Pinball start button not working

A few months ago, a good friend was over and wanted to play some pinball. Great, I said, I have a slot machine. This way. What didn't happen to you? That's not important. Anyway, she started the machine, pressed Start, and... Nothing. The machine did not acknowledge that the Start button had been pressed, even though the rest of the machine was in seemingly perfect working order. Nada. Zip. Bupkis. You may think I have to put in a quarter, but as you can see from the display, it is not necessary. I only ask for quarters when there are people visiting that I don't like. We might as well monetize them while they're here, right? I left it to it at the moment because he knew in the back of my mind that the microswitch button undoubtedly failed. These things fail all the time, and it would be an easy fix when the time comes. Well, today was the time, and it wasn't an easy fix. It's a good story though, so let's move on. Put yourself in me six hours ago when I started this. Convinced that it was a switch, I went on to dismantle the machine far enough to reach it (which thankfully isn't far at all). The first step with any pinball repair is to gain access to the underside of the pitch. For this we unlock the coin door, swing that yellow handle over, and remove the lockable bar on the top front edge. This allows you to slip out a large piece of glass. I've never seen one of those pieces of glass break, and they seem to be very strong, but I still feel like I'm sick every time I handle it. The next step is to remove the balls. This is very important because if you pick up the pitch with the balls still in it, chances are it will come crashing down on who-knows-what and smashing things. I'm a little rusty when working on pinball machines (honestly Johnny has been damn reliable lately) and I'll admit that here I forgot to remove the balls this time. Luckily, all that broke was my pride. The chain wheel also jumped out of the skin for noise, so it was a mess to clean up. Let's go back to pretending I didn't make the biggest mistake you can make operating a slot machine, and take your balls off first. Getting the balls out is actually a little tricky because they live in a closed trough. The computer has the function of exuding balls for this purpose, but it is buried in the service menu and it's having trouble using it. It's easier to just swipe the initiation of the solenoid with your thumb to kick them all out one by one. The next step is to lift the pitch to these runners. Some corrections can only be made from this position. Other brands of machines differ a little in this regard - some do not have these runners. 1990s Williams machines are nice this way. Random fun fact-note Johnny Mnemonic's side art is yellow, but was mostly red in my previous posts on this machine.

Red ink is so pinball companies use a cheap kind that fades badly in the slightest bit of daylight. Even the side in the shade of the window (which is alone in the shade of the alley) disappeared to yellow for the five years I owned the machine. Luckily, the art on the field is under glass, so it won't go away. At this point, the pitch rises. One trick to be aware of with the Williams machine is that you have to pull the pitch all the way forward before lifting it. The hinge has two positions, and if you don't do it right, the pitch slips back into the closet while you lift it, which is really horrible and tied to damaging things. I always pick up carefully, make sure the hinge is locked and the pitch won't slide backwards as it goes up. Pinball machines often have these little handstands to keep the pitch up. Honestly, I never use them because I don't like how they support only one side. I'm afraid it would tend to distort the pitch (which is thin but heavy). I'm sure the stand wants you to notice. Okay, he's got an arrow pointing down to something you should notice, but that requires looking down, and who has that much time? More conveniently, the pitch also has a position above the center that keeps it vertical. I've never had a single fall from this position, but I think it's possible. The towel protects the pitch from scratching the back box. Okay, at this point, we're still blissfully naïve, and we're following the switch hypothesis. Let's get back to it. Here's the back of the start button. It's a standard microswitch associated with spades. The connectors on both sides are designed for the light inside the button. Notice the flipper buttons to the right of my finger. Johnny's got two on the other side. The main ones use a two-stage optical sensor, which gives a very rough approximation of analog behavior. This is part of Williams' Fliptronics II system, which gave you a very visceral-feeling fin. The second fin button is only used to control Cyberglove toy, so it gets an ordinary old leaf switch. At the same time, these microswitches are overrated for their work and woefully inadequate. They are overrated in that they are typically 120V switches with current capacity somewhere around the amplifier. They are the same switches that you can find everywhere in appliances, power tools, garage door openers and almost anything else of a large and electric nature. In this application, they only switch the 5V logical signal from the processor. However, they need to stand up to many years of abuse by teenagers, which is why such heavy switches are used. The problem is that they tend to see so more cycles than microswitches are really good for, and as such they wear out quite quickly. They are also very susceptible to internal corrosion and leaf switches (a precursor to microswitches in arcade and pinball machines) cannot be serviced. This is a microcosm of the fixability debate that you see in many areas. Is it better to have cheap things that can be easily replaced, but do not last long, or expensive things that last a long time and can be maintained, but require this maintenance? Philosophy aside, the good news is that these switches are very easy to check and replace. Arcade people will recognize that the luminaire as the same single arcade buttons used to hold microswitches. It is a plastic fork with two nubbins that register in the mounting holes on the switch. You lift the top out of the way and the switch comes out. You can replace one of them in less time than it takes to clean and set up the sheet switch, so that's it. The next logical step was to test the switch. Time for you olde multimeter (no figure speech-my Micronta is almost 40 years). As is suspected, the switch is quite scaly. It was easy to get him to a position where the button clicked (the inner spring contact was over-centered), but continuity was not present. A little pushing would plug it in. There was a weird gray area after the engagement that was sometimes registration and sometimes not. Sometimes proof can lead you ad a ride. Maybe there were a few problems, but rather this switch, although suspicious, was fine. However, because of the slightly scaly behavior, my mistaken hypothesis seemed to be confirmed and I confidently pushed the wrong way. I usually have a couple of switches, so I dug through a pile of junk. That pile of junk discovered this one. From advanced forensics (i.e. looking at it) we can say that it is used. However, it seems to work perfectly, so that's the point. I cleaned the contacts on my new switch with some scotch-brite and installed it. It's always best to set up a new part for success, so contacts get some TLC. Out with the old ones, inside with... Well.. also old. At this point, I was so sure I corrected that I grabbed Novus and polished the pitch before mounting. Every time the glass is turned off, it never hurts to give the pitch a little shine. Johnny is the king of speed already, and the fresh shine makes him nuclear. All that was left was to press the Start button and rejoice in the victory. I can't wait for all the chickens I have here in the form of eggs. There are so many of them! Aaaaaaa sad trombone. Still no Johnny. Well, now it's getting interesting. To maintain our ingenuity about us, we must keep in mind the basic technique of debugging any complex system. Start close to the problem, and work your way upstream. Every link in the chain is guilty until proven innocent (as is social media). Another thing I did was what I was supposed to start with- switch diagnostic tool in Menu. It is possible that the Start button works, but there is something wrong with the higher features of the game. It's best to rule it out. This confirmed that the CPU actually didn't see the Start button at all, which is actually good news. That said, the problem is probably not a bad ROM or anything. With the switch test mode still active, I started working my way upstream from the problem. You can set it so that the device beeps when the button you are looking for is detected. This allows you to go about debugging with the playfield up and the screen is not visible. Those Williams engineers knew what they were doing. These machines are made for uptime! It's easy to forget what the establishment really looks like nowadays. Another thing you can try is to shorten the wires on the switch directly to see if it registers. Still nothing, so we have to go further upstream. After the wires back from the switch, their next stop is the coin door control board - the outer PCB, which collects all inputs from the front of the machine and passes them back to the main CPU board. It contains fin buttons, coin mechanisms, tilt bob, slam switch (see: teenagers), and so on. Let's look at the board and see what we can learn. At this point I have busted out of a manual that is generally your best friend in tweaking pinball machine problems. Williams manuals have complete diagrams, parts diagrams, harness routing, work. After the switch is eliminated, the other suspects are wires leading to the PCB. A quick continuity check confirmed they're fine, so let's take a look at the connector now. An easy test is to measure continuity from the far end of the wire to the washers on the PCB. If it works, we know the connector is fine. All this checked out, so let's look at the PCB itself. Coin door PCB is actually very simple. It's just a bunch of connectors and some diodes. You might think that pinball machines simply run all their switches back into the CPU, which will decide how to act on them. However, there are too many switches that could do this. No processor or microcontroller (especially from the 1980s and 1990s) has enough inputs for all these switches. Instead, they are arranged in an array as well as a keyboard. Each switch is at the intersection of a row and a column wire and has a diode that separates it from others in the matrix. The CPU scans the matrix by quickly browsing columns and rows to find a closed circuit. This is an effective design, but it has a few key flaws: 1) Scanning takes time and things happen very quickly in a pinball game. A common mistake is that switches are omitted if they are physically close together on the pitch and the ball moves very quickly. The design technique to work around this is to group switches that are physically close to each other into the same row/column (depending on the scan on the matrix to make sure you get scanned in quick succession. 2) The matrix relies on diodes to make switches different, and if any diode goes wrong in a row or column, all sorts of strange things start to happen to other switches in that row or column. Now that we've ruled out the possibility that the problem is connecting physical switches, wires, and connectors, we need to turn to matrix diodes. That's what we're going to control next. To do this, we need a scheme. The diagram for coin door PCBs tells us which diodes are for which switches on the connector in question (J7). The mounting diagram then tells us which switch is on which Pin J7. The Start button is pin 11 on this connector, which oddly enough has two diodes in the series on it. This is very unusual, and I tried to grok why it could be. However, we can start by testing all diodes. This is quite often a problem with problems with the switch, so I would not be surprised. Before you get out the meter, there's a simple test you can do. If there is a bad diode somewhere, as I said before, it will cause problems in other switches as well. So a good trick is to try all the switches in the same column and row as your bad one. This is such a common procedure that the manual has a switch nut on the back cover. When we go through all the sibling switches in test mode, we find two unusual things. Normally, the wrong diode will be all switches in the same row or column. In this case, I had two other switches in my column that were bad, but not all of them. That's strange! The Start button and bob tilt were not registrations. The plot will solidifie! It's not yet clear what's going on, but I had enough evidence to start suspecting diodes, so I decided to pull out the pcb coin door and employ it. The PCB is held on wooden sides with four uncomfortably long screws. With pcb free (except connectors), we can run one more test. Before I get to the diodes, I thought one more connector test might be fine. It was worth trying the short-circuit pins on the connector to see if the game would register buttons. According to the scheme, short-circuit pin 6 on pin 11 should register as Start, but still nothing. Back to the diodes. With a PCB on the table, I could get out the diode tester and go into town. This raises a permanent question- can you test diodes in the circuit? The answer is... Sometimes. If the circuit is simple enough to predict side effects, then yes. If you are not sure, the best desolder one leg to remove the variable. In this case, I decided to try in the circuit, because this board is very trivial. It's literally just a few diodes that cover some connectors. All the diodes checked out well, uncomfortably. However, there was one thing niggling at me.... that double diode on the pin with the wrong button. Why two diodes? I tried voltage measurement (using diode mode on the meter) through where my switch goes, and it reads as if it were a single diode. It doesn't make sense because there are two in a series. It should show twice the voltage drop on the diode tester. It didn't give me anything. Just to make sure I wasn't crazy, I grabbed two diodes from my supply and tested them in a series. Sure enough, they show double the voltage drop in diode test mode, just as you would expect. This really seemed to suggest one of these series of diodes was a short circuit and therefore registers as a single diode. Why do you need two? I don't know, but if he's bad, that could be the problem. However, I tested all the diodes individually and found that they were fine. Then I tested two series of diodes together, and got... without a connection. Co? How? That's when I threw away all my assumptions and used the meter to track down this board. This didn't give me much. You know what I found? Goram scheme is wrong, that's what. Hey, funny story-- D9's actually there. Okay, not so funny after two hours of trying to tune it out. So with the mystery of the Big Diode that figured it out, I learned... Well... Nothing, really. I had an amazing feeling breaking the code, but I was actually back at the beginning with the problem. I kept coming back to the fact that the tilt bob and launch button were also dead though. That was a suspicious coincidence. If not a diode problem, what else do these three switches have in common? A study of the scheme revealed that two of them are side by side in the J7 connector, which is suspicious, but the trigger button has its own connector. So i guess there's no problem with the connector. I've been considering pining the connectors again, but that's a lot of work, and the evidence just doesn't point in that direction. I spent a little more time in a mental trap that it had to be a coin door PCB which was a problem because of all the unsuccessful buttons associated with it. That was the only pattern I've had so far, which was compelling. It took me some time to start thinking laterally again, at which point I realized that I needed to continue going upstream. Like it or not, Logically, I've eliminated everything from here. Another countercurrent was a harness carrying signals from the coin door plate back to the CPU board. The next sensible step was to test the continuity of this harness. This would allow me to check the connectors at both ends and all the wiring between them. This meant digging back into the schemes because there is not one nice harness that goes from coin door PCB to CPU. The wires broke off on the way back and ended up in all the crazy places. Each wire potentially ends up somewhere unique. Or is it? More on that in a moment. Back to continuity of wire control... This is a bit physically demanding because pinball machines are large and multimeter leads are short. It was doable, the other person would be useful. At this point the investigation inexorably led back to the CPU board. That wasn't great news because I'm not looking forward to pulling that. My simple saturday morning fix turned into a big job. However, I made progress, so I continued. Remember how I couldn't find what three bad switches (tilt bob, start button, start button) had in common? Well, tracking that coin door harness back to the CPU answered my question. All three switches end up on the same connector on the CPU board! J212! I knew right away something was wrong. That connector was replaced earlier, according to me, on this blog. I totally forgot! My other thought was that maybe my fix failed and this connector went wrong. Before I fall for it, I can try one more thing. At this point in the system, short pins cannot be combined to simulate switches. You activate entire rows and columns and generally make the CPU unhappy. However, you can bridge the pins with a diode to fake the switch nut to see your button. By shorting the 1 pin pin to pin line 3 with the 1N4004 diode, I can simulate the Start button. However, it hasn't registered yet, so my problem is out of this connector. Another countercurrent behind this connector was the header on the CPU board. Once upon a time I moved the batteries outboard because they leaked on this connector. You can see where this is going. I pulled out the connector to look at it, and it seemed fine. However... Well, post-chapter climbs. Those pins don't look good at all. Could that be the problem? Back when I replaced that connector to remove corrosion, I remember thinking that ideally I should replace the header as well. The thing about alkaline battery corrosion is that it's basically electric cancer. It's never going to go away unless you cut out everything within six feet of it. Okay, the metaphor seems really weird in there, but I get it. At the time I thought these pins could re-corrode if left in place, but I did the calculation to save time by cleaning and tinging it properly later if they behaved up. It's later, and they acted up. So what am I supposed to do? Clean them again and address them later. Time happens to be short today so I can't get this project feature-creep to the point of pulling that CPU board and doing surgery on it. This will have to be a project for the next day. I cleaned up the pins with a nail file and some cream paper, and I put it all together. Did it work? The answer you can probably guess when you look at the slider in this article, but... ... yes, it worked. The CPU now detects the Start button, tilt bob and start button. Result! Well, that was a damn satisfying bit of tweaking, eventually. I still intend to replace that header, but in the meantime Johnny back to the line and ready to entertain your guests (free if I like). you).

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