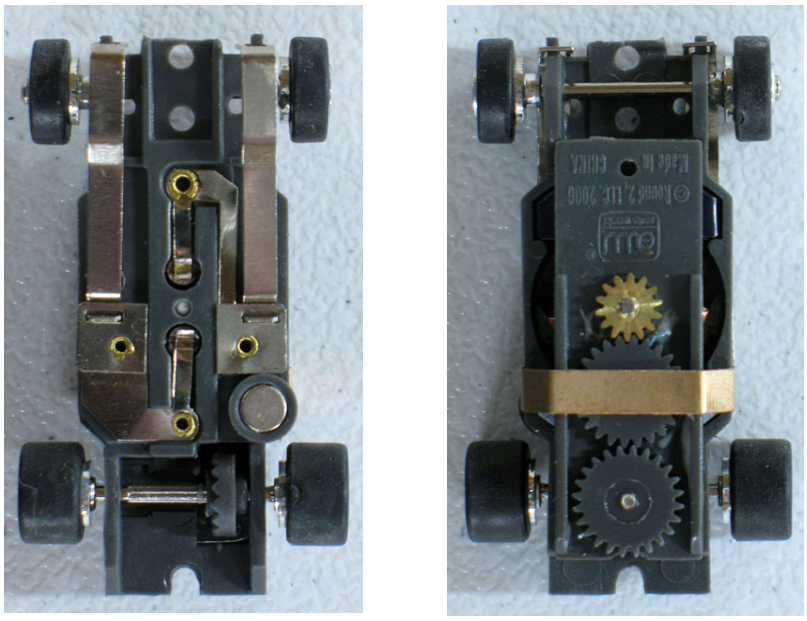
Auto World Hot Hop-Up Hints

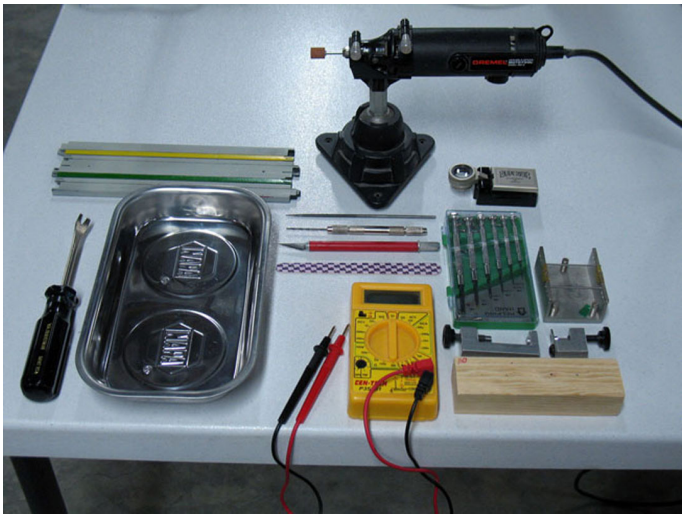
Performance Tuning: The Thunderjet Ultra-G

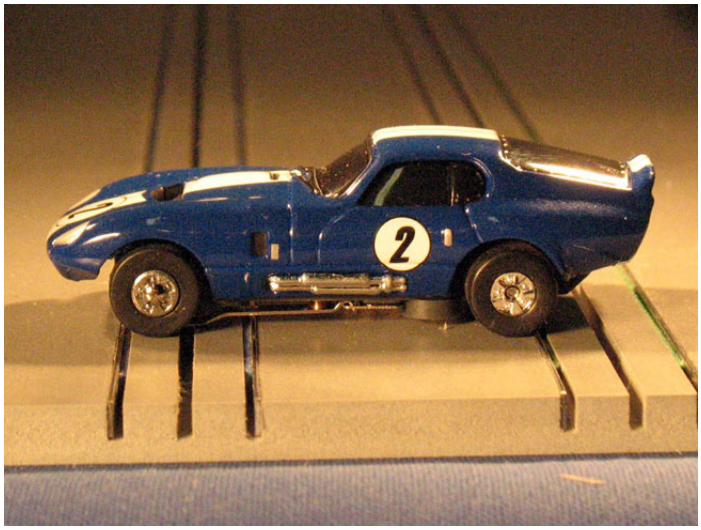
In 2005, Round 2 and Auto World were formed and with it, brought the revival of the production pancake chassis design. These chassis designs have a long lived legacy and have made a good deal of the history in HO racing and local battles in basements and family rooms across America and throughout the world. They offer a unique driving experience and allow for enough creativity to drive the hobbyist or the enthusiast to new discoveries and modifications. Pair this with the wide range of body styles Auto World has released and you have the recipe to race everything from legendary historic cars, to the muscle car wars of the 60's and 70's, hot rods and tuners and modern day super cars that can speed across your family room or basement raceway. And Auto World didn't rest on the laurels of providing only a wide range of body styles. Like any good engineering organization, the next question came along, "how do we improve the design"? Keeping the nostalgic scale in both size and speed, improving the handling characteristics seemed the next logical place to go. And so the Thunderjet Ultra-G was born. Based on the Thunderjet chassis, a strategically placed neodymium magnet was located on the lower chassis to increase the handling, allowing faster cornering and driving through banked turns with ease. But every design has room for improvement and also requires maintenance to keep the performance level at maximum. The article below will explain the basic, day to day care and feeding of your Thunderjet Ultra-G and we will also take a look at what you can do to tweak a bit more power and cornering out of your mini speedster.



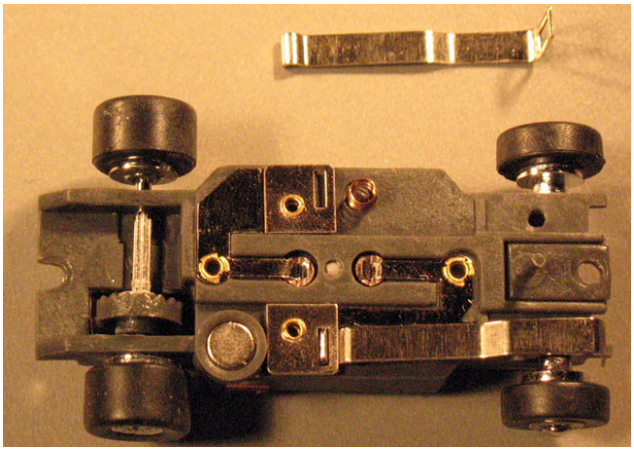
Auto World Thunderjet 500 Ultra-G Chassis
Top and Bottom View

Having and using the right tools is important. Here are the tools that will be used throughout this article. From R to L starting at the bottom: Tack Puller, Parts tray, DVOM, Wood Armature Block, Tire Press, Gear Puller, Armature Balance Jig, Jeweler's Screwdrivers, Emory Board, Hobby Knife, Pin Vise with Drill Bit, Round Jeweler's File, Track Section, Dremel Tool with Stand, and a Jeweler's Loop. These are just a few of the items that are regularly used. As you grow in this hobby, you will discover many useful tools and items to help you create better and faster cars

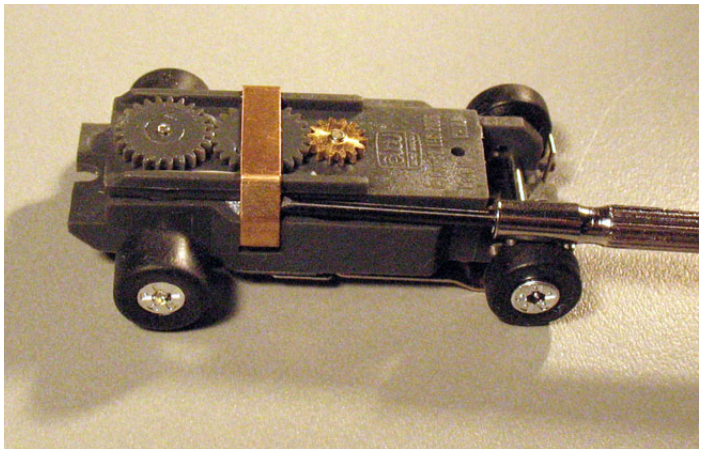




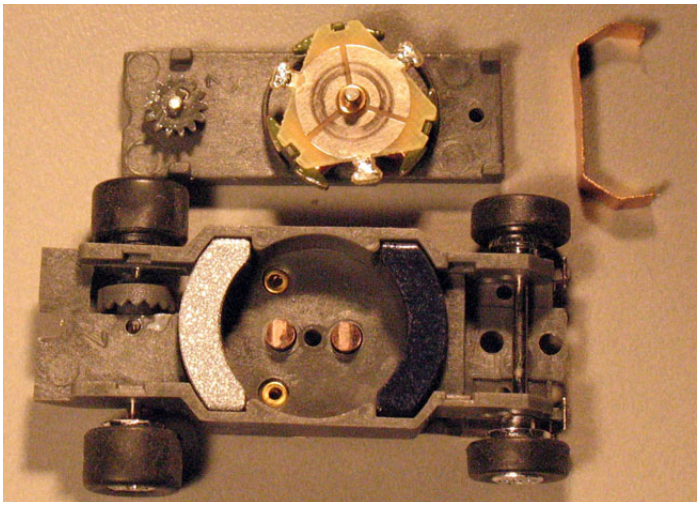
Our focus for this tune up will be an Auto World Cobra GT Coupe, using a Thunderjet 500 Ultra-G chassis. To start off let's disassemble the chassis. We will assume the body and guide pin have been removed. I like to do this over a parts tray just in case any of the little parts hiding inside jump in a direction I wasn't looking in. We will strip the chassis bare and inspect all of the parts that make up this machine. Turn the chassis over and remove the pickup shoes and springs. Do this carefully, the springs like to shoot off if you get into a hurry. Flip the chassis back over and remove the gear plate retaining clip and remove the idler gear and gear plate. Gently lift the magnets and motor brushes out of the chassis. There are small motor brushes that live under the armature and we don't want to lose those. After you have all of the inner workings removed, the tires and rims follow suit. The rims are much tighter and more difficult to remove so do this carefully to avoid bending an axle. Once an axle is bent they are next to impossible to straighten or true and will hamper the performance and handling of the car. I use an upholster's tack remover to pry the rims off. It provides equal pressure to the rim and enough leverage to get even the most stubborn of rims off an axle. There are plenty of great remover tools specifically aimed at HO rim removal. These usually have a pin to press against the axle, running through the hole in the rim. Some newer versions of dress rims are solid, covering the axle and this type of tool will damage the rim. So if appearance is important, make sure to use a prying type tool. Always make certain that you apply even pressure on the rim when prying. This will help avoid bending axles or splitting rims. Always pry against the flat side of the crown gear on the rear axle. Otherwise you may flatten the teeth on the gear and cause the mesh to bind.



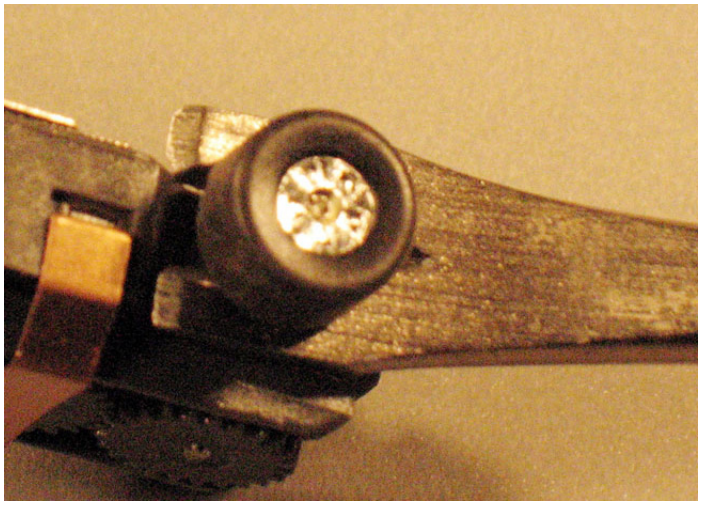
Always take your time and examine all of the parts as you disassemble the chassis



Disassemble your chassis over a parts tray to prevent small parts from disappearing.



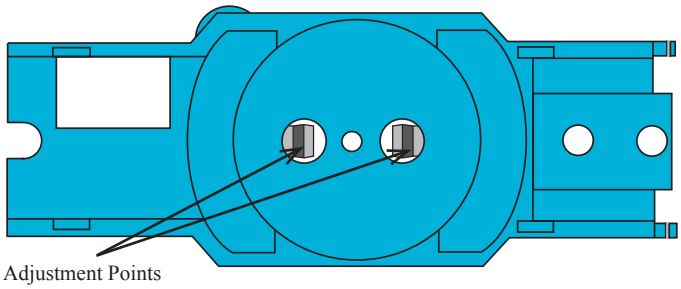
There are lots of small parts that live inside your slot car. Keep track of what order they came in for later.

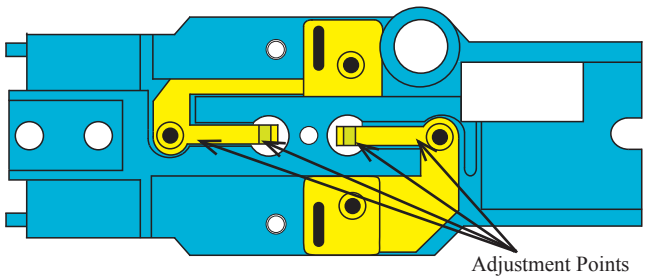


When removing rims apply pressure evenly so not to bend axles and never use pressure on the teeth facing side of the crown gear

Now we have a bare chassis, look at the remaining components that are fixed in place. On the bottom facing side are the electrical components. These will be nickel plated units retained with hollow rivets running through to the plastic part of the chassis. Make sure all of these electrical parts are clean. The nickel plateing does not oxidize as easily as copper of silver, but you should still make sure these parts are kept clean for best performance.

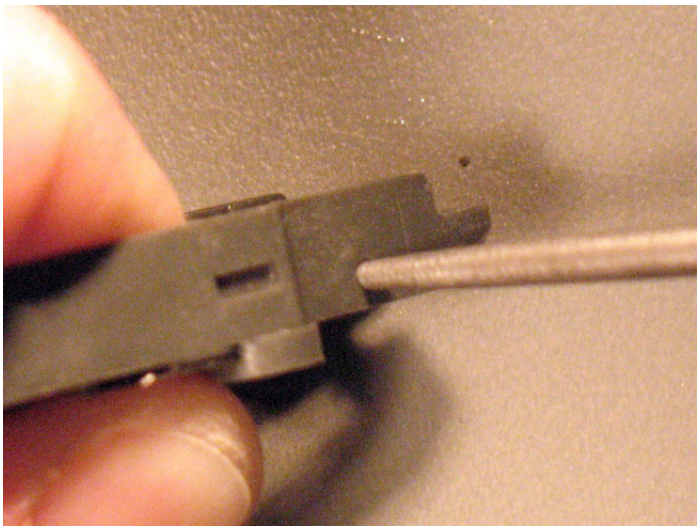
The motor brush springs are leaf spring units. These are the most difficult component to get adjusted to provide maximum performance. They are not only the conductor of the electric current to the armature, they also regulate the pressure the motor brushes have on the armature commutator. If too much pressure is applied, friction slows the armature and builds heat, not enough tension and a lower amount of current transfers to the armature and top RPM is not reached. Examine the springs closely. Are they parallel to the chassis surface or do they protrude above or below the chassis. Getting these aligned will go a long way to getting a consistent performance out of the chassis. Use a small jeweler's screwdriver to "GENTLY" press or pry the leaf springs. By pressing at the base of the spring you can add pressure without bending the tab that attaches to the motor brush. Always adjust the tabs of the motor brush as a last resort. Once pressed in or out they are much more difficult to change back due to their location. For this step, focus on getting the springs level and parallel with the floor of the chassis. We will fine tune them after the motor is re-assembled.



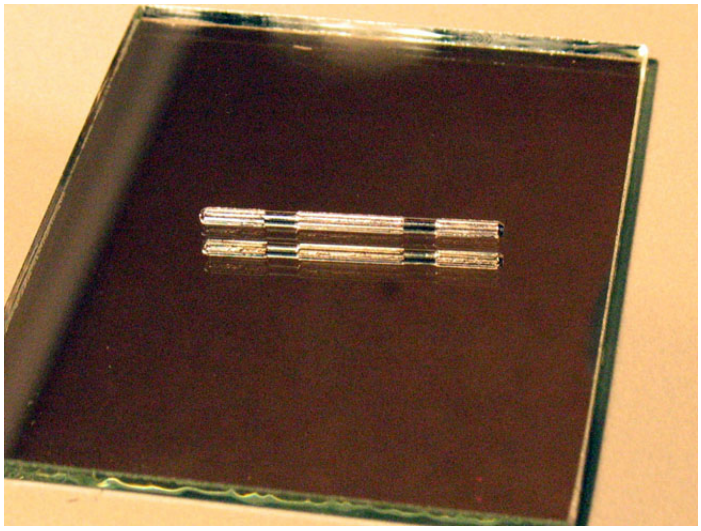


The bare ThunderJet 500 Chassis illustrations show the adjustment points for the motor brush leaf springs. Concentrate on getting these level with the chassis' floor surface. You can fine tune them after re-assembly.

Now that you have the brush springs squared up, it's time to examine the chassis bushings. Vibration and friction are the two biggest robbers of performance you will face. By making sure all moving parts turn as freely as possible we will closely examine all of the points where an axles, gears and armatures pass through. Make sure there are no distortions, flash or burrs where the axles or armature and gear shafts pass. If you detect such items, gently remove them with a round jeweler's file, making sure not to remove too much material. If too much is removed you will create a bushing with too much play. That will also cause vibration, friction and a loss of power. Test fit the parts frequently, removing the smallest amount each time between test fittings. If you do remove too much or the bushing is already too large, place the axle in position (do not do this with the armature shaft!), making sure that the smooth portion of the axle is riding within the bushing. Place a small drop of CA super glue in the bearing around the axle and allow to dry completely. After the glue has set up, begin turning the axle until it is moving freely of the hardened glue. Make sure to do one side of the axle at a time, until you have filled all of the gaps and the axle turns free before applying the next drop. Open the glue filled bushing VERY GENTLY with the round file and test fit the axles frequently. Apply a small drop of oil to each bushing and test the turning of the axle again. Repeat the process until the axle moves smoothly within the bushings. Apply this process to the front and rear axles. We will examine the steps for the armature next.

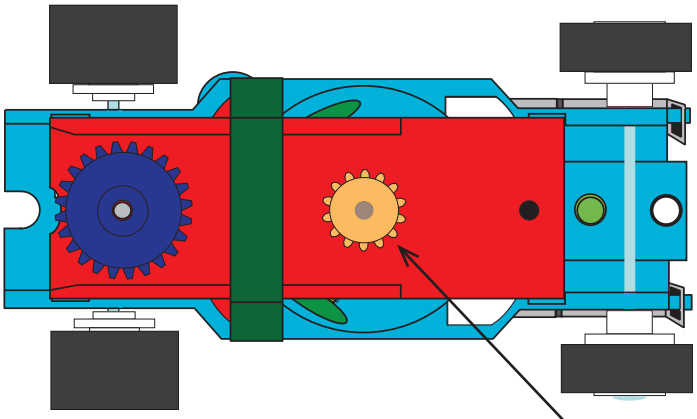


Examine the axle bushings for flash, burrs or distortion. File with a round file test fitting often as you go.

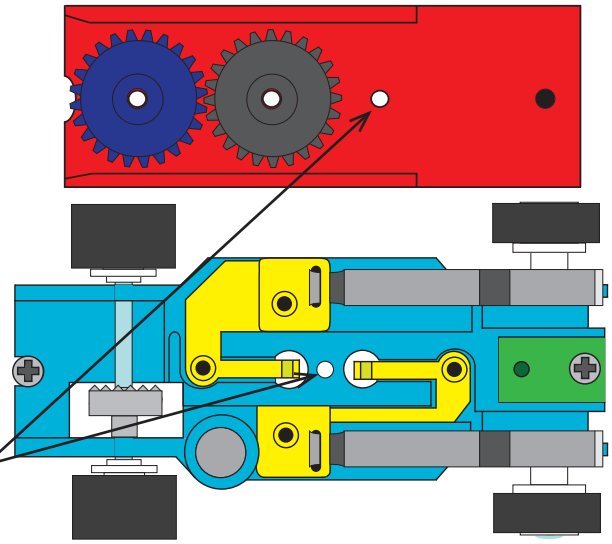


Use a mirror or similar flat surface to test for bent axles. Bent items will show easily on a glass surface.

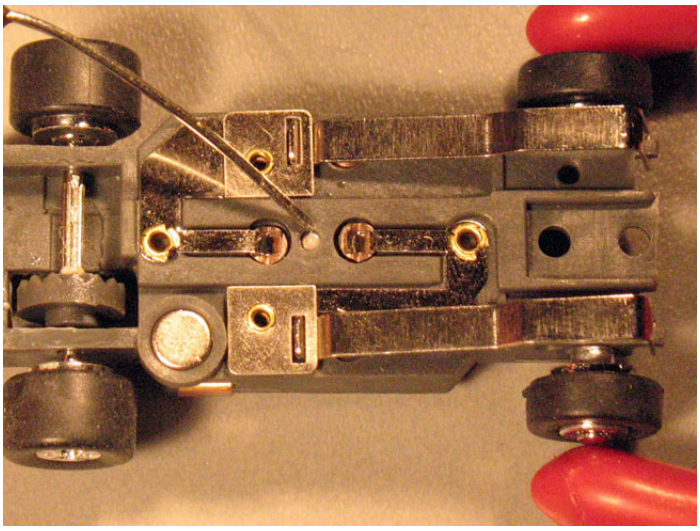
When cleaning the armature bushings you will apply the same technique, but because this is an electrical component some extra care will need to taken. With the motor brushes, magnets and the idler gear removed (the middle one), place the gear plate and armature assembly on the bare chassis (motor brushes are still removed) as pictured below. Place the retaining clip back over the gear plate to hold it secure. Using the pinion gear (mounted on the armature shaft), spin the armature. See if you feel a vibration or if the armature spins freely or binds. Before any action is taken, place a small drop of oil on the armature shaft at the gear plate and the lower chassis. Spin the armature again and see if the it moves more freely or if vibration is reduced. If so, you may proceed to the next steps. If not, here's how to reduce the play in the armature shaft.



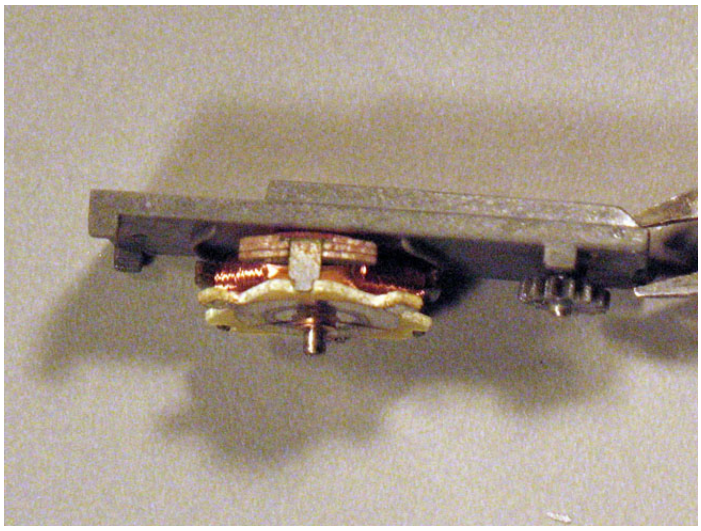
Reassemble just the gear plate, armature and lower chassis to test the action on the armature shaft



Examine the bushings if the armature binds or does not spin freely.



Oil the armature bushings and test for binding again.



Checking the wobble of the armature on the gear plate

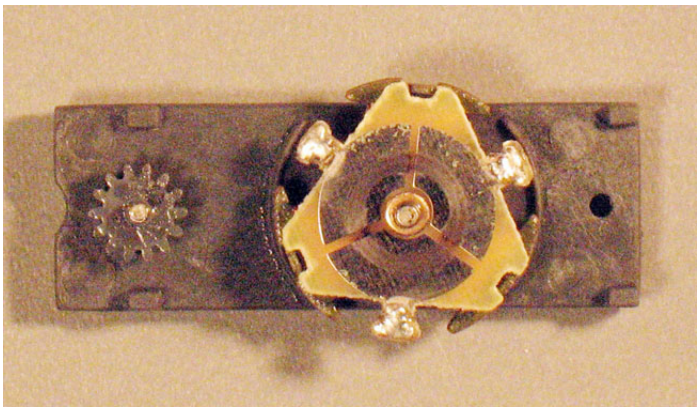
Disassemble the chassis again. Spin the armature on the gear place by itself. It should have a minimum of wobble to it, since the lower part of the shaft is not in a bushing, but should spin freely. Examine the lower chassis and look for distortion, flash or burrs on the armature bushing. Following the procedure with the axles, gently file away any imperfections in the bushing. If you take away too much material, use the CA super glue method as described above, but use an old non-functioning armature to space the glue. That way you do not damage a good armature with the glue if it were to seep out. Once complete, reassemble the gear plate and chassis as before and test the armature for free spinning. You may need to file or adjust the new lower bushing to make sure everything stays aligned. This same procedure can be used on the upper bushing in the gear plate. You will need to remove the pinion gear to do so. The pinion gear is press fit unit, so you will need a new one or solder the original unit back in place once the upper armature bushing is in completely adjusted.

Let's continue working with the electrical system. We will include the pick up shoes, springs, electrical plates mounted to the lower chassis, motor brushes and armature. Once again, disassemble the chassis completely. We'll start with the armature. Using a digital volt-ohm meter (DVOM), set the dial to read ohms. My DVOM starts at 20 Ohms as the lowest setting. Touch the probes to two of the solder points of the armature. You are measuring the resistance of the windings of the pole between the two solder points you are touching. Depending on the model armature you have, you could see readings from 4.9 to 18.9 Ohms. The lower the Ohms the hotter or faster the armature. But here's the trade off, the lower the Ohms, the more Amperage you will need to see the performance of that lower reading. As with many things relating to slot cars, there's a happy median you should reach. This depends of course on your power source. If you are running on race-set power packs you may see up to 1 Amp and that would be shared by both lanes. A low Ohm armature may draw all of the available amperage (or at least attempt to) and that will be seen quickly by the racer if one of ther cars de-slots. Most often the controller will get hot and start giving off a burning smell. So for purposes here, we'll assume a home power pack running 19.6 Volts and giving off 1 Amp or less.

Measure each of the armature poles and note the Ohm reading for each. You want the reading to be as close to the same as possible. My meter can read into the thousandths of an Ohm, so if I'm off .001-.005 I do not get too concerned. But if you see 1/10th or higher, your armature is electrically out of balance (not to be confused with mechanically out of balance, we'll address that in a future article). Short of de-winding the armature poles that are higher to match your poles with lower readings, you don't have any options other than swapping for an armature with matching readings. In the pancake design, I have not seen this happen very often in comparison to in-line armatures.

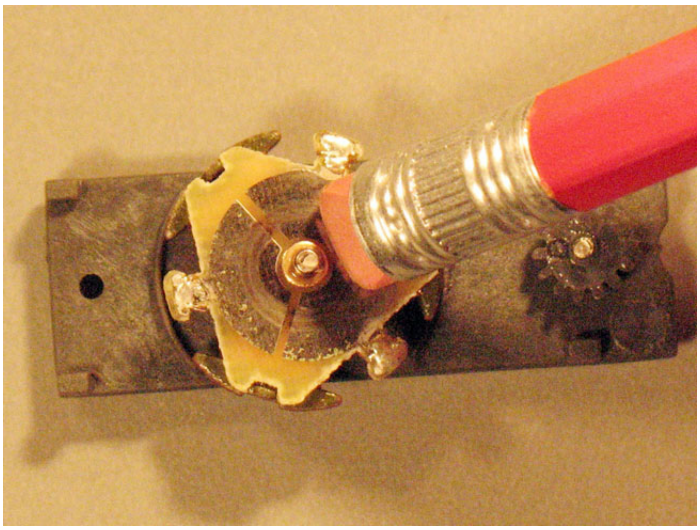
This is how to measure the Ohm rating of each armature pole

As with all of the electrical parts in the chassis, the cleaner they are the better the performance will be. The same can be said for the armature commutator. That is the shiny silver or copper plate on the bottom of the armature. It should be divided into three plates that are spaced between the armature poles. The magnet wire on the armature poles get their power from these plates. The plates touch the motor brushes which receive power from the leaf springs and pick up shoes...the knee bones connected to the leg bone etc.... So with all of these connections your car is relying on, clean conductors are a must to get top performance from the motor. The commutator can get dirty rather quickly. Oil that lubricates the lower armature bushing often circulates up to the commutator. Those are the black circular streaks you see on the comm. These need to be cleaned from the surface. Most often a good eraser will remove the streaks. Make sure to wipe away any residue the eraser may leave. An old piece of T-shirt is good for that. If there are grooves or streaks that the eraser can't remove, you can use a very fine grade of sanding cloth, 8,000 - 12,000 grit at minimum. This will polish any of the stubborn streaks from the comm.

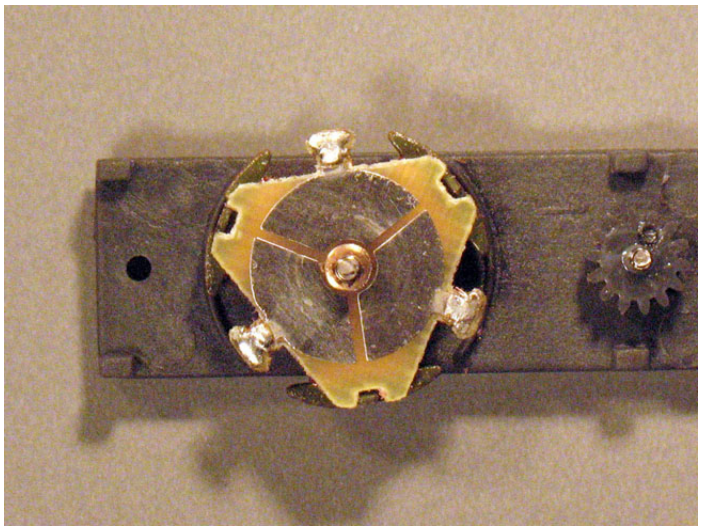


Here's the stock T-Jet armature straight from the chassis. It can use a little TLC.

Here is one brand of 8000 and 12000 grit sanding material. It is washable and works well with electrical parts

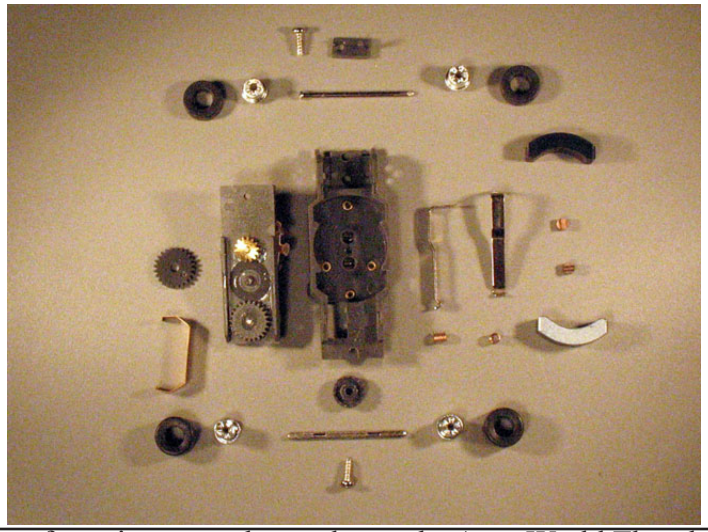


You can use an eraser or extra fine (8000 + Grit) sandpaper.



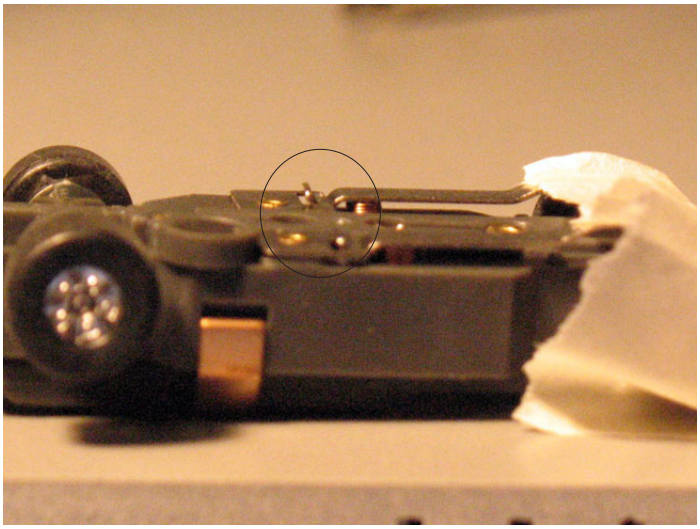
All clean and ready for power!

With the chassis striped bare, let's look at the electrical parts that are riveted in place. These are nickel plated components. The rivets should be hollow. These components can be tarnished or stained after some exposure to air and moisture. They conduct the electricity from the pick up shoes to the motor brushes. The cleaner they are, the more power will reach the motor. Take a small, pointed jeweler's file and clean the tops of the leaf springs where the motor brushes sit, that are visible from the inside of the chassis. Turn the chassis over and take a look at the electrical parts on the bottom of the chassis. The hinge points for the pick up shoes and connections to the leaf springs are clearly visible and most likely dirty. Use a light abrasive paste like Simi-chrome or jewelry polish to clean the surfaces. Be aware that continual use of these products on the nickel plated surfaces will eventually wear the plating away, exposing the core material below. Make an extra effort to clean the hinge points where the pick up shoes are attached. This is the weakest electrical connection in the system and the cleaner it is the better.

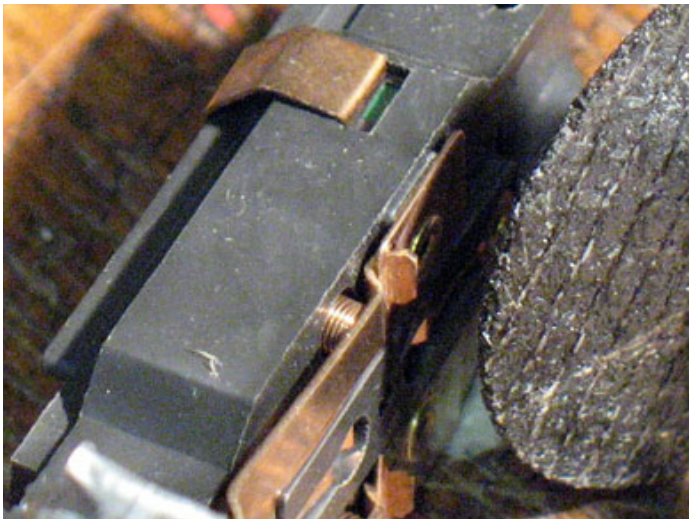


There are lots of moving parts that make up the Auto World Thunderjet Ultra G. Half of the performance gains in the design can be accomplished with keeping these parts clean and well lubricated

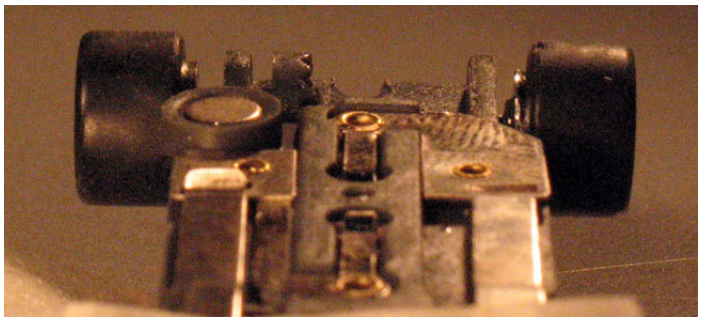
Pick up shoes and springs...first contact. On the Auto World Thunderjet Ultra G style chassis the pick up springs are located in an insulated plastic cup and spindle and do not conduct any power to the motor. The key performance tip for the pick up shoes is keeping the contact surface clean and keeping the surface in level contact with the track rails. Look at the pattern that forms on the shoe surface. Is it evenly worn across the surface from the front of the step to the rear? Is it worn only at the front, middle or rear? Does the hinge at the rear of the shoe hang on the track rails? How dirty is the groove on the hinge? The wear spots on the pick up shoes should be even across the surface. If you start to see deep grooves, replace the shoes. The hinges are notorious for dragging against the track rail if they are bent or misaligned. You can see this easily by placing the chassis on a test strip of track and using a feeler gauge to see if there is any space between the hinge and the rail. This is also a good method to see if your rivets are dragging as well. To fix the hinge you can use two methods: grind or file the end of the hinge down or bend the hinge slightly upward so the hinge edge is relocated at a higher position. If bending the hinge, make sure the contact surface has not changed on the pick up shoe touching the track rail.



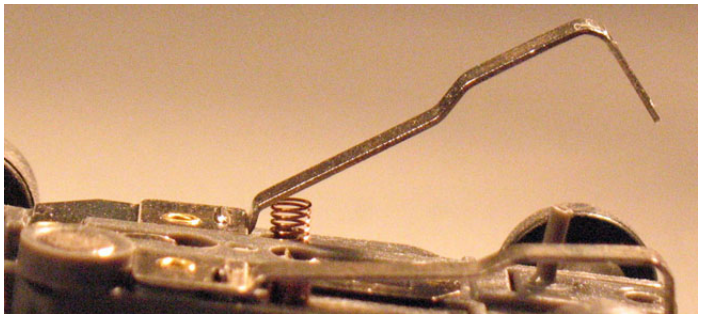
Here is a good example of the pick up shoe hinge protruding enough to drag the rail



This is an example of bending/grinding the hinge to prevent drag. This can keep the pick up shoes from hanging on track joints and causing the car to de-slot

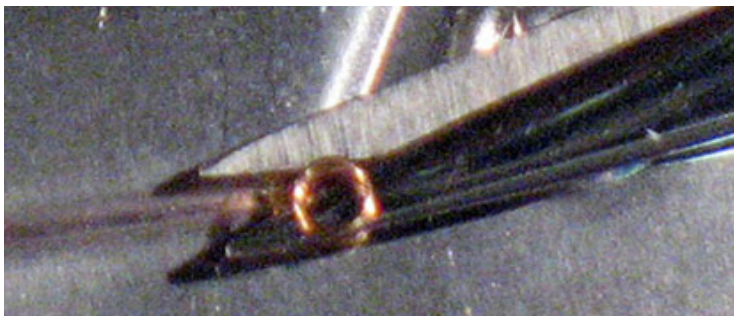


The PU Shoe on the left is stock, the one on the right has been ground down to prevent hanging on the rails.



The Pick Up Spring can have too much tension causing the chassis to bounce.

How stiff is the tension on the shoe? You want enough to ensure contact with the track rail, but not so much that the car will hop or bounce out of the slot. If the chassis raises up from the track, you can adjust the pick up springs by removing a loop from the spring's coil. Once again, do this in small increments and test the results. Once removed you cannot go back and add to the spring. This will help enhance the handling of the chassis.



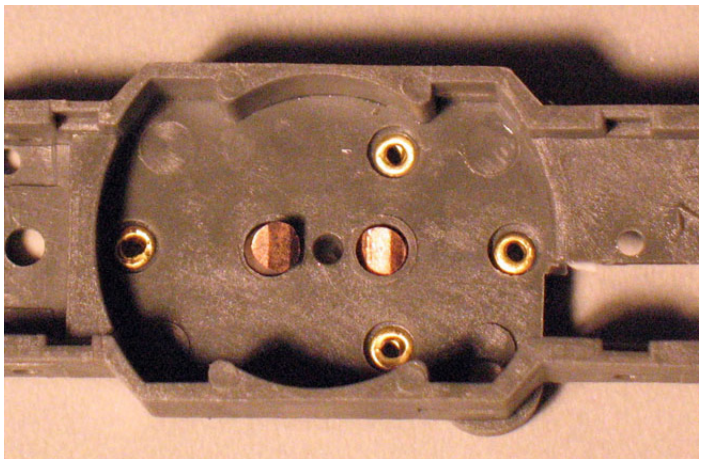
Removing a single coil from the pick up spring.

Now that we have the most of the electrical parts clean, let's take a closer look at the motor brushes. These are specifically made for this model chassis. They are domed on the top surface (Hemi Brushes?) and have a corresponding groove cut in the bottom surface to match the shape of the leaf springs. The groove at the bottom prevents the brush from rotating in the cup and losing electrical connectivity.

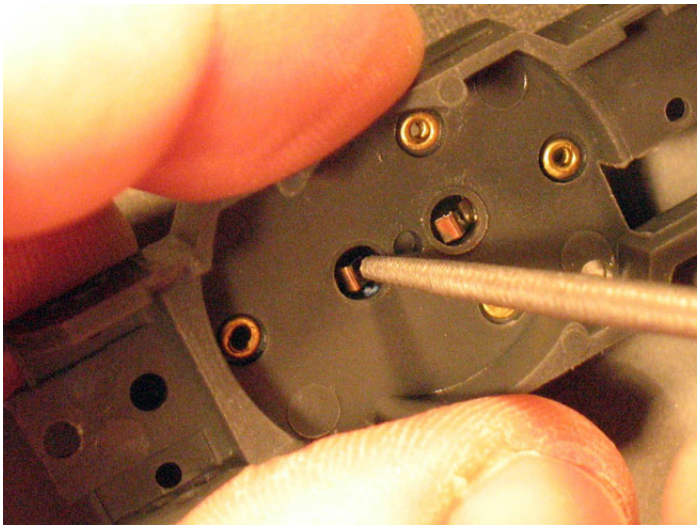
Examine the profiles of the motor brushes. Are the top and bottom surfaces square to the sides or do they have an angle? If the top surface that touched the commutator are not flat, they may be riding crooked in the brush tube (cup) and causing excess friction and reduced contact surface. This can hamper current flow, not allowing the motor to run as fast as possible. If you squared your leaf springs in the previous steps, you should have most of the problem fixed, if not, make those adjustments now.

Set one brush in the cup. Press in down gently and see if it binds against the cup. It should travel freely up and down inside the cup. If not, remove the brush and using a round jeweler's file, sand the inside surface of the brush cups. Be careful not to push on the leaf springs below and damage them. Go around the surface edge of the cup in a circular motion, not up and down. Clean any filed material out and test fit your brushes again. Remove small amounts of material at a time, test fitting the brushes frequently. Once they are able to travel freely you are ready for the nest step.

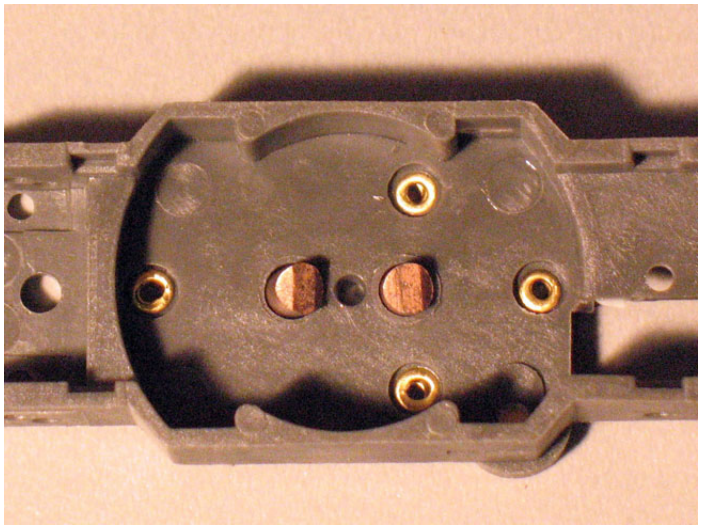
Motor brushes. The top one is the bottom view, the lower one, the top of the brush. Note the groove in the top brush. This helps prevent the brush from rotating.



The brushes should move freely in the cups. Here is one that sticks, hampering contact and performance.

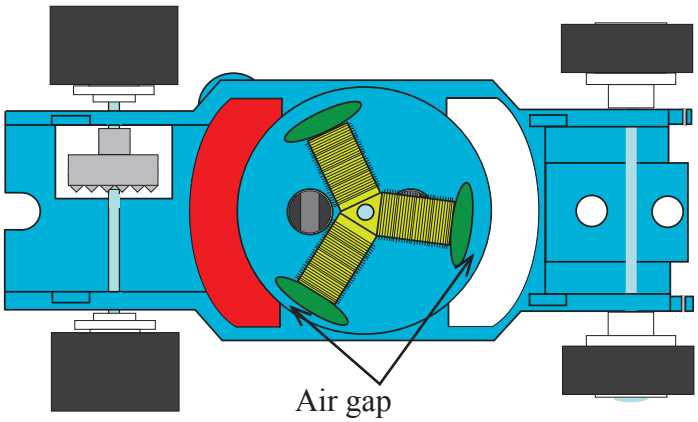


Remove small amounts of the brush cups with a round jeweler's file, checking fit frequently. Do not remove more than you have to.

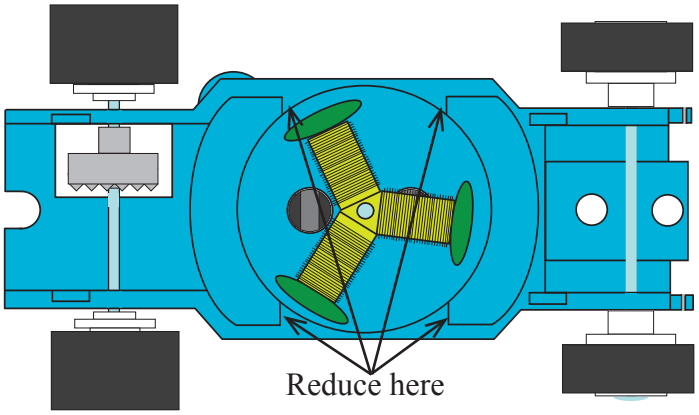


With the motor brushes floating free, electrical contact remains at peak and increasing performance.

Motor magnets are the next item we need to take a look at. There are limited modifications that can be done here, keeping within the stock parts plan. However, there are a couple of items that can be improved. The closer the magnetic field is to the armature, faster RPM and torque can be achieved. Remove all of the parts from thew chassis again and reassemble the lower chassis, magnets and armature gear plate. Turn the armature until you can see one pole next to the magnet face. Look at space between the armature pole and the magnet. You should see a gap of about 1/16th of an inch or so. We can get this a bit closer and see the performance increase. These modifications will require altering the chassis. The magnets have a flat side on each side of the inside curved surface. There are matching retainers built into the lower chassis that hold the magnets in place. By removing a small piece of that retainer on each side of the chassis, for both the front and rear magnets, we can bring the magnets closer to the armature. This leaves a gap on the rear curved surface of the magnet and the lower chassis. We have two options here: use a magnetic piece of metal to create a flux collector or cardboard or plastic as a spacer. The flux collector works on the principle that some magnetic field strength is lost to the opposite pole that is not being used by the armature. A flux collector in simple terms, re-focuses some of that lost field strength back to the leading edge of the magnet, the side the armature is acting with. By increasing the field focus you can generate more RPM and torque. A piece of track rail is ideal for making flux collectors for the pancake chassis. The plastic or cardboard spacer simply keeps the magnet closer to the armature and prevents vibration, but does not add any additional advantages.



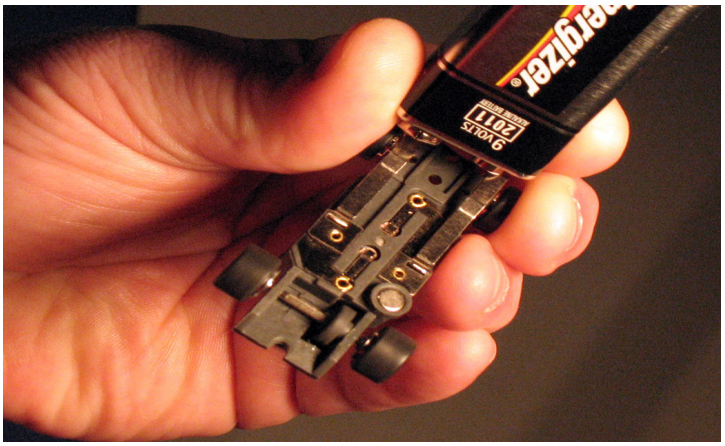
This illustration highlights the gap between the armature poles and the motor magnets.



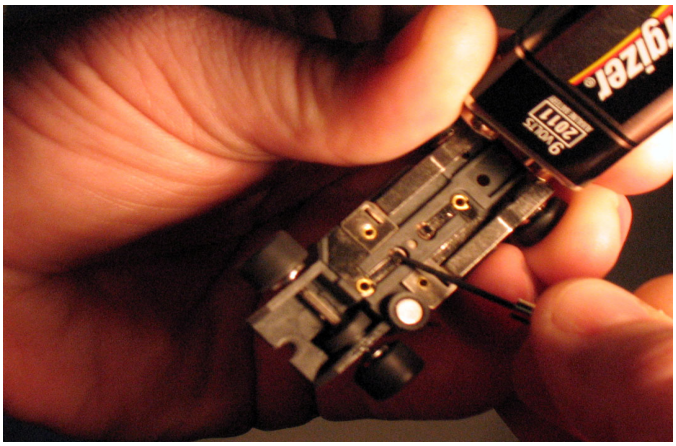
By removing a small amount of the areas shown above, you can shim the magnets closer to the armature and increase performance

A Thunderjet chassis with the magnets moved closer with plastic shims in place.

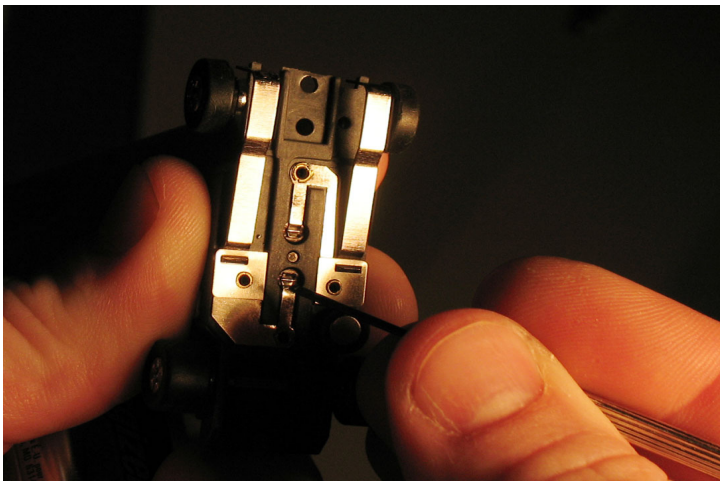
Fine tuning the motor brush tension is the last step tweaking the electrical components of the chassis. Reassemble the lower chassis, magnets, motor brushes, pickup springs and pick up shoes. Place a power source up to the pick up shoes. I use a 9 volt battery or a low voltage power pack with alligator clip placed onto the pick up shoes. The motor will most likely squeal when you start it up. Very lightly lubricate the armature bushings. You should not have any of the gears in place yet, so those won't come into play here. Once the armature is spinning under power and the squealing has been resolved, turn the chassis over so you can clearly access the brush springs. With the armature spinning, lightly touch one of the brush springs and see if you hear the RPM increase or decrease. Do the same procedure with the other brush spring. At this point you will need to disassemble the chassis and increase or decrease the brush spring tension according to what you heard during the touch tests. This may take several times to get right. Make small adjustments and test again so you don't over-compensate and bend a leaf spring too far in one direction or the other. These adjustments are temporary. As the brushes wear down, readjustment of the springs will be required. Take your time with this step. Just a minor change can bring much higher performance or place too much friction on the armature and cause heat damage.

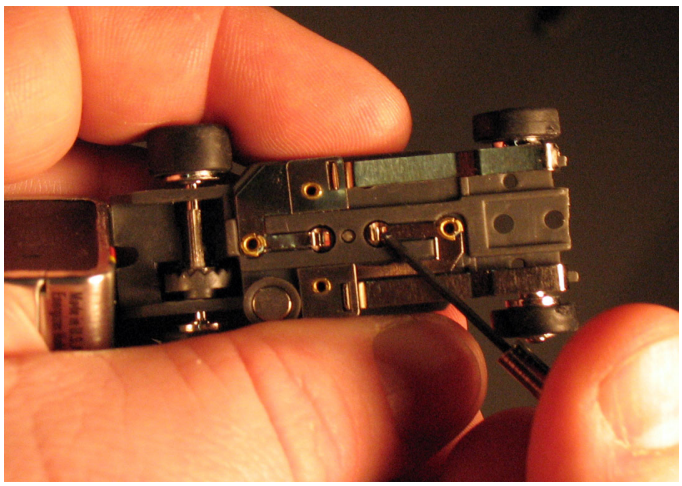


After removing the idler gear, power the armature up. I'm using a 9 volt battery, but track power can be used too. Oil the armature shaft to eliminate any squeal.



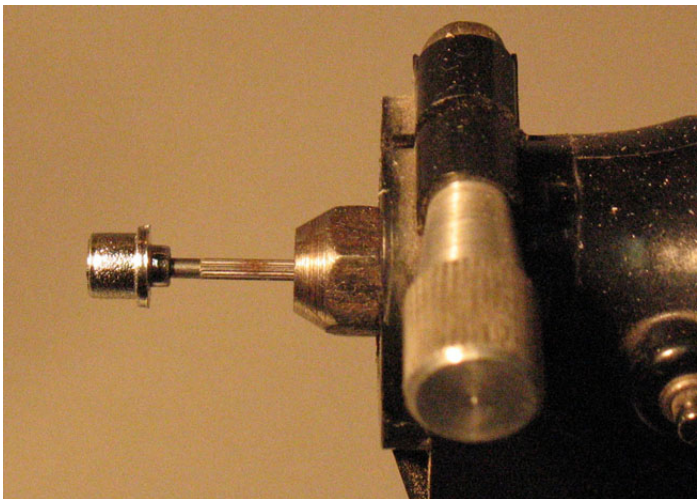
Press very gently on the brush spring and listen closely to see if the RPMs increase or decrease. The higher pitch the sound, the faster it is turning.



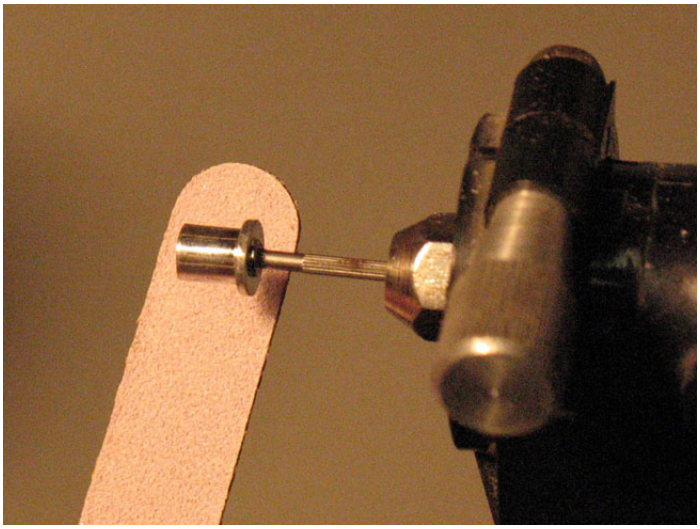


Adjusting the leaf springs will take patience. You may have to disassemble the chassis again to get the adjustments correct. Bend these springs as little as possible. They are very thin and can break off if adjusted too frequently. Use a small jeweler's screwdriver or similar small tool to make your adjustments.

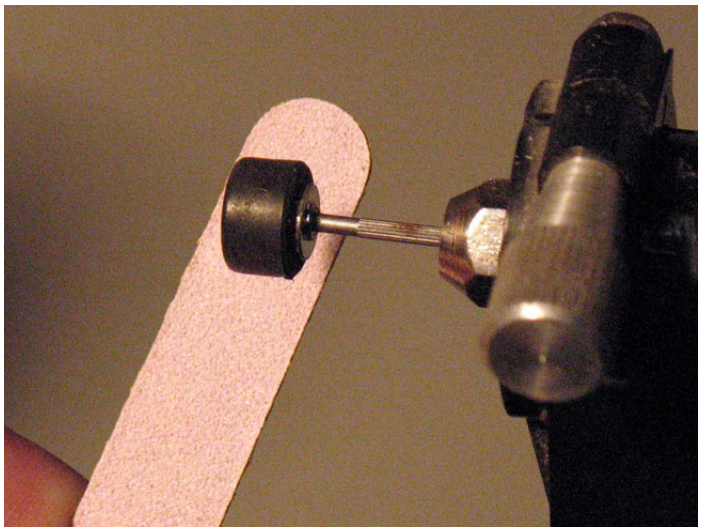
Tire and rims need to be true and round. Remove the tires and examine the rims. Make sure there are no cracks and they are mounted straight and have no wobble. Replace the rims if you detect any of these signs. Make sure there are no burrs or mold flashing on the rims. These can distort the shape of a tire and lead to hopping or chattering when you get up to top speed. Lightly sand around the rim surfaces that contact the tire, including the inside retaining lip. Do this for both sets, front and rear. Examine the tires and make sure they sit on the rims and make contact around the entire rim. Any that are distorted may be restored by soaking them in hot water and placing them back on the rim, face down until they cool. This practice can sometimes get the tire to retain its proper shape. If that does not work, you can sand the tire surface to even out the footprint or contact surface with the track. This can be done by using the car chassis and motor to turn the rear wheels while running them over an emery board or sandpaper. I strongly discourage this process as it tends to get dirt and debris into your motor, gears and axles. I have a set of axles that I know is straight and true, a couple of front and rear units. These are mounted in a moto-tool and rims and tires are attached as needed and sanded there. This guarantees that I have a straight axle and it is not distorting the rim or tire while they are being shaped. When shaping your tires, make sure you have an even and flat surface across the tread area of the tire. If your axles are true and your tires are in proper shape, you should eliminate any chatter and hopping caused by them.



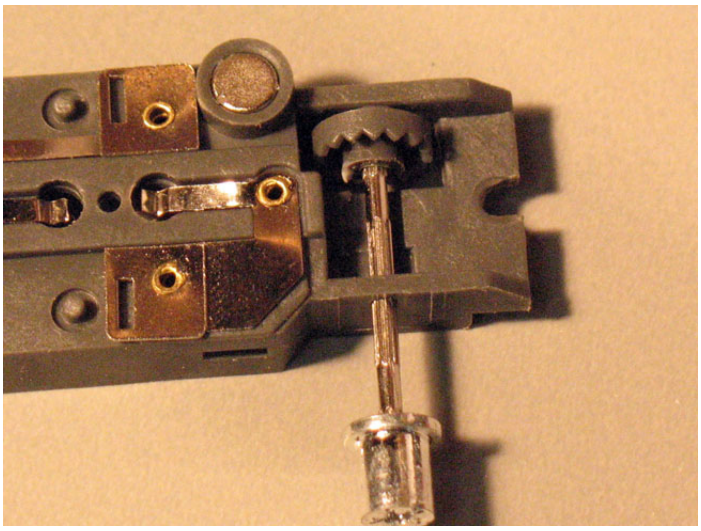
By using a straight axle and a moto-tool, you can true up any problems you find with the stock rims.



Using an emory board, sand any blemishes from the rim.

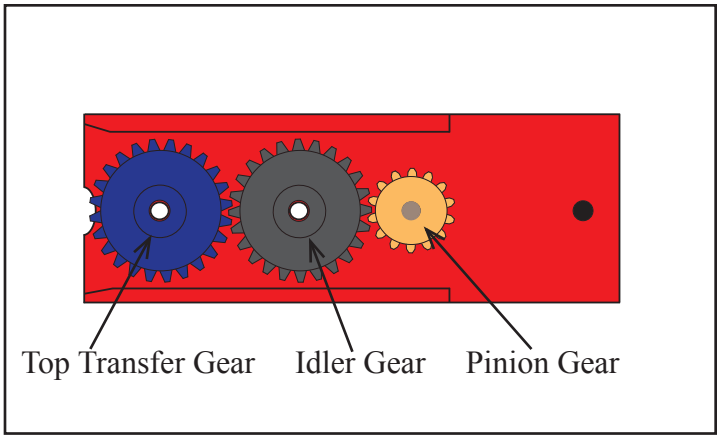


Using the same method as the rims, you can true up your tires and improve the handling characteristics.

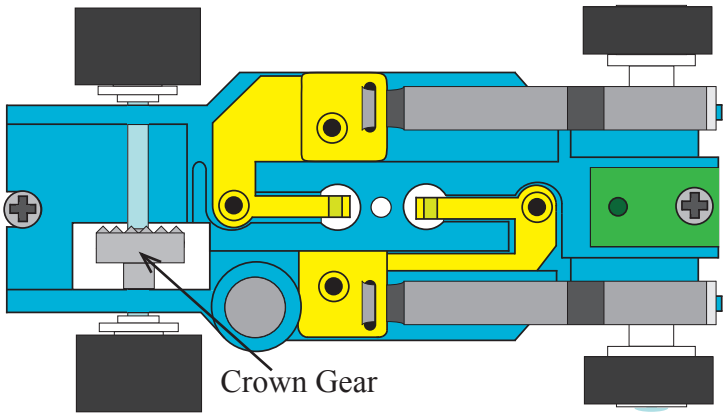


Press the rear axle back in place. Make sure to press against the back side of the crown gear. This will prevent the teeth from flattening or other damage that could hamper performance.

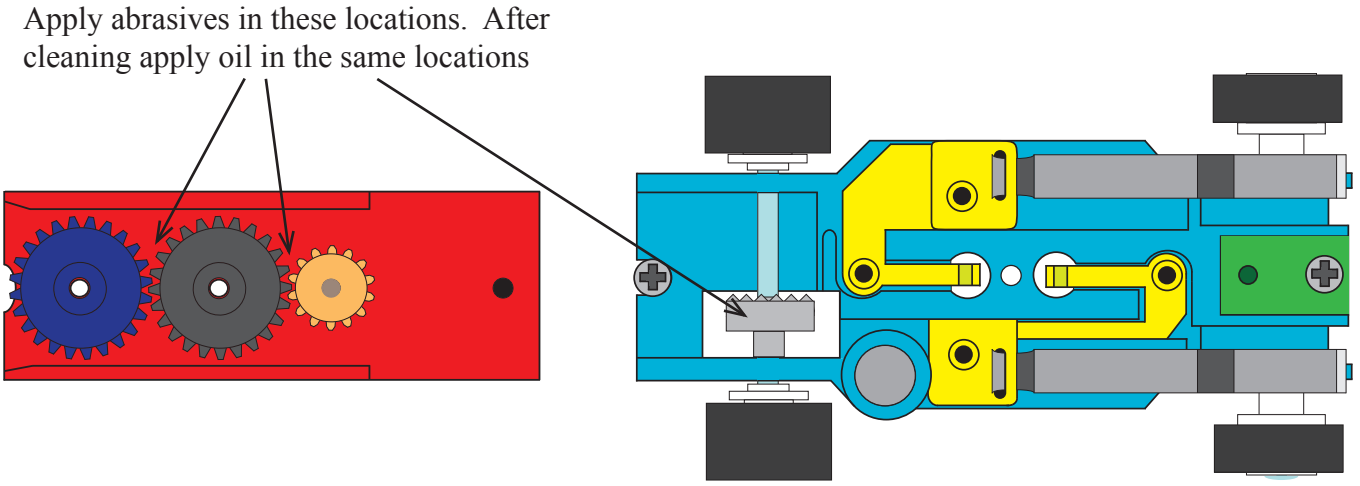
Now that we have the axles and armature turning smooth, let's look at the biggest loss of power we have in a pancake car: the gearing. In the pancake design, you have a minimum of 5 gears to traverse from the armature to the rear axle. That's a lot of friction to over come to get the tires spinning. However, this same arrangement is what allows the car to run so smoothly in transition from start to full speed and back down again. The gears or the axles they are attached to, all ride on a plastic bushings or guides. The key to getting the best performance is attempting to reduce friction and vibration. By improving the gear mesh and creating a smoother transition between the teeth of the gears, friction is reduced and speed and predictable performance is gained. The best way I have found to accomplish this task is use a micro-abrasive on the gearing. With the chassis assembled and in running condition, apply a small amount of abrasive to the teeth of the gears at each point where they meet. Do this for all of the gears. Toothpaste or mild abrasive polishes like Simichrome will work the best. Using a low voltage (a 9 volt battery is ideal), let the motor run for about 10 to 15 minutes, working the abrasive into the gear mesh. Re-apply the paste as needed during this run in time. Once the abrasive has worked in, disassemble the chassis and wash the gears and lower chassis in warm water and dry thoroughly. I use a toothbrush to make sure I have all the spots between the teeth clean. Flossing is optional :). Reassemble the unit and oil the gears lightly. You will discover the meshing action is much smoother and the car will run a bit more quietly. This process also dampens vibration. You can repeat this process until you achieve the smoothness you are looking for. Make sure to clean the abrasive completely before reassembling the chassis.



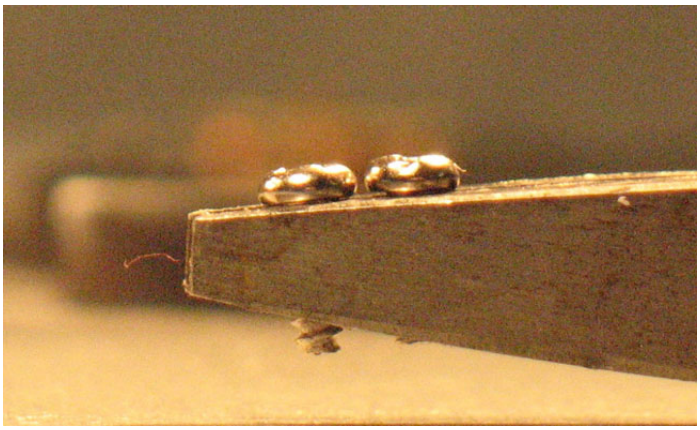
This is the top view of the gear plate. The Pinion, Idler and Top Transfer gears are all visible. The Lower Transfer Gear rides below the Top Transfer Gear beneath the gear plate.



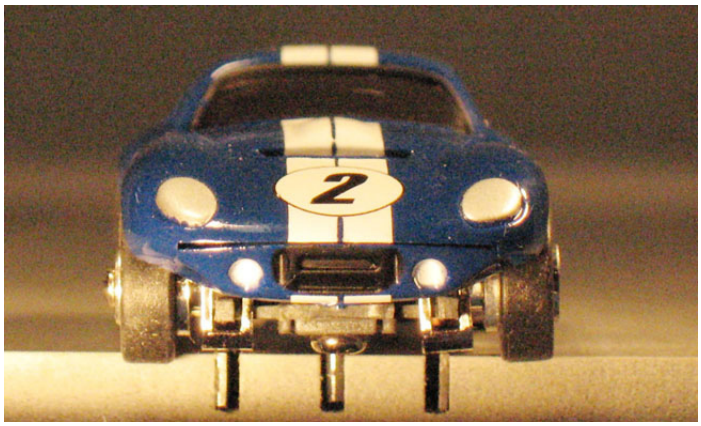
The bottom view of the lower chassis shoes the crown gear and its location on the rear axle.



The last couple of things to take into consideration are the guide pins and body mount screws. Other than the pick up shoes and tires, the guide is the only part that is constantly in contact with the track, or at least we hope it stays in contact! Make sure your guide is not worn, bent or dragging the bottom of the slot. The front body mount screw can also drag, causing poor performance and could damage your track after prolonged use. Use a scrap piece of track and make sure you have clearance. I use a feeler gauge to make sure the body mount screw is not touching the track. If you see contact, file or grind the top surface of the screw, removing small amounts, checking to see if you have gained clearance. Be careful so as not to grind so much away that the slots in the screw are no longer usable.



File down body mount screws to prevent them from rubbing the track or causing you to de-slot.



Here's a shot of a guide pin that was binding in the slot because it was not straight. Make sure the guides are straight and not dragging the bottom of the slot.

These are just few ideas on how to make the stock or mostly stock Auto World Thunderjet Ultra-G chassis perform a bit better and more predictable. There are lots of good aftermarket items out there to increase performance even more. Silicon tires, weight kits, hotter armatures and stronger magnets are but a few things that you can do to go beyond the box stock world. Thunderjet Ultra-G's are great entry level cars to start the new beginner with and there's enough to tinker with to keep the gear-heads happy for many races to come.

Go Fast, Turn, Go Fast Again. Repeat Until You See the Checkered Flag!