SHOP TIPS

Autolite Ford

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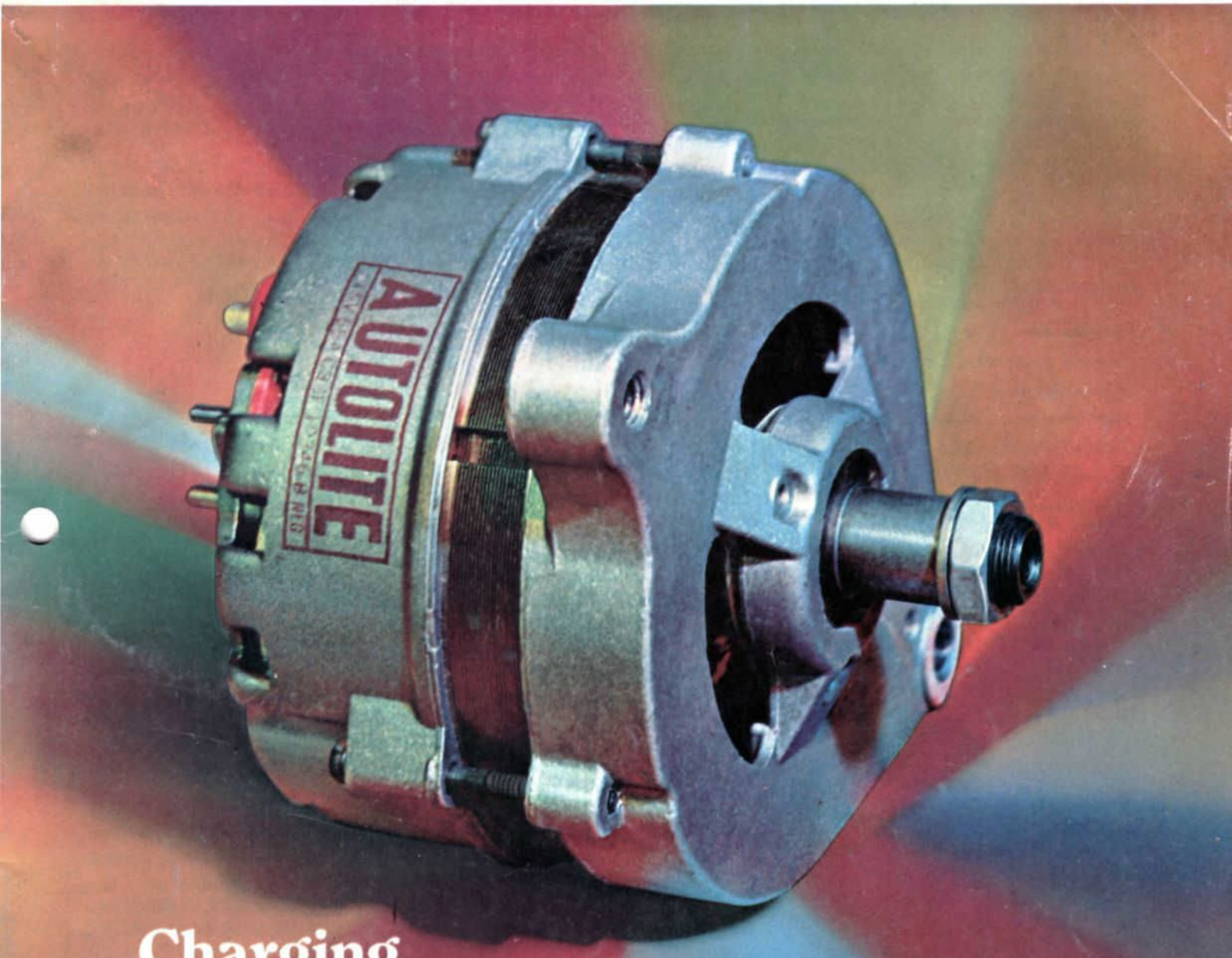

Charging System . . . *Troubleshooting*

SEE CENTER INSERT FOR TIMELY PROMOTIONS!

CHARGING SYSTEM

Technical parts and service information published by the Autolite-Ford Parts Division and distributed by Ford and Lincoln-Mercury dealers to assist servicemen in Service Stations, Independent Garages and Fleets.

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Be sure and file this and future bulletins for ready reference. If you have any suggestions for additional information that you would like to see included in this publication, please write to: Autolite-Ford Parts Division, Merchandising Services Dept., P.O. Box 3000, Livonia, Michigan 48151.

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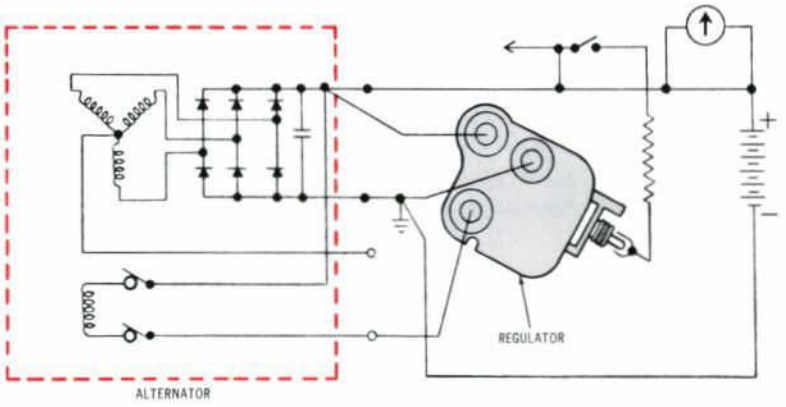


Figure 1—The Electrical Circuit for the Integrated Charging System Regulator.

INTRODUCTION

Over the years, we have made many reliability and performance improvements in the charging systems of our cars and trucks.

The units that make up the charging system have proven records of exceptional durability and low maintenance costs.

To achieve these end results one of the major product changes occurred with the introduction of the 1965 models. At that time, a change was made from using a direct current producing generator to an improved alternating current producing alternator . . . as standard factory installed equipment. Alternators not only increase the efficiency of the lighting and ignition systems but also provide a more positive charging of the battery . . . especially at low engine speeds.

Then, to provide control and regulation of alternator output, an electro-mechanical regulator . . . different from the type used in the earlier generator system . . . was placed in production. This new type of regulator contains only a field relay and a two-stage voltage limiter, both having points that open and close as system demands vary.

It does not have a current limiter device because an alternator is considered to be "self-limiting" as it produces electrical energy. This regulator is non-adjustable, therefore if it does not test to specifications it must be replaced. Adjustments or repairs are not recommended since it is carefully calibrated at the factory.

About the same time, Ford introduced the transistorized regulator to work in conjunction with an alternator. In this type of regulator (used primarily in the truck line-up), there are no mechanical points that open or close. Electrical control of the current is provided for by means of electrical switches such as transistors, Zener diodes and the use of many different resistors. Then, in 1969, a new type of regulator appeared, called the integrated circuit type, often abbreviated IC. This IC regulator, attached to the rear of the alternator casting, was first introduced as standard equipment on 1969 Thunderbird and Continental Mark III models. Coverage was increased in 1970 to also include the Lincoln-Continental luxury car.

This IC regulator cannot be adjusted or repaired since it is completely sealed in a molded plastic case and consists of solid state devices. Failure to meet test specifications means replacement is necessary.

...TROUBLESHOOTING

GENERAL INFORMATION

This issue of *Shop Tips* is designed to help you become even more of a professional service mechanic by showing you simplified troubleshooting methods for pinpointing the cause of troubles in the charging system.

However, to do this, you must first be able to identify and understand the differences among the 2 types of voltage regulators used in Ford-built passenger cars. It will also be helpful to recognize the six (6) alternator models Ford has produced over the past few years. Information contained in this article also concerns easy-to-follow methods to "eyeball" the charging system and how to hook up test equipment correctly.

Details are outlined to show you how to perform an Output Test, a Voltage Limiter Test and a Field Relay Test, regardless of which one of the different regulator or alternator models you're working on.

From all of this you will then be fully qualified to determine if the unit being tested is OK or NOT OK.

CHARGING SYSTEM UNITS

All units that make up a charging system must work together as a "team" to be able to produce sufficient electrical power for the electrical systems and the many electrically operated accessories.

Another function of a charging system is to restore the electrical energy used up by the battery during starting.

Let's briefly review the units that are part of all charging systems on any automotive vehicle. First, we need an *alternator*, which is a mechanically driven machine that converts rotating motion into electricity. Then to control the electrical power produced by the alternator and help keep the battery in its proper "state of charge" another device, called an *alternator regulator* is needed.

Finally, to connect all the electrical parts and units of the charging system together, we require a number of wires wrapped in insulation . . . known as a *wiring harness*. Then to guard the entire charging system and electrical system we need a safety device called a *fuse link*. This protective feature, found on all 1970 Ford Motor Company passenger cars, guards the alternator from circuit overloads that may be caused by an improperly connected booster battery or a charger. Or, when a short to ground occurs in the wiring harness.

Now, to tell the motorist whether the charging system is working properly or not, an electrical indicator is needed. Some passenger cars use an indicator gauge (ammeter) and others a "charge/no charge" light.

To complete the entire system, a drivebelt is required to turn the alternator rotor (and water pump) using power supplied from the crankshaft pulley.

And, let's not minimize or overlook the importance of the battery in the charging system. By storing chemicals it produces electricity and thus it too is a source of electrical power. As the electrical power is partially used up, it receives a recharge from the alternator. Later on in this article you will see how and why the battery plays a major role in the proper diagnosis of charging system troubles.

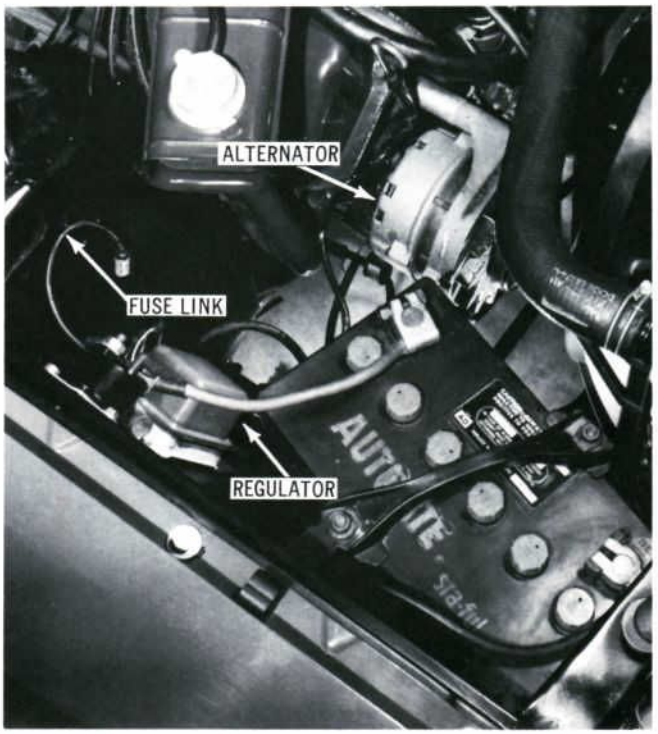


Figure 2—A Typical Charging System with All Units in View.

CHARGING SYSTEM

ALTERNATOR MODEL DESIGNS

Although we have previously mentioned that an alternator is superior to a generator in that it produces electrical power at lower engine speeds, we must also consider that much of today's driving is done at expressway speeds. At these higher operating speeds, an alternator can produce more power than the vehicle's electrical system can safely handle.

Ford Engineering has learned over years of development that just one alternator model may not be the best electrical power producer for all automotive/truck situations. It is for this reason that there are six (6) different alternator models now being used in Ford vehicles.

First there are the standard-duty alternators as shown in Figures 3, 4, 5, and 6, which have output ratings of 38 . . . 42 . . . 55 and 60 amperes. Then as shown in Figures 7 and 8, there are two heavy-duty alternators with output ratings of 65 and 85 amperes.

All alternators in the standard-duty grouping have the same identical external appearance, with the exception of some 55 ampere models which have a machined surface on the rear housing to receive the specially designed integrated circuit (IC) regulator.

The 65 and 85 ampere, heavy-duty alternators shown in Figures 7 and 8, are very similar in external appearance. However, closer examination of the 85 ampere model will reveal finned aluminum diode plates visible through the rear housing openings. These two heavy-duty models differ from the standard-duty alternators in two ways; they are larger and their brushes are mounted in a small housing located at the rear of the alternator.

PURPLE
STANDARD-DUTY

Figure 3—The 38 Ampere Alternator.

ORANGE
STANDARD-DUTY

Figure 4—The 42 Ampere Alternator.

RED
STANDARD-DUTY

Figure 5—The 55 Ampere Alternator.

GREEN
STANDARD-DUTY

Figure 6—The 60 Ampere Alternator.

BLACK
HEAVY-DUTY

Figure 7—The H-D 65 Ampere Alternator.

RED
HEAVY-DUTY

Figure 8—The H-D 85 Ampere Alternator.

...TROUBLESHOOTING

Continued

ALTERNATOR IDENTIFICATION

Because of the number of different model alternators Ford has produced over the years, it is extremely important to be able to identify each so as to determine their rated output before making an output test of the unit. Alternators produced BEFORE the 1970 model year have the identification data printed in colored ink on the housing as shown in Figure 9.

Since 1970 though, Ford-built alternators have a die-cut code stamp on the engine mounting boss of the housing. See Figure 10. This stamp has a patch of colored paint surrounding stamped figures.

In both identification methods, the color code and numbers give the rated output of the alternator.

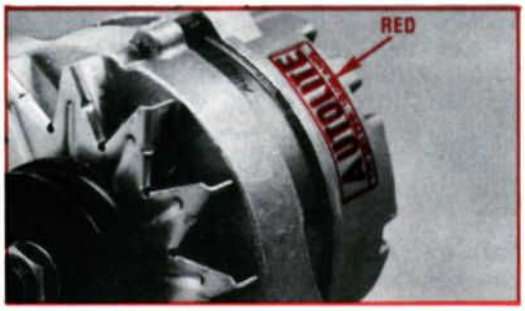


Figure 9—Stamp and Color Code Identification Prior to 1970.

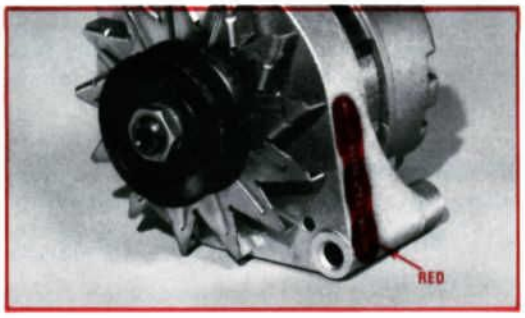


Figure 10—Stamp and Color Code for 1970 Models.

The specification chart listed below will help you to readily identify each alternator model.

ALTERNATOR SPECIFICATIONS

SUPPLIER	STAMP COLOR	AMPERES
Autolite	Purple	38
Autolite	Orange	42
Autolite	Red	55
Autolite	Green	60
Autolite	Black	65
Autolite	Red	85

NOTE: All Belt Tension Gauge Readings: New 140, Used 70-110.

VOLTAGE REGULATORS

There are two (2) types of voltage regulators used on Ford, Lincoln and Mercury passenger cars. Each can be readily identified by their external appearance. They are the Electro-Mechanical type and the Integrated Circuit type. Both types, regardless of their design and construction, control the output of the alternator. Let's review them separately.

The Electro-Mechanical regulator (see Figure 11), unlike the IC type, does have mechanical parts that move by electricity. Inside its housing are a *voltage limiting device* and a *field relay* (or switch).

The *voltage limiter* does just what the name implies . . . it limits the power to the alternator field circuit. A *field relay* is needed because there must be some method to disconnect the battery from the regulator when the engine is stopped. If not, there would be a constant drain on the battery. The electrical connector plug is attached to four(4) terminals on the regulator base. They are labeled *"I"* for Ignition . . . *"A"* for Positive Battery Post . . . *"S"* for Stator and *"F"* for the Field Circuit. When this electrical plug is firmly connected to the regulator, all of the necessary electrical connections between the regulator and the charging system circuit are completed.

Integrated Circuit regulators *(IC)* are altogether different in appearance, size and internal construction from all other regulator types. Inside the small compact unit is a printed circuit, which is sealed in a molded plastic case. Only one terminal is outwardly visible and to this is connected the wire leading from the ignition switch. See Figure 12.

All other electrical connections are made through the studs which attach the unit to the rear housing of the alternator. Only the 55 ampere alternator uses this IC regulator since this particular alternator has a machined surface to accept it.

Figure 11—The Electro-Mechanical Type Regulator.

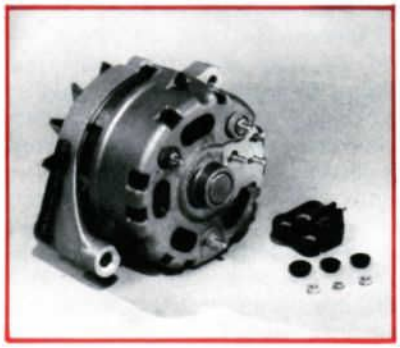


Figure 12—The Integrated Regulator Separated from the Rear of the 55 Ampere Alternator.

CHARGING SYSTEM

TROUBLESHOOTING AND CIRCUIT TESTS

FUSE LINK

A safety feature has been added to the charging system in all 1970 Ford Motor passenger cars. This "fuse link" is used to protect the alternator from an excessive overload caused by an improper hookup of a booster battery or charger to the system or when a short-to-ground occurs in the wiring harness. This 9-inch long section of insulated wire will burn out in much the same manner as a cartridge type fuse does when excessive current is sent through the circuit.

Connecting points of the fuse link differ from car to car. Bubbles or an irregular rippled surface of the insulation indicates that it has burned or blown out. In some extreme current conditions, the insulation may melt and the ends of the burned wire will show. If you are not sure, make a standard continuity test of this fuse link to find if it is "open."

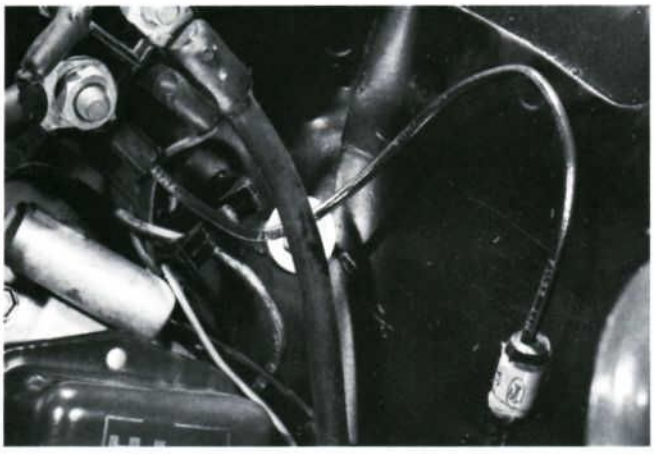


Figure 13–The Fuse Link Installed in a 1970 Ford Motor Car. Note the Words "Fuse Link" Stamped in White Lettering on the Insulation.

BATTERY TESTS

It is vitally important to have a good battery so that the charging system tests give accurate results. To determine if a battery has the ability to deliver the needed amount of current, a Battery Capacity Test must be performed. To do this, a high rate discharge tester and a voltmeter are needed.

First check to see if the battery is low in charge, and if so, give it a recharge. Then, connect the test equipment to the battery by following the manufacturer's instructions for the particular test equipment you have. Then place an electrical load on the battery that is three (3) times more than the ampere hour rating. *Never leave the high discharge load on the battery for more than 15 seconds.*

A voltmeter reading of 9.6 volts or more indicates the battery is in good condition. Below 9.6 volts indicates an individual cell test should be made. Use the type of cell tester that has two prongs that immerse into the electrolyte. Gauge readings will indicate cell condition.

The third test of the battery is to check each cell with a hydrometer. A difference between any two cells of more than 50 points (0.050) indicates the battery is bad and should be replaced. However, if any two cells show a difference that is less than 50 points (0.050) the battery should be recharged at the rate and time shown in the chart. Then retest again.

BATTERY CHARGING TIME SCHEDULE

Specific Gravity Reading	Charge Rate Amperes	Battery Capacity—Ampere Hours				
		45	55	70	80	85
1.125—1.150①	35	65 min.	80 min.	100 min.	115 min.	125 min.
1.150—1.175	35	50 min.	65 min.	80 min.	95 min.	105 min.
1.175—1.200	35	40 min.	50 min.	60 min.	70 min.	75 min.
1.200—1.225	35	30 min.	35 min.	45 min.	50 min.	55 min.
Above 1.225	5	②	②	②	②	②

① If the specific gravity is below 1.125, use the indicated high rate of charge for the 1.125 specific gravity, then charge at 5 amperes until the specific gravity reaches 1.250 at 80°F.

② Charge at 5-ampere rate only until the specific gravity reaches 1.250 at 80°F. At no time during the charging operation should the electrolyte temperature exceed 130° F.

TEST EQUIPMENT

The equipment needed to perform charging system tests is relatively inexpensive and will pay for itself many times over in solving electrical problems easily and quickly. You will need a tachometer and a voltmeter/ammeter of enough capacity to read system electrical values plus a battery post adapter switch. Both a jumper wire and a good test light will also be required.

VOLTAGE LIMITER TEST

To make an accurate voltage limiter calibration test, the specific gravity of the battery must be at least 1.230. If it isn't, either recharge the battery following the charging time schedule in the chart recommendations, or install a fresh battery. As a safety measure, make sure the handbrake is set firmly and/or have the rear wheels off the ground.

Now, to perform the voltage limiter test procedure follow the steps as listed and make the test equipment hookup as shown in Figures 14 or 15, depending upon the type of regulator in the charging system.

1. Install the battery post adapter switch.
2. Connect the test equipment.
3. Close the battery post adapter switch.
4. Connect the tachometer.
5. Turn off all electrical accessories.
6. Start the engine.
7. Open the battery post adapter switch.
8. Operate the engine for a few minutes to stabilize the entire charging system.
9. Increase engine speed until the tachometer reads 2000 rpm.
10. Allow the battery to normalize for a few minutes.
11. Read the voltmeter.
12. Compare voltmeter reading with the Voltage Limiter Test Chart.

REGULATOR	VOLTAGE LIMITER VOLTAGE RANGE
INTEGRATED CIRCUIT	13.3 Volts to 15.3 Volts
ELECTRO-MECHANICAL	13.5 Volts to 15.3 Volts

...TROUBLESHOOTING

Continued

VOLTAGE LIMITER TEST EVALUATION

If you find the voltage reading is within the specification called for, the voltage regulator is OK.

If either the Integrated Circuit or Electro-Mechanical Regulator is not within the specifications listed, it must be replaced. Repairs or adjustments are not recommended by the factory. Before replacing either of the two types of regulators, *first disconnect the battery ground cable.*

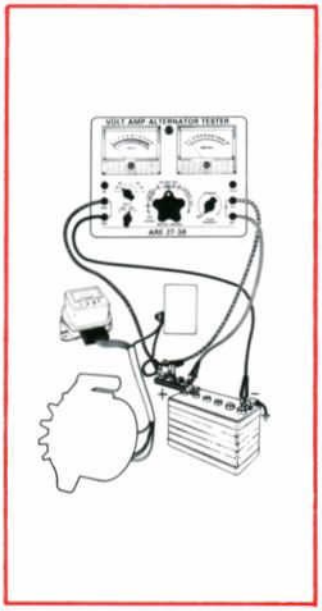


Figure 14—The Voltage Limiter Test for Electro-Mechanical Voltage Regulators.

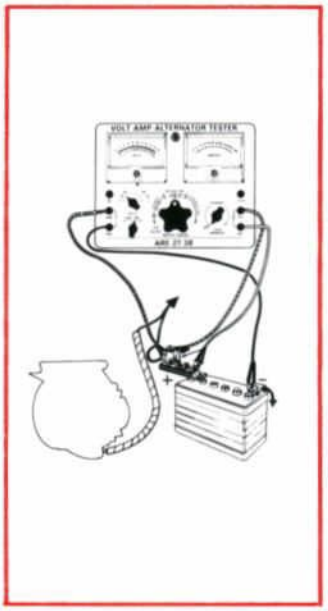


Figure 15—The Voltage Limiter Test for IC Type Regulators.

ALTERNATOR OUTPUT TEST

To make an accurate alternator test, follow the test procedures in the exact order listed. Test equipment hookup, shown in Figures 16 and 17, depends upon the type of regulator you have found in the charging system.

1. Connect the test equipment into the charging system as called for by the particular equipment you are using and the type of system you are working on.
2. Connect the tachometer.
3. Close the battery post adapter switch.
4. Turn off all electrical accessories.
5. Start the engine.
6. Open the battery post adapter switch.
7. Increase engine speed until the tachometer reads 1500 rpm and hold at this throttle setting.
8. Turn the rheostat control knob to energize the alternator field circuit . . . while at the same time holding the voltage at 15 volts by turning the master control clockwise.
9. Check the ammeter reading and *ADD 5 amperes* to it to make up for the loss caused by current used in the ignition system and field system operation.
10. If the added-on reading is within 5 amperes of the rated output for the particular alternator the car is equipped with, the alternator is OK.

ALTERNATOR OUTPUT TEST EVALUATION

If the output of the alternator is *5 amperes or more below* the minimum specifications, it usually indicates an *open diode*. An output of *10 amperes or more under the minimum* specification indicates a *shorted diode*. A reading of *5 amperes or more* under the specification is sufficient cause for you to remove the alternator and repair it as necessary.

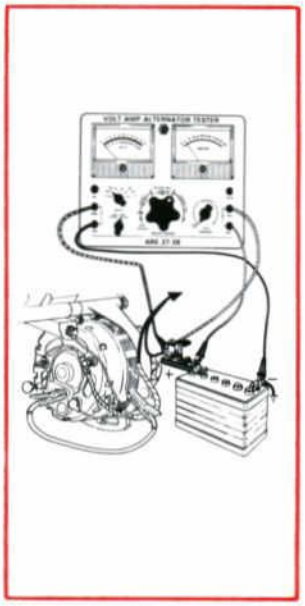


Figure 16—Alternator Output Test of Charging System with IC Regulator and 55 Ampere Alternator.

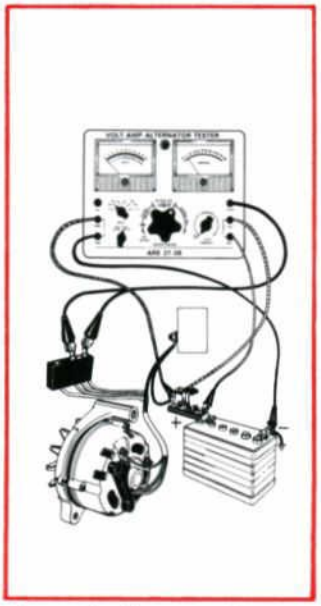


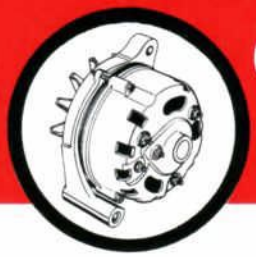
Figure 17—Alternator Output Test of Charging System with an Electro-Mechanical Regulator.

FIELD RELAY TEST

As we discussed, only the Electro-Mechanical regulator has a Field Relay as part of the charging system circuit on Ford-built passenger cars. No field relay is used with the IC regulator.

1. To make this test, hook up the equipment as shown in Figure 18 or as the equipment manufacturer calls for.
2. Set the tester controls as called for by the equipment maker. These will vary among the different manufacturers of test equipment.
3. Slowly rotate the field rheostat knob clockwise from the maximum counterclockwise (off) position . . . until the test light comes on.
4. Check the voltmeter reading the instant the test light lights. THIS IS THE RELAY CLOSING VOLTAGE.

Closing voltage should be somewhere between 2.5 and 4.0 volts. If the closing voltage is *OVER* or *UNDER* when checking the electro-mechanical type regulator, the regulator must be replaced.



CHARGING SYSTEM ...TROUBLESHOOTING

Continued

CIRCUIT RESISTANCE TEST

An insulated circuit resistance test will help determine resistance conditions in the charging system circuits. This test requires a constant current flow of 20 amperes and a voltage drop measurement in each circuit. Improper, loose, or corroded connections are a common cause of this condition. To make this test proceed as shown in Figures 19 and 20.

1. Connect the tester leads as shown or as the equipment maker calls for with his particular equipment.
2. Set the tester controls.
3. Turn off all electrical accessories.
4. Close the battery post adapter switch and start the engine.
5. Open the battery post adapter switch.
6. Increase engine speed until the ammeter reads 20 amperes. If voltmeter shows full scale reading before 20 amps is reached . . . stop the test and repair the cause of this excessive reading.
7. Look at the voltmeter. A reading of more than .3 volts on a system with an indicator light indicates a faulty system. A reading of more than .7 volts on a system with an ammeter indicates a faulty circuit. In either of these two cases all electrical connections in the circuit should be inspected and the cause of excessive voltage repaired.

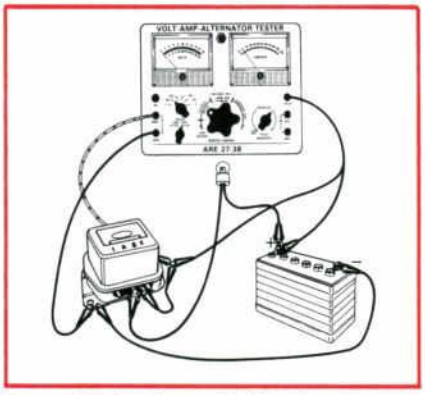


Figure 18—Making a Field Relay Test on a Charging System Equipped with an Electro-Mechanical Regulator.

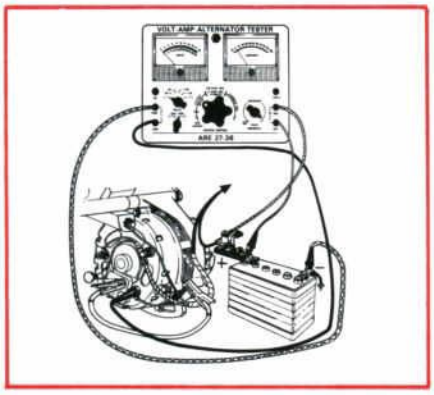


Figure 19—Making a Circuit Resistance Test on the IC Regulator Equipped System.

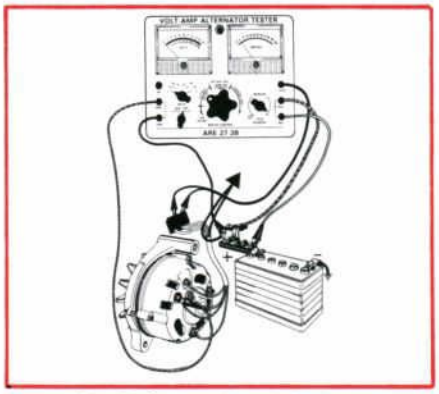
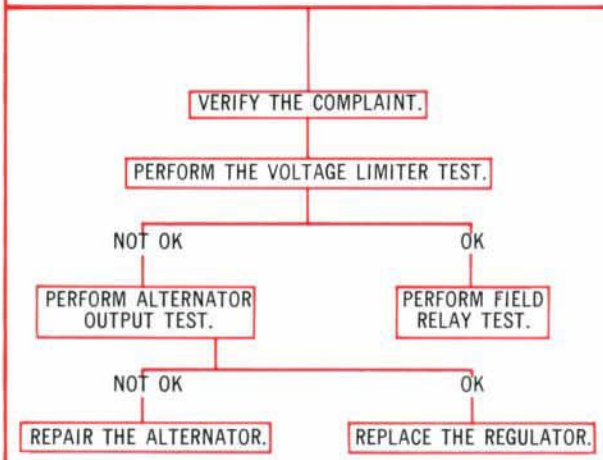


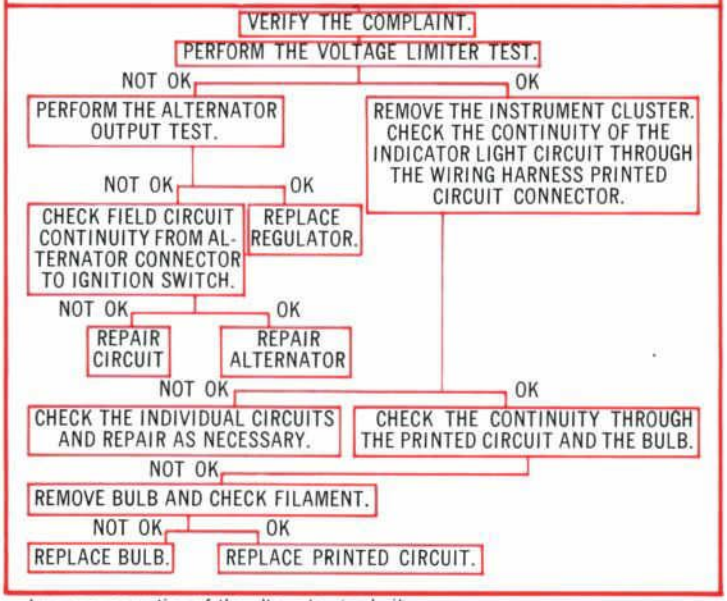
Figure 20—Making a Circuit Resistance Test on an Electro-Mechanical Equipped System.

TROUBLESHOOTING CHARTS

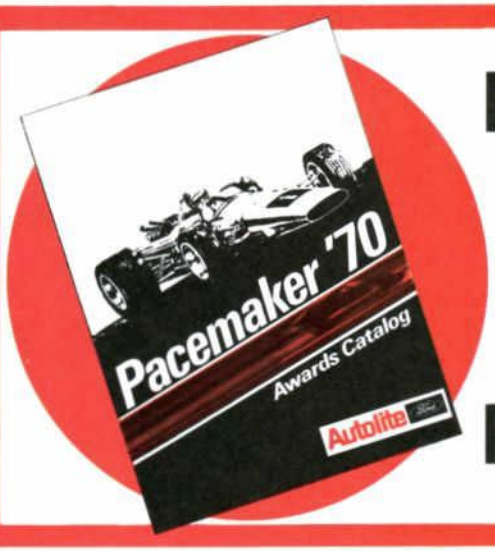
CHARGE INDICATOR LIGHT STAYS ON AFTER ENGINE STARTS.



CHARGE INDICATOR LIGHT DOES NOT LIGHT WHEN THE IGNITION SWITCH IS TURNED ON.



CAUTION: 1970 Cars and Light Trucks—Improper operation of the alternator (and oil) warning light can sometimes be traced to a blown fuse in the heater motor circuit. The first clue to improper warning light operation is the loss of bulb "proof" when the ignition switch is turned to the "RUN" or "START" position. When a blown fuse is the cause of the malfunction it is common for the warning lights to come on after the engine is started and running.



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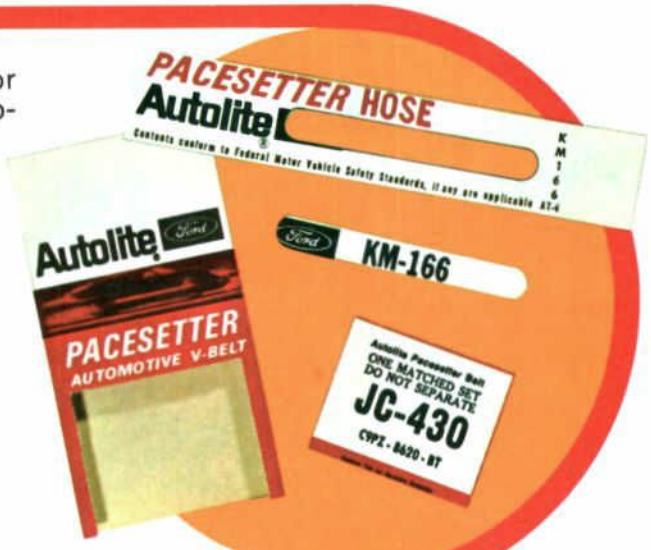
Sell Autolite performance-proven V-Belts and Radiator Hose and earn exciting Pacemaker Awards. All Autolite V-Belts and Radiator Hose feature either a sleeve tear tab or hose label tear tab. Any combination of ten sleeve tear tabs and hose label tear tabs have the equivalent value of one Pacemaker Prize Point. And Autolite is the only supplier in the industry to offer these valuable tear tabs on all V-belt and radiator hose products. Combine these tabs with the other Pacemaker Prize Points you earn on your purchases of Autolite Shock Absorbers and Electrical Tune-Up Kits. Take advantage of these continuous Autolite bonus programs! You can choose from more than 1800 nationally-known brand-name items... for yourself, for your wife and children, for your home.



PREMIUM QUALITY: Autolite's new V-Belt and Radiator Hose line provides premium quality product coverage for all Ford-built vehicles and most other domestic and foreign passenger cars and domestic light trucks. All Autolite V-Belts and Hose feature premium construction design and are made of the highest quality materials available to give trouble-free service.

UNIQUE SALES NUMBERING SYSTEM: A glance at a hose label or belt sleeve tells you immediately the size of the part and/or its intended use. Autolite's new belt and hose numbering system makes your selling and stocking job easier and more efficient. Also to assist you . . . the V-belt numbering system is explained in detail on the back of every Pacesetter and Hi-Trac V-Belt sleeve.

CATALOG AND WALL CHART: To further help you properly service your customers, a new 595-page catalog has been prepared with complete application and product information on the entire Autolite V-Belt and Hose line. In addition, a colorful Wall Chart is available to provide you with handy applications on popular passenger cars.

PUT AUTOLITE'S NEW V-BELT AND HOSE LINE TO WORK FOR YOU —AUTOLITE PARTS ARE AVAILABLE AT OUR PARTS COUNTER!

AUTOLITE Sparks Indy 500 Winner for the Fourth Consecutive Year!

Memorial Day, 1970 marked the fourth consecutive victory for Autolite in the famed Indianapolis 500 Mile Race as Al Unser took the checkered flag. Autolite's winning streak at Indy was started by A. J. Foyt in 1967 and followed by Bobby Unser in 1968 and Mario Andretti in 1969.

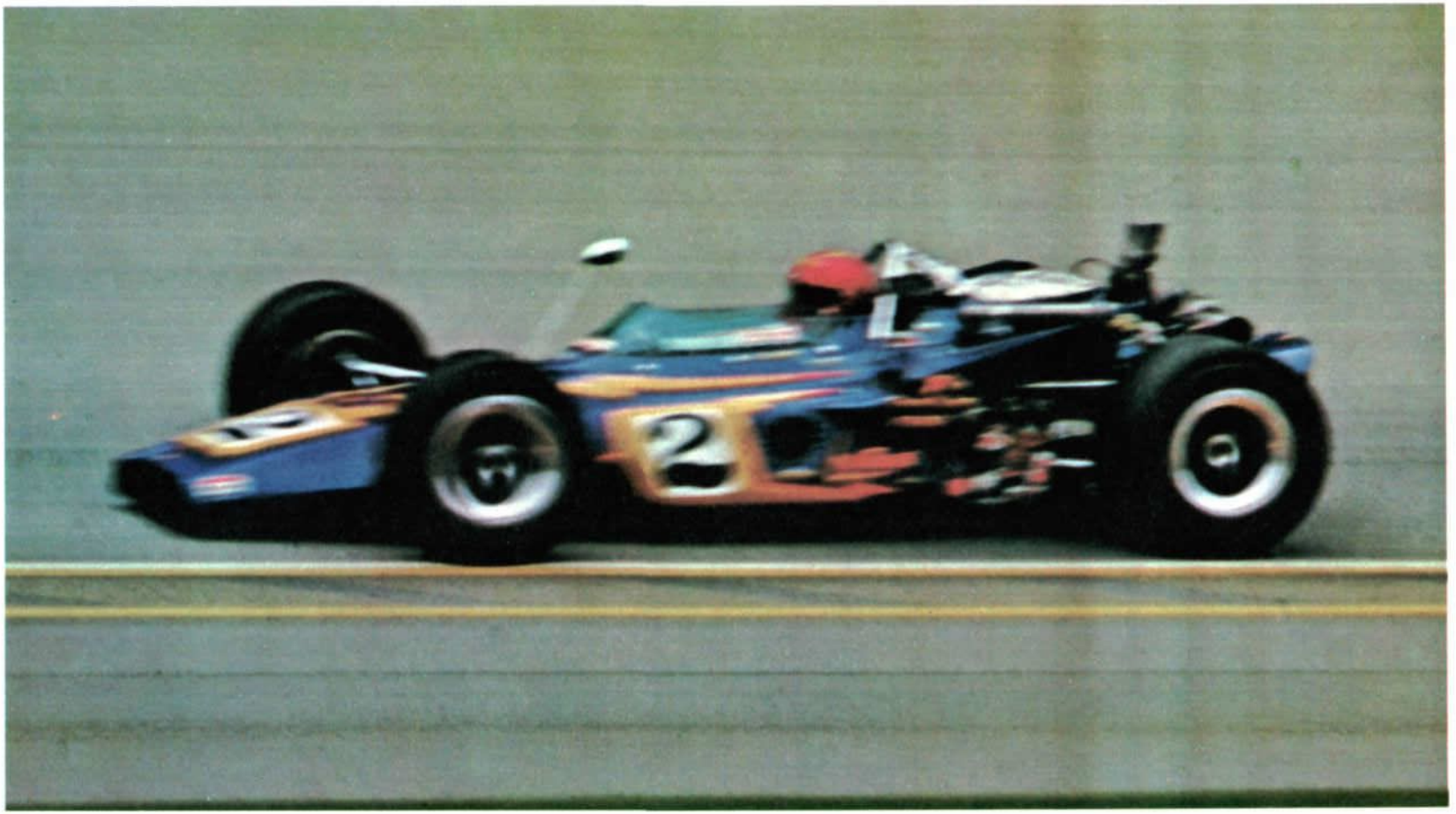
The 1970 Autolite Indy 500 victory is a feather in your cap because this win will be promoted and advertised on television and in major consumer publications to support *your* Autolite parts sales efforts. A special advertising campaign was launched on June 7 as Autolite's 1970 Indy victory message reached 11 million homes on ABC's "The FBI." Autolite's victory advertising also appeared on "The FBI" on June 21st.

In addition, the June 29 issue of *Sports Illustrated* carries an Autolite Indy 500 victory advertisement which will reach over seven million adult readers. Another ten million car-oriented men will see an Autolite Indy victory ad in the August issues of *Hot Rod, Road & Track, Sports Car Graphic* and *Popular Mechanics,* and in the September issues of *Car Craft, Car & Driver, Motor Trend, Popular Science* and *Mechanix Illustrated.*

Autolite's 1970 Indy victory coupled with a hard-hitting national consumer advertising campaign to support it, provides a powerful selling message to assist you in increasing your sales of all Autolite products.

Free Photo of Indy Winner!

The photograph of the 1970 Indianapolis winner on the opposite page has been especially prepared for framing. To remove the photograph, simply tear along the perforated line. When mounting the photograph in a frame, we suggest that a cardboard backing be used to provide extra support.



Autolite Ford

"I've only got two hands...!"

Ever felt like snapping . . . "I've only got two hands!"

In these days of mechanic shortages and increased workloads, instead of repairing, the answer is to replace with Authorized Remanufactured Ford Parts. You'll save time. You'll save money . . . and the new-part quality, guaranteed by a nationally honored warranty, protects customer goodwill.

See us for a complete line of Remanufactured Ford exchange parts.

Replace with the brand that gives you an extra hand!

NATIONAL WARRANTY

Every Remanufactured Ford Part is warranted nationally by the Remanufacturer to be free of defects in materials and workmanship for 90 days or 4000 miles from date of installation, whichever occurs first. Complete OHV engine assemblies are warranted for 12 months or 12,000 miles on passenger vehicles, and 6 months or 12,000 miles on trucks, whichever occurs first. This Warranty includes parts replacement plus related labor.

Ford and Lincoln-Mercury dealers will honor this warranty anywhere in the country.

Remanufactured

Ford

Engines · Parts

COOLANT RECOVERY SYSTEM

A CURE FOR ENGINE OVERHEATING

Engine overheating has been the curse of motorists since the early days of the automobile. Today, the installation of a Coolant Recovery System is a simple method for preventing engine overheating due to excessive loads, high temperatures or hilly terrain.

WHY ENGINES OVERHEAT

Most of the automobile radiators are filled to a point about an inch and a half below the radiator cap. When the cap is put into place and locked in position, air becomes trapped in the top section of the radiator. With the engine running, coolant is circulated by the water pump and some of the trapped air is drawn into the system.

Under normal driving conditions the system works satisfactorily. But when the engine is forced to work harder, during slow-moving traffic or when towing heavy loads, more heat is produced. The heat of the engine causes the air and the coolant to expand. The air expands at a much greater rate than the coolant, so in addition to heat, greater pressures are developed. Next, air acts as an insulator. Coolant with air bubbles mixed with it cannot reach the metal surfaces of the radiator and effectively transfer heat to the cooler radiator surfaces. The heat is built up a little more. When the pressure in the cooling system becomes great enough both coolant and air are forced past the radiator cap valve and through the overflow tube and a portion of the coolant is lost.

When the engine is stopped and begins to cool, the coolant contracts and creates a partial vacuum in the system. More air is then drawn into the cooling system. The next time the engine is worked under a load it has less coolant in the system to carry the heat to the radiator. Eventually, the aerated coolant reaches the boiling point and the engine overheats.

WHAT THE COOLANT RECOVERY SYSTEM DOES

The prime job of the coolant recovery system is to get the air out of the cooling system. With all the air removed the coolant can transfer heat from the engine to the radiator core more effectively. The cooling system will also operate at lower pressures.

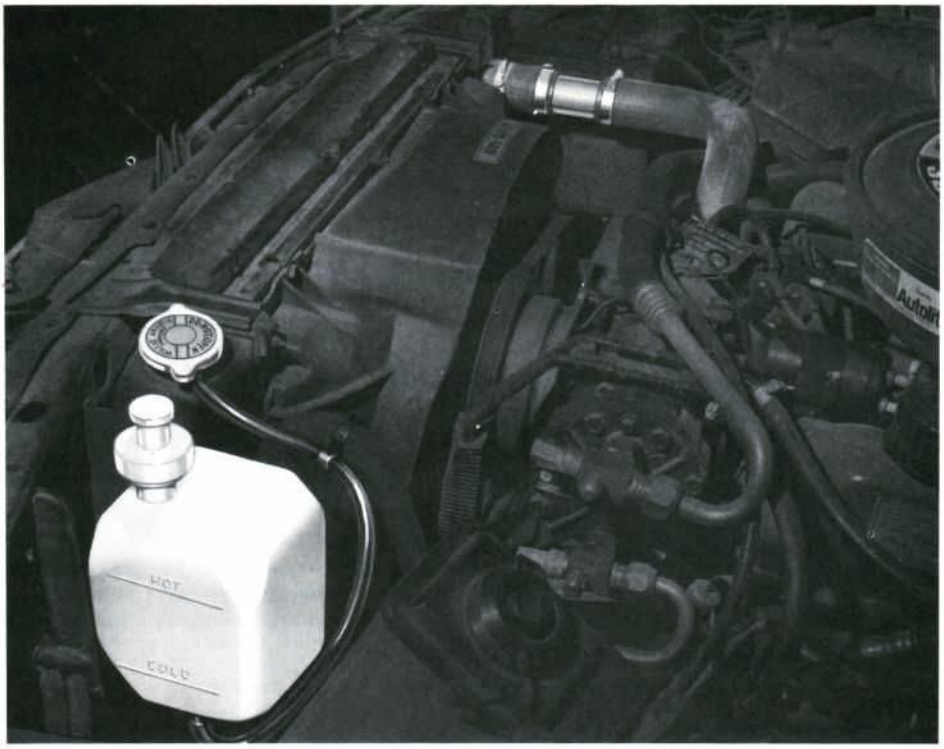
HOW THE COOLANT RECOVERY SYSTEM WORKS

The standard radiator cap is removed and replaced with a cap that seals the filler neck from the atmosphere. One end of a plastic tube is connected to the overflow tube. The other end of the plastic tube is connected to the reservoir tank. A plastic sight tube is included for vehicles with 1½″ upper radiator hoses. Sight tubes of 1¼″ and 2″ are also available as a service part.

When the engine is running the coolant begins to heat up and expand. Then when the pressure exceeds the rated specification, the expanding air and coolant pass the check valve in the special radiator cap, through the plastic hose and into the reservoir tank, rather than to the pavement.

First the air escapes, then the coolant. When the engine is stopped the coolant begins to cool down and contract. This develops a vacuum in the system causing the coolant in the reservoir tank to be drawn back into the system. Air does not reenter the system.

After a few cycles all the air is removed from the coolant and cooling system efficiency is increased. The system can be checked for air bubbles by observing the sight tube in the upper radiator hose.



Typical Installation of the Coolant Recovery System. This kit, Part Number DOAZ-8522-A, covers all passenger cars and the majority of light trucks.

DETROIT LOCKER

DETROIT AUTOMOTIVE LOCKING DIFFERENTIAL ASSEMBLY

The Detroit Automotive Locking Differential is now available for the 1970 Mustang, Fairlane, Torino, Cougar and Montego equipped with a 4.30:1 axle ratio.

THE NON-SLIP DIFFERENTIAL

The conventional differential operates on the principle that one rear axle is driven by a ring and pinion gear and the other axle is freewheeling. If the driven axle leaves the road or encounters a patch of ice, forward movement of the car ceases.

The Detroit Automotive Locking Differential drives *both* rear axles. If one wheel slips or leaves the ground the other wheel maintains the forward power. When the vehicle makes a turn the outboard wheel travels faster and that axle disengages from the driving unit and runs free until both wheels are again running at the same speed. The design of the Detroit Automotive Locking Differential makes it impossible for either rear wheel to travel slower than the ring gear speed.

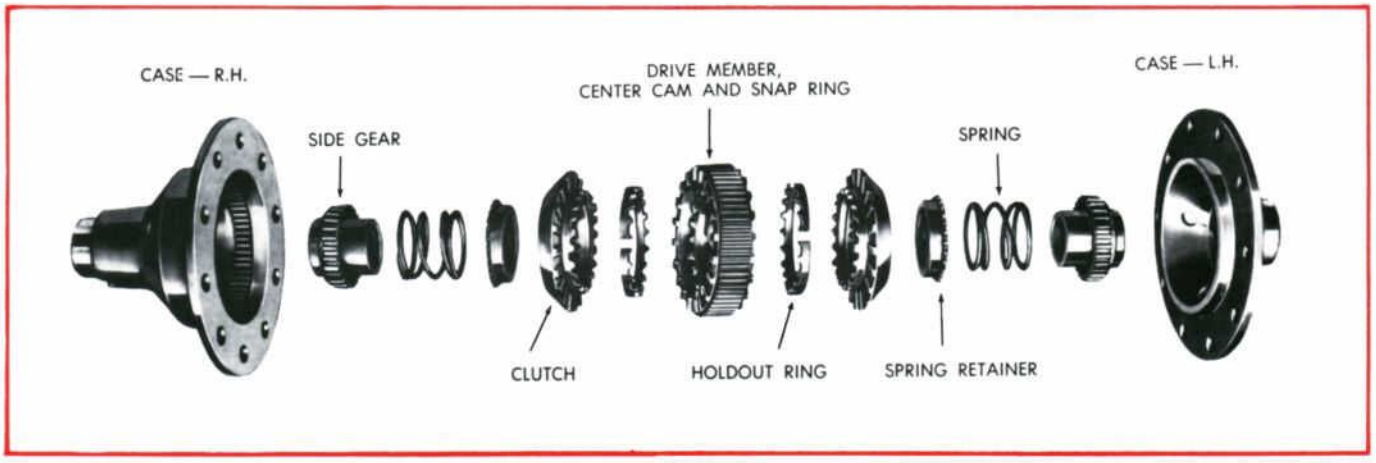


Figure 1—Exploded View of Detroit Locking Differential.

HOW THE DETROIT AUTOMOTIVE LOCKING DIFFERENTIAL WORKS

When a vehicle is being driven in a straightforward direction the clutch teeth, on both sides of the center drive member assembly, are fully engaged with the clutch teeth on each driven clutch member. Also, the fixed cams of the driven clutch member and the rotatable "hold-out" ring are fully meshed with the cam surfaces of the floating center cam member on the inside diameter of the center drive member.

Positive engagement of the driving and driven clutch members is assured by the pressure of the two springs which force the driven clutch members inwardly against the center drive member and also by the positive locking action developed by the mating undercuts on the driving faces of the clutch teeth.

In this condition both clutches remain fully engaged so that the assembly operates as a solid unit and each rear wheel is driven forward at ring gear speed.

When a vehicle is driven rearward, the center drive member shifts the driving force to the opposite set of driving faces on the mating clutch teeth. The assembly operates as a unit and the wheels are forced to rotate at ring gear speed.

When a vehicle makes a left-hand turn the right rear wheel must travel faster than the left rear wheel. The cams of the center cam located in the drive member are held to the rear of the driving clutch teeth (Figure 2). The right-hand driven clutch member must rotate faster to make the turn. The cams in the center drive member serve as ramps upon which the mating cams on the right-hand driven clutch member can rise enabling that driven clutch member to disengage from the center drive member. The center cam ramps are high enough to permit the clutch teeth on the driven clutch member to clear the teeth on the center drive member. The holdout ring keeps the center cam lifts and the driven clutch lifts from reengaging until the right wheel and the ring gear are running at the same speed. As the vehicle completes the turn and is again driven in a straightforward direction the right wheel slows to the same speed as the ring gear and the center drive member and the right driven clutch member reengage. A right-hand turn is accomplished in the same manner, the left side releasing and over-running ring gear speed.

NON-SLIP FEATURE

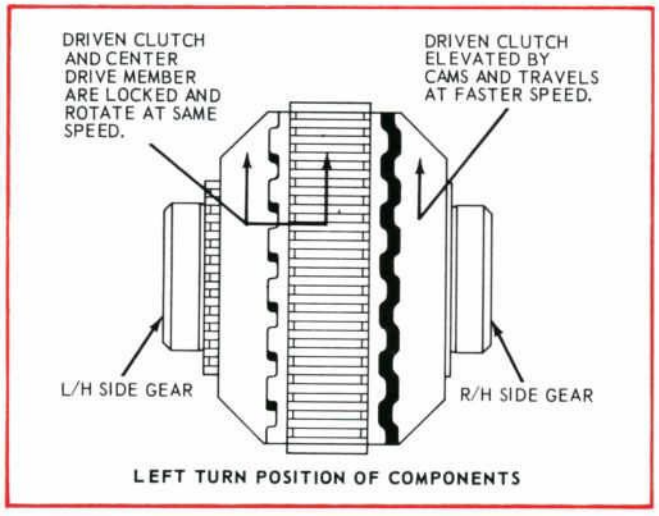


Figure 2—Left Turn Position of Components.

DISASSEMBLY OF THE DETROIT AUTOMOTIVE LOCKING DIFFERENTIAL AND CASE

The procedure for the removal of differential case, bearings and ring gear is the same for all Ford axles as outlined in the appropriate shop manuals.

1. After the ring gear and the differential bearings are removed, place the differential case assembly (cover down) in a press and apply pressure to contain the preload springs between the differential case and cover. Remove the three screws retaining the case halves.
2. Release the press ram and remove the differential case cover.
3. Remove the side gear, spring, spring retainer, holdout ring and driven clutch assembly, center drive member, driven clutch assembly, spring retainer, spring and side gear.

ASSEMBLY OF THE DETROIT AUTOMOTIVE LOCKING DIFFERENTIAL AND CASE

1. Place tool in vise (similar to Ford Tool Number T66L-4204-A2), and insert the right-hand case over the tool.
2. Install the side gear in position (polished surface toward case). Place the preload spring and spring retainer on the side gear. Position the holdout ring and driven clutch asasembly over the spring retainer. Place the center drive member over the driven clutch assembly (be sure the key or slot in the center cam of the drive member is placed between the opening of the holdout ring). Place the driven clutch assembly over the center drive member (again, be sure the opening in the holdout ring is between the key or slot of the center drive member).
3. Place the spring retainer, spring and side gear in position.
4. Place the cover in position, matching the cover to case retaining screw holes. With hand pressure force the cover down, rotating left and right until the splines index properly and both cover and case halves are mated. When both halves are completely together, retain this pressure by holding with both hands.
5. Remove the differential case assembly from tool, turn it over so the differential case assembly rests on the cover side (still retaining hand pressures).
6. Install the three case-to-cover screws and tighten.

BENCH CHECK

Prior to installation into the vehicle, a bench check should be performed to assure proper operation.

1. Install the differential case assembly in a vise so it is held stationary.
2. Insert axle shafts in both R/H and L/H gear splines.
3. With an assistant, rotate both axle shafts in the same direction (normally, both axle shafts will be stopped after rotating only a few inches).
4. Hold the left-hand axle shaft firmly against the stop, and rotate the right-hand axle in the opposite direction; a faint clicking or indexing noise may be heard. By holding the left-hand axle shaft firmly against the stop, the right-hand axle shaft will disengage freely, which simulates an overriding wheel during a turn.
5. Now rotate both axle shafts in the opposite direction as far as possible. Both axle shafts will be stopped after rotating only a few inches.
6. Firmly hold the left-hand axle shaft against the stop. Rotate the right-hand axle shaft in the opposite direction; again, a faint clicking or indexing noise may be heard.
7. Repeat steps 3 through 6 starting with the right-hand axle shaft.

IN-VEHICLE TEST FOR PROPER INSTALLATION AND OPERATION

1. Raise rear axle so that wheels are free to turn.
2. Place transmission in gear.
3. With an assistant on the other side, start test by rotating both wheels in a forward direction as far as possible. Normally, both wheels will be stopped after rotating only a few inches.
4. With one person firmly holding the left wheel forward (against the stop), rotate the right wheel rearward; a faint clicking or indexing noise may be heard. The left wheel must be held firmly against the stop or the right wheel will not disengage freely.
5. Now rotate both wheels rearward as far as possible. Again, both wheels will be stopped after rotating only a few inches.
6. With an assistant on the other side, firmly holding the left wheel in the rearward position, against the stop, rotate the right wheel forward again. Listen for a faint clicking or indexing sound. Again, the left wheel must be held firmly against the stop or the right wheel will not disengage freely.
7. Repeat steps 3 through 6, starting with the left wheel.

OPERATING CHARACTERISTICS OF THE DETROIT AUTOMOTIVE LOCKING DIFFERENTIAL

1. A pull may be experienced during acceleration if tire pressures are unequal, and/or different size tires are installed on the rear.
2. During heavy to full throttle acceleration the rear end tends to yaw slightly and may or may not require corrective steering, depending on road conditions.
3. During turning maneuvers, a clicking or ratcheting noise will be heard due to the outside wheel turning faster than the inside wheel. This clicking or ratcheting is caused by the driven clutch assembly overrunning the drive member, which is turning at ring gear speed. The frequency of the clicking or ratcheting will vary depending on the radius of the turn and vehicle speed.
4. When traveling at cruise speeds, moderate acceleration may make the vehicle veer to the right; upon deceleration, the vehicle will then veer to the left. This condition may be more pronounced on crowned roads.

CATALOG CHANGES

1970 AUTOLITE READY REFERENCE CATALOG

On this page and the opposite page are a number of Autolite parts changes. These are published for your benefit to help you keep your Autolite-Ford Parts Catalogs up-to-date. Current parts numbers, indicated in **RED**, should be entered in your personal copies of the *1970 Autolite Ready Reference Catalog* and the *1970 Autolite All Products Catalog*. As you will note, we have indicated after each car model listed, the page number to turn to in each catalog, so that you can quickly make the necessary entries in a few moments.

From time to time this type of supplementary parts information will be incorporated in this publication, thus making it easier for you to order new Autolite-Ford parts.

YEAR	CYL.	ENG. C.I.D.	ELECT. TUNE-UP KIT *	SPARK PLUGS STD.	SPARK PLUGS RESIS-TOR	SPARK PLUGS GAP
COMET/MONTEGO *(Turn to PAGE 252)*						
1970	(8 cyl.)	S/T 4 Bbl. Carb 351	—	AF42	ARF42	.035″
	(8 cyl.)	A/T 4 Bbl. Carb 351	—	AF42	ARF42	.035″
	(8 cyl.)	S/T 4 Bbl. Carb. 429	—	—	BRF42	.035″
1970	(8 cyl.	A/T 4 Bbl. Carb. 429	—	—	BRF42	.035″
	(8 cyl.)	S/T 429 CJ	—	AF32	ARF32	.035″
	(8 cyl.)	A/T 429 CJ	—	AF32	ARF32	.035″
COUGAR *(Turn to PAGE 254)*						
1970	(8 cyl.)	302 4 Bbl. Special	—	AF32	ARF32	.035″
	(8 cyl.)	S/T 2 Bbl. Carb. 351	TKF-1	BF42	BRF42	.035″
	(8 cyl.)	A/T 2 Bbl. Carb. 351	TKF-1	BF42	BRF42	.035″
	(8 cyl.)	S/T 4 Bbl. Carb. 351	—	AF42	ARF42	.035″
1970	(8 cyl.)	A/T 4 Bbl. Carb. 351	—	AF42	ARF42	.035″
	(8 cyl.)	S/T 428 CJ	—	BF32	BRF32	.035″
	(8 cyl.)	A/T 428 CJ	—	BF32	BRF32	.035″
FAIRLANE/TORINO *(Turn to PAGE 256)*						
1970	(8 cyl.)	A/T 2 Bbl. Carb. 351	—	AF42	ARF42	.035″
	(8 cyl.)	S/T 4 Bbl. Carb. 351	—	AF42	ARF42	.035″
	(8 cyl.)	A/T 4 Bbl. Carb. 351	—	AF42	ARF42	.035″
	(8 cyl.)	S/T 4 Bbl. Carb. 429	—	—	BRF42	.035″
1970	(8 cyl.)	A/T 4 Bbl. Carb. 429	—	—	BRF42	.035″
	(8 cyl.)	S/T 429 CJ	—	AF32	ARF32	.035″
	(8 cyl.)	A/T 429 CJ	—	AF32	ARF32	.035″

YEAR	CYL.	ENG. C.I.D.	ELECT. TUNE-UP KIT *	SPARK PLUGS STD.	SPARK PLUGS RESIS-TOR	SPARK PLUGS GAP
FORD *(Turn to PAGE 262)*						
1970	(8 cyl.)	A/T 2 Bbl. Carb. 390	TKF-1	BF42	BRF42	.035″
	(8 cyl.)	4 Bbl. Carb. 428	TKF-7	BF32	BRF32	.035″
	(8 cyl.)	S/T 2 Bbl. Carb. 429	—	—	BRF42	.035″
	(8 cyl.)	A/T 2 Bbl. Carb. 429	—	—	BRF42	.035″
	(8 cyl.)	S/T 4 Bbl. Carb. 429	—	—	BRF42	.035″
	(8 cyl.)	A/T 4 Bbl. Carb. 429	—	—	BRF42	.035″
MERCURY *(Turn to PAGE 264)*						
1970	(8 cyl.)	S/T 2 Bbl. Carb. 390	TKF-1	BF42	BRF42	.035″
	(8 cyl.)	A/T 2 Bbl. Carb. 390	TKF-1	BF42	BRF42	.035″
	(8 cyl.)	4 Bbl. Carb. 428	TKF-7	BR32	BRF32	.035″
	(8 cyl.)	A/T 2 Bbl. Carb. 429	—	—	BRF42	.035″
	(8 cyl.)	A/T 4 Bbl. Carb. 429	—	—	BRF42	.035″
MUSTANG *(Turn to PAGE 266)*						
1970	(8 cyl.)	S/T 2 Bbl. Carb. 302	TKF-1	BF42	BRF42	.035″
	(8 cyl.)	A/T 2 Bbl. Carb. 302	TKF-1	BF42	BRF42	.035″
	(8 cyl.)	302 4 Bbl. Special	—	AF32	ARF32	.035″
	(8 cyl.)	S/T 2 Bbl. Carb. 351	TKF-1	BF42	BRF42	.035″
	(8 cyl.)	A/T 2 Bbl. Carb. 351	TKF-1	BF42	BRF42	.035″
	(8 cyl.)	S/T 4 Bbl. Carb. 351	—	AF42	ARF42	.035″
1970	(8 cyl.)	A/T 4 Bbl. Carb. 351	—	AF42	ARF42	.025″
	(8 cyl.)	428 S/T (CJ)	—	BF32	BRF32	.035″
	(8 cyl.)	428 A/T (CJ)	—	BF32	BRF32	.035″
THUNDERBIRD *(Turn to PAGE 268)*						
1969	(8 cyl.)	429	—	—	BRF42	.035″
1970	(8 cyl.)	429 C.I.D.	—	—	BRF42	.035″

*Includes a set of Spark Plugs, Points and Condenser.

CATALOG CHANGES | 1970 AUTOLITE ALL PRODUCTS CATALOG

YEAR	CYL.	ENG. C.I.D.	ELECT. TUNE-UP KIT *	SPARK PLUGS REG.	SPARK PLUGS RESIS-TOR	SPARK PLUGS GAP
CAMARO *(Turn to PAGE 10)*						
1967	(6 cyl.)	230	TKG-5	AG52	AGR52	.035″
	(6 cyl.)	250	TKG-5	AG52	AGR52	.035″
1967	(8 cyl.)	327	TKG-1	A42	AR42	.035″
	(8 cyl.)	350	TKG-1	A42	AR42	.035″
1968	(6 cyl.)	230	TKG-5	AG52	AGR52	.035″
	(6 cyl.)	250	TKG-5	AG52	AGR52	.035″
1968	(8 cyl.)	327	TKG-1	A42	AR42	.035″
	(8 cyl.)	350	TKG-1	A42	AR42	.035″
	(8 cyl.)	396	TKG-6	AG3	AGR31	.035″
1969	(6 cyl.)	230	TKG-8	—	AGR52	.035″
	(6 cyl.)	250	TKG-8	—	AGR52	.035″
	(8 cyl.)	302	—	—	AR32	.035″
CHEVROLET *(Turn to PAGE 16)*						
1965	(8 cyl.)	283	TKG-1	A42	AR42	.035″
	(8 cyl.)	Trans. Ign. 283	—	A52	AR52	.035″
1965	(8 cyl.)	327	TKG-1	A42	AR42	.035″
	(8 cyl.)	Trans. Ign. 327	—	A52	AR52	.035″
	(8 cyl.)	All Lifters 409	—	AG32	AGR32	.035″
	(8 cyl.)	Trans. Ign. 409	—	AG32	AGR32	.035″
1966	(6 cyl.)	250	TKG-5	AG52	AGR52	.035″
1966	(8 cyl.)	283	TKG-1	A42	AR42	.035″
	(8 cyl.)	327	TKG-1	A42	AR42	.035″
1966	(8 cyl.)	396	TKG-6	AG3	AGR31	.035″
	(8 cyl.)	Trans. Ign. 396	—	AG3	AGR31	.035″
1966	(8 cyl.)	427	TKG-6	AG3	AGR31	.035″
	(8 cyl.)	Trans. Ign. 427	—	AG2	AGR21	.035″
1967	(6 cyl.)	250	TKG-5	AG52	AGR52	.035″
	(8 cyl.)	283	TKG-1	A42	AR42	.035″
1967	(8 cyl.)	327	TKG-1	A42	AR42	.035″
	(8 cyl.)	396	TKG-6	AG3	AGR31	.035″
1967	(8 cyl.)	427	TKG-6	AG3	AGR31	.035″
1968	(6 cyl.)	250	TKG-5	AG52	AGR52	.035″
1968	(8 cyl.)	307	TKG-2	A52	AR52	.035″
	(8 cyl.)	327	TKG-1	A42	AR42	.035″
	(8 cyl.)	396	TKG-6	AG3	AGR31	.035″
	(8 cyl.)	427	TKG-6	AG3	AGR31	.035″
1969	(6 cyl.)	250	TKG-8	—	AGR52	.035″
	(8 cyl.)	327	TKG-9	—	AR52	.035″
	(8 cyl.)	350	TKG-9	—	AR52	.035″
	(8 cyl.)	396 (349)	TKG-11	—	AGR31	.035″
	(8 cyl.)	2 Bbl. Carb. 427 (349)	TKG-11	—	AGR31	.035″
	(8 cyl.)	4 Bbl. Carb. 427(349)	TKG-11	—	AGR31	.035″
1970	(6 cyl.)	250	—	—	ARF52	.035″
	(8 cyl.)	350	TKG-9	—	AR52	.035″
	(8 cyl.)	400 2 Bbl. Carb.	TKG-9	—	AR52	.035″
	(8 cyl.)	454 (345 H.P.)	—	—	ARF42	.035″
	(8 cyl.)	454 (390 H.P. Hi Perf.)	—	—	ARF32	.035″

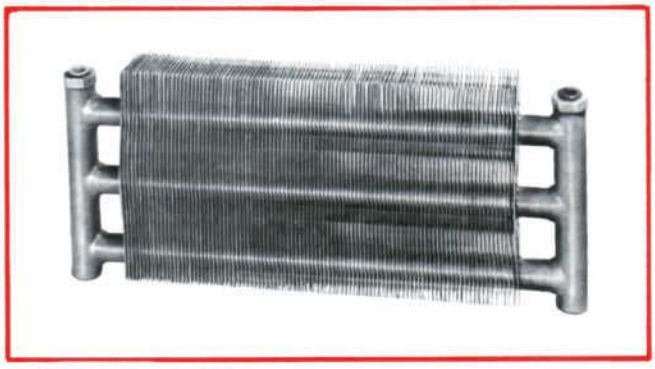
YEAR	CYL.	ENG. C.I.D.	ELECT. TUNE-UP KIT *	SPARK PLUGS REG.	SPARK PLUGS RESIS-TOR	SPARK PLUGS GAP
CHEVY II/NOVA *(Turn to PAGES 16 & 18)*						
1962	(4 cyl.)	153	—	AG52	AGR52	.035″
1962	(6 cyl.)	194	TKG-5	AG52	AGR52	.035″
1963	(4 cyl.)	153	—	AG52	AGR52	.035″
1963	(6 cyl.)	194	TKG-5	AG52	AGR52	.035″
1963	(8 cyl.)	283	TKG-2	A52	AR52	.035″
1963	(8 cyl.)	327	TKG-2	A52	AR52	.035″
1964	(4 cyl.)	153	—	AG52	AGR52	.035″
1964	(6 cyl.)	194	TKG-5	AG52	AGR52	.035″
1964	(8 cyl.)	283	TKG-1	A42	AR42	.035″
1965	(4 cyl.)	153	—	AG52	AGR52	.035″
1965	(6 cyl.)	194	TKG-5	AG52	AGR52	.035″
	(6 cyl.)	230	TKG-5	AG52	AGR52	.035″
1965	(8 cyl.)	283	TKG-1	A42	AR42	.035″
1965	(8 cyl.)	327	TKG-1	A42	AR42	.035″
	(8 cyl.)	Trans. Ign. 327	—	A52	AR52	.035″
1966	(4 cyl.)	153	—	AG52	AGR52	.035″
1966	(6 cyl.)	194	TKG-5	AG52	AGR52	.035″
	(6 cyl.)	230	TKG-5	AG52	AGR52	.035″
1966	(8 cyl.)	283	TKG-1	A42	AR42	.035″
1966	(8 cyl.)	327	TKG-1	A42	AR42	.035″
	(8 cyl.)	Trans. Ign. 327	—	A52	AR52	.035″
1967	(4 cyl.)	153	—	AG52	AGR52	.035″
	(6 cyl.)	194	TKG-5	AG52	AGR52	.035″
	(6 cyl.)	230	TKG-5	AG52	AGR52	.035″
1967	(8 cyl.)	283	TKG-1	A42	AR42	.035″
	(8 cyl.)	327	TKG-1	A42	AR42	.035″
1968	(4 cyl.)	153	—	AG52	AGR52	.035″
	(6 cyl.)	230	TKG-5	AG52	AGR52	.035″
	(6 cyl.)	250	TKG-5	AG52	AGR52	.035″
1968	(8 cyl.)	307	TKG-1	A42	AR42	.035″
	(8 cyl.)	327	TKG-1	A42	AR42	.035″
	(8 cyl.)	350	TKG-1	A42	AR42	.035″
1969	(4 cyl.)	153	—	—	AGR52	.035″
	(6 cyl.)	230	TKG-8	—	AGR52	.035″
	(6 cyl.)	250	TKG-8	—	AGR52	.035″
	(8 cyl.)	307	TKG-9	—	AR52	.035″
	(8 cyl.)	350	TKG-9	—	AR52	.035″
	(8 cyl.)	396	TKG-11	—	AGR31	.035″
	(8 cyl.)	396 (375 H.P.)	TKG-11	—	AGR31	.035″
1970	(4 cyl.)	153	—	—	AGR52	.035″
	(6 cyl.)	230	—	—	ARF52	.035″
	(6 cyl.)	250	—	—	ARF52	.035″
	(8 cyl.)	307	TKG-9	—	AR52	.035″
	(8 cyl.)	350	TKG-9	—	AR52	.035″

*Includes a set of Spark Plugs, Points and Condenser.

TECHNICAL

AUTOMATIC TRANSMISSION ACCESSORY OIL COOLER KIT —TRAILER TOWING SEVERE DUTY

To provide additional protection against severe conditions of high ambient temperatures, loads and grades, an accessory automatic transmission oil cooler kit, C9AZ-7K177-A, Class AA has been released. To reduce possibilities of fluid expanding out of the filler tube or vent due to transmission overheating while towing. Figure 1.



CLASS I TRAILERS— NOT INCLUDING TRAVEL TRAILERS

All Vehicles—No Change Required (current specifications for Class I trailer towing still apply).

CLASS I TRAILERS— TRAVEL TRAILERS ONLY

Mustang, Falcon—Use Class I trailer towing package plus install Autolite-Ford accessory transmission cooler kit.

Fairlane, Ford, Light Truck—Use Class II trailer towing package, available thru production.

Thunderbird—Use Class II or Class III trailer towing package, available thru production, plus install Autolite-Ford accessory transmission cooler kit.

CLASS II OR CLASS III TRAILERS

Fairlane*, Ford, Thunderbird, Light Truck—Use of Class II or Class III trailer towing package available thru production, plus installation of Autolite-Ford accessory transmission cooler kit is recommended.

**Not recommended for Class III trailer towing.*

NOTE: To insure maximum efficiency, it is mandatory that the cooler be connected to the radiator as shown on kit instructions: Out of transmission to auxiliary cooler, to radiator and return to transmission. Do not bypass radiator transmission cooler.

MAVERICK AUTO-FLEX (AB-155) REAR SHOCK ABSORBERS AVAILABLE

There has been some confusion about the availability of the Auto-Flex rear shock absorbers for the Maverick. An earlier parts bulletin listed only the part number for the *front* Auto-Flex shock absorber for the Maverick. The rear Auto-Flex shock absorber (AB-155) is available for the Maverick.

HEATER CORE AND HEATER HOSE REPLACEMENT

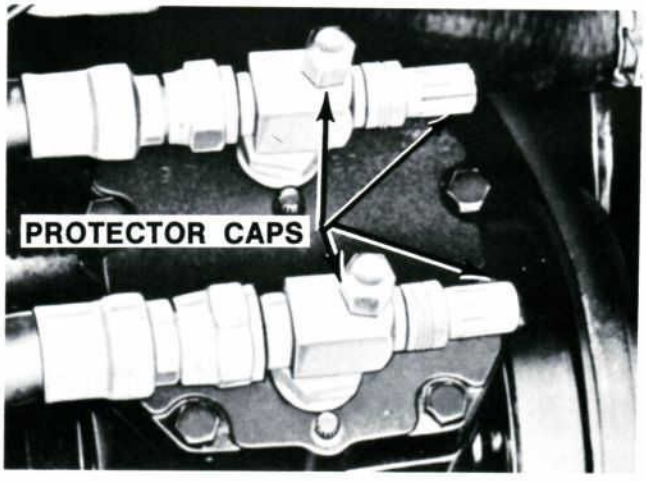
Damage to a newly installed or reinstalled heater core can occur when forcing on a dry heater hose on a dry heater core tube. The excessive force required to install the hose may result in a break in the solder connection at the tube.

Heater hose installation force can be reduced significantly by applying a soap solution to the heater core tubes and the ends of the heater hose. The reduced installation force will greatly reduce the possibility of damaging the heater core solder connections.

Don't forget to install the hose clamps.

CLARIFICATION—MAY SHOP TIPS

In the May, 1970 issue of *Shop Tips*—Figure 23, page 12 has an incorrect callout. The figure shows Protector Caps on an air conditioning compressor. Three of the arrows point to the protector caps and the fourth arrow points to a hex head bolt. See corrected illustration below.



SERVICE BRIEFS

ALL 1970 FORD-BUILT VEHICLES WITH THE C4 AUTOMATIC TRANSMISSION

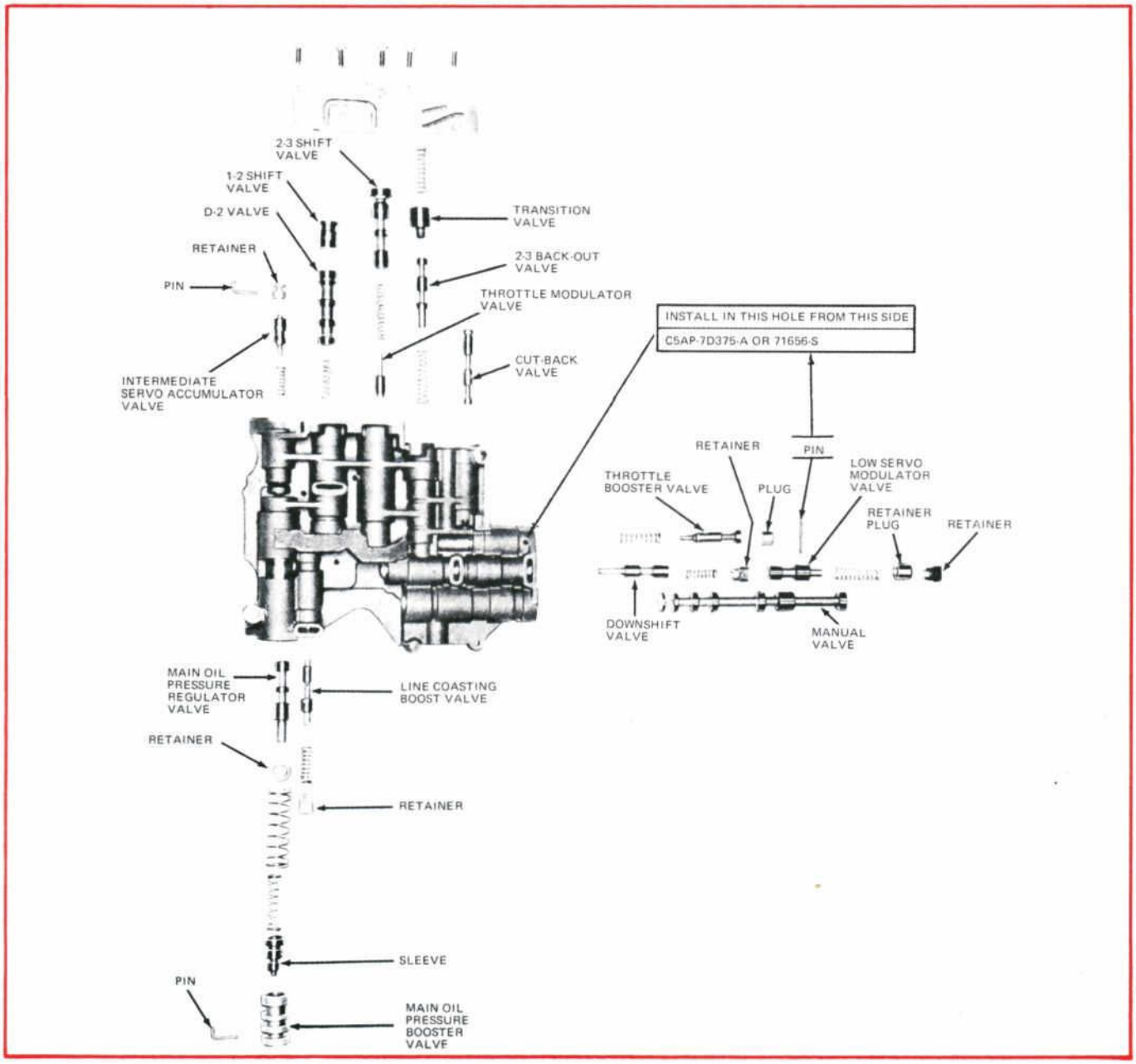
REVISED THROTTLE BOOSTER VALVE RETAINING PIN

A new press fit type of throttle booster valve *Retaining Pin* has just been released. This new pin, (Part No. 71656-S), is readily identified by its three (3) grooves and replaces the previous loose fitting type pin.

If it is found necessary to remove the throttle pressure booster valve when cleaning the main control valve body, this new type press fit pin can be easily removed by simply prying it upward using a pair of side cutters.

It should be pressed into position from the top of the valve body casting and *not* from the machined surface. The three grooves must be *up* when the pin is installed correctly.

Note the illustration for location to other valve body parts.



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