POWER POINT PRESENTATION
ON
UITILIZATION OF ELECTRICAL ENERGY

IV B. Tech I semester (R14EEE1116)

Prepared

By

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Unit-1

ELECTRIC DRIVE

ELECTRICAL ENERGY

- It is flexible
- Easily available
- Can be converted to other forms of energy.
- Can be easily transported to required location
- Economical
- Mature technology
- Saves manual labor in industry and domestic applications

UTILISATION

Electrical energy is used in various applications:

1. Electric Drives; DC and AC motors
2. Electric heating and welding
3. Illumination
4. Electric Traction
5. Electric Vehicles

DC MOTOR

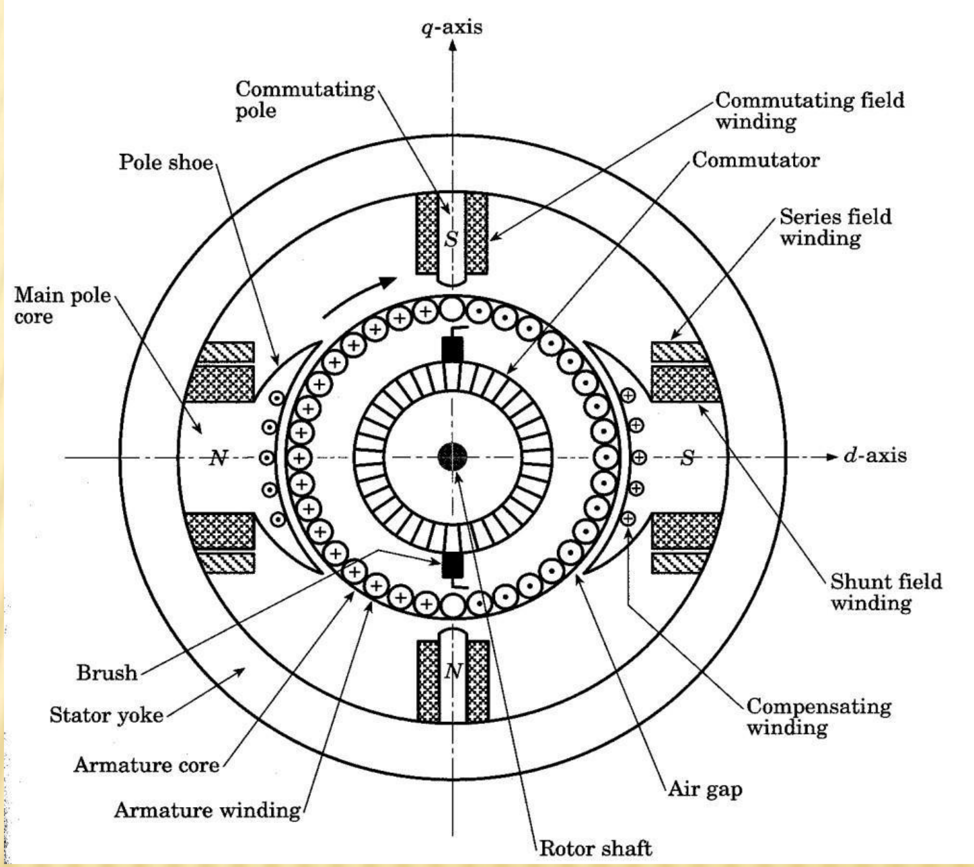
- The direct current (dc) machine can be used as a motor or as a generator.
- DC Machine is most often used for a motor.
- The major advantages of dc machines are the easy speed and torque regulation.
- However, their application is limited to mills, mines and trains. As examples, trolleys and underground subway cars may use dc motors.
- In the past, automobiles were equipped with dc dynamos to charge their batteries.

DC MOTOR

- Even today the starter is a series dc motor
- However, the recent development of power electronics has reduced the use of dc motors and generators.
- The electronically controlled ac drives are gradually replacing the dc motor drives in factories.
- Nevertheless, a large number of dc motors are still used by industry and several thousand are sold annually.

CONSTRUCTION

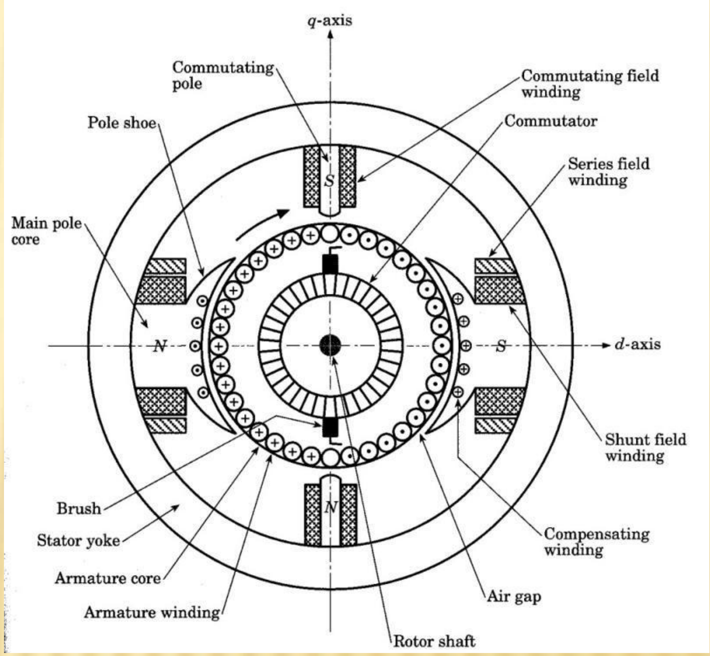
DC MACHINE CONSTRUCTION



General arrangement of a dc machine

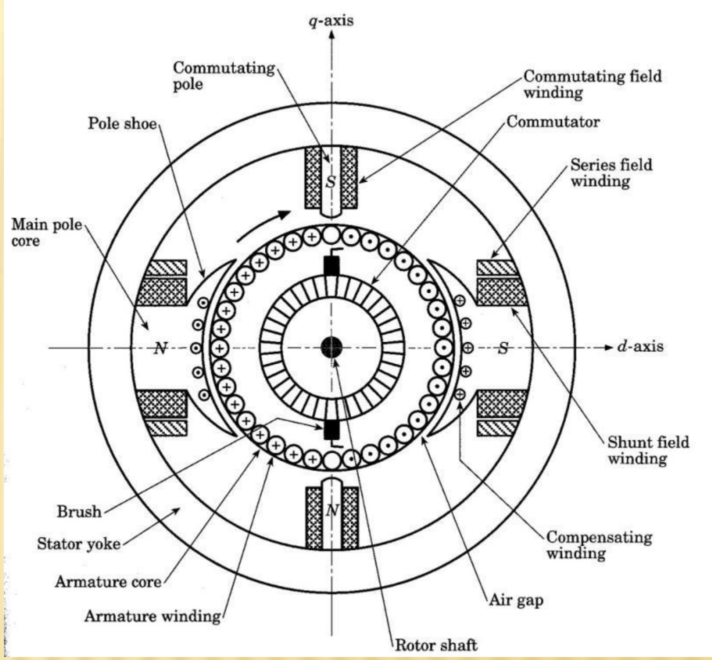
DC MACHINES

- The stator of the dc motor has poles, which are excited by dc current to produce magnetic fields.
- In the neutral zone, in the middle between the poles, commutating poles are placed to reduce sparking of the commutator. The commutating poles are supplied by dc current.
- Compensating windings are mounted on the main poles. These short-circuited windings damp rotor oscillations. .



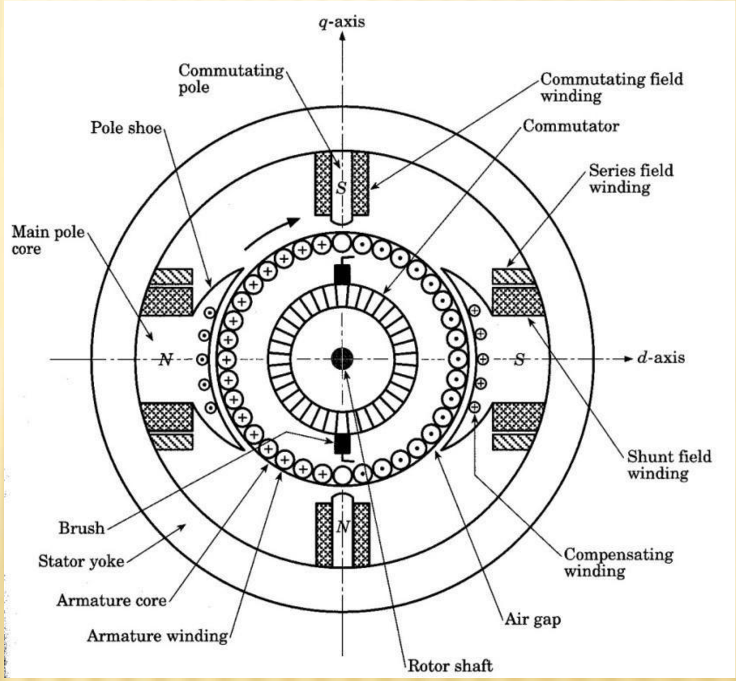
DC MACHINES

- The poles are mounted on an iron core that provides a closed magnetic circuit.
- The motor housing supports the iron core, the brushes and the bearings.
- The rotor has a ring-shaped laminated iron core with slots.
- Coils with several turns are placed in the slots. The distance between the two legs of the coil is about 180 electric degrees.



DC MACHINES

- The coils are connected in series through the commutator segments.
- The ends of each coil are connected to a commutator segment.
- The commutator consists of insulated copper segments mounted on an insulated tube.
- Two brushes are pressed to the commutator to permit current flow.
- The brushes are placed in the neutral zone, where the magnetic field is close to zero, to reduce arcing.



DC MACHINES

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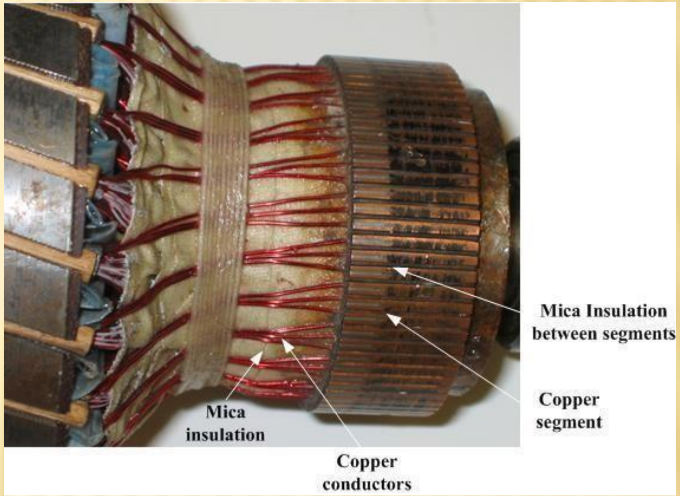
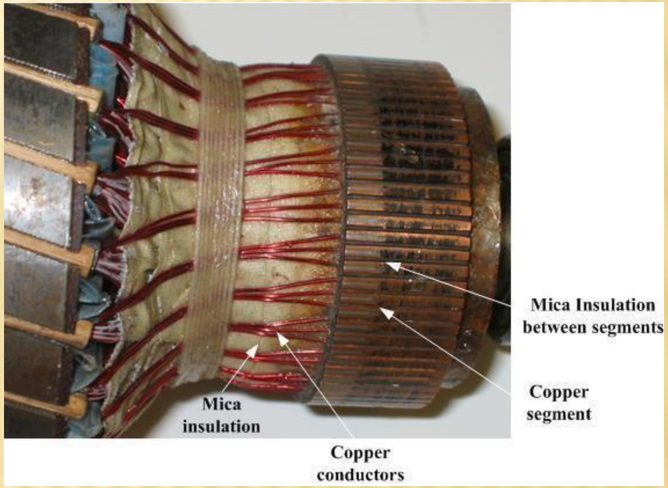


DC MACHINES

- The *commutator* switches the current from one rotor coil to the adjacent coil,
- The switching requires the interruption of the coil current.
- The sudden interruption of an inductive current generates high voltages .
- The high voltage produces flashover and arcing between the commutator segment and the brush.



DC MACHINE CONSTRUCTION

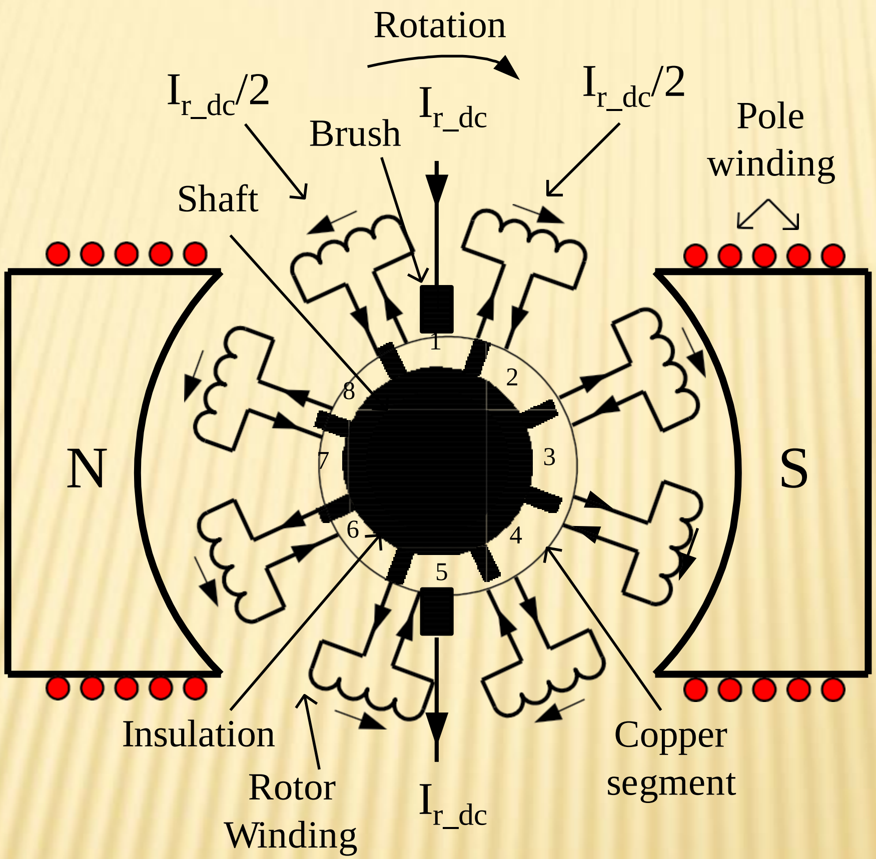


Fig: Commutator with the rotor coils connections.

DC MACHINE CONSTRUCTION

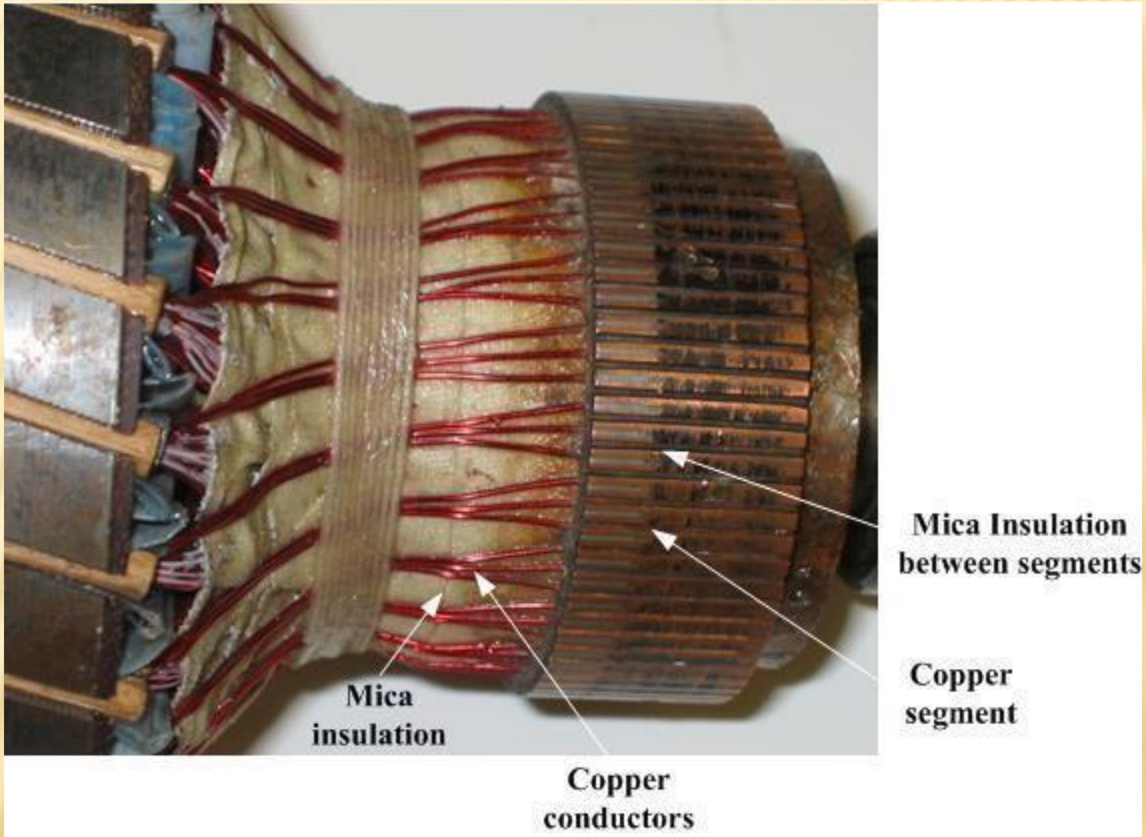


Fig: Details of the Commutator of a dc motor.

DC MACHINE CONSTRUCTION

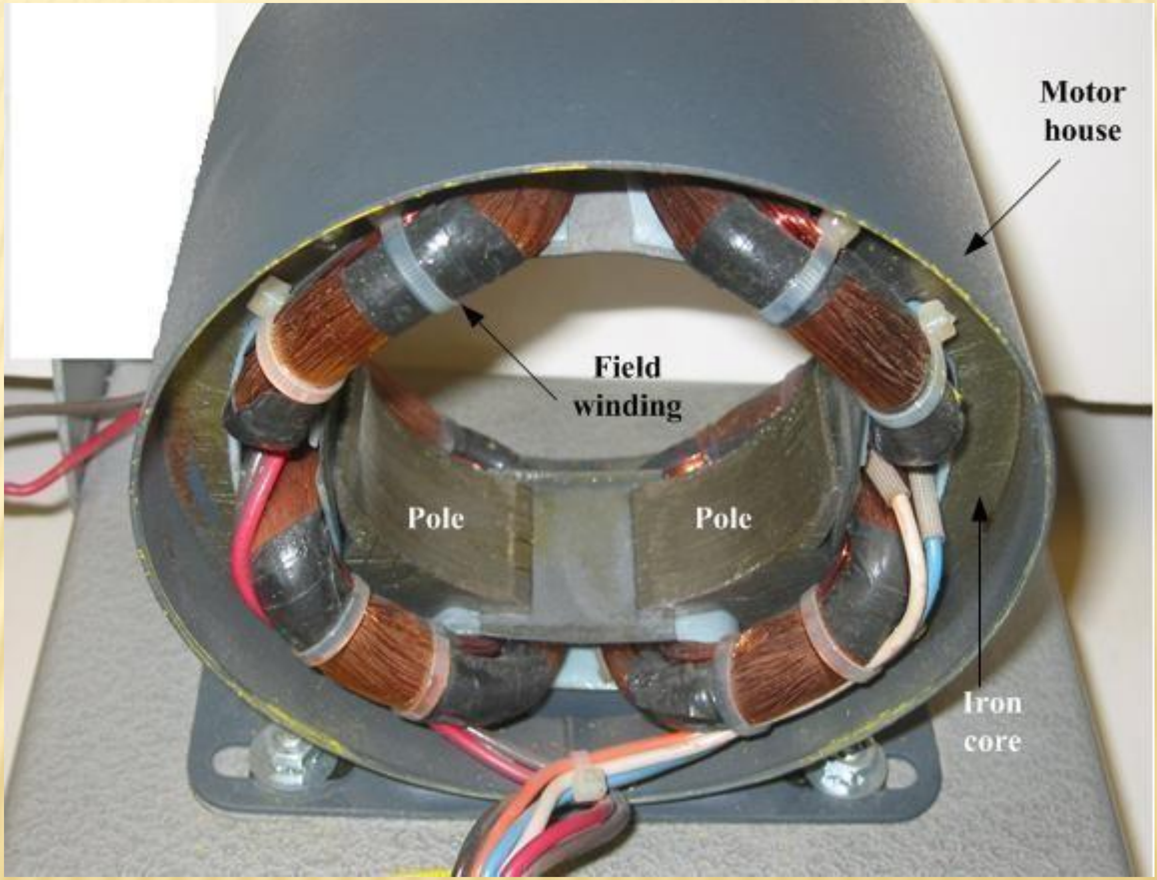


Fig:DC motor stator with poles visible.

DC MACHINE CONSTRUCTION

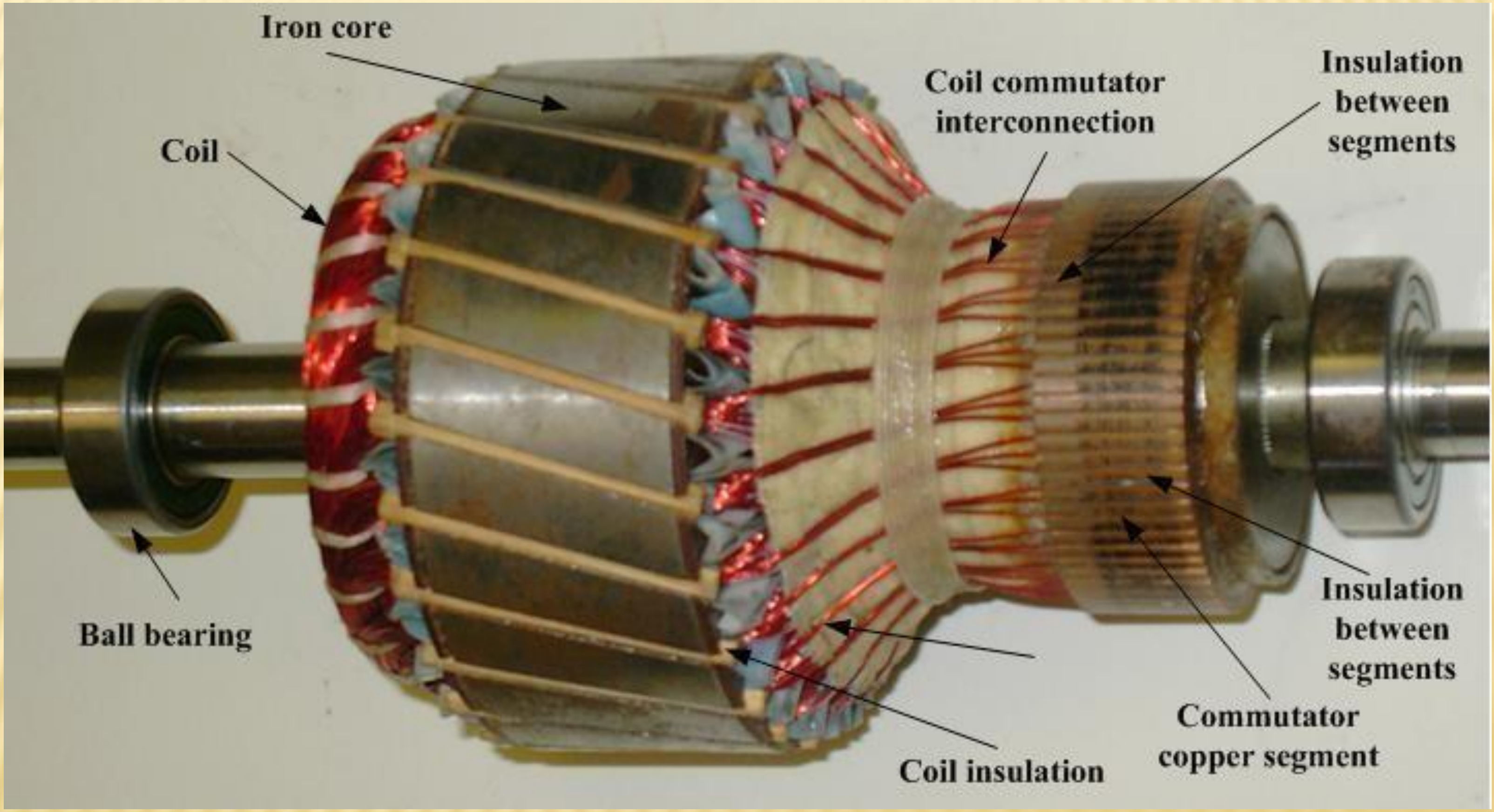


Fig:Rotor of a dc motor.

DC MACHINE CONSTRUCTION

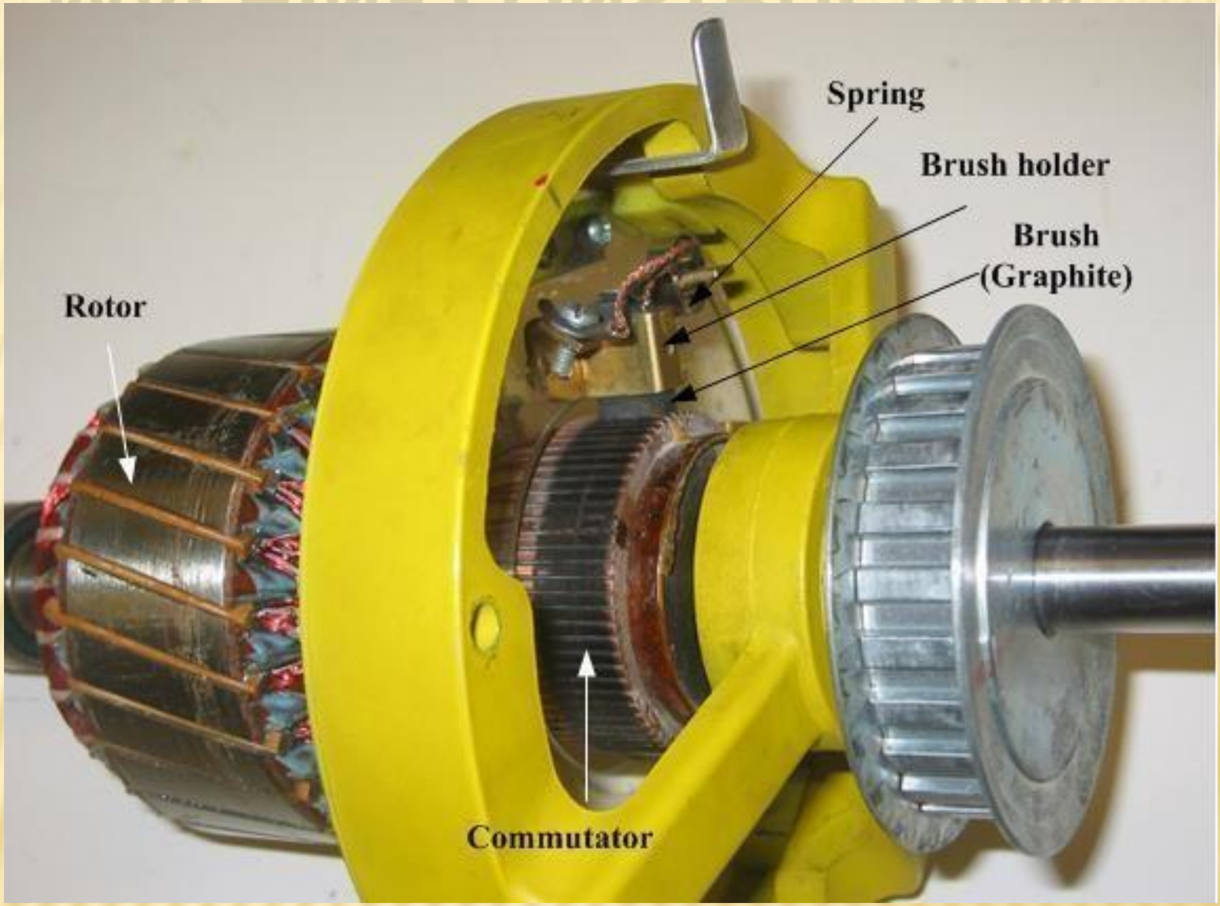
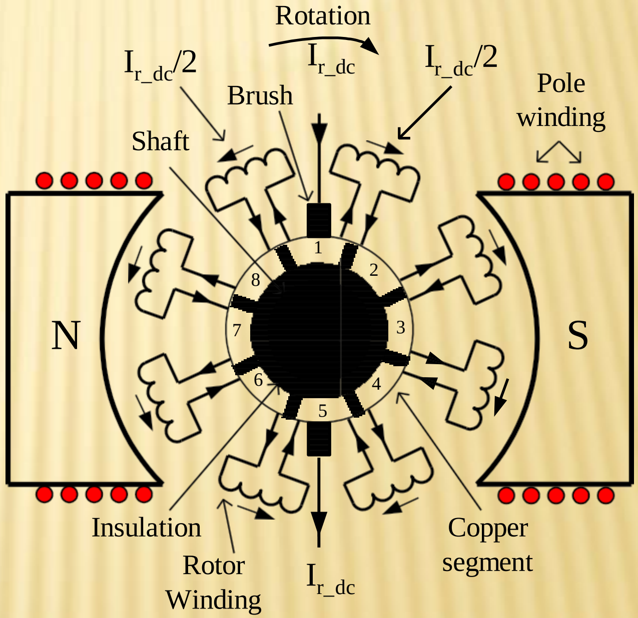


Fig: Cutaway view of a dc motor.

DC MOTOR OPERATION

DC MOTOR OPERATION

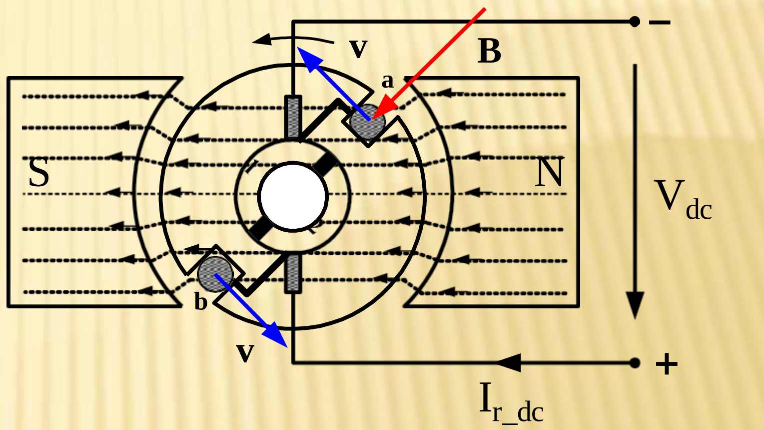
- In a dc motor, the stator poles are supplied by dc excitation current, which produces a dc magnetic field.
- The rotor is supplied by dc current through the brushes, commutator and coils.
- The interaction of the magnetic field and rotor current generates a force that drives the motor



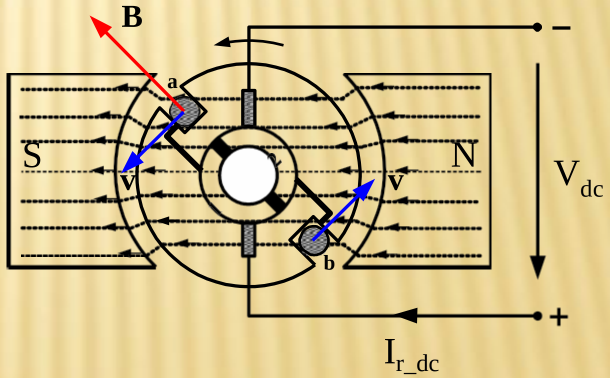
DC MOTOR OPERATION

DC MOTOR OPERATION

- The magnetic field lines enter into the rotor from the north pole (N) and exit toward the south pole (S).
- The poles generate a magnetic field that is perpendicular to the current carrying conductors.
- The interaction between the field and the current produces a Lorentz force,
- The force is perpendicular to both the magnetic field and conductor



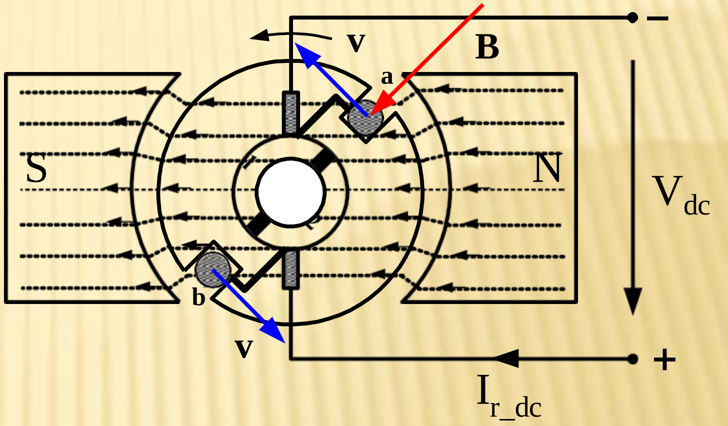
(a) Rotor current flow from segment 1 to 2 (slot **a** to **b**)



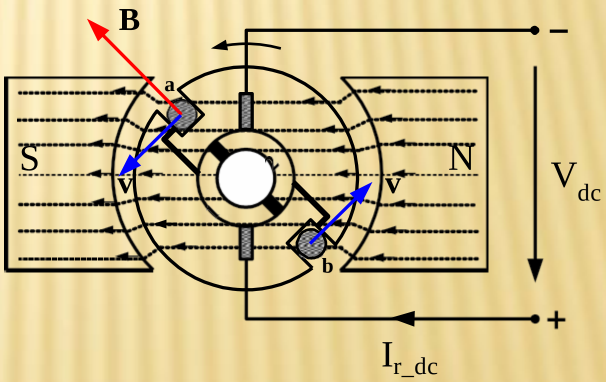
(b) Rotor current flow from segment 2 to 1 (slot **b** to **a**)

DC MOTOR OPERATION

- The generated force turns the rotor until the coil reaches the neutral point between the poles.
- At this point, the magnetic field becomes practically zero together with the force.
- However, inertia drives the motor beyond the neutral zone where the direction of the magnetic field reverses.
- To avoid the reversal of the force direction, the commutator changes the current direction, which maintains the counterclockwise rotation. .



(a) Rotor current flow from segment 1 to 2 (slot **a** to **b**)

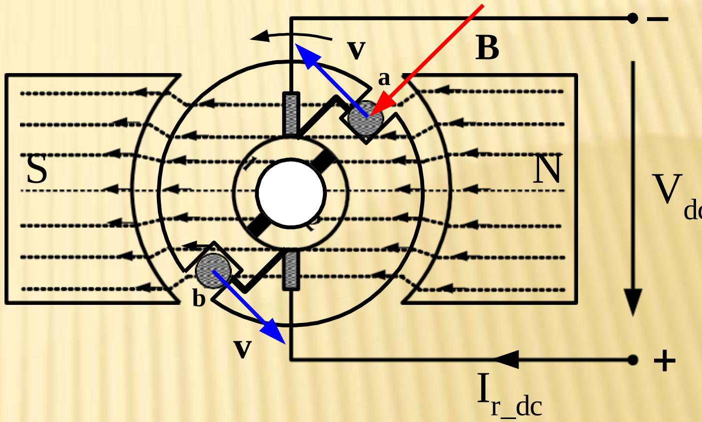


(b) Rotor current flow from segment 2 to 1 (slot **b** to **a**)

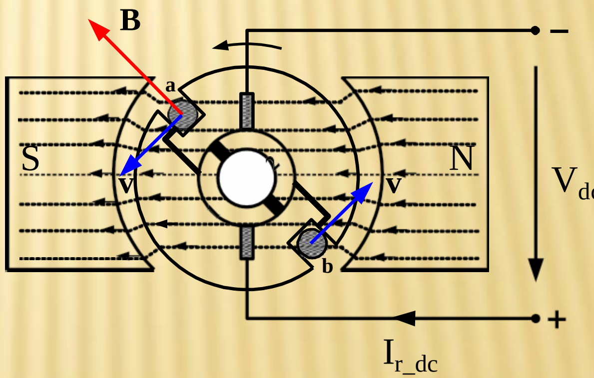
DC MOTOR OPERATION

DC MOTOR OPERATION

- Before reaching the neutral zone, the current enters in segment 1 and exits from segment 2,
- Therefore, current enters the coil end at slot a and exits from slot b during this stage.
- After passing the neutral zone, the current enters segment 2 and exits from segment 1,
- This reverses the current direction through the rotor coil, when the coil passes the neutral zone.
- The result of this current reversal is the maintenance of the rotation.



(a) Rotor current flow from segment 1 to 2 (slot **a** to **b**)

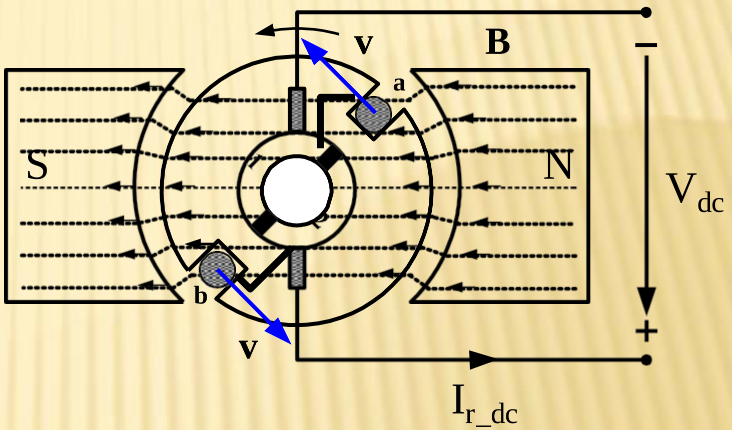


(b) Rotor current flow from segment 2 to 1 (slot **b** to **a**)

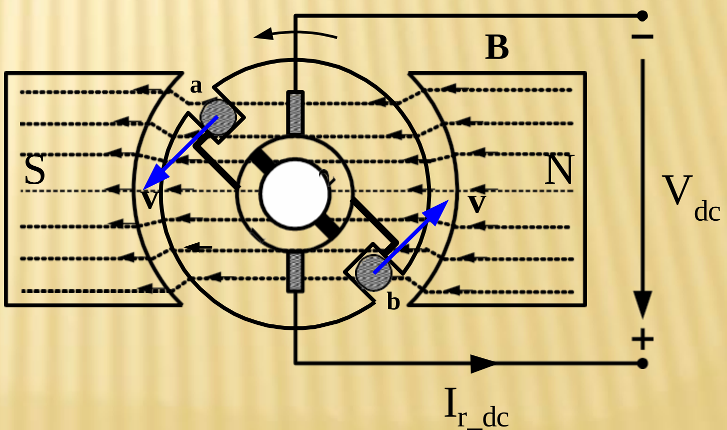
DC
GENERATO
R
OPERATIO
N

DC GENERATOR OPERATION

- The N-S poles produce a dc magnetic field and the rotor coil turns in this field.
- A turbine or other machine drives the rotor.
- The conductors in the slots cut the magnetic flux lines, which induce voltage in the rotor coils.
- The coil has two sides: one is placed in slot a, the other in slot b.



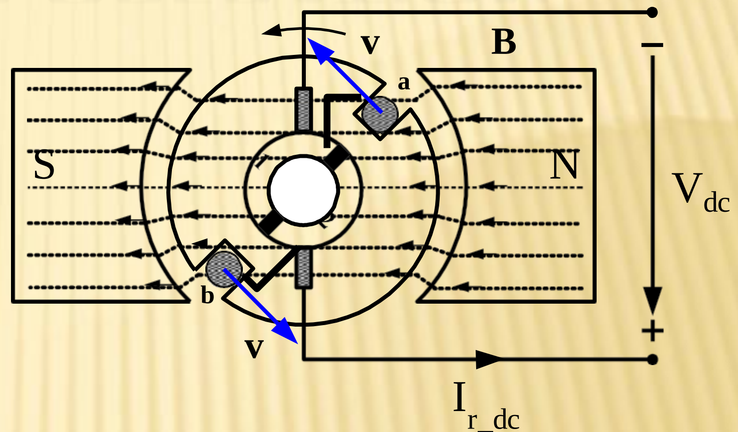
(a) Rotor current flow from segment 1 to 2 (slot **a** to **b**)



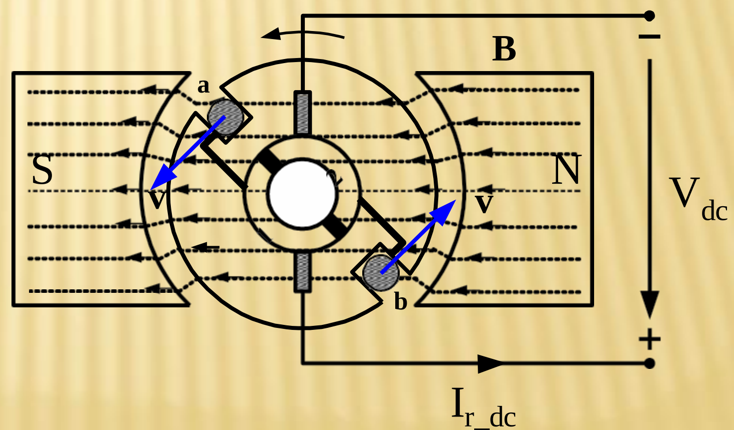
(b) Rotor current flow from segment 2 to 1 (slot **b** to **a**)

DC GENERATOR OPERATION

- In Figure 8.11A, the conductors in slot a are cutting the field lines entering into the rotor from the northpole,
- The conductors in slot b are cutting the field lines exiting from the rotor to the south pole.
- The cutting of the field lines generates voltage in the conductors.
- The voltages generated in the two sides of the coil are added.



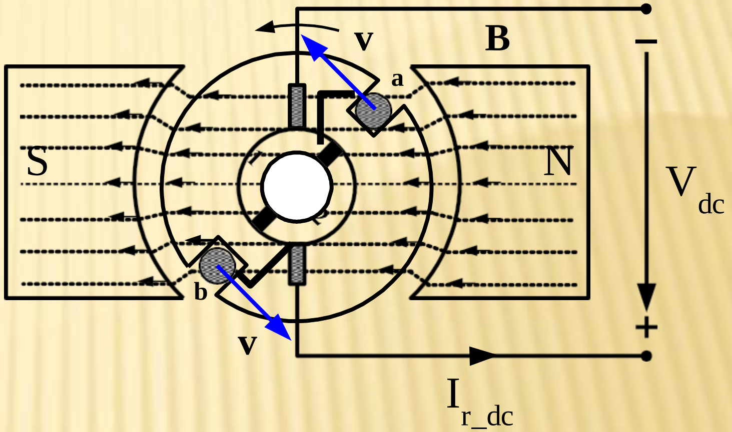
(a) Rotor current flow from segment 1 to 2 (slot **a** to **b**)



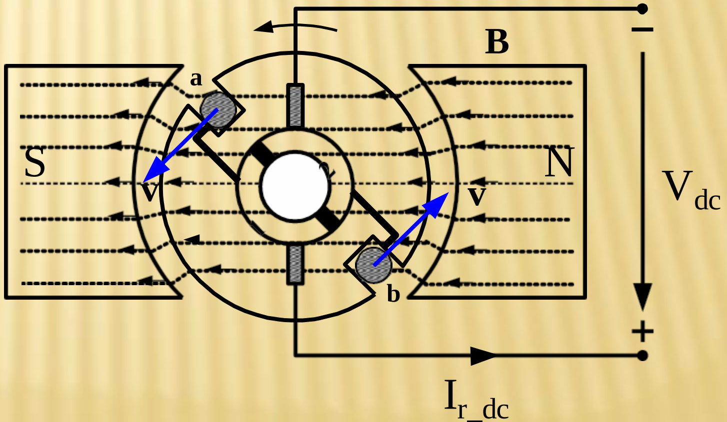
(b) Rotor current flow from segment 2 to 1 (slot **b** to **a**)

DC GENERATOR OPERATION

- The induced voltage is connected to the generator terminals through the commutator and brushes.
- In Figure 8.11A, the induced voltage in b is positive, and in a is negative.
- The positive terminal is connected to commutator segment 2 and to the conductors in slot b.
- The negative terminal is connected to segment 1 and to the conductors in slot a.



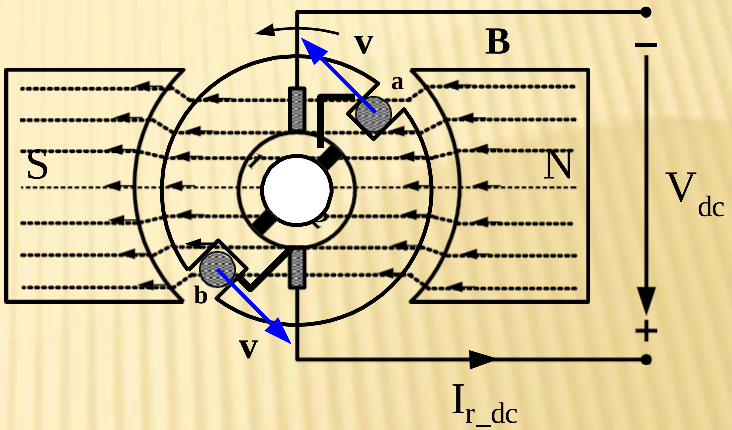
(a) Rotor current flow from segment 1 to 2 (slot **a** to **b**)



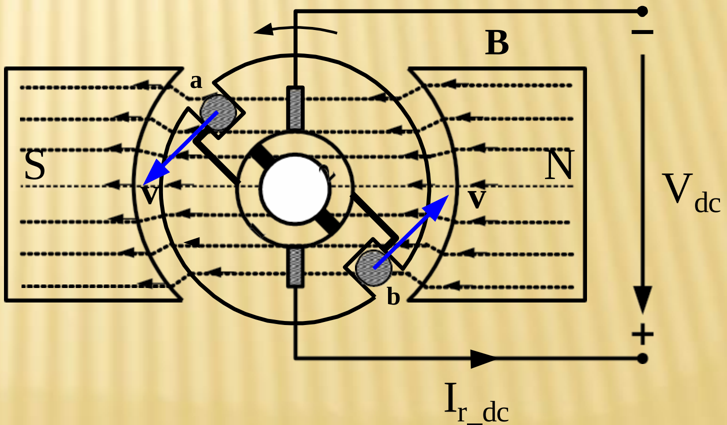
(b) Rotor current flow from segment 2 to 1 (slot **b** to **a**)

DC GENERATOR OPERATION

- When the coil passes the neutral zone:
  - Conductors in slot a are then moving toward the south pole and cut flux lines exiting from the rotor
  - Conductors in slot b cut the flux lines entering the in slot b.
- This changes the polarity of the induced voltage in the coil.
- The voltage induced in a is now positive, and in b is negative.



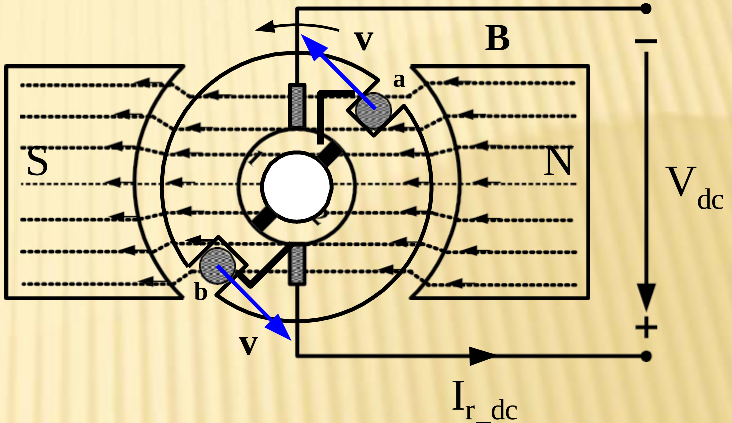
(a) Rotor current flow from segment 1 to 2 (slot **a** to **b**)



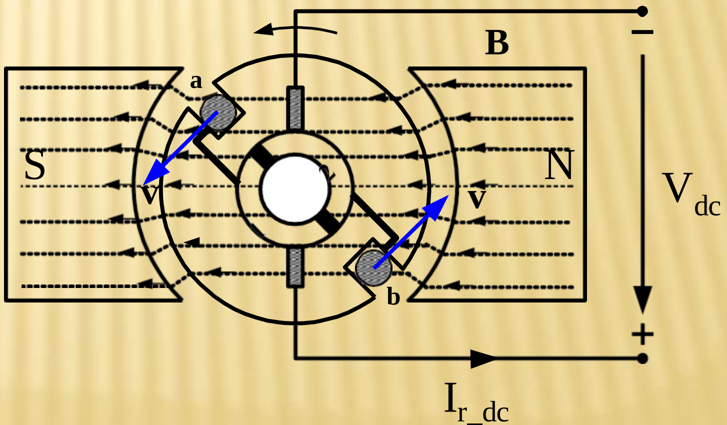
(b) Rotor current flow from segment 2 to 1 (slot **b** to **a**)

DC GENERATOR OPERATION

- The simultaneously the commutator reverses its terminals, which assures that the output voltage (V_{dc}) polarity is unchanged.
- In Figure 8.11B
  - the positive terminal is connected to commutator segment 1 and to the conductors in slota.
  - The negative terminal is connected to segment 2 and to the conductors in slot b.



(a) Rotor current flow from segment 1 to 2 (slot **a** to **b**)



(b) Rotor current flow from segment 2 to 1 (slot **b** to **a**)

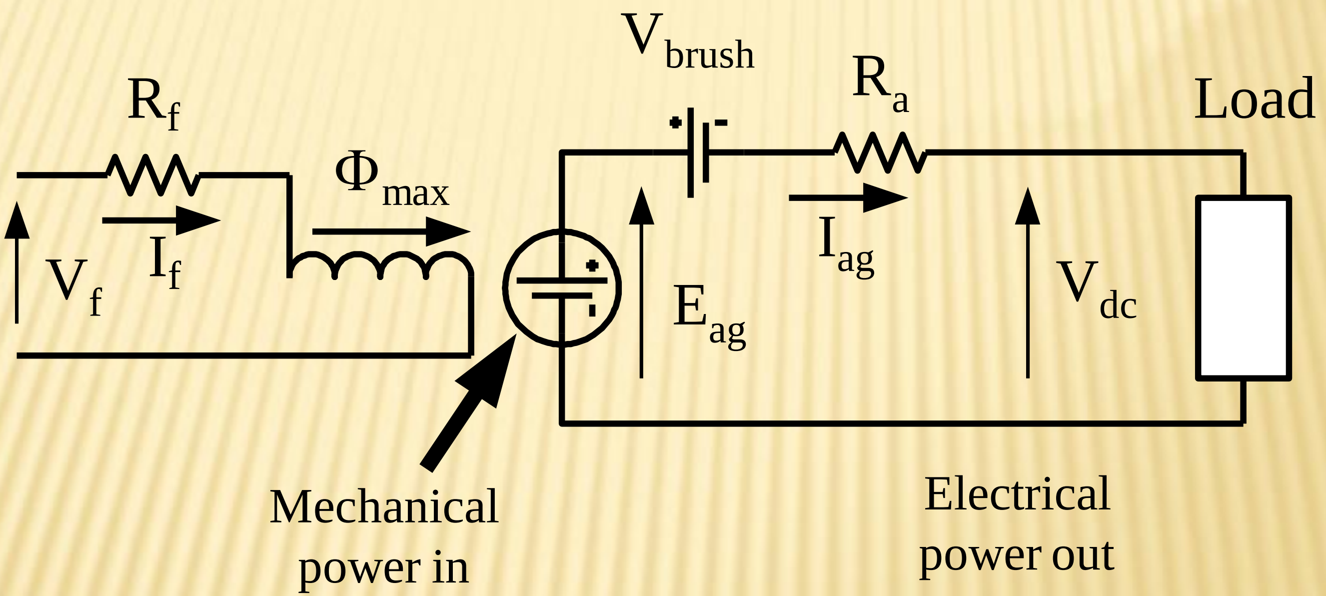
DC MACHINE EQUIVALENT CIRCUIT

GENERATOR

DC GENERATOR EQUIVALENT CIRCUIT

- The magnetic field produced by the stator poles induces a voltage in the rotor (or armature) coils when the generator is rotated.
- This induced voltage is represented by a voltage source.
- The stator coil has resistance, which is connected in series.
- The pole flux is produced by the DC excitation/field current, which is magnetically coupled to the rotor
- The field circuit has resistance and a source
- The voltage drop on the brushes represented by a battery

DC GENERATOR EQUIVALENT CIRCUIT



Equivalent circuit of a separately excited dc generator.

DC GENERATOR EQUIVALENT CIRCUIT

- The magnetic field produced by the stator poles induces a voltage in the rotor (or armature) coils when the generator is rotated.
- The dc field current of the poles generatesa magnetic flux
- The flux is proportional with the field current if the iron core is notsaturated:

$$\Phi_{ag} = K_1 \, I_f$$

DC GENERATOR EQUIVALENT CIRCUIT

- The rotor conductors cut the field lines that generate voltage in the coils.

$$E_{ag} = 2\,N_r\;B\,\Box_g\,v$$

- The motor speed and flux equations are:

$$v = \omega\frac{D_g}{2} \qquad\qquad \Phi_{ag} = B\,\Box_g\;D_g$$

DC GENERATOR EQUIVALENT CIRCUIT

- The combination of the three equation results the induced voltage equation:

$$E_{ag} = 2N_r B \ell_g v = 2N_r B \ell_g \left(\omega \frac{D_g}{2} \right) = N_r \left(B \ell_g D_g \right) \omega = N_r \Phi_{ag} \omega$$

- The equation is simplified.

$$E_{ag} = N_r \Phi_{ag} \omega = N_r K_1 I_f \omega = K_m I_f \omega$$

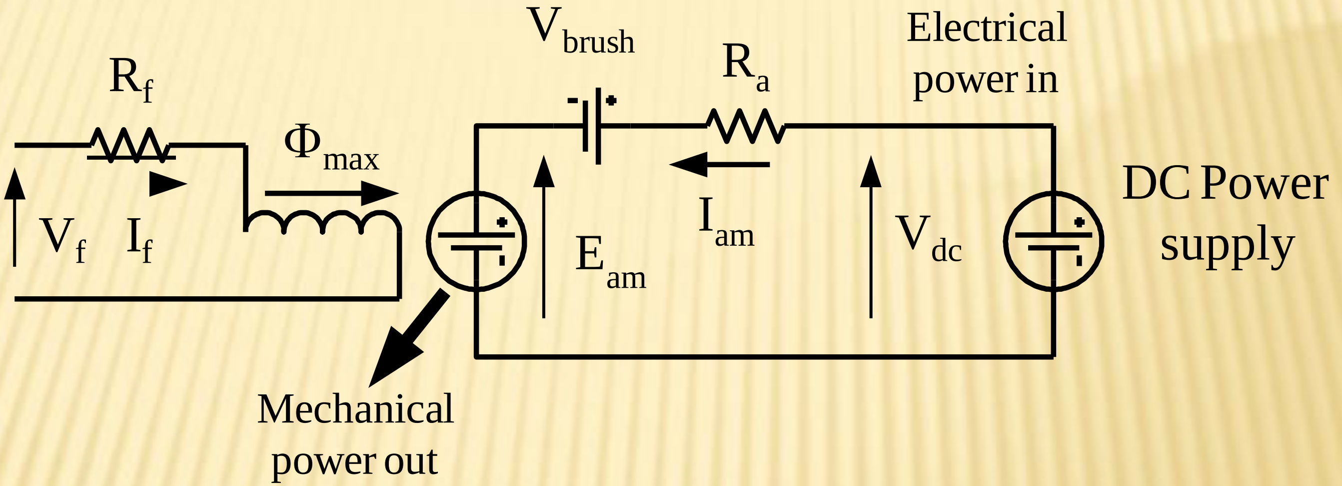
DC GENERATOR EQUIVALENT CIRCUIT

- When the generator is loaded, the load current produces a voltage drop on the rotor winding resistance.
- In addition, there is a more or less constant 1–3 V voltage drop on the brushes.
- These two voltage drops reduce the terminal voltage of the generator. The terminal voltage is;

$$E_{ag} = V_{dc} + I_{ag} \ R_a + V_{brush}$$

MOTOR

DC MOTOR EQUIVALENT CIRCUIT



- Equivalent circuit of a separately excited dc motor
- Equivalent circuit is similar to the generator only the current directions are different

DC MOTOR EQUIVALENT CIRCUIT

- The operation equations are:
- Armature voltage equation

$$V_{dc} = E_{am} + I_{am} R_a + V_{brush}$$

The induced voltage and motor speed vs angular frequency

$$E_{am} = K_m I_f \omega$$

$$\omega = 2\pi n_m$$

DC MOTOR EQUIVALENT CIRCUIT

- The operation equations are:
- The combination of the equations results in

$$K_m I_f \omega = E_{am} = V_{dc} - I_{am} R_m$$

The current is calculated from this equation. The output power and torque are:

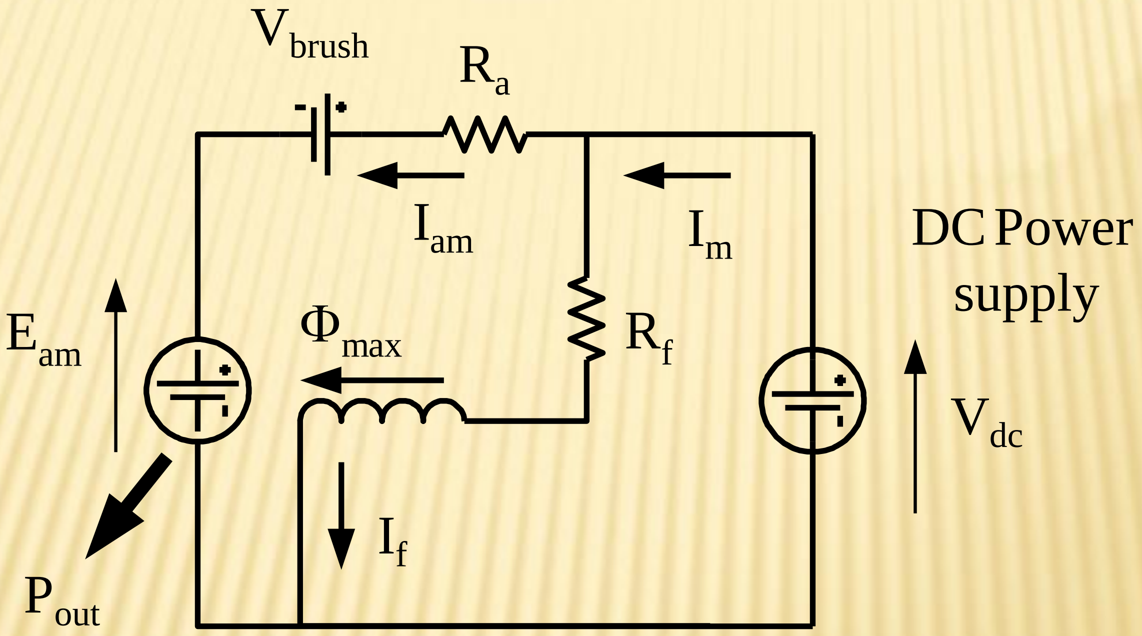
$$P_{out} = E_{am} I_{am} \qquad T = \frac{P_{out}}{\omega} = K_m I_{am} I_f$$

DC Machine Excitation Methods

DC MOTOR OPERATION

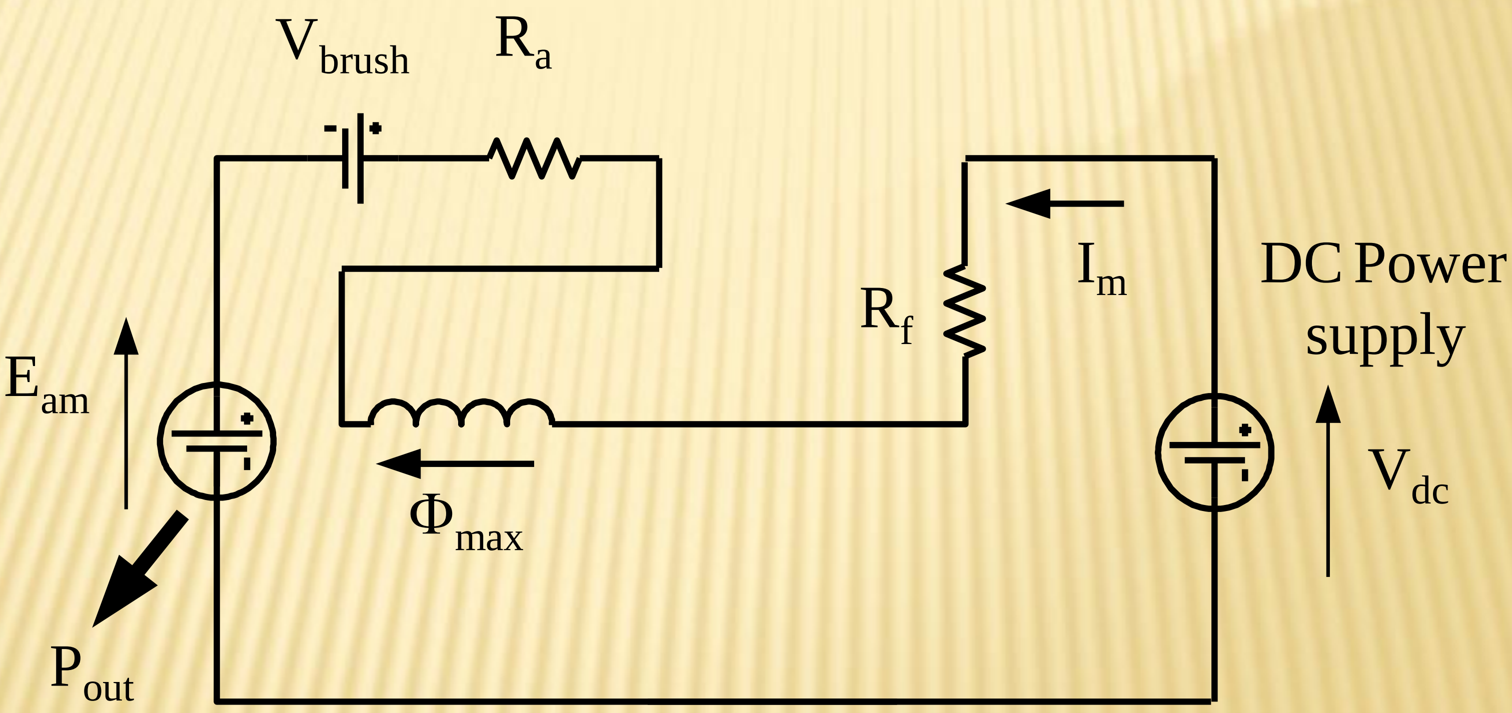
- There are four different methods for supplying the dc current to the motor or generator poles:
  - Separate excitation;
  - Shunt connection
  - Series connection
  - Compound

DC MOTOR EQUIVALENT CIRCUIT



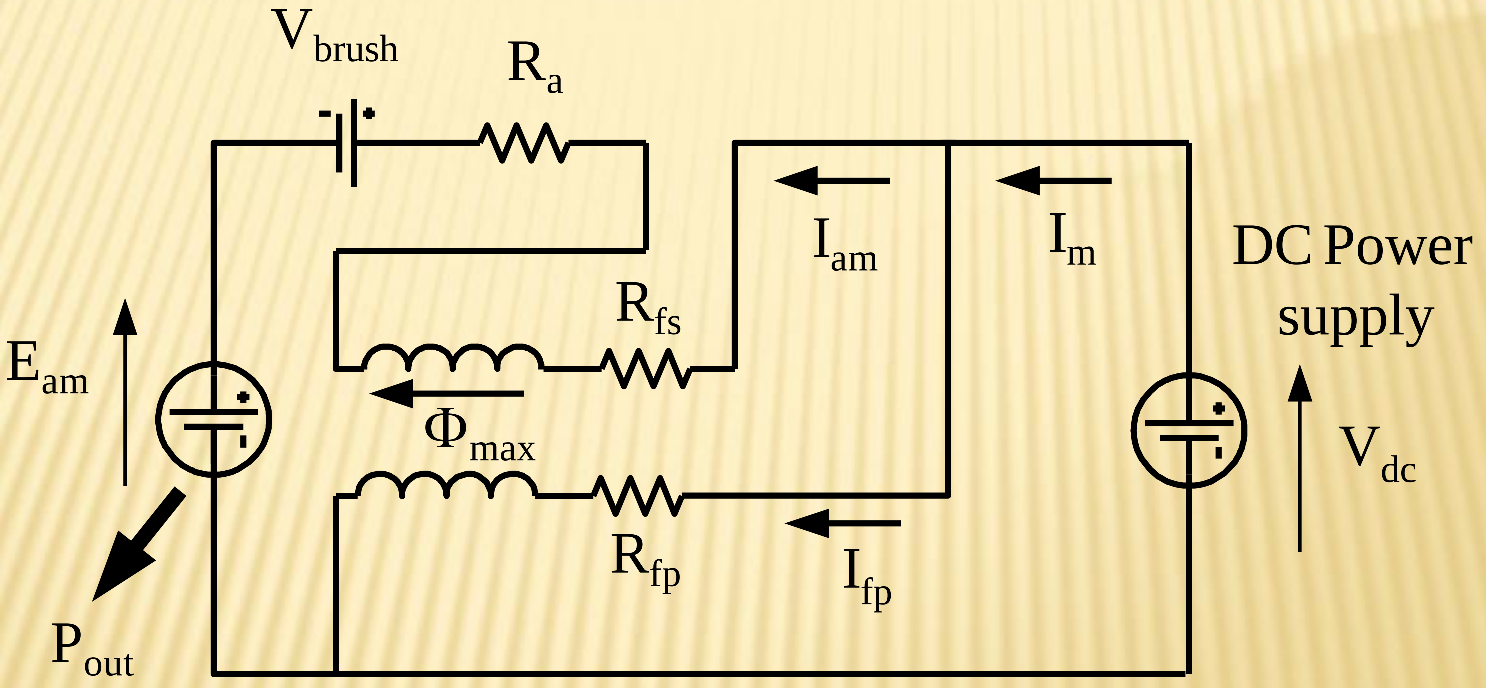
- Equivalent circuit of a shunt dc motor

DC MOTOR EQUIVALENT CIRCUIT



- Equivalent circuit of a series dc motor

DC MOTOR EQUIVALENT CIRCUIT



- Equivalent circuit of a compound dc motor

UNIT - II
ELECTRIC HEATING AND WELDING

OUTLINE

- Introduction.
- Definition.
- Electric Resistance Heating.
- Types of Electric Resistance Heaters.
- Mathematical analysis
- Fan heaters.
- Conclusion.

INTRODUCTION

The energy is converted from shape to other shape

Such as:

- Electrical energy
- Thermal energy

DEFINITION

Electric heating is any process in which electrical energy is converted to heat. Common applications include heating of buildings, cooking, and industrial processes.

An electric heater is an electrical appliance that converts electrical energy into heat . The heating element inside every electric heater is simply an electrical resistor, and works on the principle of joule heating: an electric current flowing through a resistor converts electrical energy into heat energy.

A heat pump uses an electric motor to drive a refrigeration cycle, drawing heat from a source such as ground water or outside air and directing it into the space to be warmed. Such systems can deliver two or three units of heating energy for every unit of purchased energy.

ELECTRIC RESISTANCE HEATING

Electric resistance heating converts nearly 100% of the energy in the electricity to heat. However, most electricity is produced from oil, gas, or coal generators that convert only about 30% of the fuel's energy into electricity. Because of electricity generation and transmission losses, electric heat is often more expensive than heat produced in the home or business using combustion appliances, such as natural gas, propane, and oilfurnaces.

TYPES OF ELECTRIC RESISTANCE HEATERS

- Electric Furnaces
- Electric Baseboard Heaters
- Electric Wall Heaters
- Electric Thermal Storage
- Control Systems

MATHEMATICAL ANALYSIS

According to Joule's Law, the heat power produced by a resistor is:

$$P = IV$$

where

P is the power in watts

I is the current in amperes, and

V is the potential difference in volts,

and according to Ohm's Law *I* and *V* are related as follows:

$$V = IR$$

where

R is the resistance of the heating element, in ohms.

FAN HEATERS

A fan heater is a variety of convection heater that includes an electric fan to speed up the airflow.

This reduces the thermal resistance between the heating element and the surroundings, allowing heat to be transferred more quickly.

CONCLUSION

Although they all use the same physical principle to generate heat, electric heaters differ in the way they deliver that heat to the environment.

SOLID-STATE WELDING PROCESSES

COLD WELDING

- Pressure is applied to the workpieces through dies or rolls

- Preferably both work pieces should be ductile

- The work pieces should cleaned thoroughly

- Can not join dissimilar metals

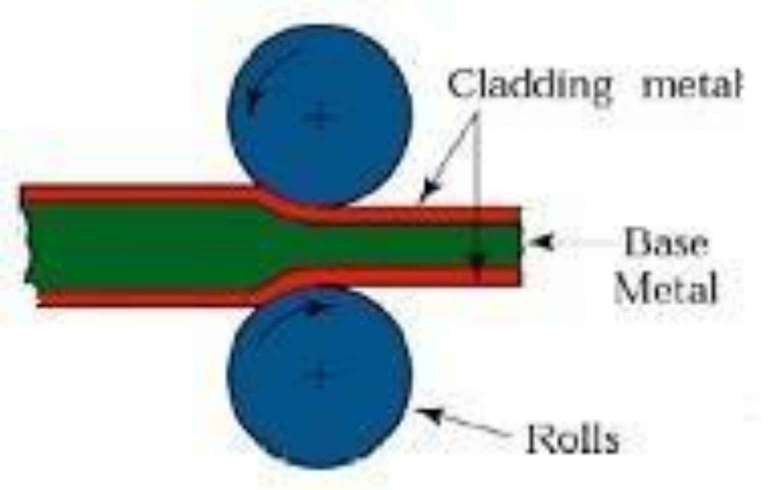


Fig: The roll bonding or cladding process

ULTRASONIC WELDING

- Surfaces of the two components are subjected to a static forces and oscillating shearing force
- Produces a strong, solid-state bond
- Versatile and reliable for joining metals

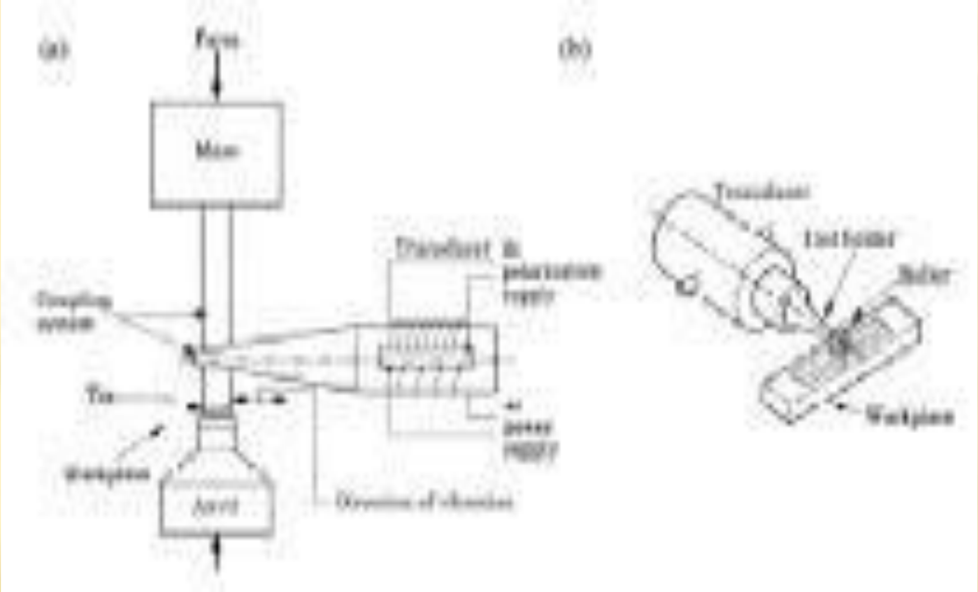


Fig: a) Components of an ultrasonic weldingmachine for lap welds.The lateral vibration of the tool tip cause plastic deformation and bonding at the interface of the work piece b)Ultrasonic some welding using a roller c)An ultrasonically welded part

FRICTION WELDING

- Developed in the 1940's
- Parts are circular in shape
- Can be used to join a wide variety of materials

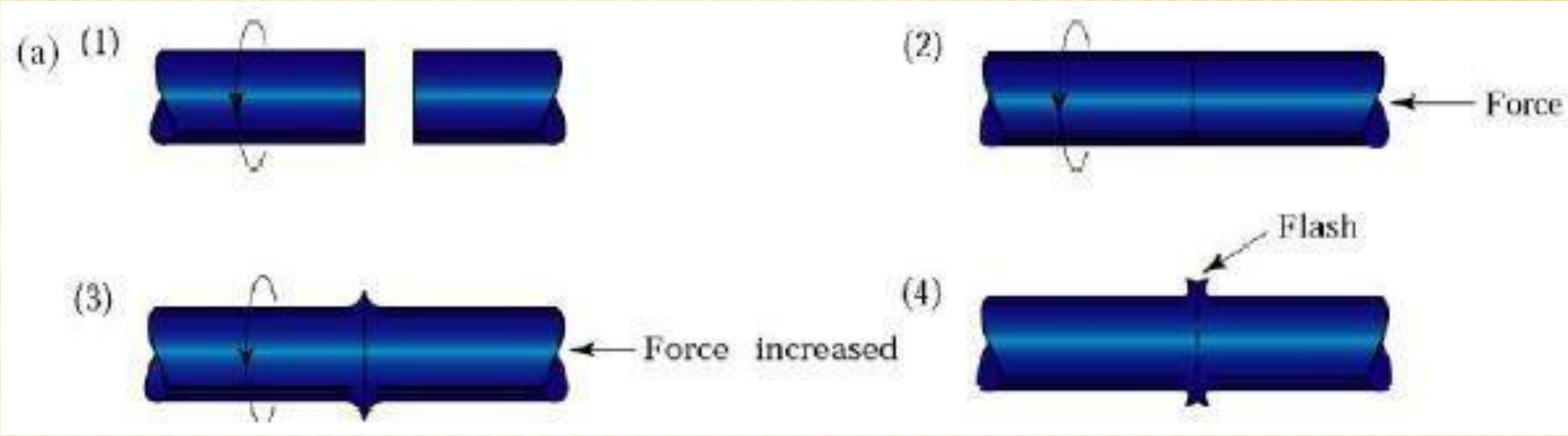


Fig: Sequence of operation in the friction welding process 1)Left-hand component is rotated at high speed. 2) Right-hand component is brought into contact under an axial force 3)Axial force is increased;the flash begins to form 4) Left-hand component stops rotating;weld is completed.The flash can subsequently be removed by machining or grinding

FRICTION WELDING

- Process can be fully automated

- Can weld solid steel bars up to 250mm in outside diameter

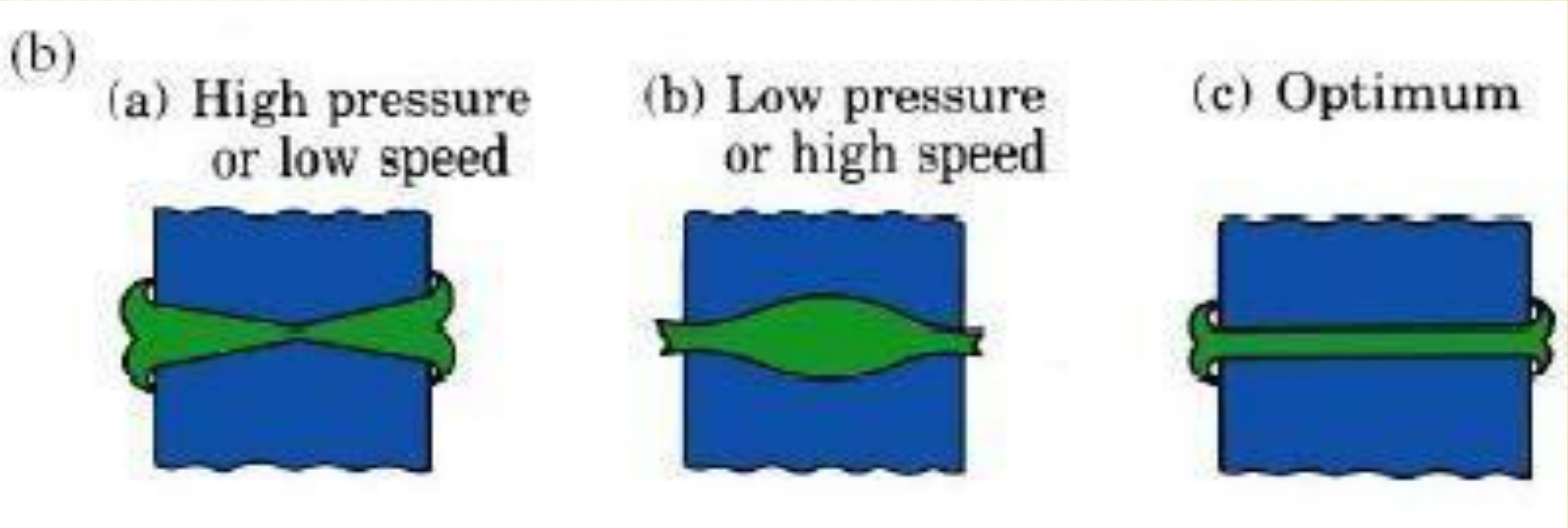


Fig:Shape of friction zone in friction welding,as a function of the force applied and the rotational speed

INERTIA FRICTION WELDING

- Modification of Friction Welding
- Energy is supplied by a fly wheel
- The parts are pressed together by a normal force
- As friction at the interface increases, the fly wheel slows down
- The weld is completed when the flywheel stops

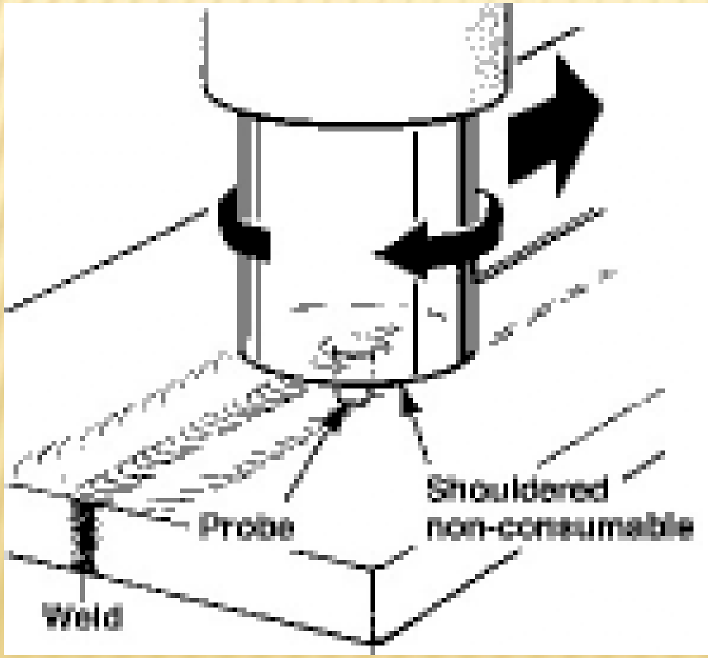


Fig : The principle of the friction stir welding process. Aluminum-alloy plates up to 75mm (3in) thick have been welded by this process

LINEAR FRICTION WELDING

- Parts are joined by a linear reciprocating motion
- Parts do not have to be circular or tubular
- In this application, one part is moved across the face of the other part using a balanced reciprocating mechanism

FRICTION STIR WELDING (FSW)

- New Process for welding aerospace metals
- Research is being directed towards using this process for polymers
- FSW uses a 3rd nonconsumable tool inserted between the two bodies to heat the material to be joined

RESISTANCE WELDING

- Developed in the early 1900's
- A process in which the heat required for welding is produced by means of electrical resistance across the two components
- RW does not **requiring the following**:
  - Consumable electrodes
  - Shield gases
  - Flux

RESISTANCE SPOT WELDING

- RSW uses the tips of two opposing solid cylindrical electrodes
- Pressure is applied to the lap joint until the current is turned off in order to obtain a strong weld

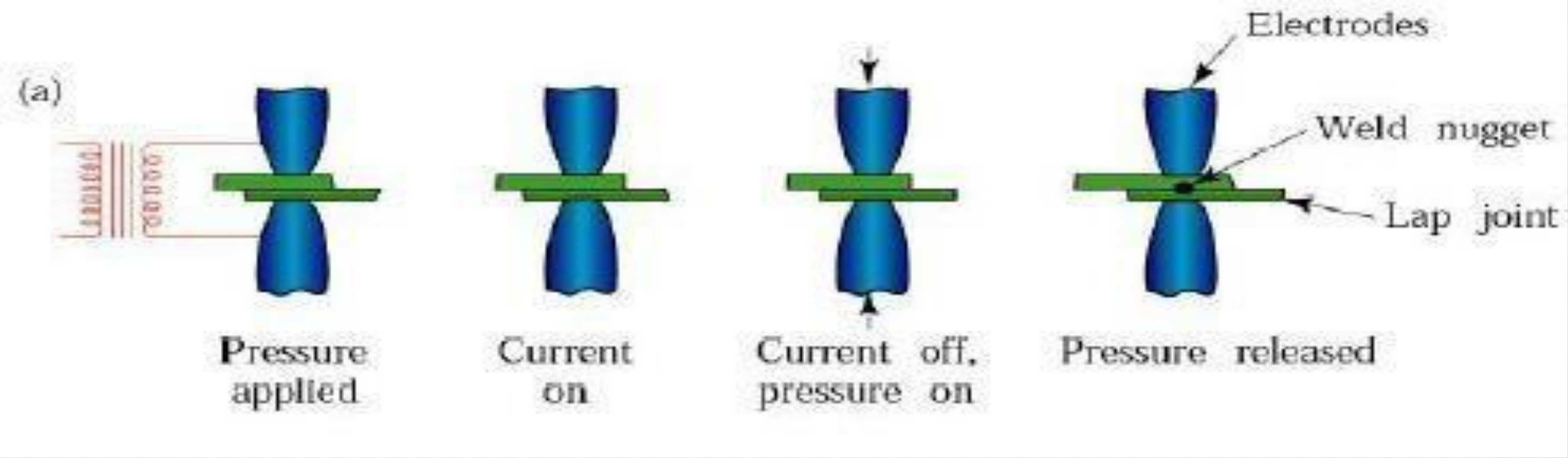


Fig: (a) Sequence in the resistance spot welding

RESISTANCE SPOT WELDING

- Surfaces should be clean
- Accurate control of and timing of electric current and of pressure are essential in resistance welding

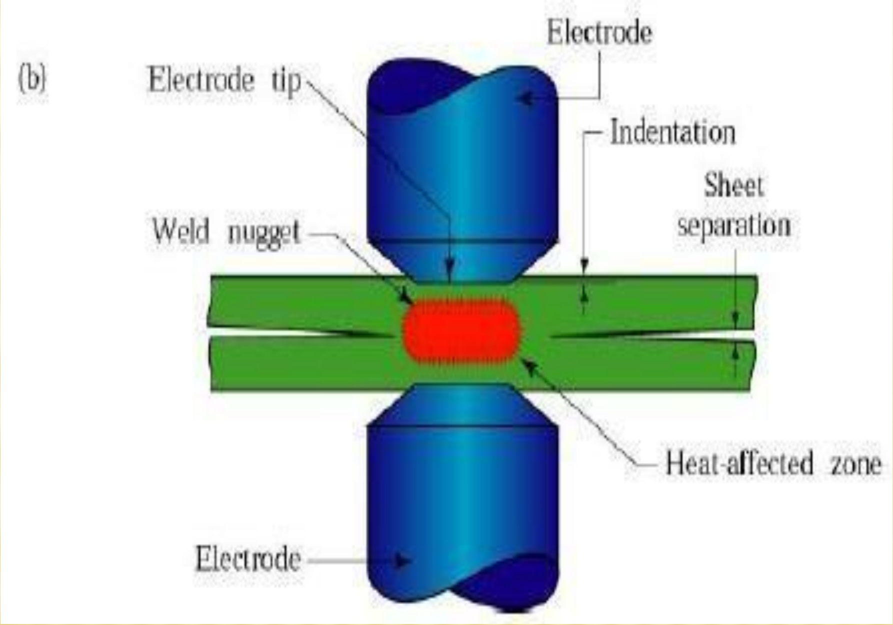


Fig: b)Cross-section of a spot weld,showing the weld nugget and the indentation of the electrode on the sheet surfaces.This is one of the most commonly used process in sheet-metal fabrication and in automotive- body assembly

RESISTANCE SEAM WELDING

- RSEM is modification of spot welding wherein the electrodes are replaced by rotating wheels or rollers
- The electrically conducting rollers produce a spot weld
- RSEM can produce a continuous seam & joint that is liquid and gas tight

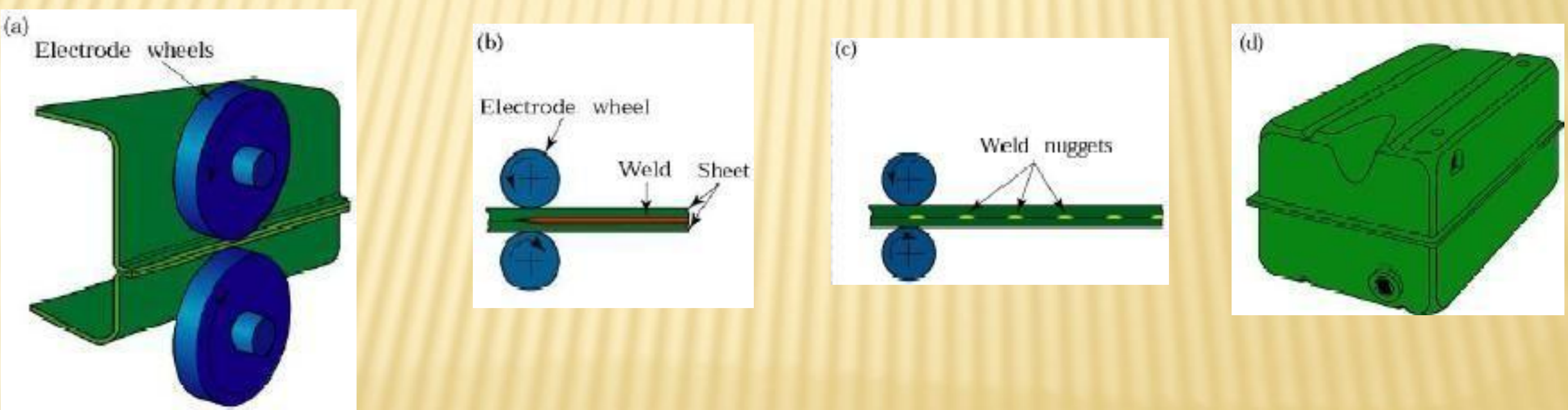


Fig : (a) Seam-Welding Process in which rotating rolls act as electrode (b) Overlapping spots in a seam weld. (c) Roll spot weld (d) Resistance-welded gasoline tank

RESISTANCE PROJECTION WELDING

- RPW is developed by introducing high electrical resistance at a joint by embossing one or more projections on the surface to be welded
- Weld nuggets are similar to spotwelding

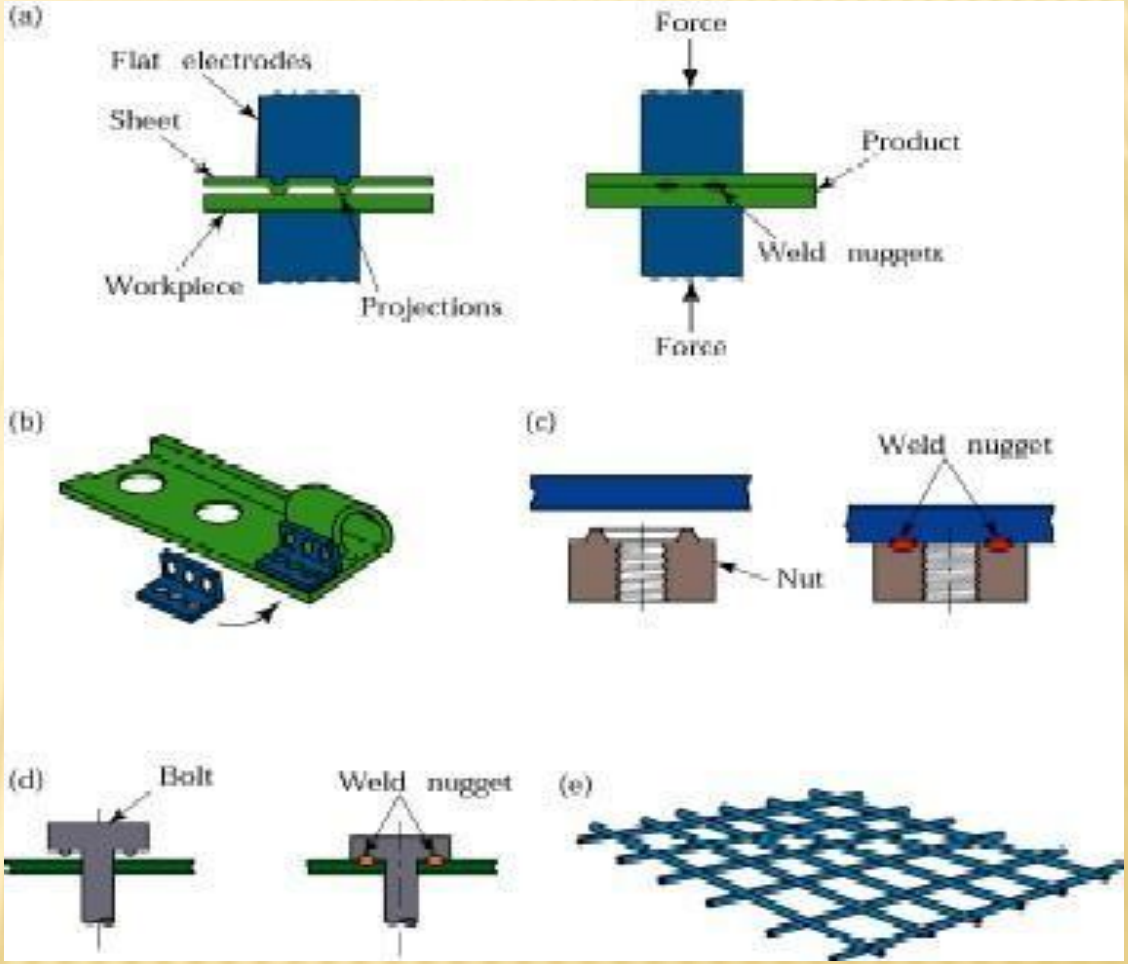


Fig: a) Resistance projection Welding b)A welded bracket c) & d) Projection welding of nuts r

RESISTANCE PROJECTION WELDING

- The electrodes exert pressure to compress the projections
- Nuts and bolts can be welded to sheet and plate by this process
- Metal baskets, oven grills, and shopping carts can be made by RPW

FLASH WELDING

- Heat is generated from the arc as the ends as the two members contacts
- An axial force is applied at a controlled rate
- Weld is formed in plastic deformation

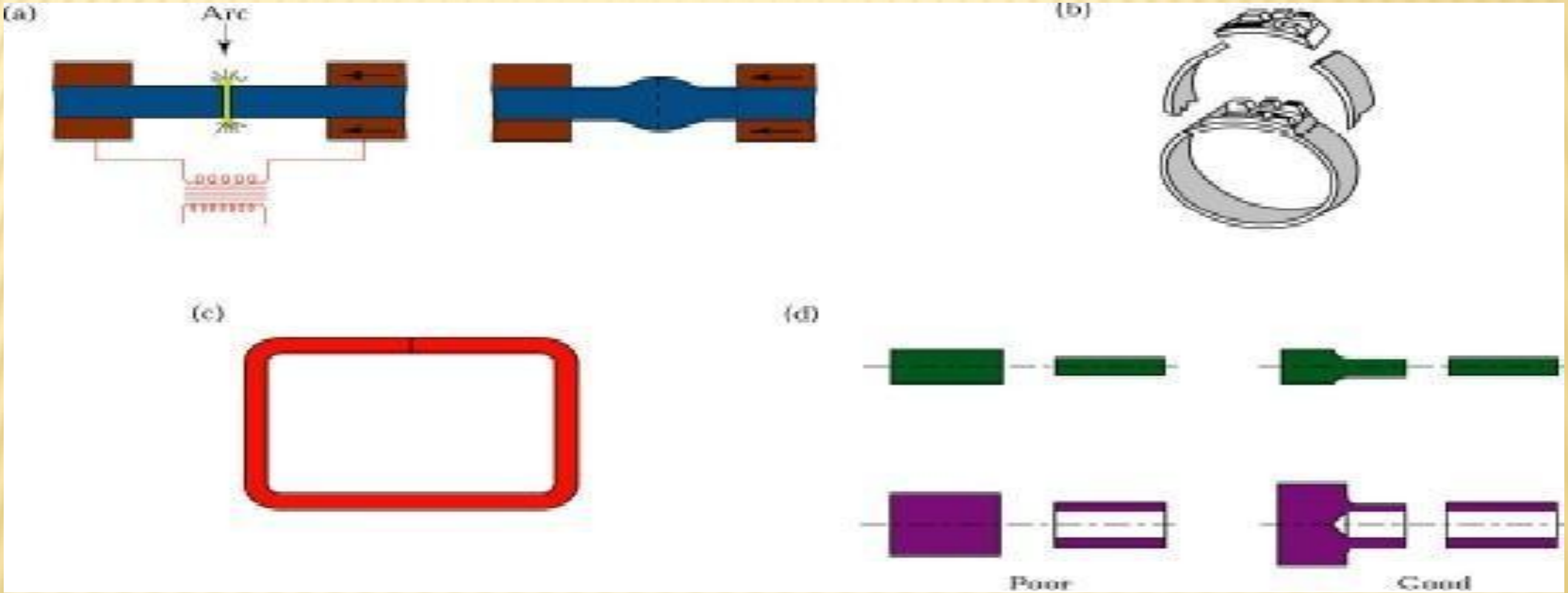


Fig : (a)Flash-welding process for end-to –end welding of solid rods or tubular parts

(b) & (c) Typical parts made by flash welding (d)Design Guidelines

STUD WELDING

- Small part or a threaded rod or hanger serves as a electrode
- Also called as Stud arc welding
- Prevent oxidation to concentrate the heat generation
- Portable stud-welding is also available

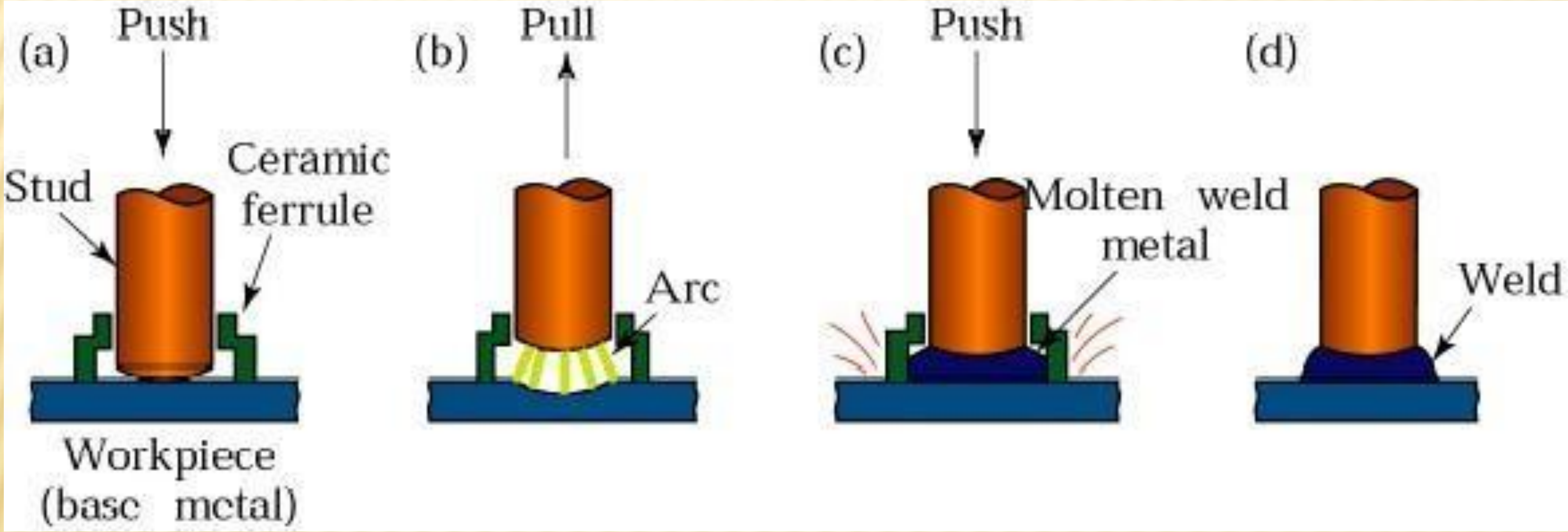


Fig:The sequence of operation in stud welding,which is used for welding bars threaded rods

an

d

UNIT - II

ELECTRIC HEATING AND WELDING

CONTENT

- Types of low intensity discharge lamps
- Colour rendering of low intensity discharge lamps
- Operating principles of low intensity discharge lights
- Control equipment associated with low intensity discharge lights
- Efficacy of low intensity discharge lights
- Common faults in fluorescent lights

TYPES

- Fluorescent
- Low Pressure Sodium Vapour
- Induction Lamps

FLUORESCENT

History

- Worked on by Edison & Tesla in the 1890s
- Daniel Moore worked on Edison's ideas and developed it further up to a working system until in 1904 a number were installed in shops and offices
- General Electric bought the patents in 1912
- 1938 saw GE commercial production of 4 different sizes of lamp

PRINCIPLE OF OPERATION

A vacuum is created inside the tube

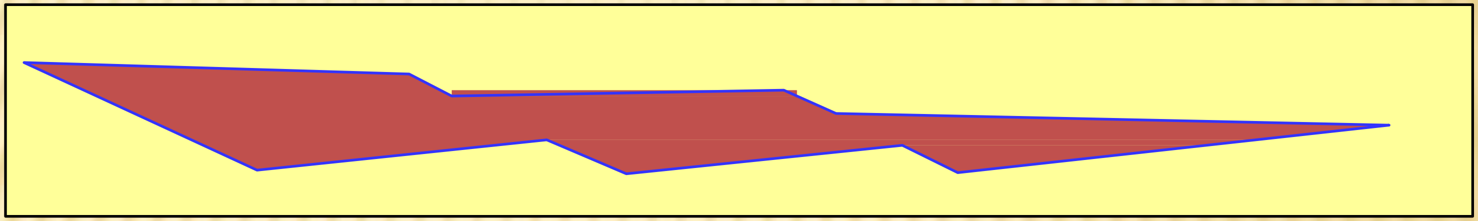
0.3% of the outside Atmosphere

A glass cylinder is filled with

- Mercury Vapour
- Argon
- Xenon
- Neon
- Krypton

PRINCIPLE OF OPERATION

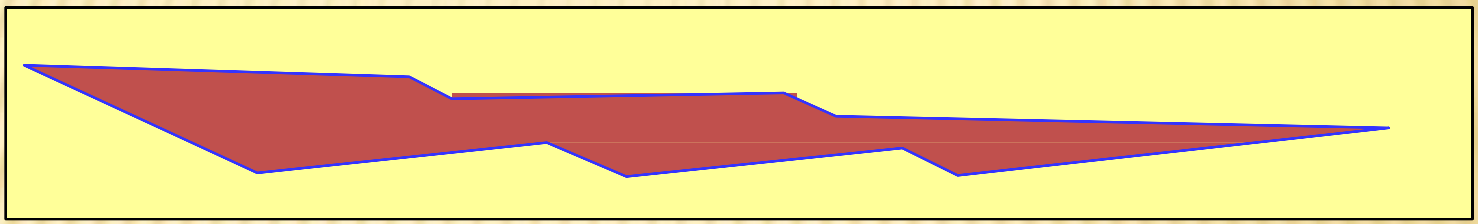
An arc is established between the two ends of the tube through the gas



The current is carried by free electrons and +ions

PRINCIPLE OF OPERATION

An arc is established between the two ends of the tube through the gas



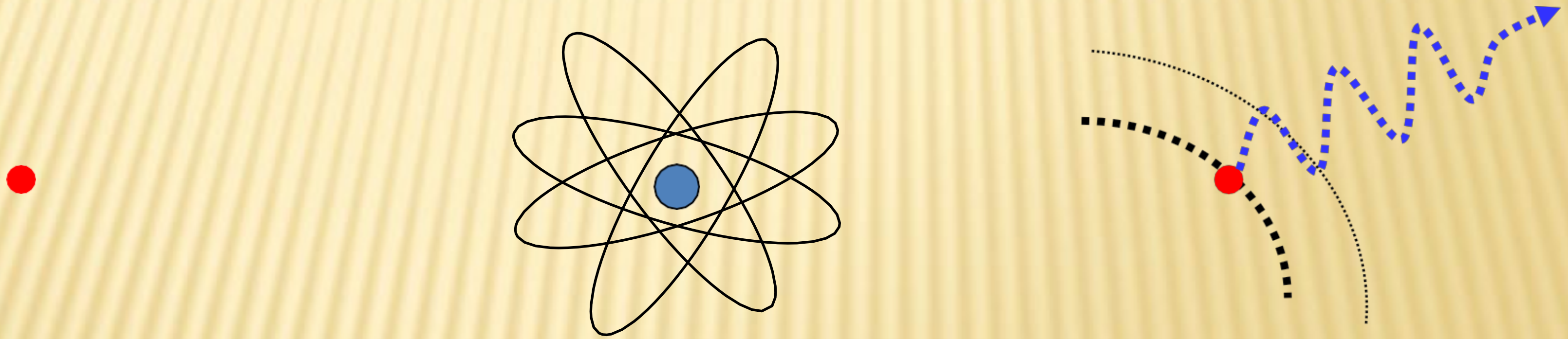
The current is carried by free electrons and +ions

FLUORESCENT

Principle Of Operation

When a free electron hits an atom

One of the outer electrons in the atom is forced to a higher level



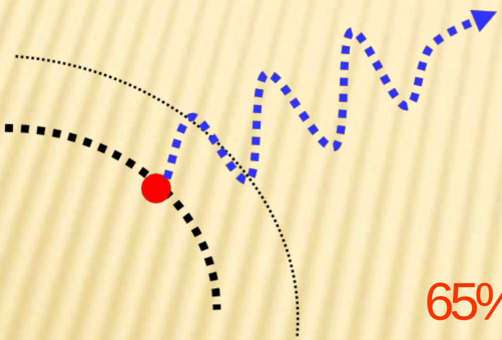
It is unstable and falls back to its original position

The energy released is in the form of a light photon

FLUORESCENT

Principle Of Operation

The wave length can be either



65% • 253.7nm
or
10 – 20% • 185nm

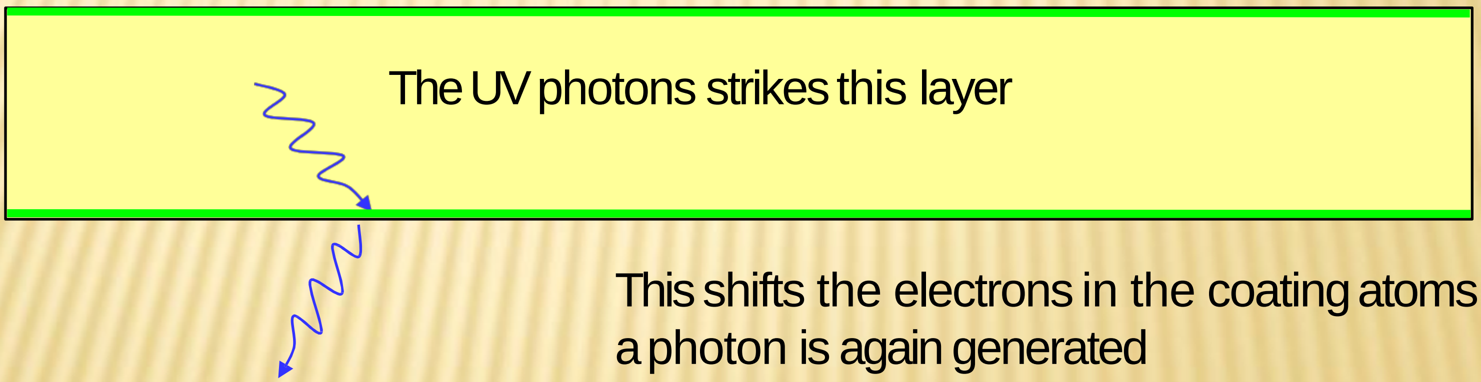
Ultra Violet Spectrum

Invisible to the eye

FLUORESCENT

Principle Of Operation

On the wall of the tube is a mixture of fluorescent & phosphorescent materials



Visible light

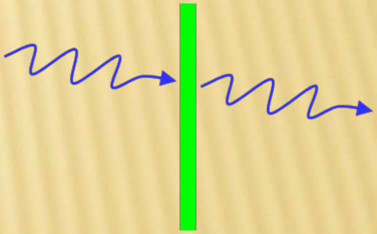
The wave length is dependant on the coating materials used

WHAT'S THE DIFFERENCE BETWEEN

Fluorescent & Phosphorescent Materials

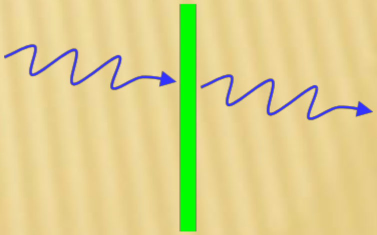
Fluorescent

Only glows when struck by UV light



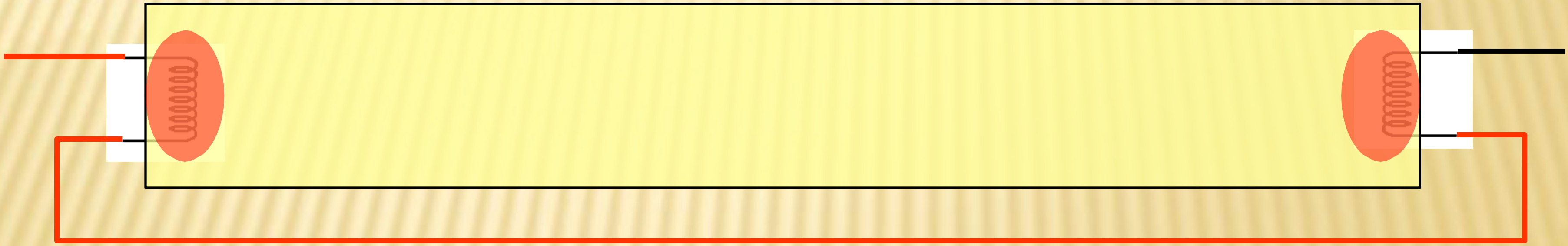
Phosphorescent

Glows when struck by UV light.
As well as
Glows for a period after the removal of UV light



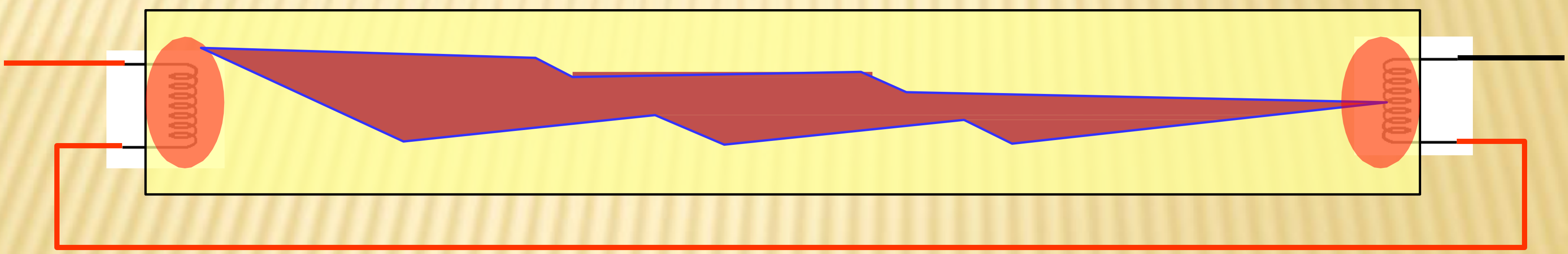
HOW DO WE START A FLUORESCENT TUBE

- Gas is heated by elements at each end of the tube



HOW DO WE START A FLUORESCENT TUBE

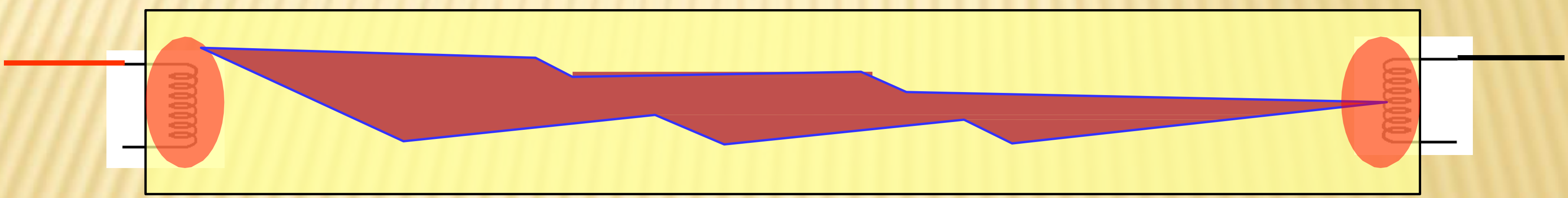
- Gas is heated by elements at each end of the tube
- High voltage is placed across the tube



HOW DO WE START A FLUORESCENT TUBE

How Do We Start A Fluorescent Tube

- Gas is heated by elements at each end of the tube
- High voltage is placed across the tube
- Arc is established and current is controled



HEATING ELEMENTS

- Made of Tunsten
- Electrons are emited from this element
- The electrons collide with and ionize the gas atoms in the bulb surrounding the filament to form a plasma
- As a result of avalanche ionization, the conductivity of the ionized gas rapidly rises, allowing higher currents to flow through the lamp



HEATING ELEMENTS

- To aid the emission of electrons the elements are coated with
  - Barium
  - Strontium
  - Calcium Oxides
- This reduces the thermionic emission temperature

How Do We Create A High Voltage

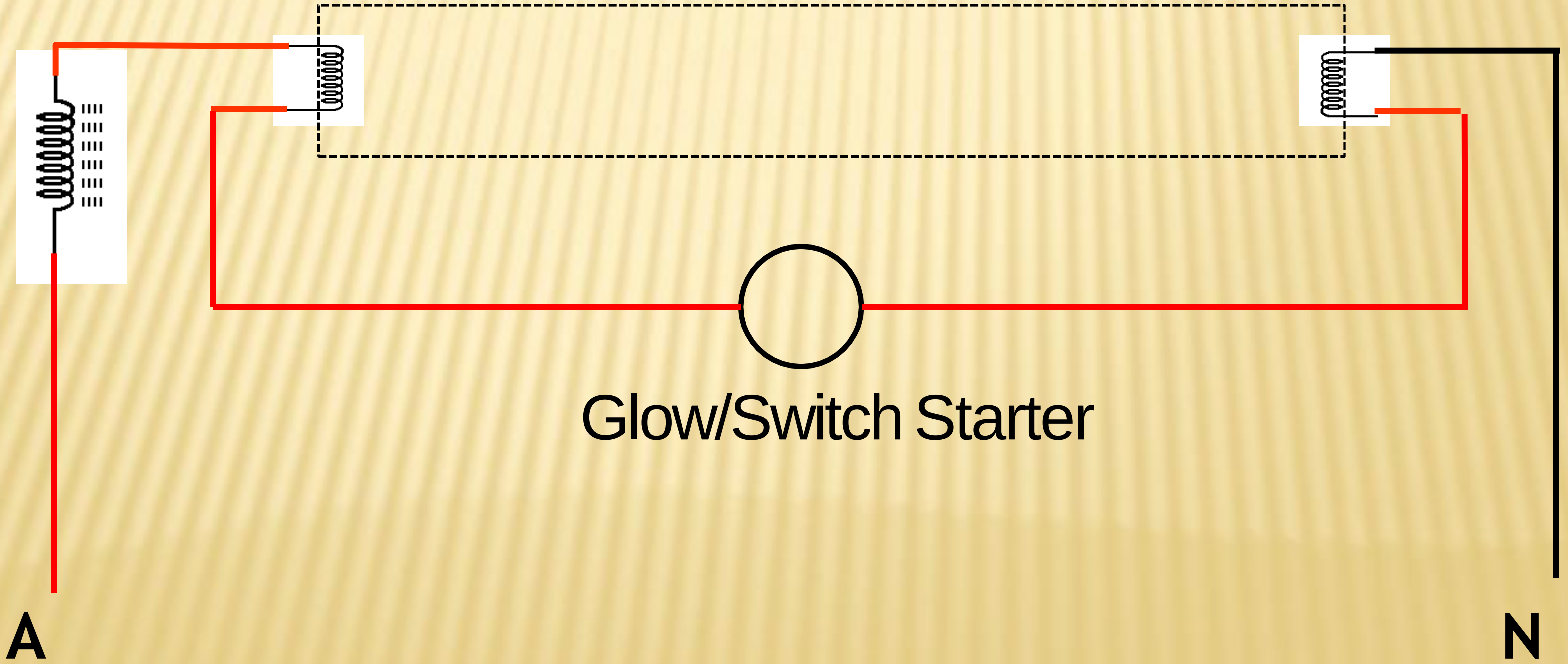
Mostly comes from a back emf generated by a coil when switched off

HOW DO WE CONTROL THE CURRENT?

- Tube exibits a Negative Differential Resistance
- If connected directly to the mains would rapidly self distruct
- Constant current source to regulate the current flow through the tube usually in the form of an inductor (Ballast)

FLUORESCENT CONTROL CIRCUIT

Fluorescent Control Circuit



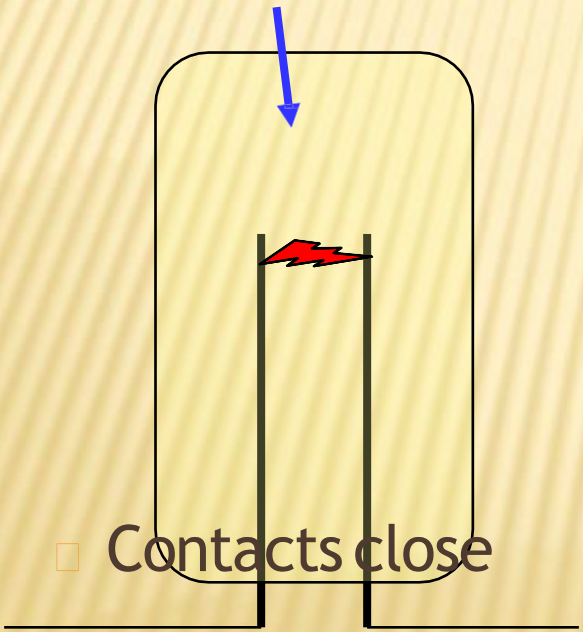
FLUORESCENT STARTERS

Fluorescent Starters

How The Work

FLUORESCENT STARTERS

Glass Envelope filled with Neon Gas



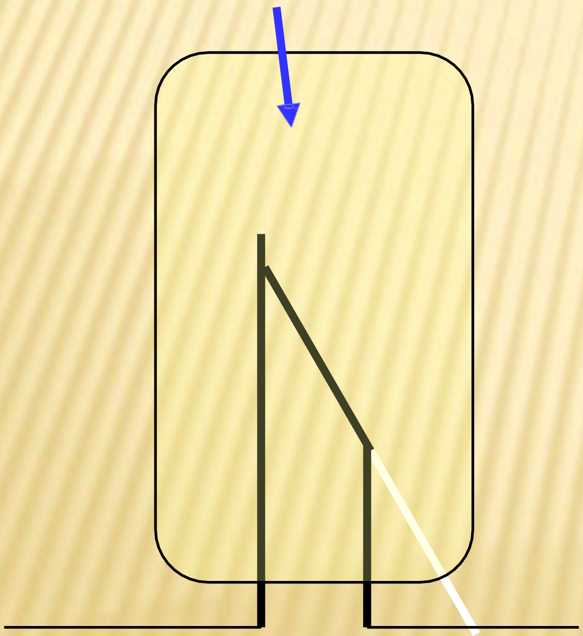
- Power applied to light fitting
- Current passes through heating elements
- Current jumps across gas in starter
- Heat of arc bends bimetalstrip
- Contacts close

Fluorescent Starters

FLUORESCENT STARTERS

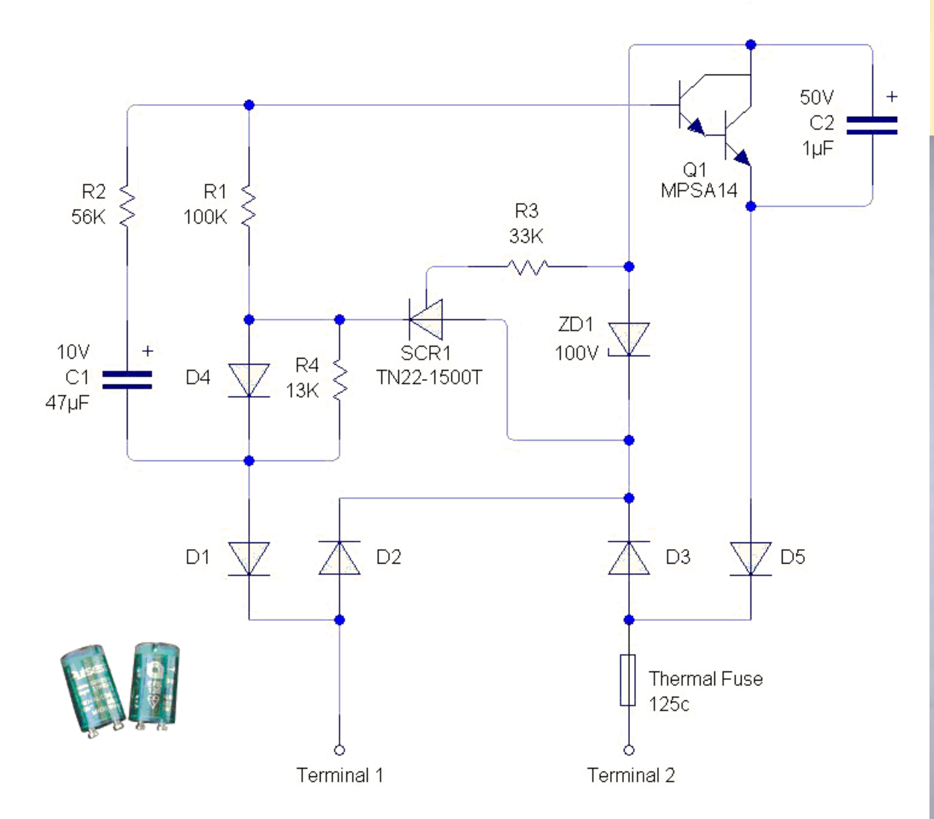
How Th e Wo k

Glass Envelope filled with Neon Gas

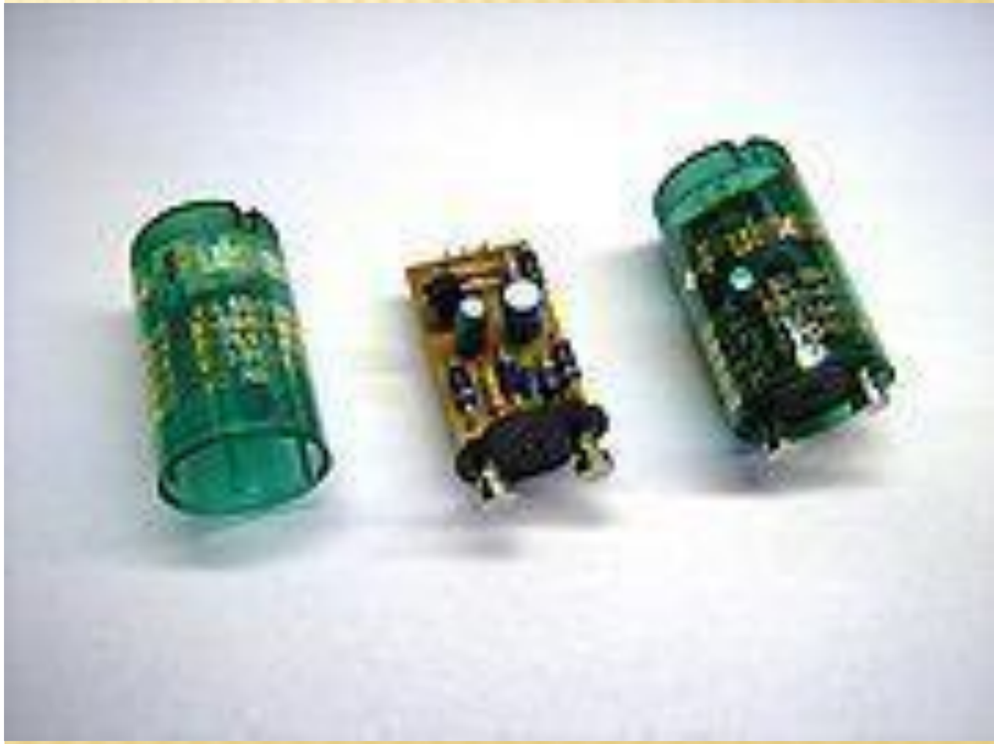


- Power applied to light fitting
- Current passes through heating elements
- Current jumps across gas in starter
- Heat of arc bends bimetalstrip
- Contacts close
- Bimetal strip cools
- Contacts snap open
- open circuiting supply tofitting

ELECTRONIC STARTERS



Arlen EFS-120 "Pulsestarter"



BALLAST

- Provides the high voltage kick in a switch start system
- Limits current when tube running
- Consumes (Wastes) 12% and 15% of input
- Being replaced with electronic ballasts
- With the addition of a filament transformer can be dimmed

ELECTRONIC BALLASTS

- More efficient 5% and 8%
- Operates the lamp at higher frequencies (20-40kHz)
- Less lamp flicker
- Faster start as a HV spike happens more often
- Can have the option to dim the lamp as low as 10%

OTHER FLUORESCENT TUBES

- Previous example is of a hot Cathode tube
  - Thermionic emission Lamps
    - Preheat Starting System

OTHER FLUORESCENT TUBES

Cold Cathode

Electrons are liberated only by the level of potential difference provided

i.e. operate at a very high voltage

- Cathodes are operated below their thermionic emission temperature
- Have no thermionic emission coating to wear out,
- Have much longer lives than is commonly available with thermionic emission tubes.
- Generally less efficient than thermionic emission lamps
- Can be instantly switched on/off.

OTHER FLUORESCENT TUBES

Rapid Start

Special Ballast Required

- Ballast provides filament power windings within the ballast
- Rapidly and continuously warm the filaments/cathodes using low-voltage AC
- No inductive voltage spike is produced for starting
- Lamps must be mounted near a grounded (earthed) reflector to allow the glow discharge to propagate through the tube and initiate the arc discharge
- May have "starting aid" strip of grounded metal is attached to the outside of the lampglass.

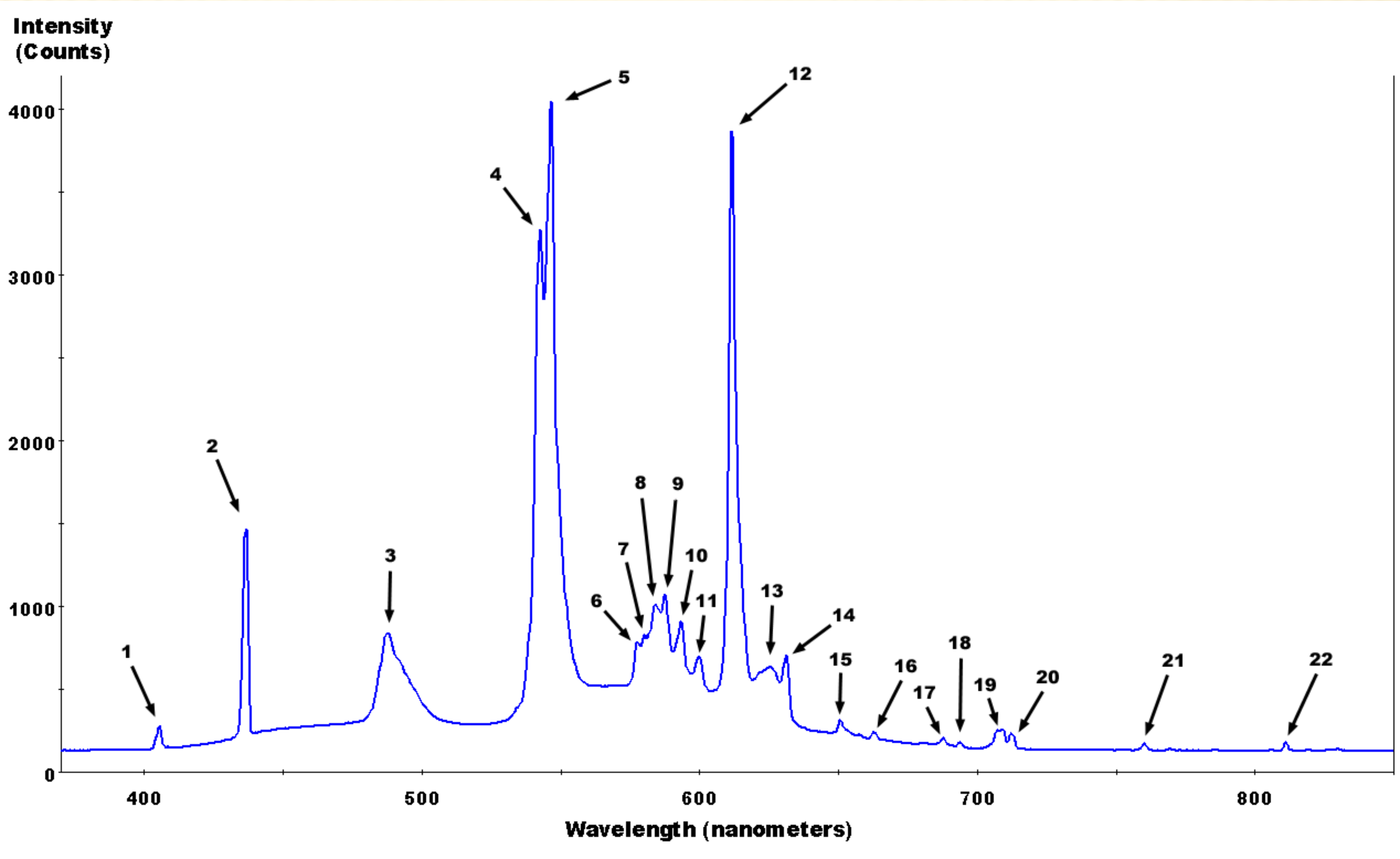
COLOUR SPECTRUM OF A TYPICAL FLUORESCENT TUBE

Colour Spectrum Of A Typical Fluorescent Tube

Combination of light directly emitted by:

- Mercury vapor
- Phosphorescent coating

Colour Spectrum Of A Typical Fluorescent Tube



COLOUR RENDERING OF FLUORESCENTS

The ability of the applied light to make the object appear as if it was viewed in normal sunlight

COLOUR RENDERING OF FLUORESCENTS

Daylight and, an incandescent lamp
CRI = 100%

- Fluorescent lamps CRI Range from 50% to 99%.
- Low CRI have phosphors which lack red light
- Skin appears less pink, and hence "unhealthy" compared with incandescent lighting.
- For example, a tube with a CRI = 50%, 6800 K will make reds appear brown.
- 1990s, higher quality fluorescent lamps use a *triphosphor* mixture, based on europium and terbium ions
- Have higher CRIs of typicaly 82 to 100%
- more natural color reproduction to the human eye

LUMINOUS EFFICACY

- Fluorescent lamps convert more of the input power to visible light than incandescent lamps.
- 100 W incandescent lamp may convert only 2% of its power input to visible white light
- fluorescent lamps convert about 22% of the power input to visible white light
- 50 to 67 lm/W
- Electronic ballast gives about 10% efficacy improvement over an inductive ballast
- Fluorescent lamp efficacy is dependent on lamp temperature
- The ideal temperature for a T8 lamp is 25 °C
- T5 lamp = 35 °C

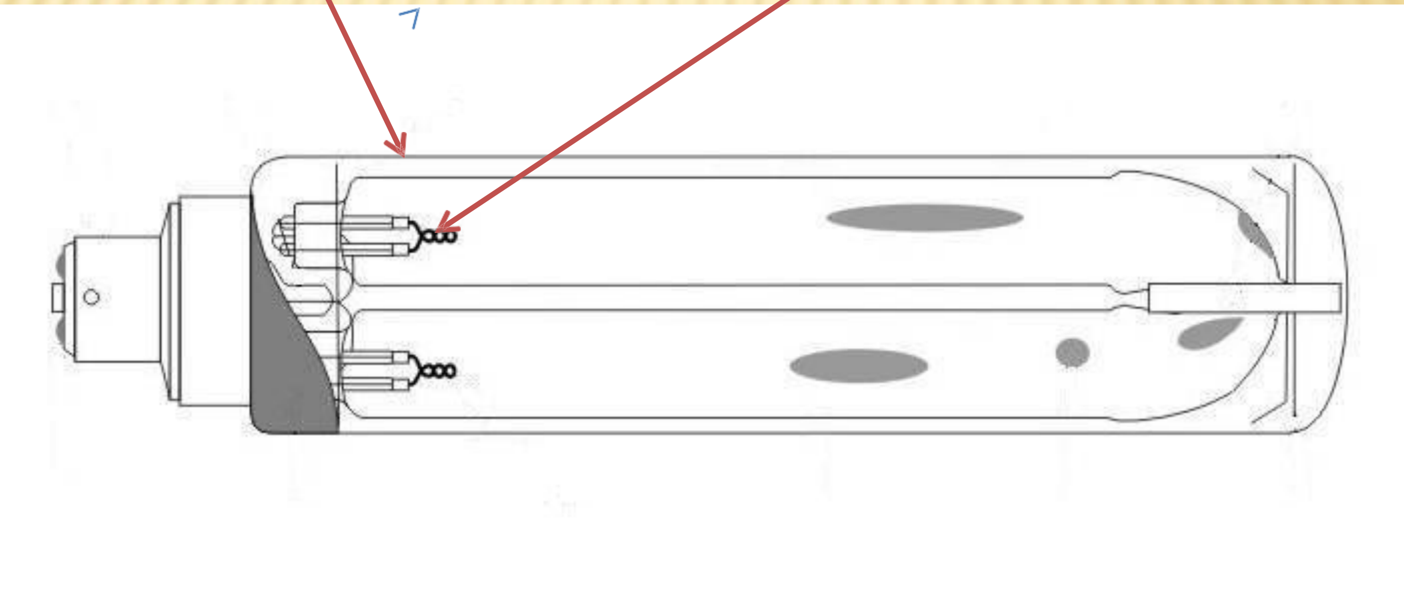
LOW PRESSURE SODIUM VAPOUR

- Low pressure sodium (LPS)
- Sodium Oxide (SOX)

LOW PRESSURE SODIUM VAPOUR

Outer envelope coated with an infrared reflecting layer of indium tinoxide

Cathode Same as A fluorescent (made from coated tungsten

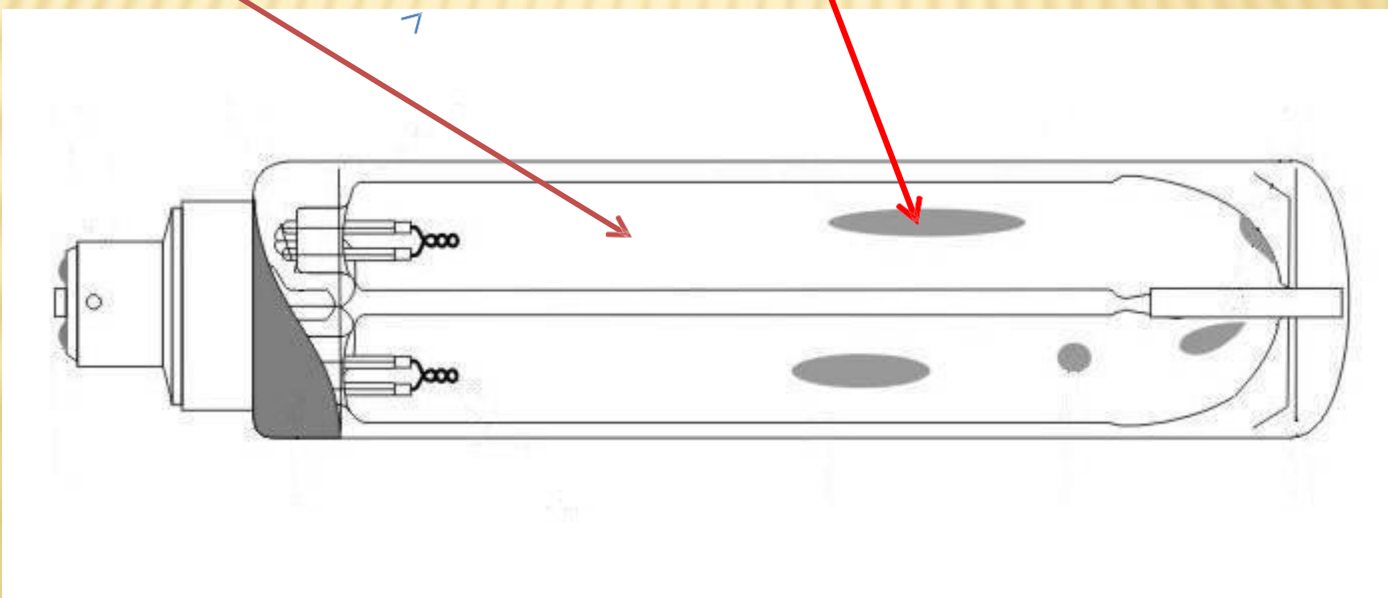


LOW PRESSURE SODIUM VAPOUR

Low Pressure Sodium Vapour

Sodium only vaporises when pressure and temperature builds

Discharge Tube

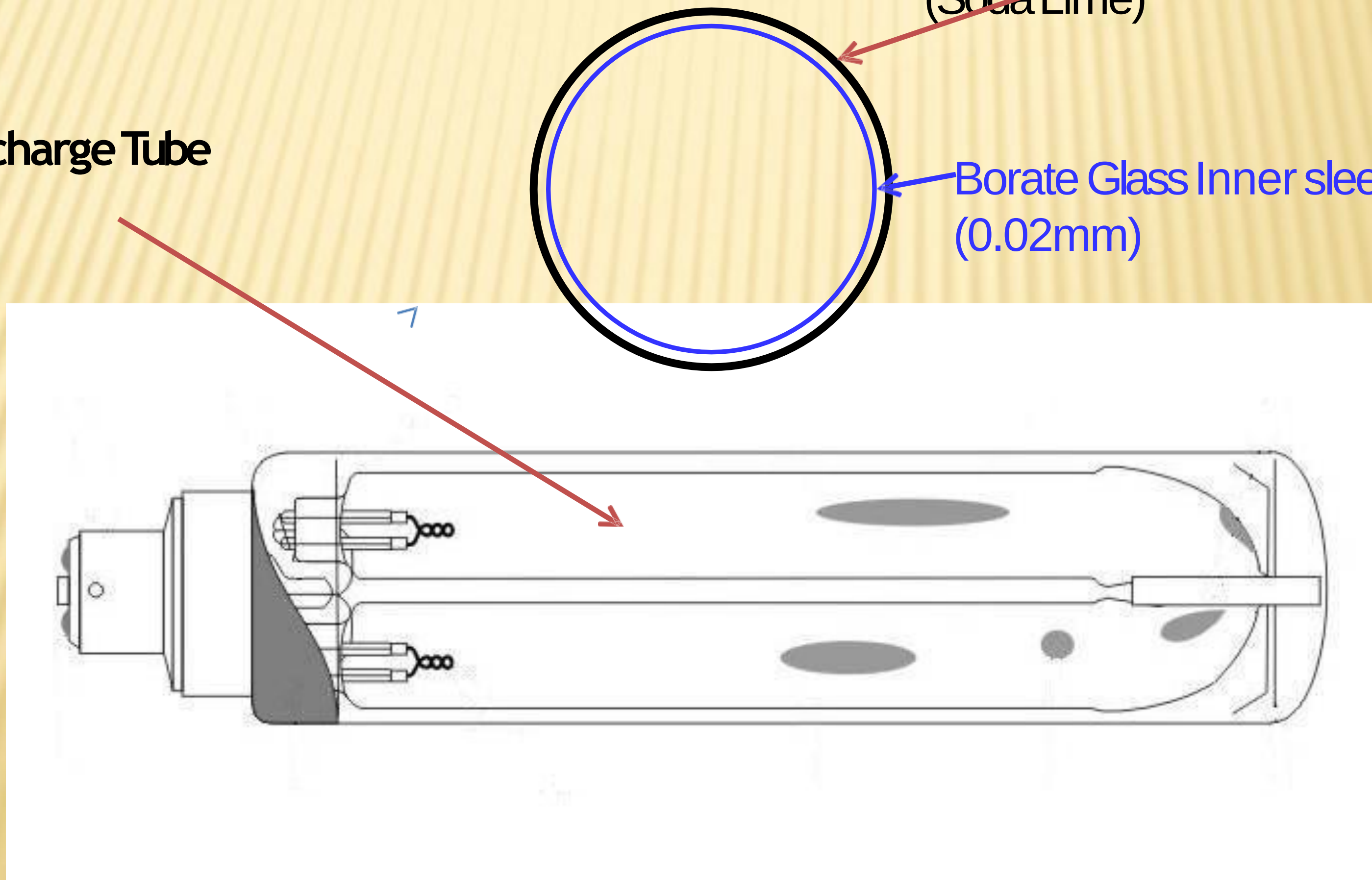


LOW PRESSURE SODIUM VAPOUR

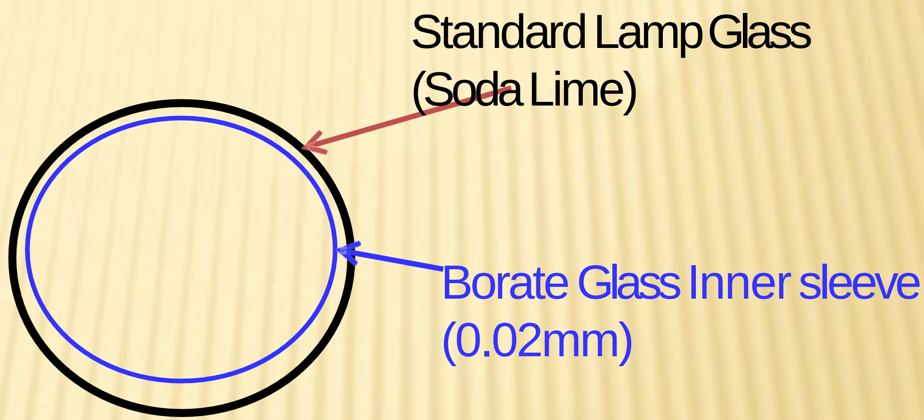
Standard Lamp Glass (Soda Lime)

Borate Glass Inner sleeve (0.02mm)

Discharge Tube



LOW PRESSURE SODIUM VAPOUR



- At operating temperature the Sodium reacts with ordinary glass tuning it brown
- Stained and unstained areas have different operating temperatures
- The differences in temperatures will cause ordinary glass to crack

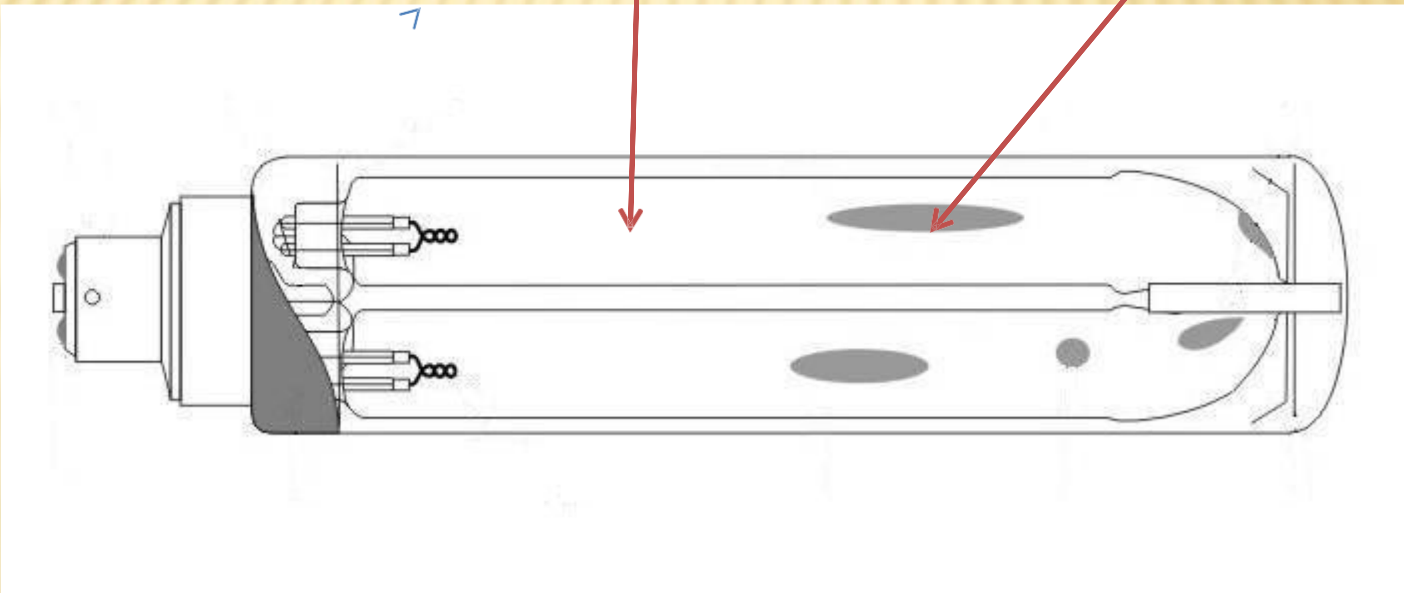
Borate glass

- Does not react as much and has with the sodium
- Has a very low rate of thermal expansion
- “Short Glass” short working temperature range
- Used to line standard glass (then easer to work with)

LOW PRESSURE SODIUM VAPOUR

Sodium only vaporiseswhen pressure and temperature builds

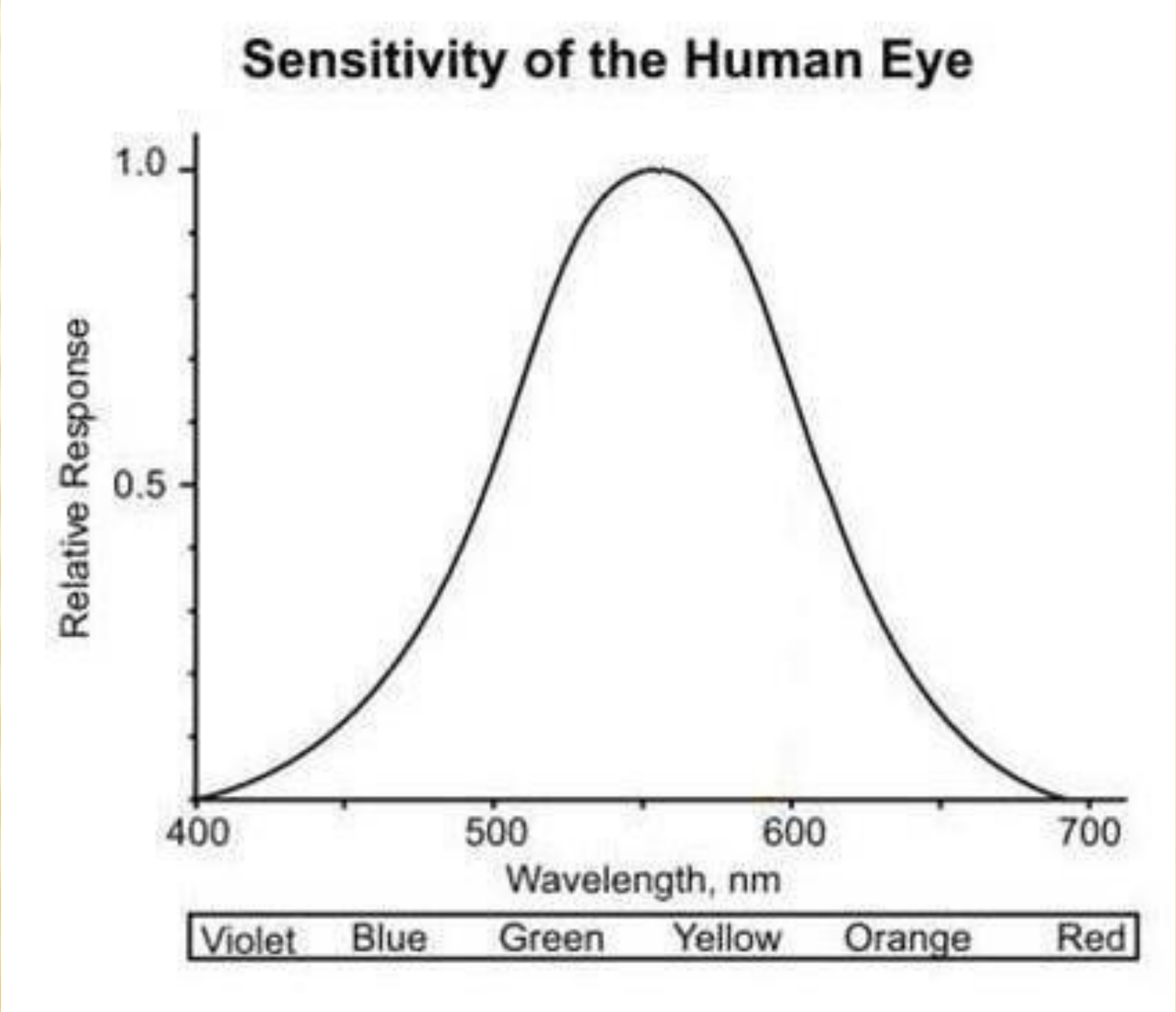
Discharge Tube



(monochromatic).

LOW PRESSURE SODIUM VAPOUR

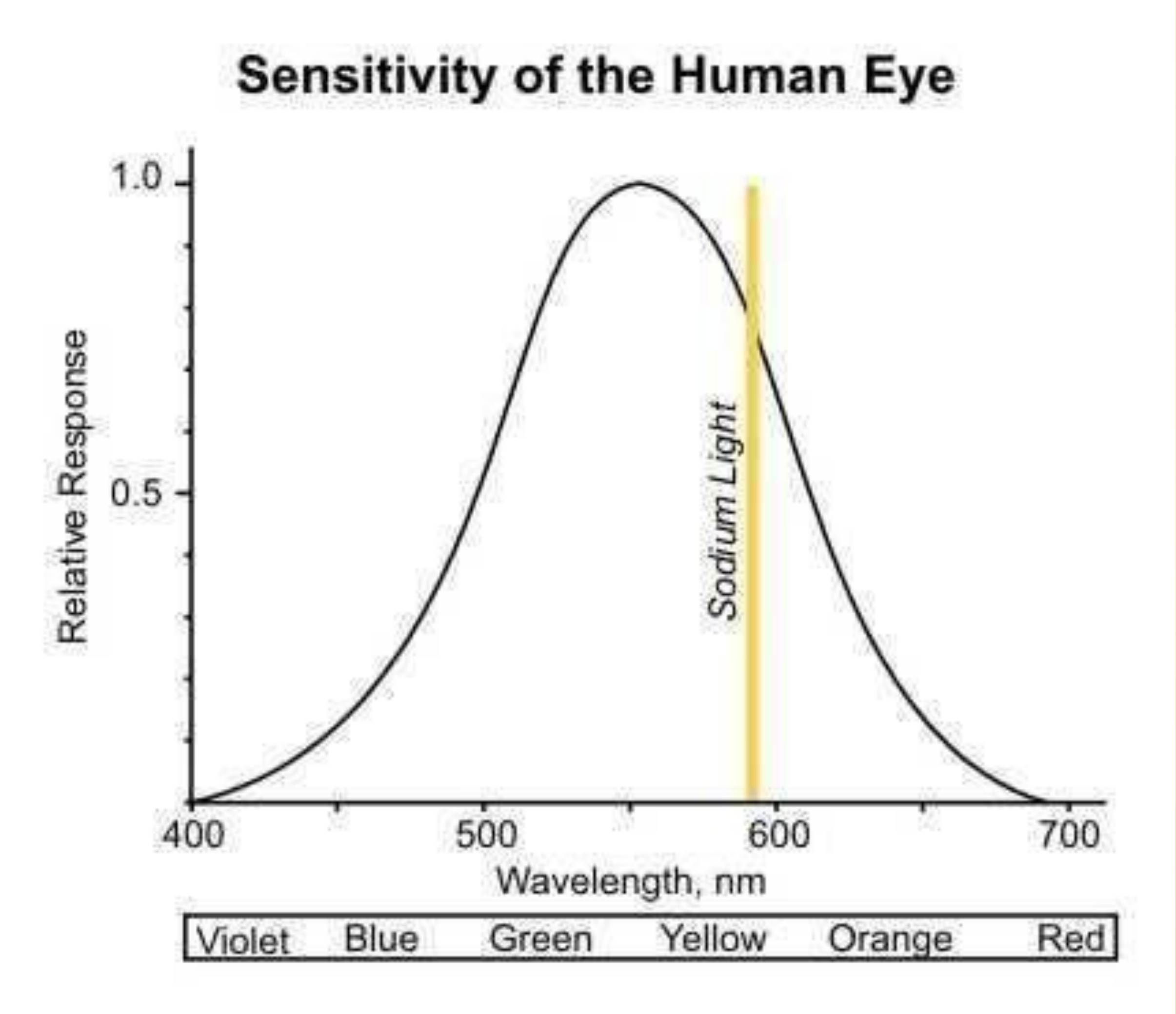
Low Pressure Sodium Vapour



(monochromatic).

Monochromatic

LOW PRESSURE SODIUM VAPOUR



LOW PRESSURE SODIUM VAPOUR

- Strike voltages as high as 23kV are required to restart a hot lamp
- Once an arc has been struck the ionised gas becomes a conductor with a resistance often lower than 100 Ω.
- The voltage across the lamp must be reduced to around 100V
- Up to 80% efficient in turning light into electricity
- Physically big bulbs

LOW PRESSURE SODIUM VAPOUR

Low Pressure Sodium Vapour

- Striking voltage is not sensitive to temperature
- Lamp will restrike as soon as the power is restored and no cooling down time is required
- The burning position is generally confined to the horizontal position ±20°
- No colour rendering is possible every colour to either yellow or muddy brown

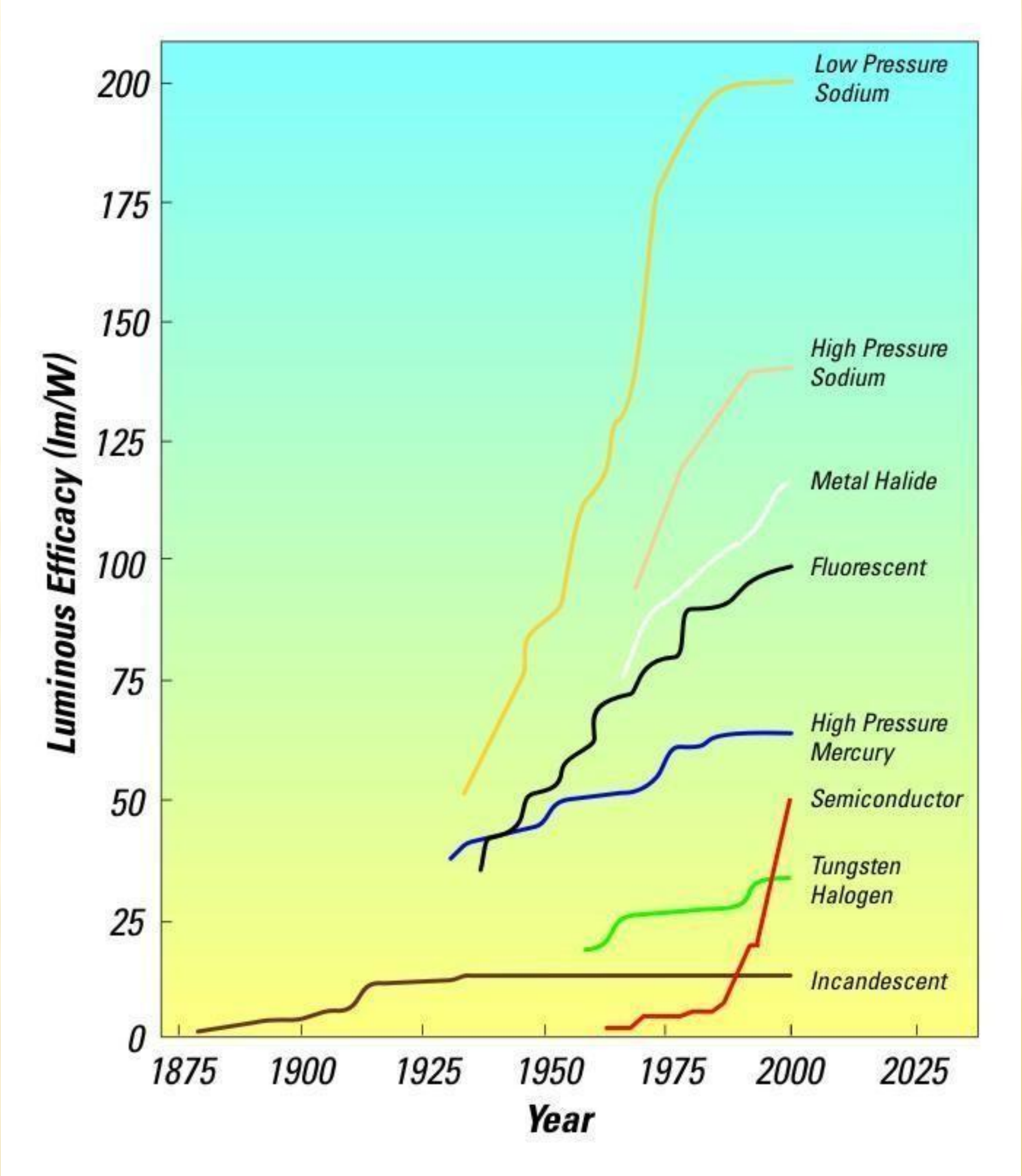
LOW PRESSURE SODIUM VAPOUR

Low Pressure Sodium Vapour

	Ra
Incandescent Lamp	100
Florescent Lamps	
Colour 33	65
Colour 54	72
Colour 83	86
Colour 93	93
Low Pressure Sodium	**-44**
High Pressure Sodium	26
High Pressure Mercury	45
Metal Halide	70

LOW PRESSURE SODIUM VAPOUR

- Rated life is shorter than other types of discharge lamps
  - SOX18 – 14,000 hours
  - Other Discharge lamps – 18,000 hours
- 100 to 200lm/W
- Wires or conductive coatings around the arc tube can assist with starting

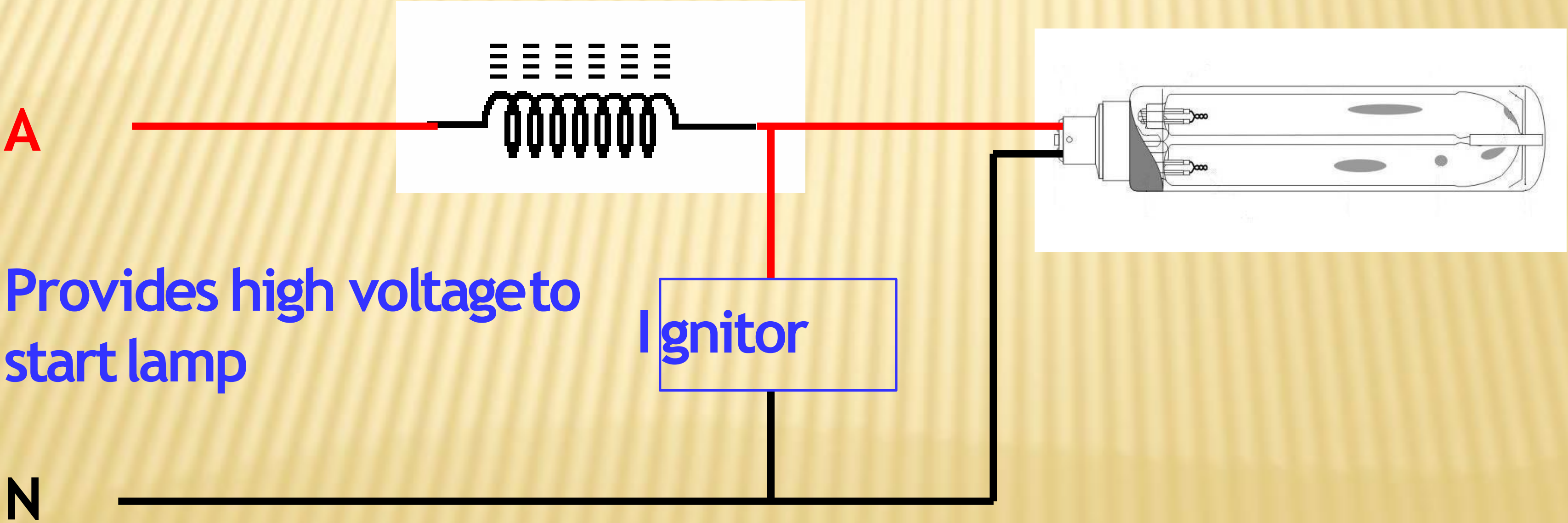


Low Pressure Sodium
High Pressure Sodium
Metal Halide
Fluorescent
High Pressure Mercury
Semiconductor
Tungsten Halogen
Incandescent
Luminous Efficacy (lm/W)
0
25
50
75
100
125
150
175
200
1875
1900
1925
1950
1975
2000
2025
Year

LOW PRESSURE SODIUM VAPOUR

Control Equipment

Limit current when operating



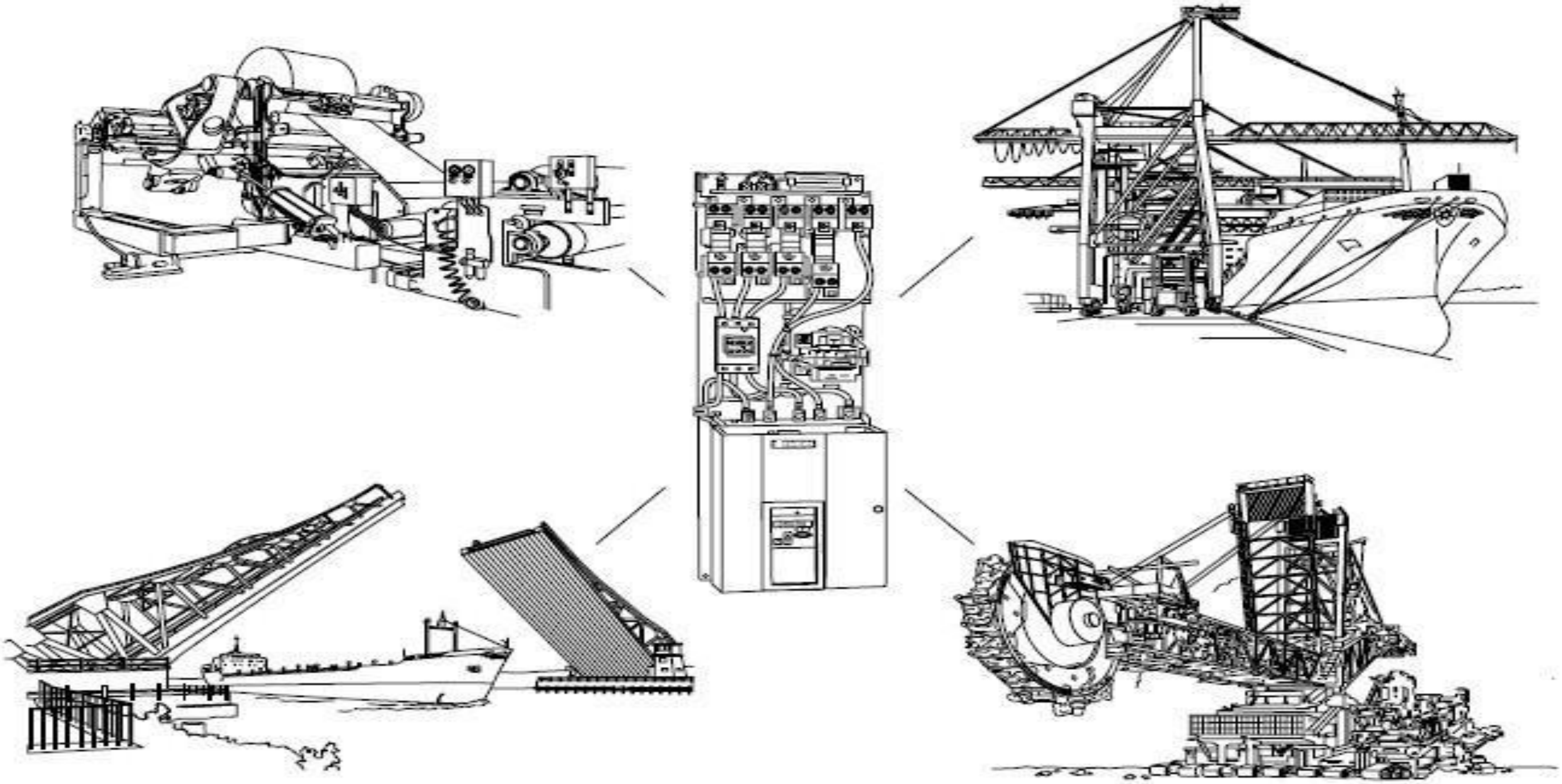
Provides high voltage to start lamp

UNIT-IV
ELECTRIC TRACTION-I

INTRODUCTION:

- The locomotion in which the driving force is obtained from electric motor is called the electric traction system.
- There are various system of electric traction existing such as electric train, trolley buses, diesel-electric vehicles and gas turbine electric vehicles

ELECTRIC TRACTION SYSTEM



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MAJOR CLASSIFICATIONS OF TRACTION

- Non-electric traction:
  examples
    steam engine drive
    ic engine drive
- Electric traction:
  examples
    diesel electric drive
    gas turbine electric drive

REQUIREMENTS OF AN IDEAL TRACTION SYSTEM

- The starting tractive effort should be high so as to have rapid acceleration.
- The wear on the track should be minimum.
- The equipments should be capable of withstanding large temporary loads.
- Speed control should be easy.
- Pollution free.
- Low initial and maintenance cost.
- The locomotive should be self contain and able to run on any route.

MERITS OF ELECTRIC TRACTION

- High starting torque.
- Less maintenance cost
- Cheapest method of traction
- Rapid acceleration and braking
- Less vibration
- Free from smoke and flue gases hence used for underground and tubular railway.

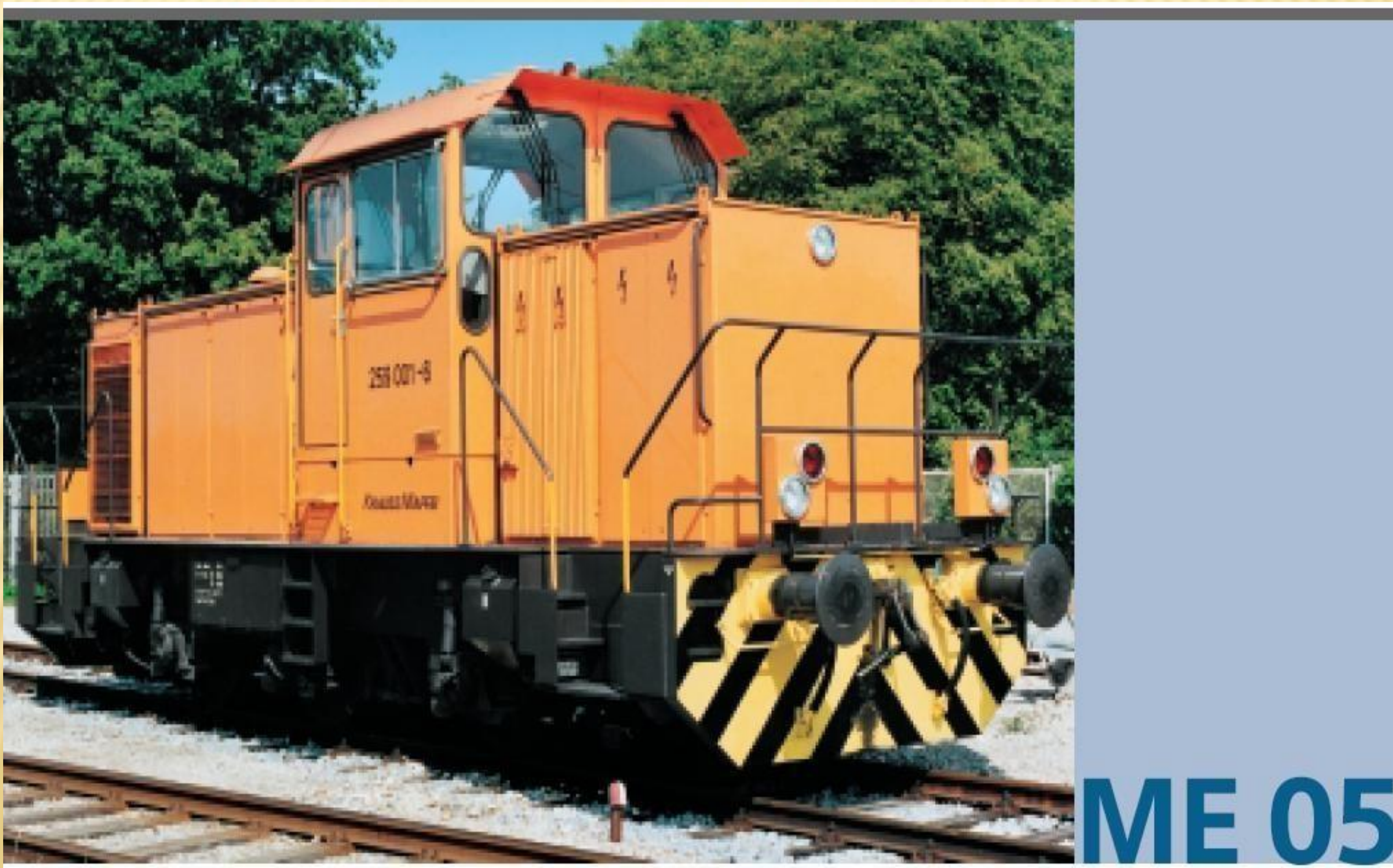
DEMERITS OF ELECTRIC TRACTION

- High capital cost.
- Problem of supply failure.
- The electrically operated vehicles have to move on guided track only.
- Additional equipment is required for achieving electric braking and control.

DIFFERENT SYSTEMS OF TRACTION:

- Direct steam engine drive
- Direct IC engine drive
- Steam electric drive
- IC engine electric drive
- Petrol electric traction
- Battery electric drive
- Electric drive

IC ENGINE ELECTRIC DRIVES



SUPPLY SYSTEMS FOR ELECTRIC TRACTION:

- D.C system
- A.C system
  - Single phase
  - Three phase
- Composite system
  - Single phase AC to DC
  - Single phase to three phase

SPEED TIME CURVE FORTRAIN MOVEMENT

- Acceleration
  - Constant acceleration
  - Speed curve running
- Free run or constant speed period
- Coasting period
- Retardation or braking period

TYPICAL SPEED TIME CURVES FOR DIFFERENT SERVICES

- Urban or city services
- Sub urban services
- Main line services

TYPES OF SPEED IN TRACTION

- crest speed
- Average speed
- Schedule speed

FACTORS AFFECTING ENERGY CONSUMPTION

- Distance between the stops.
- Train resistance
- Acceleration and retardation.
- Gradient
- train equipment.

TRACTION MOTORS

- DC series motor
- Ac series motor
- Three phase induction motor

TRACTION MOTOR ELECTRICAL FEATURES

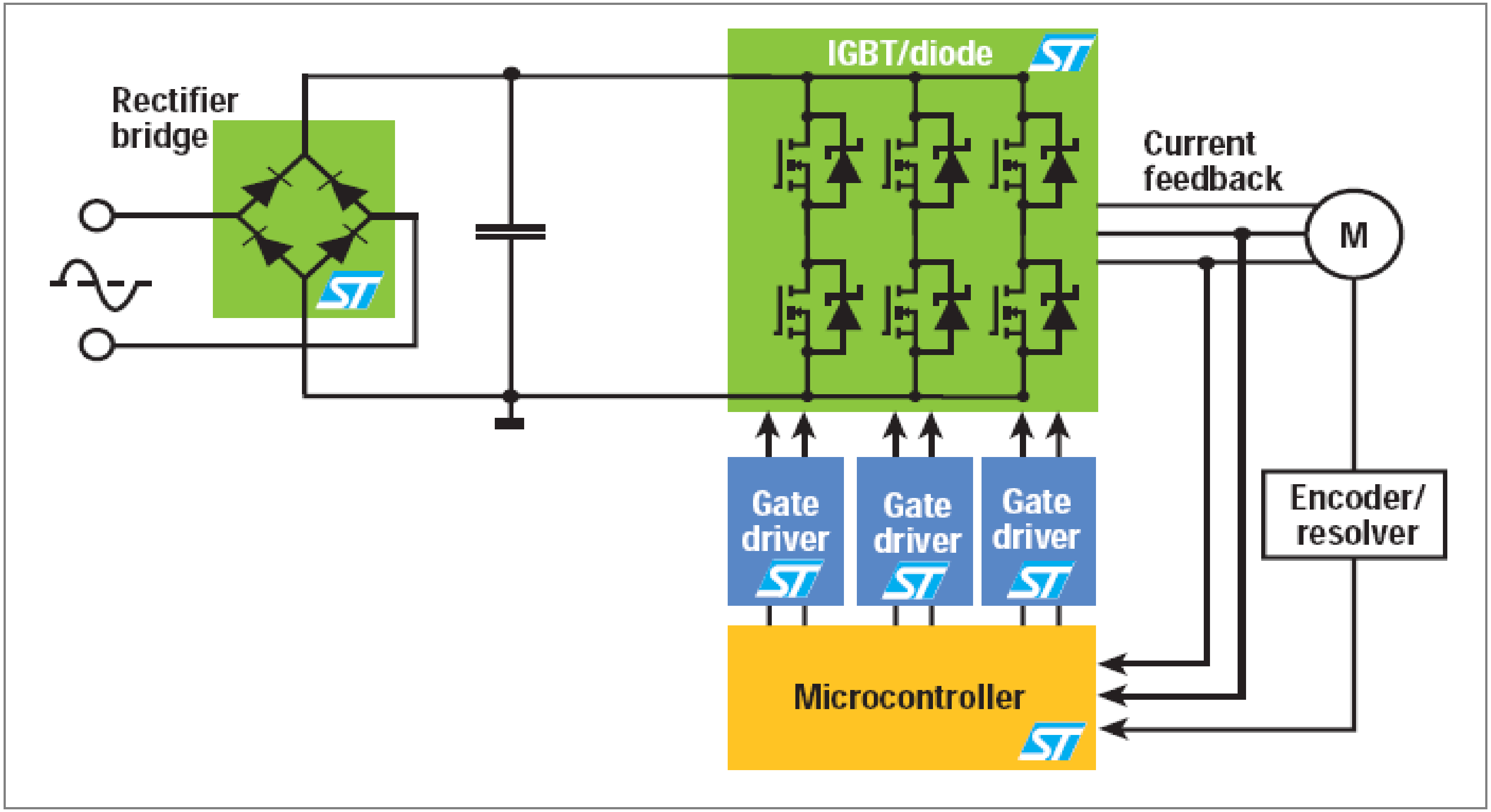
- High starting torque
- Simple speed control
- Regenerative braking
- Better commutation
- Capability of withstanding voltage fluctuations.

MECHANICAL FEATURES

- Light in weight.
- Small space requirement.
- Robust and should be able to withstand vibration.

UNIT-V
ELECTRIC TRACTION-II

MICRO PROCESSOR CONTROL



High-frequency vector three-phase induction motor drive

TRACTION MOTOR CONTROL

- Rheostat control
- Series parallel control
- Field control
- Buck and boost method
- Metadyne control
- Thyristor control
  - Phase control
  - Chopper control

BRAKING

<u>ELECTRIC BRAKING</u>

- Plugging or reverse current braking
- Rheostatic braking
- Regenerative braking
  - DC shunt motor
  - DC series motor
  - Induction motor

<u>MECHANICAL BRAKING</u>

- Compressed air brakes
- Vacuum brakes

RECENT TRENDS IN ELECTRIC TRACTION

- Tap changer control
- Thyristor control
- Chopper control
- Micro processor control


Thank you!