility in motor operation.

3. Independent Inverter Control:

- Enables precise adjustment of each winding's power, enhancing efficiency and reliability in variable speed applications.

4. Turn Ratio Optimization:

- Calculates optimal turn ratio for stator windings, ensuring efficient utilization of power and maximizing motor performance.

5. Direct Connection to DC Voltage Source:

- Streamlines system architecture for improved efficiency and reduced complexity in power delivery.

6. Overcoming Technical Limitations:

- Addresses challenges such as torque capability compromises and demagnetization, enhancing overall motor reliability and longevity.

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