Char. & Application

(1) (T Vs I_a) → Electrical char.

(2) (N Vs I_a) → Speed char.

(3) (N Vs T) → mechanical Char.

The performance or behaviour of the motor is to be known in order to analyse it's suitability of application. The basic o/p parameter of a motor are it's torque & speed.

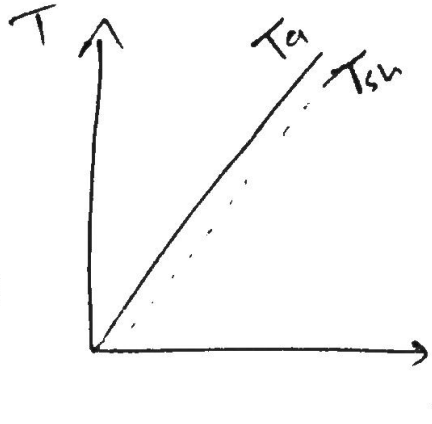
The variation of the torque & speed should be known before loading the motor practically

SHUNT MOTOR

(1) T Vs I_a

$T \propto \phi_{sh} I_a$

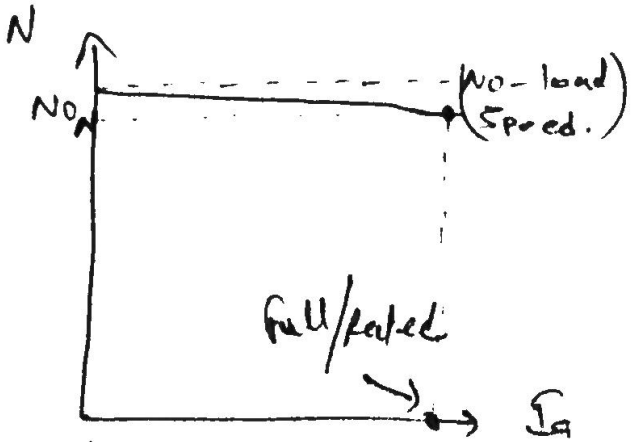
($T \propto I_a$) (ϕ_{sh} → Constant)



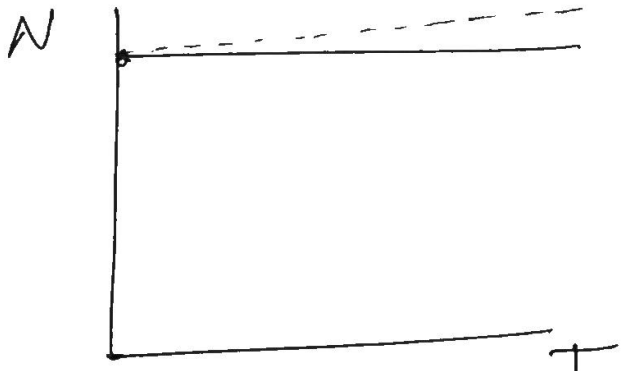
(2) N Vs I_a

$N \propto \frac{E_b}{\phi} \propto \frac{V - I_a R_a}{\phi}$

$\therefore (N \propto V - I_a R_a)$



③ N Vs T



The torque develop in shunt motor is quite linear. the drawback is due to low starting torque. it has superior speed characteristics.

The no-load speed remain approx. Constant upto rated load. which means the motor has good speed regulation.

*Speed regulation — It is the change in the speed of motor when the full load is removed.

Expressed as — $\% S.R. = \frac{N_0 - N}{N} \times 100$

$N_0 \rightarrow$ No load speed
$N \rightarrow$ Full load speed

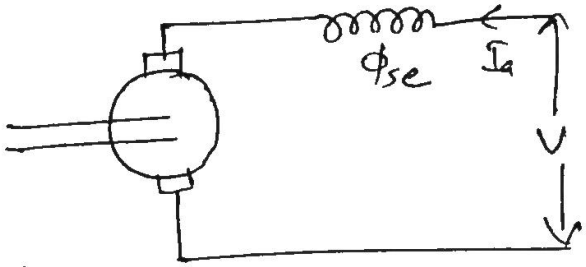
The motor should have good-speed regulation which means a very less value.

Application :—

Due to it's Constant speed (approx.) it is used in manufacturing process. & machine tools.

⇒ Steel plants (steel Rolling), Paper, Textile, lathe machine, fans, Blowers, Pumping (Centrifugal & Reciprocating)

Series motor



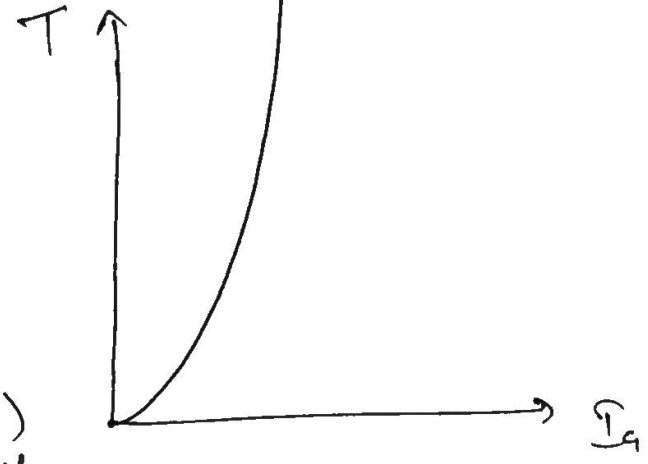
⇒ *Never start a series motor on no-load, as its speed becomes dangerously high. And the motor may get damaged due to large centrifugal forces. Therefore a series motor is started with some load across it's shaft. (minimum 15%)

① T vs I_a

$T \propto \phi_{se} I_a$

$\boxed{T \propto I_a^2} \left(\phi = I_a\right)$

(parabolic) curve

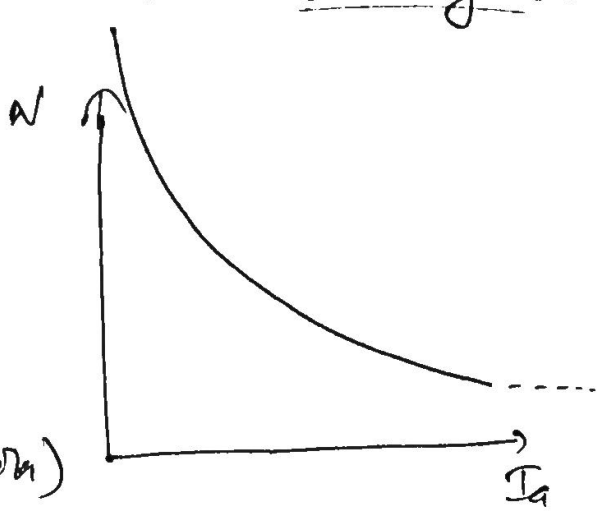


∴ As the torque varies as the square of I_a (I_a^2) it has highest starting torque then any electric-motor. This outstanding torque characteristic make DC series motor popular & is exclusively used for traction purposes.

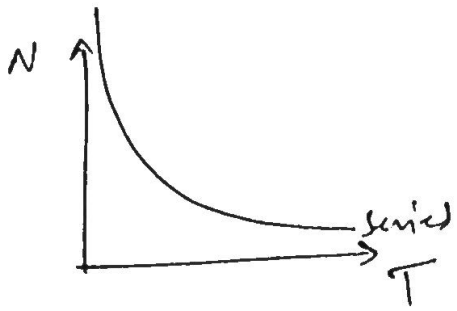
② N vs I_a

$N \propto \dfrac{(V - I_a R_a)}{(\phi_{se})}$ (↓ N, ↓ numerator, ↑ denominator)

(Rectangular hyperbola)



(3) N Vs T



* Due to Series flux the motor has Poor Speed-regulation. There is large variation in Speed, when the Series motor is loaded, which need to be maintained by any speed ctrl method.

* It is not suitable for belt drives., But generally used in Hign Inertia load Such as →

→ Electric traction (locomotives)

→ Cranes, hoists etc.

⇒ Due to the Presence of Shunt flux, Shunt motor has good Speed regulation.

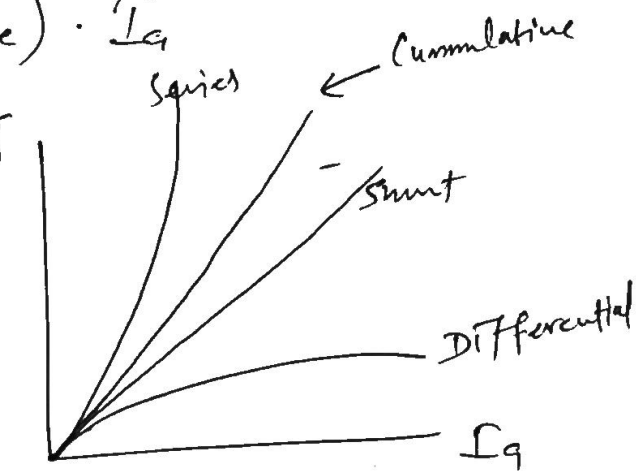
⇒ Due to the Presence of Series flux, Series motor has ~~high~~ Starting torque.

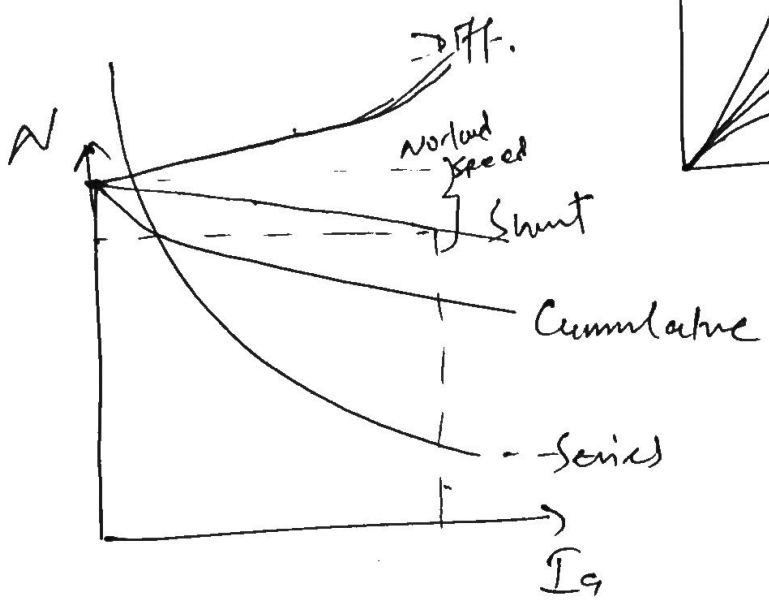
⇒ Cumulative Compound motor Consist of both (Shunt as well as Series flux), which are adding in nature. therefore its Char⇒ lies in between Shunt & Series motors.

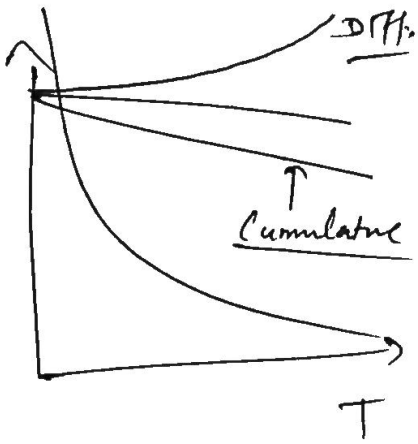
Cummulative Compound motor

① $T \propto (\phi_{sh} + \phi_{se}) \cdot I_a$

② $N \propto \frac{(V - I_a R_a)}{(\phi_{sh} + \phi_{se})}$ ↑







Apps:-

⇒ High torque intermittent loads, Shear & Punches (Pressings).

⇒ Lift, elevators, Conveyors, Compressor, Gear making m/c etc.)

* The Shunt flux offer definite No-load Speed & the Series flux develop high torque at loaded Condition.