SMOKE ANIMATION FOR TRAINS

Brookgreen Gardens, Pawley's Island, SC

Based on the design created by Dave Bodnar (http://www.trainelectronics.com/articles.htm) we made several smoke "machines". These were used in a train display during Nights of a Thousand Candles at Brookgreen Gardens in Pawley's Island, SC. This is an annual exhibit that runs each December. During the 11 nights of operation in 2019 over 60 thousand guests visited the gardens

DISPLAYS

The Smokers were used to animate a car with a blown engine at a drive in movie and a volcano and jungle display in an amusement park. Pictures are below:

Car with blown engine. A red light under the car lights and then the smoke engulfs the car.

A smoking volcano and jungle display in amusement park.

MOUNTING ARRANGEMENT

Each animation was fed by its own Smoker. The exhibit runs for approximately six hours over 10 to 11 nights. We took Dave's basic idea and created a design that we thought would be easy to maintain over a long period of time. Because of the long exhibit time, we wanted the maximum smoke juice feeding the heater. We used two pill bottle from our "collection". A large (2" dia, 3 ½ " high) and a small version (1 ¾ " dia, 2 ¾ high). The larger one was used for the heater and smoke juice and the smaller one for the bottom air chamber. The heater was installed per Dave's instructions in the bottom of the larger bottle. We drilled a clearance hole in the bottom of the air chamber bottle and then used hot melt glue to attach them to each other-- bottom to bottom. Other holes for the airline and wire were drilled in the bottom bottle per Dave's instructions.

The thread on the top of heater bottle was removed for about half of the circumference. We ground the thread off using a grinding/sanding wheel in a Dremel tool. This was done so the top could be screwed on and off with only a partial revolution.
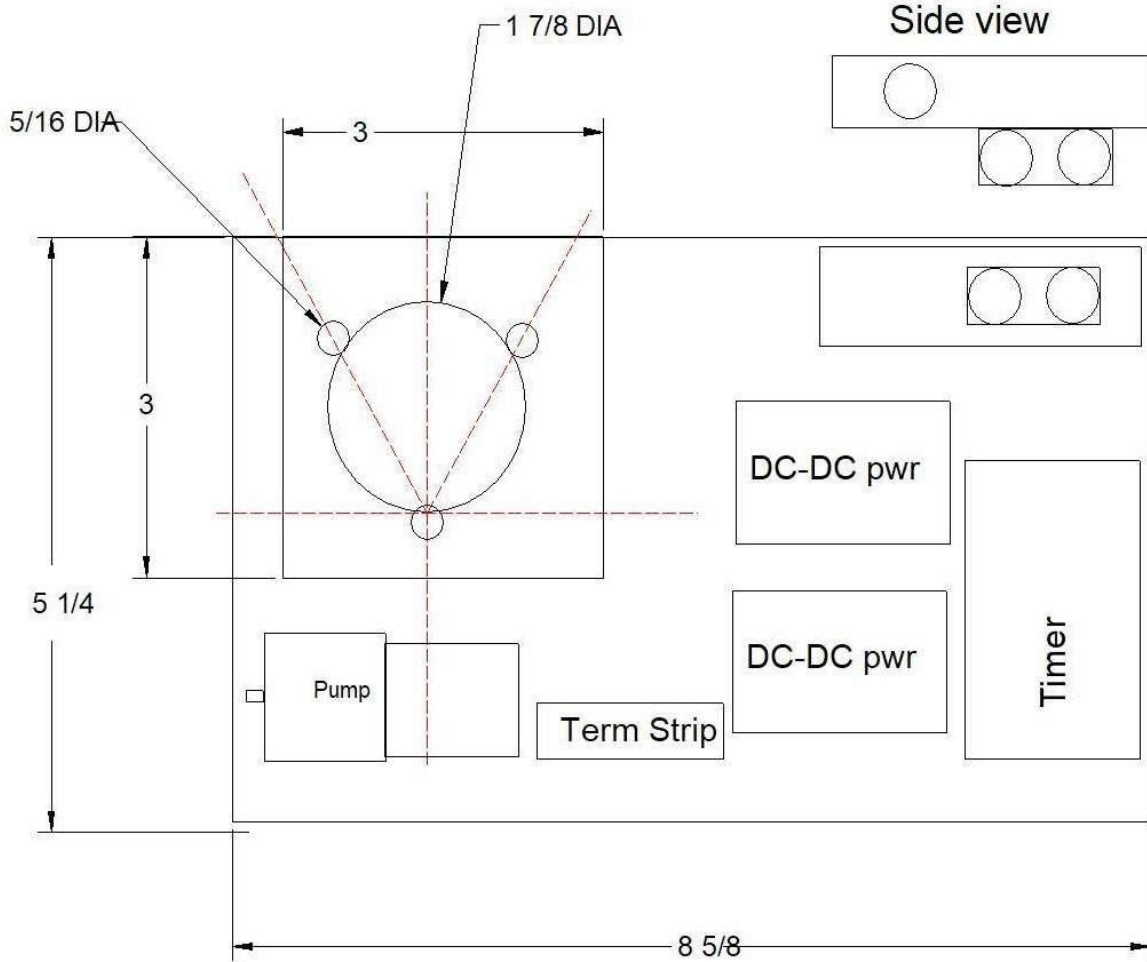
The stack of pill bottles needed a protective mounting. So we came up with arrangement you see here. It is all mounted on a piece of 3/8" plywood. We used a piece of ¾" pine with a 1 7/8 inch counter sink and drilled for three 5/16" dowels (approx. 6" long) to hold the stack of medicine bottles. A piece of aluminum channel designed to be edging for ¾" plywood (outside dimension is 7/8 ") is mounted on two pieces of ¾" wood blocks. This makes a good place to mount the switches and power plug. It also acts as a nice handle to pick up the smoker. The pump is mounted on a piece of 2 x 4 that has been bored through with a 1 ¾ inch diameter bit. The 2 x 4 is then cut and half, attached to the plywood, with the pump cushioned with a piece of ¾ inch pipe insulation, and fastened with a cable tie in a hole drilled through the block. The two power supplies and the timer are attached to the plywood using short standoffs. No glue was used so everything could be disassembled if necessary.
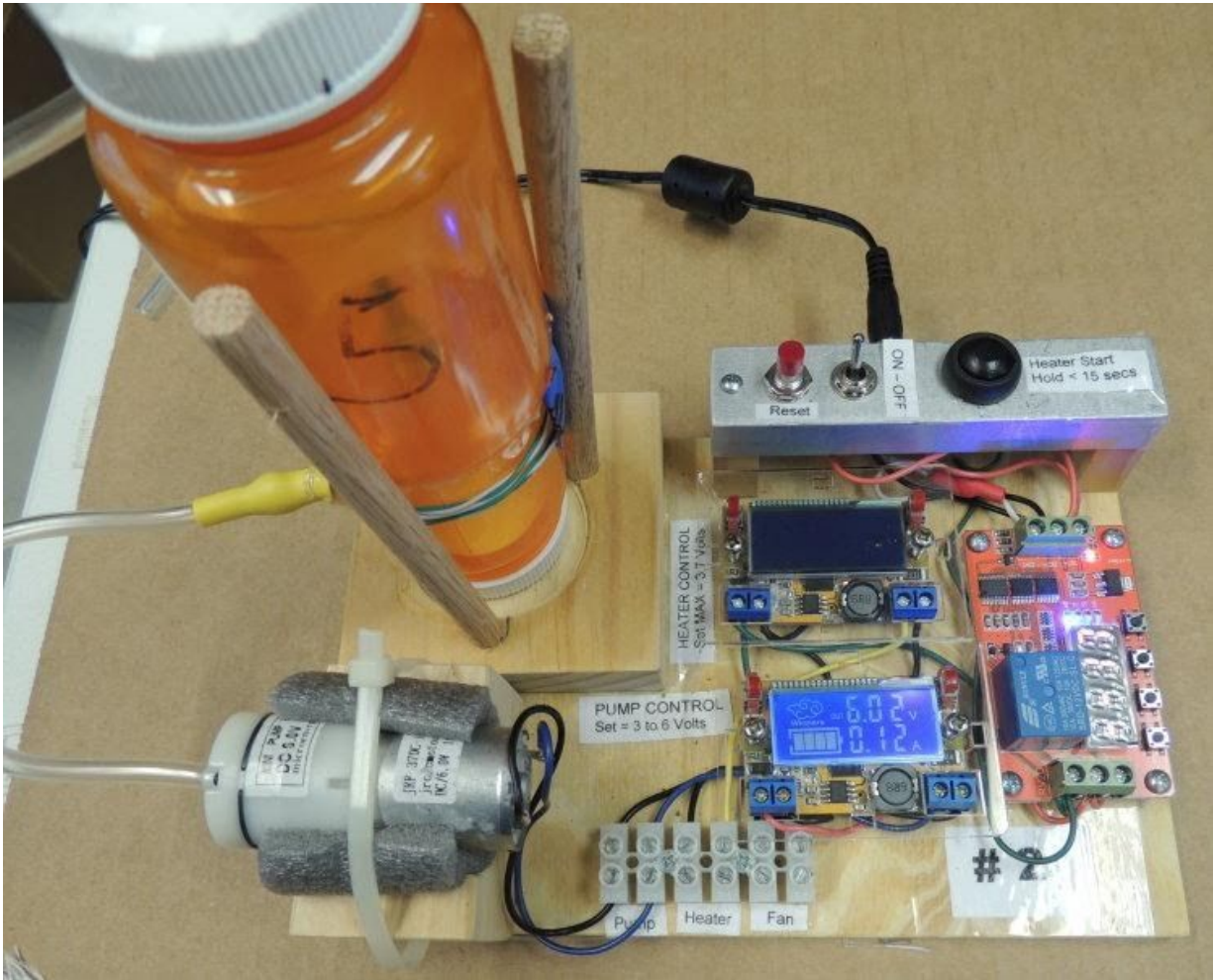
Picture of Smoker without binding posts and with the heater start switch.

WIRING DIAGRAM

The wiring diagram "A" incorporates two DC-DC power supplies. One is for the pump which allowed us to run at full 6 volts for maximum air flow. The other is for the heater to keep it at 3.7 volts. We also wired the pump to be on all the time to reduce condensate forming in the air lines. The initial plan for the displays called for a remote switch initiated by guests to start the smoke sequence. We installed terminal posts to provide easy connection points for the remote start switch. After a demo of the smokers controlled just by the timer was seen, we decided not to have any guest interaction. This also assisted in the crowd through put. Provisions were included to install a small 1" by 1" 12 volt fan to enhance the effect. These were never used. Though not shown on the diagram, the light under the drag racing car was powered by the timer when the smoke heater was on.

Wiring diagram "B" reflects the changes we incorporated for the second year of operation. We eliminated the binding posts since we were not using the remote switch and added a Heater start switch. Holding this switch down allows you to manually turn on the heater to get the smoke started at the beginning of the operation or when you need to restart the system after adding "smoke juice" during the evening.

OPERATION OF FRM01 TIMER

The FRM01 TIMER worked very well for the operation of the Smokers. It comes with several program options depending on your application. If used with a remote switch to start the smoke cycle, we decided Program #13 was our best choice. The program used for all of our operations was the continuously running option -- Program #17. We used T1 as the OFF time and T2 as the ON time. After you start the program running by closing the RESET switch it runs for a specific number of cycles. The number of cycles is set by the NX setting. We initially set NX for a 100 or so cycles to see how the smoker worked, needed more smoke juice, etc. Anytime you close the RESET switch the cycle counting starts over. We eventually increased the number of cycles to several thousand. The OFF and ON times are selected based on the effect and the amount of smoke you want to generate. Having the smokers readily accessible on the table behind the exhibits made it very easy to adjust the times and add the smoke juice as needed.

DOUBLE PUMPER

To make the smokers readily accessible they were placed on the table at the back of each exhibit with a plastic airline running about 4 to 5 feet to the discharge point. Though convenient for operations we experienced a small problem with condensate forming in the airlines even with the pumps running all the time. So for the second year of operation, we built a new smoker with two pumps and fed the volcano and jungle exhibit through a Y connector feeding an airline going to each exhibit. The layout and a picture are shown below:
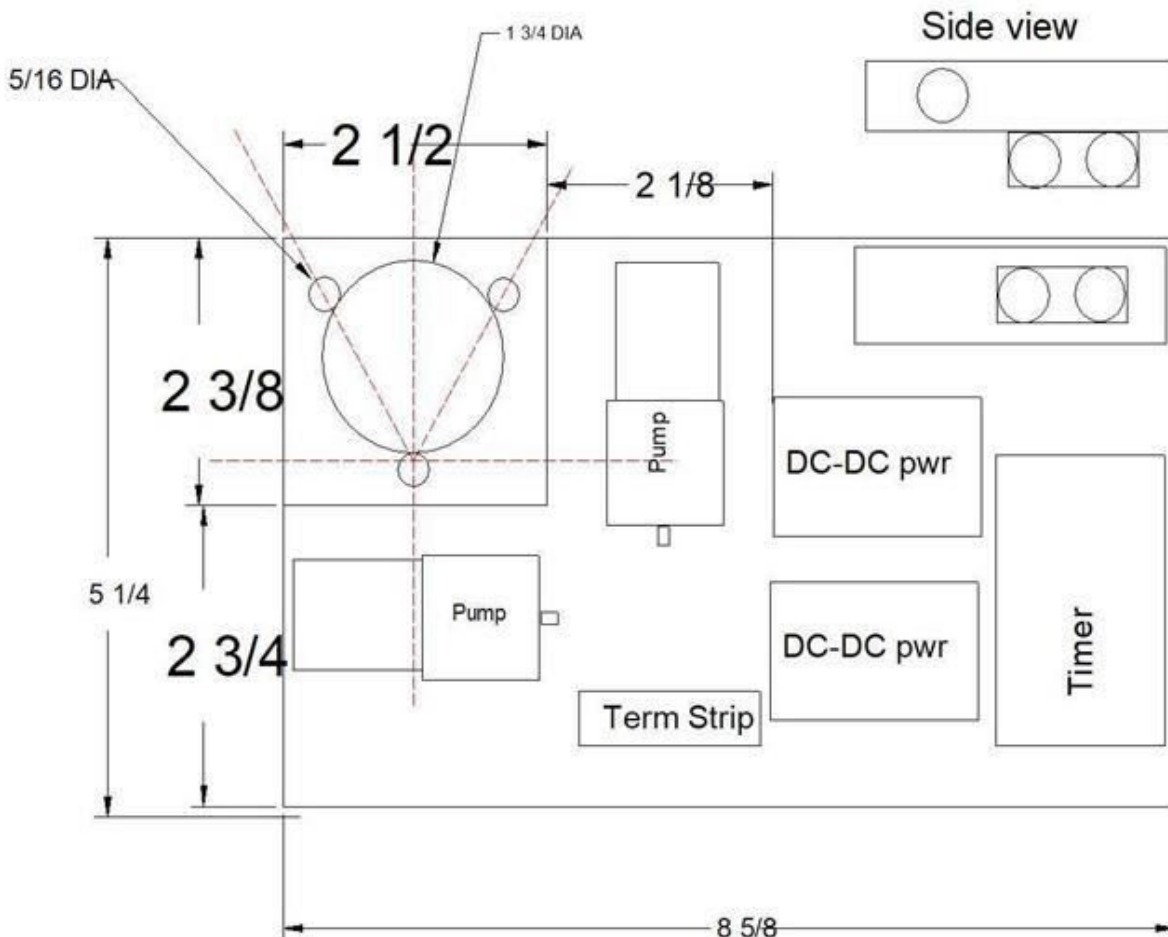
We powered the two pumps at 6 volts from the DC-DC power supply. However, we could have eliminated the second DC-DC power supply and fed 12 volts to the two pumps in series.

SHUT DOWN PROCEDURES

After a few nights of operation we developed the following steps when shutting down the systems.

1. About 10 minutes before closing, turn the power switch off and then back on again – do not close the RESET switch. This turns off the heater and stops the generation of smoke. It does leave the pump running so you hopefully will blow out all the smoke and not leave any in the airlines to cool and form condensate.

2. At closing, shut everything down. Remove the top cap on the heater pill bottle and disconnect the tubing from the pump. The wiring for the heater is left long so you can lift the whole

assemble out of the dowels. Pour out all the remaining smoke juice from the top bottle into a container. You can reuse the juice the next time you load system up. If you do not empty all the unused juice out of the top bottle, it will leak down through the heater and collect in the bottom bottle.

3. The last step at closing is to blow out all the airlines. You can do this with a can of compressed air. To make a better seal between the can and the tubing, we glued an airline straight line fitting to the red tube that comes with the canned air. This can be seen below:

OTHER MAINTENANCE

The smoke juice is not easy stuff to work with. We always used wet wipes to clean up after filling or shutting down. Also, we periodically washed out the pill bottle assembly. Plain water is all that is necessary. Disconnecting the heater wiring from the terminal strips makes this easy to do.

Be careful when loading the smoke juice and do not drip any on the DC-DC Pwr modules or the timer. Adding a cover over them would help. When filling the bottle smoke juice, pour in enough to cover about half of the heater. We found this to be more than enough to run the smoker for a six hour operation.

We built spares so we could quickly change out items during the night when we had problems. We had extra complete heater/air chamber bottle assemblies as well as complete smokers. Several times we had smokers completely stop on us. We changed them out to the keep the show running. After cleaning them up and restarting them the next day, the problem children worked fine. Never did figure what caused the problems.

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