



# Mid-Atlantic Antique Radio Club

*Collecting and Preserving Our Electronics Heritage*

## Re-Stuffing Components

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What Are We Talking About

# Topics

- Electrolytic Capacitors
  - Aluminum Cans
    - Wet Electrolyte
    - Dry Electrolyte
  - Paper
- Paper Capacitors
  - Common Paper
  - Atwater Kent Paper
- Philco Bakelite Capacitors

- Other Capacitors
  - Metal Case Non-electrolytic Capacitors
  - Metal mica capacitors
  - Large metal cans
- Resistors (Reproduction vs Stuffing)
  - Dogbone
  - Atwater Kent Ceramic
  - Cloth Covered Wire Wound
- Repair vs Stuffing

# Electrolytic Capacitors

- Aluminum Cans – Wet
  - Opening
    - Do they contain electrolyte?
      - How to drain
    - What if they are covered in cardboard?
      - Remove or cut through?
    - Where to cut open?
      - Top or Bottom?
    - Is positive terminal a bolt or rod?
      - Removing bolt
      - Removing rod

## – Re-Stuffing

- Brass is preferred terminal placement material
- What to do about negative terminal?
  - » Hole through side or out bottom?
- Axial replacements are easier to work with
- Ensure positive terminal is well insulated
  - » Rubber grommet
  - » Liquid Insulation
  - » Black auto gasket material

## • Aluminum Cans – Dry

### – Somewhat harder problem

- Opening is same as wet electrolytic
- Removing internals is harder
  - Most are Tar/wax filled
    - » Heat gun or outdoor gas grill
    - » Drill and large lag screw
    - » May need to be inventive
    - » May take a long time
  - Remaining steps are same as re-stuffing wet electrolyte

- Paper Electrolytics

- These are basically handled in the same manner as will be discussed in the next topic

# Paper Capacitors

- Common paper capacitors
  - Opening
    - Heat gun is my preferred method
    - Aluminum foil tray
    - Oven mitt
    - Appropriate size wood/metal dowel
    - Melt wax from both ends removing wire connections
    - Heat entire body and push internals out with dowel
    - While capacitor body still warm wipe with rag to clean



## – Re-stuffing

- Insert replacement capacitor
- Fix in place using hot glue gun
- Fill in voids (Wax Paper, Paper Toweling, or more glue) to leave only a small area that needs to be refilled with wax
- Melt some bee's wax in small container
- Use vice or other means to hold capacitor vertical and pour in the melted bee's wax
- When first end hardened, reverse and do same for other end
- If new label is required use Microsoft Powerpoint and computer to make new label copying old label
- Glue label on with white glue and coat entire capacitor with wax by quickly drawing through some melted bee's wax and wiping with rag

- Atwater Kent Paper Capacitors

- Opening

- A little harder because wire leads come out side rather than ends
    - Need to cut leads off as close as possible to body first to prevent damaging cardboard tube
    - When removing remaining leads after wax melted out of ends need to use needle nose pliers or tweezers to prevent tearing out holes

- Re-stuffing

- Tricky part is getting leads of new capacitor back in holes in side of tube
    - First one is easy
    - Second one requires manipulation with needle nose pliers and extreme care to not rip out either one of the holes
    - Remainder of process is same as previously discussed

# Philco Bakelite Capacitors

## – Opening

- is much the same paper capacitors
- Biggest difference is they are sealed with tar
- Heat gun still best method, although you can use a gas grill or in extreme circumstances, your wife's oven
  - Watch that you don't burn the Bakelite
- Use aluminum foil tray to catch melted tar
- Clean body after internals removed using a tar remover (gasoline or kerosene work well)

## – Re-stuffing

- Most of these contain more than one capacitor, so either make drawing of connections or use the Philco Capacitor info/drawings to make sure you get connections correct
- Fix capacitors in place with hot glue gun
- Insert piece of cardboard cut to size in opening
- Melt tar with heat gun and pour on top of cardboard

# Other Capacitors

- Metal can non-electrolyte capacitors
  - Most familiar with Atwater Kent multi-capacitors but have seen some others
    - Process remain pretty much the same as far as melting out wax and removing capacitors
      - Will require a substrate on which to mount the new capacitors
      - Have used both Bakelite sheet and perfboard
      - Need to draw out arrangement to have wires terminate in the correct order
      - Mount capacitors with hot glue and ensure leads are properly insulated (shrink tubing)
      - Seal end as described earlier with wax or tar

## – Atwater Kent Metal Can (2<sup>nd</sup> Variety)

- These require a BIG soldering iron
  - Best to do outside
- Remove bottom using BIG soldering iron
  - Use iron on one side holding condenser more or less vertical so solder runs down
  - When have an opening insert screwdriver blade
  - Heat remaining side with iron using screwdriver to separate bottom from shell
  - After bottom off, use heat gun to melt out wax
  - Pry paper capacitors out and un-solder any remaining leads and make sure holes for leads are clear
  - Use iron to clean off any left over solder from the edges of the shell and the bottom

- Re-stuff with proper value capacitors
  - Ensure they are in correct location and that they will not prevent reinstallation of the bottom
  - Most have all ground terminals connected together
  - Drill small hole in one side of shell to connect ground terminals
  - Reposition bottom into case
  - With shell lying flat use iron to re-solder case
- Reinstall on chassis
  - Most of these were originally riveted to the chassis and to maintain original appearance this can be done again, but using bolts and nuts is much easier

- Metal Mica Capacitors
  - Open up capacitor by prying up edge of case
  - Heat gun helps to free up wax and remove top plate
  - Replacement capacitor needs to be thin enough to fit in case
  - Use existing terminal connections and cardboard internals as necessary to preserve original appearance
  - Ends can be sealed with wax
- Large Metal Cans
  - These are generally treated the same as the previous metal can capacitors
    - These are however most likely filled with tar.
    - Best choice is to use the gas grill
    - Heat on an aluminum foil pan at about 250-300 degrees
    - Depending on size, may take awhile
    - Will need screwdriver, putty knife, stick or some other tool to get internals out
    - Cans can again be cleaned with tar remover prior to re-stuffing

- Re-stuffing will probably require a substrate since these cans generally contain more than one capacitor
  - Will also require a baffle so you only have to seal the end with tar vice refilling the whole can



# Resistors

- Resistors really can't be "Re-stuffed", but some can be replicated
  - Dogbone Resistors
    - Replicate by using silicone mold and epoxy
    - Mold is made using silicone rubber and an original dogbone resistor of the correct size
    - Micro-Mark has several different molding kits available with detailed instructions for making the mold
    - New resistor of proper wattage is carefully centered in half the mold and then the other half is replaced
    - Epoxy resin is mixed and poured into mold
    - After epoxy has hardened, mold opened and replica of dogbone resistor is removed
    - Replica is cleaned of any excess epoxy material and the hand painted to match original dogbone resistor

## – Atwater Kent Ceramic

- These are significantly harder to replicate
- First need to obtain a hollow ceramic tube of the proper size for the required wattage
- Need to cut to proper length.
  - Use Dremel with diamond saw blade
- Need to build a metal mold to form end cap
  - Use a two pieces of  $\frac{1}{4}$ " aluminum plate 3" long and 1" wide
  - Clamp piece together
  - Drill  $\frac{7}{16}$ ",  $\frac{5}{16}$ ", and  $\frac{3}{8}$ " holes approximately  $\frac{1}{4}$ " deep
  - Drill  $\frac{1}{16}$ " hole in center of each of these holes for resistor lead
- Obtain proper wattage resistor that fit inside ceramic tube
  - Center resistor in tube and cut one resistor lead to fit in lead hole and position ceramic tube correctly in the mold

- Now ready to build replicate resistor
  - Clamp the two mold pieces together with C-Clamp
  - Position the resistor in the ceramic tube into the proper hole for the wattage in the mold
  - Position some lead shot around the ceramic tube and heat the mold and the lead shot with a propane torch until it melts and flows to the bottom of the drill hole in the mold
  - Let it cool and the lead solidify, then unclamp the mold and repeat the process for the second end
- The final step is just to paint the ceramic tube with the proper colors that the original had
- While this takes some time, it produces a real close replica and maintains the original look of the radio

## – Wire Wound Cloth-Covered Resistors

- I have had some luck in finding the break in these type resistors and it is always worthwhile to try this before replicating
- The major part needed to replicate this type resistor is nichrome wire
- How to Replicate
  - First remove the end terminals from the failed resistor for use on the new resistor
  - Construct a jig to wind the nichrome wire
  - Use a piece of vinyl or rubber coated wire as the foundation for winding the nichrome wire
  - Remove the actual wire from the coating maintaining the coating intact
  - Mount the wire coating in the jig
  - Wind the appropriate amount of nichrome wire on the wire coating being careful to not overlap any turns

- Use tape to periodically fasten in place just to facilitate easier winding
- When correct resistance is obtained secure the wire end
- Wrap the entire winding in insulating tape
- Remove from jig
- Cut ends of an appropriate sized shoelace and thread shoelace onto a metal rod or dowel expanding the opening to facilitate transfer to the wire resistor
- Fasten shoelace in place and add the terminal ends from the original resistor using epoxy glue
- Connect the nichrome wire end to these terminals using silver solder
- The cloth can be left plain or covered with melted wax if desired. I have seen both types in the radios

# Repair vs Re-stuffing

- Many components can't be re-stuffed but may be able to be repaired
  - Transformers
  - Coils
  - Speakers
- These could be topics for other presentations

# Material Sources

- Brass rod
  - Hobby Stores, Hardware Stores
- Insulating Material
  - Gasket Making material (Auto Parts Stores)
  - Liquid Tape (Home Depot)
  - Grommets (Hardware Stores, Arcade Electronics)
  - Tape (<http://www.tapecase.com/>)
  - Nichrome wire (<http://jacobsonline.biz/>)
  - Ceramic Tubes (<https://www.omega.com/>)
  - Fish Paper (<https://www.telephonetools.com/>)