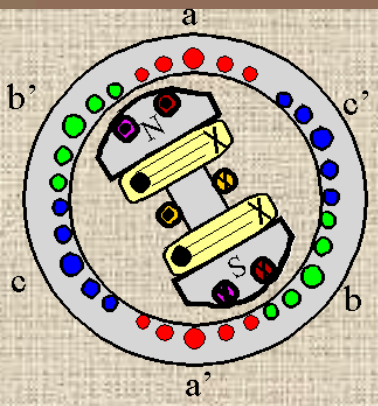
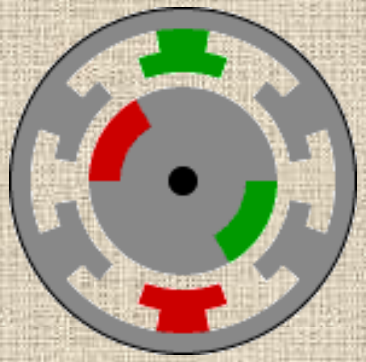
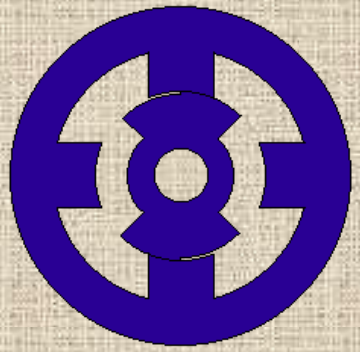
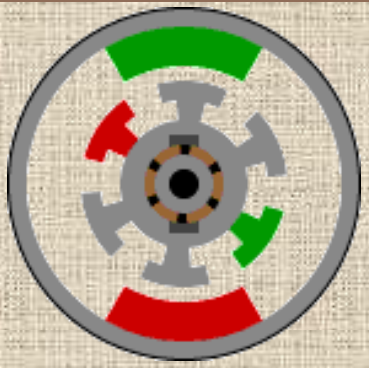
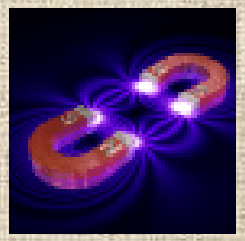




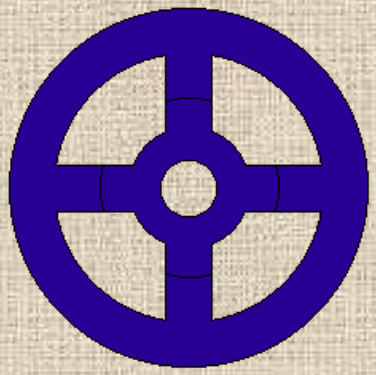


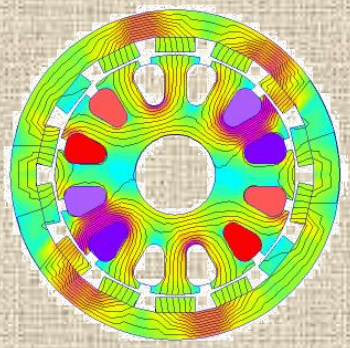


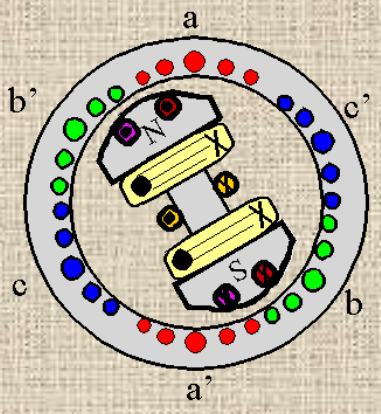


EE552 ELECTRICAL MACHINES III

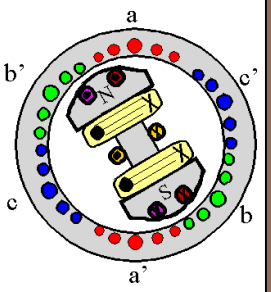
LECTURE 4



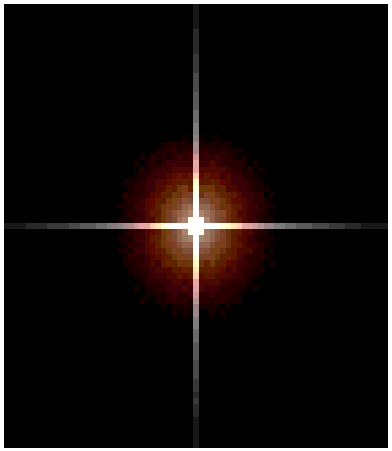




LECTURE NOTES



ELECTRICAL MACHINES III



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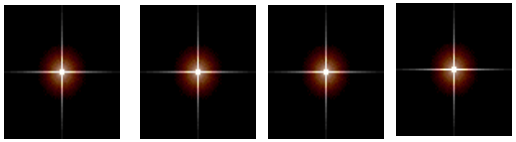

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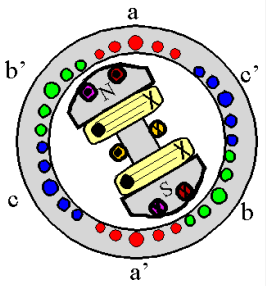
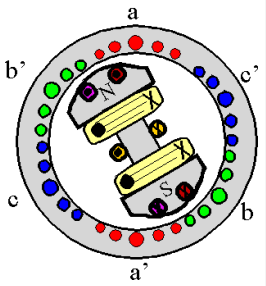
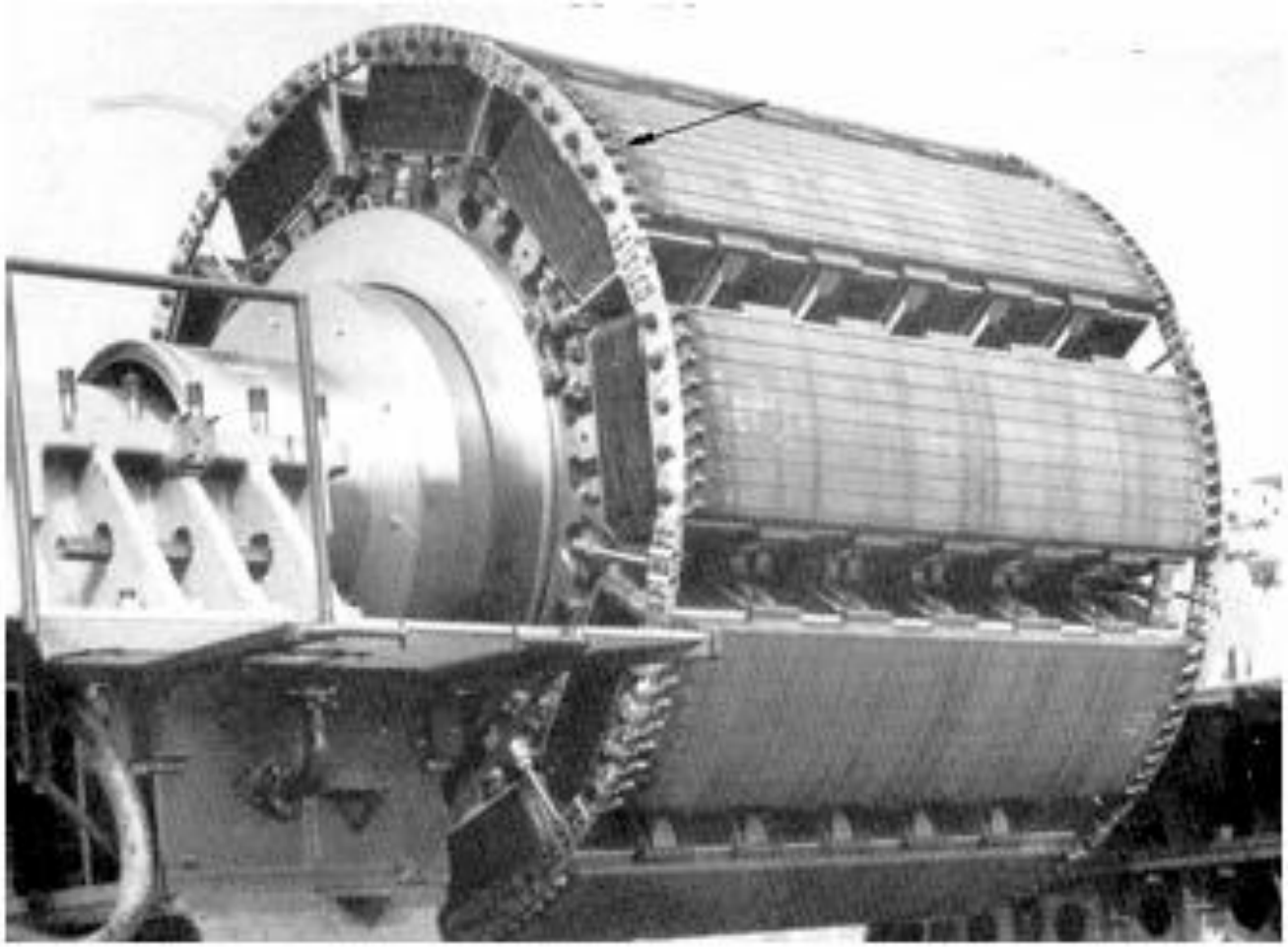


LECTURE 4

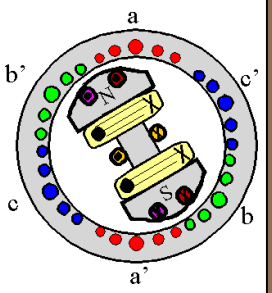
SYNCHRONOUS MACHINES

Synchronous machines





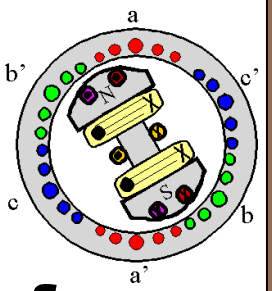
Construction of synchronous machines



Synchronous machines are AC machines that have a field circuit supplied by an external DC source.

In a synchronous generator, a DC current is applied to the rotor winding producing a rotor magnetic field. The rotor is then turned by external means producing a rotating magnetic field, which induces a 3-phase voltage within the stator winding.

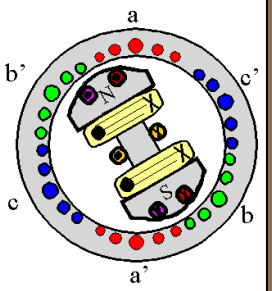
Conti...



In a **synchronous motor,** a 3-phase set of stator currents produces a rotating magnetic field causing the rotor magnetic field to align with it. The rotor magnetic field is produced by a DC current applied to the rotor winding.

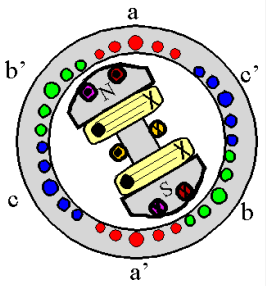
Field windings are the windings producing the main magnetic field (**rotor** windings for synchronous machines); **armature windings** are the windings where the main voltage is induced (**stator** windings for synchronous machines).

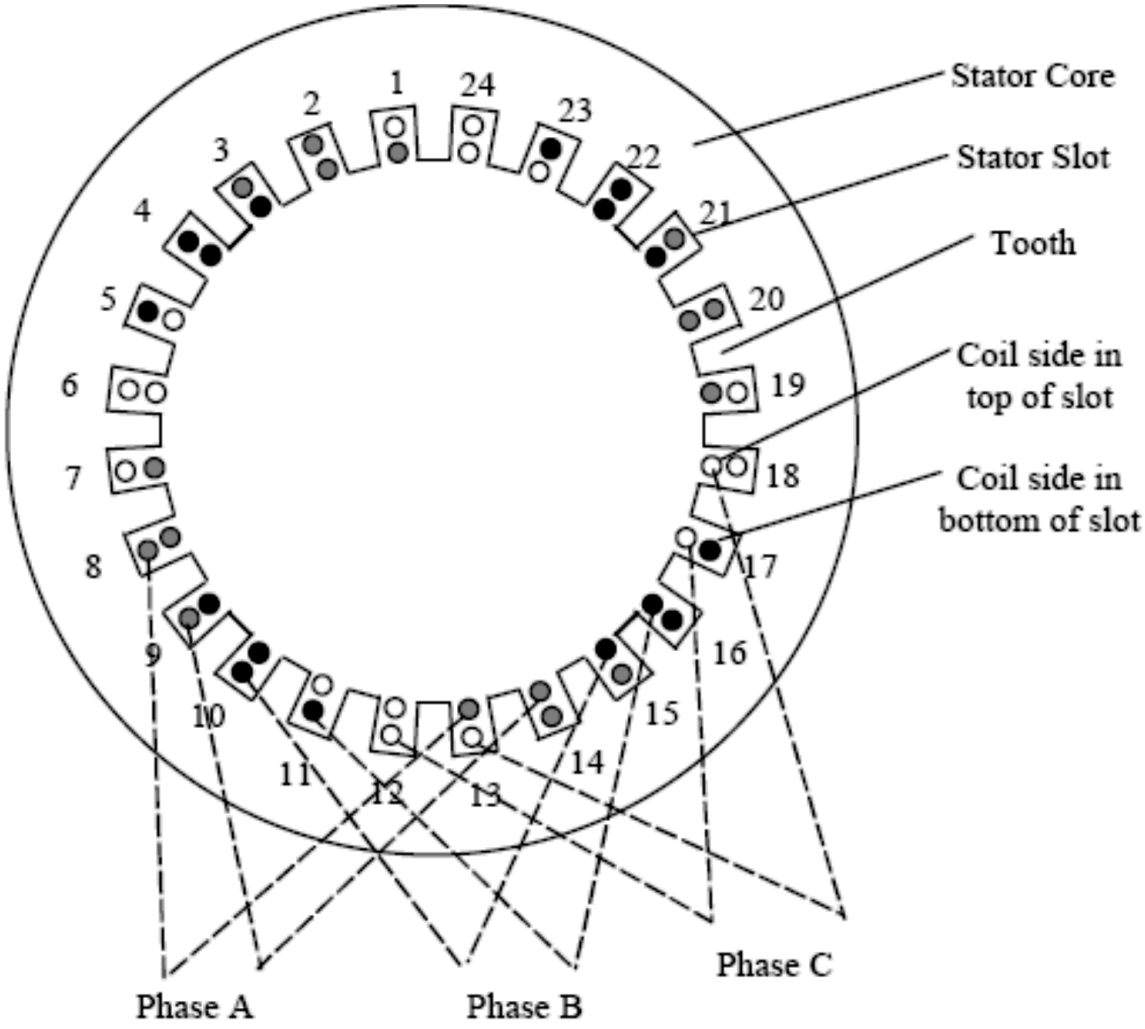
Synchronous Machines - Stator



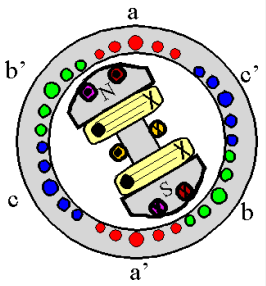
- The stator carries *the armature windings* which have constant magnitude, constant frequency emf's induced in them
- Stator made from laminated material to limit the eddy current losses.
- Fields produced in stator are rotating and time variant
- Stators are cylindrical and house a balanced three phase winding
- Small machines may have a single phase winding.

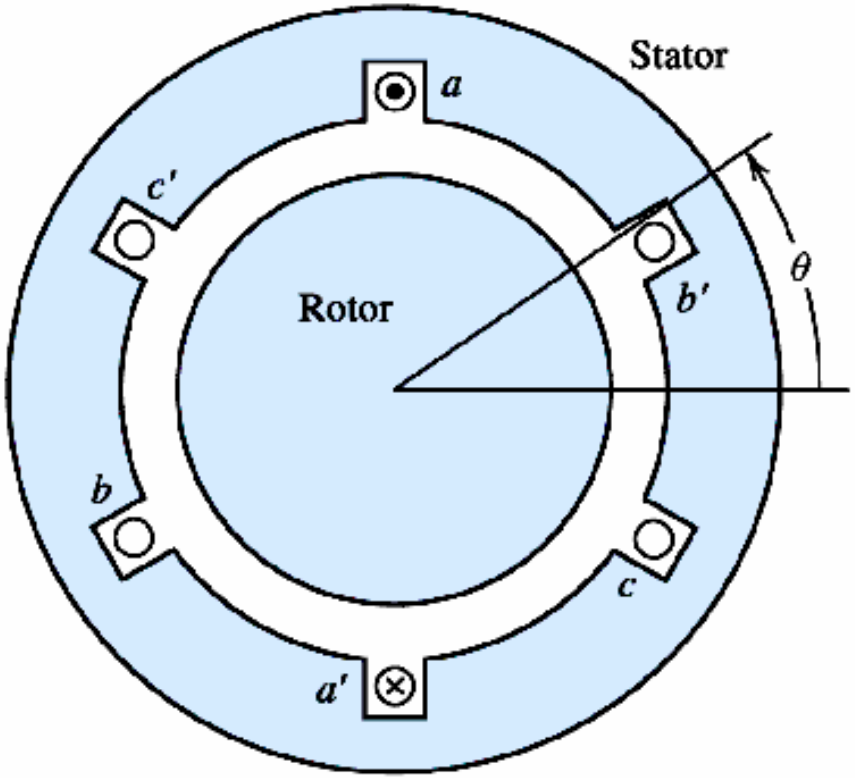
Synchronous Machine
Stator construction



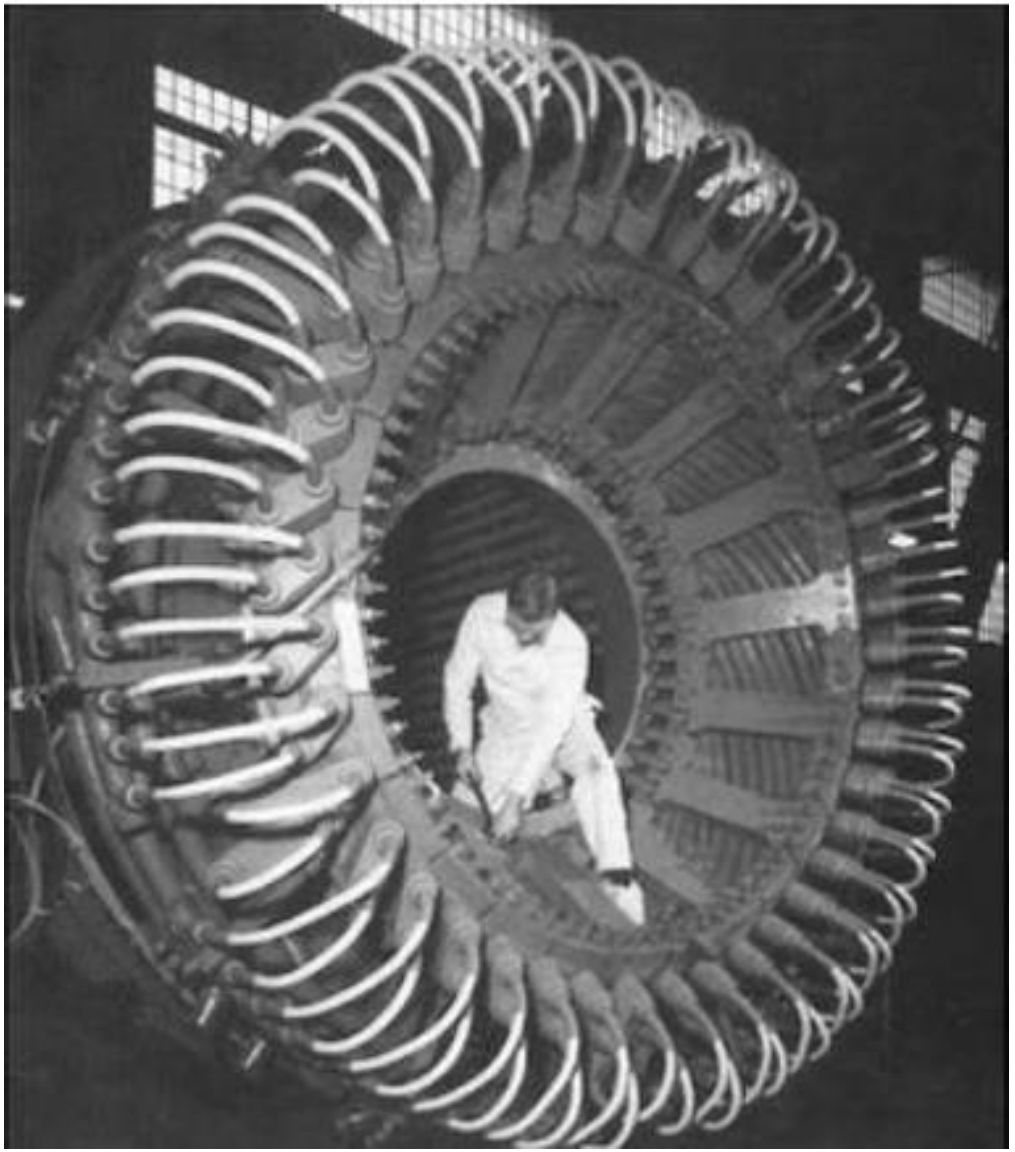


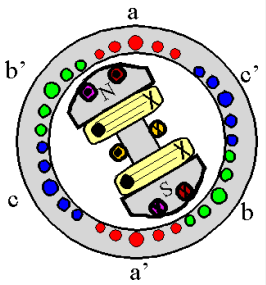
AC Machine Stator



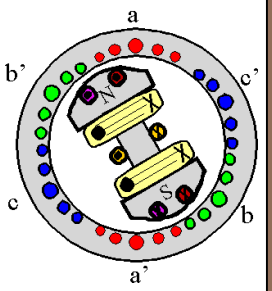


Stator





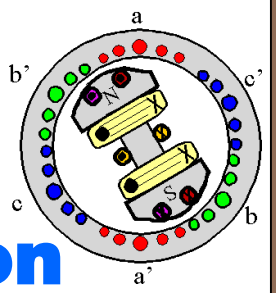
Synchronous Machines: construction: rotor types



Rotor of synchronous machine can be

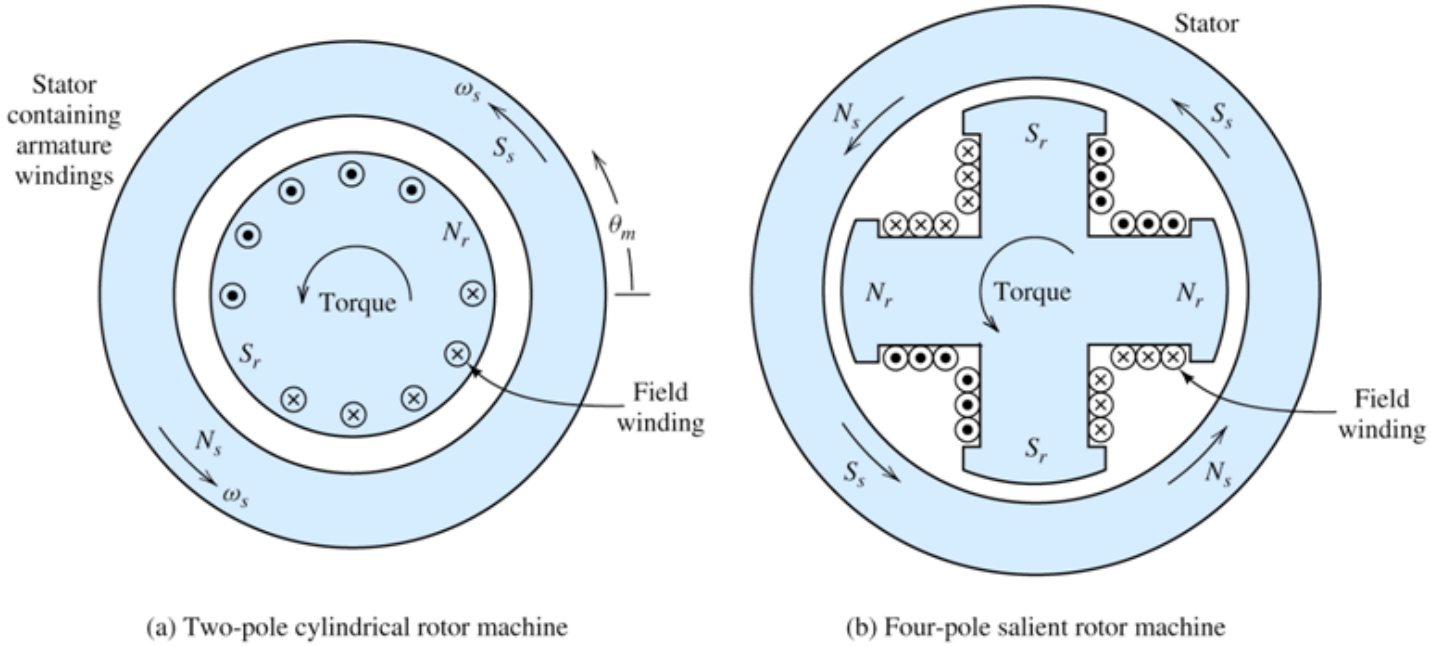
- **Cylindrical (non salient pole) type used for steam turbines (high seed)**

- **Non- cylindrical (salient pole) type used for hydraulic turbines (low seed)**



Synchronous Machine Construction

(a)CRSM (b) SPSM

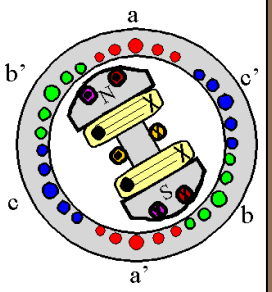


(a) Two-pole cylindrical rotor machine

(b) Four-pole salient rotor machine

Cross sections of two synchronous machines. The relative positions of the stator and rotor poles are shown for motor action. Torque is developed in the direction of rotation because the rotor poles try to align themselves with the opposite stator poles.

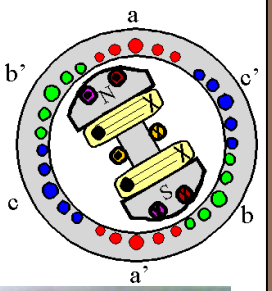
Synchronous Machines: construction: rotor types



Rotor of synchronous machine can be

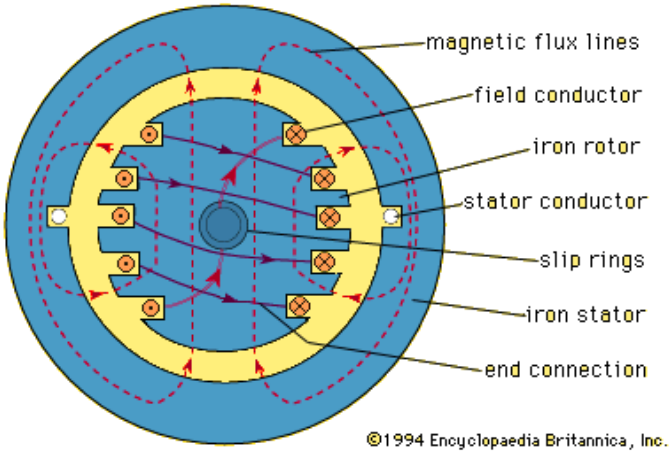
- Cylindrical (non salient pole) type used for steam turbines (high seed)
- Non- cylindrical (salient pole) type used for hydraulic turbines (low seed)

SYNCHRONOUS MACHINES

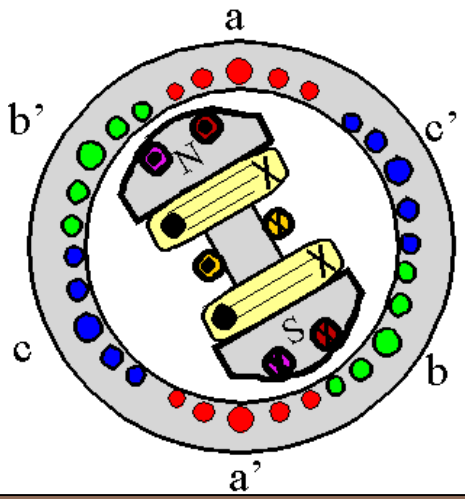


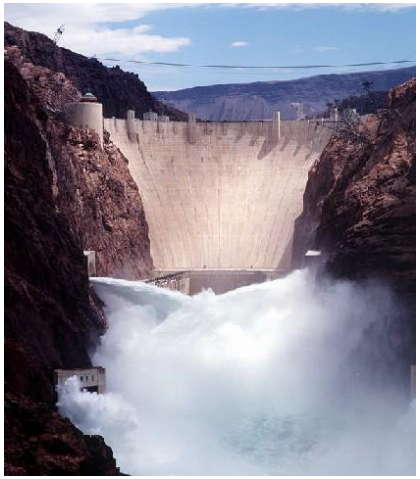
Two types:

1-Cylindirical rotor: High speed, fuel or gas fired power plants

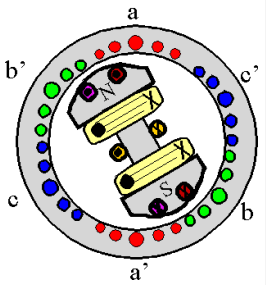


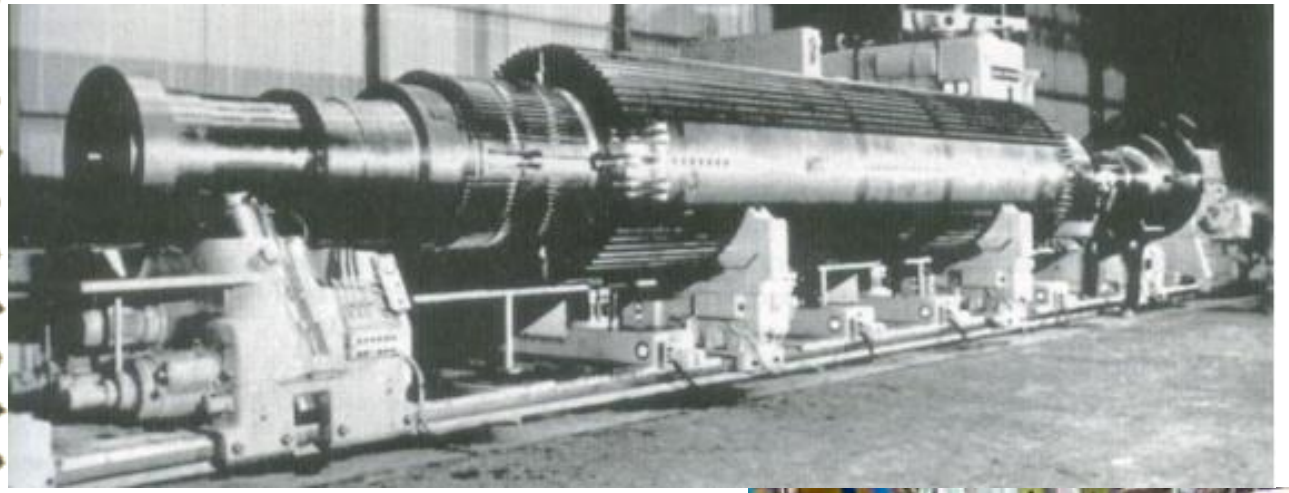
2-Salient-pole rotor: Low speed, hydroelectric power plants



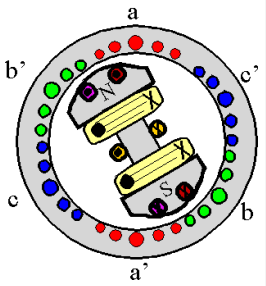


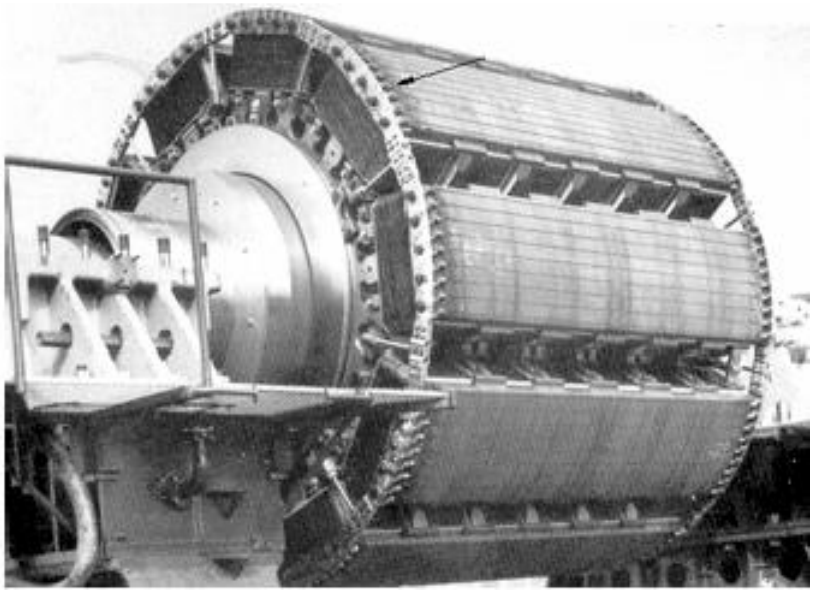
Round Rotor Machine

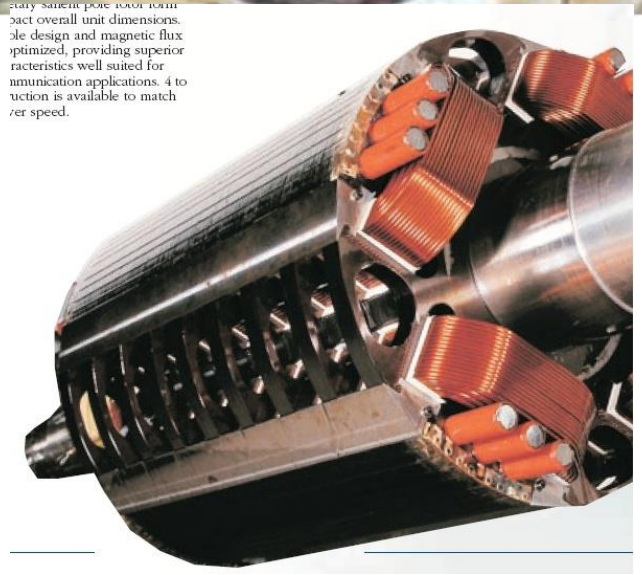




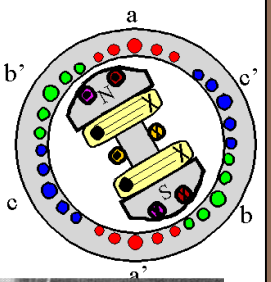
Salient Rotor Machine



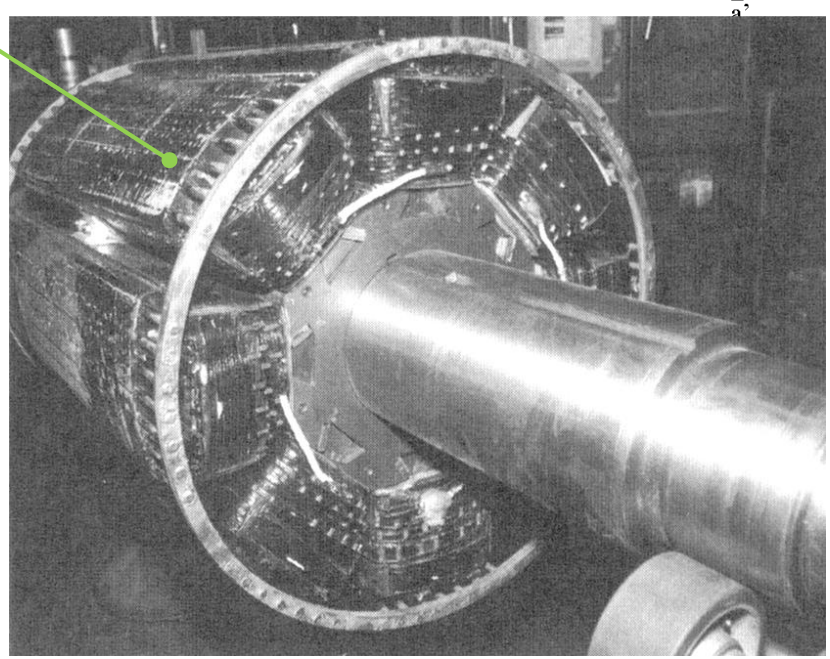


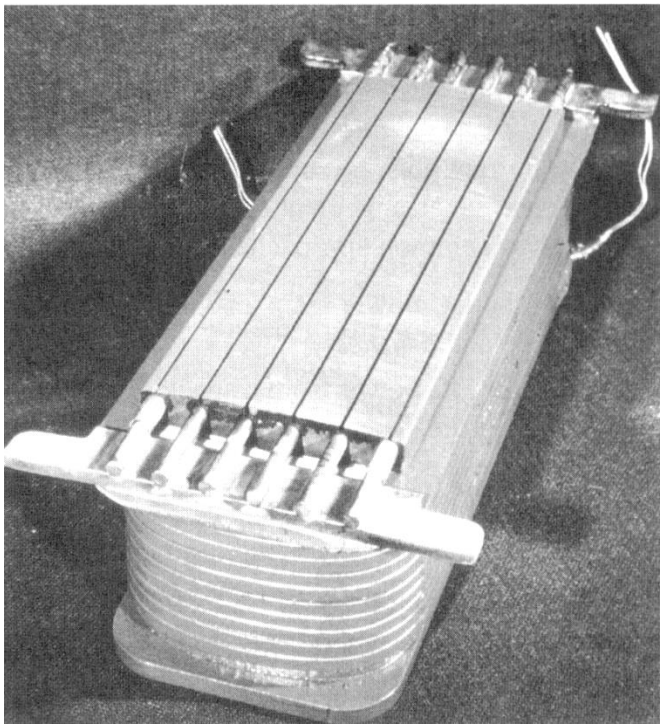


Construction of synchronous machines

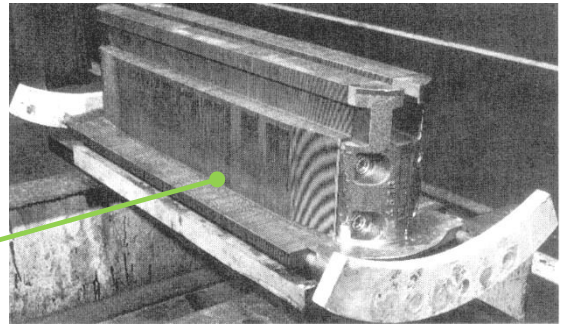


A synchronous rotor with 8 salient poles

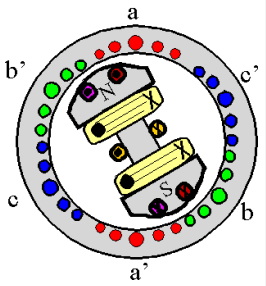


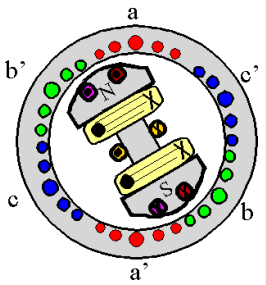


Salient pole with field windings



Salient pole without field windings – observe laminations




a
b'
c'
c
b
a'
N
S

END OF LECTURE 4