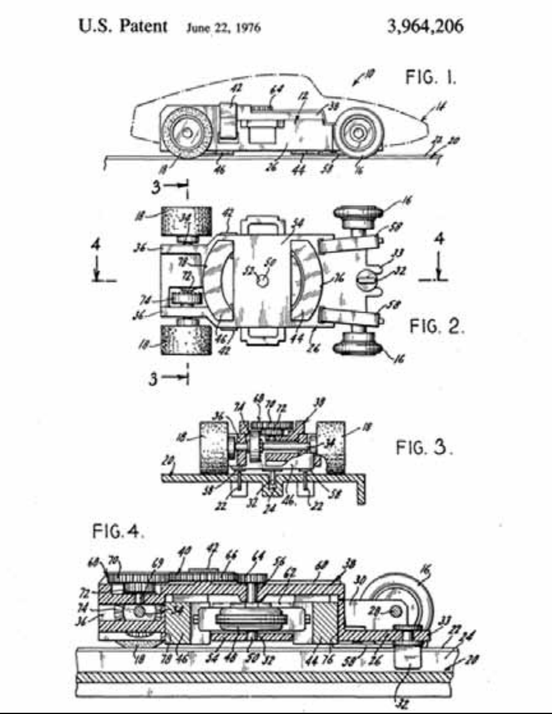
How To in HO
By
Paul Shoemaker

TUNING THE PANCAKE PART 1

The pancake motor design has been with us since Aurora Plastics released it in their Model Motoring line in 1963. Through the years this enduring design has gone through 5 upgrades and 8 variants with Aurora since its debut and even today several companies have offered there own variations of this timeless chassis design. It says quite a bit about the original engineers that came up with the pancake chassis, given that 45 years later we are still racing them, tweaking them and enjoying every moment. This series of articles will cover the basic concepts of maintenance and performance tips that can be accomplished with the stock components of the chassis. We will review the Thunderjet 500 design including the "Tuff Ones" and the modern chassis variations manufactured today. Later articles will cover the Non-Magnatraction or Original AFX Chassis, the Magna-Traction, X-Traction and the Ultra G variants made today. 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 room 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 even after 45 years. From simply adding weight and changing tires, to the elaborate pan cars of the late 60's and early 70's to today's Fray designs, the pancake chassis has always challenged and answered the call for fun and excitement.



United States Patent [19] [11] **3,964,206**

Bernhard BEST AVAILABLE COPY [45] **June 22, 1976**

[54] **MINIATURE VEHICLE WITH MAGNETIC FORCE**

[75] Inventor: **Robert Bernhard,** Hollywood, Calif.

[73] Assignee: **Aurora Products Corporation,** West Hempstead, N.Y.

[22] Filed: **Feb. 3, 1975**

[21] Appl. No.: **546,523**

[52] **U.S. Cl.** **46/251;** 46/202; 46/206

[51] **Int. Cl.²** **A63H 33/26**

[58] **Field of Search** .... 46/243 R, 243 LV, 243 P, 46/206, 236, 234, 202

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Primary Examiner—Louis G. Mancene
Assistant Examiner—Jack Q. Lever
Attorney, Agent, or Firm—Amster & Rothstein

[57] **ABSTRACT**

A miniature electrically powered vehicle including an electric motor having a pair of permanent magnets mounted in the car to serve as the stator of the motor and also being mounted to extend in close magnetic proximity to the electric rails positioned in the track upon which the vehicle is operated. The magnets are mounted one behind the other in the vehicle such that a magnetic flux path exists running between one of the permanent magnets to at least one of the electric rails and then to the other of said permanent magnets. The resulting magnetic force between the car and the track provides an increased normal force of the car against the track to increase the traction of the driving wheels and to decrease slippage and prevent the vehicle from spinning as it negotiates curves in the track.

11 Claims, 4 Drawing Figures

Patent application for the original Aurora AFX "Magna-Traction" Chassis Design

Pancake History 1963-Present

1963 - Aurora Introduces the Thunderjet 500

1967 - Aurora Introduces the Thunder Bike (Pancake Variant 1 - Motor turned vertical to accommodate Motorcycle Bodywork)

1969 - Aurora Introduces the "Wild Ones" (Upgrade 1 - Silver Plated Pickups, Sliver Plated Brushes, Spongee Tires)

1969 Aurora Introduces the "Slim-line or Formula Chassis" (Model Variant 2 of the pancake design with a more narrow chassis, gear plate, smaller magnets, armature and motor brushes. This chassis was available on only 3 cars, the McLaren BRM, Repco-Brabham and '32 Ford Pickup.)

1970 - Aurora Introduces the "Tuff Ones" (Upgrade 2 - Silver Electrical Components, Wider Rear Rims and Tires and Independent Rotational Front Rims, Taller Transitional Gear Changing From 8 or 12 Tooth to 14 Tooth.)

1970 - Aurora Introduces the "Flamethrowers" (Lighted Variant 3 of the original Thunderjet 500 Chassis. First two releases have front and rear lights)

1971 - Aurora Introduces the "Aurora Factory Experimentals" or AFX Chassis (Upgrade 3 - Complete upgrade of the pancake design. New chassis, gear plate, body mount system, guide flag/pin, gearing, rims, tires, magnets, pickup system, motor brushes and armatures are implemented in the design.)

1972 - Aurora offers the Thunderjet 500 and Tuff Ones chassis for the last time in their product catalog.

1972 - Aurora Introduces the "AFX Super II" (Upgrade 4 - Based on the new AFX chassis, the chassis and gear plate are changed to a "bullet-proof" plastic, all electrical parts are gold plated, gold motor brush cups and coil springs are added, the "Quad-Lam" armature with dual wound poles and circuit printed com, gold plated braided pickup shoes. a 19 Tooth crown gear, Blue and Yellow "oriented" magnets, set screw aluminum rear rims with sponge tires, aluminum push on front rims with "O" ring tires, Lexan pre-painted body, side weights and nose weight with body mount tubes are offered as a competition performance package. The Super II was the biggest single change offered by Aurora in an attempt to capture the competition market.)

1973 - Aurora Introduces the AFX "Specialty" Chassis (Variant 4 design based on the AFX chassis, introduces a stretched chassis and gear plate to allow an additional idler gear, totaling 4 on the gear plate, a smaller diameter crown gear, a blue poled armature (limited release), wider, taller rear rims and tires and fixed push on front rims and tires. All other components were shared with the original AFX chassis design. This new design was mounted to the body by a single front screw and a second screw secured the rear of the gear plate. The chassis allowed for longer wheel-base positions and narrow body designs. An additional extension was offered for rail dragster designs and included "bicycle" front rims.)

1974 - Aurora no longer offers the Super II in their product catalog.

1975 - Aurora Introduces the AFX "Magna-Traction" Chassis and "Magna-Traction Specialty" Chassis (Upgrade 5 - Variant 5-6 Based on the original AFX chassis, the motor magnets were enlarged and are exposed at the bottom surface of the chassis to assist traction. Motor brushes are now in molded brush cups and are suspended with coil springs. AFX "Non-Magna-Traction Chassis are no longer offered in the product catalog.)

1978 - Aurora Introduces the “Magna-Sonic” Chassis (Variant 7 Incorporated a sound box as part of the gear retainer clip. The idler gear is altered to allow this modification to function. All other components are shared with the Magna-Traction design.

1979 - Aurora Introduces the “Overheads” Chassis (Variant 8 Incorporated a geared circuit and lighting mechanism to create flashing lights for police and emergency vehicles. The idler gear was altered to allow this modification to work and the chassis has a rear guide pin location to allow reverse movement. All other components are shared with the Magna-Traction design.

1982 - Aurora files bankruptcy for the third and final time. All production is halted under the Aurora name. Patent renewals expire and become public domain over the next decade.

1989-Present - Large quantities of original production Thunderjet 500 chassis are purchased by various companies and released with new body designs.

1998 - 2004 - Playing Mantis begins production of a Thunderjet and X-traction Chassis pancake designs. These are based on the originals but are their own unique design.

2005 - Present - Round 2 / Auto World picks up production of the Thunderjet and XT Chassis pancake designs.

Aurora Thunderjet 500
Solid Rivet Chassis
Bottom View

Aurora Thunderjet 500
Solid Rivet Chassis
Top View

Aurora Thunderjet 500
Hollow Rivet Chassis
Bottom View

Aurora Thunderjet 500
Hollow Rivet Chassis
Top View

Aurora Thunderjet 500
Slimline Chassis
Bottom View

Aurora Thunderjet 500
Slimline Chassis
Top View

Aurora Thunderjet 500
Tuff-Ones Chassis
Bottom View

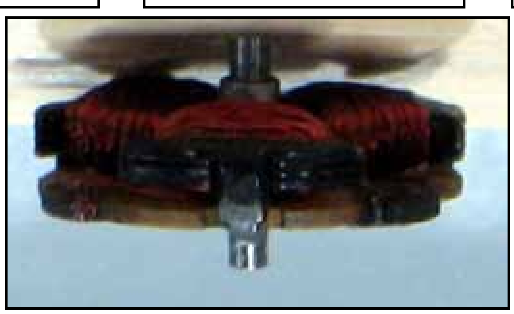
Aurora Thunderjet 500
Tuff Ones Chassis
Top View

Aurora AFX
1st Generation Chassis
Bottom View

Aurora AFX
1st Generation Chassis
Top View

Aurora AFX
Super II Chassis
Bottom View

Aurora AFX
Super II Chassis
Top View



Aurora AFX
Quad-Lam Armature
Side View

Aurora AFX
Quad-Lam Armature
Bottom View

Aurora AFX
Specialty Chassis
Bottom View

Aurora AFX
Specialty Chassis
Top View

Aurora AFX
Specialty Chassis
with Extension
Bottom View

Aurora AFX
Specialty Chassis
with Extension
Top View

Aurora AFX
Magna-Traction Chassis
Bottom View

Aurora AFX
Magna-Traction Chassis
Top View

Aurora AFX MT
Magna-Sonic
Idler Gear

Aurora AFX MT
Magna-Sonic Chassis
Top View

Aurora AFX MT
Specialty Chassis
with Extension
Bottom View

Aurora AFX MT
Specialty Chassis
with Extension
Top View

Aurora AFX MT
Specialty Chassis
with Extension
Bottom View

Aurora AFX MT
Specialty Chassis
with Extension
Top View

Aurora AFX MT
Overheads Chassis
Bottom View

Aurora AFX MT
Overheads Chassis
Top View

Auto World
Thunderjet 500 Chassis
Bottom View

Auto World
Thunderjet 500 Chassis
Top View

Auto World
Thunderjet 500
Ultra-G Chassis
Bottom View

Auto World
Thunderjet 500
Ultra-G Chassis
Top View

Auto World
X-Traction Chassis
Bottom View

Auto World
X-Traction Chassis
Top View

Auto World
X-Traction
Ultra-G Chassis
Bottom View

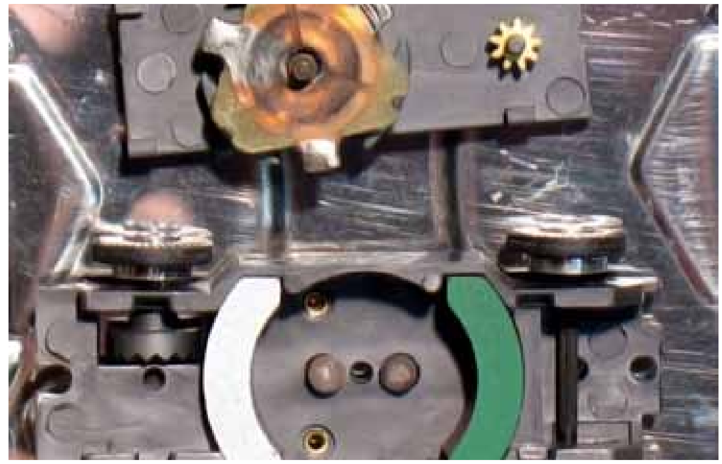
Auto World
X-Traction
Ultra-G Chassis
Top View

So let's begin with the Thunderjet 500, First Generation AFX and related chassis. These tips can be applied to old and new versions and are focused on getting good, consistent performance from the parts that came with the car. There are hundreds if not thousands of hop up and performance parts out there and they are all good to try and experiment with. We will be focusing on what we can do using the existing stock parts. Get these right and the performance parts shine even more!

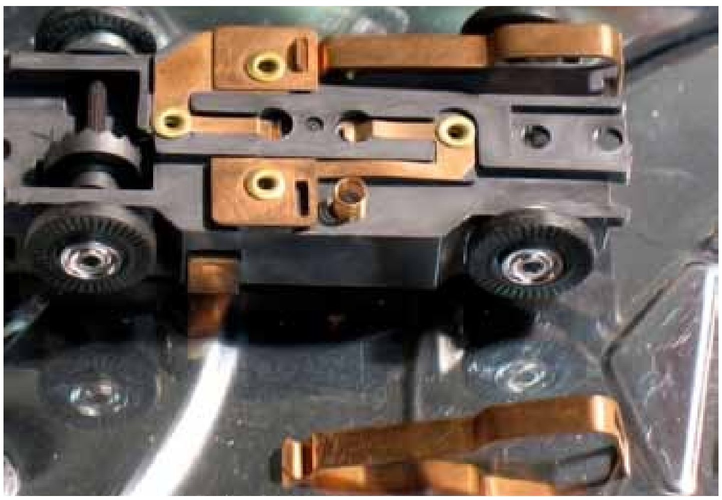
Our volunteer for this tune up will be a Model Motoring 69 Camaro, using a hollow rivet Thunderjet 500 chassis. To start off let's disassemble the chassis. We will assume the body and guide pin have been removed. I like to do this over a parts tray just in case any of the little parts hiding inside jump in a direction I wasn't looking in. 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. After you have all of the inner workings removed, the tires and rims follow suit. The rims on the newer chassis are much tighter and more difficult to remove. Do this carefully to avoid bending an axle. Once bent they are useless in running the car and are next to impossible to straighten or true. 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 require 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.

Here's the tools that are 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.

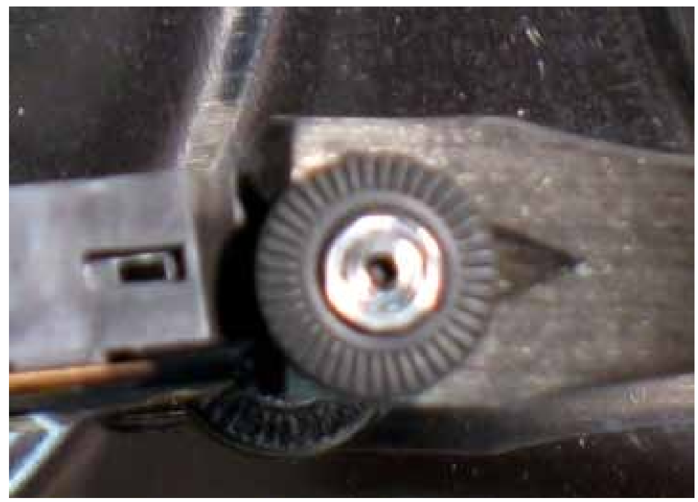
Disassemble your chassis over a parts tray to prevent small parts from disappearing.



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

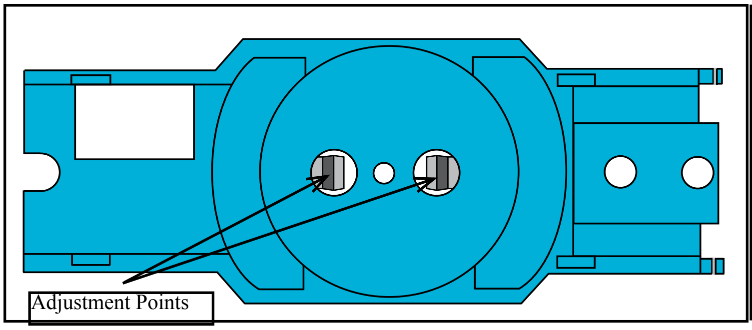


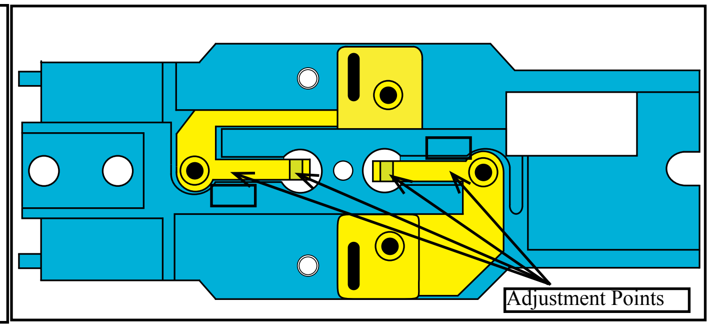
Always take your time and examine all of the parts as you disassemble the chassis



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

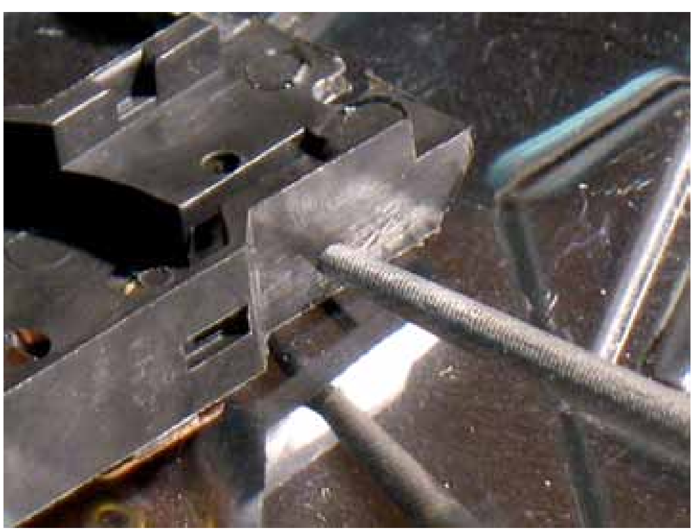
Now we have a bare chassis, look at the remaining components that are fixed in place. On the bottom facing side are the electrical components. Depending on the variant of chassis these may be copper or silver plated units retained with a hollow or solid rivet running through the plastic part of the chassis. 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 com. Too much pressure and the friction slows the armature and builds heat, not enough 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. One last item with the electrical components, make sure they are clean. Copper and silver plate oxidizes easily and the resulting corrosion is not conductive and should be removed from the surfaces.





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.

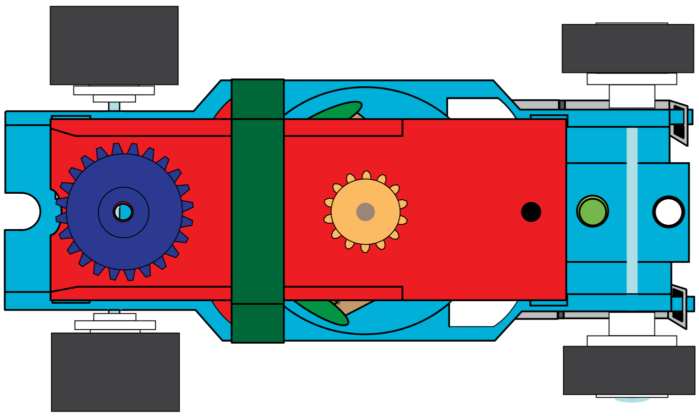
Now that you have the brush springs squared up, it's time to examine the chassis bushings. Closely examine all of the points where an axle passes through. Make sure there are no distortions, flash or burrs where the axles or armature shafts pass. If you detect such items gently remove them with a round 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 cause vibration, friction and a loss of power. 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.

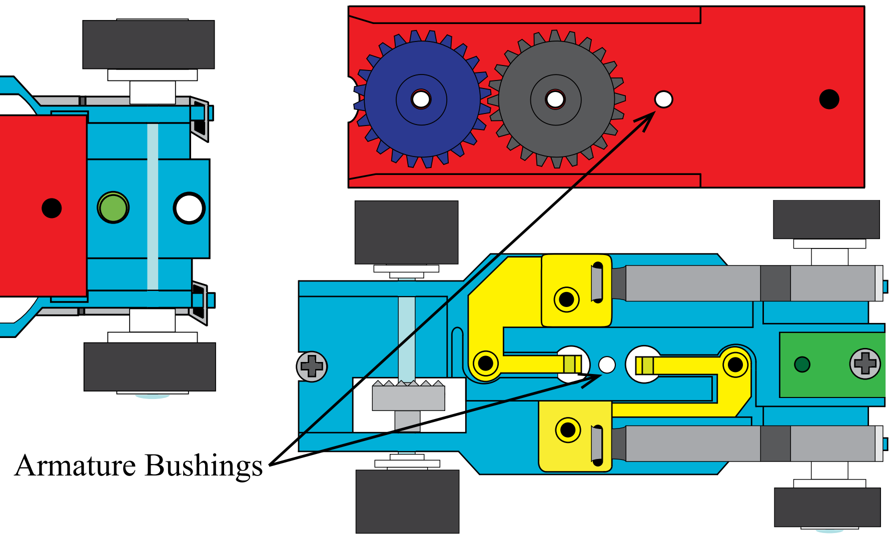


Examine the axle bushings for flash, burrs or distortion. File with a round file test fitting often as you go.

After cleaning and fine tuning, lubricate all of the axle bushings.

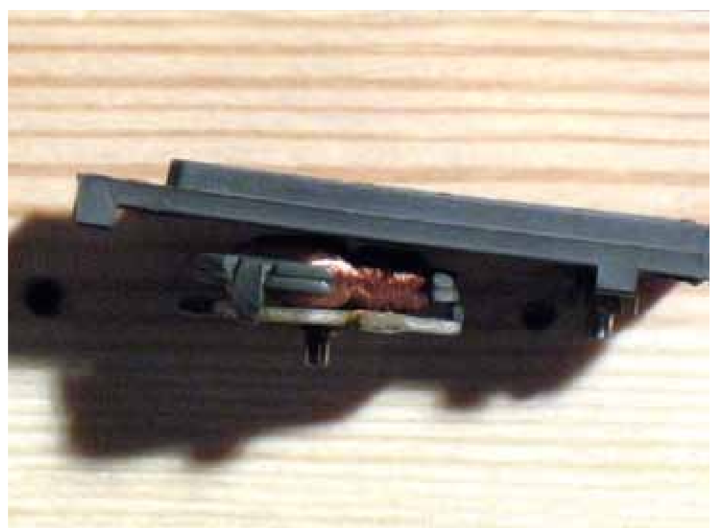
When cleaning the armature bushings you will apply the same technique, but because this is an electrical component some extra care will need to taken. With the motor brushes, magnets and the idler gear removed (the middle one), place the gear plate and armature assembly on the bare chassis as pictured 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.





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.



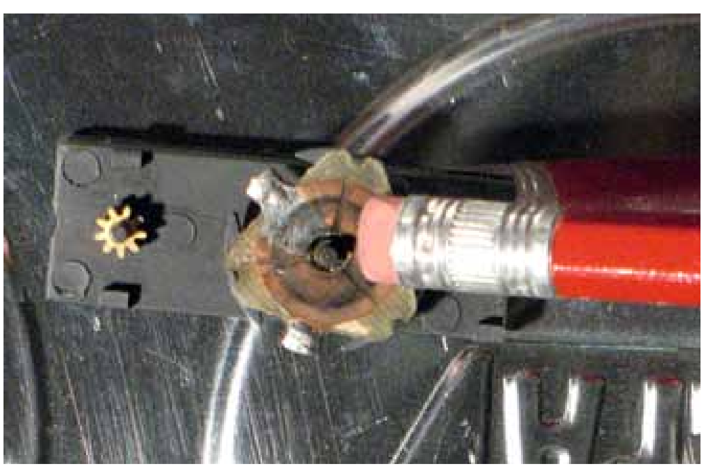
Oil the armature bushings and test for binding again.

Checking the wobble of the armature on the gear plate

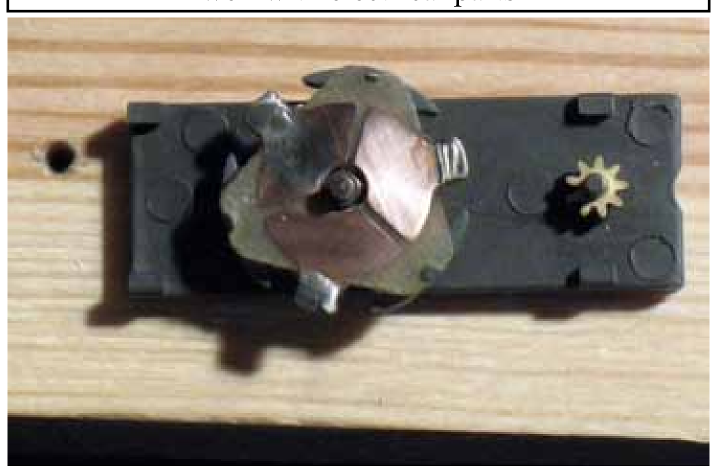
If not, disassemble the chassis again. Spin the armature on the gear place by itself. It should have a minimum of wobble to it, since the lower part of the shaft is not in a bushing, but should spin freely. Examine the lower chassis and look for distortion, flash or burrs on the armature bushing. Following the procedure with the axles, gently file away any imperfections in the bushing. If you take away too much material, you have two options: 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. The second option is to place a brass bushing in the lower chassis. Make sure this modification does not violate the rules you may compete under. K&S brass tube, .063 in diameter make great bushings. File the hole to size, carefully making sure you do not take it off center. Cut the brass tube about 3/32nds in length and polish the inside and outside edges using a round jeweler's file. Test fit the brass tube on the armature shaft first and then in place on the chassis. The armature should turn freely in the brass bushing. Using CA super glue or JB Weld glue the brass bushing in place and allow to dry completely. Make sure the top of the bushing is flush to the top surface of the lower chassis so as not to rub on the armature or commutator. Make sure the new brass bushing is square and plumb to the chassis and armature. File any excess from the bottom of the new bushing, flush with the bottom of the lower chassis so nothing drags on the track or shorts on a rail. 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 new bushing is in place. Once again, if you compete in clubs or racing organizations, please check your rules before applying these alterations.

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

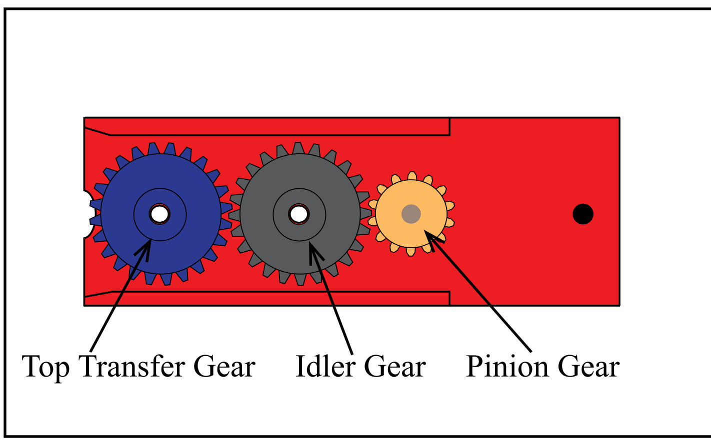


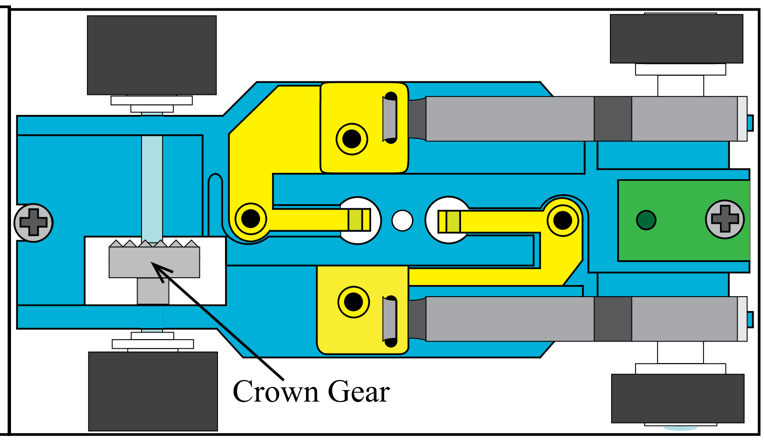
You can use an eraser or extra fine (8000 + Grit) sandpaper.



All clean and ready to rock!

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. They are in order from front to back: The Pinion Gear, Idler Gear, Upper Transfer Gear, Lower Transfer Gear and the Crown Gear. In most Thunderjets, the Pinion in 14 tooth, Idler, 24 tooth, Upper Transfer Gear, 24 tooth, Lower Transfer gear 12 tooth, Crown gear, 15 tooth. 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 bushing or guides. The older model Thunderjets used brass idler gears, the newer units have replaced those with plastic. The key to getting the best performance is attempting to reduce friction. 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. 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.

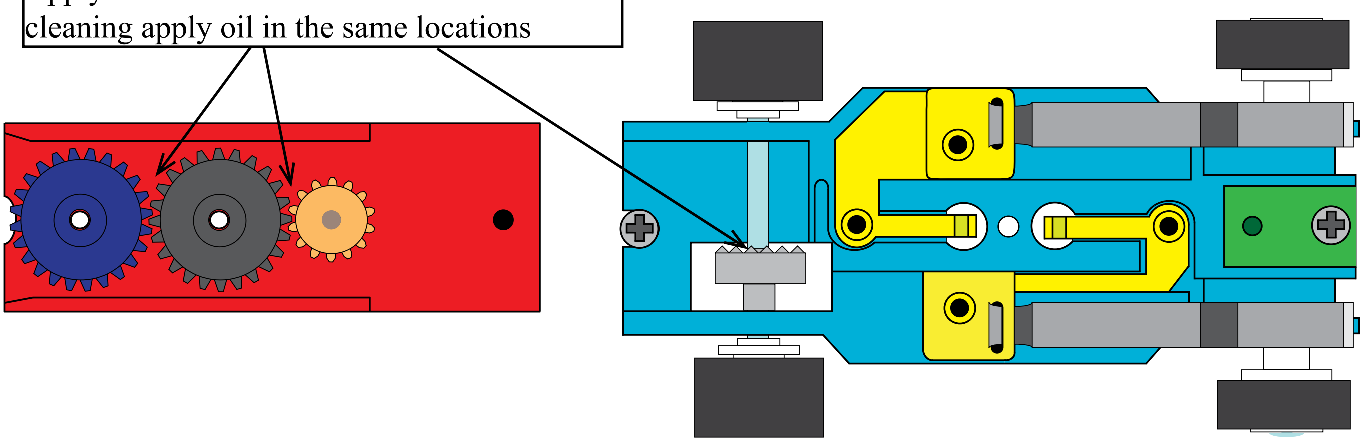




This is the top view of the gear plate. The Pinion, Idler and Top Transfer gears are all visible. The Lower Transfer Gear rides below the Top Transfer Gear beneath the gear plate.

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

Apply abrasives in these locations. After cleaning apply oil in the same locations



The electrical system is next in line to be examined. This will include the pick up shoes, springs, electrical plates mounted to the lower chassis, motor brushes and armature. Once again, if you have not done so already, disassemble the chassis completely. We'll examine each piece starting 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. 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.

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 hundredths 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 shortly). 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.

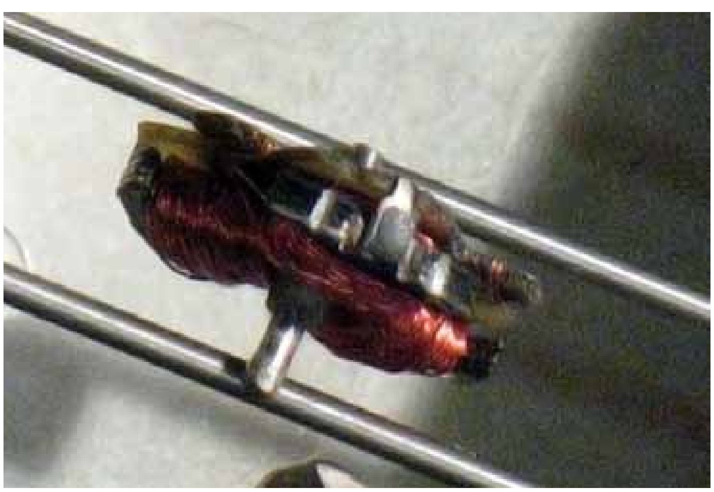
This is how to measure the Ohm rating of each armature pole

So let's say your readings are acceptable and you want to squeeze a bit more power out of the armature. You can statically balance the armature. Once again, if you race in some form of an organized program, check you rule books to see if this allowed. The tool pictured here is a balancing jig that was sold by Champion. You can make your own by assembling polished steel rods in a similar design. I have also seen razor blades used for this process. I'm somewhat accident prone (according to my wife and kids) so the polished rods were my best option. I would strongly recommend using the rods if you have kids around or have the same tendencies I have around sharp objects.

Once you have purchased or built you jig, make sure it's level across three directions as shown in the illustration below. Once you know the jig is square and level, place the axle shaft of the armature across the rods. The armature will roll and center itself with the heaviest pole facing down. Mark the pole with a marker or dot of paint and repeat the rolling process. If the marked section continues to come up on the bottom it's your heaviest pole. If another pole points down mark it with two dots and repeat the process. If the either of the two marks keep pointing down, and the opposite pole is not straight up you can begin the lightening process. Take the heaviest marked pole and remove a SMALL amount of the lamination material on the pole, using a small file or if you are steady, a grinding wheel on a moto-tool. This is a time intensive process, DO NOT HURRY THROUGH THIS. Make sure you do not hit the wires, commutator or solder points on the armature. After removing a small amount, repeat the rolling process on the jig. If the marked poles keep pointing down, continue to remove a small amount of the pole. Once you have each pole capable of pointing straight up after a roll you should be pretty close to balanced. This helps smooth out the spin on the armature and can increase torque efficiency.

Here's a nice static balance jig I bought several years ago. You can build a similar jig to balance your armatures

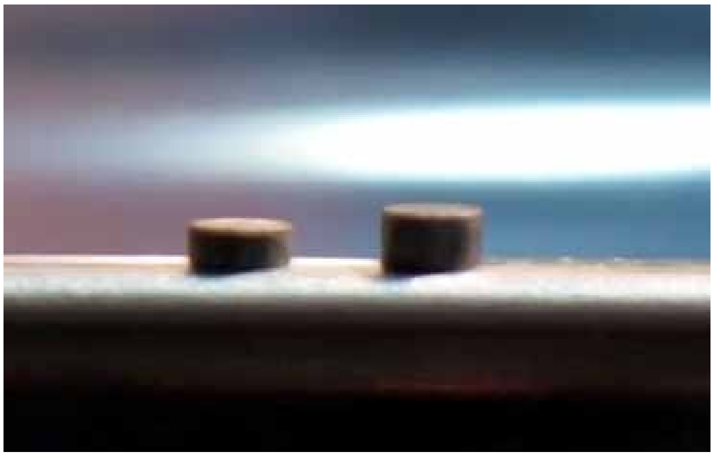
The armature pole pointing down is the heaviest and will have some material removed to balance the armature



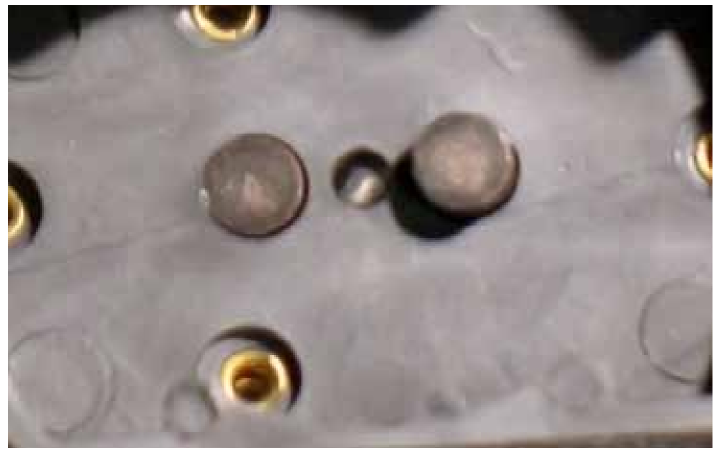
This is a sample of where and how to remove some weight from the armature pole

When the armature is balanced, no one pole falls to the bottom of the balance jig.

Now that we have the motor at peak, let's take a closer look at the motor brushes. These can be made of many different materials, most often a combination of carbon and either silver or copper. Examine the profiles of the motor brushes. Are the top and bottom surfaces square to the sides or do they have an angle? If they are not flat, they may be riding crooked in the brush tube (cup) and causing excess friction and reduced contact surface 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. Once they are able to travel freely you are set for the nest step.



Here are motor brushes. The one on the left is in good condition, the one on the right is worn away showing an unbalanced or crooked position.

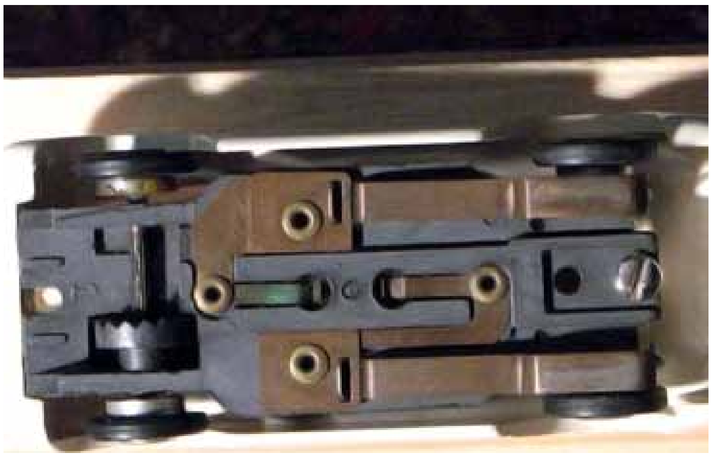


The brushes should move freely in the cups. Here is one that sticks, hampering contact and performance.

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.

With the chassis striped bare again, let's look at the electrical parts that are riveted in place. These be copper, silver plated or gold depending on the model. The rivets could be solid or hollow. These components are almost always tarnished or stained. 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 plated surfaces will eventually wear the plating away, exposing the copper core below. Once again, check rule books where this may not be allowed. Make an extra effort to clean the hinge points for the pick up shoes. This is the weakest electrical connection in the system and the cleaner it is the better.



After a bit of shelf time any chassis can get like this. Oxidation and corrosion rob power from the motor

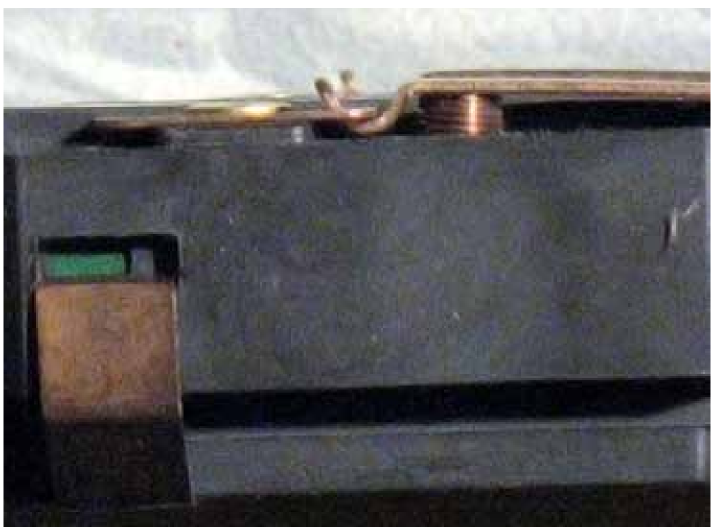
Using a mild abrasive polish, clean connections can be restored. Make sure to wipe away any residue left by the polishing compound.

Pick up shoes and springs...first contact.

On the Thunderjet style chassis the springs are located in an insulated plastic cup and spindle and do not conduct any power to the motor. In the 1st Generation AFX and related chassis, the pick up shoe springs rest in a metal cup that is directly connected to the conductive surfaces that lead to the motor. The pick up shoes are the primary provider of power in both designs, but the springs add a small secondary power path in the newer designs. The pick up shoes vary in design from model to model. There are long step, short step, no step and ski-shoe designs in all models. The material can be copper, silver, silver-plated or gold-plated depending on the model. 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 to repair them (more on that below). 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 (check the rule books) 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. Once you have the pick up shoe in place, push and release the shoe from the front mounting tab.

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 also, but check your rules to make sure this modification is allowed.

Here are some of the varieties of pick up shoe designs spanning several models of pancake chassis.
From L to R: Thunderjet 500, Tuff Ones, AW Thunderjet 500, AFX Flat Shoe,
AFX Long Step, AFX Short Step, AW Long Step.



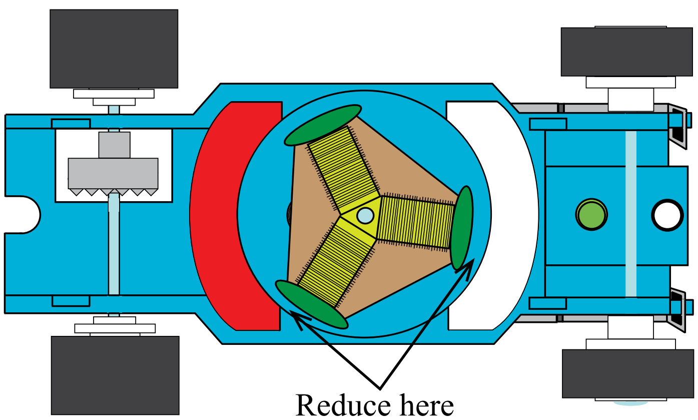
Here is a good example of the pick up shoe hinge protruding enough to drag the rail

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

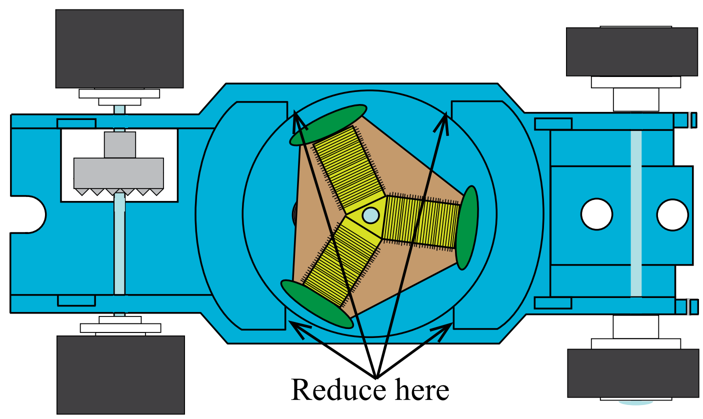
The PU Shoe on the left is stock, the one on the right has been ground down to prevent hanging on the rails.

The PU shoes on the left are new items, although the wear is slight, you can see the even wear on the PU shoes on the right. This is how they should look.

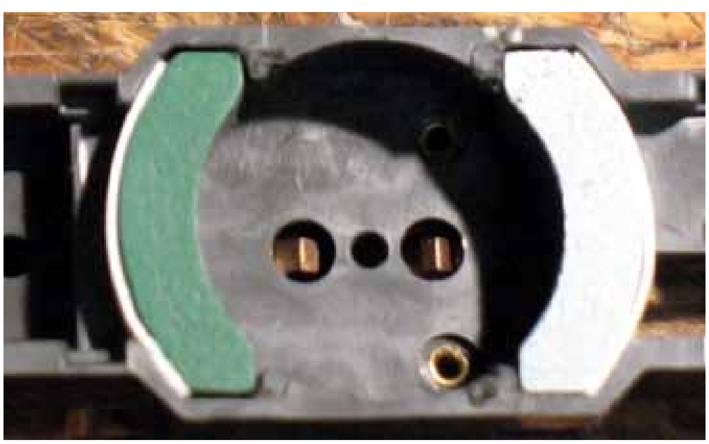
Motor magnets are the next item we need to take a look at. There are limited modifications that can be done here, keeping within the stock parts plan. However, there are a couple of items that can be improved. The closer the magnetic field is to the armature, faster RPM and torque can be achieved. Remove 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 a bit. These modifications require altering the chassis, so check those rules again and make sure you are allowed to use these changes. 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. This falls into that rules category again. Most rule sets are strict about the use of flux collectors in certain classes, so check first before using this option. The flux collector works on the priciple 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

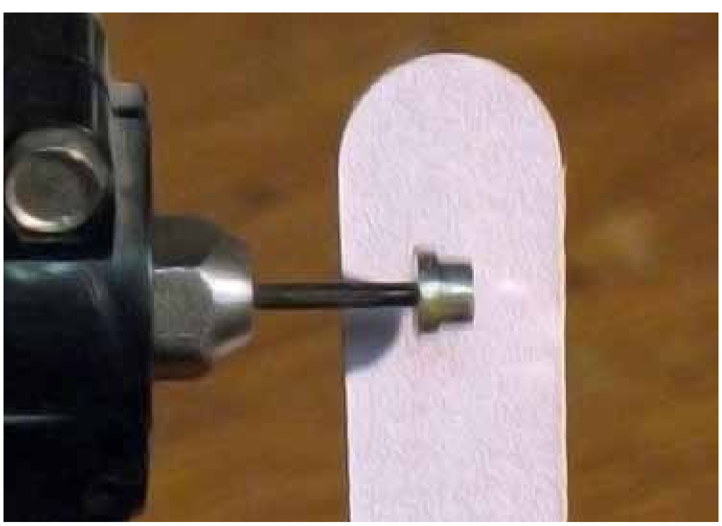


A Thunderjet chassis with the magnets moved closer and shims in place.

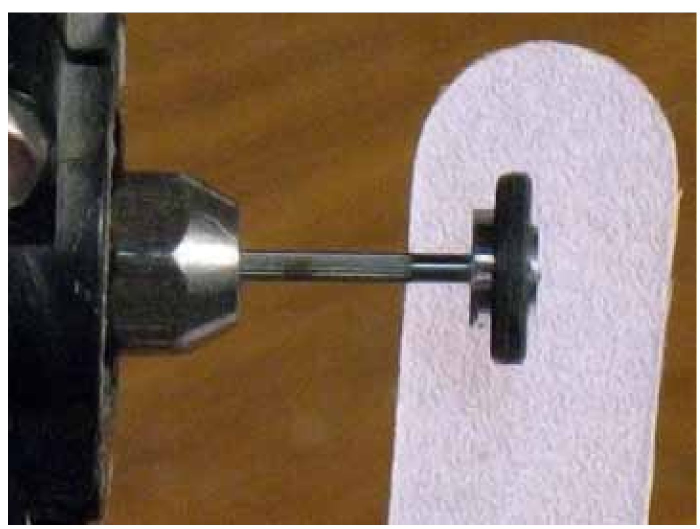
Tire and rims need to be true and round. Remove the tires and examine the rims. Make sure there are no cracks and that they are mounted straight and have no wobble. Replace the rims if you detect any of these signs. Make sure there are no burrs or mold flashing on the rims. These can distort the shape of a tire and lead to hopping or chattering when you get up top speed. Lightly sand around the rim surface that contacts 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 emory 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 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 all chatter and hopping.

The rim pictured above shows a mold mark or burr. By sanding these spots smooth, you create a more rounded surface for tire to ride on.

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 round out 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.

The last couple of things to take into consideration are the guide pins and body mount screws, if used. 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. Check your rules and make sure this modification is allowed.

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 is binding in the slot because it's not straight. Make sure the guides are straight and not dragging the bottom of the slot either.

These are just few ideas on how to make the stock or mostly stock pancake chassis perform a bit better or at least 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. The pancake design has been around for 45 years now and we keep finding out how much fun these little machines are. They 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 another 45 years to come. There's just something about the speed and handling characteristics of these mini racers that keep me coming back to them over and over again.

I hope you enjoyed this article. If you have some hop-up ideas or performance tips I encourage you to share them here or email me here at Speed Inc and I'll post a collection of tips here in the "How-To" section.

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