

## D.C Motor Starters

### Starters :-

- The starter is nothing but a variable resistance device, which is connected in a series.
- Starters are used to protect DC motor from damage that can be caused by very high current during start up

### Necessity Of Starter

- In a DC motor the value of armature current

$$I_a = \frac{V - E_b}{R_a}$$

- When the motor is in off condition, the armature is stationary and the back emf ( $E_b$ ) which is proportional to speed is zero.
- In motor armature resistance is very low.
- If the rated voltage is applied to the armature, it will draw heavy current many times that of full load current.

- And there is more possibility of damaging the brushes, commutator and windings.
- Consider a case of a 440 V, 5 H.P motor having a cold armature resistance of 0.25 ohm and a full-load current of 50 A. If the motor is started from the line directly, it will draw a starting current from the line directly, it will draw a starting current of  $440/0.25 = 1760$  A, which is  $1760/50 = 35.2$  times of full-load current.
- This excessive current will damage the commutator, brushes and winding.
- To avoid this happening, a resistance is introduced in series with the armature (for the duration period only, say 5 to 10 seconds), which limits the starting current to a safe value.
- The starting resistance is gradually cut out as the motor gains speed and develops the back e.m.f which then regulates its speed.

Note :- In a small size DC motor starter is not required because of following reasons

- a) They have high armature resistance than large motors, hence their starting current is not so high.
- b) Small in size, hence they speed up quickly.

## # Types Of Starters :-

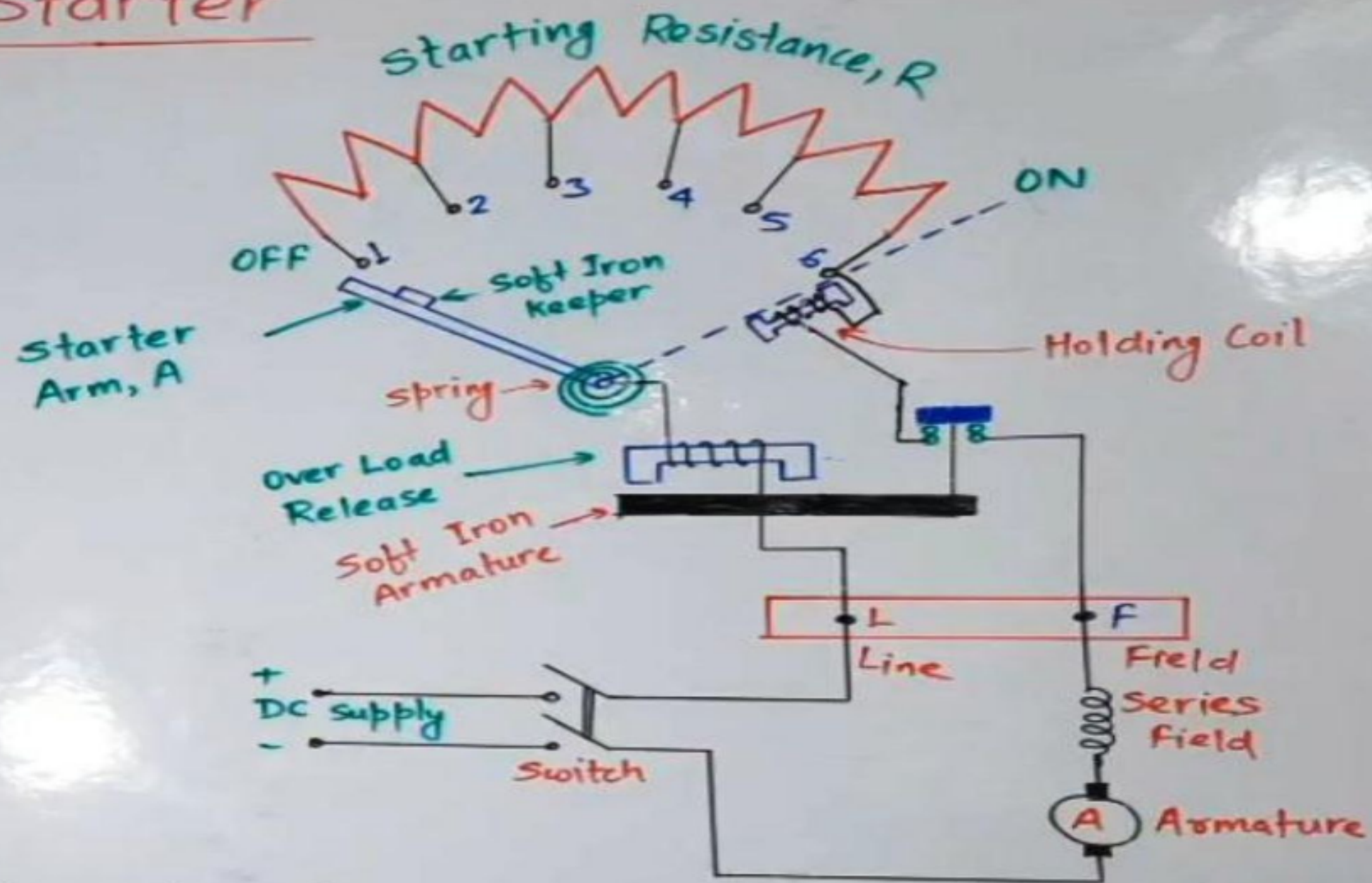
There are following types of starters

1. Two Point Starter
2. Three Point Starter
3. Four Point Starter

# 1. Two Point Starter

- A two point starter is used for starting of DC series motor.
- It has only two point L (Line) and F (Field) so its name is two point starter.
- The basic function of 2 point starter is to protect DC series motor from high starting current.
- At the time of starting large armature current is drawn by motor which is limited by 2 point starter by connection resistance is series with the armature.
- It consists of a series starting resistance, divided into many sections and connected to brass studs.
- The last stud of starting resistance is connected to terminal F to which one terminal of the armature is connected.
- The positive supply line is connected to the line terminal L through main switch.
- From the line terminal L, supply is connected to the starter arm through over-load release.
- A spiral spring S is placed over the lever to bring the starter arm to the OFF position in case of failure the supply.
- The soft iron keeper is attached to the starter arm which is pulled by the holding coil or no-volt release under normal running condition.

# Starter





## Working

- The dc supply is switched on and the started arm is moved to the right for starting the motor.
- As soon as the starter arm comes in contact with the stud no-1, the series motor gets connected through the total starting resistance to the supply main.
- When starter arm move in right hand side the resistance is decreases and value of current increases. The motor speed increases.
- When the starter arm reaches the "ON" position the starting resistance is completely cut-off and the motor starts running at normal supply.
- The arm is held in "ON" postion by the holding coil.
- When supply is fail while the motor is running then current in holding current becomes zero so that starter arm is released and current stop to flow in motor. Hence motor is turn-off.
- The spiral spring attrack the start arm in back in OFF position.
- In case of fault, accessive current flow through the overload release coil which magnetised strongly and attrack the soft iron armature up ward direction. Therefore contact between holding coil and field point is open. Hence no current flow through the motor and motor becomes safe in faulty condition.

# DC 2-POINT STARTER



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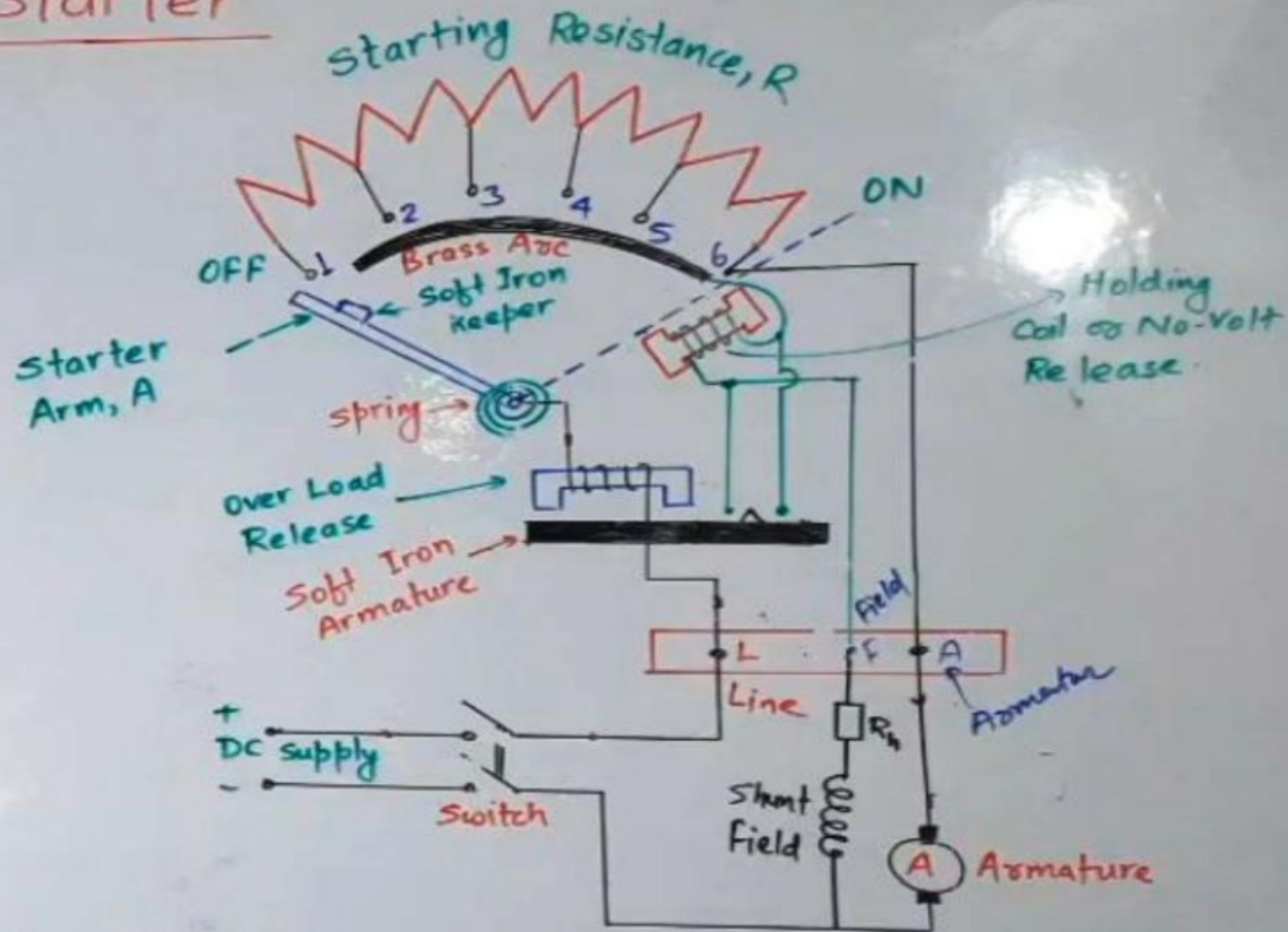


## Three Point Starter

- A three point starter is used for starting of DC shunt motor.
- It has three terminals L (Line) , F (Field) and A (Armature), so it is called three point starter.
- The basic function of 3 point starter is to protect DC shunt motor from high starting current.
- At the time of starting large armature current is drawn by motor, which is limited by 3 point starter by connection resistance is series with the armature.
- It consist of a series starting resistance, divided into many section and connected to brass studs.
- The last stud of starting resistance is connected to terminal A to which one terminal of the armature is connected.
- The terminal F is connected to holding coil and field winding.
- The positive supply line is connected to the line terminal L through main switch.
- A spiral spring S is placed over the lever to bring the starter arm to the OFF position is case of failure of supply.
- A soft iron keeper is attached to the starter arm which is pulled by the holding coil or no-volt release under normal running condition.



# Starter

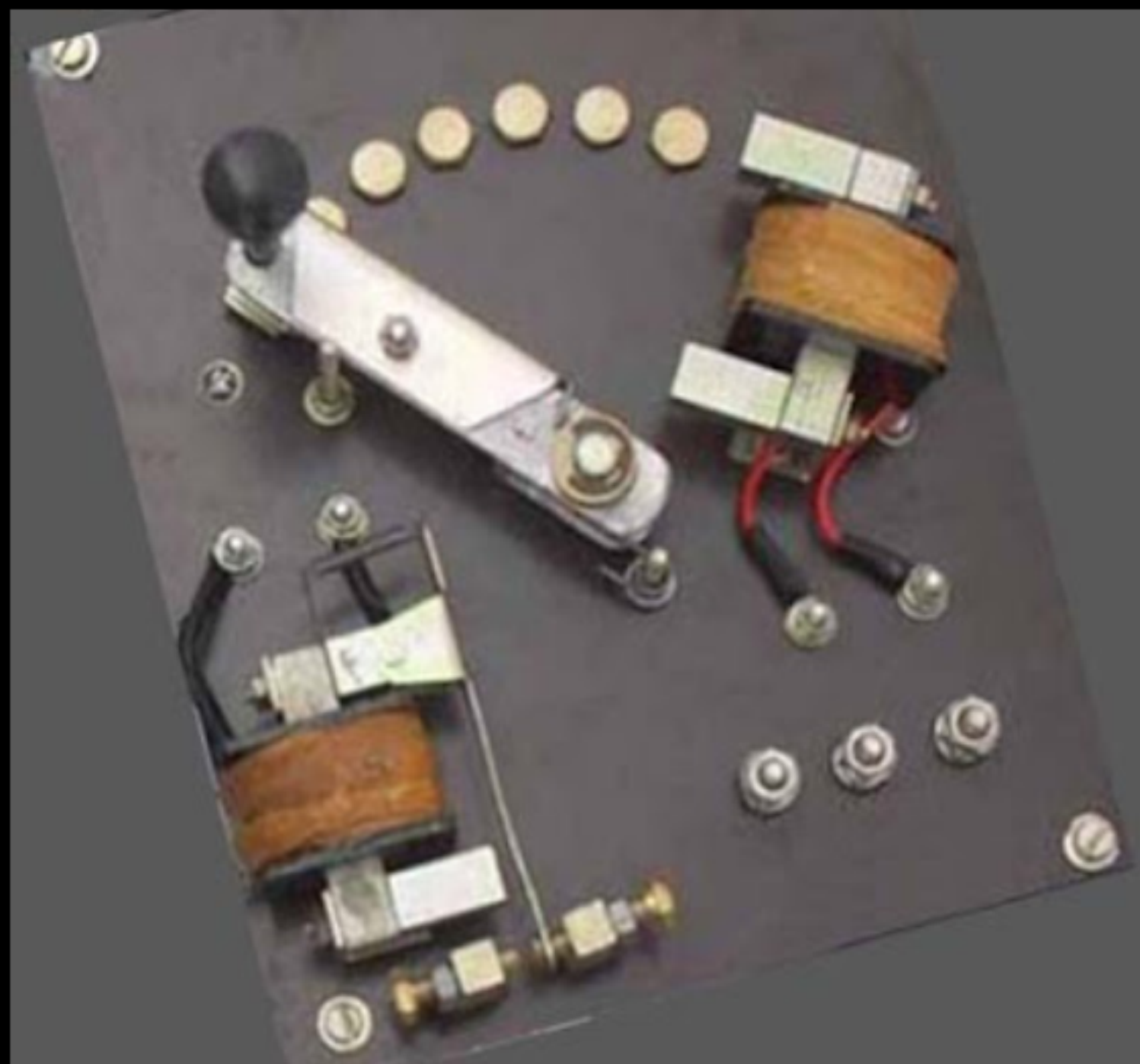


## Operation :-

- When the motor is at rest, the starter arm is in the OFF position.
- For starting the motor the dc supply is switched on by closing the main switch keeping starter arm in OFF position.
- The starter arm (or handle) is then turned clockwise to first stud to last stud.
- As soon as the starter arm comes in contact with stud no-1, whole of the starting resistance  $R$  is inserted in series with armature of the motor.
- The field winding is directly connected across the supply through the brass arc and the holding coil is also energized.
- As the starter arm is turned further the starting resistance is cut out of the armature circuit in steps and finally entire resistance  $R$  is cut out of the armature circuit.
- When the starter arm reaches the ON position the resistance is completely cut off and motor starts running at normal speed.
- Now when supply fails, the holding coil is demagnetised and so releases the starting arm  $A$ , which goes back to "OFF" position due to the force of spring.
- The over load release coil is provided to protect the motor from excessive current.
- When excessive current flows through the over load release hence it magnetises heavily which pulls up the soft iron armature.

- The no-volt release coil, being short-circuited, demagnetise and release the starting arm.
- In this case starting arm goes back to "OFF" position with the action of spring attached to it and motor is automatically disconnected from the supply main.
- Thus the motor is disconnected from the supply and is protected against over-loading.









# Four Point Starter

# Four Point Starter

