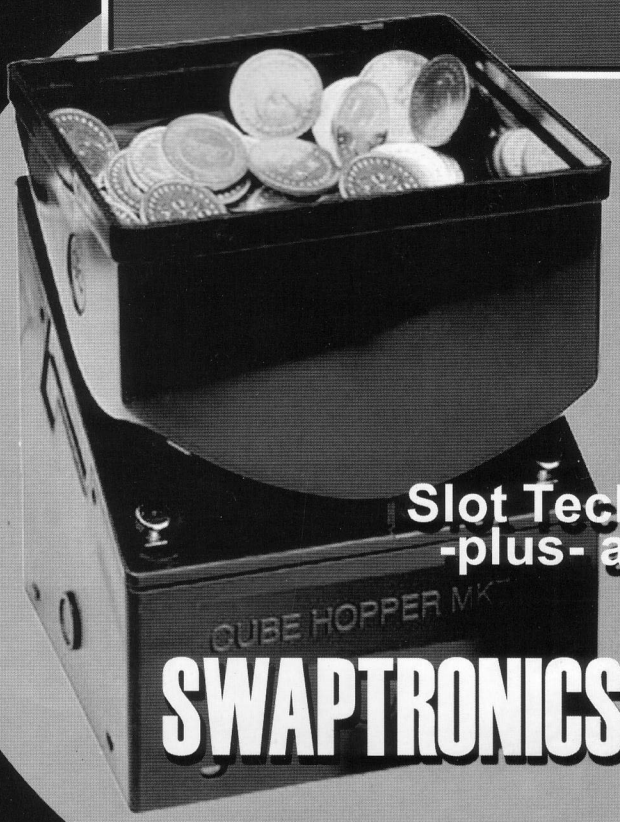
# SLOT TECH MAGAZINE

Repair and Maintenance Information for Slot Machine Technicians



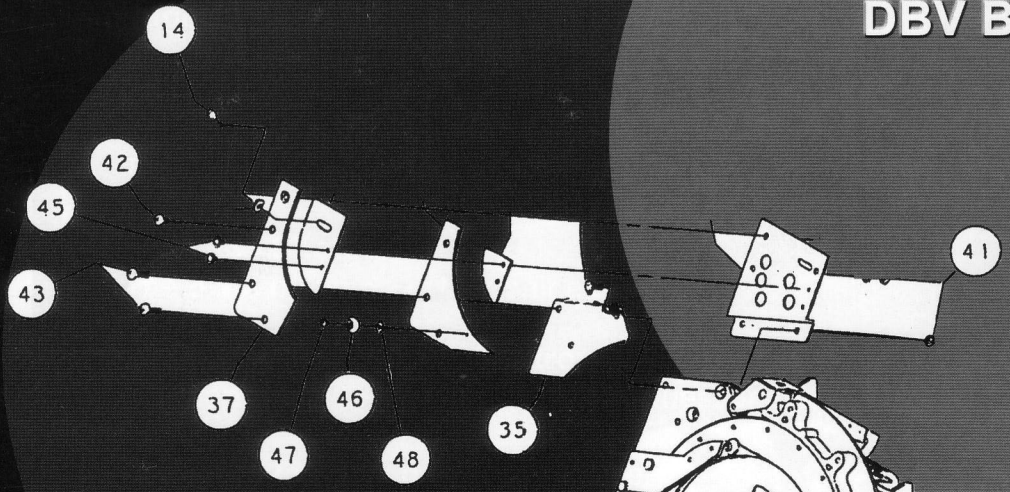

## HOPPER CHAOS

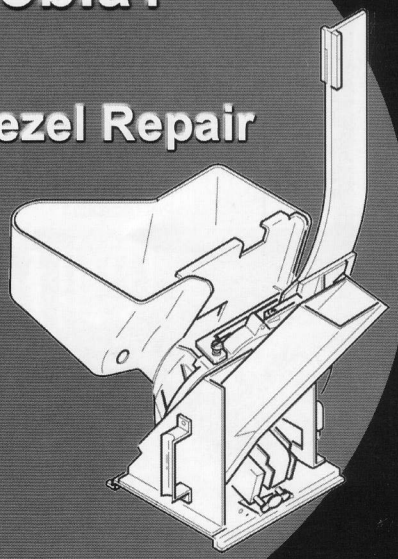
Slot Tech Magazine Visits Asahi Seiko
-plus- an escalator update you'll love

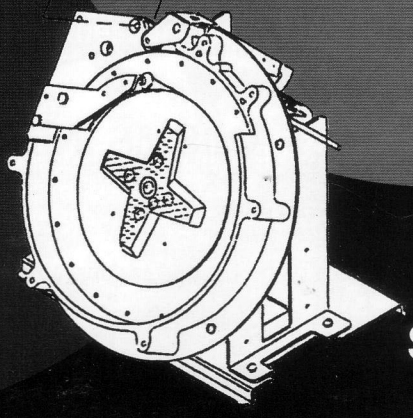
## SWAPTRONICS IGNITES CONTROVERSY!

Industry Xenophobia?

DBV Bezel Repair





September, 2001

$10.00

Slot Tech Magazine

September, 2001

# Slot Tech Editorial

Welcome to the Official TechFest, 2001 issue of Slot Tech Magazine. This historic event, held the last three days of August in Las Vegas, Nevada, ushers in the premier offering of the September issue.

Speaking of Las Vegas, just down the street from Happ Controls (the location for TechFest, 2001) are a large number of gaming companies. Within a mile or so, you'll find companies such as ShuffleMaster, AC Coin & Slot, IGT, JCM and the subject of this month's photo essay, Asahi Seiko. Take a peak inside on page 3.

As promised, IGT's Ken Locke is back with the second part of his presentation on slot machine reels and PAR sheets. This time, Ken shows us how the stepper motors themselves work. See Way Above Par, beginning on page 4.

Dion Anderson is the lead tech at Circus-Circus in Reno, Nevada. He presents us with a mixed bag of observations on many different machines. Dion's Corner begins on page 7

It's a small, flat disc with two leads coming out of the bottom. It's kind of orange colored and it tests completely shorted when it's ***good.*** What is it? See Poly Fuses, beginning on page 8.

Ok, Ok . . . So we keep running articles about hoppers and hopper maintenance. Could they possibly be ***that*** failure-prone? Can you say "Job Security?" I thought you could. Turn to page 12 for more Hopper Chaos.

Slot Tech columnist Bart Holden finally got his hands on a fancy-schmancy new digital camera. He puts it to good use this month in his outstanding, illustrated guide to DBV bezel repair for IGT S Plus machines. Turn to page 16 and let the lights shine.

WMS Gaming has stuffed some of their new machines with Kristel monitors. Slot Tech Magazine's own Mike Thomas introduces this Midwest monitor manufacturer, beginning on page 20

Almost as if we planned it (we didn't) Pete Bachran picks up where Bart Holden left off with his article on JCM bill validator repair for the floor tech. Fresh from his appearance on the Discovery Channel, you'll find Pete's contribution on page 22.

A beginning tech often will lack the troubleshooting skills needed to track down faults the "right" way through signal injection or waveform analysis. Heck, there are lots of techs that don't even know what those terms mean! That's okay because there's another approach to repair called "shotgun." Grab your 12 gauge and turn to page 25.

Slot Techs (and electronic technicians in general) seem to be a highly opinionated bunch. For some, THEIR way is the RIGHT way and they won't hear of anything else. Others (Slot Tech readers included, hopefully) are open to considering many different approaches to repair. When someone in my shop called out "Hey! You guys wanna see something interesting?" we all dashed over to our co-worker's bench to see what had been found and how we could all learn from it.

**Randy Fromm**

You may disagree with some of the approaches to repair that are presented in Slot Tech Magazine. Peppermill Casino's Stephen Brown certainly did when he read Bart Holden's article on "Swaptronics." Read all about the Great Swaptronics Controversy beginning on page 28.

About once a week, I get a telephone call or an e-mail from someone that already knows about electronics and has been unsuccessful in trying to break into the gaming industry as a slot tech or engineer. For the most part, these people have gotten the cold shoulder from casinos and from the game manufacturers. It's like some perverse catch 22. You can't get a job in gaming without industry experience and you can't gain industry experience because nobody will hire you without it.

This fear of outsiders has a name. It's called **xenophobia** and it's not healthy. It's not healthy in society and it's not healthy in industry. Every time the gaming industry has opened up to outsiders, the results have been nothing short of extraordinary. Witness the accomplishments of Si Redd and Joe Kaminkow and what just these two gentlemen have meant to powerhouse manufacturer IGT when they made the move from amusements to gaming and tell me that it ain't good to welcome outsiders.

With that in mind, Slot Tech Magazine presents one man's quest to break into the gaming industry. Read the story of Jim Ellis' pursuit of Truth, Justice and a job in Gaming in "Life is a Game of Chance" beginning on page 32.

That's all for this month. See you at the Casino.

Randy Fromm

**Randy Fromm**


**Randy Fromm's**
**Slot Tech Magazine**

**Editor**
Randy Fromm
**Technical Writers**
Dion Anderson
Pete Bachran
John Green
Bart Holden
Chris Hunt
Kinger!
Ken Locke
Herschel W. Peeler
Frank Sutter
Michael Thomas
**Advertising Manager**
Dennis Sable

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Slot Tech Magazine
1944 Falmouth Dr.
El Cajon, CA 92020-2827
tel.619.593.6131
fax.619.593.6132
e-mail
editor@slot-techs.com
Visit the website at
slot-techs.com

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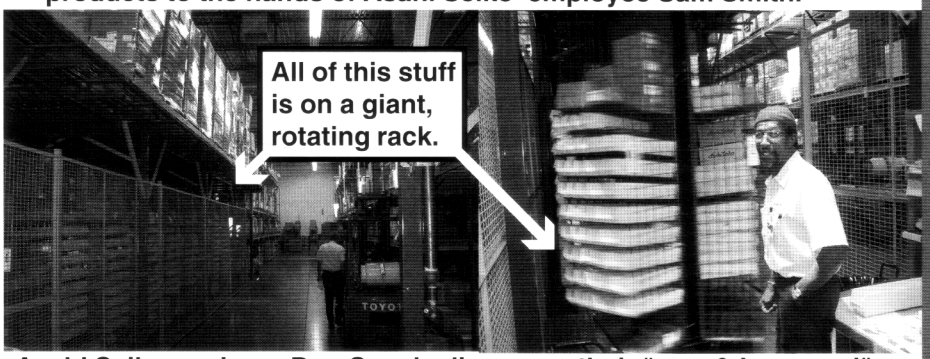
# Slot Tech Magazine Visits Asahi Seiko


Asahi Seiko's wide range of products is displayed in their office showroom. Below, the vast storage system rotates to deliver products to the hands of Asahi Seiko employee Sam Smith.

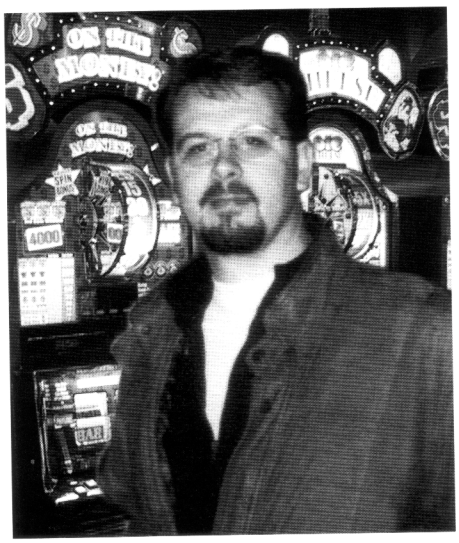



Asahi Seiko engineer Don Seagle discusses their "new & Improved" escalator design, available as a retrofit for Bally hoppers. By inverting the curve, coins travel upward with full support on the backside.


Bo Pheng works in the spotless assembly plant.

# Way Above PAR

**By Ken Locke**



"Turn this machine off! Call Gaming Control and get this patron a drink!" Smell that? Snnifff, Snif. Slot Director panic. It has a distinct odor, sort of a cross between hair gel and burnt popcorn. Eliminating this stank is usually dependant on your expertise. It's a little known scientific fact that dogs and bees can smell fear. Now, you, young Jedi, must develop this ability as well.

In part one of this series we concluded that an intimate knowledge of a PAR sheet is essential to proper game function. Reel strips, glass, software and documentation must come together in perfect concert. But like Lucas and Spielberg, I have just got to have a sequel.

First let's understand a typical stepper motor. The first thing that you notice about a stepper motor is that it has more than two wires leading into it. A typical reel motor will have four. When you manually rotate the shaft you should feel a cogging sensation as if the bearings in the motor are faulty. In the simplest sense the interior of a stepper motor looks like Illustration 1.

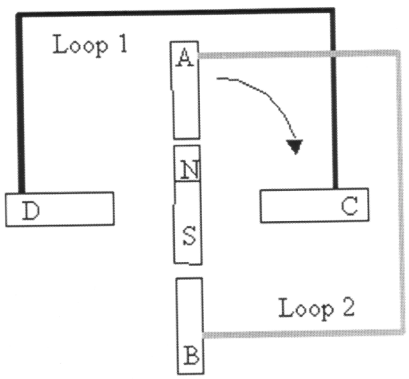



Illustration #1

Now to get the rotor to turn. If we remove the voltage from the second loop and apply it to the first loop, pole pieces A and B will have no magnetic attraction and pole pieces C and D will have.

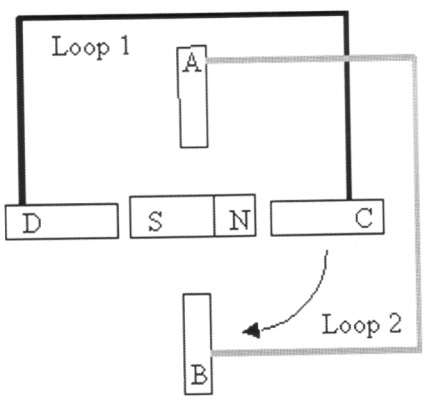



Illustration #2

We will assume that pole piece C will go South and D will go North. You can see how the magnet will take up a new position and be rotated 90 degrees clockwise.

This is a very crude movement but at least it has moved and will now hold this position. To obtain further clockwise movement we remove the voltage from the first coil and reapply it to the second coil but this time in the reverse direction such that pole piece A is North and D is South

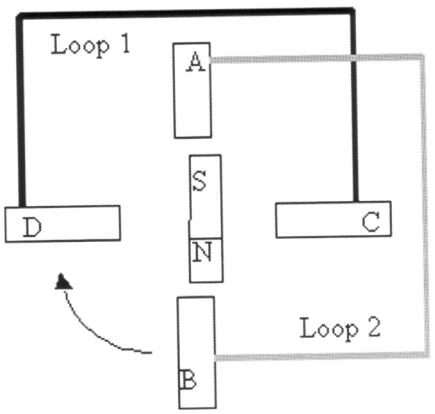



Illustration #3

The magnet rotates a further 90 degrees. To get it to move again we remove the voltage from the second coil and reapply it to the first, again in a reverse direction to when it was originally applied

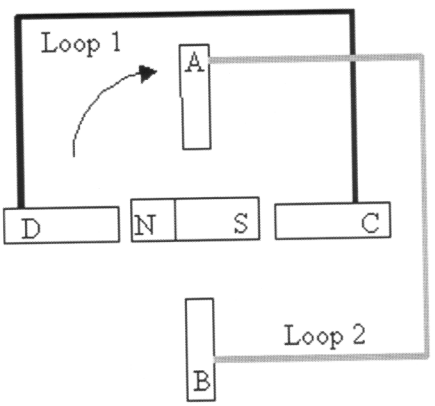



Illustration #4

This time pole piece C will be North and D will be South. Again another 90-degree movement. To arrive back at where we started we remove the voltage from the first coil and reapply it the second coil in a direction such that pole piece A is South and D is North.

To obtain another rotation we repeat the sequence. This has given us a clockwise rotation. Don't forget those Haywire machines. They rotate in the opposite direction. How do we get that to happen? Simple. We remove the voltage from the second loop and reapply it to the first but in this case in the opposite direction such that pole piece C is North and D is South. Illustration 5 shows the counterclockwise sequence.

You can see that we have set up a rotating sequence in the electromagnet that the rotating rotor magnet follows around. We have to be careful that the load attached to the shaft is not so high as to not allow the rotor to move. This could be because the load is too high or that the voltage applied to the coils is not strong enough. If this happens there will be a tendency for the shaft to just move back and forwards and the controller that is providing the driving sequence will lose positional information. It will think that the rotor is in a position other than where it actually is.

To verify that the reel is where it is supposed to be, manufacturers employ the use of encoder flags and timing optics (see illustration #6) on the inner hub of reel basket that can translate to the processor the precise position of the reel assembly.

The rate at which the driving sequence is applied to the motor is also critical, particularly when accelerating and decelerating. There is a certain amount of rotor and load inertia that needs to be overcome and it is important that the rotor not be accelerated too quickly. Decelerating is a reversal of this.

Our example is what's known as a full step and there are four steps per revolution. If we were to go to a half step sequence we could obtain twice as many steps per revolution of 45-degree steps.

Reel motors are full step with eight stationary magnets or stators with 45 degrees each and a rotor with six distinct poles with 60 degrees each. Using the principle of a Vernier mechanism the actual movement of the rotor for each step would be 60 - 45 = 15 degrees. A full 360 degree turn divided by 15 = 24 steps. If you recall last month we established 22 physical stops on a reel strip. So, we have enough steps with two left over.

On to the Reel Strip and Paytable test. This may be the most critical thing a slot technician can learn.

In days of yore, all you needed was go to Test 4 and 5 on an S-Plus. Most of you have your hand-dandy diagnostic cards to walk through this process. But, have you noticed that with newer firmware releases, not everything on the cards is on the display, and vice-versa? To eliminate confusion, use the appropriate Program Summary Report for your particular game set.

Today's reel-spinners are a bit more sophisticated, but luckily more tech friendly. Because the newest reel spinners are more graphic, we can dispense with quick reference cards

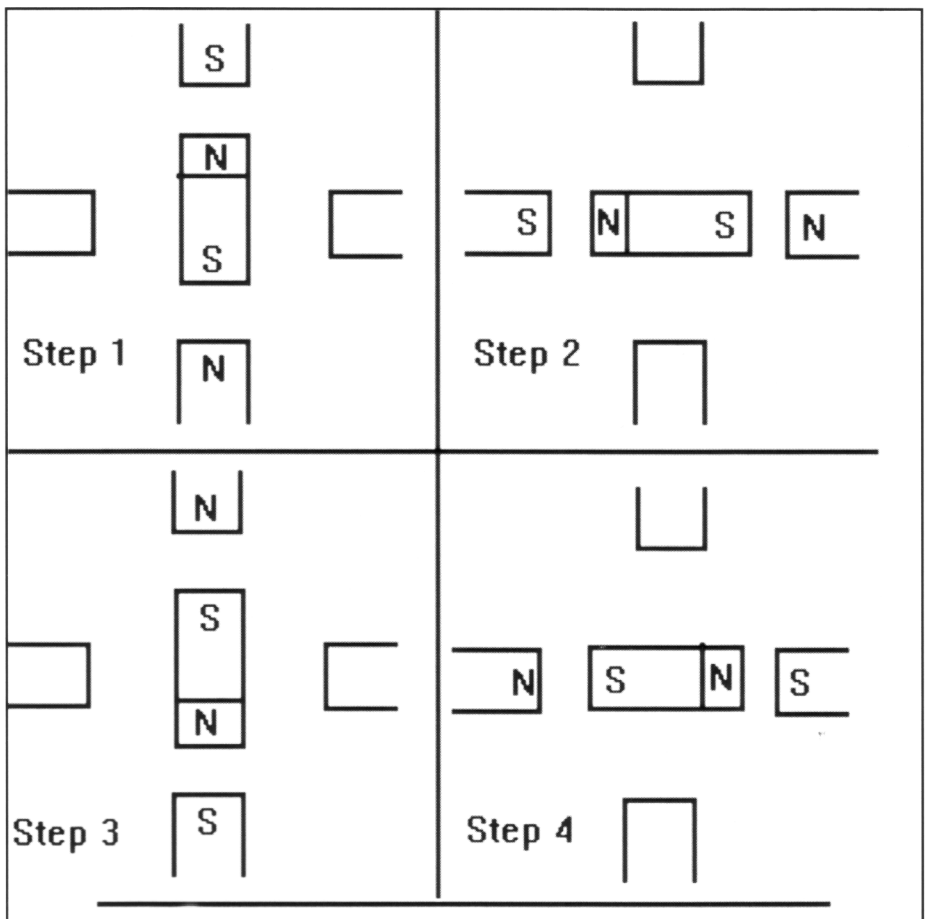



**Illustration #5 - A full step counter-clockwise**

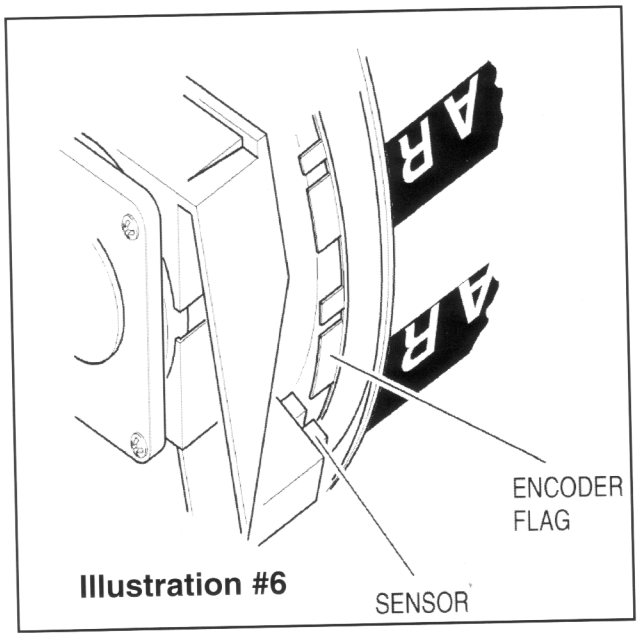


**Illustration #6**

and convoluted codes. In truth, nowadays they're simply labeled *Game Tests*.

Rather than insult your intelligence (as you know slot techs are at the top of the gaming food chain), I won't bog you down with step-by-step details of this operation. Quite simply get your PAR sheet out, refer to the Physical and Virtual reel strip listing and go for it.

In the last month's Slot Tech Magazine, I promised to reveal something that only the very best of you know about. Well here 'tis.

Your job title is "technician" and not "mechanic" for a reason. You work in technology, and as such your horizon is expanding exponentially all the time. On that horizon are things like, player tracking and ticket-in/ticket-out systems.

The performance of any given machine is constantly being evaluated by some very slick software. But fear not. You are a long way from being replaced. More to the point these new systems can't live without you. These applications ask for tons of data about your gaming floor; machine type, manufacturer, denomination, theoretical data, locale and meters just to name a few.

How do you fit in? If you recall, we called a PAR sheet a legal document. It is what the manufacturer claims is the theoretical performance of the machine. The newest slot performance software will compare this with the actual performance of the machine. Those who manage these systems may be calling on you for this data. Properly enrolling these machines into a particular system will make or break the performance of the floor.

Another thing to watch for is the new multi-denomination machines. Get ready for some new terminology. Here comes Multidenom and Multi-Denom Plus. Stay with me, this get weird

We're all accustomed to Fixed Denomination, allowing the operator to set one player credit value. These machines report meter information on accounting software in units of player credits. In other words, a quarter machine tells the system to divide by twenty-five to make the books report dollars and cents.

Multi-Denom machines, usually associated with new ticket-out machines, hold up to thirteen operator selectable credit options between .01 cent and $25. These units always report meters in terms of pennies. As such, the host account system must "see" them as all penny machines, even though nickels or quarters may be dispensed from the machines. In short, if you tell an accounting system that these machines are something other than penny games, it screws up the house's meters big time.

Multi-Denom Plus has a subtle difference. A machine becomes "Plus" by being a hopper only machine. There is a Nevada rule that hopper-based gaming machines may not be configured such that the player could be forced to wait for a hand-pay in order to cash out an amount less than one coin. This is a good rule, since waiting for a four-cent payout would be a pain in the ass.

This rule has always been enforced on fixed denom gaming machines by not allowing tokenization. It is enforced on multi-denom by not allowing the operator to enable a player denom that is not an even multiple of the hopper denom. For instance, if the hopper denom is 25 cents one, two and five cent denoms are automatically disabled.

It is further enforced via SAS by using the hopper denom as the SAS denom, instead of one cent. Whew!

That's all for this month. I hope to hear from all of you personally. Many challenges face today's slot techs and the slot machine optioning salad bar is getting longer. Just try not to get nose prints on the sneeze guard.

- Ken Locke
Ken.Locke@igt.com

**Are you a slot tech with something to share? Join the best technical writers in the industry at Slot Tech Magazine. Visit the website at slot-techs.com for writer's guidelines.**

# Dion's Corner

## By Dion Anderson

Most of you are familiar with the Williams Cast for Cash with the LCD top box. We have had a few of them black out. Powering them up and down and trying to reset them does no good; they are dead. Instead of calling a Williams tech out to troubleshoot it, swap out the power supply board (driver board) for the LCD with a known good one.

Open the LCD and remove the cover. You will see a long rectangular board that is the one causing the black out. Check the fans in the display box also. They usually burn out and cause the board to overheat and fry something. This will save you some time and the company a service fee.

**Odyssey**

I got a variance on an Odyssey game. The report showed "no bills in." Well, at least C.D.S didn't see all the bills, anyway. When they did the drop and counted the bills from the game, they were way off from what the system had seen.

I went to the machine and checked my "bills in" meters to see if they had incremented. To begin the test, I inserted a bill. The meter did not increment. I opened the door to reboot C.D.S. I had seen this problem before. You get no coin in, game start, bills or any thing until you open the door. Then the system miraculously finds all the meter readings and they increment to where they should be.

My first thought was that there was something wrong with the Sentinel board, After changing that and finding no improvement, I replaced the SMI. I still had the same problem.

The next step was the communication board on the game itself. I changed that and the problem was still there. I did an "all clear" and every thing worked like a champ. So the moral to the story is, if you get this problem, try the "all clear" first and save yourself the frustration. After the clear you will, of course, have to set your game and denom back to wherever it was so don't forget to write it all down before you do the clear.

**Williams Hopper**

Here's a quick tip on those Williams games. In their hopper, coins often jam at the base of the escalator. Usually they get doubled-up coins. Bend that little guide at the base of the escalator where it lays flush with the coin that is going up the escalator. Give it enough room to move freely and quickly. This will keep the coins from doubling up. You might, on occasion, find a dime in your nickel hopper. If the guide is adjusted correctly, it will stop at the knife, leaving a quick and easy fix as opposed to removing the guide and unjamming the escalator. The guides do come with a pretty good-sized gap. The newer ones are a little harder to tweak but it's worth the effort to tweak them when you install them. If you can keep the floor people from bending it out it, it should run sweet for a lot longer. For those who are not to familiar with it, it is the silver, elbow looking thing with two little brass screws with a larger silver screw at the top.

**IGT Slant Tops**

A quick one on the IGT slat tops with an m-door open error message but the top door checks good. Check your bottom cabinet door. They get gooped up with drinks and won't close all the way.

**S2000**

I think that the S2000 is the best reel game on the market. You have your basic reel slot with all of the I-Game features. This makes your option set up a breeze since everything is displayed on the LCD in the door. This also can be an area where you will encounter some failures; you might come across a few that are blacked out.

Some techs are intimidated by an LCD but if you think about it, they are pretty simple as far as the display itself is concerned. When you get into an LCD (either an IGT display or a Williams top unit) you'll find that most of the components are surface-mounted chip capacitors and ICs. The board work is very challenging and the components themselves are typically OEM components that are difficult, if not impossible to locate as "off the shelf" items.

When you find an LCD blacked out, it likely will mean "swaptronics" and nine times out of ten you will end up replacing the power supply or driver board. Power supply failure is common in all types of electronic systems. And hey! During this process, you can learn quite a bit about the game and how this newer technology works. Well, until next time, keep the mind working and bring on the technology.

-Dion Anderson
danderson@slot-techs.com

# Poly Fuses

**By Herschel Peeler**

A poly fuse (Resettable Polymeric Fuse) is a component that looks somewhat like a ceramic capacitor, but is a self resetting fuse-type device. Current passing through the device increases its temperature. When the current through it exceeds a given limit, the device pops into a high resistance state, as if it were a circuit breaker. When current decreases, the poly fuse cools off and resets itself.

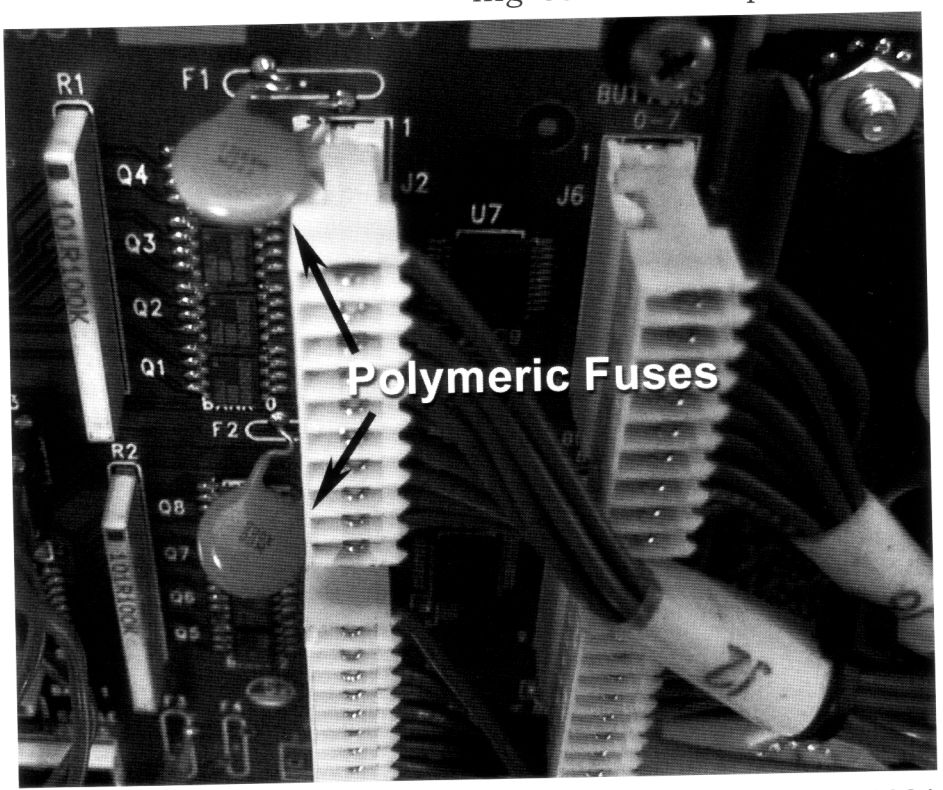
Polymeric fuses are made from a conductive plastic formed into thin sheets, with electrodes attached to either side. The conductive plastic is manufactured from a non-conductive crystalline polymer and a highly conductive carbon black. The electrodes ensure even distribution of power through the device and provide a surface for leads to be attached.

The phenomenon that allows conductive plastic materials to be used for resettable over-current protection devices is that they exhibit a very large non-linear Positive Temperature Coefficient effect when heated. What makes the polymeric conductive plastic material unique is the magnitude of its resistance increase. At a specific transition temperature, the increase in resistance is so great that it is typically expressed on a log scale.

The conductive carbon black filler material in the polymeric device is dispersed in a polymer that has a crystalline structure. The crystalline structure densely packs the carbon particles into its crystalline boundary so they are close enough together to allow current to flow through the polymer insulator via these carbon "chains."

When the conductive plastic material is at normal room temperature, there are numerous carbon chains forming conductive paths through the material. Under fault conditions, excessive current flows through the polymeric device. $I^2R$ heating causes the conductive plastic material's temperature to rise. As this self-heating continues, the polymer insulting material expands and breaks the carbon chains. Since most of them no longer conduct current, the resistance of the device increases sharply.

The material will stay hot, remaining in this high resistance state as long as the power is applied. The device will remain "latched," providing continuous protection



until the fault is cleared and the power is removed. Cooling allows the carbon chains to re-form as the polymer contracts. The resistance quickly returns to its original value.

Popular in Gaming

These have found popular use in the gaming industry to limit currents of output loads to safe values. Since operation may appear as intermittent operation, troubleshooting problems in circuits using these devices can be difficult.

When in doubt, replace the device on the output being driven, usually a coil. You should get familiar with normal resistances of coils and lamps used in the games you are responsible for. A change in 10% of the resistance of a coil is a warning of future failure. Replace it, even though it appears to work in diagnostics.

This is something to consider when making those Fill Checks. Operation may appear normal when the tech gets to the machine. Drop counts are reported to be in error but everything checks okay when you get to the game. Don't be fooled into believing that nothing is wrong. The diverter may be showing signs of overheating. If the diverter is not installed correctly, the plunger does not pull all the way into the coil. This changes the inductance of the coil, lowering its resistance, making it draw more current and overheat.

What may be happening is that when the diverter is activated, it heats up slowly. If it draws excessive current, the polyfuse kicks in, intermittently turning off the diverter. Change the coil first, making sure the plunger is fully seated into the coil when it is activated. If it still comes up on Fill Check reports, change the polyfuse for the diverter.

These are not yet available for higher voltage operation, but are available as standard products at lower voltages (below 60 Volts) from a number of manufacturers. See the below list for an example of where these devices are used.

Poly fuses are popularly used to limit current to inductive devices (Handle release coils,

Diverters, and motors). They will hold at the rated current level. See the chart below. They trip at about twice the rated current, and hold for about 4 seconds at five times the rated hold current. These are suitable replacements for slow blow fuses, but I wouldn't suggest them for limiting current to semiconductor circuits. Faster reaction time is called for.

- Herschel Peeler
hpeeler@slot-techs.com

**Where You'll Find Them**

IGT Game King Motherboard (759-044-05)
RUE400 RT1, and RT3, IGT p/n 483-042-90, Current Suppressor
RUE185 RT2, IGT p/n 483-040-90, Current Suppressor

IGT Game King Switch Panel Input / Output board (754-252-01)
RXE050 RT1 through 16, Current suppressor

Raychem (Polyswitch Resettable fuses) Original source of part.
RUE400 30 V, 4 Amp
RUE185 30 V, 1.85 Amp
RXE050 60 V, 0.5 Amp

Equal devices

Schurter
PFRA400 30 V, 4 Amp
PFRA185 30 V, 1.85 Amp
PFRA050 60 V, 0.5 Amp

Bourns (Multifuse PTC Resettable Overcurrent Protectors)
MF-R400 30 V, 4 Amp
MF-R185 30 V, 1.85 Amp
MF-R050 60 V, 0.5 Amp

Littlefuse (PTC Resettable Devices)
30R400 30 V, 4 Amp
30R185 30 V, 1.85 Amp
60R050 60 V, 0.5 Amp

Available sources: Typical cost, $0.60 to $0.85 each in small quantities.

Allied Electronics
(Any local distributor)

Digi-Key << probably the better price by a few cents. Get a catalog, if you don't have one yet.>>
701 Brooks Ave. South
Thief River Falls, MN 56701-0677
(800) 344-4539 order line, toll free
www.digikey.com

# TechFest, 2001 Sold Out!
# Plans Underway for TechFest II

Editor's Note: Wow. I am just overwhelmed by the response to TechFest, 2001. As I write this, there are still weeks to go before the event and it is booked solid. There is not a single seat left to offer. Some of you who are reading this are at TechFest right now, along with dozens and dozens of your fellow slot techs. To the best of my knowledge, this is the world's largest gathering of slot machine technicians for a three-day symposium. With your continued support, Slot Tech Magazine can continue to bring you comprehensive, reasonably priced technical training programs such as this.

Even the spacious new facilities of Happ Controls in Las Vegas could not accommodate all of the people who wanted to attend TechFest, 2001 and so TechFest II is now being planned. The sooner we have an idea of just how many would like to attend TechFest II, the sooner it can be held. It will be held in Las Vegas.

**If you are interested in attending TechFest II**, please contact Slot Tech Magazine by telephone, fax or e-mail TechFest@slot-techs.com and just say something like, "Hey, Randy. I have six people for TechFest II. Let me know when it's going to be held." There is a sign-up form on the slot-techs.com website as well.

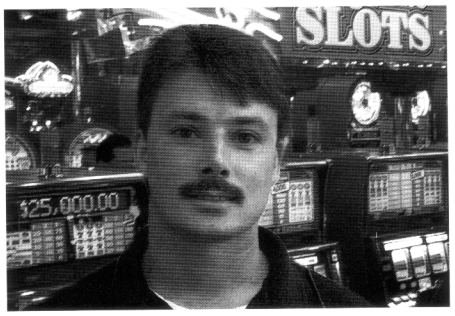
There is absolutely no obligation to attend by adding yourself or your company to the waiting list so if you have any interest in attending, please take a moment to sign up. Assume that the program will be more-or-less identical to TechFest, 2001 with perhaps a different mix of presenters and companies being represented.

**If you're wondering just what the heck TechFest is, visit the website at slot-techs.com**

- Randy Fromm

# Hopper Chaos

By John Green




Hoppers are one of the most important pieces of hardware in a slot machine. By design, they can handle a lot of abuse and with some routine maintenance, they can last for many years. Hoppers have a simple quest in life: hold coins 'till ready to be dispensed, monitor coin levels and accurately count coins as they are paid out. However, in trying to perform their simple tasks, they have to deal with mixed coins (foreign), damaged coins, coin dust and grime and even that 9 foot screwdriver that floor attendants insist on using as a stirring/jam clearing device.

Each vendor has their own concept of how a hopper should be designed. They are funny like that. Some designs are very good. Others are not so technician friendly. For instance, in my opinion, IGT holeywheel, Aristocrat and the high-speed Asahi Seiko hopper found in sigma dual hopper games are more friendly and for the most part, trouble free. On the other side of the road, there are the troublemakers to include ANY type of escalator hoppers and the Bally-Seiko upright hopper.

When you ask a hopper to push another coin through an escalator which is only thick enough to allow one coin through at a time, you are begging for trouble. Any foreign materials like paper, nylon ties, bolts, washers and paper clips will not pass through the escalator. If you remove a bolt that has a washer on it and you walk ten feet away and drop that washer on the floor, I can guarantee you that the washer will roll across the floor, up the machine and land in the hopper. Then it gets into the escalator and the whole works will be locked up tight.

How many of you have tried to coax a damaged coin up or down the escalator and wound up scraping a knuckle or jabbing your hand? It is not a matter of *if* it will happen, but *when*.

The other bad boy of the hopper world is in the Bally 5500 upright. In the perfect world of a Seiko lab, this hopper is probably a saint. Put that same hopper in a casino environment and it becomes a child that takes up too much time and effort that should be spent elsewhere. Mixed fills are a big problem for this hopper to digest. A dime in a nickel hopper will take a minimum of 10 minutes to resolve. Once a dime pushes the knife away from the pinwheel and nickels start stacking up, it puts the bolts and knife in a bind and makes them difficult to remove. To make matters worse, the bowl is designed in a way that it blocks access to the top of the knife. The knife is metal and bends once there has been a jam. This of course, invites more jams if not replaced or bent back to its original shape. A sacrificial nylon knife would be handy here; it would be more tolerant to jams and would bend back into shape. Even if it snapped off, it would not put the bolts in a bind for easier replacement. If any Seiko engineers are reading this, please, for all technicians in the world, find a better way. Please!

All hoppers, regardless of manufacturer, have the same basic design. A bowl to hold coins, a probe to monitor coin levels, a motor to drive the pinwheel/holeywheel, a knife and wiper assembly and an optic or counting device. Check your field service guides for proper disassembly/assembly, maintenance and alignments. Here are a few points of interest:

The hopper bowl is usually metal or plastic with some

type of spring ensemble. The springs allow the bowl to give to the agitation of the coins. IGT holey wheel bowls are rigid mounted. Spring placement is important as they have different tensions. Note the color of the springs. Different colors equate to different tensions. Some bowls incorporate a baffle system to keep the weight of the coins off the pinwheel; it also acts as a funnel to keep coins toward one side of the bowl. The hopper probe is usually located on the side of the bowl. In some instances, there are multiple holes to adjust for different hopper loads.

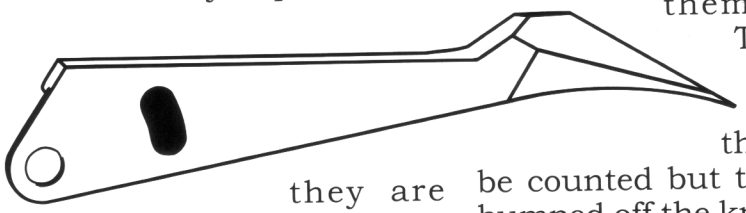
The motor and drive assembly is usually bullet proof although I have seen gears strip or loose teeth. The motors come in DC and AC versions. For the most part, DC motors are cylinder-shaped; AC motors are square with a brake assembly. IGT non-960 processor machines have the AC motor with brake assembly. The brake is pulled in when power is applied to the motor, which releases a pawl and the motor spins. Once power is removed, the brake is pulled back with assistance from a spring and the pawl stops the motor and pinwheel. If the spring is weak or missing, you will get 'extra coin paid' (3100 code). This is due to the hopper not being able to stop in time and pays an extra coin. In order to move the pinwheel without power applied, you must disengage the brake using one hand and spin the pinwheel with the other. DC motors have internal brakes and usually some kind of thumb wheel to spin the pinwheel when power is not applied.

Coin out optics come in many different shapes and sizes but are normally some sort of transmit and receive LED & phototransistor combination. As the coins are paid out, they break the light beam as it passes from the transmitter to the receiver and are counted. Each type of slot machine has a time frame in which the coin has to travel through the optics before you will get an error code. Grounding is important for the optics to work properly. This is especially

important in escalator hoppers. If an IGT slant top has an erratic pay out (says it paid out 10 but only dispensed 8 coins) I would check the ground first (green wire from optics to hopper chassis).

Many of the newer hoppers use some kind of secure optic assembly to deter cheating. For instance, IGT has moved the coin out optic away from the coin path and uses a pawl and spring to trip the optics instead of the coin itself. Some escalator coin-out optics use this same technique using a rotary flag to trip the optics as coins are counted.

As coins are pushed up the escalator, elbow springs keep the coins from sliding back down against the entry plate. These are very important. If



they are missing or not adjusted properly, the hopper will have continuous jams.

Hopper knives are used as a guide for the coins to exit the hopper. They come in nylon or metal and each hopper type and denomination use different designs to accomplish this. I personally like the nylon type, as they are inexpensive and generally bend back into shape after a jam is cleared. If it becomes damaged or worn, replace it, close the game and your done. You will be happy and the customer will be happy.

Jams involving a metal knife usually take longer to access and repair. Inspect the knives for worn tips or groves along the coin path and make sure that they fit against the top of the shelfwheel and snug against the pinwheel. Take a small screwdriver or similar object and scrape the coin goo from the top of the knife as this will slow the coins down or make them fall back into the hopper.

Another item that gives problems is paper under the pinwheel where just enough will show around the knife area to be seen. I call this Peek-a Boo paper. The machine shows the correct amount of coins paid but the customer will state that they were shorted some coins. When you inspect the hopper and do a ten coin test, everything will be fine but as soon as you walk away, that small piece of Peek-a Boo paper will pop back up and short them again. That piece of paper will allow the coins to be counted but they will be bumped off the knife and fall back into the hopper.

That brings me to this point about the "ten coin" hopper test: Never do just one. Always do at least five. This gives the hopper a chance to show its gremlins; a chance to malfunction while you are watching closely.

When you find mixed fills in the hopper, you may as well dump the hopper in the tray and remove all of the bad coins at once. If you remove the just the one that is jammed and leave, you will be right back in a few minutes. Go ahead and take that extra minute to remove them all and do five, "ten coin" tests.

Pinwheels and agitators should be checked regularly. The pins on the wheel should not be rounded or damaged. Any scars on the pinwheel indicate misaligned parts. Some hoppers use shims to align the pinwheel with the exit path of the coin. The coin should ride the pinwheel, roll over the knife and exit the hopper in a smooth motion. Holeywheel pins are located on the backside and have to be removed for proper inspection. Agitators are rubber or metal and mix the coins around so they don't stack up the same direction, thus avoiding the pinwheel. Rubber agitators are inexpensive and easy to change. Check them for missing ends and wear. Holeywheel agitators are hard plastic and I've rarely seen them damaged.

To have a smoothly operating slot floor, you must keep your hoppers healthy. Keep spares available for those times when it will take too long to service them on the floor. It is a good practice to keep a good supply of knives, entry plates, agitators and wipers on hand. Entry plates are a bit pricey but knives, wipers, agitators and elbow springs are inexpensive and disposable. A good preventive maintenance schedule for your slots is very important. If customers walk onto a casino floor and there are bulbs out, bill validators down and hoppers paying slow or jamming a lot, what do you suppose they think about spending their money there?

-John Green
jgreen@slot-techs.com

## SERVICE/DISTRIBUTION CENTERS

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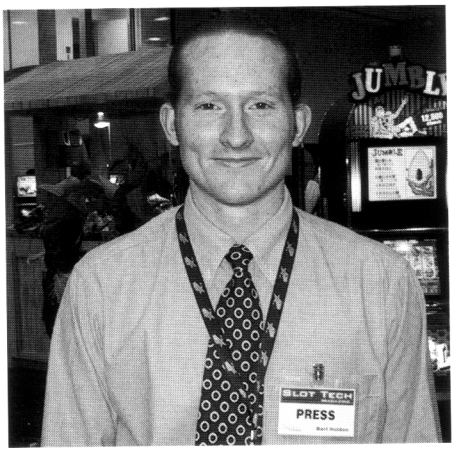
Fax: 760-251-3827
1-800-352-3837

# DBV Bezel Repair for IGT S Plus Games

**By Bart Holden**




In the May issue of Slot Tech Magazine, I wrote about Bill Validator (BV) repair and the tools and techniques used to accomplish this task. As you scour the floor day to day in search of bill validator problems, you have probably noticed a substantial number of BV bezel lights that stay out even when the BV is operational.

If you work in a casino like mine, you don't always have time to go around repairing bezel lights. You are content if the BV works. However, shortly after starting as a slot tech, I caught on to a trend. When I received the "zero bill" lists and went out to test the BVs, I noticed that most of the BVs actually worked but the lights were not lit. I realized that the customers must possess the required intelligence to have deduced that if the bezel light is out, the BV may not take their bills. They simply judge a book by its cover and move to another game. Appearance is very important in the casino industry therefore bezel problems should not be ignored.

When I started repairing my bezels, I was astonished at the speed with which this maintenance could be completed. I averaged less than five minutes at each game. Occasionally, I encountered a game that required more extensive troubleshooting involving the Central Processing Unit or a broken wire that required a continuity test to locate.

Originally, I began by taking out ten working bezel boards to swap out with faulty games. I had intended to repair the bad boards in shop. I soon realized that the boards rarely fail and that most failures can be repaired at the game with a maintenance cart full of tools, equipment, and parts. So grab a cart and load it down with the following list of items and let's fill the casino with the amber glow of illuminated bezels.

## TOOLS and PARTS

As you begin repairing bezels, you will be able to determine your personal list of tools. These are a few that I have found to be very useful. I returned to my shop about ten times before finally perfecting my cart. All of the part numbers that follow can be ordered from **Wholesale Electronics** by calling toll free at **1-800-222-2899** or by visiting their website at **www.wholesaleworldwide.com**.

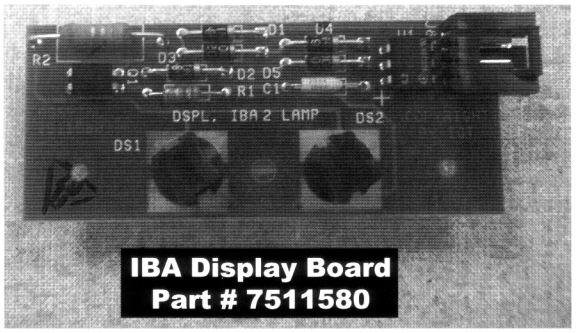
You will need a container filled with 22-18 Gauge fully insu-

Sample Tool Cart

lated flag quick disconnects part number AA-2220 and a multi purpose crimper part number ABC-500 to repair one of the most common failures. Bring along your rivet gun and a container with a few 1/8-inch rivets to replace any display boards that may be faulty. Also grab some wire strippers, a multimeter to verify wire continuity and some tie wraps to secure any wires you replace. Of course, take a lot of T-1 ¾ 6.3volt wedge lamps (part number 86) to replace DS1 and DS2 on the imbedded bill acceptor (IBA) display board. One item that caused my return to the shop was the wedge lock socket assembly, part number WBL-501. I found that several of my games were missing the entire socket.

If there aren't any safety regulations preventing you from doing so, take out a soldering iron, solder extractor, rosin core solder (part number 1802-25F) and desoldering braid (part number 24-6337-0027) for some on-floor solder repairs. Unfortunately, I have used a soldering iron as a weapon against myself on several occasions and wasn't sure if my tech manger would trust me around our most loyal customers. To my surprise, he did not object. Don't forget to wet your sponge to keep that solder tip clean. There is nothing more aggravating than heating up that soldering iron tip and placing it on an ineffective dry sponge. Finally, for the best solder joint, take out your denatured alcohol dispenser and an acid brush to clean the eyelets and contacts.

Although the IBA display boards rarely fail, it is a good idea to take four or five out on the floor. The part number for the board is 7511580. This will, at the very least, prevent interrupting your rhythm by making another trip to the shop necessary. Add a cordless drill and 1/8-inch drill bit to your cart to remove the board from the light barrier assembly. Now let's get started.



**IBA Display Board Part # 7511580**

## DIAGNOSTICS

Once you have determined that a BV is accepting bills with the absence of an illuminated bezel, you should pinpoint the problem area. Most importantly, use your diagnostics to enable the 7 volts AC and light DS1 and DS2. To accomplish this, press the internal test switch, usually located near the main power switch. Next, either push the internal test switch or use the bet one button to scroll through the diagnostics menu until you reach the output test. You will have a 10 displayed in the winner paid meter and a 2 displayed in the coins played meter. Next, use your change button to scroll through the input test menu until the winner paid meter displays a 26. Now press and hold either the spin button or pull the handle to the lower position and hold to illuminate your bezel.

## DETERMINING THE PROBLEM

With the bezel light activated, you can usually pinpoint the exact area of your problem by wiggling the four pin connector at J81 or the two wire ground on the common of your max bet switch and noticing when your light illuminates. One of those two areas is nearly always the problem with the bezel. If this is not the problem, you can see if both DS1 and DS2 are good on the IBA display board by doing a quick swap with either your "coin accepted" or "insert coin" light. You can also disconnect the connector from J81 and connect it to a spare display board to verify the board is functioning properly.

Once you have determined the problem, it is time to make the necessary repairs. Below is a list of some of the more common failures and the actions taken to repair the problem.

## REPAIRING A BAD GROUND

Should you determine that there is a bad ground connection between the max bet switch and J81 of the display

board, it is important to verify that you have continuity at each end of the two ground wires. You can accomplish this by performing a resistance check with your multimeter. If you do not have zero ohms, it is a good idea to replace the wire completely. I did find one wire at my casino that needed to be replaced. It had broken beneath the tie wrap between J81 pin 2 and the common on the max bet switch.

A more common failure (probably the most common failure) is a bad crimp on the quick disconnect flag on the max bet switch (see figure 3). Let's face it, the max credit button takes a severe beating. If it ever falls out of the lamp switch housing, it is surely doomed to be smashed repeatedly as the floor person attempts to close the slot machine door with it wedged between the bezel and the BV face plate. After this brutal crime, you can, at times, get by with crimping the connector again. However, I strongly recommend that you spend the extra nine cents and replace the connector. If you don't, you are certain to be back at the game later, repairing the bezel again. While you're replacing the connector, go ahead and strip your wires again. Don't use the same stripped end or again, your problem may reoccur.

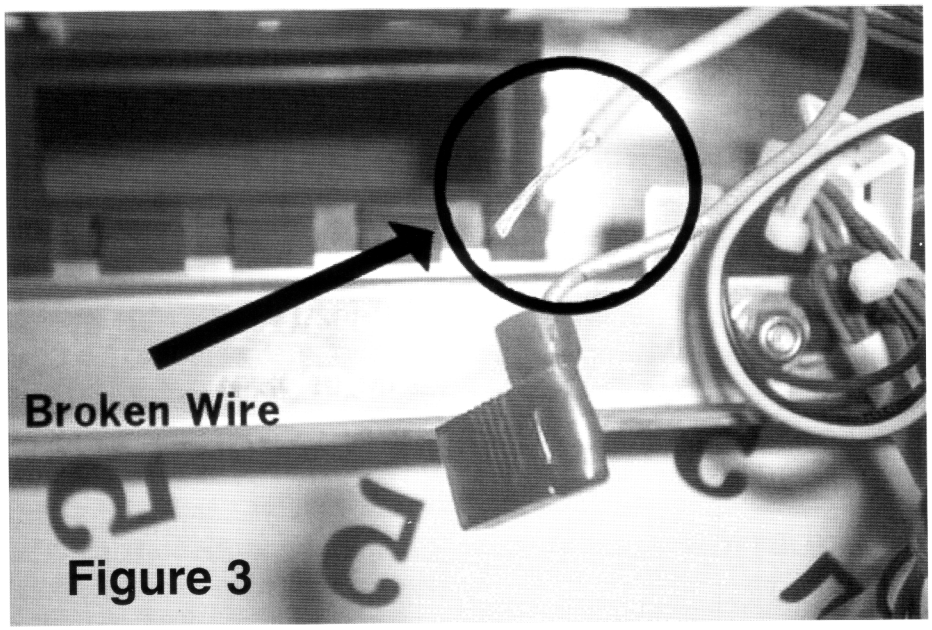


Figure 3

**RESOLDERING BOARD CONTACTS**

Sometimes you will find a board that has a bad solder connection at J81 that needs to be soldered. I always plug into the game power supply and do it right there on the floor. Granted it's between 4:00 a.m. and 7:00 a.m. and the floor is less crowded.

First, carefully remove the old component by heating up the solder joint and removing the old solder with your extractor (see figure 4). Adding a little fresh solder can help here as the flux is contained inside the hollow solder. You may have to refill the solder joint a few times to remove all the old solder and properly free the component legs. Once the connector is removed, clean the eyelets. Use your desoldering braid to make those eyelets shine. You will remove all of the old solder and most impurities by doing this. Finish the board off with a little denatured alcohol applied with an acid brush. Always let the alcohol dry on its own. Blowing it only saves you a few seconds but adds unwanted impurities to your once spotless board.

Now it is time to replace that connector and get this bezel on the completed list. Return the connector to the board and solder it in place. Heat both the component lead and the eyelet while you conservatively apply the solder. Remember, "the bigger the blob the better the job" is a **false** statement. Your solder joint should closely resemble a delicious but tiny, Hershey Kiss sitting atop your IBA display board. Again, clean your finished solder joint with the denatured alcohol and let it dry naturally.

Once the connector is in place, test the board before you fasten it to the slot machine. This way, you will know you got it right and save you the hassle of removing it again for more repairs.

**SWAPPING THE BOARD**

If you find a board that is faulty and cannot be repaired on the floor, replace it with one of your spare boards. You will need to remove the board from the light barrier assembly. This is accomplished by drilling through the rivet that is holding the two together. Use a cordless drill and a 1/8-inch drill bit to separate them. You or your bench technician can try to repair the old board

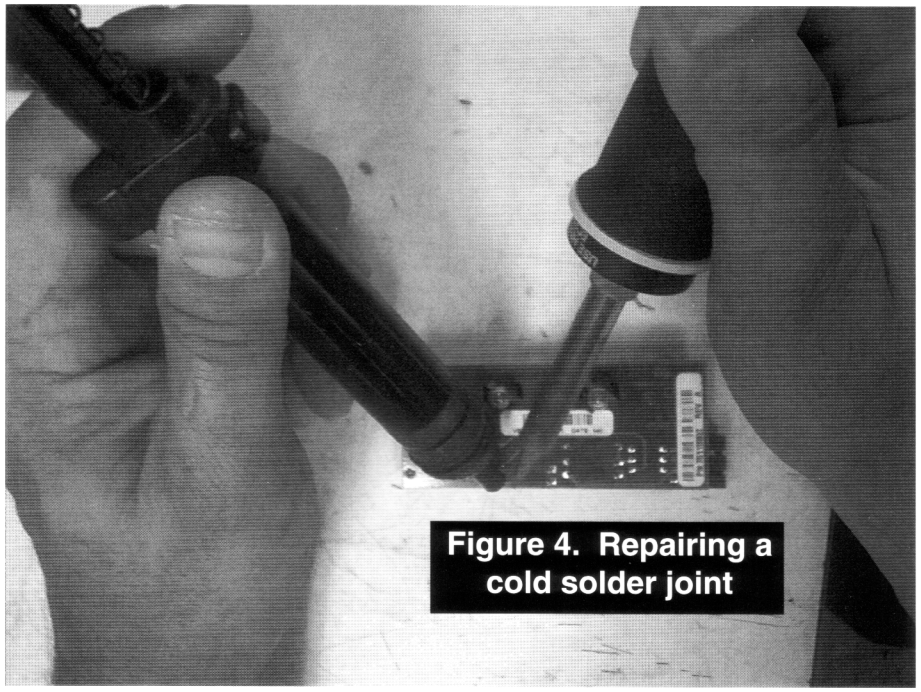


Figure 4. Repairing a cold solder joint

in the shop.

Now attach the new board to the light barrier assembly using the rivet gun and the 1/8-inch rivets. Again, test your board prior to putting the machine back together.

**Other Fixes**

Of course, you may need to swap out bulbs and occasionally you may find a game that is missing the entire bulb socket. Always be sure to replace these bulbs with the proper spare. In this case, it would be a T-1 ¾ 6.3volt wedge lamp part number 86. Using improper bulbs can lead to overheating or other problems.

You may encounter a game that has a much more complicated failure. You could have a problem caused by a fault on your central processing unit or some other major component or wiring in your slot machine. Refer to the IGT service manual. It contains useful JCM bill acceptor wiring diagrams that will assist you in the task at hand. You can also visit the website at igtproducts.com. You will need a password to get into the site.

- Bart Holden
bholden@slot-techs.com

# KRISTEL MONITORS

## By Mike Thomas


About a month ago, we received 70 new WMS Gaming Slant Top Video Slots. At first glance everything appeared to be very similar to the older models. On the outside I noticed only a few cosmetic differences along with a taller cabinet. I proceeded to open the games and noticed an internal layout consistent with the older models as well. Upon pulling the monitor out I was immediately surprised to see some differences with the outer casing and the board design. Well what do you know? It's a Kristel Monitor! I was surprised because these were the first new Williams Games that I've ever installed that came with Kristel Monitors as original equipment from the manufacturer (OEM). Until now I've only confronted Kristel Monitors in some of our VLC games. These monitors were equipped with the glass touch screens which were bonded to the monitor itself. I immediately questioned the Williams Service Representative and asked him "What's up with all the Kristels?" He replied that they were using more and more Kristel Monitors in the games now as OEM equipment. I thought, "Well, yeah I see that but what's that going to mean to the technician?" I was apprehensive because I feared that this might be a step back in regards to in-house monitor repair. I have an extensive library of monitor schematics and repair data on some of the favorites such as Ceronix and Wells-Gardner but nothing on Kristel. I also have been e-mailed by technicians in the past requesting anything on Kristel Monitors and I was disappointed that I couldn't be of any assistance.

### Relentless Search for Truth

I determined that the time had come to seek out the information and accept no failure this time. After all, I needed to know and I was determined to assume the responsibility to bring this information back to all of you. I ran down to the office, logged on to the Web and hacked in the www.kristel.com address in the URL box. I certainly didn't expect to find what I did. I was pleasantly surprised. I brought the page up and saw a standard sales/info page. On the bottom of the page I noticed a link titled "support." I commenced the double clicking and the party was on! It felt like Christmas. Before me were links with several different schematics and repair data, and a link allowing you to e-mail the engineering department directly. It appeared that all this information had come out of nowhere. It wasn't there a year ago when I first began to look for it. I decided to e-mail the engineering department and let them know that I was interested in talking with them on their new support options. I received an e-mail two days later from Keith Petri, one of the owners. He advised me to contact their Sales Manager, Kevin Michael, for any general information and that he would be available for any of my engineering questions. After a short game of phone-tag with Kevin, I was able to reach him. He was very helpful and eager to answer every one of my questions (and I ask a lot of questions).

### Background

For starters, Kevin gave me some of the background information. Kristel is a 16-year-old company, located in St. Charles, Illinois. Kristel offers not only OEM monitors to the manufacturer but replacements for the end user as well. He explained that they have a replacement for almost any monitor you may need and that they are always willing to build a monitor to specifications. He boasted about them being ISO 9001 certified. ISO stands for International Standards Organization. This organization establishes quality guidelines for industry and also ensures that these are met on a continual basis. Kevin Michael was proud to point out how ISO

and his company work together to present a high quality product.

Next, I asked him about the switch from the bonded glass touch screen to the removable type. This was a modification that was researched and mandated by Williams. The touch screen is a Microtouch, as are most touch screens today. This provides a much more economical option, which can save you around $350 over replacing a whole monitor for a touch screen failure.

**Support**

By far, I'm most impressed with the web site. Kevin explained that it is a basic, user-friendly site. I feel that this was a great decision. After all, it's content we're after, not fancy graphics. Kevin explained to me that all the schematics listed on the site should cover any of the models that you will find in a slot machine. At the top of the support page you will find a link for technical support, engineering@kristel.com, which guarantees a 24-hour or better response time. That's a tough guarantee to make and an impressive commitment to those of us out here in the field. There's no better example of downtime equaling lost revenue than with slot machines. It appears that Kristel understands that and is willing to share the burden. Don't these guys take the weekend off? They also have a toll free support number as well, which is 1-888-584-3963. When you e-mail or call you're likely to get a response from one of the following people: Keith Petri the owner, Matt Margaras, Senior Electro-Mechanical Engineer or Henry Bahr, Color Display Service Technician.

**Notes on CRTs and Autobiasing**

One of the benefits of the Kristel Monitors is the built in auto bias function in the 1428K model monitors found in slot machines. Matt pointed out "auto bias technology is a relatively new innovation in video amplifier circuits, implemented by Kristel in most of our product." With the auto-bias circuitry, Kristel Monitors do not require the usual video amplifier and /or CRT biasing adjustments to compensate for the aging of the tube.

*Editor's Note: Auto-biasing has been a hallmark of competing monitor manufacturer Ceronix since the mid-eighties.*

The auto-bias feature can make it more difficult to determine if you have a bad CRT tube, so Matt Margaras made the following suggestions:

"The best way to tell is to look at the picture quality"

- It should be sharply focused over the entire screen, and all 3 colors should be equally sharp.
- Set the picture brightness and color maximum. If you see bleeding and smearing, this means CRT is bad.
- When you first power on the picture should look normal in well under a minute. If the picture is dim, tinted or blurry for more than a minute or two the CRT is getting weak.

In addition to the above, if performing adjustments of the internal background and/or screen controls, still result in a dark picture (even after a long warm up period) the CRT may be near the end of its useful life. First, confirm that the filaments are running at correct voltage. There could be a marginal connection or bad resistor in the filament power supply. A visual examination is not a bad way to determine if the filaments are hot enough. They should be a fairly bright orange to yellow color. If possible, confirm that the video output levels are correct. For cathode driven CRTs, a high bias voltage will result in a darker than normal picture.

I want to extend my appreciation to all the guys at Kristel, especially Kevin Michael and Matt Margaras. I hope those of you who have not yet tapped this great resource find this article very useful. Kristel monitors are continually becoming a greater and greater percentage of the slot floor. If your like me, quality is key, but technical support is a major consideration as well.

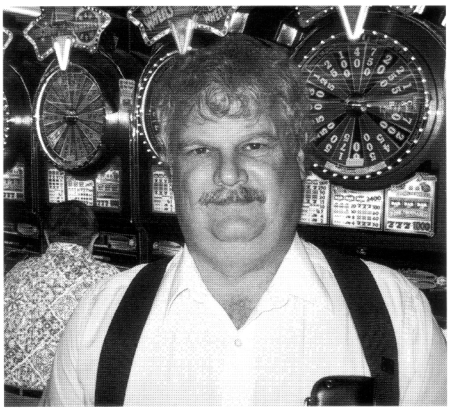
In the past, Ceronix and Wells-Gardner seemed the best options for me for replacement monitors. I can now say that I put Kristel right up there next to them.

'Till next month remember, if your not making a difference, your just taking up space. Stay positive and never stop learning!

-Mike Thomas
mthomas@slot-techs.com

# JCM Validators on the Floor

**by Pete Bachran**



In most casinos these days, sixty to eighty percent of the drop comes from the use of bill validators. More and more if the drop team is observed, it's easy to see that the drop buckets that go to hard count are getting lighter and that the stacker boxes that go to soft count are getting heavier. Players like them because they don't have to get their hands dirty handling coin.

An observant slot tech walking around the casino floor is looking to be sure that the validators are lit up and ready to take player's money. A dark validator can be as bad as a game being out of service. Lost opportunity to give a guest a chance to take a chance.

JCM is a leader in validators for gaming machines and so they will be the example used here. When coming across an unlit validator go through these steps:

First, check the bulbs. A quick way to do this is to insert a player tracking card. If the validator tries to pull it in, the indicator lights are probably bad and the validator is probably working fine. Change the bulbs and move on. If the validator acts dead, the next step is to find out why.

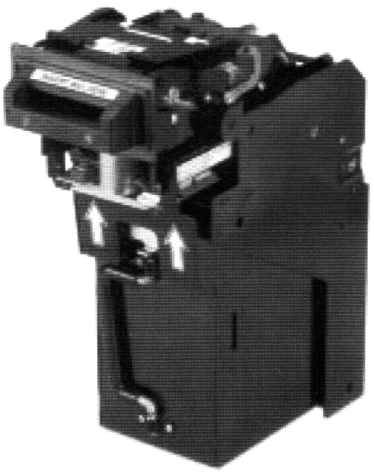
Is there a bill stuck in the transport? It's not unusual for a torn or wrinkled bill to not eject properly when the validator tries to reject it. Exchange the bill and test with the new bill. If this does not work then perhaps the validator has fallen asleep. Sometimes the JCM validators seem to just forget to reactivate themselves when a transaction or game is finished. To reawaken a sleeping validator, it is safest to turn off power to the game. Remove and replace the validator head connections and power up the game. In many cases this will bring the validator back into service.

When power is applied to it, listen to the way the head cycles. Does it give a full cycle? Is there a grinding noise? If there is a grinding noise during the power up cycle, remove the head and transport. Turn the transport over and look at the bill guides that lead the bill from the transport to the stacker box. These guides are supposed to be straight. It is not unusual to find them bent toward the rear of the transport. The grinding noise comes from the bent guide pushing the transport forward enough to cause the stacker drive gear to chatter against the chassis base plate. Straighten the guide pins, reinstall and power up again.

While the transport is out, it's a good idea to take a look at how the stacker box is seated. If the box isn't seated fully, the validator won't work. If the box is loose or more forward than it should be, it often can be put in place with a medium sized, flathead screwdriver. Place the flat of the screwdriver into the slot where the bill enters the box and with a lifting motion, push gently toward the rear to seat the box. This isn't one hundred percent successful but it works often enough to try it. Of course if you can obtain the key to open the box access door, just reseat the box. That's often not possible due to various gaming rules and house policies

# MEI
# Bill Acceptor
## ZT Series 1000

## ZT 1200



### HIGH, FOUR-WAY ACCEPTANCE

*Satisfy customers by accepting bills of all conditions. Bills can be fed in any direction, face up or down.*


### EASY TO USE

*The Recognition and Transport Unit (RTU) and the Lockable Removable Cassette (LRC) can be removed from the front with one hand. The RTU fully opens for cleaning and electrically connects automatically when inserted.*

*An easily accessible toggle switch enables the operational mode to be changed to "test" or "set-up" mode.*

### BAR CODE CAPABILITY

*Reliably accepts industry standard bar code coupons face up in both directions.*

### FUTURE FLEXIBILITY IN A FLASH

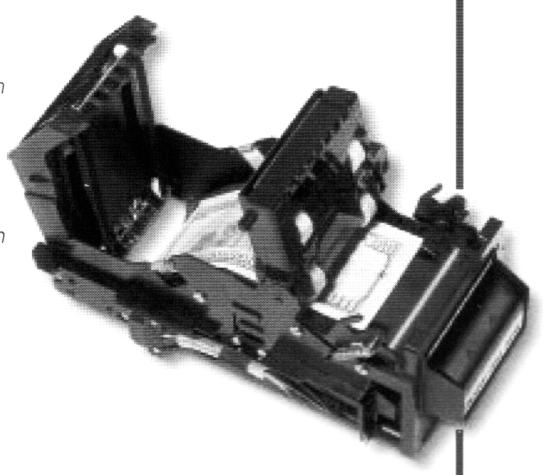
*All US models accept $1, $2, $5, $10, $20, $50 and $100 bills. The ZT Series 1000 bill acceptor can be easily updated electronically to handle new currency designs.*

### RELIABLE / LOW MAINTENANCE

*With the streamlined recognition system, sensors are embedded under the smooth plastic bill path and the magnetic head and pinch roller have been eliminated to dramatically reduce jams, debris buildup and the need for cleaning.*

### EXCEPTIONAL SECURITY

*Through the use of multiple wavelength optical sensing and sophisticated data processing the ZT Series 1000 bill acceptor sets the standard for rejecting invalid bills. Optical cross-channel sensors examine the bill path for foreign objects such as clear tape or strings. The LRC triggers an automatic "lock out" when separated from the unit for added security.*



MEI®

that often seem to be there for the purpose of keeping techs from getting their job done.

If you're checking the box on a WBA, the procedure is a little different. Remove the transport and reach into the back of this space. Turn the two gears that are back there. The one on the left should turn easily but with some resistance. The one on the right should turn only one way and at that with a bit of difficulty. If no resistance is felt on either gear, the box needs to be reseated. Sometimes this can be done by placing a small bent flathead screwdriver (every tech should have one of these) into one of the small holes in the base of the chassis and gently lever the box into place. Check the gears again to see if this has made a difference.

Clean the optics and sensors in the validator head and transport. Do NOT use anything containing alcohol. Alcohol clouds the optics and causes the belts to deteriorate. Using a damp cloth followed by a dry cloth does amazingly well. Reconnect everything and apply power.

If it still isn't working, then it's time to recall the old saying that "the next machine is your best friend." If the next game uses the same version of head and transport, swap them. If the problem moves with the head and transport then one of those two assemblies needs replacement. If the problem stays with the same game, the problem is in the machine, most likely in the stacker box, power supply or chassis.

If the problem moved with the head and transport, swap just the heads and leave the transports where they are. Where is the problem now? If it has moved back to the original game, the problem is in the head. If the problem is in the second game, the fault lies with the transport and it should be replaced.

The four wire connector that connects to the right side of the transport is for the two optics in the chassis. If one of these wires breaks, the validator will shut down because it can't figure out where the stacker is. The chassis should be replaced. If the thumbscrews that hold the transport break off, this also calls for chassis replacement. This task is easier than it first appears. The hardest part is gathering together all the necessary personnel to fulfill the rules. Remove the stacker cash box. Inside there will be either two or four screws holding the chassis in place. Remove these screws, pull out the chassis and replace with the new one. Replace the screws, reinsert the box and replace the transport. Replacement parts for the chassis are available from JCM and AGE.

If a game seems to be stealing bills with any noticeable regularity, try replacing the power supply. Often this seems to clear up a chronic problem.

Editor's note: The subject of power supply repair has been covered previously in Slot Tech Magazine and will continue in future editions as this is one of the most important skills a technician can possess. — end of note —

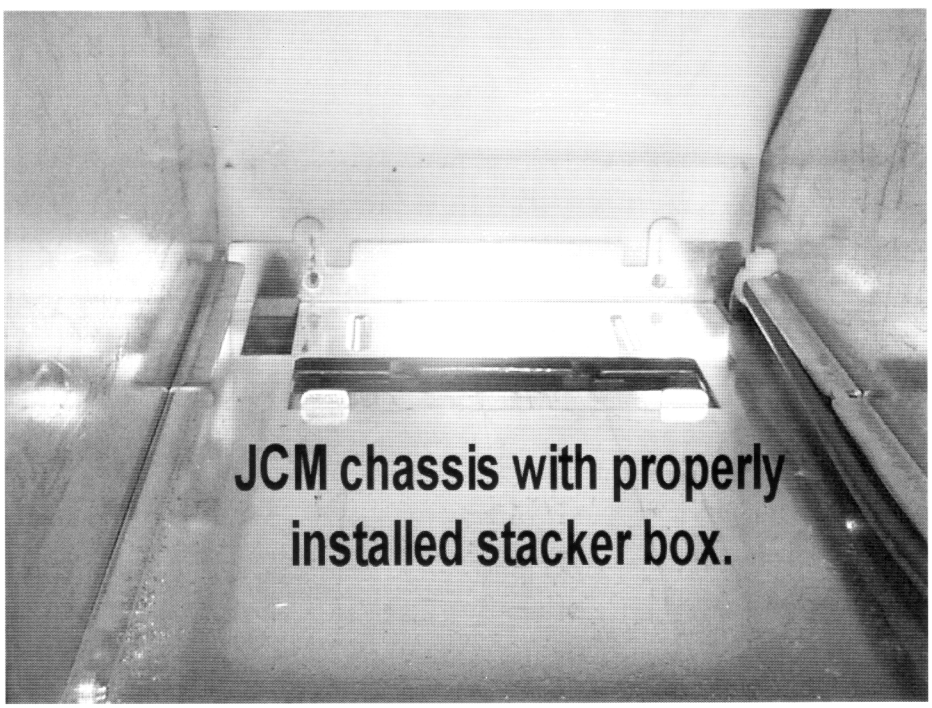
Drop teams have a tendency to break the micro switch on access doors. This will take the game out and will have to be replaced as soon as possible.

If the problem is in the stacker cash box, follow house policy on its replacement.

These hints should be helpful in getting up some of the dark validators that haunt us all.

- Pete Bachran
pbachran@slot-techs.com

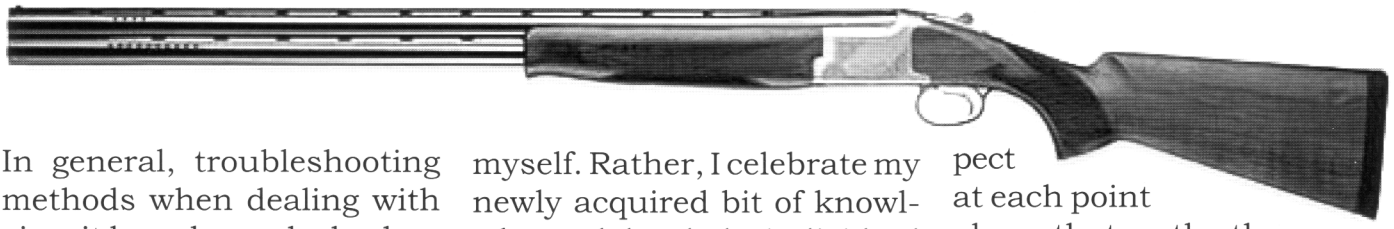
**Next Month in Slot Tech Magazine: TechFest, 2001 review. Sold out! If you missed it, make plans now for TechFest II. Visit slot-techs.com for details.**



JCM chassis with properly installed stacker box.

# SHOTGUN!

**By Frank Sutter**



In general, troubleshooting methods when dealing with circuit boards can be broken down to five basic broad categories. The first of these is the most obvious of all, to tap into your experience. Very simply, if you have seen a problem before and you have successfully repaired it, you already have a strong idea of what is likely to be causing your failure. Alternatively, if there is someone else around who might have your answer, it's OK to use their experience, as well.

Editor's Note: Sorry to barge in on you but I wanted to add my two cents worth here and agree wholeheartedly with the author. When I encounter an interesting new failure that I haven't seen before, I am always anxious to dig in and see what's wrong. After all, troubleshooting is a technician's job and I love what I do. However, when time is of the essence I do not hesitate to run the problem past others to see if they have fixed the problem in the past. Naturally, I eliminate the obvious stuff first (I don't want to seem like a dork) but even when it turns out to be something simple (as it often does) I don't beat myself up for not knowing or figuring it out myself. Rather, I celebrate my newly acquired bit of knowledge and thank the individual who gave it to me. We now return you to your regularly scheduled program. Take it away, Mr. Sutter.

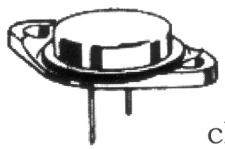
The second method, and probably the most commonly used in the casino industry, is comparison with a known-good, working board. By this, I mean taking measurements on the working board and comparing these with the bad board in order to find out where they are significantly different. The major advantage to using this method is that it eliminates the need to understand what the board is doing or what the signals mean. The only function is to pinpoint where the working board and the failing board are different.

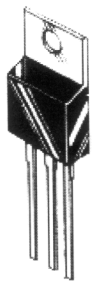
The third troubleshooting method is the one that requires schooling, experience and patience. It is signal tracing; the process of tracing out the path of the suspected signal through the printed circuit board, then testing along the points of its path for the presence or absence of this signal. The effective use of this method requires the ability to find the signal's path, the knowledge of what to expect at each point along that path, the ability to test for the presence of that signal and the knowledge to interpret the results of your test. No, it's not nuclear physics but if you have little or no experience with this method, it's best to have someone around who is more familiar and experienced. This technique is the essence of electronic troubleshooting among professionals and it really cannot be gained without at least some schooling. The good news is that using this method is rarely an absolute requirement because other methods frequently will succeed.

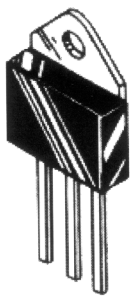
The fourth method is really advanced stuff, so much so that even experienced technicians shy away from attempting it. It's called signal injection. Essentially, it is the process of injecting an actuating signal on the input of a circuit and testing to see if the output of that circuit has the proper results. It's EXTREMELY effective in the hands of a knowledgeable technician but since it frequently involves the deliberate shorting of one part of the circuit board to another, it also has the potential to do great harm if used improperly.

After all, connecting a wire to one part of the board, powering the board up and then touching the other end of that wire to another part of the board goes against everything any of us has ever learned about electronics. It's not really that bad, assuming that you remember a couple of VERY IMPORTANT RULES but I'll talk more about this method in my next article.

The fifth and final method of electronic troubleshooting is called shotgunning. This is the process of replacing parts one at a time until the board works. As a bench technician, I'm supposed to look down on this type of thing and yet, I have had to resort to this method more often then I'd care to admit. In fact, anytime we replace a part and we're not entirely sure it's going to fix the board, we are engaged in shotgunning. The difference is that an experienced technician can narrow his guesswork from a random choice down to only a few components.







Regardless of your experience level, there are ways to narrow the selection of parts you have to guess among. Learning these techniques will give you some base level of electronic repair capabilities. Because the frequency of electronic failures diminishes with increased complexity, the simplest failures are the most common. The most difficult and catastrophic failures are far more rare. Even a technician who is inexperienced at bench repair can fix a surprising number of electronic problems once he is armed with some shotgunning capability, combined the experience he can gain on his own and pick up from others.

First and always, before you begin any troubleshooting steps, you must confirm that the reported problem exists. If you find that it does, attempt to reset the game. Also, if it is easy to do, you might try clearing the RAM. Unfortunately, most machines now carry a lot of the game parameter information in the RAM, so this troubleshooting tool is not as easy to use as it used to be.

Before you haul the board off to the shop, try it in a known-good, working machine (See "Swaptronics Controversy, Page 28 of this issue of Slot Tech Magazine). Once you are certain that it's the board that has the problem and not the machine itself, you can take the board to the shop and be confident that you are actually chasing the problem, not your tail.

Before you leave the floor however, pull out the suspected board but don't replace the known-good one yet. Instead, take a moment to compare it with your failing board. Compare the positions of the DIP switches and the jumpers, if there are any. If the board is a CPU, confirm that the suspect boards EPROM number matches the known-good board. Remember, unless the boards you are comparing come from identical systems, there is a chance that the EPROMs are supposed to be different, so make sure you are comparing apples to apples.

Check the suspect board's connector for bent pins. Check for signs of drink spillage. These spillage points can be picked out because they often will have less dust then the rest of the board. They also may also be sticky to the touch. If this quick inspection hasn't revealed any clues, replace the known-good board into the known-good system, complete all necessary paperwork and head for the electronic repair bench with the defective board.

***"High power components fail more frequently then low power components, high current components fail more frequently then low current components, and high temperature components fail more frequently then low temperature components."***

Once you get the board to the shop, if it's a CPU, grab the meter and measure the battery voltage. Expect to find approximately 3.5 V on a good battery, plus or minus 10%. If the battery is bad, you can stop troubleshooting, throw an easy fix on the CPU and get back to chasing cocktail waitresses.

If you didn't get that lucky, look the board over closely and carefully. At least 20% of all electronic problems can be solved through a careful visual inspection. That's a very conservative estimate, based on my experience only. I do not consider myself skilled at this process and yet I still get AT LEAST 20% of the problems I face solved in this way. It's worth getting good at, believe me. Visual inspection is the primary technique used in narrowing the guesswork inherent in the shotgunning process. I'll talk more about it in just a little bit.

You'll need to combine that visual data with some fancy detective work. Look for any obvious burn marks and as silly as it sounds, smell the board for the smell of overheated components. Examine the chips individually for signs of overheating, such as faded writing on the chips or a dull, flat finish instead of the shiny, smooth finish that other chips in the area have. Examine the solder connections on the bottom of the board for brown discoloration or a flat gray finish instead of a bright, shiny solder joint. Check extra carefully around the solder joints of large or high-power components. Look for signs of cracking, leakage or swelling in any component on the board.

If you still haven't found anything that looks suspicious, you've finally worked your way down to pure guesswork. Even at this point, there are still a couple of tools that can help narrow the choices you will make. For example, it will help if you can pinpoint the area of the board that has the circuitry that controls the failing function of the board.

In the absence of any other clues to narrow the choice of parts to guess from, remember this: High power components fail more frequently then low power components, high current components fail more frequently then low current components, and high temperature components fail more frequently then low temperature components. These high temperature, high current devices are easy to spot because they will always be physically larger then the low current components. They often will have a "heat sink," which is a radiating device to carry the excessive heat away from the component during operation. When replacing these components, it's critical that you carefully observe and replicate the heat considerations built in to the design of the board. If you do find the bad component and replace it without its heat sink, it won't last long at all.

If the high wattage components are not your problem, you have to go by the statistical frequency of failure. If there is an electromechanical device in the circuit such as a relay, suspect these first. If not, remember that silicon devices (chips and transistors) fail more frequently then any other components. Among these, and aside from high wattage devices, suspect the optocoupling devices first. The second most common failure is the electrolytic capacitors while the third most common failure is the low-wattage resistors.

If all this educated guesswork still hasn't led you to a fix on the board, it's time to set the board aside for a more experienced bench technician to look at. However, if you follow these guidelines carefully, you will get some boards repaired and you will be able to add this capability to your resume. Good luck with it, and until next time, keep 'em runnin'.

- Frank Sutter
fsutter@slot-techs.com

# SwapTronics Controversy

## *Swaptronics Controversy!*

Well, not really controversy but I did receive the following letter in response to Slot Tech writer Bart Holden's article entitled "swaptronics" from the April, 2001 issue of Slot Tech Magazine. Here is the letter, along with my response as publisher of Slot Tech Magazine, Mr. Holden's response as the author of the article and a couple of other opinions as well. Slot Tech Magazine would like to hear from readers as well in this regard. Your opinion is always welcome. -rf

--------- start of letter ---------

Subject: "Swaptronics"!
From: "Stephen Brown" SBrown@peppermillcas.com
To: editor@slot-techs.com

I received this sample Slot-Tech mag. in the mail read thru it and when I got to "Swap-Tronics" got all my mechanics together and told them once again if I ever found them doing this I would fire them onthe spot. Do you not research what you print? Swapping was "ok" back when electro mechanical and TTL based machines were out. But now days if you do "Swap-Tronics" you will most likely end up with two bad machines, having already talked with the service managers from local reps. of IGT,WMS, Sigma (mikhon) etc. They very much agree, bring out a spare part and try that or better yet take the suspected part out and test it. A very recent example of this was a few weeks ago, IGT came out on a dead trial game, he started swapping parts back and forth, 4 hours later I had 3 dead games on a Friday night before a holiday weekend. They came out twice more that weekend, the second time brought the count to 4 games dead. By late swing Saturday they were back to 3 but had run out of parts in their vans. So I was stuck with 3 dead games until Monday and then they tried to charge me for 19 hours. I reminded them these were on trial and they caused the excessive hours.

This is not an isolated incident and not just IGT, the games these days are more like mini computers with intranets running inside. Always checking on each device from hoppers to coin acceptors to touch screens to hard meters to bill validators, all inter-linked and all susceptible to data corruption.

Some brands are less prone to these problems, but as progress moves on, more and more will be prone to damage by "Swap-Tronics" other than that I do like the mag. but I guess I will have to screen it when it arrives.

Stephen Brown (Slot Repair Mgr. Peppermill Casinos)

----------end of letter----------
---------start my reply---------

Dear Stephen,

First, let me thank you for taking the time to write. Slot Tech Magazine exists to promote dialog on repair issues. Through discussion and dissemination of information, the tech community will benefit greatly.

*"Stephen Brown (Slots)" wrote:*

*>Do you not research what you print?*

Stephen, this was reportage. I do not doubt that the events, about which Mr. Holden reported, occurred exactly as he described. In that regard, research was not necessary. He was only describing what he did. He was not saying in any way, "You should do this or that."

Let's also consider the fact that eventually, the repair was successful and he reported it as such. Had he blown something up, he would, presumably, have had the cajones to admit his error in print in order to warn others to NOT do it, as you have just done with your missive to me.

It's called "learning from other people's mistakes." Heck, I'll learn anyway I can. I am certain that you do as well.

*>bring out a spare part and try that or better yet take the suspected part out and test it.*

Your point is extremely well taken. I couldn't agree more. Every operation should be well stocked with spares for everything that is on the floor. I have no doubt that the Peppermill has such stock. However, many small operations around the world are not so fortunate. Please be aware that Slot Tech Magazine is read by slot techs in places like Argentina, Cyprus, Ireland and Korea. Slot techs are often crippled by a lack of spare parts. Ask the lone technician at a slot palace in Saipan or Cyprus to go back to the shop for replacement PCB and he's likely to laugh at you. Also, many casinos (especially Native American casinos that are new to the business) don't have test fixtures at all. Many do not even know that such a thing exists let alone how to use one.

*>A very recent example of this was a few weeks ago, IGT came out on a dead trial game, he started swapping parts back and forth, 4 hours later I had 3 dead games on a Friday night before a holiday weekend.*

That is certainly a risk. At the very least, you guarantee that at least two games are down for the duration of the repair and that isn't good, for sure. Of course, the possibility of this situation is mitigated greatly by a COMPLETE AND EXACT knowledge of the system you're working on and by PROPER swapping techniques as opposed to the willy-nilly swapping of modules just to "see what happens." Certainly, at the very least, you would NEVER swap a bad power supply into a good machine nor would you attempt to place a module from a working machine into a bad machine that has a faulty power supply. That's just basic common sense (technician sense, anyway).

You are correct too in the fact that new machines love to communicate with each other and with their own internal components and systems. As you know, it's not unusual to have an inoperative game that has no hardware faults at all but is improperly configured or has one of a dozen other problems that not all the swapping in the world will identify.

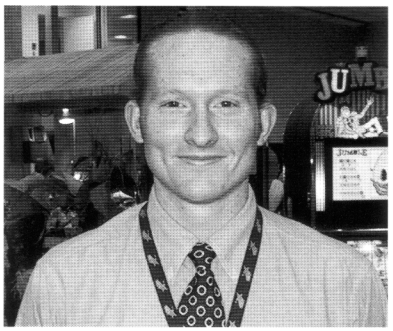
*>other than that I do like the mag. but I guess I will have to screen it when it arrives.*

I encourage you to do so. I'd love to hear from you on a regular basis in this regard. Open dialog is welcome and I'm pleased to hear from you. If you'd like to consider contributing to Slot Tech Magazine, you will find writer's guidelines at the slot-techs.com website.

Best regards,

Randy Fromm
Publisher - Slot Tech Magazine

---------end my reply---------



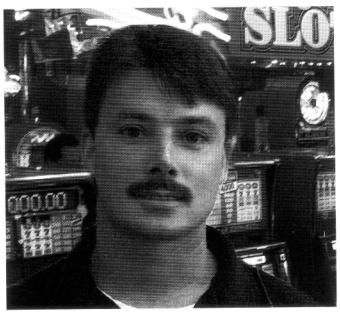
---begin reply---
---from Bart Holden---

Randy,

I like getting the feedback. I agree with what the gentleman says to a point and it is his prerogative to manage his department as he sees fit. With the use of some common sense, you can successfully troubleshoot using swaptronics. What exactly is the difference in grabbing a spare part from the shop or the game? If you blow a good part, either way you're out one good part. By the way, I have never done so. I don't think my tech manger would rather see me give up and call a vendor to troubleshoot the game or we could have ordered the entire IO board rather than save money by just ordering the chip that we needed. If I had it to do over again, I would both troubleshoot the slot machine in the same fashion and resubmit my article.

***And Randy, remind me to omit "Master of Swaptronics" from my resume if ever I apply for a position at Peppermill casino.***

Bart Holden



------- end of reply-------
--- begin reply ---
----from John Green----

I agree to a point. IGT S+ and PE+ platforms could care less, unless you are pulling a cpu or monitor, they could care less if you pull parts with power (bv, reels, compartor, etc).

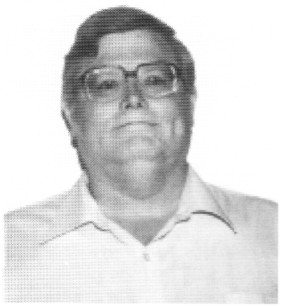
However, WMS and IGT are going to a serialized CPU and motherboard that will give you a mismatch code and requires a clear chip on their newest games. I believe that if you make sure power is turned OFF before swapping parts (other than the newest motherboards and CPUs) you will be ok.

I would try from spare parts on hand first then go to another game, but then it depends on the situation (customer waiting, shorthanded, etc).

If you use proper procedures for swapping, go for it. Unless you have a game with a direct short somewhere, you shouldn't bugger up swapped parts.

If IGT screwed 4 of his games up, then I would question procedure and knowledge before I blamed swap-tronics. Today's slot machines are not like a mini-computer, they ARE mini-computers right down to the 960 processor, data busses and duarts. The magazine is mostly written with people's opinions along with facts as is every magazine on earth. Does this guy censor every magazine that he comes in contact with to protect his family, his friends and his co-workers? Take articles for what they are worth, throw out what you don't like and absorb the rest.

--- end of reply---



---begin reply from---
--Herschel Peeler--

I support those who replace rather than swap. When swapping, there is always the possibility of doing damage either way. Installing a bad part in a good game can down a second game. Installing a good part in a game with a problem can damage a second assembly.

Most of the time we get away with it with no penalty. When it really counts, Murphy's Law catches up with us. Our customers are here to gamble, not us. 'Replace the parts' is the first choice.

As aptly pointed out, that is not always a prerogative. Reality often falls short of perfection. If you are the supervisor, you set the standards for your shop. If those who hold the purse strings are reluctant to cut loose funds for spare parts, it is your job to explain the need to them. This falls under the heading of "communicates effectively" on your evaluations.

----end of reply----

**Any further comments on the subject? Send to editor@slot-techs.com**

# Life is a Game of Chance

**By Jim Ellis**


***Editor's Note: I received the following letter from Jim Ellis. I figure that anyone willing to write over 1800 words on why he is just dying to break into the gaming industry deserves to be heard. He makes some interesting points too about customer service and technical service. If you're reading this while at the TechFest, look around you. He's in the room here somewhere.***

Dear Randy,

It was nice talking to you today. As we discussed on the telephone, here is a little bit about me, my engineering background and why I am trying to break into the gaming industry.

I began my career as an electrical test engineer working my way up through the technology ranks to eventually achieve the credentials of Chief Information and Technology Officer with the appropriate prestige that goes along with these positions.

My first love is that of being an imagineer (an engineer with an imagination beyond the call of duty). An imagineer is a technical person who spends his/her life constantly wondering why this was done that way and "why not try this?" In other words, a person who constantly wants to improve things by re-innovating on the original and so forth.

**Actual Experience**

Three years bench repair, on-site servicing and installation of pinball and video game systems while working my way through college.

Co-founder, President of computer games company. Developing advanced 3-D texture mapped PC games in a multi player environment. Sold the company.

Worked with NASA developing 3-D situational awareness simulators for the CanadaArm for space station freedom. Later used in interactive displays in Museums across Canada.

Developed multi-platform vehicle and weapons simulators for military training centers.

Smart appearance, fit and healthy and can lift more than a hundred pounds. Twenty years of experience managing advanced technology projects and teams. Very experienced in human factors, industrial design and GUI. Technology generalist with proven track record.

**Position Preference**

Gaming systems or Platform project manager with leading and innovative manufacturer. Application or systems hardware development, player, account tracking systems.

Casino, hospitality systems management, telecom and data transport.

Casino floor management or service repair management

Gaming systems instructor

Senior slot tech with appropriate training

**Life is a game of chance**

For some years, my wife and I have visited Las Vegas in the winter and summer allowing us an escape from the day to day grind of corporate life. We are not what I would consider gamblers, we just enjoy visiting the wonderful casinos along the strip that make us feel so welcome with two foot hot dogs and the like.

While on a driving trip to New Orleans, we passed by Biloxi Mississippi and saw all these signs for casinos. Well, we thought that we had died and gone to heaven. Our first non-Vegas casino was the Isle of Capri on casino row which included the Magic and Grand Casinos.

We began visiting Biloxi, then Gulf Port about ten miles further down the coast. I guess we average about a trip every three weeks or so and find it to be one of the most relaxing switch off the brain getaways that we have tried to date.

On our second visit to Biloxi, we decided to stay on casino row for a long weekend. We joined the players club and began racking up points. This is when things got a bit wonky. We had accumulated several hundred points, cash-back etc. so we dropped in at the hotel reception desk, located about one hundred feet from the players club in direct line of sight.

A lovely and pleasant young lady asked if she could be of service. "Yes, please. Could you check to see if we have a room comp?"

She looked at us with a big smile and said, "You'll have to check with the VIP desk"

"Oh. Can you not just check your computer?" I asked.

"No." she said. "We do not have that information."

I felt this was a bit odd. Is the hotel a separate business from the casino? Anyhow, who am I to argue with the experts? Off we went to the players club across the hall. After waiting in line for five minutes or so, we were informed that they cannot make that decision and we would have to visit the VIP booth.

So, off we went to find the VIP desk. We eventually found it hidden around the corner. I asked the hostess the same question. She looked up with a blank expression and said, "Let me find the person who can authorize this."

I asked, "Doesn't the tracking info show up on your screen?"

"Yes," she said "but I cannot make the decision."

"But do we have the points or not?" I asked.

"Yes, but I need a senior hostess to approve it." she replied.

Anyhow, several more minutes passed while the senior was tracked down. "Yes sir, you have two nights free stay on us."

Great! Thank you and off we go gambling.

Now it's time to check out. This is where things got crazy. I explained that we had two nights of room comps. The front desk clerk did not have access to this information on the hotel system and had to phone the VIP desk who then had to pull the file, print out the info and fax it to the front desk reception so our check out could proceed.

To me, this was a ludicrous, inefficient business transaction. It was bad for the hotel and bad for the customer who was waiting for all of this to happen. Being the technology solutions design person that I am, my mind was already working on the solution. Who designed this system? More so, who was the idiot who approved it all in the first place? With this, I began my mission.

***"The smell and sound of a casino is a living, breathing environment that transports people beyond the drudgery of their lives."***

**Several Visits Later**

We tried all of the hotels and casinos over the next few months. I took a great deal of professional interest in how service was performed in all aspects of the operations. Here are my general impressions across all locations, including the newest casino hotel addition to the bay:

I started noticing some games that were chronically out of order. At first one passes this off as a recent breakdown and moves on to the next machine. However, due to the reasonably frequent visits that we make it became apparent that this was not the case. Several of the bigger corporate casinos had the same machines with the same problems over a period of months. A coin dropping through to the tray with only the occasional coin being accepted was another common problem. Why is it happening? Why is it not being fixed?

One of the central casinos had more than fifteen machines with bill acceptors that were out of order. They have remained this way for several weeks and as of this writing are still not fixed. I could understand this on a busy night with staff shortages or when there are just too many breakdowns occurring at the same time but hey! What's going on here?

In another casino that we used to frequent, they had a bank of dollar double diamond machines that where a joy to play. Well, one weekend we showed up ready to risk fifty bucks when bam! I walk around the corner and they have all been converted from Double Diamonds to some awful palm tree coconut theme. The graphics just did not do it for us and were just plain blah! The machines had died as well. To date, this bank of slots has remained for the most part empty and void of human life for the past several months.

As of last week, they have changed yet again. They are now a bank of Diamond Fives, quarter slots and the only action seems to be slot tournaments.

Why am I telling you all of this?

Well, I got to thinking a few months ago that I would like to switch industries if not profession and see what I could do to remedy all of the above. My wife and I thought it might be exciting to get out of the industry that we had been in for most of our careers and switch to the gaming industry.

I said to my wife. "Let's pack our bags and move to Reno or Vegas."

Nine Months Later

After months of research on locations, casinos, manu-

facturers and schools, I am still at a standstill on how to get my foot in the door. I would have an easier time joining the Mafia or getting hired as CEO of IBM than getting an on-site interview for a job in the gaming industry. Now don't get me wrong, I know that if I pulled up stakes, moved to Vegas and asked for a job at the bottom I could probably achieve this but when I present my resume with my technical visionary background I am looked at as though I crawled out from under a rock and must be crazy!

To me, the gaming industry can offer a smart technology "think on your feet" type much greater opportunities than that of standard industry. Why do I say this? Well, except for the back office systems such as accounting and operations there is a big difference in the end customer. Everything I have designed or have been involved with has ended up either in a customer's closet or in many cases, as an electronic gadget and hardware appliance to be used in the home or office.

The missing link to me is the wonderful customer dynamic that transpires when a gaming device is plunked in front of a living, breathing customer. This customer is surrounded by the excitement of winning or loosing pennies or fortunes on every flip of a card or push of a button. The smell and sound of a casino is a living, breathing environment that transports people beyond the drudgery of their lives. It's a fantasyland that is eyeball rich in the latest architecture, human factors and culinary delights that await you around the next corner. Wow, what a life!

**Back to Reality**

So, why is it so difficult for a person like me to get a good job where my global corporate technology experience can help make a difference? Over the past several months I have applied on-line as requested for many jobs in the gaming industry at both the corporate and support level where I know that my past corporate experience along with my personal casino customer experiences would allow my creative juices to help make things better.

I have also applied to the game manufacturers, where my many years of advanced technology and platform development (winning several chairman and President awards of excellence for innovation) would be an asset. Guess what? No one even responds. Not even a "Dear Jim" letter. I even called the slot manufacturer's Human resource departments asking for an on site. I was told that they do not talk to people anymore and that I must apply for positions on-line only.

To me this is madness. How many good people with good technical experience have they missed out on recruiting that may have changed the company's future? Is the gaming industry so sure that they are always right and that outsiders know nothing?

Well, I do not know what to do. Having no gaming contacts and no so-called "industry experience" I'm not likely to get any if I cannot get my foot in the door in the first place.

So in closing, how the heck do I get a job in gaming?

HELP!!!

- Jim Ellis
AceSimmer@aol.com

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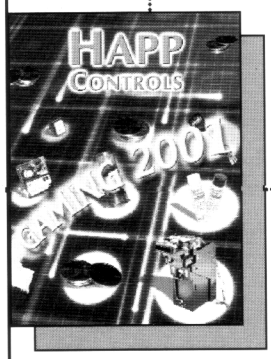


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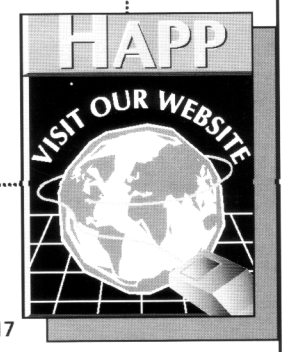


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