A Look at Cranking Motors:
Parts and Principles
Part IV

Courtesy Electrical Rebuilder's Assoc.

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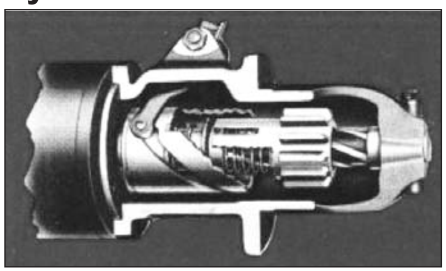
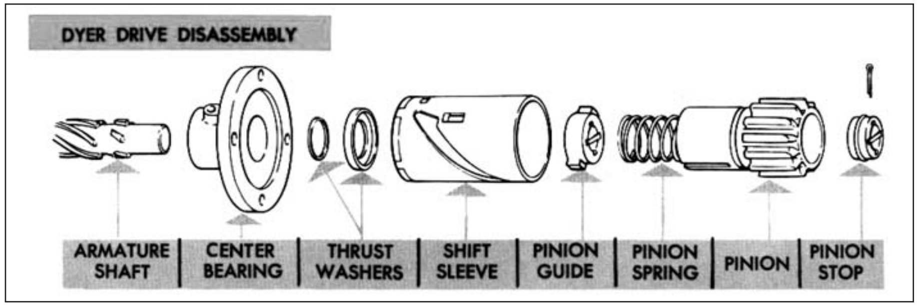
Dyer Shift Drive



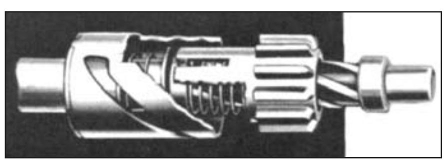
The Dyer drive is a special type of drive mechanism that provides positive meshing of the drive pinion with the flywheel before the cranking motor switch is closed and before the armature begins to rotate. This action eliminates clashing of pinion teeth with flywheel teeth as well as the possibility of broken or burred teeth on either the engine flywheel or the drive pinion. The Dyer drive is used on heavy duty applications where it is very important that the pinion be engaged before rotation begins.



Engagement of the pinion while in motion would be impossible because of the high horsepower developed and the acceleration of the armature when the cranking circuit is completed.

The Dyer drive mechanism consists of thrust washers, a shift sleeve, pinion guide, pinion spring, pinion, pinion stop and cotter pin. The pinion guide is a snug fit on the spiral splines of the armature shaft, while the pinion (which has internal splines matching the armature splines) fits loosely on the armature shaft splines.

In the position shown in the illustration below, the drive assembly is at rest. The drive pinion is retained in this position by the pinion guide which drops into milled notches in the armature shaft splines. The pinion can be released from this position only by movement of the pinion guide through operation of the shift lever.



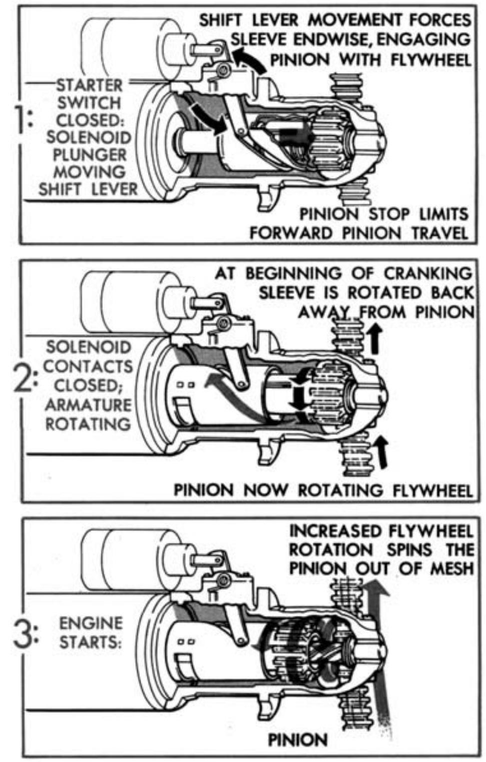
Movement of the shift lever causes the shift sleeve, pinion guide, pinion spring, and pinion to be moved endwise along the armature shaft so that the pinion meshes with the flywheel teeth, provided the teeth align properly. Further movement of the shift lever then closes the cranking motor switch, and cranking takes place.

If the teeth are not aligned and meshing cannot take place at once, the pinion is rotated against the flywheel teeth until alignment occurs and meshing is accomplished.

The pinion rotates because it is a loose fit on the armature shaft splines, while the pinion guide is a tight fit. The continued forward movement of the pinion guide causes it to rotate as it follows the spiral splines on the shaft. This rotation is transmitted, by means of the two lugs on the pinion guide, to the pinion. The pinion rotates without any forward movement until alignment of the teeth takes place, then it is thrust forward into mesh.

The pinion stop (1) limits forward movement of the pinion. As the shift lever completes its travel it closes the cranking motor switch which is linked mechanically with the shift lever.

The motor armature (2) then begins to rotate. The shift sleeve is carried back to its original position, rotating back out of the way. The instant that the engine begins to operate, it attempts to drive the pinion faster than the armature is turning, with the result that the pinion and pinion guide are spun back out of mesh with the flywheel teeth. The pinion guide (3) drops into the milled section of the shaft splines locking the pinion in the out-of-mesh position.



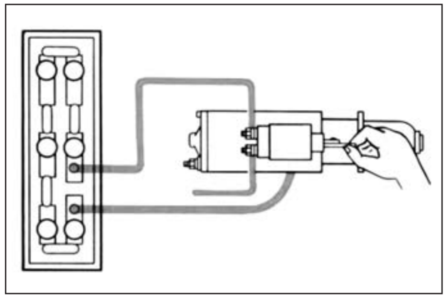
It is impossible to start another cranking cycle without completely releasing the shift lever. The lever must drop all the way back to the at-rest position. With pedal operated shift levers it takes a few seconds to perform this operation. Solenoid operated shift levers return to the starting position more quickly.

On any automatic disengaging type of cranking motor drive it is always good policy to wait five seconds after a false start before attempting another start. In this period of time the engine will be at complete rest. Then, when the cranking motor shift lever is again operated, it picks up the shift sleeve and causes it, the pinion guide, spring, and pinion again to move along the shaft into the meshing position.

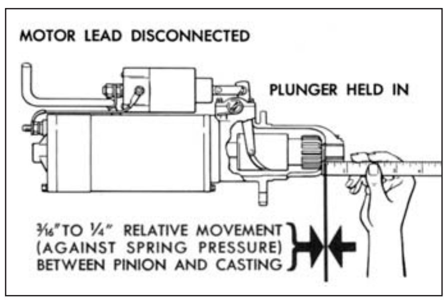
When the shift lever is in the extreme forward position and the switch contacts in the solenoid are closed, there should be at least 3/16 to 1/4 inch travel of the pinion against the pinion spring pressure in the out-of-mesh direction. It is very important that this adjustment be maintained in service.

On solenoid operated cranking motors the solenoid should never be replaced without checking the free travel of the pinion when in the cranking position. This usually means that the cranking motor must be removed from the engine for this service operation.

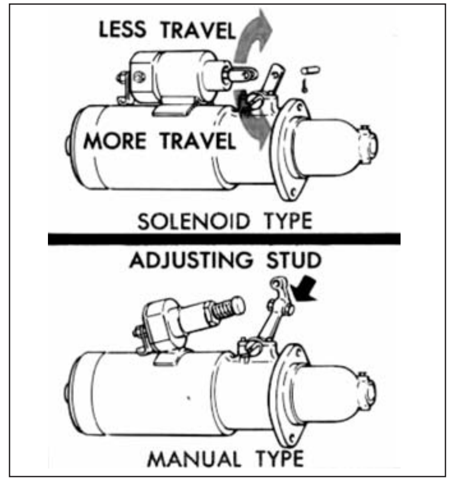
Loose solenoid mounting screws or worn linkage parts will also change the amount of free travel and cause improper engagement. This adjustment can be checked easily on the solenoid controlled types by disconnecting the lead from the solenoid to the cranking motor and using the battery current through the solenoid to hold the shift lever in the forward position.



Since disconnecting the motor lead opens the pull-in coil of the solenoid, it will be necessary to assist the movement of the plunger by hand. Make sure the plunger reaches its extreme travel position, closing the switch contacts. The cranking motor armature will not revolve with the motor lead disconnected. The pinion travel can be checked by pushing the pinion back against the spring pressure with a scale and measuring the relative movement between the pinion and the casting.



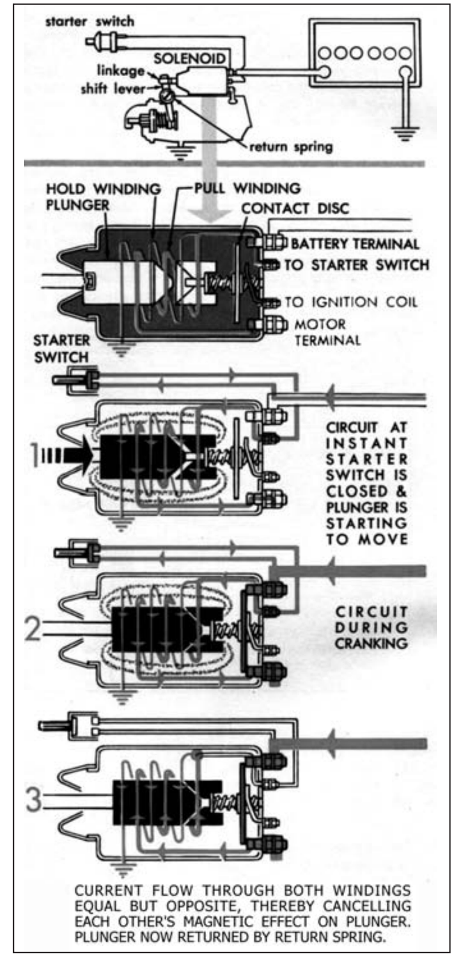
The adjustment can be changed by turning the plunger stud in or out of the solenoid plunger as necessary. One-half turn of the stud will change the adjustment 1/16 of an inch. On manually shifted units, the travel of the pinion against the pinion spring may be adjusted by loosening the locking nut and turning the adjusting stud on the shift lever as required.



The moving parts on this type of drive may be lubricated to prevent excessive wear. Periodic inspection should be made, however, to see that dirt accumulations do not pack in behind the drive and prevent normal operation.

Cranking Motor Solenoid Circuits

The solenoid switch on a cranking motor not only closes the circuit between the battery and the cranking motor but also shifts the cranking motor pinion into mesh with the engine flywheel ring gear. This is accomplished by means of a linkage between the solenoid plunger and the shift lever on the cranking motor. Solenoids are energized directly from the battery through a starter switch or in conjunction with a solenoid relay.



When the circuit is completed to the solenoid, current from the battery flows through two separate windings, designated as the “pull-in” and the “hold-in” windings (1). These windings produce a combined magnetic field which pulls in the plunger so the drive pinion is shifted into mesh and the main contacts in the solenoid switch are closed.

The two windings have different size wire but contain approximately the same number of turns. The heavy pull-in winding is required to complete the plunger movement. When the air gap is decreased the hold-in winding is sufficient to retain the plunger in position.

Closing the main switch contacts connects the battery directly to the cranking motor and at the same time partially shorts out the pull-in winding, since it is connected across the main contacts (2, page 8). The heavy current draw through the pull-in winding occurs only during the movement of the plunger and will not register on an ammeter.

When the control circuit is broken after the engine is started, current no longer reaches the hold-in winding from this source. However, there is a flow of current from the battery through the main switch contacts then through the pull-in winding (in a reverse direction) and through the hold-in winding to ground (3, page 8).

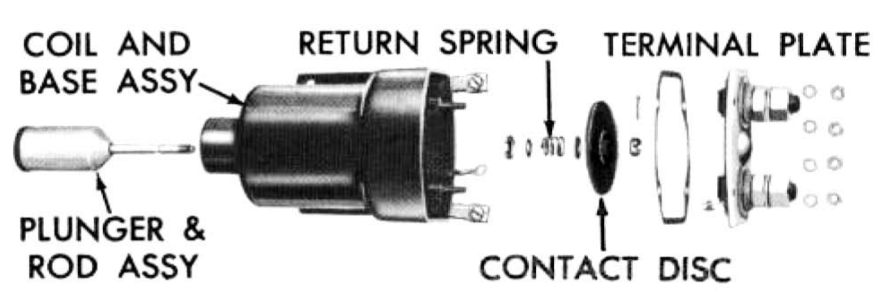
With the same number of turns in each of the two windings and the same amount of current flowing through both, the magnetic forces created are opposed and counteract each other. Tension of the return spring then causes the plunger to return to the at-rest position and breaks the cranking motor circuit.

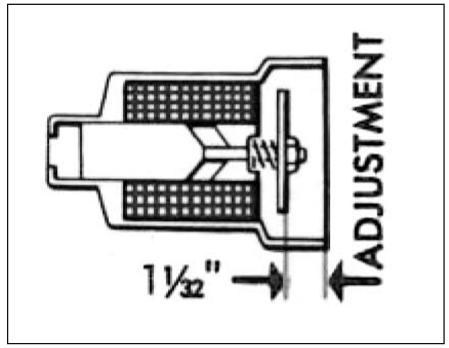
As few as 15 shorted turns in the pull-in winding would result in less magnetic force to oppose the magnetic field of the hold-in winding and the switch contacts would remain closed. Continued cranking after the control circuit is broken indicates either shorted turns in the pull-in coil or an out-of-line mounting of the solenoid which causes binding of the plunger.

Either low system voltage or an open circuit in the hold-in winding will cause an oscillating action of the plunger. The pull-in winding has sufficient magnetic strength to close the main contacts, but when they are closed the pull-in winding is shorted out. Under these conditions there is no magnetic force to keep the contacts closed. Whenever chattering of the switch occurs, check should be made for a complete circuit in the hold-in winding as well as the condition of the battery.

Solenoids used with the Dyer drive cranking motors have a replaceable contact disc which is adjustable. The location of the disc when assembled should be 1 1/32 inches below the edge of the housing with the plunger in a retracted position. This position is important to assure proper pressure between the contact disc and the terminal contacts while cranking.

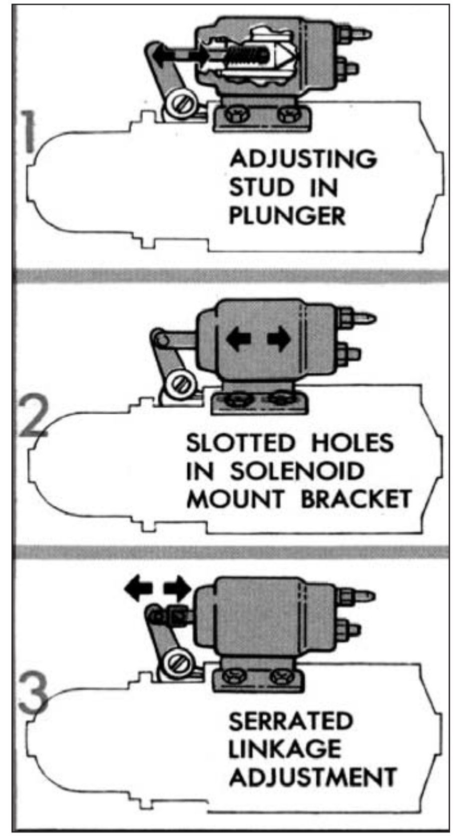
DISASSEMBLY OF SOLENOID ON DYER DRIVE





Since the Dyer drive is designed to engage the pinion with the flywheel ring gear before the cranking circuit is completed, the pinion travel adjustment is very important. This adjustment was covered under the subject of Dyer drives.

Clutch type cranking motors must have the clearance checked without compressing the spring. Some units employ a solenoid having a stud adjustment as explained above with relation to Dyer drive motors. Other units use solenoids having slotted holes in the mounting bracket so that the entire unit may be shifted on the motor frame to obtain adjustment. A third method has a serrated linkage adjustment which should be adjusted according to specifications. Always check alignment of the linkage on these units to prevent binding.

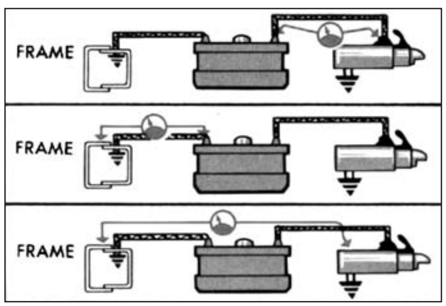


The pulling power of a solenoid increases at an increasing rate as the air gap of the plunger is reduced. Locating the pinion adjustment to the high limit, on either the clutch or Dyer drive type motors, will, in effect, reduce the air gap and a more powerful magnet is obtained. Never replace a solenoid on a motor without checking pinion clearance. Satisfactory performance depends upon this adjustment.

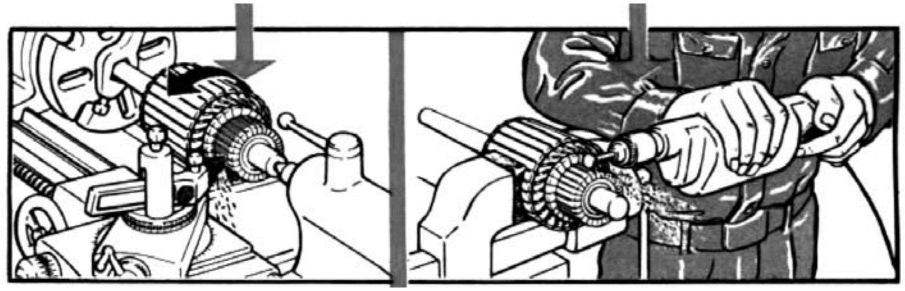
Periodic Cranking Motor Maintenance

Periodic checking of the cranking motor will go far toward eliminating failures due to neglect or lack of attention. Door-to-door delivery or other similar service where many starts are made daily, operation in dusty or very humid climates, or sub-zero temperatures, put an added strain on the equipment and tend to wear parts more rapidly. More frequent checking of the cranking motor is desirable under such conditions.

Every 5,000 miles the following checks should be made: The specific gravity of the battery electrolyte should be checked and cables and connections inspected; all connections should be clean and tight and the cables should be in good condition. The maintenance program on the battery itself will call for more frequent inspection of the battery and cables.

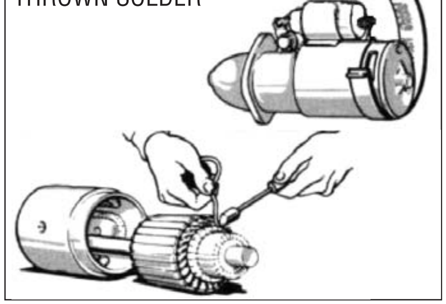


To prevent overheating, the cranking motor must not be operated for more than 30 seconds at a time without pausing a few minutes to allow it to cool off. If the commutator is rough, worn, out-of-round, or if it has high insulation between the segments, the armature must be removed from the cranking motor so the commutator can be turned down in a lathe and the insulation undercut 1/22 of an inch.



Thrown solder indicates that the cranking motor has been overheated due to excessively long cranking periods. Such abuse may cause open circuits to develop at the commutator riser bars which results in burned commutator bars. Each time an open circuited bar passes under a brush severe arcing occurs and the bar soon becomes badly burned. If the bars are not too badly burned the armature may be repaired by resoldering the leads in the commutator riser bars and then turning the commutator down and undercutting the insulation.

THROWN SOLDER



The brushes should make good, clean contact with the commutator and should have the proper spring tension. Brushes must have free movement to enable them to follow the commutator. If they are badly worn so that they will not last until the next inspection period they should be replaced.

The brush spring tension should never be below specified limits. Cranking motor brushes carry high current and good contact between the brush and the commutator will reduce resistance. Most motor brush springs test above the specified tension but since the cranking motor is used intermittently, this is not objectionable. New brushes should be installed if the old ones are worn too much to last until the next disassembly period. The brush seat may be improved by the use of a brush seating stone.

The cranking motor mounting must always be tight and the drive must be in good condition. The condition of the drive can be established by operating the cranking motor two or three times and noting the action of the drive. The cranking motor must be removed if the drive is to be actually seen and examined. On overrunning clutch type cranking motors, operating the motor also serves as a check on the freedom with which the shift lever operates.

As a final step in the periodic maintenance procedure the cranking motor should be lubricated by adding a few drops of light engine oil to the visible hinge cap oilers.

The bearings in many cranking motors are of the oil-less type. However, they require oiling when the cranking motor is re-assembled after the periodic disassembly.

At periodic intervals, the cranking motor should be removed from the vehicle and disassembled so that all parts can be cleaned and inspected and defective parts repaired or replaced. The frequency of this procedure will depend on the type of equipment and operation. For average conditions the cranking motor should be disassembled once a year, or every 25,000 miles of operation.

The armature and field windings must not be cleaned in any grease dissolving solution or by any high temperature grease removing method, since this will damage the insulation. Parts may be cleaned with a brush dipped in olium or other neutral spirits. It may not be necessary to remove the field windings from the field frame unless the winding insulation is damaged or charred, or the windings are open or shorted.

If the cranking motor uses the Bendix type drive, the drive is cleaned with kerosene and lubricated with a trace of light engine oil on the sleeve spiral. Avoid excessive oiling.

The overrunning clutch type drive must never be cleaned by any high temperature or grease dissolving method since this would remove the grease originally packed in the overrunning clutch, causing the clutch to fail quickly. The drive pinion on the overrunning clutch should turn freely in the overrunning direction and should not slip in the driving direction. Locate the solenoid adjustment so that the pinion has the proper clearance under operating conditions.

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See Part V in the July issue.