



## Restoring Arcade and Pinball Games, Part Three

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### Scope.

This document is a restoration guide for flipper pinball games. No experience is assumed. This document does not cover pinball repair. If your game doesn't work, first see <http://marvin3m.com/fix.htm> and get your game working. **This document is part three of three** (part one is [here](#) and part two is [here](#)).

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### 2k. The Cabinet: Polish the Shooter

The shooter (or plunger) is often neglected in a restoration. Believe me, it looks like crap! You need to remove it, buff it, replace the shooter spring and plunger tip.

*The inside view of a shooter. Remove the rubber tip and note the "C" clip in front of the spring. Rotate the metal plate that bolts the shooter to the inside of the cabinet, to remove the "bend".*



To remove the shooter, open the game and lift the playfield. Remove the rubber plunger tip, and notice the "E" or "C" clip in front of the spring. Remove the clip with needle nose pliers, and the spring will slide off, and the shooter will slide out from the front.

If your game is a manual ball load type (like this game), you should remove and polish it too. Again, it has a small "C" or "E" clip holding the two washers and short spring in place. Remove those and a second clip is revealed. Remove it and the ball lifter will slide out from the front.

Note the clip probably needs to be replaced. You can get a new "E" clip at any decent hardware store.

Now buff the handle of the shooter on your buffing wheel. It's not a bad idea to buff the metal plate that bolts to the outside of the cabinet too. Re-install when done. Note on pre-1965 Gottlieb's, the nylon bushing that houses the manual ball load lever can be easily replaced (it's the same part as the playfield flipper bushing).

Left: Shooter Before buffing. Right: Shooter After buffing.



## 2L. The Cabinet: Clean the Score Reels

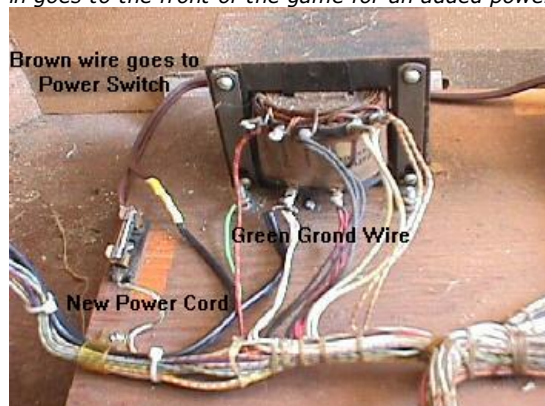
*Cleaning the credit wheel. Note how nice a job Novus#2 did on the cleaned (lower) portion of this reel.*



The score reels will be dirty. So get the Novus#2 and a rag out. Remove the score reels from the backbox; there will be some easy way to do this (a clip or a tab). Then apply some Novus#2 to a rag, and clean the reel. Works equally well on plastic and metal reels. And don't forget to clean the credit wheel too! Make sure you hold the wheel to prevent it from turning while you clean. Otherwise you might damage the mechanism.

## 2m. The Cabinet: Install a new Power Cord and Switch

*The Gottlieb power transformer. Note the new (black) power cord and the attached ground (green) wire. The brown wire spliced in goes to the front of the game for an added power switch.*



Your game is at least 25 years old. Believe me, it is time for a new 3 prong power cord! While you're at it, install a power switch (if your game doesn't have one). And fully ground your game.

You can get a new 3 prong power cord from [Pinball Resource](#). Or just go to the local store and buy a 3 prong extension cord, and cut off the female plug. Or you can also buy a 2 prong 15 foot extension cord (cheap) at the Dollar store, and again cut off the female end. You now have a nice new power cord to work with.

To remove the old cord, just cut the old cord off, but leave the part in the wiring harness (it's attached with a cloth string called "gut"). Do not cut the gut. Install the new 2 or 3 prong cord in the same manner as the old one, and attach it over

the wiring harness with nylon lock ties. On 3 prong cords, the green (ground) wire should be tinted with solder, and then attached to the frame of the power transformer (see picture). Re-attach your new power cord to the wire harness with nylon ties.

If your game is older and does not have a power switch, you can install one. Get a SPST (Single Pole, Single Throw) or DPST (Double Pole, Single Throw) switch. Power rating for the switch should be 120 volts 3 amps or higher. (You should use a DPST switch, and turn both sides of the power cord off, but frankly I never do that.) Using a SPST switch just turns off one side of the power. Splice the one power cord lead at the transformer to a 4.5 foot length of 2 prong (2 wire) line cord. Technically you should splice the switch into the line cord's "hot" wire (not the "neutral" wire). The hot wire on the power cord should have "lines" molded into the insulation (as today's power cords are all polarized). Run the line cord up to the front of the game, where the switch will be located. Attach the other wire of the 4.5 foot line cord to the original power connection.

Also it's a good idea to put the switch on a raised 4" square block, so the switch lever does not protrude below the game's bottom panel. Then drill a 2" hole in the bottom of the cabinet wood, and put the wood block over the hole. Otherwise the switch can be easily broken if the legs are removed and the lower cabinet moved. Again I don't do this (I just remove the switch's nut and push it into the cabinet when I move the game), but it's not a bad idea.

On older games that never had a power switch, I disable the Lock relay (bending the Lock relay's switch blades so its permanently "on"), and remove power going to the relay. The lock relay is usually burned up anyway, so adding a power switch defeats the relay and it's one less thing to worry about.

*New power switch at front of the game. Run a length of 4.5 foot dual wire line cord to the front of the game. Drill a 15/16" hole in the wood for the SPST (Single Pole, Single Throw) or DPST (Double Pole, Single Throw) switch. You should use a DPST switch, and turn both sides of the power cord off, but frankly I never do that. Using a SPST switch just turns off one side of the power. Also it's a good idea to put the switch on a raised block, so the switch lever does not protrude below the game's bottom panel. Otherwise the switch can be easily broken. if the legs are removed and the lower cabinet moved.*



### **Ground your Game.**

Another good idea is to ground your game. To do this, run the power cord's ground wire to the metal frame of the power transformer. Then run a wire from the transformer's frame to the back end of the metal side rails. Run another wire from the front end of the side rail to the coin door and lock down bar. Lastly, run a wire from the coin door to the other side rail.

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## **2n. The Cabinet: Install a New Start Button**

*Old start buttons. Notice the part that you see on the coin door has worn the original red away.*

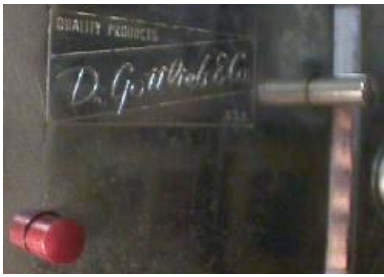


One thing I notice on all Gottlieb EM pinballs is the coin door start button is an ugly grey. It shouldn't be. Originally from the factory, the start button was **red** anodized. From thousands of plays, the red anodized coating has worn off. A red start button brings attention to itself. You *want* to press it!

Steve Young from [Pinball Resource](http://PinballResource.com) who has remanufactured the original Gottlieb red start buttons.

For \$3 you can get rid of that old corroded grey button, and replace it with a fresh looking, attention grabbing, new red button.

*The new red start button installed. Good contrast against the coin door, making a new game easy to find for neophytes.*



Installation is simple: open the coin door and remove one screw from the start switch/slam switch assembly (remove the one that is closest to the start switch). Now rotate the switch assembly to the side. Remove the "E" clip that holds the start button in place. The old button will pull out from the front of the coin door. Install the new button and replace the "E" clip. While you're there, check that the fish paper is in place on the start switch (to insulate the start button from shock). Replace the fish paper if worn or ripped. Swing the switch assembly back in place, and tighten the removed screw. Adjust the start switch (normally open) and slam switch (normally closed) as needed.

[Pinball Resource](#) also makes new red anodized flipper buttons too. Yes, those were red from the factory too. I sometimes buy these, but new red flipper buttons aren't nearly as noticeable as a new red start button. Also the red wears off flippers buttons more quickly than the start button, as they're used more per game.

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### 3a. The Mechanics: Rebuilding EM Pinball Flippers

Flippers are the interface between you and the game. Having good strong flippers is mandatory. The parts that are in the game are probably 25 years old or older. Here's the parts needed for flipper repair. One of each part is needed for each flipper.

- Mandatory: Nylon flipper coil sleeve - if this sleeve can not be removed from the original flipper coil, then a new flipper coil is also needed. Gottlieb part #A-5064 (1 21/32") or A-5065 (1 7/8"). #5 pictured below.
- Mandatory: Nylon thru-the-playfield flipper bushing. Gottlieb part #A-2408. #0 pictured below.
- Mandatory: plunger and bakelite link. These are usually sold together, if bought from the Pinball Resource. I don't suggest trying to assembly the plunger/link yourself. Gottlieb part #A-3396 (game dependent). #6 pictured below.
- Often needed: flipper pawl return spring (there are often separate right and left side versions). Gottlieb part #A-3328 (left), A-3329 (right). #8 pictured below.
- Often needed: EOS switch. #1 pictured below.
- Sometimes needed: flipper pawl (specify right or left side). For Gottlieb, it is best to use the "old style" pawl (more explained on that below). Gottlieb part #A-5982/A-5983 or A-3399/A-3400. #3 pictured below (old style).
- Sometimes needed: flipper shaft. Gottlieb part #A-6888. #7 pictured below.
- Sometimes needed: plastic flipper bat (the part the ball hits). Gottlieb part #A-5095 or A-5394 or A-5393. #2 pictured below.
- Sometimes needed: flipper coil. Gottlieb part #A-5141. #4 pictured below.
- Rarely needed: upper flipper coil mounting bracket. Gottlieb part #A-5147. #9 pictured below.
- Optional: Coil stop. Gottlieb part #A-5189. #10 pictured below. Also available, just the core of the coil stop and aluminum nut, without the mounting bracket. Gottlieb part #A-4862. #11 pictured below.

*Gottlieb flipper rebuild parts.*



If you are keeping the same flipper coil, replace the flipper coil's nylon sleeve (a thirty cent part). Also always replace the metal plunger and link with a new one. Often the plunger link is metal - the replacement should be bakelite (a brown fiber-ish plastic), which will wear better and is lighter weight (for better flipper performance). These new parts will give optimal performance as there won't be any "slop" to absorb flipper energy.

When rebuilding the flippers, it's not a bad idea to replace the coil stops. New coil stops will make your flippers quiet when holding the cabinet flipper button in. Also sometimes the old coil stops are magnetized enough to hold the flipper in the up position. You can buy new stops, or just rotate the flipper and backbox Replay unit coil stops. The replay unit gets very little use, so its coil stops should be in excellent condition. Just move these stops to the flippers, and the flipper stops to the replay unit.

Many EM games have wear marks on the playfield from the flippers. This is known as "flipper drag". This is caused from worn or cracked nylon flipper bushings, which go through the playfield. These nylon flipper bushings should ALWAYS be replaced to stop flipper drag. New flipper bushings are slightly taller than originals to prevent this problem.

Also make sure the flipper return spring is not too tight. There should be enough spring to return the flipper, and no more. Too much return spring and it is only being fought by the flipper coil. You can adjust the flipper spring in 1/3 turn increments (by moving the spring's anchoring position to another of the three screws).

Lastly, make sure the EOS (end of stroke) switch is adjusted correctly. It should open about 1/8" when the flipper is fully "flipped". Also file the EOS switch clean with a small metal file.

You may also want to install new Gottlieb EM "hi power" flipper coils (as shown in the above picture). These are available from the [Pinball Resource](#), and provide about 10% more power (probably not necessary if you have done all the above maintenance).

*Rebuild the flipper with new plunger and link. Remove the coil stop to release the parts.*



### EM Flipper Rebuild Instructions.

Work on one flipper at a time. This way if there is some issue, you can always look at the other flipper for comparison. Note these instructions have 1950s and 1960s Gottlieb flippers in mind, but apply to most other game makers and eras of EM flippers.

1. Put the playfield in the "up" position, leaning it against the backbox. Find a small step stool to stand on.
2. Remove the coil stop (lower bracket) from the flipper coil. This will allow the removal of the flipper coil (just slide the flipper coil off the plunger).
3. Slide the old coil sleeve out of the flipper coil. If the coil sleeve will not come out easily (I use a yellow handled nut driver to push the old sleeve out of the coil), replace the entire coil (which should come with a new coil sleeve).
4. If using the original coil, inspect the three wire lugs. Visually check the three lugs and make sure the tiny coil winding wires are attached to the lugs. The center lug (the common lug) should have both a thin and thicker winding wire attached to it. The other two outside lugs should have a single winding wire attached to it (one thin, one thicker). If any of these wires are broken, replace the coil (though sometimes one winding can be unwound, the wire sanded to remove the insulation, and resoldered to the solder lug). A multi-meter (DMM) can also be used to check the coil. With one lead of the DMM on the center common lug, and the other on the thick wire outside lug, about 4 ohms should be seen. Move the outside DMM lead to the thin wire lug, and about 100 ohms should be seen. Note the game wires going to the center flipper coil lug may need to be removed to get accurate DMM readings.
5. On pre-1969 Gottlieb games, remove the spring clip from the flipper pawl, which holds the plunger/link to the pawl. The plunger/link can now be removed. Throw the original away, as a brand new plunger/link should be used. On 1969 and later Gottlieb games, the flipper pawl is attached to the plunger's link by a roll pin. This complicates things a bit. See below for more information\*.
6. Remove the flipper pawl from the flipper shaft. Usually there are two allen screws or small 1/4" screws holding the pawl to the flipper shaft. As the pawl is removed, the flipper spring will also need to be unwound/removed.
7. Remove the flipper/flipper shaft from the top side of the playfield. It should freely pull out.
8. Undo the three screws from under the playfield that hold the nylon flipper bushing. Note which screw retains the flipper return spring. Throw the original bushing away, and replace with a new nylon flipper bushing. The new bushing should stick through the top of the playfield about 1/8". Re-secure the bushing with the same three screws, and reattach the flipper return spring on the same screw.
9. Replace the flipper shaft thru the nylon flipper bushing on the top side of the playfield.
10. Replace the flipper pawl onto the flipper shaft. HAND TIGHTEN the two pawl screws.
11. Reattach the flipper return spring on the flipper pawl. The spring should have enough power to move the flipper back to the home position, but not too much power. If too much spring power is used, the flipper coil will just have to fight the spring, weakening the flipper. Adjust accordingly.
12. Attach the new plunger/link on the flipper pawl using the spring clip or a "E" clip. If this is lost, they are readily available at any hardware store.
13. Hold the flipper coil in place against the upper bracket, and replace the coil stop.

The flipper is basically rebuilt, but will need some minor adjustment. Repeat the above procedure on the other flipper first.

After both flippers are rebuilt, lower the playfield. Now align both flipper bats as you would like them. Since the pawl screws are only hand tight, the flipper shafts should move in the pawls to allow easy alignment. After the flipper bats are

aligned, lift the playfield and tighten the two screws on each flipper pawl. Lower the playfield and double check the flipper bat alignment.

Note there is an upper plunger stop on many games (especially Gottlieb). This rarely needs any adjustment. It's purpose is to change the amount of plunger travel, allowing the left and right flippers to be adjusted so they have the same amount of travel and align in both the resting and extended positions. If new parts were installed for both flippers, this almost never needs to be adjusted.

The last step is to check and adjust the EOS switch. First inspect the EOS switch. If the EOS contacts are pitted or burned, replace the entire switch. If they are usable, file the EOS switch contacts with a metal file to remove any pits or burns.

Now move the flipper to the fully energized position, by moving the playfield flipper bat. The EOS switch should open about 1/8" when the flipper bat is extended. Adjust the switch as needed. Note there should be a piece of "fish paper" on the EOS switch blade that touches the flipper pawl. This electrically isolates the pawl from the EOS switch.

Also check the flipper button cabinet switch for pits and burns. File as needed, replace if it's in bad condition.

\* On 1969 and later Gottlieb pin games, the flipper pawl style was changed. Prior to 1969, a large round 1/4" pin was on the pawl, and the plunger's link just slipped over this pin, and was secured with a spring clip. This was very convenient to work on, requiring no tools to remove and install the plunger/link to the pawl. But in 1969, Gottlieb changed the flipper pawl so now the plunger's link slide between two pieces of metal, and the pawl was secured to the link with a roll pin. This made removing the plunger/link assembly much more difficult, as now the roll pin had to be hammered in and out of place.

In addition, when installing a new plunger/link into the 1969 and later pawl, if too much "hammer" was used on the pawl's roll pin, it could bend the two pieces of surrounding metal, binding the link, and making the flipper stick. Really the right way to deal with the roll pin is to use an inexpensive \$10 press punch tool, but most people don't have that tool, and hence use a nail and a hammer. Another complication is the 1969 and later style pawl is NLA (no longer available), where the pre-1969 style has been reissued and is available new from Pinball Resource.

The solution to this problem is simple. Replace the 1969 and later Gottlieb style roll pin flipper pawls with the older spring clip style pawl. The older pawls retro-fit on 1969 and later games with no modifications (the geometry and sizing is identical). The only difference is the plunger's bakelite link hole that attaches to the pawl must be made larger (or when ordering new plunger/links from Pinball Resource, specify the old style pawl and they will come correctly drilled). This solution solves the availability problem (old style pawls are readily available), and installation/removal of the plunger/link is much easier.

### 3b. The Mechanics: Rebuilding EM Pinball Pop Bumpers

Having quick and perky pop bumpers make any game a lot more fun. And chances are your game needs it anyway. Tell tale signs would include chipped bumper skirts (the bumper skirt is the plastic part the ball contacts on the bumper that tells the bumper to "pop") and lots of dirt.

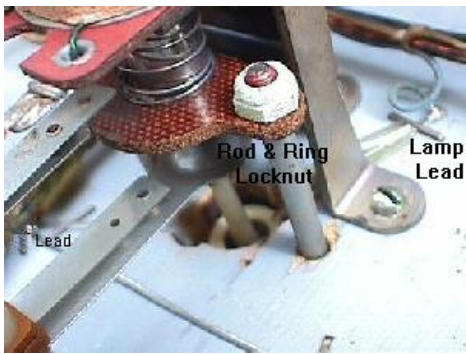
This procedure also applies to stationary bumpers. These bumpers look like pop bumpers, but don't "pop". They have no coil or rod & ring assembly.

*The top of a pop bumper with the cap removed. Note the two screws that hold the bumper body to the playfield. Also note the wedge style light socket. This will be replaced with a bayonet (#47) style socket. The top of the metal ring of the rod & ring assembly is also visible.*



From the top of the playfield, remove the bumper caps. Usually two small screws hold it in place (though some are press fit). Then remove the light bulb. You will see two screws that hold the bumper body to the playfield, next to the light socket. Remove these two screws.

*Bottom of the playfield: This picture shows the lamp socket leads and the rod nuts, and plunger/coil assembly.*



From the bottom of the playfield you need to remove the two locknuts from the rod & ring assembly. Then unsolder the two light socket leads underneath the playfield. On some games (including this one), there are staples that secure these leads, which you will have to remove. Now the bumper body and rod and ring can be removed from the top of the playfield.

Also check the bakelite and metal armature links that slide inside the coil plunger, which the rod and ring assembly bolt to. These often crack or break and need replacement. The steel link breaks the most often. The older Gottlieb version is no longer available, but you can replace them with new Williams steel armature links, part number 01-5492. I do NOT recommend the Williams part though. They are not hardened steel (like the Gottlieb part), and often break. You can get a new style Gottlieb metal armature that is hardened from [Pinball Resource](#). It is slightly bigger though. So you either have to grind it smaller, or modify your pop bumper bracket (see pictures below).

**Left:** Modified Gottlieb pop bumper brackets to accommodate the newer (bigger) Gottlieb metal armature plate. Note the sides are indented with a grinder.

**Right:** The top of this picture is a new Gottlieb metal armature link. These are hardened steel, and will not break. Below it is the cheap Williams metal armature link that is so soft, I can bend it with my fingers!



Note when re-assembling the armature plates, the bakelite spacer mounts closest to the rod & ring nuts, and the steel link contacts the metal bracket.

**Inspect the Rod and Ring.**

It is very important you inspect the rod and ring assembly for defects. If the rods are loose, replace the rod and ring assembly. If the threaded ends are not square to the rod, this is also cause for replacing the rod and ring.

**Tighten or Re-peen the coil stop.**

The coil stop on the pop bumper bracket should be tightened or re-peened (if it's a riveted coil stop).

**Check the pop bumper spring.**

The spring that goes over the pop bumper plunger is probably very tired. You should either replace this spring, or re-stretch it to the length of the pop bumper coil.

**Install a New pop bumper lamp socket.**

Don't even attempt to re-use the old lamp socket. Buy a new socket from [Pinball Resource](#). The old socket is probably corroded anyway, and should be replaced.

After removing the two screws inside the bumper body (and disconnecting the rod and ring and bumper lamp socket from under the playfield), lift the bumper body off the playfield. Note all the dirt and crud that lives under the bumper body! If you have clear plastic trim platter protectors, there will be lots more crud under those. Now is a good time to clean the playfield under the bumpers with Novus2. When finished with the Novus2, wax this area.

**Left:** Removing the pop bumper coil and replacing the coil sleeve.

**Right:** Note the metal armature link touches the metal bracket. Also note the two links' openings face each other, mounting from opposite sides.





### Pop Bumper Performance Tips:

- While you're under the playfield, replace the pop bumper coil sleeve. Remove the two screws that hold the pop bumper coil to its bracket. The two screws hold the coil retainer in place. The old coil sleeve should just slide out. If it doesn't, the coil is heat damaged and should be replaced. Install a new coil sleeve. This will increase performance.
- Polish the ring of the rod & ring assembly on your buffer. This will smooth the surface (which contacts the ball) and reduce friction. This makes the ball kick faster. A cheap and easy performance tip if you already have a buffer. If the rod & ring is damaged, bent or has loose rods, replace it. New rod & rings assemblies need the ring polished too, as they aren't that smooth.
- Remove the bakelite and metal armature links from the coil plunger. Using "Goop" (available at most hardware stores), glue them together. Then "Goop" the bakelite and metal armature links to the pop bumper coil plunger. Remember, the bakelite spacer mounts closest to the rod & ring nuts and the plunger. Put the plunger in a vice to let the whole assembly dry overnight. This will remove any play between these devices.
- While you're replacing the coil sleeve, you can also unwind three "layers" of coil winding wire from the pop bumper coil. This will lower the coil resistance, and make the bumper faster. See the following [performance tips](#) for a description of this. But basically, first remove the paper wrapping from the coil. Then cut the outside coil winding from the solder lug (don't cut the inside coil winding; you can't unwrap wire from the inside!). Unwrap three layers of wire. A layer is about 40 turns of wire. After the third layer is unwound, leave about two inches of wire and cut off the extra wire. Now sand the wire to remove the painted enamel insulation, and put it through the solder lug. Wrap the remainder around the solder lug. Replace the coil and solder the wire in place on the solder lug.

*Lifting the pop bumper off the playfield.  
Note the chipped bumper skirt.*

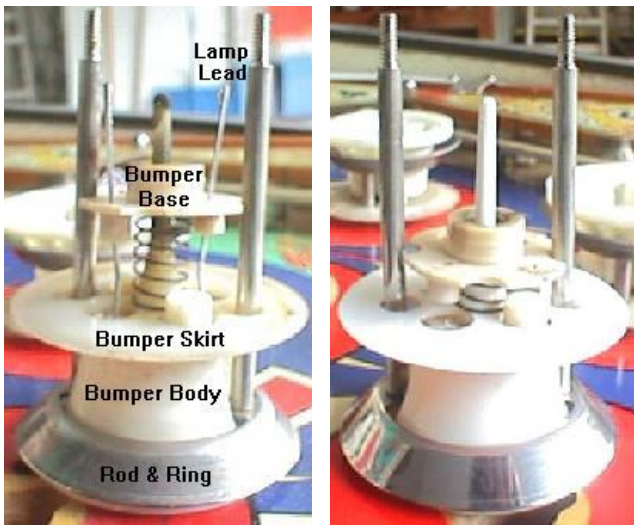


### Trim Platters.

Gottlieb games after 1965 have round mylar (clear plastic film) "trim platters" that protect the pop bumper area. Remove the mylar and clean the glue off the playfield with Goo Gone. Clean the playfield with Novus#2. At this point you can replace or add the clear trim platters, but I wouldn't unless there's excessive wear.

Note trim platters come two ways: adhesive backed, and non-adhesive. I personally like the adhesive backed units. They don't shift or move, and dirt doesn't get under them. Also, the non-adhesive trim platters can actually contribute to pop bumper wear. As the ball skates across the platter, they shift slightly on the playfield. The shifting of the platter can cause wear, hence defeating their purpose.

*The parts of a pop bumper. The picture on the left was take before cleaning. The picture on the right was take after cleaning the body, replacing the skirt, and polishing the ring. Use these pictures for reference when re-assembling. Note the orientation of the bumper base in these photos; the two lamp lead holes have extents. These extents do not line up on top of the bumper body's extents.*



Clean the bumper body with Novus#2. Replace if cracked or damaged (bumper bodies aren't expensive). Sometimes the bumper base will break off inside the bumper body when you are separating the parts. Replace as needed. Replace the bumper skirt. They are only 70 cents brand new, and look lots better, even if the old ones aren't damaged. Also install a new light socket for the pop bumper. If you game had 555 wedge type bulbs (as this game does), get #47 bayonet style sockets. The bayonet #47 light sockets sit lower in the bumper body. This prevents the bulbs from burning the back side of the bumper caps.

**Fixing Pop Bumper Playfield Wear.**

If you have excessive playfield wear around the pop bumpers, there is an easy fix. Match the playfield paint and apply it to the bottom side of a new (non-adhesive backed) trim platter. Then when the trim platter is installed, it covers the playfield wear with the same color as the playfield, shown through the clear mylar. A very clean fix without altering the playfield itself.

Left: Ready to add a new light bulb.  
 Right: The finished product.



Re-assemble from the top of the playfield. If your replacement bumper skirt has a small "tit", it goes towards the top of the playfield (it stops the ball from balancing on the top edge of the skirt). Secure the bumper body to the playfield with its two screws. Then from underneath the playfield, put the locknuts back on the rod & ring assembly. Do NOT over-tighten the rod and ring locknuts, or you will break the rod! Re-solder the light socket.

**Clean the Spoon Switch.**

If you did install new bumper skirts, the bumper switch that the new bumper skirt activates will need re-adjusted. This switch is called the "spoon" switch (because the bumper skirt's "penis" rides inside its spoon-like receptical). But before you do that, remove that entire spoon switch assembly from the game. Note the crud that lives inside the "spoon". This accumulates from (wrongly) lubricating the spoon. Clean the crud out with alcohol and leave this DRY (though some people say to lub the spoon with white grease, I disagree, as it will only attract dirt). Polish the surface with 1000 grit sandpaper (or higher grit). Re-install and adjust the bumper skirt activated spoon switch.

Note if there is too much tension on the skirt's "penis" from the spoon switch, this will cause the "penis" not to center. There should be just a bit of tension, and no more. Also make sure the penis doesn't ride outside of the spoon switch too much (or the skirt switch will stick on, and lock the pop bumper coil on). You will have to move the position of the spoon switch to adjust this.

For a final touch, install new pop bumper caps (if available for your game). At \$5 each, they really make your game look sharp. Save your original pop bumper caps.

### 3c. The Mechanics: Performance Tips

*Installing a new coil sleeve on the slingshot kicker.*



#### **Replacing Coil Sleeves.**

If you haven't replaced any coil sleeves, now is the time to do that. You only need to do this on things that will make a difference in game play. This includes the slingshot kickers and the pop bumpers (if you didn't replace the sleeves when you rebuild them). Replacing the coil sleeve on other coils that don't impact game play is a waste of time and money.

On the slingshot kicker or pop bumpers underneath the playfield, you'll need to remove the two screws that hold the coil bracket in place. This will allow you to remove the coil and replace the coil sleeve.

If your game uses metal coil sleeves, these definitely need to be replaced with new nylon coil sleeves!

#### **Polish the Pop Bumper Rod and Ring.**

As discussed in the above [rebuilding the pop bumpers](#) section, the pop bumper ring needs to be polished. Even new rod and ring assemblies need polished! When rebuilding the pop bumpers, buff the part of the pop bumper metal ring that contacts the ball. It should be as smooth and shiny as a mirror to reduce friction. This allows more of the pop bumper's energy to be transferred to the ball.

*A new rebound rubber with an added mini-flipper rubber.*



#### **Increase Playfield Slope.**

As simple as this seems, if you increase the angle of your pinball machine, it will play faster! Try moving your two inch rear leg levelers up all the way. Then put your front leg levelers down all the way (or remove them!). If your playfield is clean and waxed, this will increase ball speed dramatically.

#### **Make sure your Flipper Return Spring is not Over-wound.**

This happens a lot. Unfortunately, sometimes it is done on purpose to try to "fix" a flipper that stays up when the button is released. (On an otherwise clean, adjusted flipper, this kind of sticking occurs because of a magnetized coil stop. The only real cure for this is to replace the coil stop.) With a properly adjusted flipper return spring, there will be only the weakest of return pressure on the flipper linkage. You will know you have it right if the flippers just BARELY swing to their at-rest position when you raise the playfield up. The weight of the flipper bats causes them to be sluggish, which should give you an idea of how weak the return springs really are when properly adjusted.

#### **Clean and Adjusted EOS Flipper Switches.**

If the EOS switch or cabinet switch contacts are dirty or pitted, they will have some resistance that will make the flippers weaker. Clean the EOS switch contacts and adjust them. EOS switches should be solidly closed and open about 1/8", only at the very end of flipper travel. When you check EOS adjustment, operate the flipper by pushing the plunger into the coil until it hits the stop. Don't just rotate the flipper bat or push on the linkage because slop in the linkage will keep you from getting an accurate adjustment. After adjustment, be sure that the EOS switches really do open when the flipper is energized. If they stay closed, the flipper coil will burn out. If the flipper still seems really weak, look for cold or broken solder joints on the wires at the EOS switch and where they attach to the coil. While you're at it, clean the flipper button contacts too. Note you should use a metal file for cleaning these switch contacts, since they are tungsten and won't file well with a flexstone.

Also check the wires going from the flipper coil to the EOS switches. They should be stranded wire, not a solid core wire. If it is solid core (very common on Williams games), replace it with a good quality stranded wire. Solid core wires can easily break internally, making the flippers weak.

#### **Rebuild the Flippers and Hi-Power Flipper Coils.**

Previously discussed in [rebuilding the flippers](#). Having good, strong flippers is very important; flippers are the game's direct connection to the player! Weak flippers

will ruin any game. Rebuilding the flippers includes replacing the coil sleeve and the plunger link, and checking the old plunger for mushrooming. Hi-power Gottlieb EM flipper coils are also available from [Pinball Resource](#). These are about 20% more powerful.

#### More Powerful Pop Bumpers and Slingshots.

You can increase the power of your pop bumpers and slingshots easily by decreasing their coil resistance. The lower the resistance, the more powerful the coil. Increased power means the ball kicks around more and makes the game more lively. To do this, you'll need to remove about 10% to 20% of the coil windings from the coil (don't get greedy and try to remove more than 20%; if you get below 2 ohms the coil will become a "short" and no longer work!). This is very easy, and only takes a few minutes. I do this when I'm replacing the coil sleeve on a pop bumper. Just unwind three "layers" of wire from the coil. This will lower the coil resistance, and make the device stronger. Note you do not have to unsolder the coil from the game to do this! Here are the steps:

- Un-wrap the paper wrapping from the coil and save it.
- Cut the outside coil winding wire from the solder lug (do **not** cut the inside coil winding wire! You can't unwrap wire from the inside).
- Un-wrap three layers of wire. A layer is about 40 turns of wire.
- After the third layer is unwound, leave about two inches of wire and cut off the extra wire.
- Sand the extra two inch length of wire to remove the painted enamel insulation.
- Put the two inch wire length through the solder lug hole from which you originally cut the coil winding. Wrap the remaining wire around the solder lug.
- Put the coil wrapper back on the coil, and secure it with a 1/2 inch piece of electrical tape.
- Replace the coil (if removed).
- Solder the wire lug to secure the re-attached coil winding.

I don't tend to do this modification to the slingshots on games with small flippers. The problem with really strong slingshots is the game gets a lot harder to play! The ball kicks around more, and is much harder to catch in the flippers. Not a problem for long flipper games, but short flipper games become quite difficult to control the ball. But I definitely do this modification to pop bumpers. Good strong pop bumpers makes a game much more lively and fun. Be your own judge. Start with doing the pop bumpers and see how you like it.

**Left:** Un-wrapping the coil winding from the coil. Here we're about half way through the first coil layer.

**Right:** Three layers of coil windings have now been removed. An extra two inches of wire is left, and sanded clean. Then it's inserted through the (previously cut) solder lug. The remainder will be wrapped around the solder lug, and re-soldered.



#### Re-face the Rebound Rubber.

Ever notice when you plunge the ball how "dead" the upper ball arch's round rebound rubber seems? Even a brand new rebound rubber is hard and dead. But you can re-face these rebound rubbers to give them added bounce and life. This makes the game seem much "snappier" and fun.

Just stretch a red mini-flipper rubber over the rebound rubber (don't use black mini-flipper rubbers, they are too hard). This will give instant life to an old, dead rebound rubber, or to a new rebound rubber. It is also easier to clean and replace. Mini-flipper rubbers are used on newer games like Twilight Zone and the Addams Family.

### 3d. The Mechanics: New Under-Playfield & Backbox Lamps

When replacing bulbs, it's also a good idea to clean and re-tension the light socket. The [Pinball Resource](#) has a rubber pencil-like socket cleaner that works well. I also use a set of needle nose pliers and gently squeeze and tighten the sides of the lamp socket after removing the bulb. This should give the socket better contact to the lamp.

Unfortunately, if a lamp socket is intermittened, or causes the bulb to light dim,

there are other problems. Lamp sockets are pressed together with an insulating fiber ring. With time, this ring shrinks, and causes the metal parts to fit loosely together. This allows air (and humidity) to get between the parts, and cause corrosion. This makes the socket either not light, or light dim. In this case, retensioning the socket and cleaning won't work. You have to replace the socket!

**Left:** Fixing sockets that refuse to work. If you can't replace a socket, you can usually fix it (except on Bally games!). First move the tabbed wire to the tip of the socket base. Then add some solder to the round tube and the base of the socket. You will need to sand these surfaces before you try and solder to them, otherwise the solder won't stick.

**Right:** Over zealous factory soldering. Sometimes the factory solders the general illumination wire for the socket so the attachment screws can't be removed. This isn't so bad on Gottlieb games, which use slot head screws. But on Williams games that use phillips head screws, if solder gets inside the phillips "x", there is no easy way to remove the attachment screw. This makes replacement very difficult.



In some cases, you can not replace the socket. Some types of sockets are no longer available. Or the existing socket just can't be removed. Often the attachment screw is soldered over, so you can't put a screw driver in the screw's slot. This makes replacement difficult!

You can fix a socket though (except on Bally games - replace them!) To do this you'll have to sand the socket area clean with sandpaper, or the solder won't stick. You can move the wire that connects to the socket's tip right to the tip itself. Then solder between the socket's mounting base and it's circular bulb receptacle.

Make sure you replace all bulbs with #47 (instead of #44) bulbs. This is especially important for the bulbs in the backbox, no exceptions! The additional heat given off by the original #44 lamps can help delaminate the paint from the backglass.

### 3e. The Mechanics: Sunken/Cupped/Low/Loose Playfield lamp Inserts

This is a very common problem, especially on older woodrail pinballs. The plastic lamp inserts in the playfield (PF) shrink in size, and become lower than the playfield playing surface. Or the inserts just fall out when the playfield is raised! If an insert is too low, this will make game play odd. Sometimes to the point where the ball will get hung up on the low insert.

On 1950s pinballs in particular, it is NECESSARY to remove ALL the playfield inserts and to reseal them. I can guarantee they are all sunken below the level of the playfield. If left alone, this will wear the playfield around the inserts, and make the game play badly. On 1960s and 1970s pin games this is less of an issue, but as time marches on, these games too will need their inserts re-seated. (I have needed to do this on games as late as the 1980s.) If you are going to touch up and clearcoat a playfield, reseal the inserts BEFORE you do any of that work.

First try and get the insert out of the playfield. Sometimes they just fall out, other times they are a bear to remove. Use a socket to gently knock the insert out from the bottom of the PF using a small rubber mallet. The reason sockets work very well is because they come in so many sizes, and you probably have a toolbox full of them. Use the largest that will fit in the insert route from under the playfield.

Do NOT force the inserts out! If they don't come out with just a few light taps of the mallet, use a hair dry from under the playfield to soften the glue, allowing the insert to come out easier. Do not use a heat gun (too hot). If you pound the insert real hard it can break the top off the insert, leaving the sides still glued in the playfield. This is fixable, but it's obviously ideal to get the insert out in one piece. The hair dryer tip works really well for this. Put the hair dryer nozzle right up against the insert from the BOTTOM of the playfield, and turn the hair dryer on "high". Feel the insert from the top of the playfield. Once warm, remove the heat and tap with the insert with the socket/mallet from the bottom of the

playfield to pop out the insert.

Sometimes inserts are "cupped". If this is the case, the top of the insert will need to be leveled before re-installing. If the insert has no text or graphics, remove the insert and block sand the top face flat (turn the insert face down on a piece of 400 grit wet/dry sand paper on a solid block and sand). If there are graphics or text on the insert, water-thin Super Glue can be added to the top in THIN layers to build it. After several layers (and the superglue is dry), turn the insert face down on a piece of 320 or 400 grit wet/dry sand paper on a solid block and sand (wet). Then move to 600 grit and finally 1200 grit, then reinstall. When you polish the playfield (Novus2) that will also polish the leveled insert. Note using heat to soften the insert and then trying to push the top of the insert up/flat really does not work. The added heat will only make the insert worse, and it usually is not correctible.

Now its time to reinstall the insert. There are two ways to go. Thick superglue (SG) around the edge of the insert, reseal, level, wipe off any excess from PF, let dry. Then (optionally) add water thin Superglue around the top-side edges of the playfield/insert to seal the insert better and permanently. Any SG that gets on the playfield should be wiped off immediately before it solidifies. Polish with Novus2 when dry. If the playfield was waxed before this process that is a good thing to some degree - the wax will prevent any excess waterthin Superglue from taking hold on the top side of the playfield as you wipe it off (but don't over-wax as wax tends to get into the gaps between the playfield and inserts, causing glue adhesion problems between the insert and playfield).

If using the Super Glue method to glue inserts, make sure the playfield is CLEAN \*before\* attempting the re-gue. Otherwise when you wipe off any excess super glue from the top of the playfield, you can accidentally "lock in" the dirt to the playfield's finish. Short of sanding, you will never get that dirt out.

The other way is to take some brown paper packing tape (like used at butcher shops, not the plastic shipping tape), and put a layer or two around the edge of the insert. Wrap the brown tape so it is slightly below the top side of the insert (so the tape won't show when the insert is installed). Trim the excess tape on the bottom side of the insert with a razor blade. Wrap enough tape around the insert so it fits snug into the playfield. Then remove the insert and put yellow carpenter's glue around the PF hole, install the insert and level it. Work some carpenter's glue into the insert/playfield edges from the top side of the PF, and check the levelness again. Wipe up extra glue with a wet rag, let it dry overnight.

The second method is less caustic and reversible. It's also easier for the newbie, but both methods work well.

In regards to leveling the insert. I like to use a piece of plastic acrylic that is larger than the insert. Lay this on the top side of the PF. Push the insert up from the bottom side of the PF while keeping pressure on the acrylic plastic on the top side. This should make the insert level.

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## 4a. The Playfield: Under the Ball Arches

*The lower ball arch removed. Note the dirt. The black oval metal is the ball viewer.*



The ball arches are the metal decorative panels that covers the top and bottom portions of the playfield. From years of use, there lurks much dirt under the arches. Remove them and clean the playfield with Novus#2. Don't clean the painted arches with Novus though. Instead use Windex or 409. The arches are painted with a "splatter" type paint that has no clear coat. Novus may remove this splatter paint.

While you have the lower ball arch off, clean and buff the ball deflector and stick protector. These are the two metal items in the ball shooter lane. Also replace the two light bulbs that illuminate the coin slots.

*New ball trough sticker installed and cut for the ball four and five switch.*



It's also a nice touch to install a new ball number decal in the ball trough. This is easy when the lower ball arch is already removed. Just remove the black "viewer" metal too, and clean the bottom of the ball trough. Then apply the new sticker (available from the Pinball Resource). You'll have to cut at least two of the numbers with an exacto knife for the ball trough switches (in this case balls four and five).

*The upper ball arch with the top cover removed. The metal runway shield is shown at the lower right.*



The upper ball arch has a top arch that is painted, two spacer struts, and a middle section that is nickel plated. After removing all the screws and the top section, take the light bulbs and tinted barrels out. Then you can slide the middle section out from the back. Buff the nickel section with Novus#3 by hand, or use your buffer. Clean the playfield with Novus#2. When re-assembling, don't install the new #47 lights and the tinted covers till after the middle arch is in place. Don't forget to buff the metal runway shield on the upper part of the shooter lane too. And now is a good time to replace the rebound rubber donut.

#### **Top Ball Arch Wear.**

Excessive top ball arch wear (from the ball being served from the shooter lane) can cause the ball to "hang" in the worn ball groove. There are a couple of things you can do. The easiest is to elongate the holes in the top ball arch metal about 1/16", and shift the whole arch towards the coin door 1/16". This will give the ball a new area to ride on.

Another alternative is to take some 600 grit wet/dry sandpaper and smooth the groove. Then follow up with (Novus#3 optional and then) Novus#2. This works very well if the groove isn't too worn or dirty. If the groove is excessively worn, you'll have to take this a step further. Sand the groove smooth with 150 grit, then 220, then 400 grit. Do it only enough to remove the groove and any ground-in playfield dirt. Now the new 'fresh' wood will be much lighter in color than the lacquered wood. Re-coat the area with clear spray acrylic lacquer, feathering it in to the surrounding lacquer. Spray lacquer is available at any decent hardware store or Home Depot. Don't go nuts and spray a ton, just enough to cover. The bare wood color should blend in nicely with the surrounding areas. After drying, lightly sand with 600 grit, than polish with Novus2.

#### **Sharp Edges on the Upper Ball Arch.**

While the upper ball arch is off, check the area the ball hits and rides. Often the force that the ball hits this metal runway will mushroom the ball arch on the lower side. This causes a SHARP metal lip on the bottom edge. With the arch is off, use a metal file and file this lip smooth. Otherwise when you clean the playfield after the game is assembled, you can cut your hand on this sharp lip.

## **4b. The Playfield: Cleaning the Playfield with Magic Eraser (Melamine Foam)**

A product released in 2004 under the "Mr.Clean" brand name called Magic Eraser is making quite a stir in playfield cleaning. Magic Eraser, or "ME" as some people call it, is a new idea in playfield cleaning.

#### **"Ball Swirls".**

One of the big problems on EM pingames are "ball swirl" marks. These are largely found in front of slingshots, flippers, and pop bumpers. They are cracks in the lacquer finish from the kicking solenoid forcing the pinball down hard on the finish. It leaves a 1/16" diameter circle crack in the finish. That in itself is not a huge problem, as the cracks are very small and hard to see. But as time marches on, the cracks fill with black solenoid dust, making the ball swirl circles very very noticable and quite ugly. All conventional methods of cleaning (Novus2, Millwax, heck even sanding!) will not remove the black solenoid dust from the circle cracks. Some people have even sanded the marks with 600 grit sandpaper, and the only way the black swirl marks disappear is when the finish is completely sanded off the playfield!

### Introducing Magic Eraser (Melamine Foam).

For years there has been no effective way to make these black swirl marks disappear. Until the release of Mr. Clean's Magic Eraser. From their web site: "Mr. Clean Magic Eraser is a soft cleaning pad that acts just like an eraser. It's an innovative cleaning material that gets into grooves where dirt and grime are trapped. You'll be amazed how easily Mr. Clean Magic Eraser breaks up tough dirt, lifting it away from surfaces. And it does all this with just water alone. It's simple and easy to use—no fumes, gloves, buckets, or chemicals required."

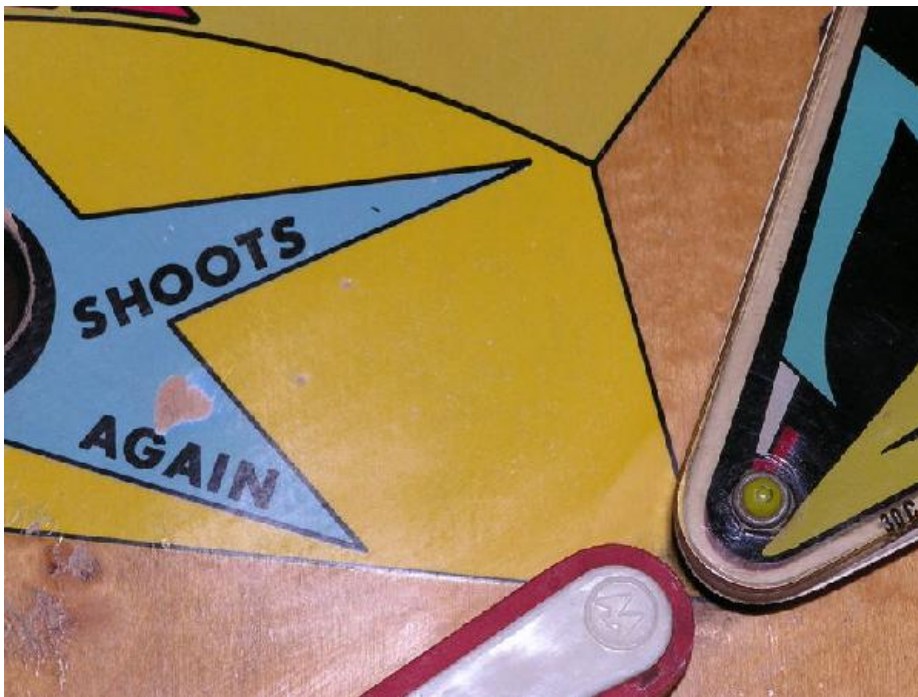
Magic Eraser is actually Melamine Foam (MF), which is a very soft yet firm and dense foam used for sound proofing. It is *\*not\** treated with any chemical (notice there are no chemical warnings on the Magic Eraser box). A wetting agent is needed with the foam (water or alcohol). Melamine foam is structured with infinitesimal fiber material that enables it to scrub off stains and dirt without causing any chemical reaction. Since there is no chemical reaction associated with the Melamine foam, it's cleaning power is due to its characteristic of infinitesimal fiber material within the foam. It is able to penetrate the stained area and scrape them out. A regular sponge with chemicals will not be able to show the same results because it can not penetrate a stained spot as deeply & detailed as Melamine foam. Also, because regular cleansers or detergents are in liquid form, they have limits to penetrate an area. The limitation herein meaning the surface tension. A sponge's less dense composition only allows it to wipe at the surface, and often harsh chemicals are needed to scrub out stains. A regular sponge or scrubber is formed with large fiber material compared to Melamine foam, therefore, making it very difficult to have direct contact with contaminant spot or area. Lastly, Melamine foam is environment-friendly and not harmful to humans.

Playfield before using MF. Notice the dirty "ball swirls". The white haze at the lower left corner is the by-product of using MF and alcohol. Novus2 removes this and gives the shine. Pic by Chris.



Playfield after using MF and Novus2. Notice the small portion of playfield wear in the blue star is slightly bigger now. Remember MF can remove finish, so be careful! Pic by Chris.





### Using Melamine Foam (MF) on a Playfield.

The properties of Melamine foam make it excellent for cleaning playfields. The procedure is pretty simple: clean the playfield as you would normally with Novus2 or another similar cleaner. Just get the dirt off best you can, don't try and go too nuts and totally polish the surface. Some people even use Mean Green for this task, but it's liquid form is not suggested for older EM playfield. Others uses straight Naptha as an initial cleaner, which works well and won't raise wood grain. The idea here is to remove all the top surface dirt, showing what areas need the MF.

Now get a Mr. Clean Magic Eraser (ME) or similar Melamine Foam (MF) product. Note there are cheaper alternatives available than Magic Eraser. Melamine foam is available in larger sheets that can be bought less expensively. The foam cuts very easily (like butter!) with any sharp knife or razor blade. A two inch square of foam 1" thick seems to work well for this task (the Magic Erasers come in 5" x 2.5" x 1" pads, so cut it into smaller pads). Also get some alcohol at the local grocery. It doesn't really matter what type, just the cheapest. I personally use 92% Isopropyl Rubbing Alcohol (the lower the percent, the more water in the alcohol). Alternatively you can use Naptha. Do *\*not\** use straight water with MF as water and pinball playfields do not go together (water is grain raising and can damage the playfield). Alcohol and Naptha do not have wood grain-raising properties, and evaporates quickly preventing any wet damage to the playfield.

Wet the MF pad with the alcohol (or Naptha). The pad needs to be damp but not soaking wet. Now scrub a small 2" square area. Go slowly. If you scrub too long or too hard you CAN take up the playfield finish! Wipe the area with a paper towel often as you go, checking your progress. The MF pad will change "feel" - if the MF pad gets a sandpaper feel stop and examine the playfield and possibly change to a new MF pad. Remember the enemy of good is better - if you scrub too long you may remove the playfield finish. The MF pad will turn gray and will reduce in size. It will disappear fairly quickly, and this is normal. Just use another MF square pad when the current one is no longer usable, or when the MF pad feels gritty.

A white haze will result from the MF cleaning. To finish off the process and to remove the haze, use Novus2 and a small rag to polish the freshly MF cleaned area. Naptha also works well to remove the haze (but does not polish).

Results vary depending on the playfield, but very often black swirl marks or stubborn dirt will clean up quite well. The round playfield cracks will still be there, but the black solenoid dust should be gone, making the swirl cracks nearly impossible to see. Because the swirl cracks are still there, some protection should be applied over the freshly cleaned area. Mylar or a clearcoat is best, but wax works too. But since the game is now "home use", it will take many years of play for the marks to look bad again, so some people do nothing to protect the cleaned area. I recommend a clearcoat to preserve the finish, but that choice is obviously yours.

Melamine Foam works great on the upper ball arch area of the playfield, around pop bumpers, in front of slingshots, and in the ball shooter lane. Its a great step in cleaning because minimal sanding and no harsh chemicals are used in the process. But be careful! MF does can remove playfield finish, so go slowly and check your progress (MF is similar to using a 2000 grit sandpaper). If the playfield finish is being compromised, STOP! Remember results really vary with MF. Some playfields clean up perfectly. But others won't react to MF cleaning much at all. I have even heard of people using MF and alcohol to remove mylar glue (after the mylar is removed from a playfield using the Freeze Spray method). The MF pads can be trimmed with a knife after drying to remove the dried mylar glue, and the skinnier pad reused.

### Melamine Foam (ME) Warning!

MF is basically like sanding your playfield with 2000 grit sandpaper. This is why I don't suggest you just go nuts and do the entire playfield with it, unless the playfield is really dirty. A good idea is to first use Novus2 (or just Naptha) to clean off as much initial dirt as possible. Now see what areas need MF, and only do those areas. On older lacquer playfields, it doesn't take much sanding with anything (much less 2000 sandpaper) before the clearcoat is gone, and the playfield's graphics are destroyed. So be conservative with MF/ME and go slowly. Remember it is very easy to go too far with the foam. And once you are removing playfield ink, there's no going back. "The enemy of good is better", is something to keep in mind.

## 4c. The Playfield: Cleaning the Playfield & Replacing Rubber

Cleaning the playfield and replacing the rubber has to be the most rewarding part of a restoration project. Many people take a systematic approach to this: they completely strip the playfield of ALL parts, clean the parts, then re-assemble. I however don't like this method; I just can't remember where everything goes!

Instead, I prefer to clean the playfield a section at a time. For example, start with the right flipper and associated parts first. The advantage to this is not having to remember where parts go; if the playfield is symmetrical, use the other side of the playfield for comparison.

*The playfield and rubber before starting. This section is next to the right flipper.*



First disassemble the area to be cleaned. Take off as much as you feel comfortable. This should include all plastics and posts. Throw out the old rubber. If there are lane guides (as shown here), use a putty knife or a small screw driver to lift them off the playfield.

*Removing the playfield parts to reveal the dirt. Shown removing a lane guide. The small red metal lane posts simply unscrew from the playfield. Usually you can do that with your fingers. Be careful, the red anodized coating scratches easily.*



Now use Novus#2 and a rag to clean the playfield. It will remove the dirt and leave a nice shine. In really dirty areas, you may have to use some "elbow grease".

Be careful around the "one way" rollover switches and lane guide posts. One way rollovers are designed for the ball to just go one way, and are bent up to a point. Lane guide posts are metal pins that keep the guides in place. If you use a up and back motion to your cleaning, the points on these objects can go right through your rag is stick in your finger! It happens to me a lot, and it hurts. Also clean the playfield switch contacts now with your flexstone.

*Cleaning the playfield with Novus#2. Note the one way roll over switches and lane guide posts. Be careful cleaning around them! Note the shiny clean playfield switch contacts. Also note the two holes available for the left most playfield post. Using the left hole would be the "liberal" setting. Using the right hole would be the "conservative" setting. Personally I always use the liberal setting to increase ball time. Apparently the previous owner didn't feel the same.*



If your game has nickel plated jeweled metal posts (as this game does), you will need to buff them. Use your buffer or Novus#3 and hand buff. Clean the plastic parts with Windex or 409. Don't use Novus#2 on the painted side of the plastic. Otherwise Novus#2 is good on plastic posts and lane guides.

After cleaning and before re-assembly, wax your playfield. Trewax or a hard automotive wax such as Meguires carnauba wax works well.

Clean the light socket with your rubber pencil-like socket cleaner. Install new #47 light bulbs. Power the game on and make sure the new lamp is working properly, then turn the game off.

Be aware that some playfield posts have two holes (positions) available. The "liberal" position will allow the ball to stay in play longer or make it easier to achieve a particular target. I tend to position all posts in the liberal setting.

Before installing the rubber, wash your hands. Then re-assemble with new rubber. If you get the rubber dirty while assembling, something isn't clean! Re-evaluate your job. You can get the smudge off the new rubber with some Novus#2 and a CLEAN rag. Make sure you only install new **white** rubber. Black rubber is for 1995 and newer electronic pinballs only. It bounces less and looks bad on EM games.

After the new rubber is on, adjust the playfield switch contacts. I like to make them fairly close so light ball action will score points.

*The finished product, with new rubber, light bulb, and buffed posts.*



Step back and admire your work. Sure looks good, doesn't it? Now attack the next part of the playfield.



- \* Go to [Pinball Restoration Guide, Part One](#)
- \* Go to [Pinball Restoration Guide, Part Two](#)
- \* Return to the [Pin Fix-It Index](#)

\* Return to [Marvin's Marvelous Mechanical Museum](#)