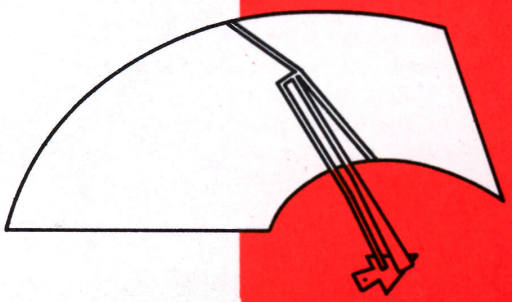
MASTER TECHNICIANS SERVICE CONFERENCE

REFERENCE BOOK

70-11

WINDSHIELD WIPERS



CHRYSLER MOTORS CORPORATION

PLYMOUTH • DODGE • CHRYSLER
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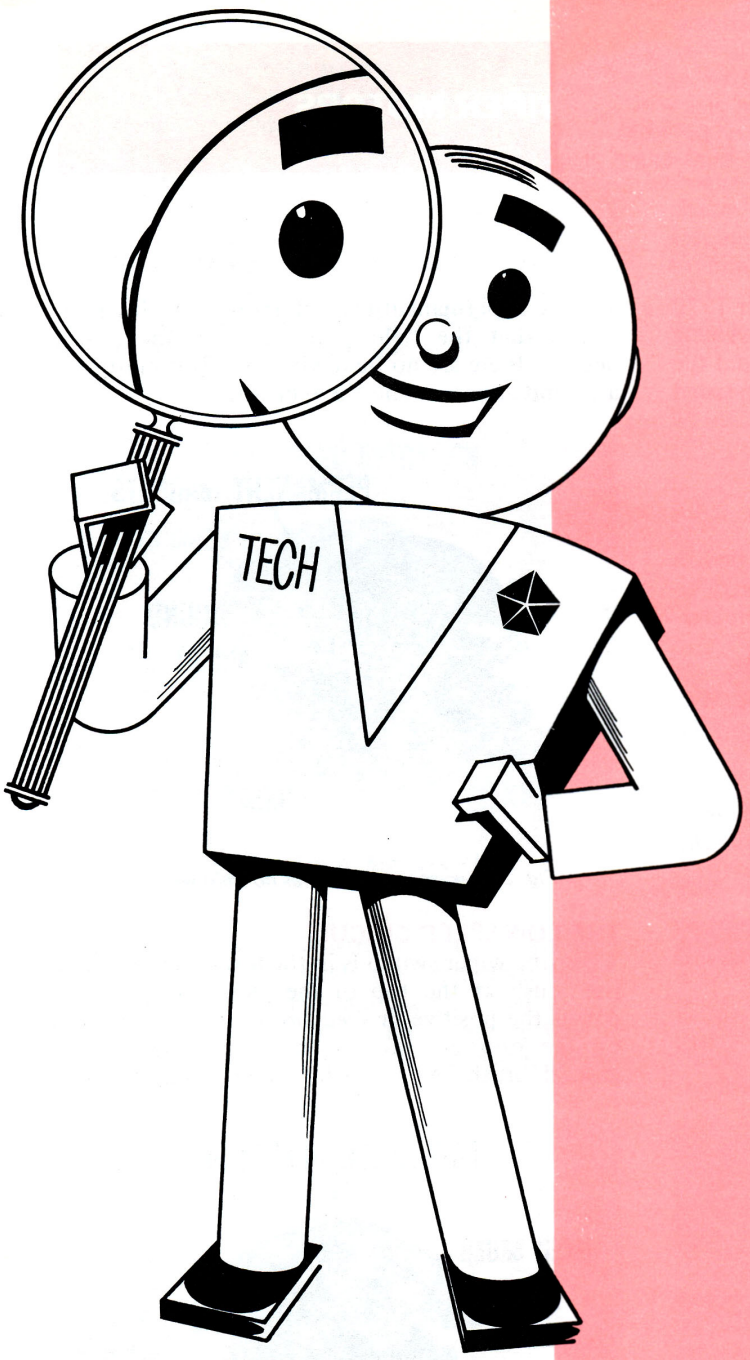
THERE'S MORE TO IT THAN MEETS THE EYE

Windshield wipers are generally so dependable that no one thinks very much about them unless they stop wiping. Even then it doesn't seem that there could be anything very complicated or difficult about windshield wiper service. But when you get into a wiper job you'll find there's more to the windshield wiping system than meets the eye.

Like we said, wipers that won't work aren't a common problem but there are quite a number of things that can keep the wipers from doing their job. For instance, it could be the wiper switch . . . the wiring or an electrical connection . . . the drive linkage . . . the wiper pivots . . . or possibly in the motor itself.

Now, it's a fact that we have three different wiper motors and windshield wiping systems on our current model cars. If you understand how each of these work and use the troubleshooting ideas Tech has worked into this session, you too can be a windshield wiper expert.



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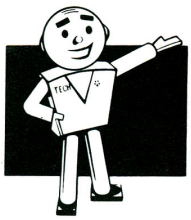


THE 1970 WINDSHIELD WIPER MOTORS

Three different wiper motors are used on our 1970 models. One of these is a two-speed, non-reversing motor, one is a two-speed reversing motor and the third is either a three-speed or variable-speed motor . . . depending on the type of switch used to control the speed of the wipers.

CHARACTERISTICS OF DIRECT CURRENT MOTORS

In order to understand how speed is controlled in each of the three wiper motors, it is necessary to know something about the operating characteristics of a direct current motor.

Fact number one: The stronger the magnetic field or the more turns in the armature windings, the slower the motor speed.

Fact number two: The slower the armature turns, the more current it draws and the more torque the motor develops.

TWO-SPEED NON-REVERSING MOTOR

The two-speed, non-reversing motor is the easiest to understand so we will explain how it works before we get into the other two motors.

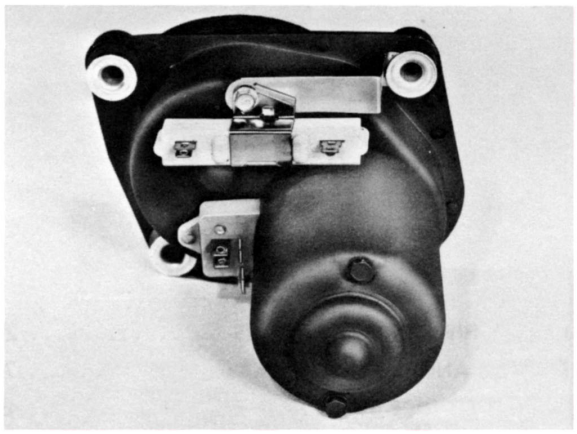


Fig. 1—Two-speed, permanent-magnet motor

This is a permanent-magnet motor which simply means that the field poles are permanent magnets . . . there are no field windings. This motor has a wound armature and three brushes.

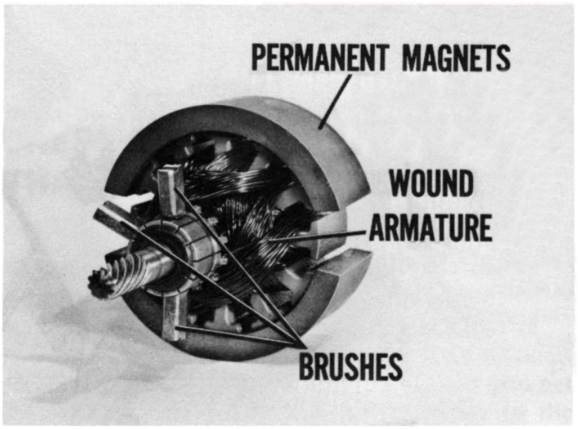


Fig. 2—Two-speed motor has no field windings

THE LOW-SPEED CIRCUIT

When the wiper switch is in the low-speed position, the brush at the top of the picture (Fig. 3) becomes the positive or feed brush. The lower brush on the opposite side of the commutator is the ground brush. As a matter of fact, this brush is

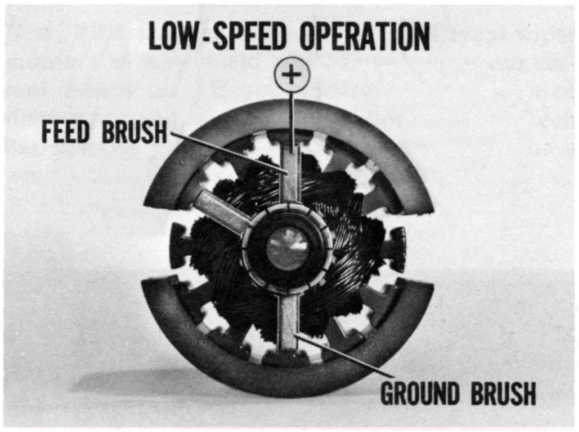


Fig. 3—Two-speed motor with ground brush

permanently connected to ground on the 2-speed, non-reversing motor. This is worth remembering because a two-speed, non-reversing motor will not run if there is a poor connection at the motor ground strap.

THE HIGH-SPEED CIRCUIT

For high-speed operation, the third or remaining brush becomes the plus or feed brush and the lower brush is the ground brush. Notice that the high-speed brush is located 60 degrees from the low-speed brush.

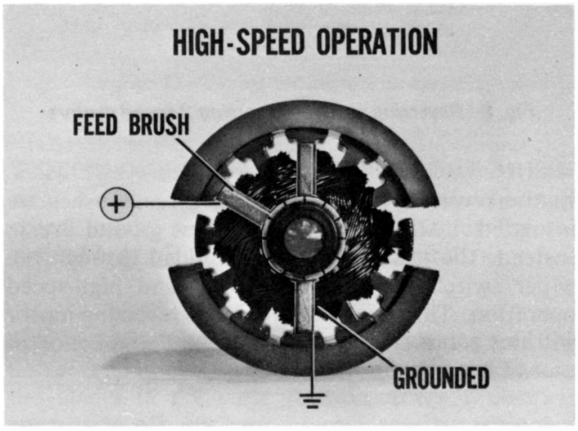


Fig. 4—Circuit through high-speed brush

ARMATURE WINDINGS AND SPEED

In the accompanying illustration you can see that when the feed is through the high-speed brush, fewer armature windings are used . . . that is why motor speed is high. When the armature feed is through the low-speed brush, more armature windings are being used so motor speed is slower.

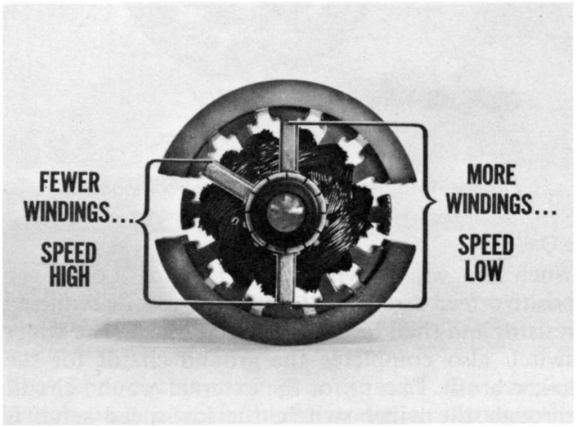


Fig. 5—Number of armature turns determines speed

TORQUE-REDUCING RESISTOR

The purpose of the white ceramic resistor on the outside of the wiper motor is frequently misunderstood. This resistor is connected in the circuit to the low-speed brush. Its primary function is not to change or reduce motor speed. Rather, since motor torque is highest at low speed, the resistor is used to limit current flow which in turn reduces low speed torque. If it were not for this torque-reducing resistor, the motor might chew up the drive gears if the wiper blades froze and couldn't move.

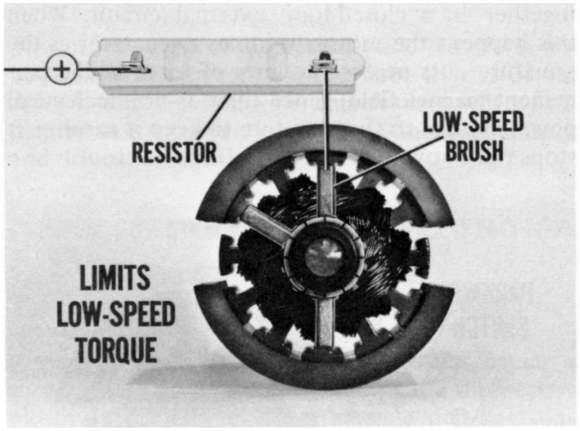


Fig. 6—Resistor prevents damage to drive gears

THE "OFF" OR "PARK" CIRCUIT

When the wipers are turned off, the wiper switch feeds the low-speed brush an entirely different external circuit. This external circuit connection leads to a parking switch built into the motor assembly. From the parking switch the circuit goes through the torque-reducing resistor and then to the low-speed brush.

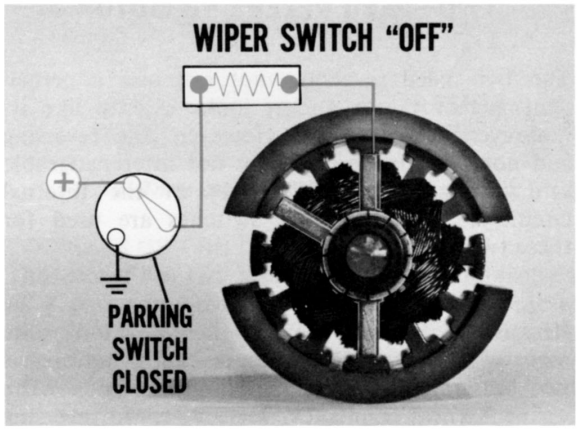


Fig. 7—Circuit through internal parking switch

THE PARKING SWITCH APPLIES THE BRAKES

When the feed is through the parking switch, the armature continues to rotate until the wiper blades reach their "park" position. At this point, a cam mechanism incorporated in the output gear opens the parking switch. This cuts off the armature feed.

In addition to cutting off the feed circuit, the parking switch connects the low-speed brush to ground. In other words, there are now two ground brushes and no positive brush. This is the same as connecting the low-speed brush and the ground brush together in a closed-loop external circuit. When this happens the motor becomes a generator as the armature cuts across the lines of force in the permanent-magnet field. Since there is no mechanical power applied to the armature to keep it turning, it stops right now instead of coasting to a stop.

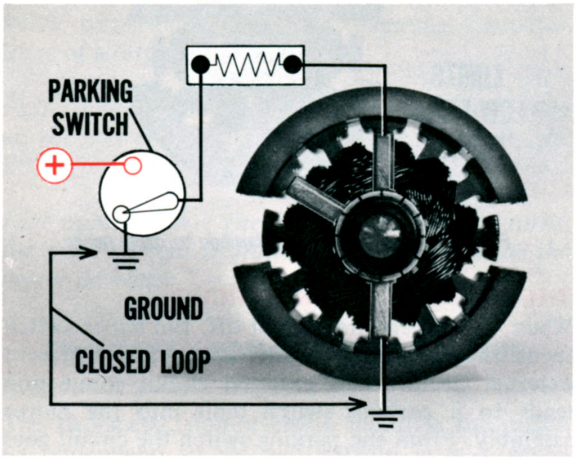


Fig. 8—Parking switch grounds low-speed brush

TWO-SPEED REVERSING MOTOR

The two-speed reversing motor is also a permanent-magnet motor and it looks exactly like its non-reversing near-twin. However, the reversing and non-reversing motors are not interchangeable and, because of differences in the internal circuitry, different wiper switches are used for these two wiper motors.

THE BRASS TELLS THE TALE

Here is how you can identify these two look-alike motors. The two-speed, non-reversing motor has two brass and two gray metallic terminals for the wiring harness connector. The two-speed reversing motor has one brass and three gray terminals.

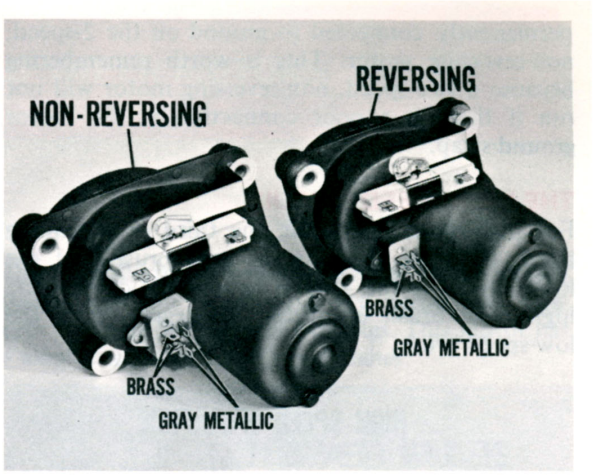


Fig. 9—Reversing and non-reversing 2-speed motors

INSIDE THE TWO-SPEED REVERSING MOTOR

In the reversing-type motor, all three brushes are insulated . . . there is no permanent ground brush. Instead, the lower brush is grounded through the wiper switch for both low-speed and high-speed operation. That's why a two-speed reversing motor will not run if there is a poor ground connection at the wiper switch.

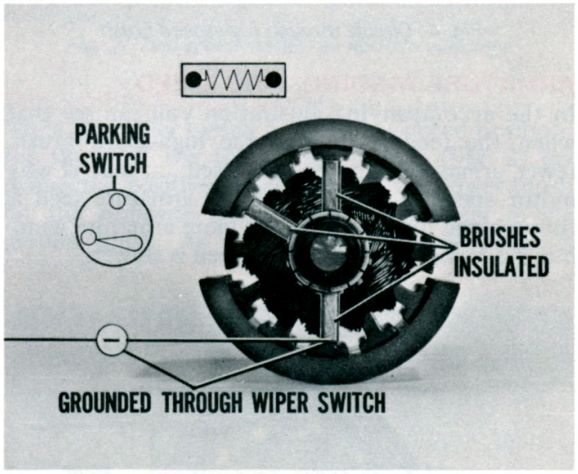


Fig. 10—Two-speed reversing motor components

LOW-SPEED OPERATION

When the wiper switch is turned to "Low", the positive feed circuit is through the torque-reducing resistor and then to the low-speed brush. The wiper switch also completes the ground circuit for the lower brush. Except for the external ground circuit through the wiper switch, the low-speed setup is the same as for non-reversing motor.

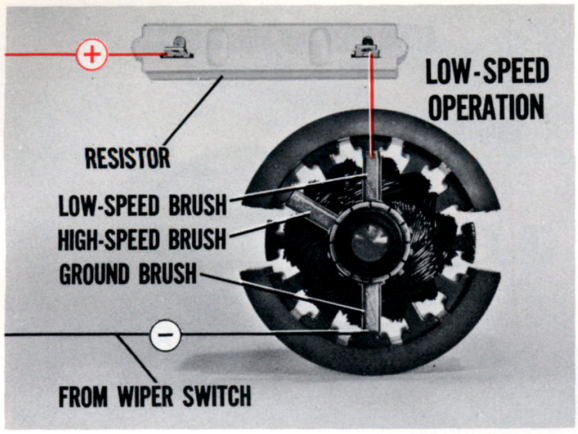


Fig. 11—Circuit for low motor speed

HIGH-SPEED OPERATION

When the wiper switch is in the high-speed position, it completes a circuit which feeds the high-speed brush. And of course, the circuit for the ground brush is through the wiper switch.

THE PARK CIRCUIT SEQUENCE

The big difference between the reversing and the non-reversing motors is in the circuits used to stop the blades in the park position. When the wipers are turned off, the wiper switch reverses the polarity of the two brushes normally used for low-speed operation. The lower brush becomes the positive feed brush and the upper brush becomes the ground brush.

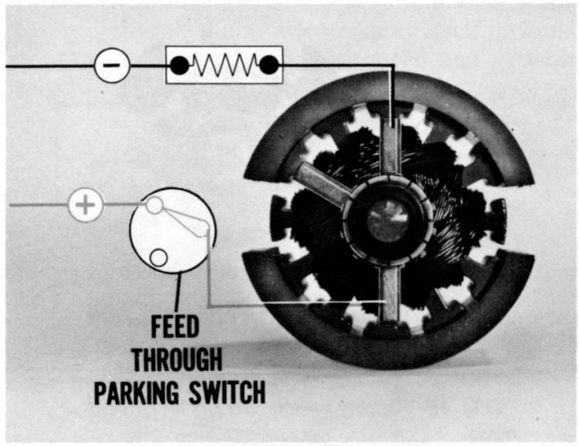


Fig. 12—Wiper switch reverses armature polarity

The feed circuit now goes through the parking switch built into the motor and then through the torque-reducing resistor. As a result, the motor will continue to run in reverse as long as the parking switch remains closed.

When the wiper blades reach the park position, parking switch contacts are moved from "Feed" position to the "Ground" position by a cam built into the wiper motor gear set. As in the case of the non-reversing motor, disconnecting the armature feed and completing the external closed loop circuit causes the armature to stop and the blades to park in the correct position without coasting.

OFF-THE-GLASS PARKING

The off-the-glass or depressed park feature is not built into the motor assembly but is part of the drive linkage mechanism. This feature will be explained in a later section devoted to wiper linkage and drive mechanisms.

THREE-SPEED OR VARIABLE-SPEED MOTOR

The same motor is used for three-speed and variable-speed wiper applications. This motor becomes a variable-speed motor when a switch having a rheostat is used to control speed. It is a three-speed motor when used with a switch which has step-type resistance units.

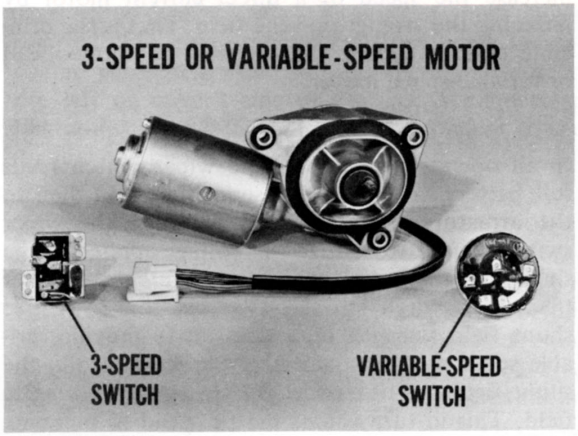


Fig. 13—Three-speed and variable-speed switches

TWO SETS OF FIELD WINDINGS

This motor has two separate field windings instead of a permanent-magnet-type field. One of these, the series field, is wound with heavier wire and is connected in series with the armature. The other field of smaller wire is called the shunt field because it is connected in parallel or across the brushes.

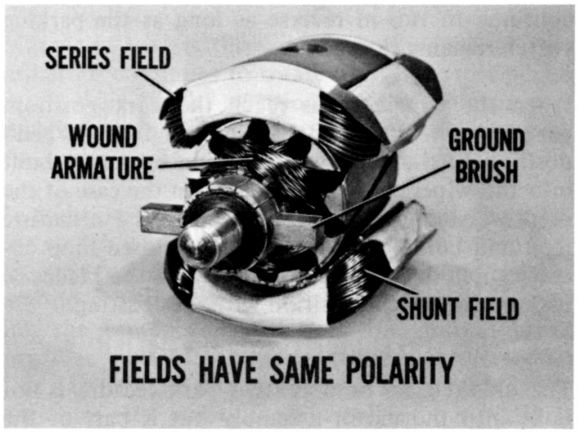


Fig. 14—Motor with two field windings

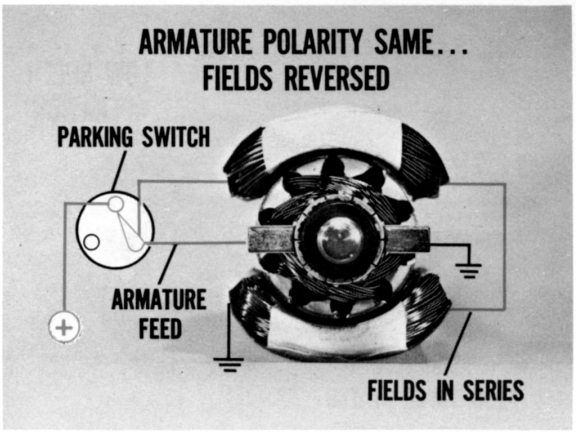


Fig. 15—Wiper switch reverses field polarity

WOUND ARMATURE AND TWO BRUSHES

A wound armature is used and only two brushes are used. One of these brushes is always positive and the other is always grounded so the polarity of the armature never changes. Like the two-speed non-reversing motor, this motor will not run unless a good ground is provided at the motor.

THE WEAKER IT GETS THE FASTER IT GOES

Earlier, when we talked about the characteristics of electric motors, we pointed out that you can increase the speed of a direct current motor by reducing the strength of the field. That is the principle used to control the speed of our three-speed or variable-speed motors.

SHUNT FIELD CONTROLS MOTOR SPEED

In all operating positions, the wiper switch feeds full battery voltage to the series field and then to the armature. The resistance unit in the wiper switch is used to change the voltage applied to the shunt field. It doesn't make any difference whether the wiper switch has step-type resistors to reduce shunt field strength or a rheostat to provide variable speed-control. Increasing the resistance in the shunt field circuit reduces the strength of magnetic field. This in turn causes motor speed to increase.

THE PARK CYCLE CIRCUITS

When the wipers are turned off, the polarity of the armature stays the same. However, the wiper switch reverses the polarity of both field circuits. This causes the motor to reverse and run in the opposite direction.

The accompanying illustration shows what happens to the internal circuitry when the wipers are turned off. Notice that all current flow is no longer through the parking switch built into the motor. The armature is now supplied directly instead of going through the series field and the two fields are connected in series with each other.

THE PARK SWITCH CUTS THE CURRENT OFF

The motor continues to run in reverse until the blades reach the park position. At this point, a cam opens the park switch. This cuts off the current to both the armature and the two fields. As a result, the motor stops with the blades in the depressed park position.

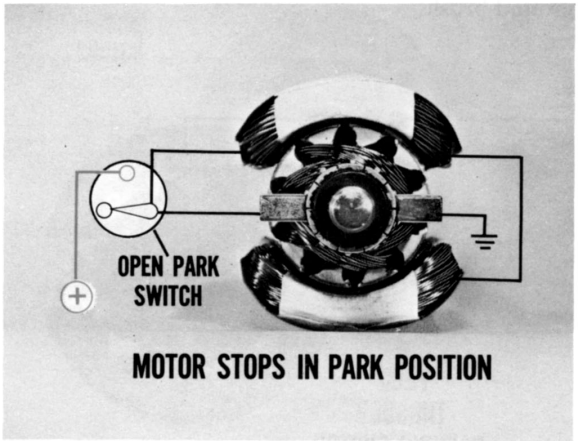


Fig. 16—Parking switch cuts off all current

THE ANTI-STREAK FEATURE

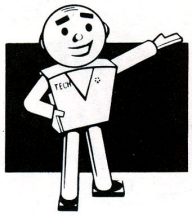
After the motor reverses, it always completes one full wipe pattern before it goes into the final phase of the park cycle. This is referred to as the "anti-streak" feature because the motor never reverses

Fig. 17—Wiper completes full wipe pattern

halfway through a wipe cycle when the wiper blades are moving upward. This eliminates the possibility of the blades leaving a streak across the glass when they reverse and move into the depressed park position.

THE DEPRESSED PARK FEATURE

In the case of the three-speed or variable-speed motor, the depressed park mechanism is built into the motor assembly. This feature as well as the depressed park mechanism for the two-speed reversing motor is explained in the next section.



WIPER LINKAGES AND DEPRESSED PARK MECHANISMS

The linkage arrangement is pretty much the same for all three wiper motor applications. The actual drive links and connecting links vary somewhat from one car model to another. On depressed park applications, the overtravel feature is incorporated in the crank arm and drive link in the case of the two-speed reversing motor. A different mechanism, incorporated in the motor assembly itself, is found on the motor used for three-speed and variable-speed applications.

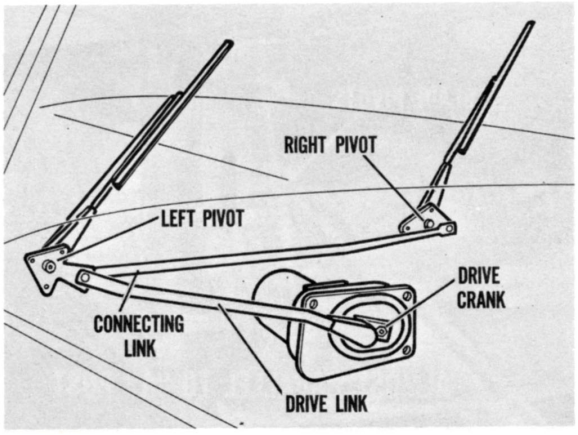


Fig. 18—Typical wiper drive linkage

TYPICAL WINDSHIELD WIPER DRIVE LINKAGE

The drive arrangement is typical of most wiper systems. The outer end of the drive crank is connected through a drive link to the wiper pivot on the left or driver's side of the car. A connecting link couples the left windshield wiper pivot to the pivot at the right side of the car.

TWO-SPEED MOTOR, DEPRESSED PARK MECHANISM

Cars equipped with the two-speed reversing motor have the depressed park feature. That is, the blades park off the glass when the final wipe cycle is completed. This disappearing act is accomplished by a cam mechanism at the end of the motor crank arm.

During normal operation the motor and the crank arm rotate in a counterclockwise direction. The cam mechanism on the end of the crank arm is positioned so that the crank throw or effective length of the crank is about 2-5/8".

As was pointed out earlier, when the wiper switch is turned off, the wiper motor reverses and rotates in a clockwise direction. This causes the cam to rotate in a clockwise direction. Rotating the cam

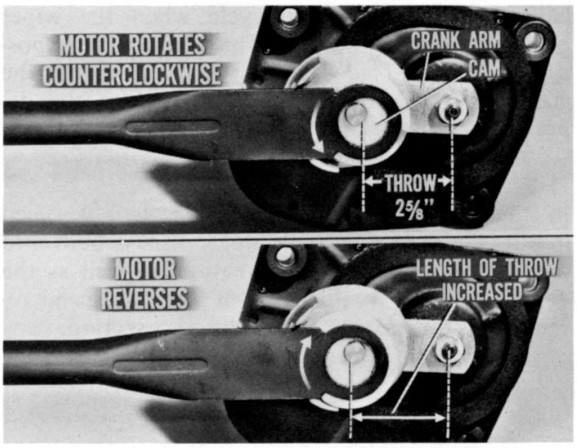


Fig. 19—Cam action provides extra travel

increases the effective length of the crank throw to about 2-7/8". This 1/4" increase in crank throw causes the outer end of the wiper blades to travel about 4" farther so that they park in the "off glass" or depressed park position.

THREE-SPEED MOTOR, DEPRESSED PARK FEATURE

On cars having the three-speed or variable-speed wiper option, the depressed park mechanism is built into the motor assembly. During normal operation the motor turns counterclockwise and the crank arm is in the position shown in the upper part of the accompanying illustration. Notice that the center of crank rotation is at the center of the output shaft . . . not around the eccentric shaft. During this phase of wiper operation the eccentric shaft merely provides the means of attaching the crank to the motor output shaft.

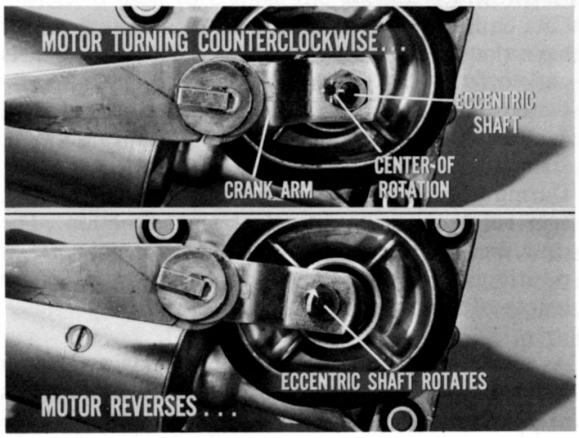


Fig. 20—Eccentric shaft provides depressed park

When the wipers are turned off, the motor reverses and completes one full wipe cycle. Then, when the wiper blades reach the lower end of the wipe pattern, the eccentric shaft actually rotates one-half revolution. This rotates the crank arm as shown in the lower part of the accompanying illustration. In other words, the overtravel action of the eccentric mechanism moves the blades off the glass and into the depressed park position.

ARTICULATED LINK WIPER ARM

On some models, an articulated link wiper arm is used at the left side of the windshield. When the left wiper blade and arm are near the lower end of the wipe pattern, the wiper blade is almost parallel to the wiper arm.

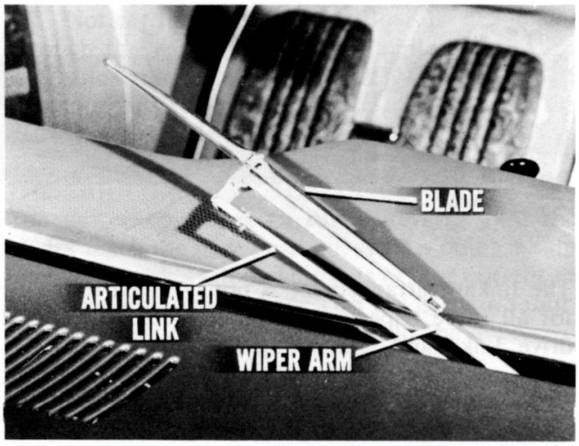


Fig. 21—Wiper blade parallel to wiper arm

As the wiper arm moves upward, the articulating link causes the lower end of the wiper blade to

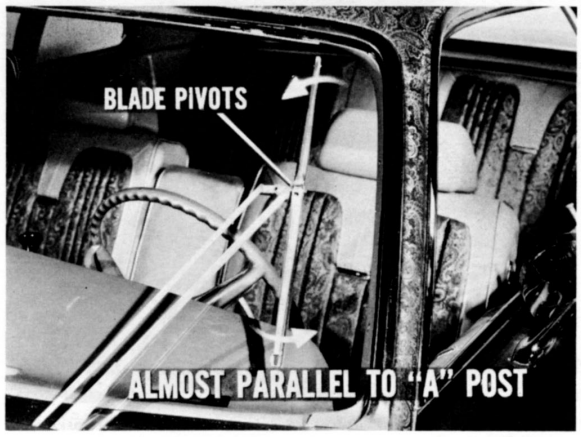


Fig. 22—Articulated link provides more wiped area

pivot so that it moves away from the wiper arm. At the extreme upper end of the wipe pattern, the lower end of the wiper blade has been moved about 4" ahead of the wiper arm and it is almost parallel to the windshield "A" post.

The advantage of the articulated link mechanism is more wiped area and better visibility through the windshield. This is most evident on the driver's side in the area adjacent to the "A" post.

NEW WINDSHIELD WIPER ARM ATTACHMENT

A new type of windshield wiper arm was introduced as a running change on some of our 1970 models. If you run into one of these models and can't find the pinhole provided on previous models for the purpose of wiper arm removal and installation, don't try to pry the arm off its pivot. Instead, take a close look at the lower end of the arm. The new arm has a built-in latch and release mechanism that allows you to remove and install wiper arms without a special tool . . . or even a small pin or paper clip. Simply lift the blade and arm away from the glass, then, pull the release tab outward. This locks out the spring pressure on the pivot and the arm can be very easily removed or reinstalled.

The accompanying illustration shows this latch as seen from both front and rear. This explains the new wiper arm latch setup better than a page full of words.

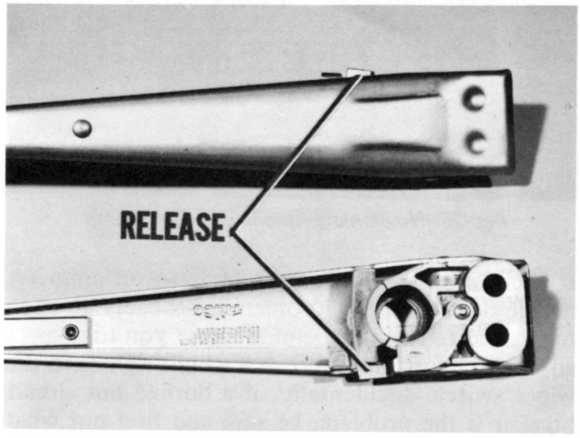
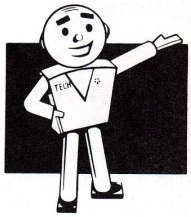


Fig. 23—New wiper arm release mechanism



DIAGNOSIS AND SERVICE TIPS

Diagnosis is mostly a matter of knowing how each of the motors work, understanding the circuitry for each position of the wiper switch and then applying a little common sense. As you very well know, it isn't easy to get at the drive linkage . . . particularly on intermediate and compact models where the linkage is buried under the instrument panel. And of course, replacing the wiper switch or even reaching the switch terminals isn't the easiest job in the world. For these reasons, it's a good idea to uncover all the clues you can before you start removing parts. Try and narrow the trouble down to the switch, the external circuit connections and wiring, or a possible bind or hangup in the linkage. You can save a lot of time, embarrassment and needless work by making a few quick easy checks before you do anything else.

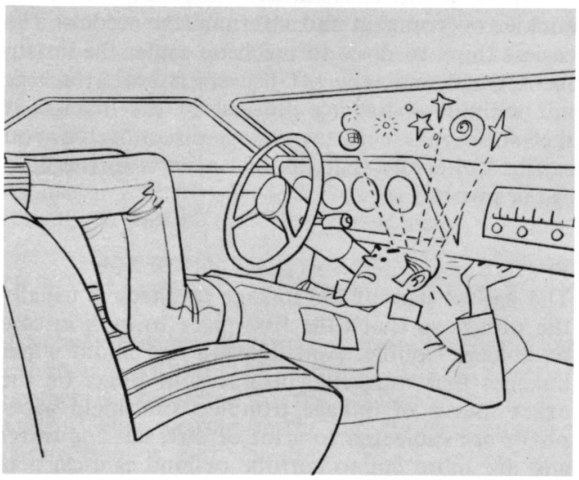


Fig. 24—Some linkages are difficult to service

READ THE AMMETER CLUES

A good troubleshooting start can be made by turning the ignition key to the accessory position and then turning the wipers on. Try each wiper switch position, including "off", to find out what kind of wiper problem you're dealing with. Watch the ammeter as you try each switch position.

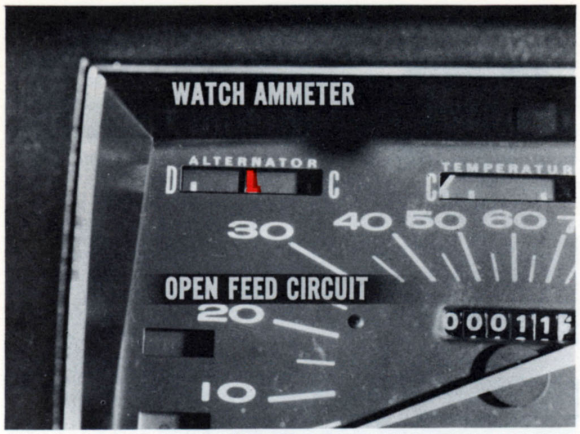


Fig. 25—No ammeter discharge or deflection

If there is no indication of discharge or ammeter needle deflection, the problem is probably an open feed circuit. This clue should cause you to suspect an open circuit breaker . . . it's built right into the wiper switch. Incidentally, if a burned out circuit breaker is the problem, be sure and find out what caused it to burn out before you turn the job back to the customer. Circuit breakers seldom fail unless they are continuously overloaded because of a binding linkage or pivot.

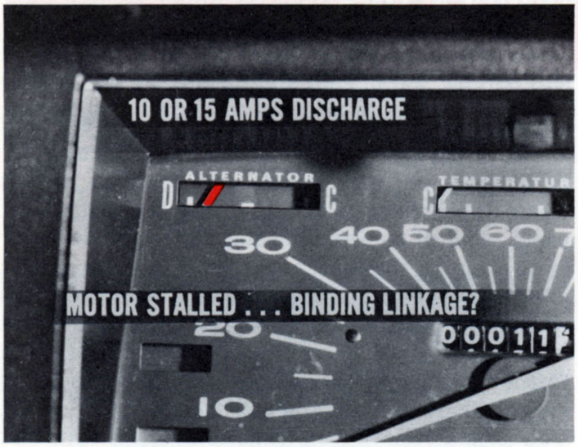


Fig. 26—Abnormally high discharge

If the ammeter needle bangs over against the discharge stop-peg and the circuit breaker pops open in a matter of a very few seconds, chances are there's a dead short somewhere. This could be in the external wiring or possibly in the motor itself. Incidentally, this is the kind of electrical problem that drives a hard-working circuit breaker to an early grave.

On the other hand, suppose the ammeter shows higher than normal discharge, but not more than about ten or fifteen amperes and it takes fifteen or twenty seconds to open the circuit breaker. In that case, the wiper motor is probably stalled and this is putting an electrical overload on the circuit breaker. This clue could mean internal motor trouble or simply a binding linkage. Read on and find out how to narrow it down to one or the other.

FOLLOW UP THOSE AMMETER CLUES

Those quick ammeter clues can help you decide what to do next. For instance, if there is no discharge at all, the obvious thing to check is the external electrical connections. On the three-speed motor, the wiring harness is part of the motor assembly so the first place to check is at the bulkhead disconnect. Two-speed motors use a separate wiring harness from motor to bulkhead, so be sure and check for loose connections at both ends of the wiring harness. And don't forget, even if the insulator part of the connector is tight, there could be a loose connection at one of the terminals inside the connector. Check the connection between each wire and its brass terminal connector.

IF THE LINKAGE BINDS, HELP IT

If a ten- or fifteen-amp discharge causes you to suspect a bind in the linkage or pivots, reach into the car and flip the wiper switch on with one hand. At the same time, give the wiper arm a gentle assist with the other hand. If a helping hand starts the wiper working again, the problem is probably mechanical rather than electrical. It isn't too hard to check this out on a car having the linkage inside the fresh-air intake chamber. The problem's a little stickier on compact and intermediate models. The easiest thing to do is to reach up under the instrument panel and take off the crank arm attaching nut without disturbing the rest of the linkage. If the motor runs with the linkage disconnected, you can be quite sure that the bad news is in the linkage or pivots.

PIVOTS MAY GET UPTIGHT WITH AGE

The easiest part of the linkage to check is usually the pivots, so that's the first place to look in case of linkage trouble. And here's a fact about wiper linkages that will help you put your finger on the exact source of linkage trouble. Windshield wiper pivots are subjected to a lot of dirt, salt and water and are more apt to corrode or bind as a car gets older. So if the car is more than a year old, suspect

a binding pivot. On the other hand, the other bushings in the linkage may be a bit tight when the car is new but they tend to wear gradually and get loose and perhaps noisy as the car gets older.

OPERATIONAL CHECK OF THE WIPER MOTOR

If you suspect motor trouble, you can use a set of jumper wires to bypass all of the wiper wiring and the wiper switch. This will tell you whether or not the trouble is in the motor without removing the motor from the car. Since each of the three wiper motors has four electrical terminals, all you have to know to check out a motor is which terminals have to be connected to ground and which ones are connected to a positive battery lead for each wiper speed . . . including "OFF".

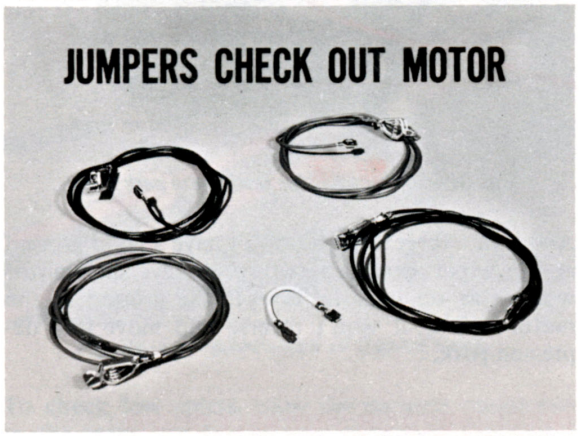


Fig. 27—Use jumpers to diagnose motor and circuit

The following wiper motor tests were performed and photographed on the bench so that the jumper connections could be easily seen and identified. These same connections will enable you to check out a motor without removing it from the car. As a matter of fact, when checking a motor on the car, the motor ground strap jumper connection will not be needed if the motor is properly grounded to the firewall. Notice in the illustrations which follow that each jumper has a brass connector soldered to its motor end to facilitate connections and minimizing the possibility of accidental shorts.

TESTING TWO-SPEED NON-REVERSING MOTOR

To check low-speed operation, a positive jumper is connected to the "L" terminal and a negative jumper is connected to the ground strap of the motor. When testing on the car, this ground strap connection is not required. These connections should cause the motor to run at low speed.

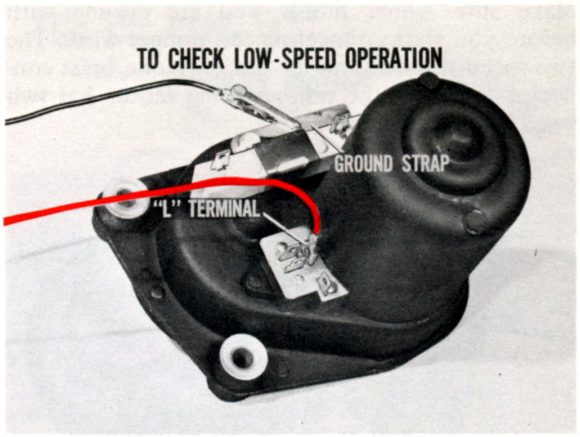


Fig. 28—Jumper connections test low speed

To check high-speed operation, connect the positive jumper to the "H" terminal and leave the negative jumper connected to the ground strap. Motor speed should increase noticeably.

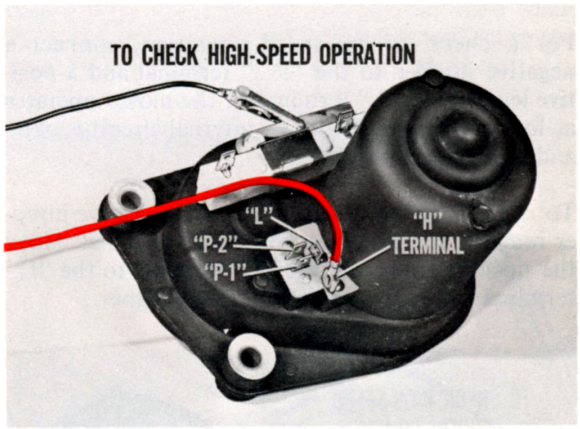


Fig. 29—Jumper connections for high-speed test

To make sure the motor goes through the park cycle when the wipers are turned off, use a short jumper to connect the "P-2" terminal to the "L" terminal. A positive jumper is connected to the "P-1" terminal. These connections route the feed circuit through the park switch built into the motor. The motor should run until it reaches the park position and then stop.

TESTING TWO-SPEED REVERSING MOTOR

Remember, the two-speed reversing and two-speed non-reversing motors look very much alike. However, since their internal circuitry is entirely different, the external test connections are different.

Make sure which motor you are dealing with before you start connecting test jumper wires. The two-speed reversing motor has only one brass connector terminal, the non-reversing motor has two brass connector terminals.

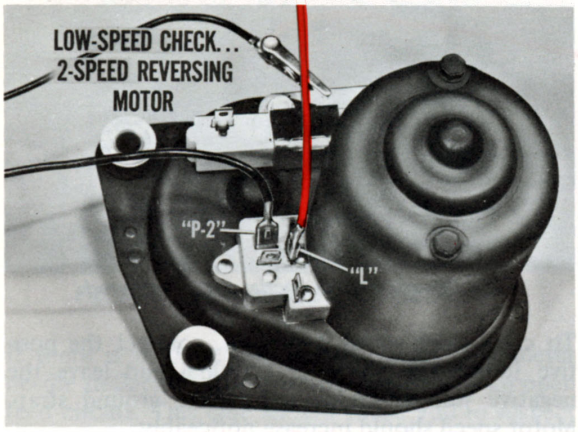


Fig. 30—Low-speed test of 2-speed reversing motor

For a check of low-speed operation, connect a negative jumper to the "P-2" terminal and a positive lead to the "L" terminal. If the motor operates at low speed, the motor and internal circuit is okay and the trouble is external.

To check high-speed operation, the negative jumper remains connected to the "P-2" terminal. Move the positive lead from the "L" terminal to the "H" terminal and motor speed should be higher.

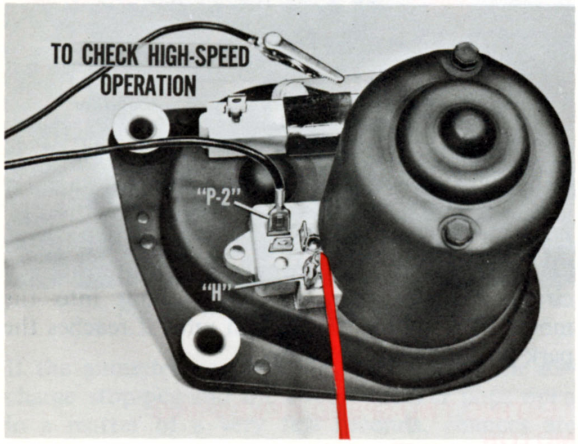


Fig. 31—High-speed test connections

To check out the park cycle, connect one negative lead to the "L" terminal and another negative lead to the motor ground strap. A positive lead is then connected to the "P-1" terminal. The motor should reverse and then stop in the park position. Of course, the ground strap jumper isn't needed when checking a motor on the car if you are sure the motor ground is good.

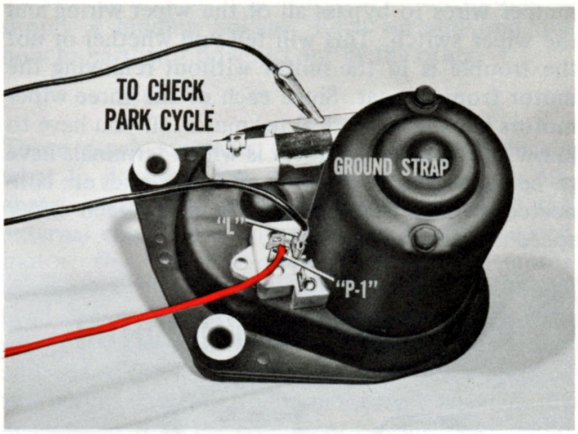


Fig. 32—Connections for testing the park cycle

And don't forget, if you don't have a good ground at the wiper switch, a two-speed reversing motor won't run on high or low. If the ground at the motor is bad, it won't reverse and move into depressed park.

THREE-SPEED OR VARIABLE-SPEED MOTOR TESTS

Since the wiring harness is part of the three-speed motor assembly, you'll have to remove the harness connector from the bulkhead disconnect to get at the motor leads. Three-speed and variable-speed

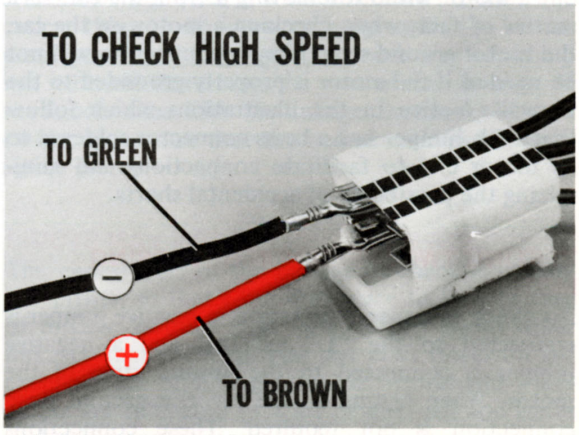


Fig. 33—High-speed check of 3-speed motor

applications use different bulkhead connectors, however, the same wire color code is used for the motor leads in all applications. So, the tests described in the following paragraphs will work regardless of the shape of the connector used.

To check high-speed operation, connect a negative jumper to the green-wire terminal and a positive lead to the brown-wire terminal. These connections supply current to the series field and to the armature but not feed current to the shunt field. As a result, the motor should operate at high speed.

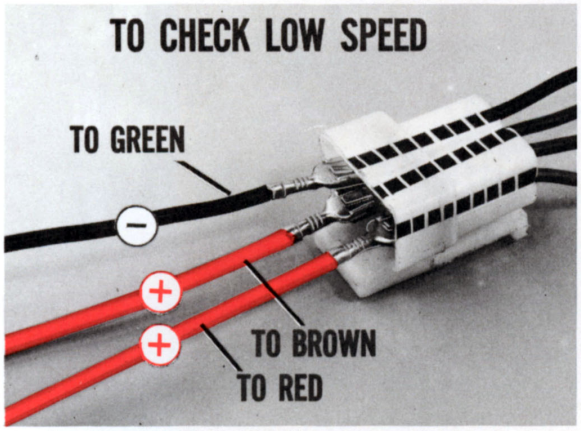


Fig. 34—Low-speed check of 3-speed motor

To check low speed, leave the jumpers connected to the green and brown wire terminals. Connect a second positive jumper to the red wire terminal. This feeds current to the shunt field. As was pointed out earlier, increasing the total field strength reduces motor speed. So, connecting the positive jumper to the red-wire terminal should cause the motor to slow down.

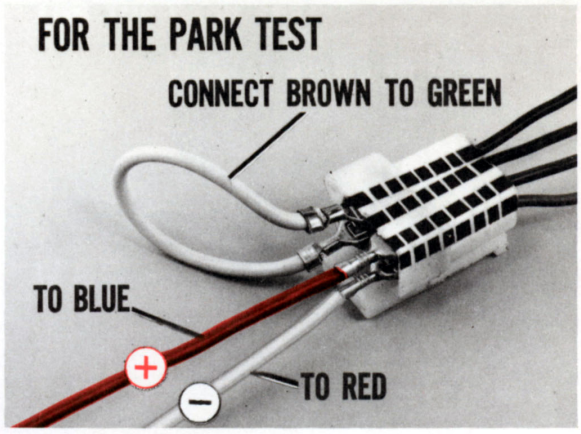
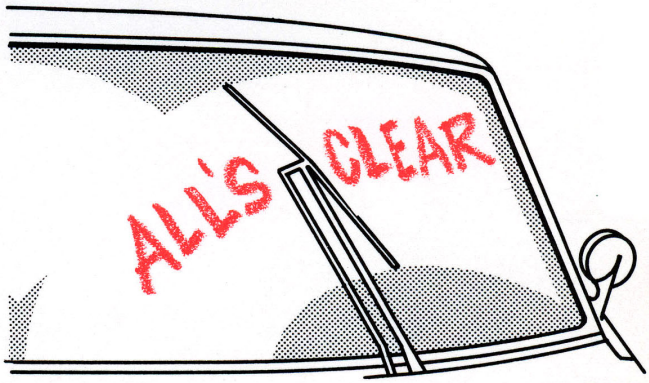


Fig. 35—Connections for testing the park cycle

For the park test, a positive jumper is connected to the blue-wire terminal and a negative lead is connected to the red-wire terminal. The green-wire and the brown-wire terminals are connected together by a short, third jumper. These connections duplicate the circuits provided when the wiper switch is turned off and should cause the motor to go through the complete park cycle.



HOT LINE NEWS FLASH

As you probably know, parts for repairing the 3-speed or variable-speed wiper motor have been available for some time. Just before press time Tech learned that parts packages for servicing both the 2-speed reversing and the 2-speed non-reversing motors have been authorized. Service instructions and service part numbers will be announced in a Service Bulletin as soon as material for these service packages is available.

Use the diagnosis and motor testing information in the Reference Book to determine whether or not the windshield wiper trouble is actually in the motor. As soon as service parts are available, you'll be able to make the necessary repair, whenever you find that the trouble is actually in the motor, instead of replacing the entire assembly. So keep your eyes open for that windshield wiper service bulletin and keep this Reference Book handy.

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