ELECTRICAL POWER ENGINEERING

Power Generation

The three-phase current has emerged as the simplest form of power, in terms of both transmission and universal application, in the area of public power supply.
In fact, three-phase currents can be transmitted to a voltage level which is suitable for the distances the power has to be transmitted and, furthermore, it is ideal for being used by the consumers.

The major problem is that electrical power cannot be stored in large quantities and, consequently, it has to be generated at the same time the consumer needs it. The generation of electrical energy is performed almost exclusively by means of high power synchronous machines, or alternators, whose construction design depends on the type of drive, which can normally be steam, gas or water.

Then, if the synchronous generator must be connected in parallel with a constant- voltage constant-frequency system, it has to reach its nominal speed, and the excitation voltage has to be increased from zero until the stator voltage is brought up to the same level as that of the network. To obtain this situation, the magnitude, the phase relation and the rotational direction of the two voltages must be in agreement.

This procedure is termed synchronisation. In this section a two-pole alternator is investigated.
A dc shunt wound machine performs the drive function.

To determine its characteristics the synchronous machine is operated in what is known as an isolated operation. In this configuration the generator supplies energy to one consumer only.
In this case, the alternator determines the voltage magnitude and the frequency.

Then, various synchronisation circuits are assembled and the response of the machine is investigated in a constant-voltage constant-frequency system. Here, voltage and frequency have constant values and are predetermined by the system.

Alternator and parallel operation - GTU101.1

Variable dc power supply	DL 1013T2	1
Resistive load	DL 1017R	1
Inductive load	DL 1017L	1
Capacitive load	DL 1017C	1
Shunt dc motor	DL 1023PS	1
Three-phase synchronous machine	DL 1026A	1
Optical transducer	DL 2031M	1
Universal base	DL 1013A	1
Electronic tachometer	DL 2025DT	1
Experiment transformer	DL 1055TT	1
Three-phase power supply	DL 2108TAL-SW	1
Variable dc power supply	DL 2108T01	1
Power circuit breaker	DL 2108T02	1
Moving coil ammeter (100-500-1000mA)	DL 2109T1A	2
Moving coil ammeter (1.25-2.5A)	DL 2109T2A5	2
Moving iron voltmeter (600V)	DL 2109T1PV	1
Synchronization indicator	DL 2109T1T	1
Phase sequence indicator	DL 2109T2T	1
Double frequencymeter	DL 2109T16/2	1
Double voltmeter (250-500V)	DL 2109T17/2	1
Power meter	DL 2109T26	1
Power factor meter	DL 2109T27	1
Synchronoscope	DL 2109T32	1
Moving coil ammeter (100-1000mA)	DL 2109T1AB	1
Moving coil voltmeter (15-30V)	DL 2109T2VB	1
Connecting leads	DL 1155GTU	1
Accessories: Table	DL 1001-1	1
Accessories: Frame	DL 2100-3M	2
Accessories: Storage cabinet	DL 2100TA	1
For Countries with 3-phase mains different from 380V :		
Three-phase transformer	DL 2100ATT	1

Experiments

- determination of the effective resistance of stator and exciter windings of the alternator
- determination of the mechanical and iron losses of the alternator
- recording the open-circuit curve at various speeds
- determination of the ohmic and stray losses of the alternator
- recording the short-circuit curve at various speeds
- calculating the synchronous reactance
- recording the response of the alternator operating with the excitation and speed kept constant under different types of load
- recording the regulation characteristics at different power factors
- determination of the conventional efficiency of the alternator using the open- and short-circuit test results
- becoming familiar with various lamp circuits used to connect an alternator
- in parallel to a constant-voltage constant-frequency system
- parallel operation using a synchronoscope
- response of the alternator on a constant-voltage constant-frequency system
- recording the V-curves (Mordey curves) of the synchronous motor

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