## D . C motor characteristics

The characteristic curves of a motor are those curves which show relation between the following quantities .

1. Torque and armature current T a / I a
2. Speed and armature current
3. Speed and torque

It is useful to remember that

$$T_a \; \acute{\alpha} \; \varnothing I_a \qquad \text{and} \qquad N \; \acute{\alpha} \; \frac{E}{\varnothing}$$

- ## Characteristics of series motor
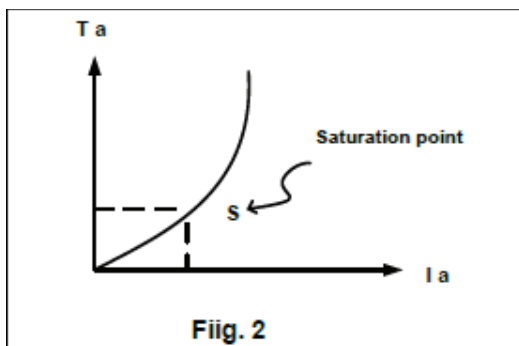### 1. T a / I a characteristic

T a  ά  Ø I a , in this case as field winding also carry the armature current

Ø  ά   I a  up to the magnetic saturation point .

T a   ά  I²a

T a / I a  curve is parabola up to saturation point as shown in fig . 2 . After this point the curve will be a straight line . It is clear that before point (s) the torque is directly proportional to the  I2a  , therefore this type is used for loads which need high starting torque .



Fiig. 2

## 2. N / I a characteristic

Variation of speed can be deduced from the formula

$$N \; \acute{a} \; \frac{E}{\varnothing}$$

Change in E for various loads current is small . With increased I a , the flux Ø also increased . Hence , speed various inversely with armature current as shown in fig .3 . When load is heavy,

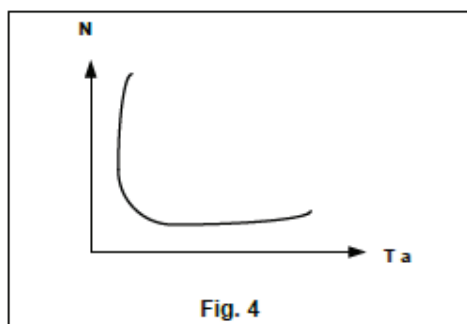I a is large , hence speed is low . When Ia falls to small value , speed become dangerously high . Series motor should never be started without somemechanical load on it .



Fig. 3
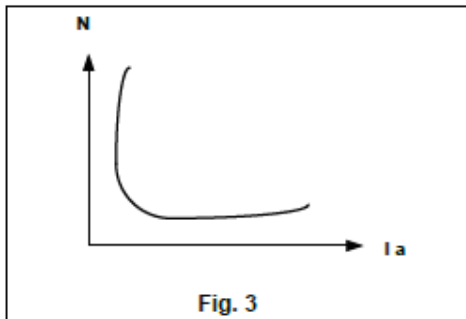
## 3. N/T a

The relation between speed and torque can be obtained from T a/I a and N/I a characteristics .

It is found that when speed is high , torqueis low and vice versa as shown in fig . 4 .



Fig. 4

## Characteristic of shunt motor :

### 1. T a ∕ I a characteristic

Assuming the flux Ø to be constant ( though at heavy loads , flux decrease due to increased in armature reaction. ( T a ά I a )

The relationship between T a and I a is a straight line through the origin as shown in fig . 5 . Since a heavy stating load need a heavy starting current , shunt motor should never be started on heavy load .



**Fig. 5**
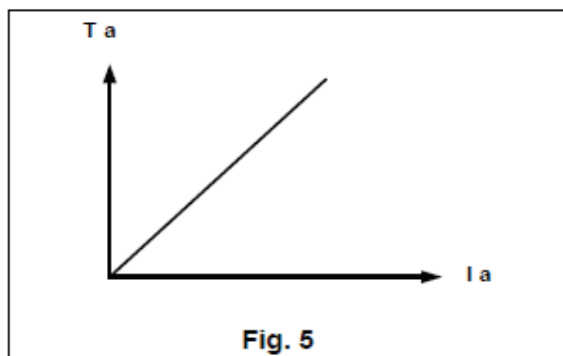
### 2. N∕I a characteristic

f the flux Ø assumed to be constant then N ά E. As E is also practically constant , speed is for most purpose constant.

In fact both Ø and E decrease with increasing load , therefore there is some decrease in speed as shown in fig .6. Shunt motor is taken as a constant speed motor .



**Fig. 6**
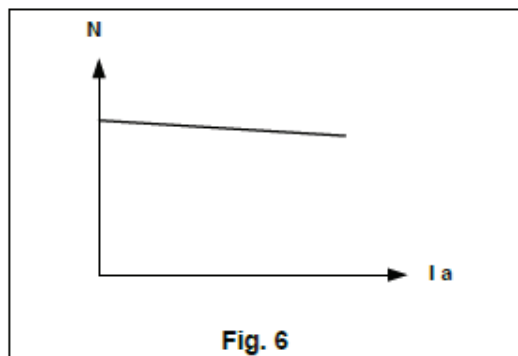
## 3. N / T a

It can be deduced from 1 and 2 above . The relationship between N and Ta is shown in fig .7 .



**Fig. 7**