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STARTING MOTOR

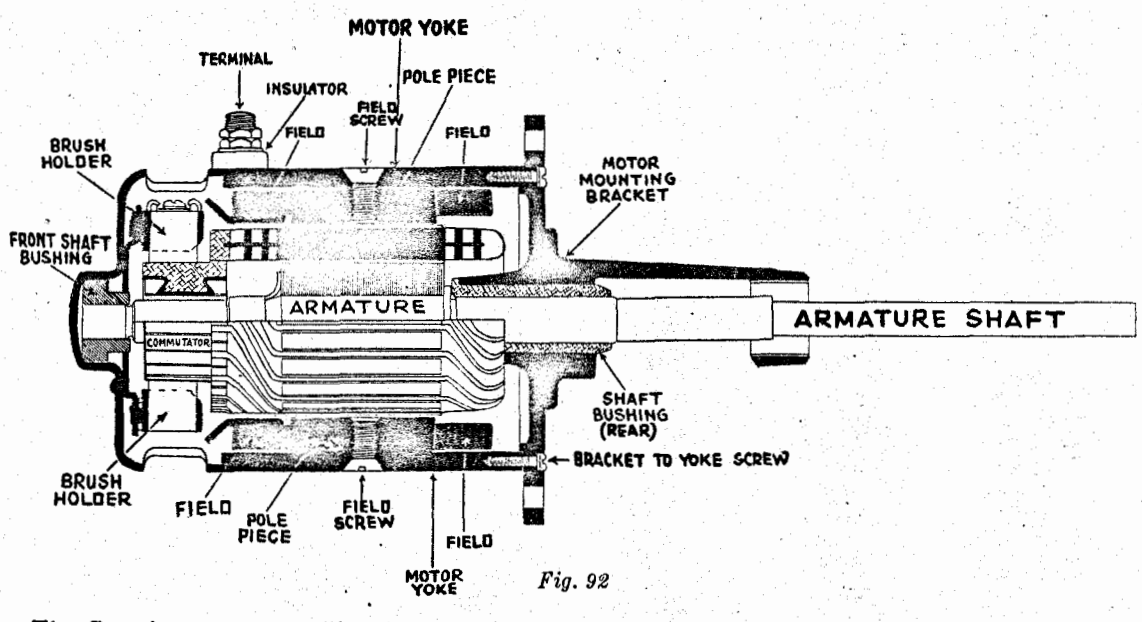

Fig. 92

The Starting Motor, unlike the Generator, will often continue to function and turn the engine over long after it should have been repaired, and it is perhaps due to this that mechanics have often overlooked it in diagnosing various electrical troubles.

The Starting Motor and Bendix Assembly in good condition will turn the engine in a snappy manner, which is necessary for quick engine starting, that is, provided the storage battery is in normal condition. If, however, the Starting Motor is sluggish in its action, it will turn the engine over slowly, consuming excessive battery current, lowering the voltage at the coil points and making the motor hard to start. This condition also often causes the battery to run down quickly.

To overcome battery trouble, the mechanic often sets the Generator charging rate too high, causing the Generator to burn out, or damaging the battery on long drives, when the cause of the trouble was actually in the Starting Motor or Bendix.

The Starting Motor, although somewhat harder to remove from the engine than the Generator, is much easier to understand and repair. To remove the Starting Motor from engine—first remove the Bendix cover, remove the Bendix Head Spring screw from Bendix Head. The Bendix Head should be easily removed from the Starting Motor Shaft. If it sticks it can be removed by a Puller similar to the one shown in Fig. 93. Now remove the Bendix Head key and pull the rest of the assembly from the shaft. Remove the four screws from Motor Head and lift Starting Motor from Transmission Cover.

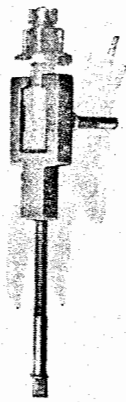

Fig. 93

Bendix

The Bendix Drive, Fig. 94, is the most important unit of the starting system. Its purpose is to connect and disconnect the Starting Motor from the Fly Wheel Ring Gear. Its unique action is obtained by the gear which is loosely threaded on the Bendix Shaft. This gear has a counterweight on one side which will keep it from turning when the shaft turns. This causes the Bendix gear to work forwards on the thread and as it does so the teeth make contact with the Fly Wheel Ring Gear teeth. As soon as the Bendix Gear has worked forward to the end of the threads, it must turn with the shaft, turning the Fly Wheel with it.

As soon as the engine starts, the Driver, of course, removes his foot from the starter pedal and the Starting Motor ceases to function. The Fly Wheel Ring Gear then drives the Bendix Gear, turning it backwards on the thread, thereby throwing it out of mesh again.

Repairing Bendix

Carefully examine the Bendix Spring. If the Spring is in good condition the two screw holes, or eyes, in the Spring A, Fig. 95, will be in a straight line with one another. If the Spring is twisted, as shown in Fig. 96 replace it with a new one.

If a Bendix Shaft Sleeve [illegible] place it with Sleeve No. 5021½. Sleeve can easily be attached by simply placing it over the shaft until it strikes the shoulder, and using a blunt chisel and hammer, lightly hit the divided portions, above and below the corresponding groove of the screw shaft, until they nicely fit into this groove.

For example, note the illustrations. Fig. 1 shows one of the earlier model shafts, with the recess for crimping cut very near the shoulder of the shaft. Fig. 2 shows the later model shaft, with the recess for crimping cut further away from the shoulder. Fig. 3 shows the Bendix replacement sleeve, which can easily and quickly be attached to either of the two shaft models by depressing the point "A" or "B" as the case may be.

To attach the sleeve to the earlier shaft shown in Fig. 1, depress the point "A" above and below, as has been done in Fig. 4. To attach to the latter shaft, Fig. 2, depress the point "B" above and below, as shown in Fig. 5.

Care should be taken to see that the sleeve is securely fastened, yet is free to turn easily on the screw shaft. This is accomplished by simply placing a screw driver or other similar tool in the slot of the sleeve, and holding the screw shaft secure, rotate the sleeve until it turns easily. This is very important.

Beware of replacing a sleeve with any form of structure having an outside diameter greater than the sleeve that was originally on

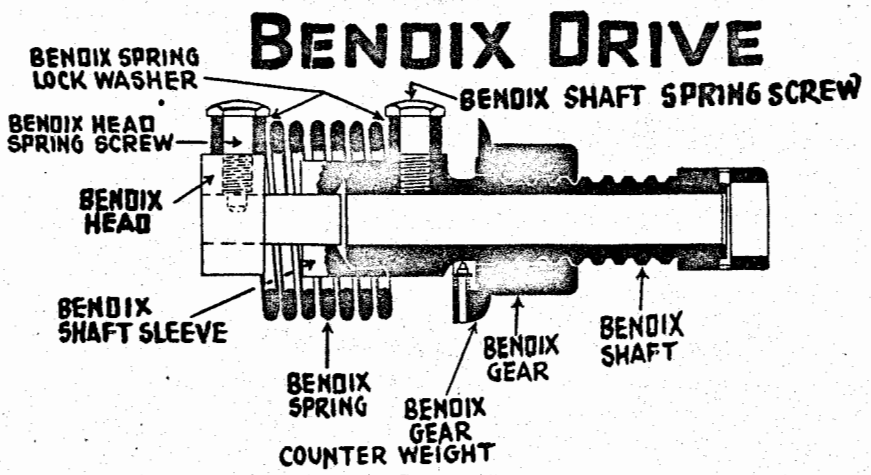

Fig. 94

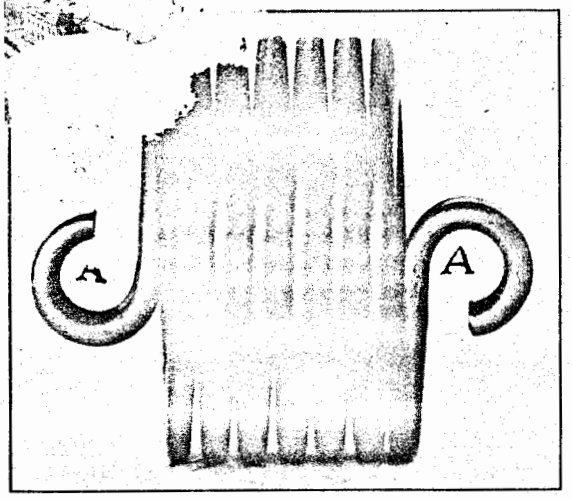

Fig. 95

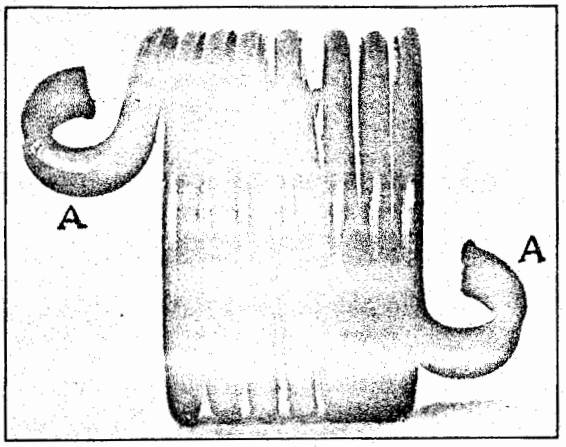

Fig. 96

the drive, as its use will interfere with the proper winding of the spring and have a destructive effect on the entire installation.

Carefully examine the Bendix Gear to see that the counterweight is tight—if the counter weight is loose, replace the assembly less Spring. Also test the gear to see that it revolves freely on the threads of the shaft.

Fig. 98 illustrates the Starting Motor wiring diagram. The current flows from the battery through the starter pedal direct to the terminal "A"—from there it flows through the fields into the insulated Brushes, "B," through the Armature "C" and out through the two ground Brushes "D" into the frame, or ground, and back to the battery.

The Field Windings are made from large copper strips which carry a very heavy amperage. This heavy flow of current makes a heavy magnetic pull on the Fields, which are set to receive a correspondingly heavy magnetic pull from the large armature windings, thereby producing power.

Due to the large internal wires, the Starting Motor will draw about 65 amperes or less when motored. When it is connected to the Fly Wheel, however, it requires around 250 amperes or more to overcome what is known as stall torque of the engine. However, after the engine does start to rotate, the amperage flow falls off to around 175 amperes.

On account of this heavy current consumption, it is necessary to have heavy cable to convey the current from the battery to the motor, because the carrying capacity of the cable depends upon its cross section area.

Figure 92 illustrated cut open view of the Starting Motor. From this you will see that its internal construction is very similar to that

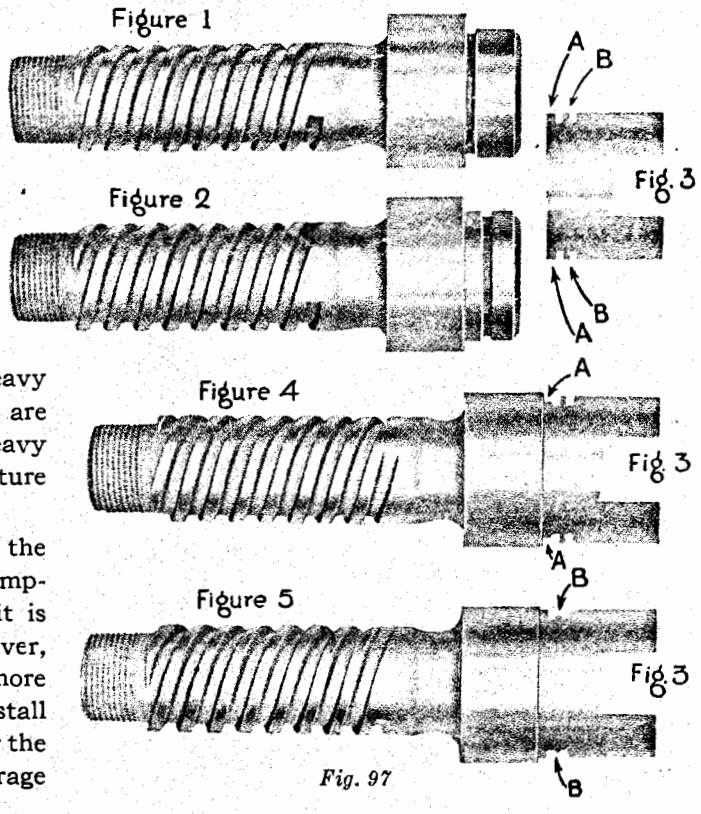

Fig. 97

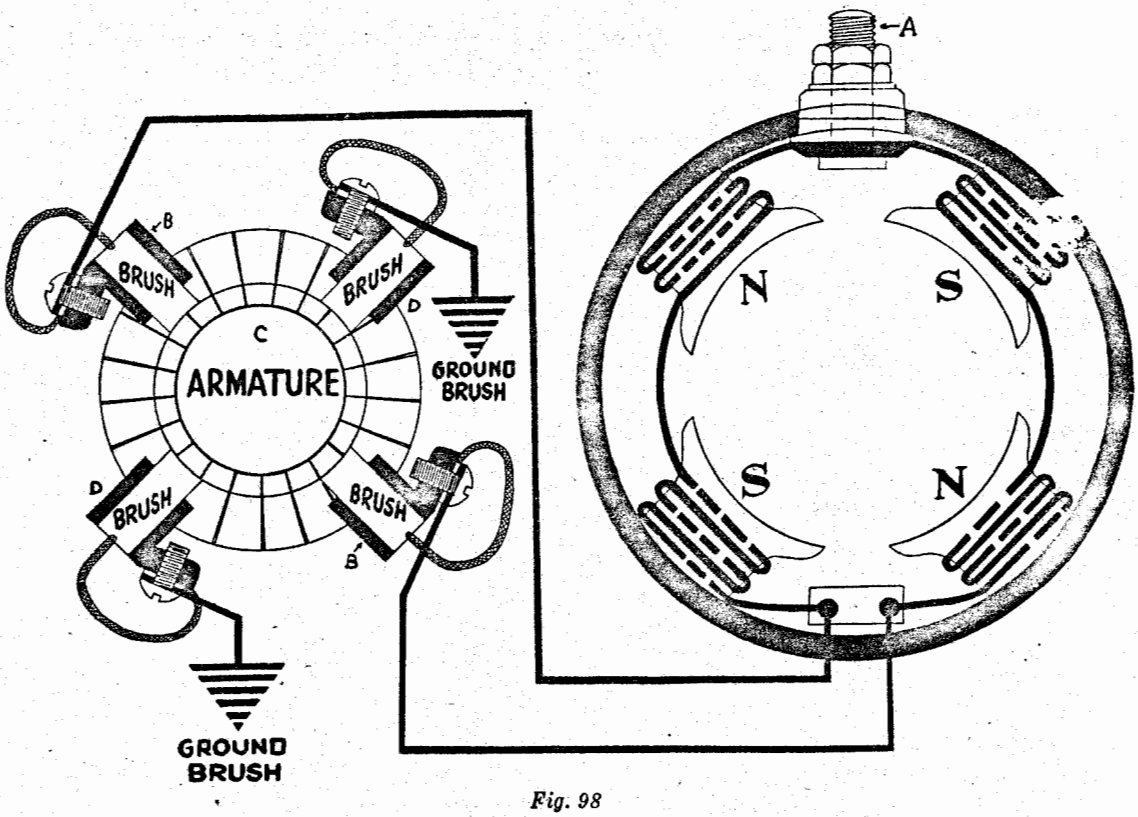

Fig. 98

of the Generator. It has four brushes, however, and the windings in the armature and field coils are much heavier; the bearings also differ in that a composition bearing is used at the front and a bronze bearing at the rear. The armature shaft is made long to accommodate the Bendix Drive.

Motor Trouble

In making tests on the Starting Motor, you proceed in practically the same manner as with the Generator.

Open Circuit

If a Starting Motor has ceased to function, about the first thing we look for is open circuit. The test for open circuit is made by running the Starting Motor free, by having it attached to the battery. If the motor fails to run and there is no indication of current passing through it, you have an open circuit: Or if the motor runs slowly and the bearings are free, it is an indication that there is a partially open circuit, brushes not seating properly, or poor contact of connections some place in the motor.

To make your inspection, remove the cover band, as you would on the Generator, exposing the Commutator and Brush Holder Assembly. If, upon making your inspection, you cannot find anything wrong, it will be necessary to dismantle the motor, testing out each unit with the test points until you find just where the trouble is. Of course, it is possible that all it may need would be to have the Brushes sanded and the Commutator cleaned. It is a good plan to use the test points on the fields to see that they are not grounded or open circuited. These tests are made in the same manner as the tests on the Generator field. In any case, the Commutator should be cleaned, the mica undercut and the brushes sanded.

Short Circuit or Ground

If, when making the free running test, the motor fails to turn, or turns very slowly, and there is an indication of a heavy current consumption, it is an indication that there is a ground or short circuit in the motor. This could be caused by grounded Brush riggings, grounded main motor terminal, grounded

armature grounded fields, short circuited armature or short circuited fields.

In making the tests of the fields, proceed as described in making the test on Generator. In making the test of the Brush Holder, use the test points on the two insulated Brushes. These should not light the light when one test point is held on the case and one point on either Brush Holders.

It is not possible to use the growler on the Starting Motor Armature test, due to its large winding so that about the only test you can make would be to test it for grounds with the test points and clean the Commutator.

The only point at which there is danger of an open circuit in the armature is at the point of connection between the end of the coils and the Commutator bar. An opening at this point can always be detected by visual examination. It could be caused by defective soldering. To remedy this, pull the lead out of the slits in the commutator riser, clean them thoroughly and re-solder properly.

An open motor armature coil can usually be quickly detected by a flat spot on the commutator, caused by the constant arcing by the commutator coil. This arcing burns the commutator continuously at one point until it has made a flat spot. This flat spot increases the trouble by causing the Brushes to jump at each turn of the armature when they come in contact with it.

If fields are grounded or short circuited, they should be replaced with new ones. In replacing them, proceed as shown under replacing fields in instructions given under Generator repairing.

Bent Shaft

One of the most frequent troubles experienced with a Starting Motor is a bent shaft. The Drivers get careless and fail to retard the spark when starting. This causes the motor to back-fire, placing a very heavy strain on the Bendix Shaft Gear and Spring. This frequently results in the bending of the armature shaft and the damaging of the Fly Wheel Ring Gear teeth.

Continued practice of starting the motor with the spark advanced will cause the Fly Wheel Ring Gear teeth to wear until the Bendix gear endeavors to ride over the top of the teeth, locking the whole assembly and the motor.

Fly Wheel Ring Gear

As the engine always stops in one or the other of two places, due to a Piston compression, one or the other of these two places on the Fly Wheel Ring Gear will receive all the starting strain, or stall torque. For this reason, the teeth on the Ring Gear will show more wear at these two places than any other.

It is always advisable to carefully examine the Fly Wheel Ring Gear teeth when overhauling the engine or repairing the Starting Motor or Bendix. If the teeth are badly worn, the Ring Gear should be replaced—if only slightly worn, however, the position of the Ring Gear may be changed one-quarter of a turn so that the Bendix Gear will engage in a different place.

Bearings

The motor is equipped with solid bearings—the rear bearing is bronze and the front bearing is a composition.

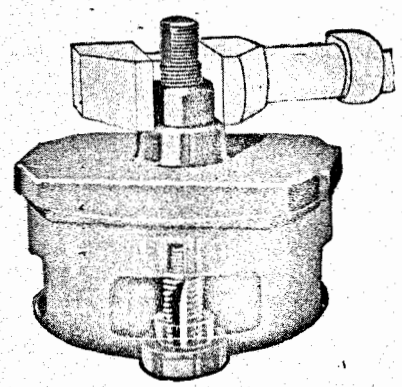

Fig. 99

As the starting motor is only actually run a few hours during the season, there is no reason

why these bearings should show a great amount of wear, unless dirt is allowed to get into them when repairs are made.

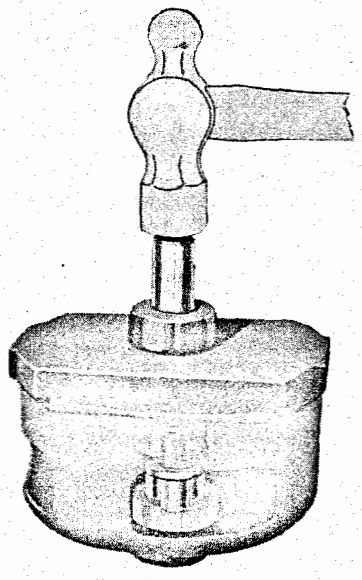

Fig. 100

If the bearings become badly cracked or worn, they may allow the armature to run off the centre, causing it to rub on the pole piece. The rear bearing is easily replaced. However, the front bearing should be removed by the use of a puller, Fig. 99.

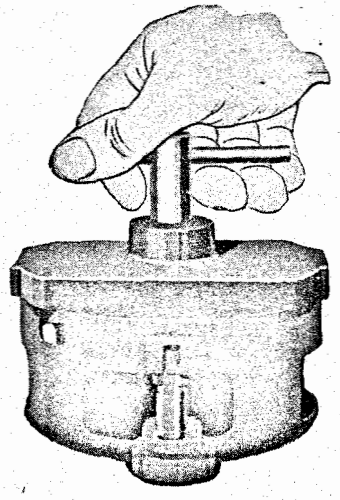

Fig. 101

This puller is turned down into the bearing by tightening the nut, as shown. The bearing is pulled out. To replace the new bearing, use special driver, Fig. 100. T[illegible]e bearing in true, then use the rea[illegible]g. 101, this align reams the bearing to fit the end of the armature shaft.

As soon as you have finished overhau[illegible] the Starting Motor, it is a good pla[illegible]t on the torque test, similar to the one shown in Fig. 102. This tester is connected to the armature shaft as shown and a fully charged battery connected up direct to the motor.

A motor in good condition should show a 36 to 38 pound reading on the scale. If a lower reading is obtained, carefully examine the battery to see that it is in good condition, and

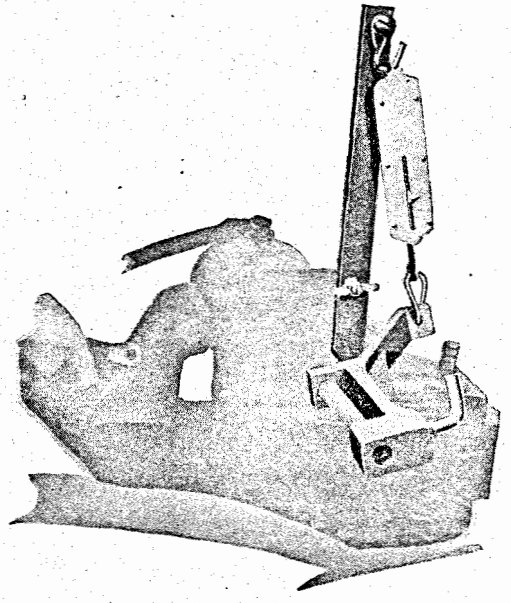

Fig. 102

if the trouble is not in the battery, again carefully go over the starting motor to see if your work has been performed correctly.

Dealer's Claims

While the Courts have given several judgments to the effect that goods become the property of the purchaser or consignee as soon as the bill of lading is signed by the carrier, it is the intention of the Ford Motor Company of Canada, Ltd. to assist its dealer organiza-

tic ...ing compensation for losses or damages ... transit.

The Company will be glad to undertake ...osecution of just claims on behalf of ... ...ien proper information accompanies claim ...ers. Dealers will understand, of course, that we cannot guarantee any settlement.

All shipments should be inspected before signing the freight receipt and if they are not in perfect condition, this fact should be called to the Railway Agent's attention and noted on both the freight bill and receipt.

The seals and general condition of carloads should be noted upon opening so that should any damage or shortage be discovered the probable cause may then be explained. Details of this kind materially strengthen the claim.

If the contents appear to have shifted in any manner it is advisable to call a Railway representative for inspection of the load as the damage may be shown to have resulted from rough switching and this should be determined while the contents are being unloaded from the car. In some cases defective equipment may be the cause of damage.

The principal point is to have the Railway representative make an inspection of any suspicious condition and have this noted on the freight bill before signing for the goods but if the loss or damage is found after the receipt has been given, which may happen if the containers are in good order, have the railway Agent make an inspection at once and mark the freight bill.

After this has been done forward the original freight bill and full details to the Branch without delay, having in mind the claim must be entered within four months.

If any repairs are made attach a statement showing the material and labor expended.

Markings on Lincoln Clutch Ring and Flywheel

A mark for setting the spark for the left block has been added to the timing marks, as shown in Fig. 103. Instead of the "RET" mark formerly used, the points are now marked R1 and R2. R1 for cylinder No. 1 right block and R2 for cylinder No. 2 left block.

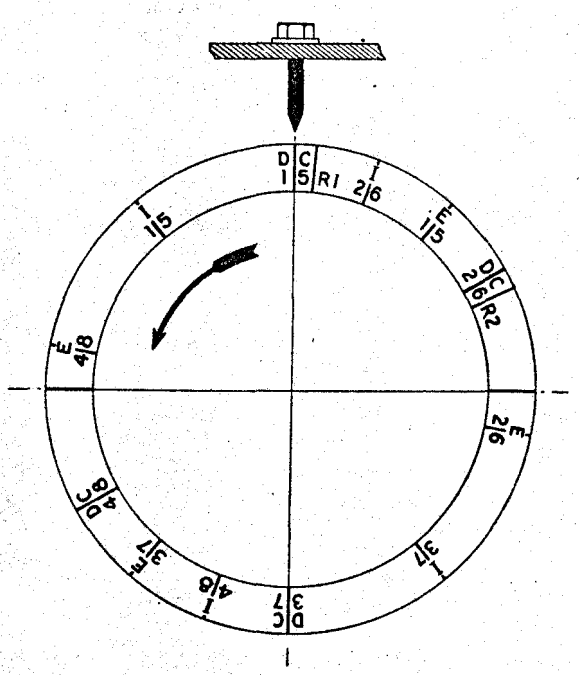

Fig. 103

Wrench Chart

In the February edition of the Ford Service Bulletin we are illustrating a wrench chart.

An enlarged wrench chart similar to this size 2′ x 2′8″ can be obtained free of charge from the Prescott W. Robinson Sales Co., Ltd. of Montreal. This chart makes a very handy reference for mechanics in learning a correct size and shape of wrench to use on the different belts and nuts of the Ford car.

MOTOR TROUBLE CHART

MOTOR TROUBLES

- **Mechanical Troubles**
  - Worn Bearings
  - Shaft Bent
  - Commutator Burst
  - Loose Pole Piece
  - Broken Bendix
  - Armature Off Centre

  → All Indicated by Excessive Current Draw and Slow Cranking or Complete Failure to Crank and Excessive Noise

- **Electrical Troubles**
  - **OPEN CIRCUIT**
    - Brush Rigging
      - Pigtails
      - Brushes Not Contacting

      → Brushes Too Short; Poor Spring Pressure; Dirty or Burned Commutator

      → All Indicated by Low Current or No Current and Failure to Crank. If Only Partial Open Occurs the Current Draw will be Low and Cranking Slow.
    - Armature → Intense Blue Spark at Brush and Flatted Commutator with Slow Cranking
    - Fields → No Current; No Cranking
  - **GROUND OR SHORT CIRCUIT**
    - Fields → Excess Current; Slow Cranking
    - Armature → Excess Current; Burnt Insulation; Slow Cranking
    - Commutator → Excessive Current; No Cranking
    - Brush Rigging
      - Main Terminal
      - Brush Holders
      - Pigtails and Connectors

      → Indicated by Excessive Current and No Cranking or Slow Cranking

Fig. 104