THE EXCHANGE

AN ELECTRICAL REBUILDER'S ASSOCIATION PUBLICATION

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What is a rebuilder?

BY JIM THOMAS

According to Wikipedia, rebuilding is an old term for remanufacturing. I guess that is true—we rebuilders do "remanufacture" starters and alternators—and plenty of us old-timers have been rebuilding for many many years! But really, as rebuilders, who are we? More importantly, what singular abilities do we bring to the automotive industry that give value to our customers, and down the line, to their customers?

The item that got me started on this article, was a consumer-help column in one of the nation's daily newspapers. The column was written by a gentleman who seemed to be quite qualified to write answers to automotive vehicle owners' questions. He had been in the automotive repair trade for 30 years and was an ASE Master Tech. However, his answer to a consumer's question shocked me, so I thought I would share my thoughts.

The car owner wrote that he was at his wits' end with the following problem: His 2001 Mercury Villager had both the battery light and the brake-warning light on. The owner, following advice from several repair shops, decided to replace a three-year old battery, hoping that the battery light would "reset". Upon further advice, he then checked the brake fluid level and also checked to be sure that the emergency brake was releasing properly. As a final plea for help, he wrote in for advice to the Master Tech, because nobody that he had asked about this problem thus far, was able to help him, and he wanted to know, "What am I missing?" The answer from the Master Tech was surprising—he said, "I have absolutely no idea, but if you find out, let me know!" By now, most of us that rebuild for a living, are saying to ourselves—bad diodes! Yes, that's right! But the customer didn't know that, neither did the Master Tech or any of the other "professionals" that the customer had asked. That is what prompted me to write this article. The point of all of this is, that we rebuilders, sometimes forget just how much we know, and just how valuable we are to the automotive industry and to our customers.

We rebuilders are unique in the automotive industry, because we rebuild a broad spectrum of units and are expected to know all about them! This gives us the edge over the majority of car repair technicians. Rebuilders also have the ERA website, which helps us by providing answers we need to do the job at hand. The ERA has the combined experience and input of many rebuilders who respond to questions posted on various forums, with names like: Technical Help, Quality Concerns, Business and Industry News, Wanted and For Sale. In addition to the forums, there are numerous videos produced by the ERA and its members, which offer a wide range of step-by-step training guides for the unusual and specialty units that cross our doorsteps. A large library of articles and information, written by our own highly qualified techs, are stored in a very searchable database. Along with donated files of information from suppliers and vendors, there is a vast amount of information for rebuilders at their fingertips. Whatever you need to "help you help your customer", can

(See REBUILDER, pg. 6)



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Richer Automotive Electric
Life is richer when you share

BY THE EXCHANGE STAFF

You could say that James R. Richer was born with rebuilding in his blood. His great-grandfather was a blacksmith who operated a livery stable in Escanaba, MI in the late 1800's, servicing horsepower of the four-legged variety. His grandfather, Thomas Richer, opened and operated Richie Electric Company, one of the first specialized automobile electric businesses on Michigan's northern peninsula. His father, James W. Richer, started Richer Automotive & Truck Electric in Escanaba and moved it to southern California in 1993.

James R. Richer had apprenticed under his father at the Escanaba shop as a teenager, but after finishing high school, he joined the US Navy. It was his attempt at trying something new. In the navy, Richer learned to service and repair all types of electrical equipment, some of which were highly sophisticated. "I enjoyed my time in the Navy," he said. "It was different, and it really did give me the opportunity to see the world." A sailor's life, however, was not for Richer. "I missed rebuilding, to be honest," he said. "I missed working on starters. I've always liked this job and the pride that goes with it." After completing his four-year commitment to the Navy, Richer joined his dad in California, where they partnered in the rebuilding business.

After 20 years in Oceanside, about 35 miles north of San Diego, Richer Automotive & Truck Electric is well established and a source for all types of alternators, starters, DC motors and generators. "We do not do anything under the hood of a car," Richer explained. "The reason is, 90% of the repair shops in the area are our customers. We don't want to compete against them." How has Richer managed to keep repair shop customers with all the competition that is out there? The answer is simple: "I assist them when they run into a problem. We beat the chain stores and parts warehouses by doing diagnosis when a customer needs it." In other words, Richer's shop sits on the vanguard of change in the rebuilding business. In order to remain on the cutting edge of this change, Richer cites education as the key and names several seminal influences from his life.

"My dad could always fix anything. He is a positive role model for me. I had two good mentors learning the trade, my dad and an employee back in Michigan, Eric "the sticker" Sullivan. Dad is 70 now and semi-retired. However, he's still active in the day-to-day business operation."

Richer also cites Wagner Alternators, IMI HiTorque Starters, and J&N Auto Electric as great helps throughout the

(See RICHER, pg. 13)



Richer Auto & Truck Electric Co., Oceanside, Calif.



The Richer crew—Jim, Jim and Brad

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What Is Quality?
Part three

BY BOB THOMAS

Quality is an overused word that is practically meaningless today, whether you read it on a billboard or hear it in a sales pitch. However, if that word happens to come from someone you trust, it carries a lot more weight! In other words, hearing the word "quality" from a close friend is significantly more convincing than hearing it from a stranger.

This is the premise for what is often referred to as "word-of-mouth advertising", and you won't find it listed on any corporate advertising budget. It has been said that it is the best form of advertising you can have. It has also been said that you cannot buy it, but that is not exactly true. You cannot write a check to buy it, that is for sure. But it is there if you want it, and it does have a cost. You have to be willing to work for it.

The single most important encounter any business can have is when something goes wrong for a customer, and it doesn't matter who, what, when, where, why or how. Your reaction to that customer at that moment in time, more than anything else you could possibly do, will define your business in the mind of that customer. This is not about simply taking care of a warranty issue. If handled properly, an unhappy customer returning to your door with a problem, can become your best opportunity to get great word-of-mouth advertising.

I'm not suggesting that you should cease traditional forms of promoting your business, but I am saying that there is no better form of advertising than a customer whose expectations have been exceeded. There is no better opportunity to exceed those expectations than when a customer returns, carrying a "problem" part that was purchased from your business. It really does not matter why that starter or alternator didn't work for him, as long as you solve his problem, and he leaves happy.

There is no simple formula for success on this subject. Every single case will be different. But here are a few tips that have worked for me.

Stay calm—Nobody enjoys returning an item he has purchased. When a customer returns to your business with a problem, the first thing that you have to do is to put him at ease. To accomplish that, you have to be at ease yourself. If you can stay relaxed, it has a calming effect on the customer.

Prepare—Warranties and returns are an inevitable part of doing business. Think about what you are going to say in advance. Whatever you do, don't put the customer on the defensive by accusing him of anything, even if you know he did it. Everything, from the first words out of your mouth to the expression on your face, will make a difference.

Prioritize—A customer who is having a problem should always come first. No matter how busy you may be, no matter who else is in the shop at the time, a customer with a problem should receive your immediate and undivided attention.

Apologize—The simple words "I'm sorry" can work wonders. Even if you know that the customer is wrong, you will never convince him of that until you have gained his trust. Let him know that you are unconditionally sorry about the problem he is having. Make it a point to say "I'm sorry" several times. It works.

Listen—Invite him to explain the problem in detail, and don't interrupt while he is talking. Show respect by paying close attention to everything the customer has to say. If you need to ask him questions, wait patiently until he is finished talking before you do.

Care—Make sure that the customer knows that you are concerned that he had a problem. Take the time to get to the root cause, if possible, and explain it to him using words he can understand.

Truthful—If it is your fault, admit it, and tell him that you are really sorry that it happened. You will be surprised by the reaction that you get

(See QUALITY, pg. 9)

OBITUARY

Tanya Louise Love, better known in the rebuilding industry as Tanya Roman, passed away on July 21, 2013 after a long unexpected journey at Mobile Infirmary, in Mobile, AL. Tanya spent more than 20 years in telephone sales for several electrical rebuilding suppliers including WAI, Transpo and Regitar before moving to Mobile. She was 56 years old and is survived by a husband, six children and 10 grandchildren.

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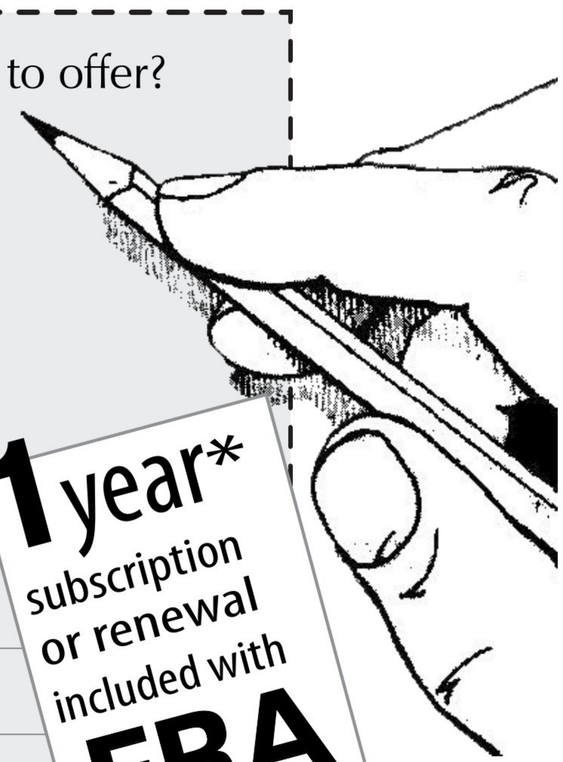

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From The President's Desk
Electrical problems can snowball in summer

COLUMN BY HANK HENKE



As I sit here writing this column, it is 100 degrees outside. Rebuilders in Arizona, Texas, Louisiana or Florida may think that this is normal for July, but it's not normal here in Indiana. Thank the Lord for air conditioning! I hope this hot weather brings in some extra work for all of us. If you are like me, you take it for granted that extra work always comes with hot weather. Have you ever really sat down and thought about why starters and alternators fail more often in hot weather? Here is what I believe happens:

Batteries fail because they "gas" more as the temperatures increase. However customers never seem to think about this, so they see no need to check electrolyte levels more often in the summer months. Also, the hotter the battery gets, the lower the resistance in the battery is. This allows the battery to accept more current, which causes even more gassing and heat build up. When a battery reaches 130 degrees, it is no longer accepting a charge, it is only gassing and generating heat. Extreme heat in a battery can distort the plates, which can short the cells. As the gassing occurs, corrosion increases on and around the terminals and cables. Extremely hot weather is really hard on batteries and cables, but who wants to check battery electrolyte levels or clean battery cables when it's 100 degrees outside?

The problems can snowball ... The lower battery resistance which causes the battery to accept more current, can also make the alternator work harder and get even hotter than it normally would. The heat can affect the drive belts, too, causing slippage, which adds more heat to the belts, the pulley and the alternator from the increased friction. The belt slippage can reduce the alternator's ability to charge properly, so now you have possibly introduced undercharged batteries into the equation!

The vehicle gets parked for a lunch break, and when the driver returns to go back to work, the engine will not turn over. He calls his shop and tells them that the starter doesn't work. So the starter gets replaced. Nobody bothers to check the batteries, because they are "new" (meaning, they are about 11 months old, if anyone actually checked). Nobody checks the cables, because they "look" okay. Nobody checks the belts, because they were just replaced under the regular maintenance schedule (last year). But when that new starter fails to start after lunch the following day, it's the rebuilder's fault, because "he doesn't know how to build a starter that works!"

How easy it would be if customers understood how the electrical systems work and what to look for when they have a starter or alternator failure.

Hank Henke, ERA president, is owner of United Starter & Alternator, Lowell, Ind.

ERA

WEB TIP

The complete online Exchange is now available to all!

Selected articles from this newspaper have been available to read online since 2004, the year the ERA website was started. But it was never possible to read the entire paper—until now.

We are pleased to make the entire paper available online, from front page to back page. It's all there—every article, every photo and every ad, even the classified ads!

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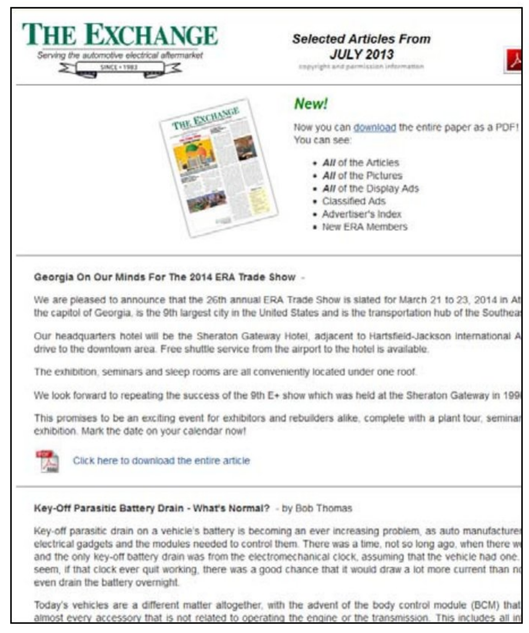
If you just want to browse the major articles, we have continued the tradition of presenting them exactly as before The lower part of the web page contains excerpts from the articles, along with a download link. We hope you enjoy this new feature.



The complete paper can be viewed by clicking the link at the top of the page.

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Plain Talk
It's a sign of the times

COLUMN BY ROB BUKSAR



I was on the phone with my friend, Doug Sluiter (Sluiter Auto Electric) complaining about losing my electricity and being shut down due to a recent storm. For most of my life, northwest Indiana has been blessed with moderate weather. But in the last 10 years, something has changed. We now go directly from winter to summer, and we have lost spring and fall entirely! What appears to have replaced those 2 seasons are gale-force winds with torrential rain, golf ball-sized hail, blistering heat and flooding everywhere. It's been a lousy trade!

Once I finished whining, Doug jumped in and said, "Now, do you really want to hear something?" "Of course," I said, "Lay it on me!"

Doug said that his neighbor at home was a heating and cooling contractor, who just happened to stop by his shop to say hello. Once they exchanged greetings, Doug's neighbor asked, "Doug, are you ready for a new air conditioning unit for the shop yet?" Doug immediately assumed that his neighbor was trying to pump up his sales by selling him a new shop air conditioner, which he really didn't think he needed. Doug said that even though his unit was 20 years old, it still worked just fine, and he wasn't interested in buying a new one. The heating & cooling guy asked Doug when was the last time he used the air conditioner? Doug said, "Not since last year, but we're about due to turn it on again." The heating & cooling guy invited Doug outside, because he wanted to bring something to Doug's attention. They both walked outside, about 100 feet away, where it was possible to see what was on the roof of his building. To Doug's surprise and dismay, his huge roof-mounted air conditioner was no longer there! Somebody had climbed up onto his roof, had cut all the lines, had cut all the bolts and had wrestled that big old air conditioner off the roof and into a truck. Then they had taken off with it! Hence, Doug's neighbor sold him another air conditioner. As for Sluiter, he joined the growing list of folks falling victim to a society and an economy gone wild in a sick way!

Now, I have another story that I want to share before I sign off. I'm confident that you'll get a kick out of this one!

I'm sure of lot of you old-timers out there remember Barney Kaplan of Barney Kaplan Surplus, (BKS). Barney was one of the original "players" in the rebuilding business. He began his business during Harry Truman's presidency. Barney, currently 95 years young and retired, is doing pretty darn good, taking everything into account.

Barney ushered in rebuilding as an industry. He's seen it through its "heyday". He's seen its demise as an industry and its transition into an expensive hobby. To quote "Deadline Detroit" journalist Bill McGraw, "Barney Kaplan ran an amazing operation inside the old, sprawling museum-like building on Epworth Ave. near Livernois and W. Warren. He supplied companies that rebuilt parts for automobiles, ships, tanks and other mechanical contraptions. The building was filled with rotors, solenoids, bushings, coils, generators, shafts, bolts and many other greasy things." (You can see the link to the full story at the end of this article.)

Barney has since closed his operations and has sold his building. I'm sure it wasn't because he wanted to. Globalization, cheap new offshore parts, and the mind-boggling changes that accompanied all of this, rendered Barney's business "terminal", along with the many other companies that have fallen. Barney retired kicking and screaming!

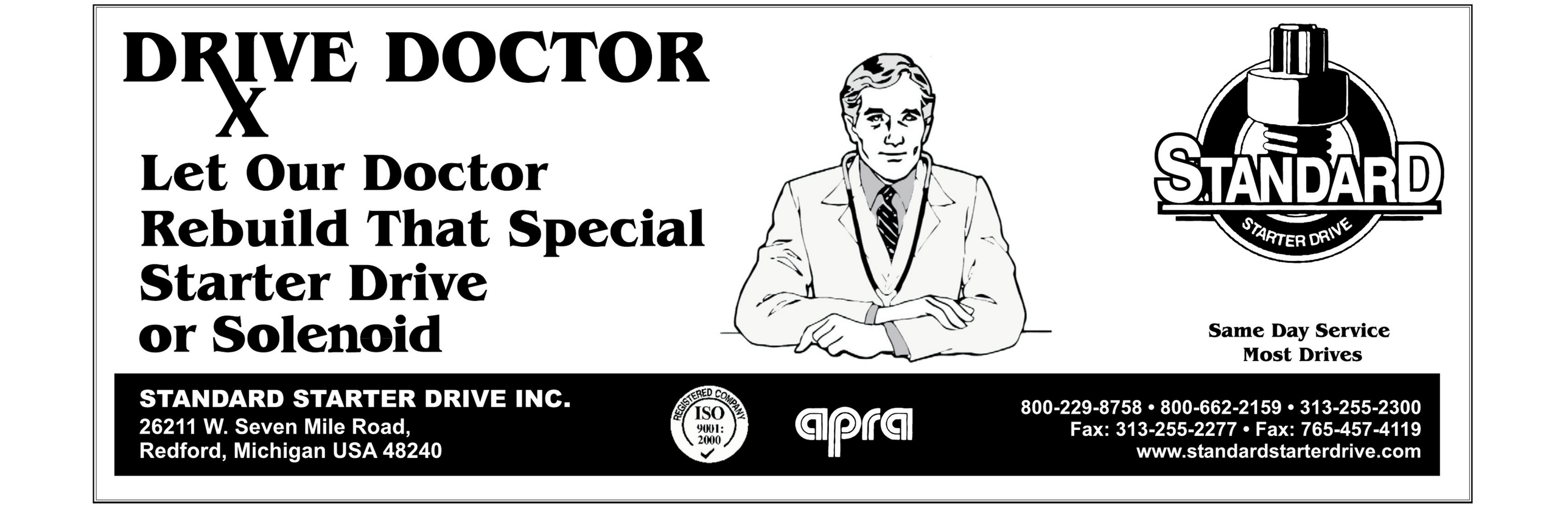
Now, if you're wondering where

(See SIGN, pg. 6)



A scrapper walks into the BKS building.
(photo courtesy Deadline Detroit www.deadlinedetroit.com)





Understanding Starter Drives
Part four: Heavy duty applications

BY BOB THOMAS AND WES GRUENINGER SR.

Editor's Note: This is Part Four in a series of articles on starter drives. Part One (May 2013) covered screw-type drives. Part Two (June 2013) covered barrel drives. Part Three (July 2013) covered roller-clutch drives.

Developing a starter drive to reliably withstand the high resistance of cranking a diesel engine, has been a challenge for over a century. The high compression ratios of a diesel require a much more robust cranking motor, and that places extreme demands on the starter drive, through which all of the power of the starter must be transferred to the engine.

In previous articles, we have explained the Bendix-designed screw-type compression-clutch drive (*see Figure 1*) and double-roller-clutch drives (*see Figure 2, pg. 7*). A variety of creative approaches were used to handle the unique starting needs of many early diesel engines. They included the use of a manual compression-release valve along with a smaller starter motor. This allowed the engine to be brought up to starting speed with the release valve open. Energy developed and stored in the weight of the turning flywheel, was then combined with the starter to continue cranking after the compression-release valve was closed. Variations of compression release are still used today in some specialized applications, some of which are now electronically controlled.

Smaller gasoline engines, called "pony" or "pup" motors were used to crank diesel engines, too. The operator would start the pony engine (*see Figure 3, pg. 7*), run it up to speed, and then release a clutch that connected it to the large diesel engine. The pony engine had an added advantage of being able to warm up the diesel engine block prior to cranking it, as the two engines often shared the same cooling system. A pony engine could also crank longer, as its only limit was the amount of fuel in the tank. More efficient and powerful electric starter motors, many using gear reduction, now dominate the diesel starter world.

The vast majority of diesel engines, at least for the last 60 years, have utilized conventional DC cranking motors with a variety of starter-drive designs. World War II and the effort to win it, forced rapid changes in new technologies. Big pieces of military equipment required large diesel engines and reliable means to start them quickly. Better starter drives were needed. Some drives, which were developed for the war effort, never made it into the private market. One such drive is the Eclipse-Bendix ratchet drive, which was used on PT boats (*see Figure 4, pg. 7*).

Delco-Remy introduced the Dyer drive (*see Figure 5, pg. 7*), used on early 40MT starters at about the same time. The Dyer drive is named after Leonard H. Dyer, an inventor who designed and

(See STARTER DRIVES, pg. 7)

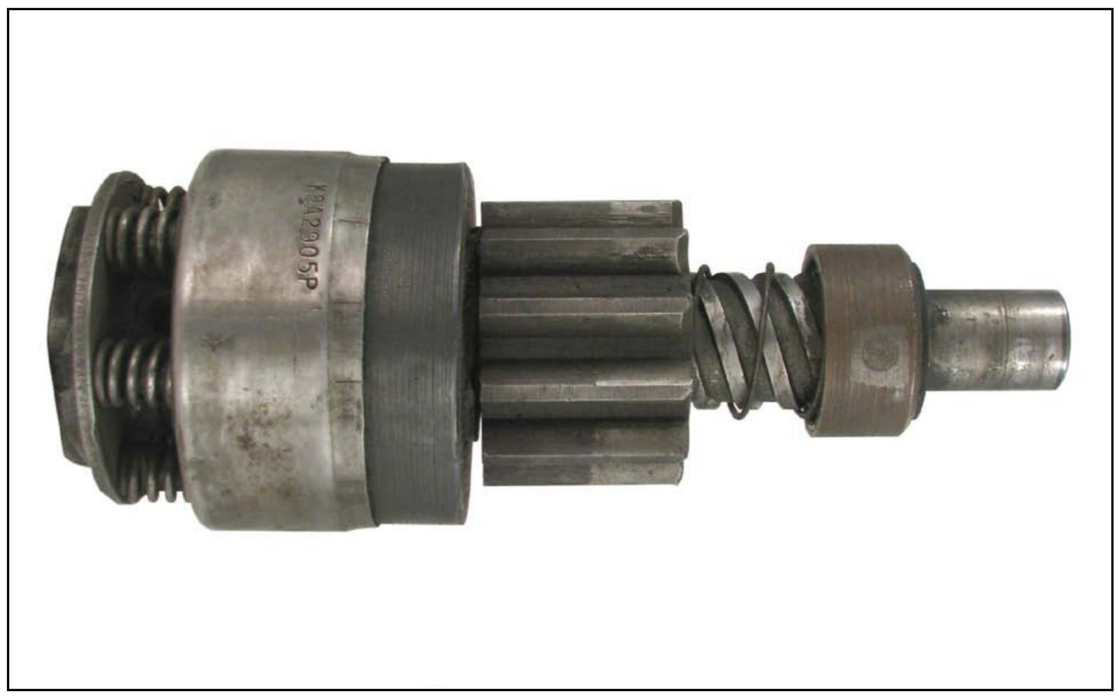


Figure 1—Bendix screw-type compression drive

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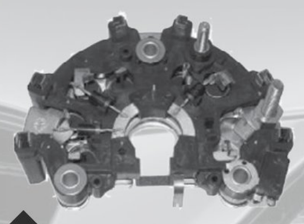

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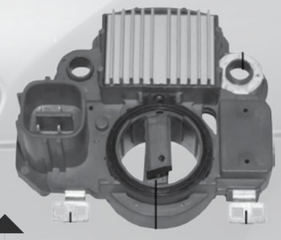

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SIGN

(Continued from page 4)

this is all going, I will now do a "Paul Harvey" kind of thing, "Now for the rest of the story". As in Sluiter's story earlier, there is some insult to add to the injury.

Frankly, I've often thought that Barney was one of the few men who should have been commended for all of his help and contributions given to others. Many got their start or owe their expansion or even survival to Barney Kaplan. I was one of the many recipients of Barney's wit and wisdom. I thought that a little button or even a T-shirt saying, "Thanks, Barney," might be appropriate. Instead, I was emailed a photo of the former "BKS" building with an accompanying article. It was posted on July 10, 2013, by Bill McGraw, at DeadlineDetroit.com

McGraw writes, "One of two dozen places raided by police on Monday was a marijuana grow operation in a west -side Detroit warehouse with the initials "BKS" on the façade. The initials stood for Barney Kaplan Surplus. ... Kaplan's business obviously was long gone by the time marijuana growers moved in."

McGraw says, "I drove by Kaplan's old building Tuesday and Wednesday, and it was crawling with scrappers brazenly stripping the place of anything metal. On Tuesday, in daylight, they had two trucks sitting out in front, and smaller operators were on hand with shopping carts. One scrapper said cops had passed without stopping."

In some ways, you could see Kaplan's old building as a miniature of what has happened to not only our industry but to the whole country! Our nation's economic backbone once had been made of thousands of companies that manufactured many diverse products. Many of them manufactured things that had engines, which was a huge industry that spawned "parts guys" like Barney Kaplan and thousands of others who built and rebuilt motors, brake cylinders, compressors, starters, alternators, etc.

We have swapped it all for no jobs, an out-of-control drug problem, indoor marijuana grow operations and scrappers so fearless that they see an open door and think nothing of picking a building clean of its metal, wiring and fixtures ... and all of this with a wink and a nod from the local police!

Doug and Barney, I'm sorry for your losses, and I feel your pain. I've been broken into and robbed more times than I'm willing to admit.

I would liked to have seen a "Thanks, Barney" T-shirt or button, but I just don't think it's going to happen. I'm afraid that Barney's legacy may be lumped together with the "Cheech and Chong" comedy albums that no one listens to anymore, or the episodes of "Sanford and Son" that no one watches ... a sad sign of the times.

In spite of it all, I love you, Barney. Thanks a bunch for all that you've done for so many!

God Bless America and please help us find our way!

Below is a link to the article about Barney Kaplan written by Bill McGraw for the online site DeadlineDetroit.com.

http://tinyurl.com/ncq7rre

ERA

REBUILDER

(Continued from page 1)

be found on this wonderful website—a source of information including such things as: identification of units, wiring diagrams, which starter can be used as an upgrade for better, longer service ... and more! It's all there ... allowing rebuilders to excel in the auto electric field.

Training for rebuilders is also made available as part of the ERA trade show, held once a year in various locations around the county. With the explosion in the number of new alternators and starters, the ongoing training provided by the ERA at their show is a valuable asset to rebuilders. If you haven't been to an ERA trade show recently, you really should make plans to go—if for no other reason than to rub shoulders with other rebuilders like yourself and to meet your suppliers face to face. Rebuilders sharing information for the benefit of our industry, is what will make us strong for the future.

We rebuilders are the experts in our automotive electrical industry, and as my story about the bad diodes shows, we are needed! We have to continue to let people know what we can do for them, to help them keep their vehicles and equipment working and staying on the road.

Jim Thomas is owner of Smith Auto Electric, Yakima, Wash. He served as ERA President from 2007–2009.

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DRIVES

(Continued from page 5)

patented mechanical systems for the first automobiles. Many of his patents were filed years before the actual production of vehicles began. That put Dyer in an enviable position, collecting royalties from virtually every single auto manufacturer of the day, and there were hundreds of them. While his patents have long expired, some of his drawings look strikingly similar to some systems still used today. The Dyer drive is actually based on a patent that was intended to be used for transmissions.

The rather unique principle of the Dyer drive, is that the meshing of the pinion with the ring gear takes place with the pinion turning in the reverse direction of what it will be turning during the actual cranking. The reverse motion is achieved by means of the helical screw threads on the armature shaft, that run all the way to the stop collar. Note that the drive in the photos is for a CW application, yet the chamfer on the pinion teeth is cut for, what would ordinarily be, CCW with any other type of drive. Do not let this fool you if you happen to be working on one of these starters. In addition to this, the ring gear used with Dyer-drive applications is also different. It has a chamfer cut on, what would seem to be, the back side of the teeth. For this reason, you cannot substitute a later style starter for a Dyer-drive starter, unless the ring gear is also changed. Failure to change both will result in milling of the pinion.

In the at-rest position, the Dyer-drive pinion is locked in place to prevent it from drifting into the ring gear if the engine is running. This is accomplished by way of a small recess cut into the splines near the base of the threaded area of the shaft (*see Figure 6*). This notch holds the pinion guide stationary, until the shift sleeve pushes it over the recess. The Dyer-drive shift lever (*see Figure 7*) is also unique, as it actually takes very little pressure to engage a Dyer drive. The shift lever applies pressure to the shift sleeve, which can be moved independently and freely on the shaft, unattached from the pinion. The shift sleeve applies pressure to the pinion guide in the back of the pinion. This pushes the pinion guide out the recess, allowing it to move easily on the threaded part of the shaft. The solenoid contacts in a Dyer-drive 40MT starter, cannot close until the pinion has achieved full engagement of the ring gear (*see Figure 8*). This minimizes the chance of milling, provided that everything is adjusted properly. Once the pinion is fully engaged, it will stay in place, not moving back until the engine starts, even if the solenoid is disengaged in the event of a no-start. (*see Figure 9*) The Dyer-drive pinion can be returned to the at-rest position by the ring gear, only after the engine starts, much like the Bendix screw-type drive pinion.

It should be noted that pinion travel must be checked and adjusted, for this drive to function properly. To accomplish this, you must ground the motor terminal of the solenoid and power the switch terminal, which will engage the pinion to the end of its travel and prevent the armature from motoring. Then, you must push back on the pinion until it stops, keeping in mind that you will be further compressing the pinion spring that is already partially compressed. There will be considerable resistance when you push the pinion back. The distance of the space, between the end of movement and where it stops, must be at least 3/16" but not more that 1/4". Be prepared to take the measurement before you power

(See STARTER DRIVES, pg. 10)



Figure 2—Delco 37MT and Denso double-roller diesel drives



Figure 3—Pony Engine used to start a large diesel engine

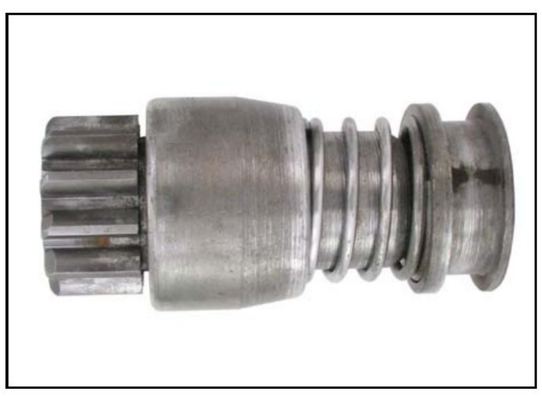

Figure 4— Eclipse-Bendix ratchet drive used on PT boats in WW2

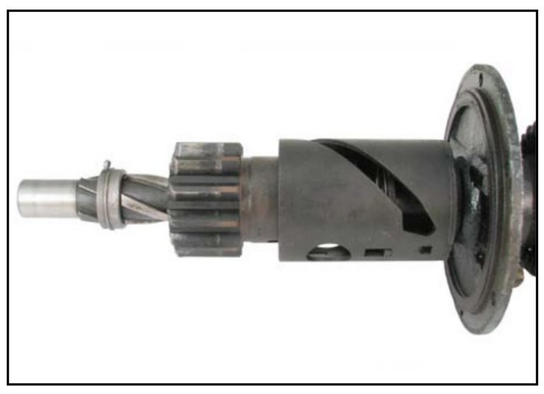

Figure 5— Dyer drive in the at-rest position on armature shaft

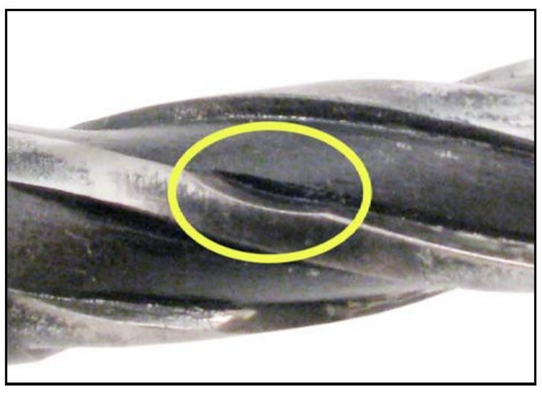

Figure 6— Recess cut in spline holds Dyer drive to prevent drift

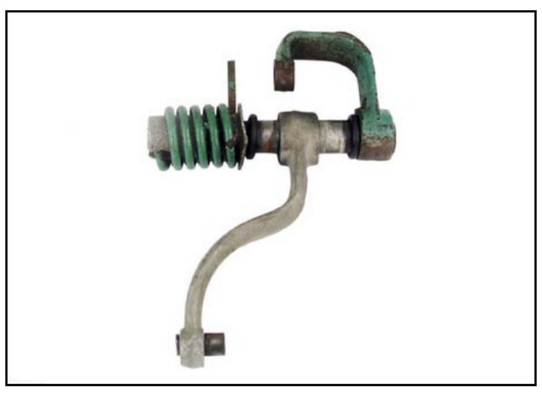

Figure 7— Dyer-drive shift lever

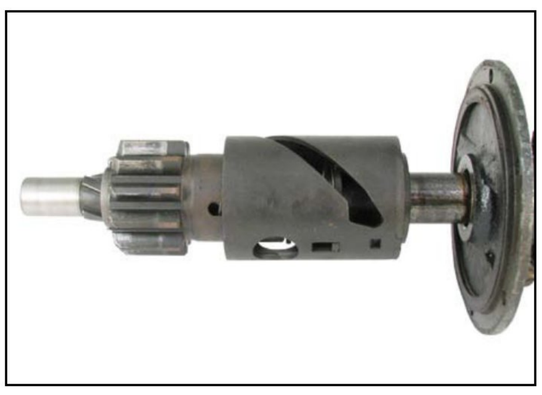

Figure 8—Dyer-drive pinion and shift-sleeve positions during cranking

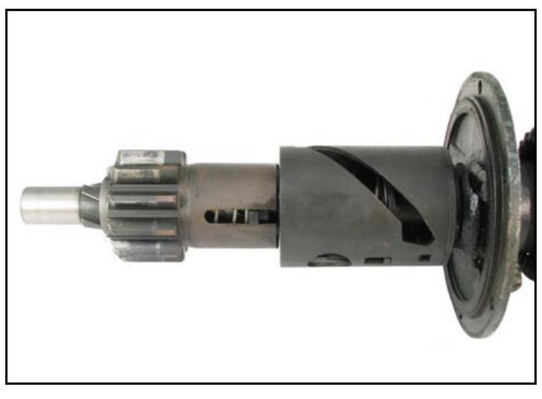

Figure 9—Dyer-drive pinion and shift-sleeve positions after solenoid disengagement following a failed start. Note the pinion stays in the ring gear.

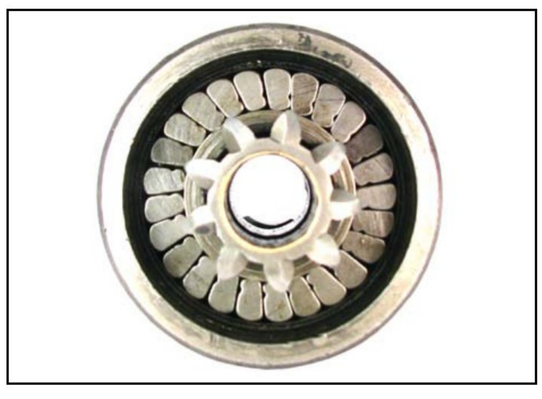

Figure 10— Top view of sprag rollers packed tightly in drive body around the pinion

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ROTOR POLARITY CHART

Testing a rotor for amperage draw is a task that most rebuilders often do without ever thinking about it. You pick up the probes, hold each probe to one of the slip rings for a few seconds and read the amperage draw on the meter's scale. It can be done in a matter of seconds. If you have ever asked if it matters which lead goes where, the most likely answer was, "No, you will get the same reading either way." The amp draw will always be the same, regardless of the polarity you use.

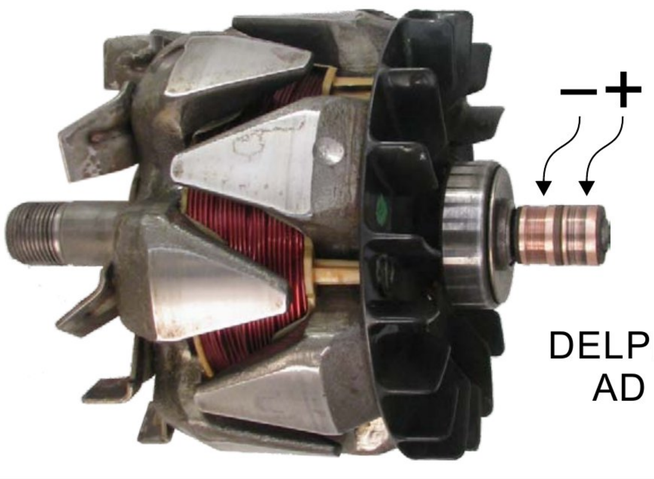
However, something else is going on when current passes through that rotor. You are polarizing the magnets, north and south, whenever you test a rotor. When the test current is removed, residual magnetism remains. How much residual magnetism depends upon the magnetic quality of the steel in that rotor, but it is a noticeable amount. You will have felt it if you have ever tested several rotors together on a flat surface.

In most cases, but not all, the polarity of that rotor will not matter. If it were to become reversed, the field circuit of the completed alternator would easily override it the moment the regulator turned on. But there are instances where reverse polarity can cause start-up problems, particularly when small amounts of current are used to initiate turn-on. The most common instance is a self-exciting circuit, where the residual magnetism alone must generate enough current to excite the regulator field circuit. In many self-exciting circuits, the excitation current may not be sufficient to overcome the reverse residual magnetism.

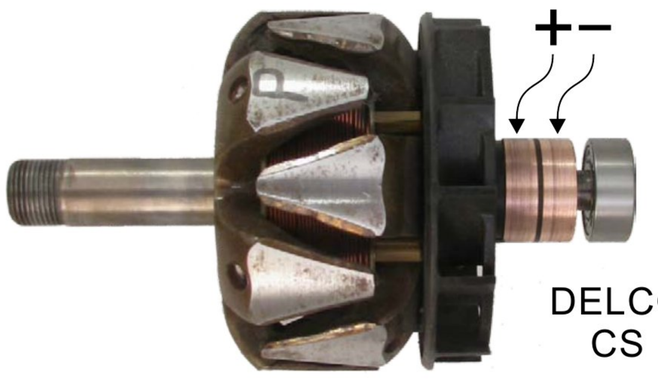
There are other alternators, not self-exciting, that rely on low current for turn-on. They are ignition-activated, but through a resistor (and sometimes a diode in series with a resistor). Some Mando and Motorola alternators that were used in marine and industrial applications are excited in this way. If you do not observe the polarity when you test one of these rotors, you may be unable to achieve turn-on during a bench test. In that case, if you are able to access a trio terminal, you can easily excite the alternator by jumping it to B+ while the alternator is spinning. This simultaneously re-polarizes the rotor correctly. If there is no trio, or if you cannot access it externally, you can try flashing a phase terminal—one of the stator connections. But again, you may not have easy access to a stator terminal, and in some cases, that may not help anyway.

An obvious simple solution to this is to test rotors using the same polarity with which they will operate, especially those in the cases described above. Of course, that requires thinking about what you are doing when you test a rotor for current draw. To make it a little easier for you, we have prepared a chart listing some of the more common rotors that might fit these problem applications. Keep in mind that if you are building a positive-ground self-exciting alternator, you must take the time to determine which way the current is going to flow through the rotor. For example, in an SI series Delco alternator, rotor current will flow in the same direction for either polarity. However, a CS series positive-ground Delco alternator, will have reversed current flow through the rotor.

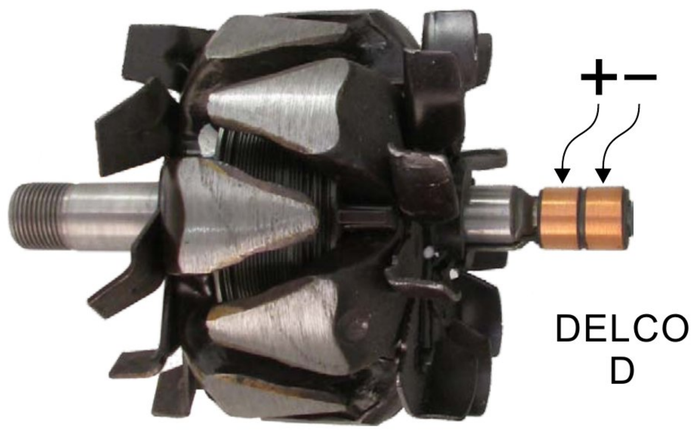
If you are a member of the ERA you can download this chart to print it out. It is located in the Technical Library.



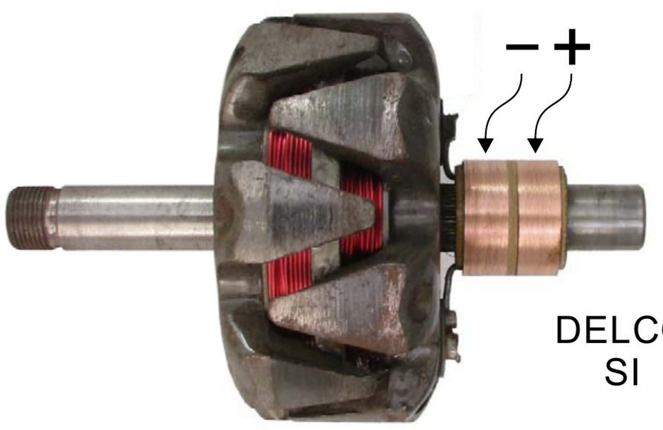
DELPHI
AD



DELCO
CS



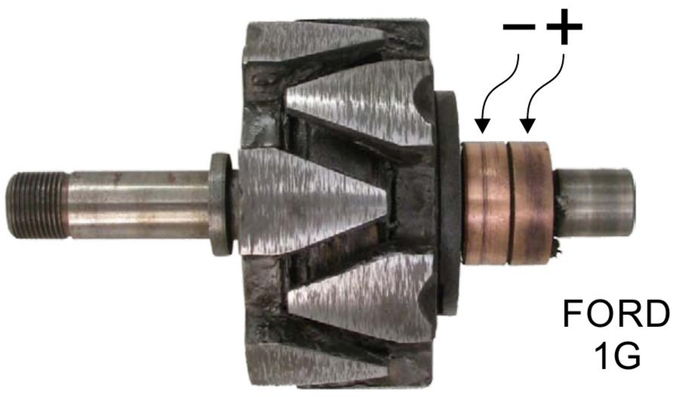
DELCO
D



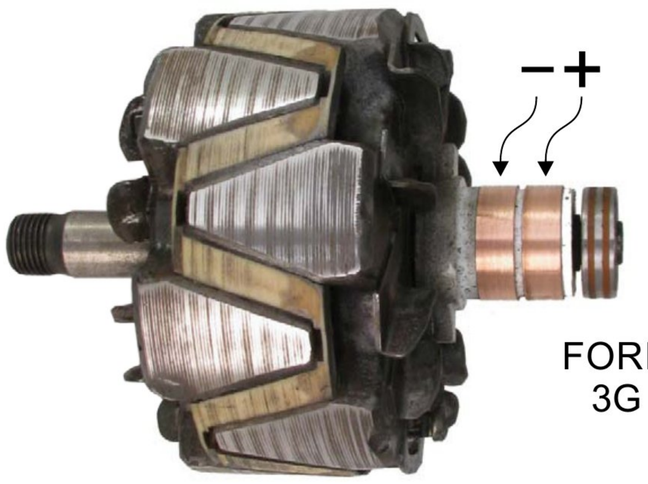
DELCO
SI



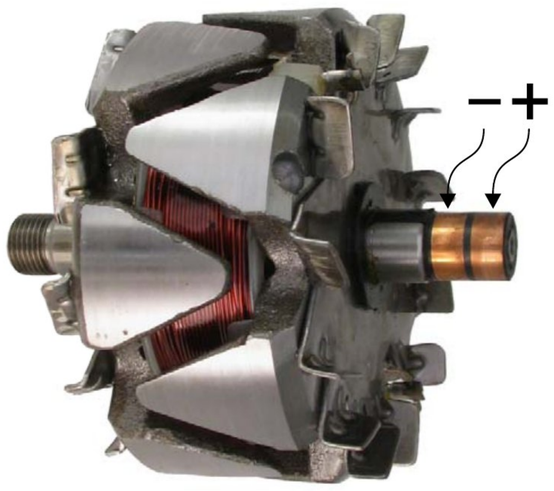
DENSO
IF/IR



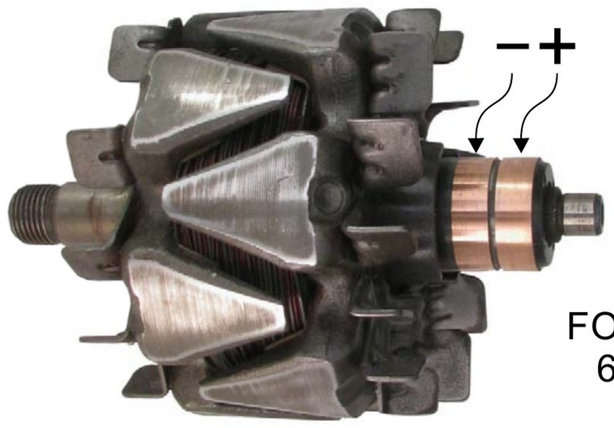
FORD
1G



FORD
3G



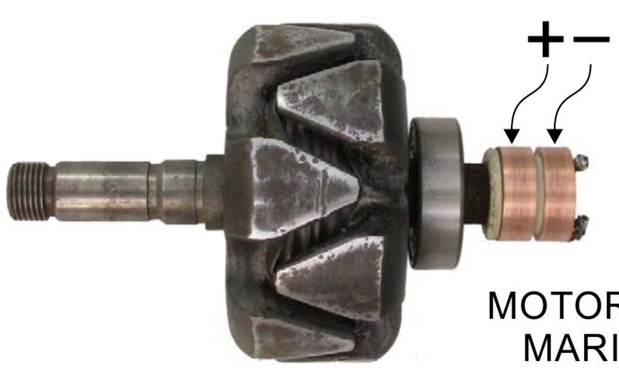
FORD
4G



FORD
6G



MANDO
MARINE



MOTOROLA
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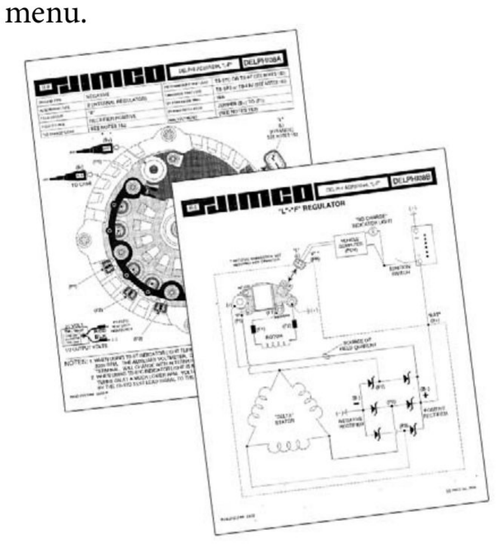

QUALITY

(Continued from page 2)

most of the time. If it is the customer's fault, avoid finger pointing. Simply tell him what scenarios could have caused the problem, and let him figure it out from there.

Reassure—Let the customer know that you are going to solve the problem for him, whatever it takes. Don't be afraid to make a commitment to that effect. Don't just hand him a replacement part and send him out the door, unless you are sure that it will solve his problem.

Exceed—Close the encounter by exceeding the customer's expectations. This is where most business owners miss the boat. The tendency is to equate the warranty obligation to the minimum required to satisfy. But the minimum does not exceed. Don't be afraid to give up a few dollars to ensure that you exceed what that customer expected when he walked in.

I close with this thought. A single satisfied customer using the word "quality" to describe your business, can have more positive impact than spending hundreds of dollars for professional advertising using that same word. If you think of it that way, you cannot afford NOT to exceed every customer's expectations.

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DRIVES

(Continued from page 7)

the solenoid, as you do not want to keep power on the pull-in coil for more than a few seconds at a time. It will heat up very quickly. Pinion adjustment is done by turning the threaded solenoid plunger shaft in or out. "Out" widens the gap. "In" closes the gap.

Chronologically, the sprag-clutch starter drive followed the early screw-type compression drives. Sprag clutches of various types have been used in automatic transmissions, superchargers, helicopters and conveyor belt systems. However, the type of sprag clutch used in starter drives is actually a variation of the roller clutch. Instead of using round balls as the locking mechanism between the drive body and pinion barrel, like the standard clutch drive, the sprag clutch uses oblong rollers—a lot more of them and packaged tightly together. (*see Figure 10, pg. 7*)

The body and pinion barrel are both smooth and perfectly round, unlike a roller drive that has cavities for rollers and springs. As you can see in *Figure 10*, the oblong asymmetrical rollers are slanted in one direction. This allows them to rotate freely in one direction, but lock up in the other direction, as their shape produces a lever-like action between the body and the pinion barrel. Most sprag drives use a garter spring to hold the rollers tightly together, which helps during assembly, too. (*see Figure 11*)

Sprag drives have the ability to slip slightly upon impact, but quickly lock tight and not slip during cranking. They are actually very easy on the ring gear, reliable and long lasting. Their downside is their initial cost. The rollers and bodies are very expensive to manufacture, requiring precision machine work and multiple heat-treatments. For this reason, they were used by starter manufacturers for only a few decades. The fact that we still see them in starters today, attests to their durability.

A cost effective alternative to the sprag drive, that did not give up anything in the way of reliability, came from Facet, in the form of a new type of ratchet drive. They called it Positork, and it quickly became the drive of choice for diesel applications (*see Figure 12*). For most starters that originally called for a sprag drive, there is a Positork drive to replace it. They are basically interchangeable (*see Figure 13*), but each has its own advantages. A sprag drive provides a softer gear engagement, while a Positork drive is less likely to slip. Which is best, depends upon what your customer needs and, unfortunately, what might be available at the time.

There are probably more Positork drives in use today on diesels than any other type. They are readily available as new, aftermarket and rebuilt, for many applications, including some that originally came OE with double-roller drives, like Delco's 37MT starter.

What makes this drive so dependable and different from previous ratchet drives, is the reverse backside of the ratchet teeth. (*see Figures 14 and 15*) The teeth on a Positork ratchet look like a ripsaw blade. As you can see, it would be almost impossible for these teeth to skip. A hard rubber cushion is compressed into the base of the barrel to soften the impact.

Over-running, which happens when the drive remains engaged momentarily after an engine has started, is aided by a release mechanism inside the pinion. If you take one of these drives apart, (*see Figure 16*) you will find three centrifugal weights made of a phenolic material similar to Bakelite. These weights ride on small pins inside the pinion gear (*see Figure 17*) with the rounded side facing the clutch. There is a disengaging ring, a thick steel ring with a cup-shaped curvature, on the inward side. The disengaging ring rests inside the clutch. (*see Figure 18*) The rounded side of the centrifugal weights seat against the curved side of the disengaging ring shown. When a Positork drive over-runs at a high speed, the weights are forced from the center by centrifugal force. They push the disengaging ring and clutch against the meshing spring and away from the pinion. This creates separation between the ratchet teeth and permits the Positork to be over-run at speeds of up to 25,000 rpm without damage.

In addition, the indexing spring is designed to provide some forward rotation of the pinion when abutment with the ring gear occurs. This rotation allows the pinion to find alignment quickly and eliminates milling. When pinion clearance is adjusted properly, milling should not be a problem with a Positork drive.

It would seem that the Positork is the best drive ever, so you may wonder why Denso never used it. Delco also seems to have abandoned it in their most recent starters. I am afraid only the OE manufacturers can answer that question. Our guess is that it could have been replaced in the effort to achieve the softer engagement once provided by the sprag drive. Then again, it could have something to do with the cost, which is responsible for many of the changes we see today. Your guess is as good as ours.

Our thanks to Hank Henke, Ken Plourde and Chuck Showalter for technical help with this article.

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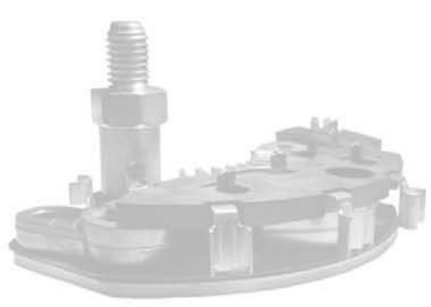
Building OE Quality For The Aftermarket





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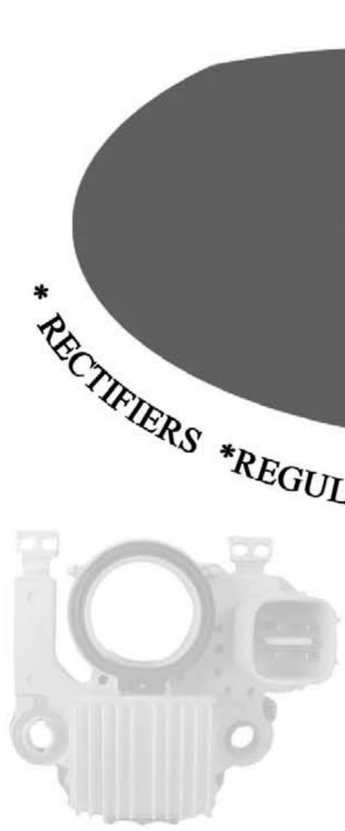



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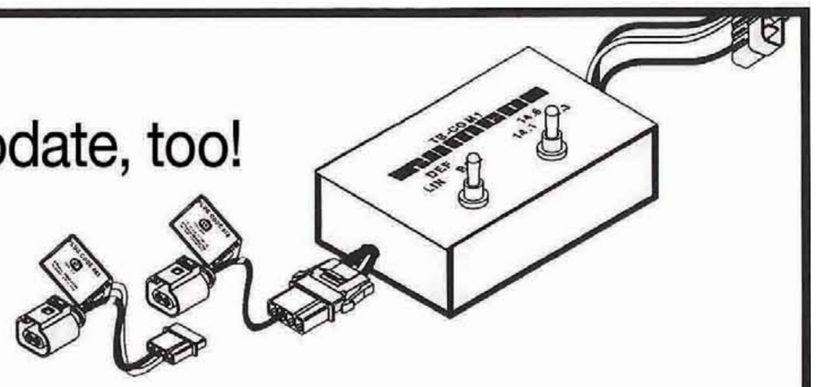

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Figure 11— Sprag rollers held tightly around the pinion by a garter spring.



Figure 12—A typical Positork starter drive.



Figure 13— The sprag (bottom) and Positork (top) drives will interchange



Figure 14— Positork ratchet prior to locking



Figure 15—Positork ratchet locked



Figure 16—Positork disassembled – the rubber cushion has not been removed from the case



Figure 17— Pinion with centrifugal weights and pins



Figure 18— Centrifugal counterweights as they rest against the disengaging ring

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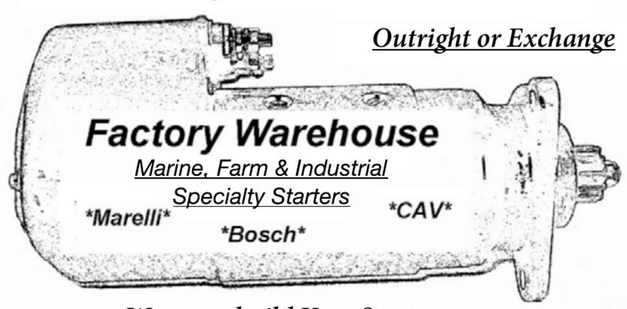
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RICHER

(Continued from page 1)

years. The Joe Davis seminars and the ERA have really helped us," Richer said. "His technical seminars have provided us with up-to-date information in streamlining the rebuilding process. I really hated to see Joe retire. And the ERA website has helped to fill Joe's void by providing information whenever I needed it."

Today, Richer has made the transition from student to mentor. In 2006, Richer earned an AA degree in business management. The experience quickly opened up several new opportunities for Richer and his shop.

"A customer of ours was hired to teach auto repair classes and happened to be teaching the same nights I had my classes," Richer explained. "I started visiting his classroom, and that led to me assisting in the electrical diagnosis, repair, and replacement of electrical circuits for his course. When the school decided to expand the automotive program, they asked me to teach an electrical class part-time."

Richer turned them down twice, but the third time they asked, he accepted the challenge. The time was right. These days, the program allows Richer to train tomorrow's talent for the rebuilding field as well as those skills necessary to properly diagnose and repair electrical problems and mechanical failures.

"We have one part-time employee, Brad Armstrong, who is a product of the automotive program at MiraCosta College in Oceanside. Brad possesses a mechanical aptitude and an ability to think outside the box. He's also got good public relations. He's real professional and has a real knack for the rebuilding industry."

In his five years of working with students like Brad in higher education, Richer has sharpened his knowledge base and skills for troubleshooting, public relations, and diagnosing real world electrical problems. According to Steve Vail, Richer's department chair at MiraCosta, "Bringing Jim onboard was one of the easiest and wisest moves I've ever made as a chair."

Richer's talent and passion for teaching is evident when you listen to him talk about his classroom. "I don't want to stop teaching, even though it forces me to put in 60 hours a week between the rebuilding shop and the college," Richer said. "Something special happens when a student finally understands. One of my students who was very good and always worked hard, had trouble with electrical. Then, one night in class, the light clicked on." Richer could tell he finally had it. "The next day, he showed up at the shop with his dad. He wanted his dad to meet me."

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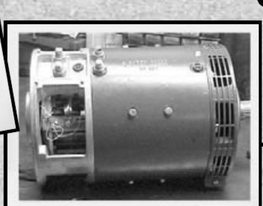
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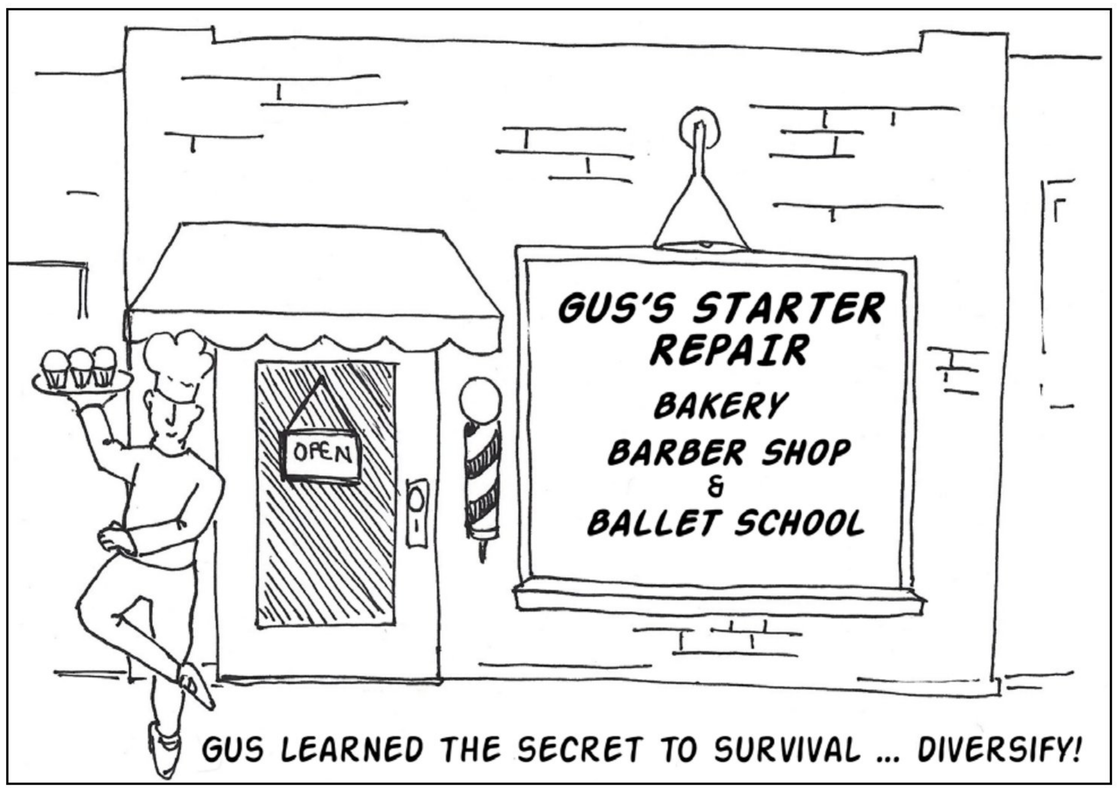
■ **BBB Industries** has recently added multiple new part numbers to its catalogs. The company added 18 new part numbers to the automotive catalog, covering over 1.6 million vehicles in operation, which includes 8 part numbers that cover 2012 applications, and 14 additional part numbers that expand its already leading import car coverage. In addition, 85 new part numbers have been added to the small engine catalog and 6 part numbers have been added to the heavy duty offering.

BBB Industries, a leading remanufacturer of starters, alternators and power steering products, is also celebrating its 25th anniversary this year.

For more information on these and other products, visit their e-catalog and their website at www.bbbind.com

FIELD DAY—by Betsy Grueninger



Tech Tip

Intermittent no-start. GM reports some 2002-2004 Chevy Astro and GMC Safari vans with rear-wheel drive may exhibit an intermittent no-start condition. A possible cause may be a missing retaining clip on the battery cable. The missing clip allows the positive-battery cable to rub against the inner tie rod or center drag link, causing a direct short to ground.

Installing an updated battery cable assembly (GM Part No. 15085788) should solve the problem.

—Submitted by Ken Plourde, Guy's Electric Service, South Windsor, Conn.

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What Causes Broken Starter Housings ?
"The usual suspects"

BY BOB THOMAS

A customer with a broken starter housing is something every rebuilder has or will face on occasion. It is not an everyday occurrence, but like other things in life, it happens. Those of us who have been around for decades have probably seen more than our share of them. If it is a common starter, you may feel that replacing a housing is more of a profit generator than a problem. But what if the starter is uncommon or even rare? In those cases, the first question we ask ourselves is, "Where am I going to find one of those housings?" But that is not really the important question.

What you should be asking yourself is, "Why did it break?" Was it happenstance, a by chance happening that is unlikely to occur again? Or is that just wishful thinking on your part? It may be true that some housings, especially ones made from cast aluminum, are more susceptible to being damaged. One thing is certain. For every broken housing you see, there are thousands of those same starters out there that have survived a starter's lifetime without breaking, if not several lifetimes. Starter housings do not break all by themselves. They must have help from somewhere. We will try to explain some of the places that "help" can come from and how it can be avoided.

First off, no starter can generate enough force to break its own housing. As a physics teacher once said after explaining one of Newton's Laws, "You can write home about it!" It is a fact! Starter housings are engineered to handle lateral forces far greater than those created during the normal operation of the starter. When a starter housing shows up at your door broken, you can be sure about one thing, something caused it. Failure to deal with that cause can only lead to more broken housings.

When you encounter a customer with a broken housing, you have to ask them if they know what caused it to break. If they do, and admit it, that is great. The case is solved. But if they do not, then you have to explain some of the possible causes to them. Even if you do not enjoy teaching customers, the responsibility is yours if you want to be viewed as the local starter expert.

So what can break a starter drive-end housing? Here is list of the "usual suspects":

Improper Installation—Dropping the starter on a hard surface, like a concrete floor, is certainly one way to break a housing. Another is when the installer attempts to pull the starter into place by tightening a mounting bolt without supporting the starter. In both cases, you will usually be able to see evidence on the housing or the customer will tell you up front.

Cranking with Higher Voltage—We said earlier that a starter cannot create enough force on its own to break a housing (*see Figure 1*). We should have clarified that this is true only if it is being used with the voltage for which it was designed. There are still people out there who believe that it is okay to double the voltage to a starter without damaging anything—6 volts to 12 volts or 12 volts to 24 volts. When you double the voltage without changing the resistance in the starter, you will cause amperage to double at the same time. Power is equal to voltage multiplied by amperage, so you will be quadrupling the power of the starter if you double the voltage. To put this into perspective, a 1kW starter suddenly has the torque of a 4kW starter.

Failed Start—Whenever an engine is cranked and fails to start, the engine will stop near the top of a compression stroke, but it does not sit there long. Usually, it will roll back slightly to relieve pressure in the cylinder. That reverse motion of the crankshaft may take several seconds and be unnoticeable. If the operator is in a hurry and attempts to re-engage the engine during that roll-back, a head-on collision between the ring gear and the starter drive takes place. This probably accounts for more damaged starters than any other cause. Delco-Remy put out a service bulletin explaining it in 1955 (available in the ERA website Tech Library). They obviously saw it as a problem then, as it still is today.

Starting Fluids—The use of ether or other starting fluids can cause detonation if used in diesel applications unless the manufacturer prescribes it. This untimely explosion can break housings, pinion gears and even armature shafts (*see Figure 2*).

Ignition Timing—Kick-back while cranking can be caused by an ignition timing problem and can result in a broken starter housing. On an older vehicle with a distributor, this could be caused by a cracked distributor cap or faulty plug wires. On new engines, defective crank position sensors can result in kick-back during cranking.

Ring-Gear-to-Pinion-Clearance—Incorrect clearance between the pinion and ring gear can break a housing, too. If clearance is insufficient, and the teeth bottom out, you can easily get enough lateral pressure to crack a housing. Examine the pinion closely for signs of too little clearance. This was once a common problem with GM pad-mount starters (*see Figure 3*), but it can also happen on Fords, if the bell-housing cover plate that locates a Ford starter is damaged. Engine, transmission and flywheel swaps are the primary cause of improper clearance. Above all, pinion clearance must be measured when this is suspected. Listening to a few starts is not a substitute for taking a measurement. Shims can be added to GM pad-mount starters to increase pinion clearance.

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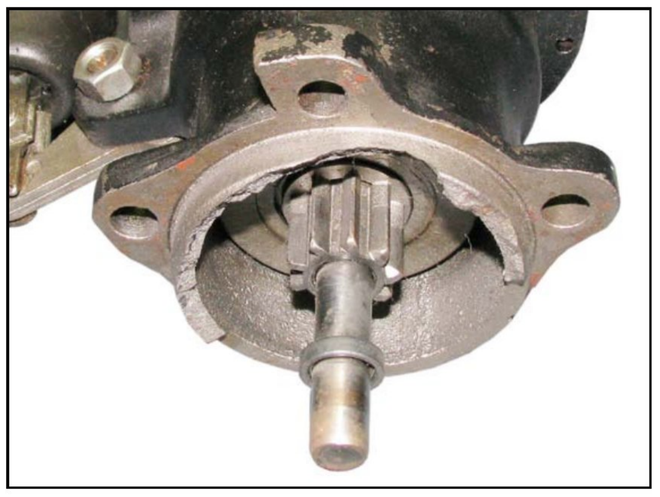
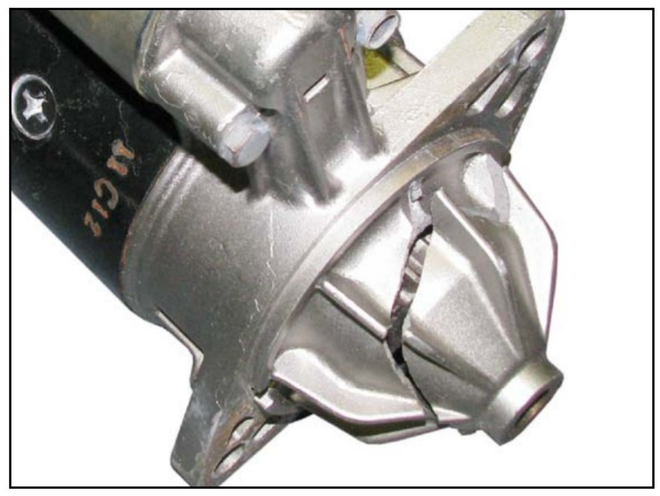


Figure 1—This 6-volt Delco-Remy starter was damaged when the owner converted the vehicle to a 12-volt electrical system but did not update the starter to 12 volts.

Figure 2—This Hitachi starter, used on a Yanmar diesel engine, was damaged when the operator used starting ether on a difficult-to-start engine.



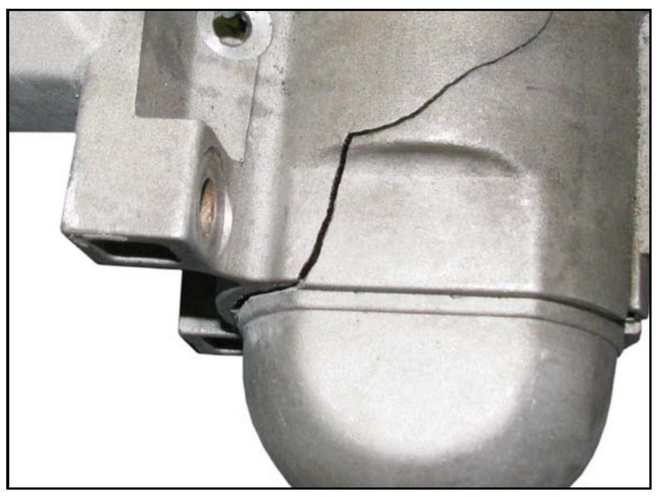
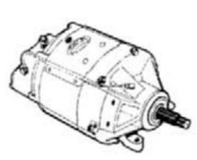


Figure 3—The damage to this Delco-Remy pad-mount drive-end housing was caused by improper drive-pinion-to-ring-gear clearance. Clearance is adjusted by inserting shims between the drive-end housing and the engine block.



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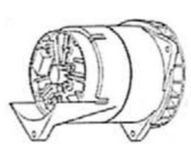

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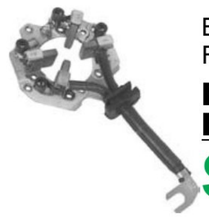

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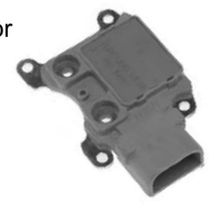


REGULATOR Ford 3G
GRAY
Ref: F794
FD-203
$2.95



240AMP Stator
Ford 3G, 4G, 6G
Made in USA
FD-223SHD
$28.95



200AMP Stator
Ford 6G 2-lead/phase
Made in USA
FD-401SHD
$28.95



QUICK-DRY PAINT	AMSCO#	PRICE
Black Semi-Gloss	SP-162	$3.65
Black Hi-Gloss	SP-164	$3.95
Cast Blast	SP-190	$3.95
Stainless Steel	SP-198	$4.50
Aluminum	SP-170	$3.95
Clear	SP-180	$3.95

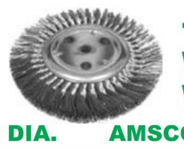


RAPID FIX
ADHESIVE 25ML
"Amazing"
RF-25
$21.95



Solder 1 lb.
Rosin core
40% tin, 60% lead

DIA.	AMSCO#	PRICE
.062"	RC-46-1	$13.95
.093"	RC-46-1T	$13.95



Twist-Knot Wire Wheels

DIA.	AMSCO#	PRICE
6"	WW-116	$12.95
8"	WW-118	$19.95



Super Lube
Dielectric heat transfer grease & bearing lube

OZ.	AMSCO#	PRICE
3	MPL-2	$3.95
16	BL-16	$8.95



RECTIFIER Ford 3G
130 AMP LARGE
Ref: FR2023
FD-204
$7.95



RECTIFIER
Ford 4G
Ref: FR3003
FD-306
$9.95



RECTIFIER Ford 6G
130AMP LARGE
Ref: FR6023
FD-287
$9.95



Hitachi Reg, Rect,
Brushholder Combo
13612, 13639, 13712
HT-528K
$19.95



50A Pressfit
Avalanche
Threaded
Bolt Hole

RECTIFIER
CS130 & CS130D
Ref: DR4200
DA-154
$4.25

OEM Quality Premium Ball Bearings

REF#	AMSCO#	PRICE
6-100-4	6000RRP	$0.95
6-101-4	6001RRP	$1.25
6-200-4	6200RRP	$1.05
6-201-4	6201RRP	$1.15

REF#	AMSCO#	PRICE
6-202-4	6202RRP	$1.05
6-203-4	6203RRP	$1.15
6-302-4	6302RRP	$1.65
6-303-4	6303RRP	$1.75

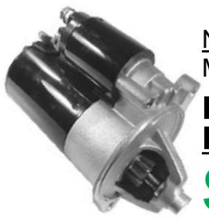
REF#	AMSCO#	PRICE
6-304-4	6304RRP	$2.50
6-305-4	6305RRP	$2.95
6-904-4	6904RRP	$1.50
6-905-4	6905RRP	$1.75



ARMATURE Ford
6669, 6670
Ref: 61-212
FS-834
$14.95



Armature Hitachi
17713, 17779
Ref: 61-8114
HT-154
$9.95



NEW Ford PMGR 10-T
Mustang, T-Bird, Van
LESTER 3205
FS-905
$36.95

NEW Delco PG260L 11-T
Blazer, Tahoe, Van
LESTER 6449
DS-2229L
$39.95

NEW John Deere,
Kohler 10-T, CCW
LESTER 6744
DS-1775
$49.95

NEW Mitsubishi 12-T
7.3L Powerstroke
LESTER 17578
VS-17578
$74.95

NEW Ford OSGR 12-T
7.3L Powerstroke
LESTER 6669
FS-906
$64.95

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SOLENOID Ford PMGR
Fits Lester 3205
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FS-725U
$6.50

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PMGR Lester 6643
Ref: 66-207
FS-722
$6.50

SOLENOID PG260M
Fits Lester 6449
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DS-602
$6.50

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SOLENOID PG260
Lester 6562 4-Term
Ref: 66-133
DS-622
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