SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE NAME : 19OE120 AUTOMOTIVE ELECTRONICS

I YEAR /I SEMESTER MECHATRONICS ENGINEERING

Unit 3 – STARTING / CRANKING AND ELECTRIC SYSTEMS

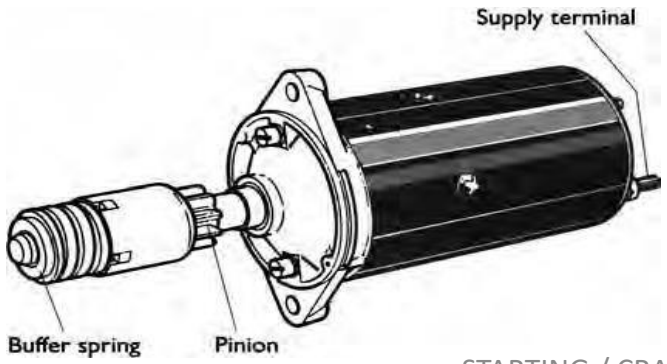
STARTER MOTOR TYPES

- **The drives used are as follows,**

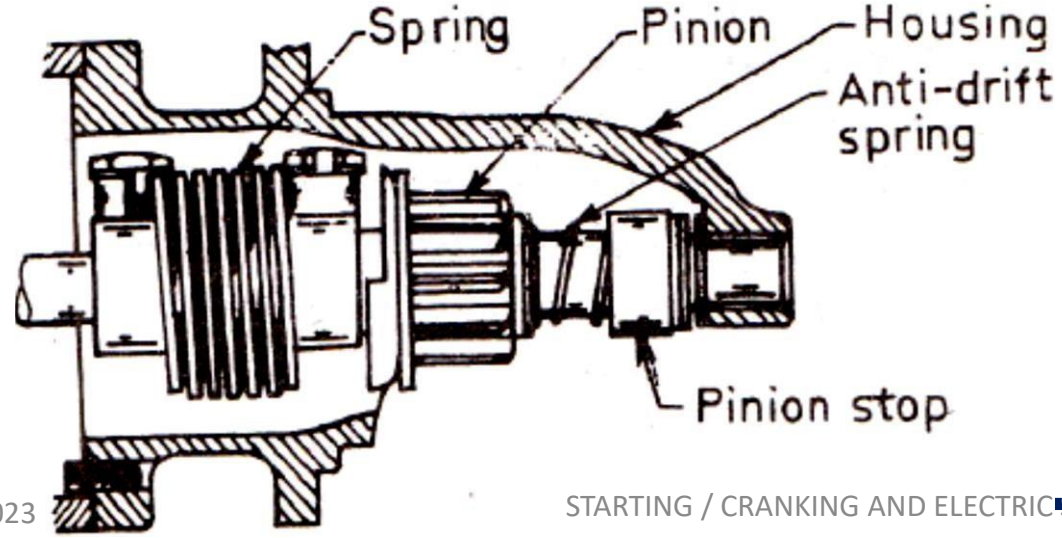
1. Bendix drive (Inertia Type)
2. Folo-thru drive
3. Barrel type drive
4. Rubber compression drive
5. Compression spring bendix
6. Friction clutch drive
7. Overrunning clutch (Pre-engaged Starters)
8. Dyer drive
9. Axial or sliding armature

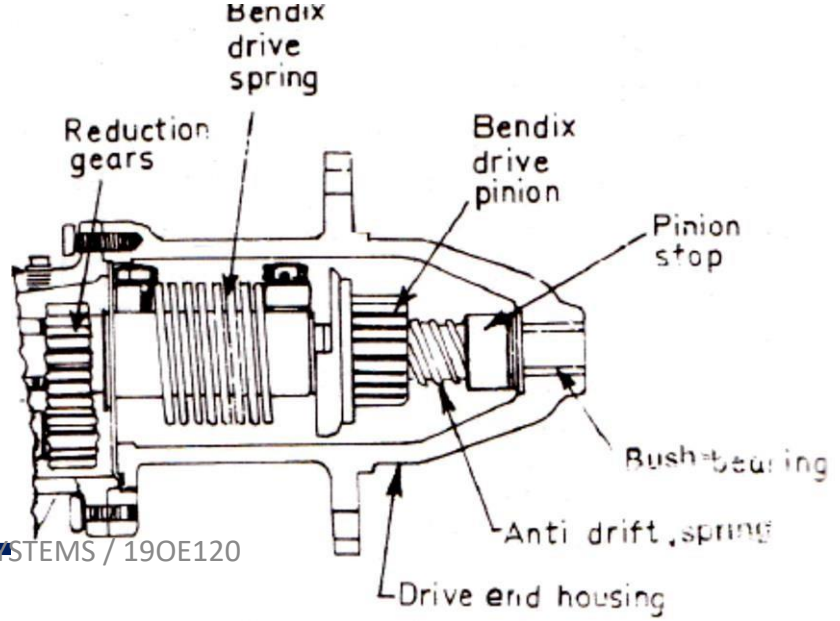
❖Inertia Starters (Bendix Drive):

- Invented by Vincent Hugo Bendix in 1910.
- The inertia type of starter motor has been the technique used for over 80 years, but is now becoming redundant.
- The starter shown in Figure is the Lucas M35J type. It is a four-pole, four-brush machine and was used on small to medium-sized petrol engine vehicles.
- It is capable of producing **9.6 Nm with a current draw of 350 A**. The M35J uses a face-type commutator and axially aligned brush gear. The fields are wave wound and are earthed to the starter yoke.

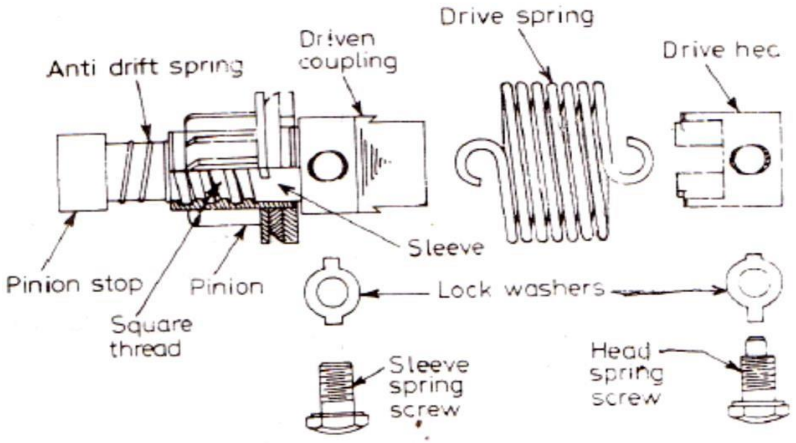


- The starter engages with the flywheel ring gear by means of a small pinion. The toothed pinion and a sleeve splined on to the armature shaft are threaded such that when the starter is operated, via a remote relay, the armature will cause the sleeve to rotate inside the pinion.
- The pinion remains still due to its inertia and, because of the screwed sleeve rotating inside it, the pinion is moved to mesh with the ring gear.
- When the engine fires and runs under its own power, the pinion is driven faster than the armature shaft.





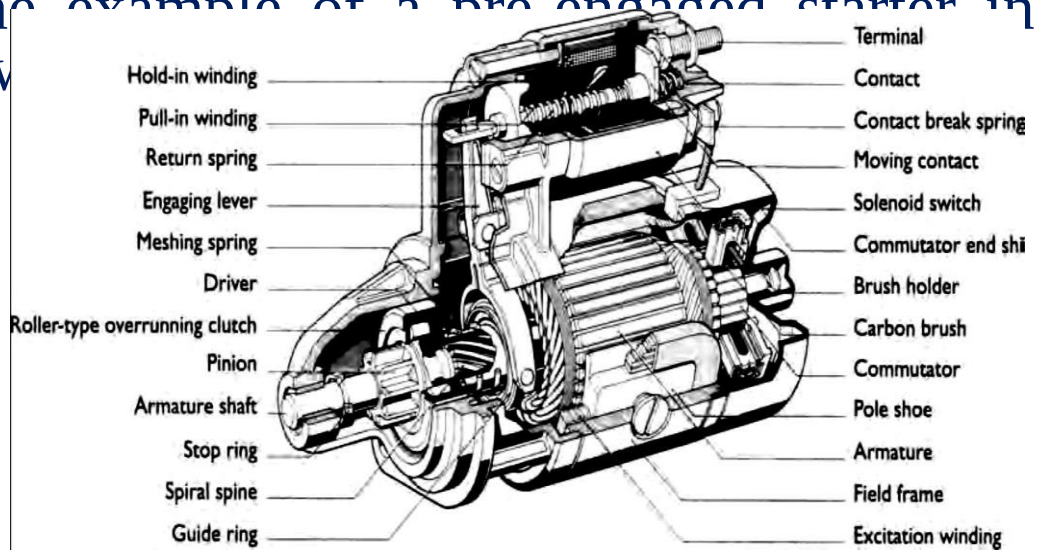
- This causes the pinion to be screwed back along the sleeve and out of engagement with the flywheel.
- The main spring acts as a buffer when the pinion first takes up the driving torque and also acts as a the buffer when the engine throws the pinion back out of mesh.
- One of the main problems with this type of starter was the aggressive nature of the engagement.
- This tended to cause the pinion and ring gear to wear prematurely. In some applications the pinion tended to fall out of mesh when cranking due to the engine almost, but not quite, running.



- The pinion was also prone to seizure often due to contamination by dust from the clutch.
- This was often compounded by application of oil to the pinion mechanism, which tended to attract even more dust and thus prevent engagement.

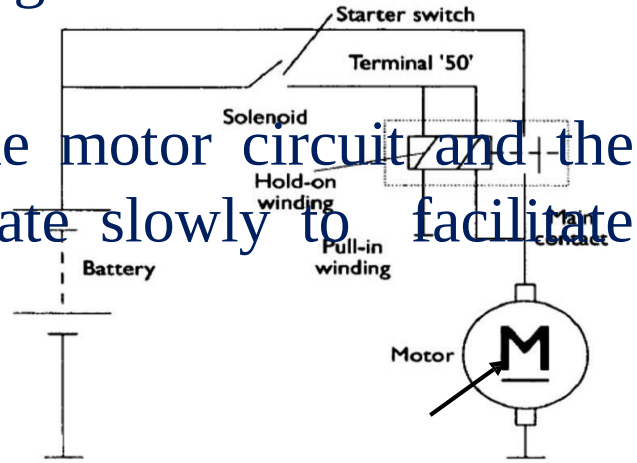
❖Pre-engaged Starters:

- Pre-engaged starters are fitted to the majority of vehicles in use today. They provide a positive engagement with the ring gear, as full power is not applied until the pinion is fully in mesh.
- They prevent premature ejection as the pinion is held into mesh by the action of a solenoid. A one-way clutch is incorporated into the pinion to prevent the starter motor being driven by the engine.
- One example of a pre-engaged starter in common use is shov



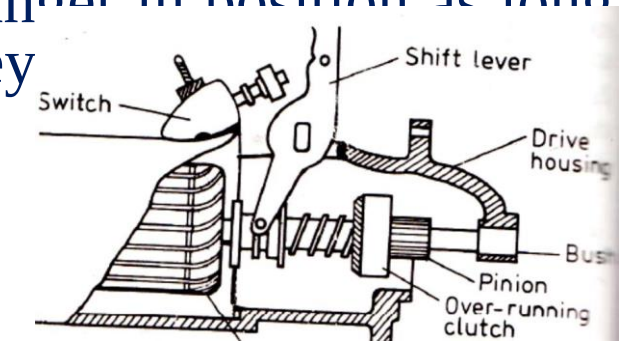
- Figure shows the circuit associated with operating this type of pre-engaged starter. The basic operation of the pre-engaged starter is as follows.
- When the key switch is operated, a supply is made to terminal 50 on the solenoid. This causes two windings to be energized, the hold-on winding and the pull-in (draw-in) winding. Note that the pull-in winding is of very low resistance and hence a high current flows.

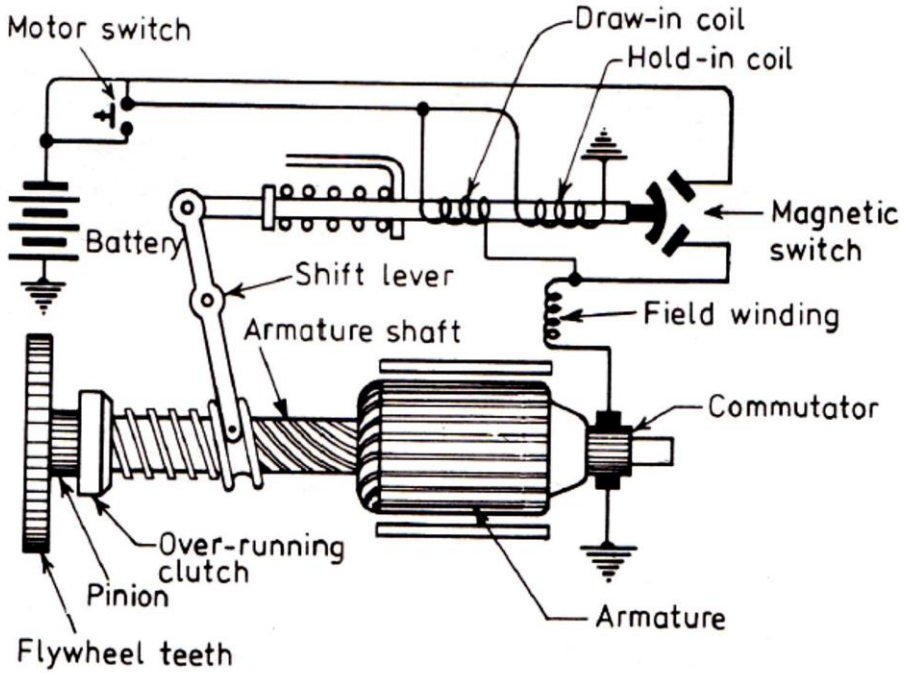
This winding is connected in series with the motor circuit and the current flowing will allow the motor to rotate slowly to facilitate engagement.



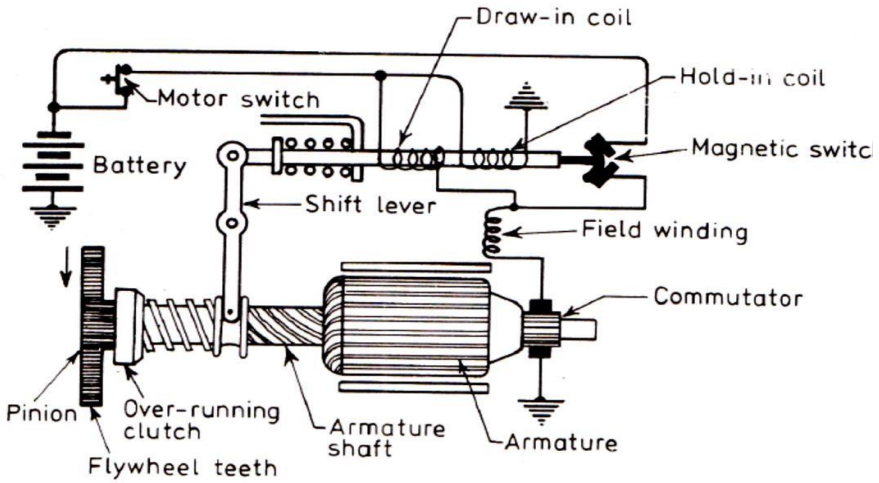
- At the same time, the magnetism created in the solenoid attracts the plunger and, via an operating lever, pushes the pinion into mesh with the flywheel ring gear.
- When the pinion is fully in mesh the plunger, at the end of its travel, causes a heavy-duty set of copper contacts to close. These contacts now supply full battery power to the main circuit of the starter motor.
- When the main contacts are closed, the pull-in winding is effectively switched off due to equal voltage supply on both ends.
- The hold-on winding holds the plunger in position as long as the solenoid is supplied from the key

Manually Operated Overrunning





(a) Disengaged position



(b) Pinion engaged and motor cranking

- When the engine starts and the key is released, the main supply is removed and the plunger and pinion return to their rest positions under spring tension.
- A lost motion spring located on the plunger ensures that the main contacts open before the pinion is retracted from mesh.
- During engagement, if the teeth of the pinion hit the teeth of the flywheel (tooth to tooth abutment), the main contacts are allowed to close due to the engagement spring being compressed. This allows the motor to rotate under power and the pinion will slip into mesh.