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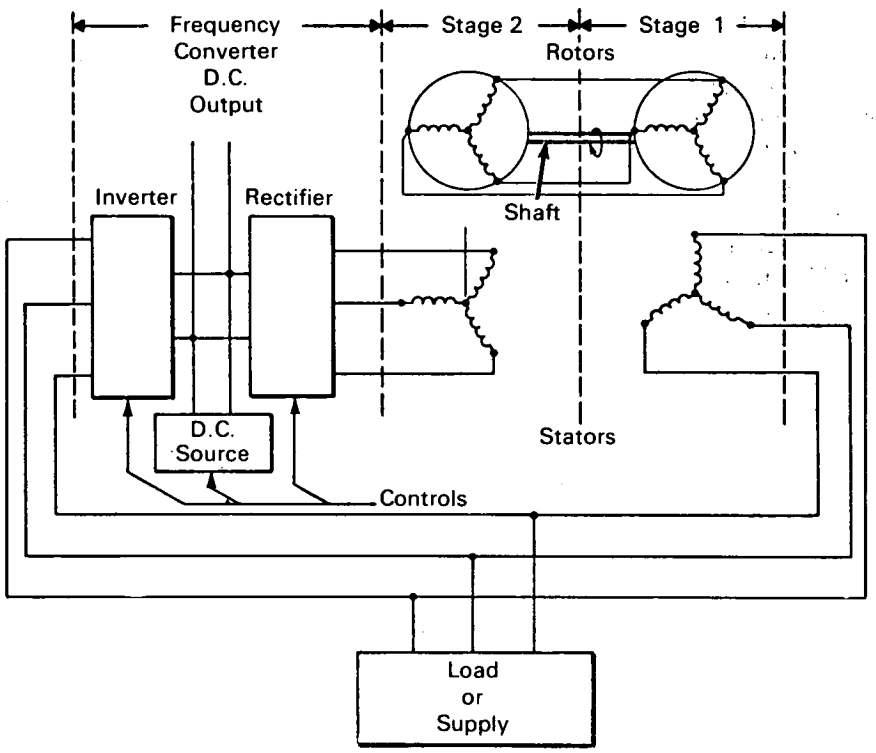
NASA TECH BRIEF

Induction Generator Produces Constant-Frequency Voltage from Variable-Speed Drive



A two-stage, polyphase induction generator has been designed which will produce constant-frequency ac from a variable-speed mechanical drive. It can also be used as an induction motor which will operate over a range of speeds while powered from a constant-frequency source. Major advantages of this device over previous designs are that it requires neither slip rings to connect external circuitry to the rotor windings nor special adjustable-frequency power supplies or external reactive sources, and that, as a motor, it operates over a wide speed range with a reasonably high power factor.

The device is composed of two standard polyphase (usually three-phase), wound-rotor induction generators mounted on a common shaft. The windings of the two rotors are connected in reversed phase sequence, and the two sets of stator windings are connected in parallel through a dc-coupled electronic frequency converter. A schematic diagram of the device is shown in the figure, with the two generators labeled Stage 1

(continued overleaf)

and Stage 2. Normally, the common shaft is driven by a variable-speed prime mover (not shown). The rectifier circuit converts the variable-frequency output of Stage 2 into dc, which is reconverted to constant-frequency ac by the inverter circuit. The dc source is connected temporarily to provide starting excitation to Stage 1.

The constant frequency ac is supplied to the stator of Stage 1 and to the output load. Because of the reversed-phase connection of the two rotors, the net effect in operation is that Stage 1 acts as an induction generator driven above synchronous speed, while Stage 2 is driven below synchronous speed. After frequency conversion, the power generated by Stage 2 is added to that of Stage 1 to supply the output load with constant frequency ac regardless of the speed of the prime mover.

In operation as a motor, Stage 1 is fed with constant frequency ac from the supply. Slip-frequency power generated in Stage 1 supplies the rotor losses and feeds Stage 2, which thus operates as a second induction motor supplied through its rotor. Power induced in the stator of Stage 2 is fed through the frequency converter and returned to the power supply.

The power level produced in the generator mode, or the output shaft speed in the motor mode, is controlled by adjusting the voltage ratio of the frequency converter, thereby controlling the amount of power coupled between the stages.

Reference:

Riaz, Mahmoud: Energy Conversion Properties of Induction Machines In Variable-Speed Constant-Frequency Generating Systems. AIEE Transactions, vol. 78, Part II, 1959, pp. 25–30.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
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Washington, D.C. 20546
Reference: TSP70-10478

Patent status:

This invention is owned by NASA and a patent application has been filed. Royalty-free, nonexclusive licenses for its commercial use will be granted by NASA. Inquiries concerning license rights should be made to NASA, Code GP, Washington, D.C. 20546.

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