

PHYS 498 - Homemade Wah Pedal Project

I had several goals for this project. First and foremost in my mind when I came up with this idea was that I wanted a working wah pedal. I also wanted to learn more about how guitar electronics work—I had no previous experience with ac circuits, so I was really excited to have a chance to get some hands-on experience building one. Another goal of mine was to make the wah pedal actually sound good. This required me to learn about what kind of sounds I prefer, the different sound qualities of a wah, and how they can be changed to make an overall sound which sounds good to my ear.

My original plan was to buy a broken wah pedal and use it as a shell for my new circuit. It turns out, however, that the “broken” Dunlop Crybaby pedal that I bought simply needed a new battery connector, so I fixed it up and started playing. This helped immensely in my process of learning what kind of sound I want to hear out of a wah. I learned considerably more than if I had simply been listening to songs in which wah pedals were used. So after playing with my newly fixed Crybaby I was able to figure out what kind of sound I wanted to hear out of my homemade wah. In comparison to the Crybaby, I wanted a wah which allowed more bass and midrange through when the pedal was rocked back (the “wwwwww” part of the wah sound), less treble overall, and a more growly vocal sound. Ultimately I was looking for a fuller, more vocal sound, as opposed to the sound of my Crybaby, which was thin with way too much treble and nothing else.

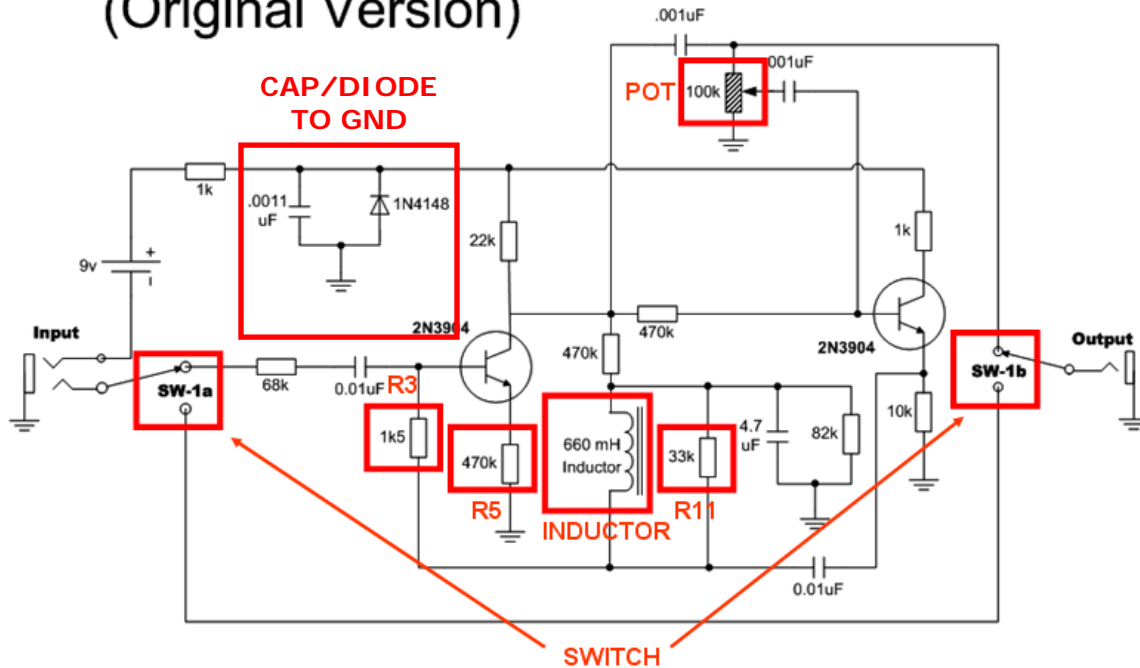
Once I had decided on the kind of sound I wanted, it was time to search for schematics. I decided against designing my own, or fusing schematics of different pedals I liked, as I really don’t know enough about ac circuits and yet to understand what’s going on. Instead I decided to take a common schematic and modify it in ways that

would give it a sound that I liked. I looked at several schematics on www.schematichaven.com, and I ultimately settled on a wah schematic which was used in the 60's and 70's for popular wahs such as the Crybaby, Vox, and Clyde McCoy pedals. There were a few reasons I chose this circuit. First and foremost, it was a simple circuit, and I knew that the fewer pieces I had to buy and the fewer pieces I had to solder, the more likely it was that I would end up with a working wah pedal by the end of the semester. This schematic, and the Crybaby itself, are also very popular, so there is quite a bit of documentation to be found on how to modify the circuit and do-it-yourself instructions. Finally, with the exception of an added output buffer, the circuit in the schematic is nearly identical to the one in my current Crybaby, so I am able to make direct comparisons between the two pedals.

I was fortunate enough to stumble upon the website of a person who modifies wah pedals, particularly Crybaby's. The website, <http://www.wah-wah.co.uk/>, provided a lot of useful info on what modifications I could make to the circuit to tweak the sound to my liking. I also found a forum which had a "Pimp My Wah" thread. The thread, found at <http://www.thegearpage.net/board/showthread.php?t=105298&highlight=wah+pedal+mod>, discussed most (if not all) of the same mods mentioned on wah-wah.co.uk, and also mentioned different transistors which could be used. Since there wasn't much that I could find on what transistors to use, and how the transistors affected the sound, I decided to follow the advice in the thread and ordered the transistors that they mentioned, which were reported to provide more "growl" in the bass and a more vocal "quack" when rocking the pedal forward.

Pictured below is the circuit schematic that I used, with boxes around all of the components that I changed.

Dunlop Wah (Original Version)



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First, I used a different switch than the single-pull double-throw (SPDT) switch, which is standard with wahs that used this schematic. The SPDT switch is undesirable because it does not allow for an actual bypass of the circuit when the pedal is set to bypass mode—the wah circuit is still loading down the signal, which can cause “tone sucking.” So instead of the SPDT switch, I opted for a triple-pull double throw (3PDT) switch, which allows for true bypass, and has extra connections which will allow me to add an indicator LED to indicate whether the wah circuit is engaged or not. I also eliminated the 0.0011uF capacitor and the diode which go to ground in the upper left. These two pieces were not present in the Crybaby, Vox, or Clyde McCoy wah schematics, so I left them

out in my own pedal. In order to achieve a more vocal sound, it was recommended to switch out the 33k R11 resistor with a 68k or 100k resistor. I opted for 100k. It was also suggested to replace the 470 ohm R5 (that's a typo on the schematic—it's not 470k) with a lower value (270-330 ohms) in order to get more gain and a better bass response. I dropped it down to 320 ohms to start off with, as lowering it too much can apparently cause distortion and give the wah a muddy sound. The final modification that I made was to increase R3 from 1.5k to 2.4k. Increasing R3 to anywhere from 1.8k to 2.7k was reported to give more midrange.

In addition to the modifications I made to the circuit, I also used higher-quality parts than what are found in my Crybaby. I opted to use a Fasel red inductor, which is supposed to imbue the wah with a more vocal quality, as well as various magical abilities which I have yet to explore (just kidding!). For my wah potentiometer, I chose to use an "ICAR" taper potentiometer. The taper of these potentiometers is not standard compared to other pots, and this particular taper is reportedly the most favorable style for wah enthusiasts, as they were used in vintage wah pedals such as the Clyde McCoy. I did not use any special capacitors—I was not as concerned with finding "tropical fish" caps as I was with having a decent inductor. I simply ordered some polyester film caps from Digi-Key, along with a bunch of metal film resistors from Pedal Parts Plus.

After putting the wah circuit together and listening to the end result, I am very pleased with the sound. It is very vocal, with much more midrange and bass. The sound is very full when the pedal is rocked back, as opposed to a muted sound on my Crybaby. When the pedal is rocked forward it has a very vocal "aaaah". This is a relief, because my Crybaby kind of sounds like a duck with a sinus infection when it's rocked forward. I

may do a few more tweaks before I decide the project is finished, but so far it sounds very nice.

I really wish that I had come up with these ideas and gotten things done sooner, but financial strain really kept me back. Hopefully this summer I'll be able to do some more playing around with guitar effects and analyze my wah pedal. Now that I have two pedals to compare, I would eventually like to hook them up to the spectrum analyzer in the lab and see how these acoustic differences are manifested in the signal of the circuit. Another thing that I may do is to put the schematic into Electronics Workbench and see how the circuit behaves. This would allow me to easily switch out different components (such as the resistors that I changed in the schematic), and see how it affects the output of the wah circuit. The computer simulation won't be able to perfectly emulate the hardware of my circuit, but it can provide a lot of insight into the quantitative difference between a wah with a more "vocal" sound as opposed to my original Crybaby.