

# M R L

## 18

# Crystal Set Circuits

by Elmer G. Osterhoudt

### C O N T E N T S

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## INTRODUCTION

This Handbook No.25 is a complete revision of BP-25 - published by us years ago. However, it is entirely different, inasmuch as the circuits have all been changed, some deleted and others added. Time really does tell when it comes to Radio circuits.

The interest in Crystal Sets hasn't waned since 1932, and was at its peak during the War when most parts and tubes were hard to get. It has now grown to a full-time hobby with thousands of Fans. An Engineer, or professional man gets as much kick out of one as a teen-ager. New enthusiasts are appearing daily.

Some of the large companies,

that got exorbitant prices for Radar crystals during the War, are getting into line with the same crystals for Radar, FM, and other Hi-Frequency uses - terming them "Crystal Diodes." To an Old Timer, they are still Crystal sets, altho to one accustomed to knocking Crystal Sets - can now buy them under the new name and have a clear conscience! There is lots of work to be done in this line yet - just look into the technical magazines and see how the Engineers are working on them. We hope this Handbook will be the means to helping you make a contribution to the "Art of Catwhisker setting."

Hayward, Calif.

E.G.O.

Cartoons by H. Kowalik

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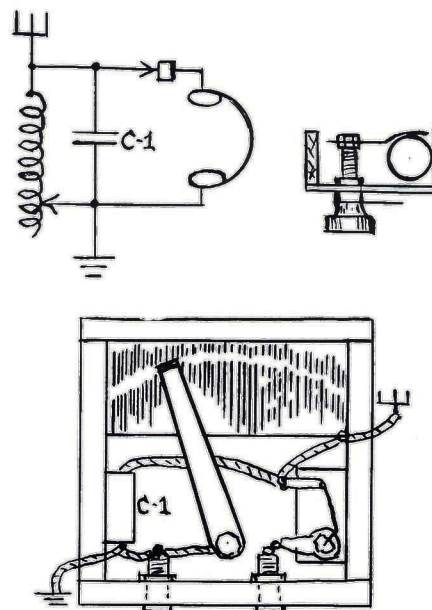
Elmer G. Osterhoudt

'WITH RADIO SINCE 1915,' including:

Radio Operator, R.C.A. Marine Service  
 Radio Mechanic, Maximum, U.S.N.  
 Technician, Electrical Products Corporation.  
 Southern California Edison Company  
 Majestic Electrical Products.  
 U.S. Motor Company  
 Manchester Radio Electric Shop  
 Modern Radio Laboratories  
 Amateur and Radio Service  
 6NW (1919)

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## MRL #19. XTAL POCKET RADIO. DP-33



## PARTS LIST:

- 1 .00025 Mica Condenser (C-1).
- 1 #19 Coil, see text.
- 1 Switch lever.
- 1 Midget Fixed Iron Pyrites Xtal.
- 2 #22 Stranded Hookup wire.
- 1/4" Plywood for box.

Build this set in a box 3" sq. and from 1/4" plywood covered with imitation leather. Or, it may be stained, painted or lacquered. Rabbet a slot along the top to hold panel, or set it down into a slot with narrow 1/8" strips. Also may be mounted on top if desired. Panel may be 1/8" composition, Bakelite or wood, layed out as per sketch. Screw down with #2 FH wood screws; may be countersunk.

Coil may be about 200 turns of #32 Enamel, closewound on a Bakelite tube 1" dia. x 2 1/2" long, or to fit snugly into the box.

Slider is a long Phosphor-bronze or spring brass strip - end of which is bent down to contact coil. Raise lever up on a bushing to clear the coil. After lever and coil are assembled - lightly sandpaper path of the lever slider on coil. A light-weight lever is used to prevent undue wearing of wire. A touch of vaseline, rubbed off, will help lever to run smoothly.

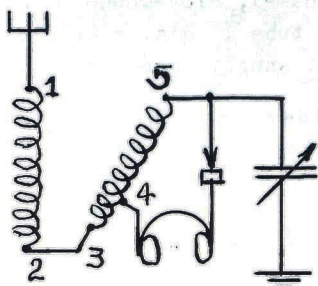
The .00025 fixed mica condenser is necessary for selectivity, and making set tune to lower frequencies. We suggest using a fixed iron pyrites or other set Xtal inside box for stability.

A good aerial and ground are essential if you want a lot of loud stations. However, for good strong local stations, we have used a gas stove, light fixture or plate, etc. as a substitute for aerial. In latter cases, try it with or without a ground, - whichever works best, as the electrical circuit may be grounded

Refer to DP-33 for scale drawing and details. Also data on other Pocket Radios and loading coil.

Note. To adjust an open-type fixed Xtal - bend catwhisker down with long-nosed pliers, to make firm contact with Xtal. Then with thumb and forefinger, adjust it sidewise for sensitivity on station.

## MRL #20 CRYSTAL SET. (DP-66)



## PARTS LIST:

- 2 #20 Coils (1-2-3-4-5), see text.
- 1 .0005 or .00035 Variable Cond.
- 1 Crystal, any type.
- 1 Crystal stand, etc.
- 2 Binding Posts for Aerial-Ground
- 2 Phone tip jacks.
- 1 Baseboard, about 6" square.
- 1 7x8 panel (if using Variometer)

This is a simple Variometer Crystal set. Two coils of a Variometer may be used in series. Or, two coils may be mounted on a board, so they may be rotated.

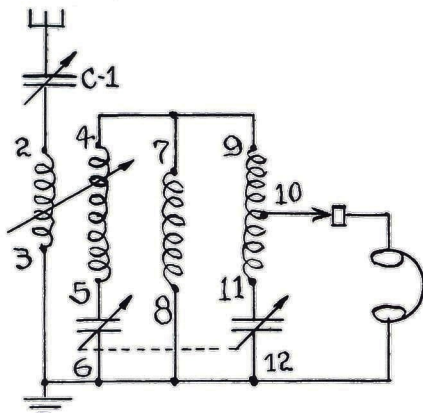
Wind **Coil (1-2)** 55 Ts #22 DCC on 2" celluloid or Bak. form, leaving about 6" leads at ends. Wind (3-4-5) of 55 Ts #22 DCC & tap it at 15 Turns. (4).

Condenser is .0005. However, a smaller capacity may be used if you add more turns to either coil. Tune in station and rotate one coil around. When OK for Ur location, screw coil down to the base.

For a Vario-coupler just connect coils together and vary the selectivity by rotating rotor. Most old-time Couplers have taps that may be tried for coverage.

In case you use a short Aerial add another loading coil in series of about 45 Ts #22 DCC on a 2" form. Any Xtal is OK altho we prefer Steel Galena.

Refer to DP-66 for data on the building of Variometer & details  
**MRL #21 XTAL. (DP-50).**



## PARTS LIST:

- 1 .0005 (or .00035) Var. Cond. (C-1)
- 1 2-gang .00035 Var. Cond. (6 & 12).
- 3 Coils, see text.
- 1 Crystal, Stand, Catwhiskers.
- 2 Binding Posts (A & G).
- 2 Phone Tip Jacks (phones).
- 1 1/8 x 6 x 10 Compo. Panel.
- 1 1/4 x 8 x 9 Plywood Base.
- 2 1 1/2 Bar Knobs and scales.
- 1 Small pointer knob.

A very selective set for local reception. Several means of controlling selectivity may be used as (1) coupling may be varied, (2) Antenna cond. may be varied to tune Aerial primary circuit, (3) gang tuning of Secondary and Tertiary circuits, (4) changing length of Aerial.

**Coil (2-3-4-5)** is a Loose Cou-

pler. Coil (2-3) is 4" in dia. of 80 Ts #28 DCC. Secondary (4-5) is 2" in dia. of 81 Ts #28 DCC. The Secondary may slide in and out or rotate as desired.

**Coil (7-8)** is 1" in dia. wound with 48 Ts #28 DCC. As this controls selectivity, you may increase or decrease turns later.

For Tertiary cir. wind coil (9-10-11) 3" dia. of 90 Ts #24 Enamel tapped at 45 Ts. (10).

Cond. (1) is .0005 or near to this cap. Cond. (5-6) and (11-12) is a 2-gang .00035 mfd. Use trimmer on various condensers to align them.

You may set position of rotor stationary after you get it to working best for your location. Coupling here depends more on the length of the Aerial you are to use, so adjust accordingly.

## PARTS LIST:

- 1 #22 Coil (3-4-5-6), see text.
- 1 .0005 or .00035 Var. Cond. (C-1).
- 1 1/8 x 7 x 8 Compo. Panel.
- 2 Switch levers (S-1 & S-2).
- 11 " points.
- 4 " stops.
- 1 Small Pointer Knob (3-4).
- 1 Crystal Stand & Catwhiskers.
- 1 Steel Galena or other Crystal.
- 1 1 1/2 Bar Knob and Scale.
- 2 Binding Posts (A & G).
- 2 Phone Tip Jacks (Phones).

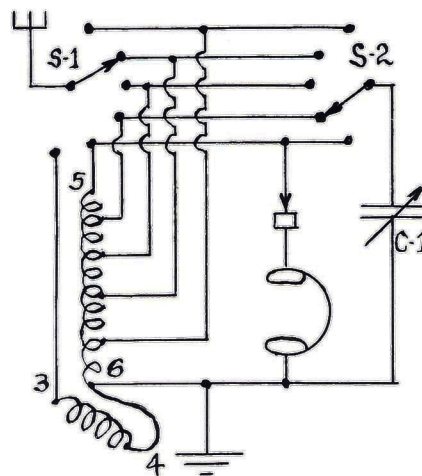
This is a tapped Coil Xtalset. By varying (S-1) you tune your Aerial. By tuning (S-2) you put Cond. (C-1) in on different taps. For greater selectivity. use the Antenna switch on the rotor.

**Coil (3-4)** of 11 Ts #22 DCC on 1 1/2" dia. rotor. Rotor may work by screwdriver adjustment as once it is set for your location and aerial it need not be re-adjusted again.

Rotor works inside Coil (5-6) of 54 Ts #22 DCC wound on 2" Celluloid form. Tap coil from start of winding at 14-27-39-48-54.

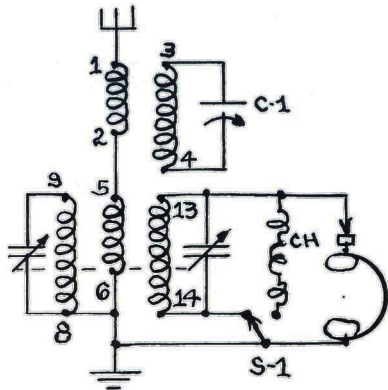
Condenser may be .0005, .00035 or near. Steel galena or any Xtal is alright. By adjusting switches, rotor and variable you will find many variations in tuning and selectivity.

## MRL #22 DX MARVEL (DP-45).



## MRL #23 COMBINATION DX. (DP-51).

This Xtal is really a Combination set as its name implies. It uses an absorption type wave-trap in series with the Aerial. It also uses a booster circuit



## PARTS LIST:

- 1 MRL QRM Coil (1-2-3-4), see text.
- 1 #23 Coil (5-6-8-9-13-14), "
- 1 .0005 Compression Var. Cond. (C-1)
- 1 2-gang .00035 Var. Cond., or near.
- 2 Trimmer Cond. for 2-gang Var.
- 1 85 mhy R.F. Choke (CH).
- 1 S.P.D.T. Panel Switch (S-1).
- 1 Steel Galena or other Xtal.
- 1 Crystal stand & Catwhiskers.
- 1 1/8 x 6 x 6 Compo. Panel.
- 1 1/4 x 5 x 5 Plywood Base.
- 2 Binding Posts (A & G).
- 2 Phone Tip Jacks (phones).
- 1 1 1/2 Bar knob and scale.

to give more volume and selectivity on stations. You may also use a switch for greater selectivity to throw in the RF Choke as in our Xtal circuit #8.

Booster and Secondary may be tuned with a 2-gang .00035 mfd. condenser if desired. Use trimmers so you get them to track. For the Aerial trap circuit, you may use trimmer condensers to build up to the station not desired, or bothers you most.

**Coil.** Wind 75 Ts #22 DCC on a 2" form, preferably celluloid, and bring out 6" leads. Wind ov-

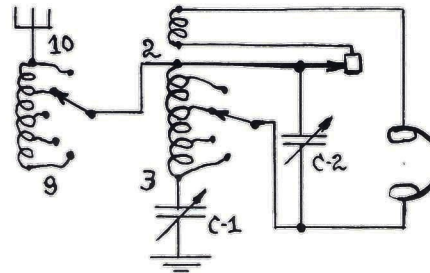
er this a sheet of wrapping paper. Then wind another 75 Ts #22 DCC over this and run leads out. Then a third sheet of paper but 1" wide x 10" long. Wind 15 Ts #22 DCC over this and anchor.

**Qrm Coil.** Use 1" x 1 1/2" long tubing, preferably fibre. Wind 110 Ts #32 Enamel over this. Then space-wind 15 Ts #24 DCC over this and cement down with light coil cement. Bring leads out to eyelet lugs or thru holes. This coil may be tuned with trimmer condensers about .0005 mfd. total capacity. When using this QRM coil, tune in station slowly that bothers you until it goes out or is weakened in volume. Then, tune balance of set as usual.

We prefer an 85 mhy RF choke to furnish inductance to the Crystal/phone circuit. Various ones may be tried. Use the SPDT switch to throw choke in and out of circuit. It will be sharpest on tap toward choke because the Crystal/phone circuit is above ground, or "floating." This allows all of signal to be tuned by condensers, instead of partly leaking off thru low-resistance crystal/phone circuit.

The principle of a built-up inductance around the Crystal is similar to #38, page 18, except, #23 uses R.F. choke and #38 an Audio frequency one.

## MRL #24 REGENERATIVE XTAL. DP-55.



## PARTS LIST:

- 2 #24 Coils (2-3 & 9-10), see text.
- 2 .00035, or near, Var. Condensers.
- 1 1/8 x 5 x 7 Compo. Panel.
- 2 Switch levers.
- 9 Switch Points & 4 Stops.
- 2 1 1/2 Bar Knobs and scales.
- 1 Steel Galena, or other Xtal.
- 2 Binding Posts (A & G).
- 2 Phone tip jacks (phones).
- 1 Xtal Stand and Catwhiskers.

Regeneration in this set tends to be more stabilization than a feedback. In this circuit we now have a loading coil in the aerial circuit to take care of long and short aeri-als. It also gives more volume on many stations.

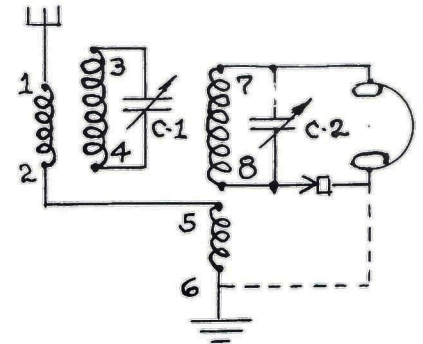
Parts may be mounted in any convenient form on 1/8" panel. Use Steel Galena crystal or any type you may desire.

**Coils.** Tuning coil (2-3) wind 90 Ts #22 DCC on 2" celluloid form 4 1/2" long. Tap at 5-25-50-90 and bring out to switch points. This will give short wave reception. Next to this wind 25 Ts #24 DCC for regeneration and run leads out. Loading coil (9-10) of 100 Ts #24 DCC on same kind of form and tap off at 0-25-50-

75-100 and bring to another set of switch points.

Condensers are .00035 or .0005 or whatever you have on hand. It should give you a lot of fun.

## MRL #25 SELECTIVE XTAL (DP-67)



## PARTS LIST:

- 1 #25 Coil (5-6-7-8), see text.
- 1 QRM Coil (1-2-3-4), "
- 1 .00035, or other Var. Cond. (C-2)
- 1 Compression .0005, or Var. (C-1).
- 1 1/8 x 5 x 7 Composition Panel.
- 1 1 1/2 Bar knob & scale.
- (2 if Variable used at C-1).
- 1 Crystal Stand and Catwhiskers.
- 1 Steel Galena, or other Xtal.
- 2 Binding Posts (A & C).
- 2 Phone tip jacks (phones).

This is a more or less conventional Xtal set, altho the arrangement is changed. Polarity of Xtal is important - as well as the way coils are connected. Tuning the QRM wave trap condenser will help to eliminate a bothersome station. Pulling primary coil (5-6) away from secondary will help to sharpen up hi-powered stations.

**Coils.** Coil (7-8) wind 90 Ts #24 DCC on 2" celluloid form 4 1/2"

long. Bring 6" leads out. Next to this wind (5-6) of 15 Ts same wire and bring out leads. Cutting turns on this last coil also sharpens stations if conditions warrant. QRM wave trap coil is usual 1" x 1½" long fibre tubing of 110 Ts #32 Enamel with 15 Ts #24 DCC spacewound over it.

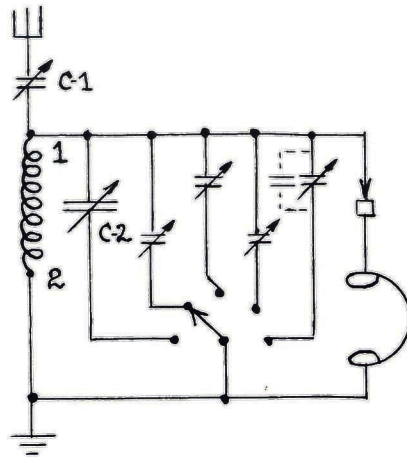
**Condensers.** Tuning condenser may be .00035 or .0005 mfd. Condenser for trap may be built up from trimmer or padder compression condensers to about .0005. However, if you want to shift it from one station to another often, it would be advisable to use a variable at C-1. Tune in bothersome station at C-2 and gradually bring C-1 around until it cuts out or diminishes in volume - and leave C-1 on this point. Go ahead and tune C-2 for other stations.

The jumper from ground to secondary shown as dotted line may be connected if you have no difficulty with interference. It will increase volume some, and make the set broader.

Polarity of crystal may be changed - whichever gives the most volume. It varies for different crystals - as well as for crystals of the same ore. Often the length of aerial may have an effect on the polarity. It seems there is no end to experiments along the line of crystal sets.

### MRL #37 PUSH-BUTTON XTAL. (DP-1).

**Note:** As original MRL #26 Xtal was partly a tube set, #37 has been substituted for a pure Xtal set.



#### PARTS LIST:

- 1 #37 Coil (1-2), see text.
- 5 (or more) compression trimmer Var. Condensers (C-1), etc. About .0001 up to .0005 maximum capacities.
- 1 .00035 Variable Condenser (C-2).
- 1 Switch lever.
- 5 (or more) switch points; 2 stops.
- 1 1½ Bar Knob and scale.
- 1 Crystal Stand and Catwhiskers.
- 1 Fixed Pyrites Xtal, or other.
- 1 1/8 x 5 x 6 Composition Panel.

This novel Xtal set may operate with pushbuttons, but we prefer a switch lever and points as being handier and more economical. Figure out how many regular local stations you want to receive, - and arrange this many switch points, plus one. By using the last point you throw in a .00035 variable condenser for

"searching."

**Coil.** Wind 90 Ts #24 DCC on 2" Celluloid form 4½" long and run 6" leads out. Cement edges, etc.

**Switch.** After laying out panel and switch points, select some trimmer compression type condensers - one for each point except point for variable condenser. If trimmer condensers don't tune high enough, shunt enough fixed mica condensers around each one to hit the station. When adjusting, be sure the Antenna trimmer cond. is adjusted where you want it for sharp tuning, as it will affect tuning of each switch position. So, leave it where it works best before attempting to balance up individual points. It is a good idea to make a scale for the points showing call of each station you get on the points. This idea is very handy as you don't have to look around for stations, - just turn the lever to correct point. When you throw in last point, this connects the .00035 or other tuning condenser in circuit. Any Crystal may be used.

For compactness, it is a good idea to use a fixed Pyrites or a Radar type crystal. Also, if you want to eliminate the variable condenser you may do so. Then it may be mounted in a much smaller box. It is also a good idea to mount the trimmer condensers so they may be easily adjusted from

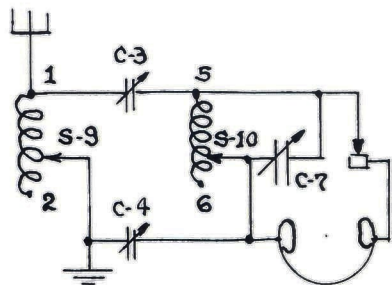
a handy screwdriver position at the rear of the box.

A little point in tuning may be of help. On first point at the switch lever tune in a station at the bottom of the dial. Then, on last point, tune in one at the top of the dial. Next adjust the Antenna trimmer so the stations are sharp and clear. Do this several times, working back and forth between the 3 condensers until you get the best results. Then, you may set the remaining points more easily for proper operation. As stated above, when you change aeri- als it is necessary to again adjust the Antenna trimmer, before it will work properly.

A 50 ft. Aerial is about right but may be tried on anything. If too near a hi-powered station it may be necessary to eliminate a ground connection. Also try it hooked to a lighting fixture, a gas stove, wire fence, etc. and each time re-adjust the Antenna trimmer condenser.

### MRL #27 VARIABLE SEL. XTAL. DP-53

By varying the Trimmer Condensers (3) and (4) you may obtain any desired degree of selectivity. Opening them increases selectivity. Trimmer Condensers may be mounted anywhere.



## PARTS LIST:

- 2 #27 Coils (1-2, 5-6), see text.
- 1 .00035, or other Var. Cond. (C-7).
- 2 Trimmer Var. Cond. (C-3, C-4).
- 2 Switch levers (S-9, S-10).
- 20 Switch Points for same.
- 4 Stops
- 1 Steel Galena, or other Crystal.
- 2 Binding Posts (A & G).
- 2 Phone Tip Jacks (Phones).
- 1 Barknob and scale.
- 1 Crystal Stand & Catwhiskers.
- 1 1/8 x 6 x 8 Composition Panel.

**Coil.** For each coil, use about 100 Ts #24 DCC tapped every 10 Turns and brought out to 2 sets of switch levers. The Antenna coil (1-2) is partly aperiodic, that is, it tunes itself to the secondary (5-6), so not necessary to have a separate variable condenser to tune it.

Tuning condenser (7) may be a .00035 or whatever you have. If you have a small condenser, then use a larger coil.

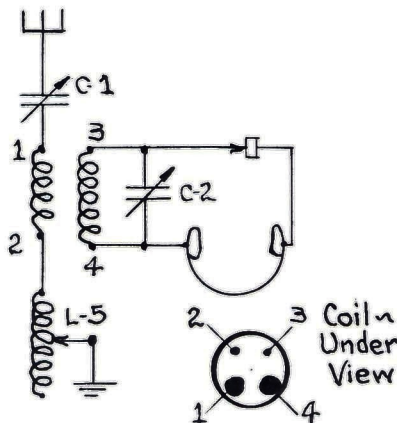
This set is adaptable to most locations in a city, as the degree of selectivity may be had that is best for your location. We have no reports of DX reception, but it may be possible.

DP-53 shows several variations of this circuit. The selectivity

condensers (C-3, C-4) may be ganged if desired. However, you must use an insulated shaft between them. Some companies make a single .00014 with shaft extending out the rear so it may be coupled onto another condenser with an insulated coupling. Of course, this would give another control and panel would have to be longer. Unless you R located in the country where you may care to fish for distance, the separate trimmers work good.

Any type of Crystal may be used, - either fixed or adjustable as you wish. If using a fixed Carborundum, use 3 volts (or two dry cells) in series with the Crystal and a switch to cut off battery when not in use.

## MRL #28 PLUGIN COIL XTAL. (DP-47)



## PARTS LIST:

- 1 .00025 (or smaller) Cond. (C-1).
- 1 Insulated Shaft extender for same.
- 1 .00014 Midget Condenser (C-2).

- 1 Set 4 pr. Type A. or 5 pr. Type 5-A Short Wave Coils (1-2-3-4).
- 1 Loading Coil (L-5), see text.
- 1 Steel Galena, or other Crystal.
- 1 Crystal Stand and Catwhiskers.
- 1 4 or 5 prong Coil socket.
- 1 Switch lever.
- 9 Switch Points (1 for zero).
- 2 Stops.
- 2 Binding Posts (A & G).
- 2 Phone Tip Jacks (phones).
- 2 Bar Knobs and Scales.
- 1 1/8 x 6 x 7 Composition panel.
- 1 3/8 x 4 x 5 Plywood Base.

The biggest drawback to a tapped coil for SW work is the dead end turns that are not in use. These act as an impedance coil coupled to the used turns, and tend to deaden the signals. Plug in coils eliminate this condition. This is proven by the big number of DX reports up to 5800 miles on Short Waves we have on file on this set.

**Coil.** Uses plug-in coils with secondary and tickler windings. We suggest removing the tickler and winding it over the secondary for SW Bands, as they need closer coupling. Leave the tickler as it is on Broadcast - unless signals are broad, then separate it a little from secondary. One fellow uses 2" diameter celluloid coils with taps. We prefer individual coils instead of taps. Be sure large wire is used on Short Wave Bands. A loading coil of about 25 turns may be added in series with Aerial if necessary to boost length of your Aerial system. Better still - is a coil of about 80 Ts tap-

ped every 10 turns - that may be thrown in or out of circuit. The diameter may be about 1 inch, & wire size about 24 Enameled.

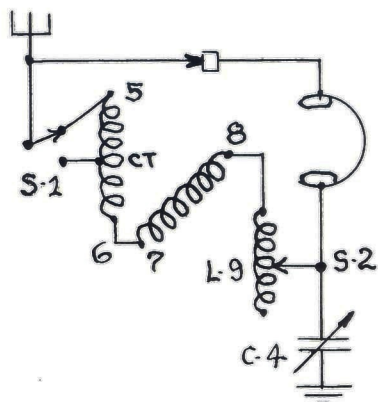
Wire up set with large hookup wire, as RF currents travel better on larger wire. Cond. (1) may be .00025 or .00035. Be sure to get rotor going to ground.

Various sizes may be tried from .0001 up if desired. Be sure to use an insulated shaft extender to front of panel for better operation. Condenser (C-2) may be a .00014 mfd. midget type.

Crystal may be Steel galena. However, we prefer Iron pyrites, Silicon or one of the new Xtal Diodes manufactured for Radar work as they oscillate well at high frequencies. For loud signals, a fixed Carborundum Xtal with 3 v. battery in series will give much more volume. Tune very slowly on 20-40 meter bands.

## MRL #29 VARIOMETER XTAL. (DP-44)

A variometer is a continuously variable inductance. Inductance may vary from 50 to 700 microhenries, by the cutting of each coil's field by the other. While a variometer has a limited inductance range - it is a good tuner. The outer coil may be tapped, if desired, for short wave tuning. Or a loading coil (9) & tap switch may be added in series to cover longer wavelengths.



## PARTS LIST:

- 1 #29 Variometer (5-6-7-8), see text
- 1 Loading Coil (L-9), see text.
- 1 .00035, or near, Var. Cond. (C-4).
- 1 Switch lever (S-2).
- 1 S.P.D.T. Toggle Switch (S-1).
- 1 Steel galena, or other Crystal.
- 1 Crystal Stand and Catwhiskers.
- 2 Binding Posts (A & G).
- 2 Phone tip jacks (phones).
- 1 1/8 x 7 x 8 Composition Panel.
- 2 1/4 Bar Knobs and scales.

Any loose coupler may be made into a variometer by hooking the coils in series.

A very simple set. Arrange in any position with controls from front of panel. Condenser may be .0005 or whatever you have. Use Steel Galena or any type of Xtal you like. Operate by varying the inductance and capacity.

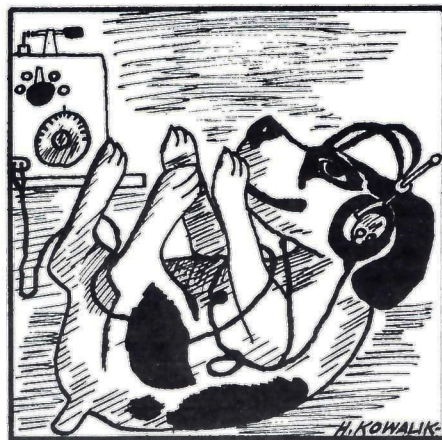
The DP-44 shows details of the Variometer construction. It is built from a stator coil (5-6) 3 1/2" in diameter and 2 1/2" long. The rotor is 2 1/2" diameter and 2" long, and made to turn inside the stator. Wind 30 turns #24 Enamel on each side of the stat-

or shaft. Take a tap off center of winding (CT) at the end of 30 Ts. For the rotor wind 32 turns #28 Enamel on each side of rotor shaft. Bring flexible leads from rotor out thru back of stator by a 1/4" hole. A panel bearing may be fastened to the stator to take the shaft thru to panel.

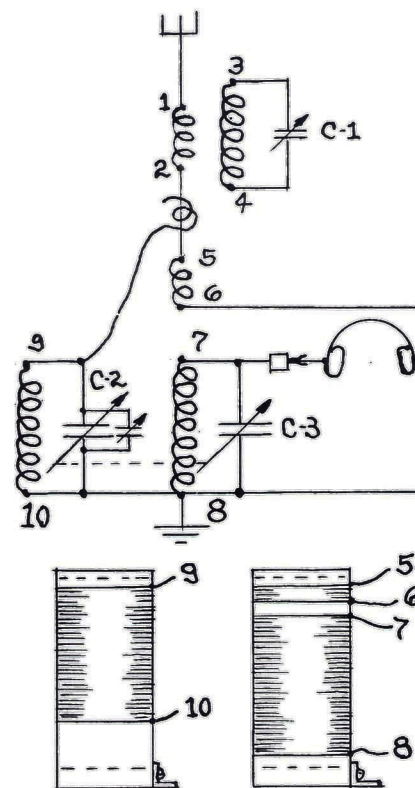
Loading coil (L-9) may be 2" in diameter and 4 1/2" long. Wind about 100 Ts #24 Enamel or DCC on this, tapping every 25 turns. Number of switch points wasn't given in parts list as it depends on loading coil taps, etc. If your condenser is small the taps must be closer together.

In tuning you will find certain variations of Variometer & condenser settings to work best for each station. Log them down on a card for quick reference.

In the country this set should do fairly well at DX reception.



## MRL #30 DX XTAL SET. (DP-46).



## PARTS LIST:

- 1 MRL QRM Coil (1-2-3-4), see text.
- 2 #30 Coils (5-6-7-8), (9-10), text.
- 1 2-gang .00035 Var. Cond. with trimmers for balancing. (C-2,3).
- 1 500 mmfd. Compression Cond. (C-1).
- 1 1/4 Bar Knob with scales to fit.
- 1 Crystal Stand and Catwhiskers.
- 1 Steel Galena, or other, Crystal.
- 1 1/8 x 6 x 8 Composition Panel.
- 1 1/4 x 5 x 6 Plywood Base.
- 2 Fahnestock clips for Ant.-Gnd.
- 2 Phone Tip Jacks for Phones.

The set uses both a series wave trap and a booster trap. A bothersome station may be cut down or out by adjusting the

series trap. Station wanted is tuned in by booster trap.

Use a trimmer compression condenser for the series trap - total about .0005 mfd. capacity. Set it on station wanted to eliminate and leave it. The other two condensers may be ganged as they have a common ground connection. May be at or near .00035 mfd.

**Coils.** Series trap is 110 Ts #32 Enam. on 1" x 1 1/2" fibre form - primary being 15 Ts #24 DCC spacewound over this, and held down by light coil cement. Coil for booster cir. is 75 Ts #24 DCC on 2" x 4 1/2" celluloid form. Couple this to the aerial with a piece of insulated hookup wire. More coupling turns; more effect you get as a booster. Be sure it is insulated at this point. On same kind of form, wind (7-8) of 75 Ts #24 DCC and leave 6" leads - and wind 8 more Ts same wire for primary. If too close to a hi-powered station, separate the 8 turns from secondary more. You may gang the two condensers and balance one up with trimmer condenser to make them track well.

Crystal worked better with us when reversed, because Antenna feeds in on the Crystal side.

Mount C-1 in back as it is set permanently on bothersome station. If large tuning variable is desired, mount Cond. on panel which must be increased in size. Mount coils upright on base.

## MRL #31 XTAL CONVERTERS. (DP-59).

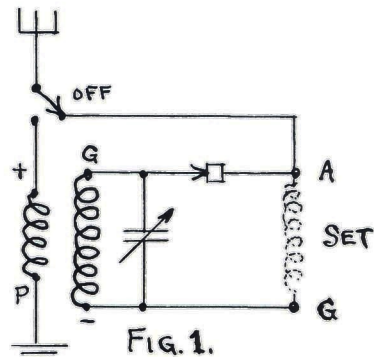


FIG. 1.

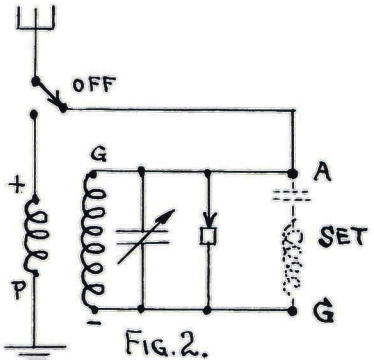


FIG. 2.

## PARTS LIST:

- 1 Set MRL Type A S.W. Coils.
- 1 .00014 mfd. Variable Condenser.
- 1 1½ Bar Knob and Scale.
- 1 Crystal Stand and Catwhiskers.
- 1 Iron Pyrites, Silicon, Diode or Carborundum Crystal.
- 4 Binding Posts (A-G) and Set.
- 1 S.P.D.T. Toggle switch.
- 1 Compo. or Plywood box 4" sq.

A crystal set using short-wave coils will work effectively on many BC sets when hooked across Aerial and Ground of the set. It is especially adaptable to Police calls as they are so near BC band. You may try your luck on higher frequencies by using some

smaller coils. It is suggested you use as large wire as possible for SW. This outfit also helps to cut down static as it allows a certain percentage of atmospheric to leak off through coil and Xtal to ground. Use any type of Xtal, altho Pyrites or Xtal diode are preferred.

Fig. 1 shows method of using the converter when an ordinarily hi-impedance primary coil is in the set. In case there is a .01 or other fixed condenser in series with the Primary coil of set - then use Fig. 2. The reason is to give a path for the signal thru the Crystal and not thru a fixed condenser.

Tickler of coil, which is used here as the primary, may be moved away from secondary if troubled with a strong station. Many report increased selectivity on their regular sets when both the converter and set are worked on the same bands. When using the converter, adjust the receiver to a point where there are no stations. Experimenting will locate the best place. If strong stations are too broad it may be necessary to eliminate ground on both converter and set.

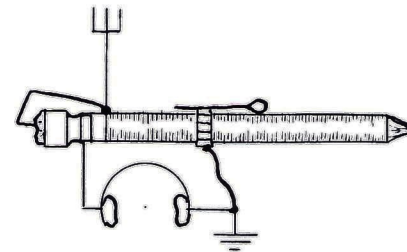
Often you may have good results by wrapping the insulated leadin from Aerial around lead at point "G" - but be sure it is insulated.

When using Carborundum crystal

use 3 v. of battery in series & by means of Vol. control switch, arrange switch to disconnect it when not in use or battery will be short-lived.

As a crystal does not receive c.w. (code) signals this may be an advantage to some. Much additional Converter information is found on DP-59, with variations.

## MRL #32 PENCIL XTAL SET. (DP-33).

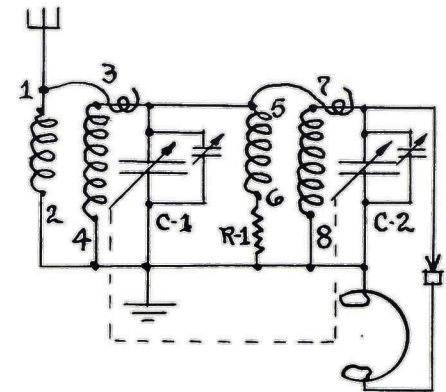


A novelty Xtal set built on a 3/8" novelty pencil obtainable in Variety stores. Wind pencil full of #32 Enamel wire and cement down with a light coil cement. Wrap clip with paper for insulation and allow ball of the clip to slide on the wire. Sandpaper path for slider. Hook up as shown. Due to fine wire and diameter of this coil, stations usually tune sharply. An aerial and ground are essential as this coil has lots of resistance to weak signals. Use Iron Pyrites or fixed Xtal in the end.

A variation is a square coil wound on wood, and placed inside

a penny match box. Connect slider to cover so it contacts wire when box is opened or closed. A fixed Xtal is used inside.

## MRL #33 SELECTIVE XTAL. (DP-2)



## PARTS LIST:

- 1 AC-DC Ant. or Det. Coil (1-2-3-4).
- 1 AC-DC Detector Coil (5-6-7-8).
- 1 2-gang .00035 Variable Condenser with trimmers (C-1, 2).
- 1 10,000 ohm ¼ watt carbon resistor (or 50,000 ohm Volume Control and knob, if mounted on panel).
- 1 1½ Bar Knob and scale to match.
- 1 Crystal Stand and Catwhiskers.
- 1 Steel Galena, or other Crystal.
- 1 1/8 x 4 x 5 Composition Panel.
- 1 1/4 x 4 x 4 Plywood Base.
- 2 Binding Posts for Ant. & Gnd.
- 2 Phone Tip Jacks for Phones.

As our original #33 was similar to #13 - we decided to make a new circuit to replace it. This set takes a 2-gang .00035 variable condenser and a set of AC-DC Midget set coils to match. You may use an Ant. and Det. or two Det. coils as you wish, depending on conditions as location, size of aerial, selectivity de-



sired, etc. Due to large impedance primaries on these coils, the pickup is very good. For a greater volume (pickup) you may wrap a piece of loose insulated hookup wire around the secondary after soldering end to primary as done on AC-DC sets for more volume. More turns; more volume.

Substitution of other resistors for the 10,000 ohm will give different degrees of selectivity because more current leaks off around the first condenser when resistor is small. For varying degrees of selectivity you may use a 50,000 ohm volume control, and regulate selectivity from front of panel. Ground may be eliminated in some instances.

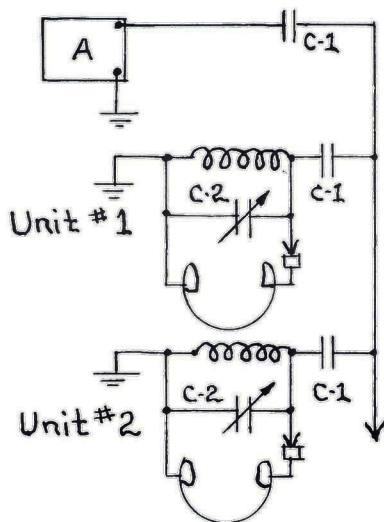
A small box may be used if desired. Mount AC-DC coils upright near the condenser stator connections.

You may use a fixed crystal of any type, or adjustable from the front of panel for better DX. Use trimmer condensers to balance up stations on high-frequency end of the dial.

You have the option of using a set of Ant-Det. coils or two of the Detector coils. If in the country away from high-powered stations, it is advisable to use two detector coils as the coupling is much closer and will give you more volume.

If using this as a portable set, use a lot of Aerial.

### MRL #34. WIRED WIRELESS. (DP-54)



#### PARTS LIST:

- 1 Oscillator or Regenerative Receiver. (A).
- Wire for transmission line to your neighbor.
- 1 .0001 Mica cond. (if not built into the Oscillator). (C-1).

#### PARTS LIST, EACH UNIT:

- 1 Coil and Condenser (C-2), to match frequency of oscillator (A).
- 1 .0001 Mica condenser (C-1).
- 1 Fixed Crystal, any type.
- 1 1/8 x 4 x 4 Composition panel.
- 2 Binding posts for Ant.-Gnd.
- 2 Phone tip jacks, for phones.

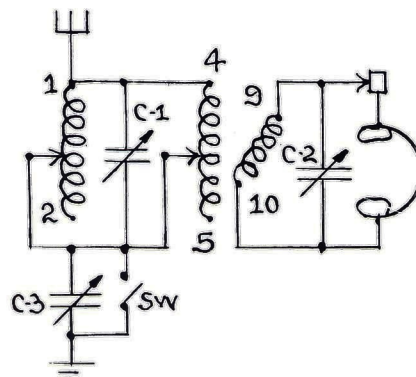
Use any regenerative set that oscillates well, and hook to a common line by a .0001 mica condenser. Hook Xtal sets up as shown on diagram. Be sure to use same value of parts in each Xtal set.

Other sets must be tuned to the same frequency as the regenerative set. We suggest using a

long wave coil and tune just above the Broadcast band to about 575 kc. This will prevent being picked up by other Radios in the vicinity, as the circuit may radiate some. Use the same long wave coil and condenser for each set.

**OPERATION.** Tune regenerative set and bring up to oscillation. Tune your own rig to pick up the signal. Then, tune each neighbor's rig to the same. Try talking into one of the phones and use other one for listening. No license required - any more than operation of a phonograph record transmitter. Be sure to use the ground connection for each rig as most energy goes thru ground.

### MRL #35. PRIZE SELECTOR. (DP-48)



#### PARTS LIST:

- 2 #35 Coils (1-2, 4-5-9-10), text.
- 3 .00035, or near, Variable Condensers (C-1, 2, 3).
- 3 1/4 Bar Knobs and Scales.
- 1 Crystal Stand and Catwhiskers.
- 1 Steel Calena, or other Crystal.

- 18 Switch Points and nuts.
- 4 Switch Points and nuts.
- 2 Switch Levers.
- 1 1/8 x 7 x 10 Composition Panel.
- 1 1/4 x 6 x 9 Plywood Base.
- 2 Binding Posts (Ant. & Gnd.)
- 2 Phone Tip Jacks (Phones).

This set may look complicated, but it really isn't. The original took first prize at a N.Y. Radio Show in Xtal set days. We have made several improvements. Not suggested for DX reception, altho it may have possibilities. When you make a set more selective - you must reduce its sensitivity. No surer law in Radio.

**COILS.** Wind both large coils on 2" celluloid form 4 1/2" long, of 100 Ts #24 DCC tapped every 10 Ts by running a 3/4" paper strip under turns to be tapped. Cement down edges, and leave 6" leads. For rotor of second coil on Bak. tubing 1 1/2" in dia. x 1 1/2" long, - wind 35 Ts #32 Enam. on each side of center hole for wooden shaft. Bring out to flexible leads made from old tinsel phone cords as pigtailed. Cover entire coil with a good light cement.

**CONDENSERS.** Use 3 .00035 or near. Ground condenser, which is used to help selectivity, may be a .00014 mfd. midget if space is limited. Tip of plate may be bent to short when in.

With all these combinations of adjustment, you may make the set work in any congested location.

When mounting coils, it is a good idea to mount (1-2) upright

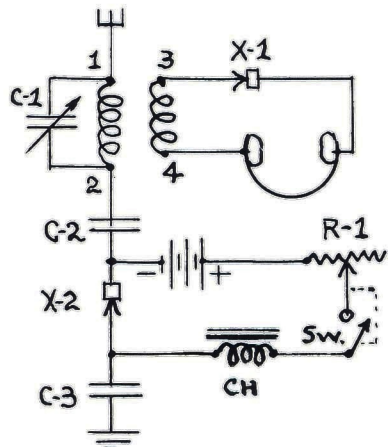
and (4-5) horizontally. At the end of the latter, arrange rotor so it may be controlled from the front of panel. Or, if you care to set it for your location, it need not be moved, and you may eliminate the panel control.

Condensers should be separate as it is hard to gang them under these conditions.

Mount switch points so they will have shortest leads possible to the coils.

Keep a log card showing where you find the stations, for future reference.

#### MRL #38. CRYSTAL BOOSTER. (DP-3).



#### PARTS LIST:

- 1 #38 Coil (1-2-3-4), see text.
- 1 .00035, or near, Var. Cond. (C-1).
- 1 .01 Bypass Condenser (C-2).
- 1 .0001 Mica Condenser (C-3).
- 1 Audio Choke, or Impedance (CH).
- 1 1000 ohm Volume Control (R-1), with switch (SW).
- 1 Fixed Pyrites Crystal (X-1).
- 1 Fixed Carborundum Crystal (X-2).

- 3 to 6 v. Dry Cells in series.
- 1 1/8 x 6 x 8 Composition Panel
- 1 1/4 x 6 x 7 Plywood Base.
- 2 Binding Posts (Ant. and Gnd.).
- 2 Phone Tip Jacks for Phones.

As our original #36 was a set using two tubes and crystal in a Reflex circuit, we have substituted our #38 using two Crystals.

Crystals, which are rectifiers - only detect. They do not amplify. Technically, to our knowledge, it is impossible to make them amplify each other. One must use a Tube amplifier or a microphone-battery-transformer combination in conjunction to get more volume. This circuit comes nearer to making Xtals amplify each other than any rig we have found.

**COIL.** On a 2" x 4 1/2" long Celluloid or Bak. form, wind 75 Ts #22 DCC and bring out 6" leads. Coil cement a strip of paper 2" x 10" over this. Over this, wind about 40 Ts same wire and bring out leads. Last winding makes an aperiodic (not directly tuned) secondary winding.

**CONDENSERS.** Tuning Cond. (C-1) is .00035 or .0005 mfd. (C-2) & (C-3) may be .0001 to .01 mfd. according to experiment.

**DETECTORS.** Receiving detector may be Iron pyrites or any kind. Boosting detector must be fixed Carborundum. You may use 3 volts (2 flash. cells) in series, or 6 v. with a 1000 ohm Volume control to regulate current to the

Xtal. Be sure to have a switch in the circuit to cut off battery when not in use.

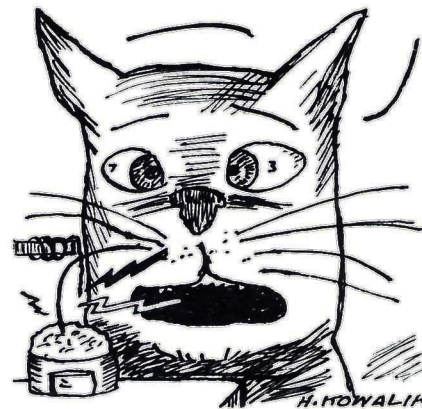
When operating this set, try cutting off Carborundum circuit switch and see the difference in volume in the phones. This booster may be adapted to any other crystal set circuit.

The choke (CH) may be a primary from an old Audio transformer, output transformer, etc. Its function is to give an Impedance to the circuit so the Carborundum will not be directly across the battery.

The 1000 ohm Volume control should have a switch ganged to the back so it may be turned off when not in use. Other values of resistance may be tried.

It may be well to try reversing the polarity of the Crystals for more volume.

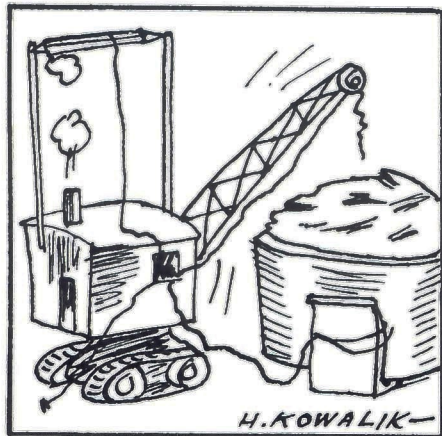
This is a revision of a British circuit of the old Crystal set days.



#### L I N G O

|          |                                    |
|----------|------------------------------------|
| A & G    | Aerial and Ground.                 |
| AC-DC    | Sets using line cord resistances.  |
| Ant.     | Antenna; aerial.                   |
| BC       | Broadcast band.                    |
| C, Cond. | Condenser; capacity.               |
| Compo.   | Composition.                       |
| CT       | Center tap.                        |
| cw       | Continuous wave; code.             |
| DCC      | Double cotton-covered Magnet wire. |
| Det.     | Detector.                          |
| DP       | MRL Detail Print.                  |
| DX       | Long distance.                     |
| En       | Enameled Magnet wire.              |
| Gnd.     | Ground connection.                 |
| Kc       | Kilocycles; 1000 cycles            |
| L        | Inductance.                        |
| mfd.     | Microfarad of capacity.            |
| mmfd.    | Micro-microfarad " "               |
| pr.      | Prong, as coils, etc.              |
| QRM      | Interference; MRL QRM Coil.        |
| R        | Resistance; resistor; are.         |
| RF       | Radio (high) frequency.            |
| S or Sw  | Switch.                            |
| SPTT     | Single pole - double throw switch. |
| S.W.     | Short wave or waves.               |
| Tr.Cond. | Trimmer variable Condenser.        |
| Ts       | Turns on a coil.                   |
| U        | You.                               |
| v.       | Volts; voltage.                    |
| Var.     | Variable; adjustable.              |
| X, Xtal  | Crystal.                           |
| 2-gang   | 2 Variable condensers              |

connected by a common shaft or connection.



A tapped coil, using a Switch lever and points to control inductance.



A tapped coil, or a slider. May mean either type.



Dotted lines show it is not included in the original circuit. Any part may be drawn this way.

Condensers:



A plain fixed condenser. May be mica, bypass or a filter as specified.



A variable tuning condenser, large or midget.



A small compression Var. Condenser; low capacity.

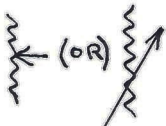


Two Var. Cond. ganged to the same shaft

Resistors:



Fixed resistor, or Resistance.



Variable, or adjustable resistance.

COILS:

Coils:



Single layer coil.



Coils over, or at end of each other, in inductive relation to each other. The transferring of energy.



An insulated lead with electrical properties, wrapped around another lead to transfer some energy to a circuit.



A coil with a rotating coil inside, called a Rotor. May be shown at the side or at end.

Accessories:



Antenna; Aerial. Usually an "L."



Ground connection.



Crystal detector; Rectifier.



Earphones; headphones; 'phones.

COILS.

We recommend a celluloid form 2" in diameter x 4 1/2" long for most of our circuits. The thin wall of celluloid makes a coil form that is very efficient in receiving distant stations. Any cardboard, Bakelite, Lucite or other kind of form may be used with fair results.

When tapping coils, run a narrow piece of heavy paper under each turn to be tapped. Coils should be mounted at least one inch away from other parts to prevent losses.

WIRE SIZES

Most MRL Crystal circuits are not critical as to wire sizes. The sizes given are the best we have found by experiment. A size up or down is alright. If a size larger is used, add about 5 more turns to specifications. If size smaller; about 5 turns less.

When using Enameled wire instead of DCC, you do not need as many turns. The efficiency of one should be equal to the other kind of insulation.

When turns of a coil are put closer together the coil is said to have a greater distributed capacity. That is, the final result is the same as connecting a fixed condenser across the coil. When you add capacity in this



"WHERE IS EUROPE ON THE CRYSTAL, CHET?"

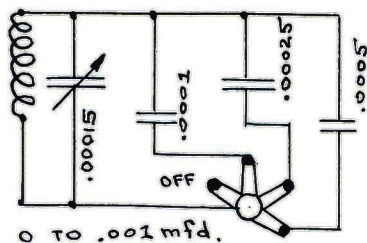
manner, it may be compensated by using less variable tuning condenser. This is the reason Enamelled and finer wire coils may have less turns, as they are laid closer together.

Finer wire gives greater selectivity because turns are closer together. This may be illustrated by #19 Xtal circuit. This uses a small diameter as well as fine wire. Adding the fixed condenser also sharpens it up.

### VARIABLE CONDENSERS.

When using tapped coils, any kind of variable condenser may be used from .00014 up. However, .00035 or .0005 is better. You may build up a number of fixed mica condensers in combination with a shorting-type switch and a .00015 mfd. variable condenser as follows:

.00015 plus .0001 equals .00025.  
 .00025 plus .00025 " .0005.  
 .0005 plus .0005 " .001



Use light spring brass or phosphor-bronze for making the fingers of the switch.

### CRYSTALS

The pointer in diagrams represents the catwhisker. Some types of crystals work better reversed. Even some of the same minerals work better reversed. Try them both ways.

Steel galena is preferred for most circuits, and must be used with a fine catwhisker. Most DX reception has been made with this crystal.

Iron pyrites may be a little less sensitive than Steel galena but is more stable. That is, the adjustment is not as critical. Iron pyrites is very good for short wave work, considerably better than Steel galena. Iron pyrites is used for most fixed crystals because it keeps its adjustment longer. It may be used with a heavy brass catwhisker for fixed crystal, or a lighter brass catwhisker for adjusting.

Silicon, a synthetic crystal, is used for general use and high frequency reception. The best catwhisker is gold, but brass is next in sensitivity. It must be used with a light contact.

Carborundum is a very stable synthetic crystal. A heavy brass catwhisker seems to be best. It may be used as a fixed crystal. Carborundum works best when about 3 v. of dry cells is placed in series with it. Cut dry cells

off when not in use. The polarity is very critical, when a battery is used.

Radar crystal diodes work very well on any of these circuits. In a test they work equal to a very sensitive Steel galena. The main advantage is that they are fixed. Do not apply heat near them, but use clips for mounting as they are mounted in soft wax and metal.

### AERIAL AND GROUND.

For city reception use about 50 ft. including leadin. In the country, away from high-powered stations, 50 to 150 ft. may be used effectively. Height is much more important than length. You may experiment with two aerials; one high and the other low and you will soon see the difference in signal strength. Keep away from trees, buildings, towers, etc. Use #14 or #12 solid Enamelled or 7/22 stranded Enamelled or tinned wire for best pickup.

Hook as many different kinds of grounds up together as you can find as water-pipes, wells, buried pipes, etc. in the country. Three-fourths of the energy comes thru the ground. However, due to strong ground waves of hi-powered stations in a large city, it is best to eliminate the ground. Especially, if one is located above the first floor the ground leadin would be too

long and cause stations to mix.

**HEADPHONES.** (See HB-1 "Phones").

A good pair of earphones is a necessity for good Crystal set reception. The weak stations can not be heard with poor phones. Be careful not to use phones that may have become de-magnetized on a tube set.

A phone rated at 24,000 ohms impedance (5000 ohms D.C. resistance) seems to work the best. Crystal or the old Baldwin mica diaphragm phones are also good. A 2000 ohm headset is very good, and may be used for most sets.

Much good phone data is found in HB-1 "Headphones: Operation and Repair," on care, repair and handling of various types of headphones.

### LONG DISTANCE RECEPTION.

There are exceptions, but seldom is DX received near a high-powered station. This is due to the strong ground wave emitted.

The best reception for any set is obtained in the Miss. valley, on plateaus, along streams, on iron mountains. Poorest reception is had in narrow valleys in the mountains, as signals do not go thru mountains easily. Reception may be good in one place & poor a mile down the road. It is necessary to experiment; that is what makes this game interesting.

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**ABOVE ANSWERS** are found in **MRL HB-2 "MRL No.2 Long Distance Crystal Set."** Order at same price and source as this one. Besides hundreds of details on building this long distance set, we have included answers to predominate questions asked us the last 22 years. Many good comments from Old Timers...Others have read it thru dozens of times. Whether you built this set or not; you still need the information. A gold mine of data not found elsewhere...Order yours today!

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