

# Setting up an Auto Top off System

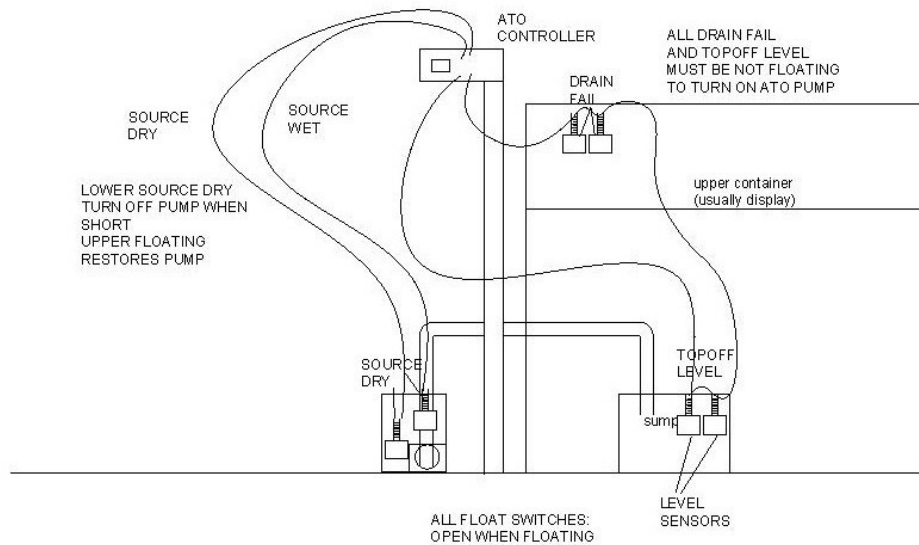
For: North Alabama Club Meeting, 23FEB19

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1. Acknowledgements:
  - 1.1. Many you tubes on latching relays.
  - 1.2. BRS auto top off video.
2. General and Safety considerations:
  - 2.1. General sump setups:
    - 2.1.1. Insure no floods with power out.
    - 2.1.2. Insure normal operation returns with power returns
    - 2.1.3. Insure the sump runs dry before the top container floods
    - 2.1.4. (I forgot that one on my original sump)
    - 2.1.5. Return system to normal operation and mark the sump level.
    - 2.1.6. Never add water above that line.
  - 2.2. Electrical:
    - 2.2.1. Alternating Current (AC) passes through the body damaging muscles and nerves.
    - 2.2.2. Direct Current (DC) "skims" along the skin not affecting muscles and nerves.
    - 2.2.3. In tank use DC no AC
  - 2.3. Ebay is not the most reliable source LOL.
  - 2.4. Reliability: If a float switch has a random failure every 365 days two switches side by side (wired in series) will have a failure every  $365 \times 365$  days or 365 years.
3. Materials:
  - 3.1. Float switches \$1-\$2 each with free shipping from china.
    - 3.1.1. Might take several weeks.
  - 3.2. 12V DC dual pole dual throw relays with socket and led when engaged. \$2.88 ebay free shipping
  - 3.3. Heat moldable plastic strips \$15 from Polly Plastics factory 2 day shipping.
  - 3.4. 100' doorbell wire. ~\$10 for 100'. Home supply stores.
  - 3.5. 120v to 12vdc adapter. \$6 ebay
  - 3.6. ~4"x6" waterproof project box ebay \$6 free shipping.

- 3.7. Water pump max pump height at least 20' Local \$50 or so.
- 3.8. Egg crate \$10 home supply stores
- 3.9. Plastic sheeting \$6 home supply stores.
- 3.10. Various pvc pipe and fittings for plumbing and protecting the floats.
- 3.11. JB weld plastic weld. \$3 home supply stores.
- 3.12. Aquarium silicon sealant. \$3 home supply stores
- 3.13. ½" ID and other plastic tubing. Home supply stores.
- 3.14. Nipples for pump to pvc. Home supply stores.
- 3.15. 2 wire (lamp) extension cord. \$1.50 lowes
- 3.16. Nylon hex standoffs and screws. \$2-4 rc hobbies. (used to mount 12VDC printed circuit)
- 3.17. Rosin core solder, heat shrink tubing \$5 harbor freight
- 3.18. Small twist wire connectors \$3 home supply stores

#### 4. Overall setup/theory:



- 4.1. Where possible use two float switches (tank and toff level) for reliability.
- 4.2. The pump is the only 120v AC, the rest 12VDC.
- 4.3. With water in the source container:
  - 4.3.1. Any level sensors in the top off tank 'floating' turns off the pump.
  - 4.3.2. If the display drain is blocked one or both of the drain fail floats will float turning off the ATO preventing display flood.
- 4.4. When the lower source dry float is not floating, power to the pump is turned off to prevent the pump from running dry.
- 4.5. When you add water the pump remains off until the upper source dry float floats. At that point the pump is again controlled by the sump/display floats.
- 4.6. Relay LEDS:
  - 4.6.1. Relays will turn on a led when engaged.
  - 4.6.2. On the pump control relay, the led means the pump is running.
  - 4.6.3. On the latching relay source empty, the led will light indicating the source is low and you need to add water.
- 4.7. It is possible to reverse the function of the float switches. My first 'try' did that and added a float switch to open when water was down to the source tank. And it did turn off the pump. But water was still in the plumbing which returned to the source. Which refloated the switch. So the relay cycled on and off. This wears out the switch and pump. Hence I added the latching relay function.

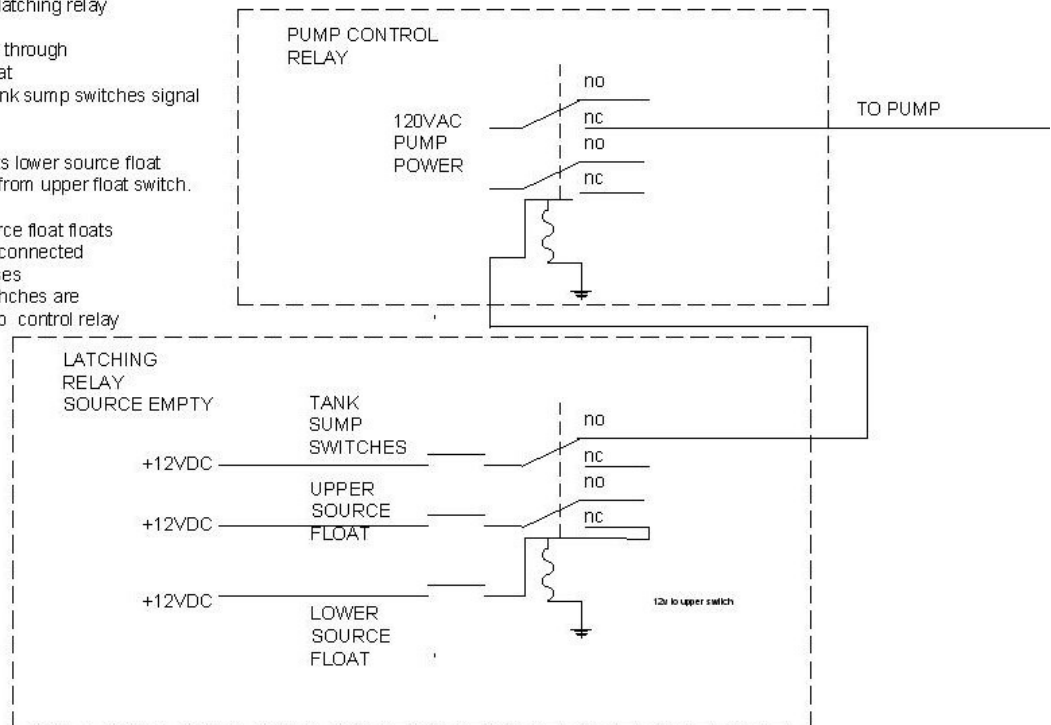
## 5. Circuit diagrams:

tank sump switched pass 12v  
to pump control relay  
which energizes to pass 120vac to pump

if lower source float sinks  
12vdc energises latching relay  
which:  
a) passes 12vdc through  
upper source float  
b) disconnect tank sump switches signal  
(pump off)

when water floats lower source float  
12vdc still fed from upper float switch.

when upper source float floats  
the 12vdc is disconnected  
relay deenergises  
tank sump switches are  
passed to pump control relay



### 5.1. Pump control relay.

5.1.1. Turns on pump when 12vdc applied across coil.

5.1.2. 12VDC is supplied when any float switch is floating in sump or display and there is water in the ato source.

### 5.2. Latching relay source empty.

5.2.1. With no coil voltage, the tank/sump switches pass through the normally closed to the pump control relay. Controlling the pump.

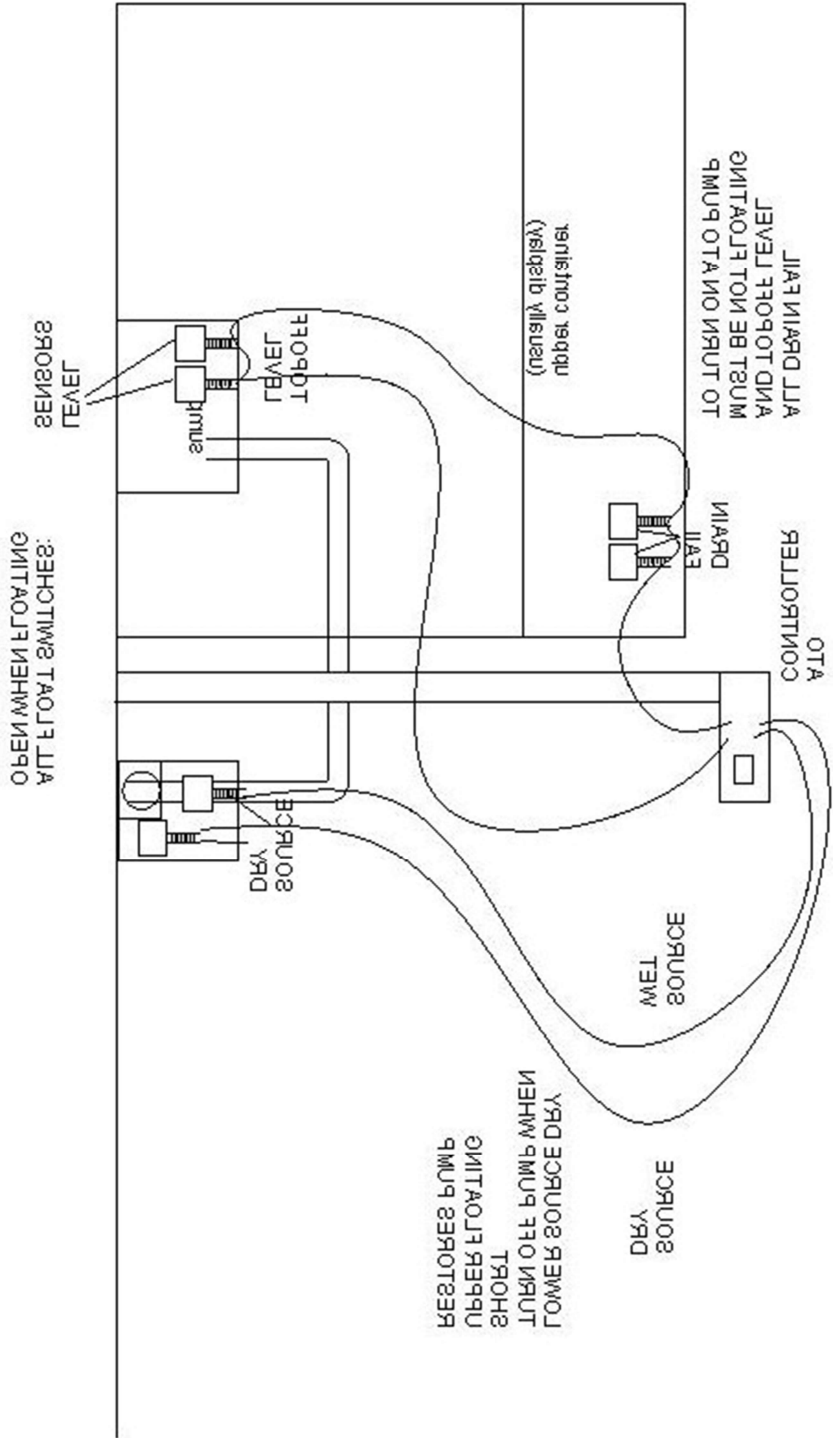
5.2.2. As the water level in the source goes down the upper source float drops. This passes the 12VDC to the normally opened contact which does not affect operation.

5.2.3. As the water level continues to go down in the source, eventually the lower source float drops providing 12VDC to the relay coil. Closing the contacts.

5.2.3.1. The tank sump switches is now connected to the normally closed contact isolating the tank sump switches from the pump control relay. Turning off the pump.

5.2.3.2. The upper source float now connects 12VDC to the normally closed (NC) contact and therefore the relay coil.

- 5.2.3.3. The relay coil now has 12VDC power from the lower source float and the upper source float.
- 5.2.4. As water is added to the source the lower source float floats. The relay remains engaged because 12VDC also comes from the upper source float.
- 5.2.5. As more water is added eventually the upper source float floats breaking the 12VDC to the relay coil. At that point the tank sump switches resume controlling the pump.



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