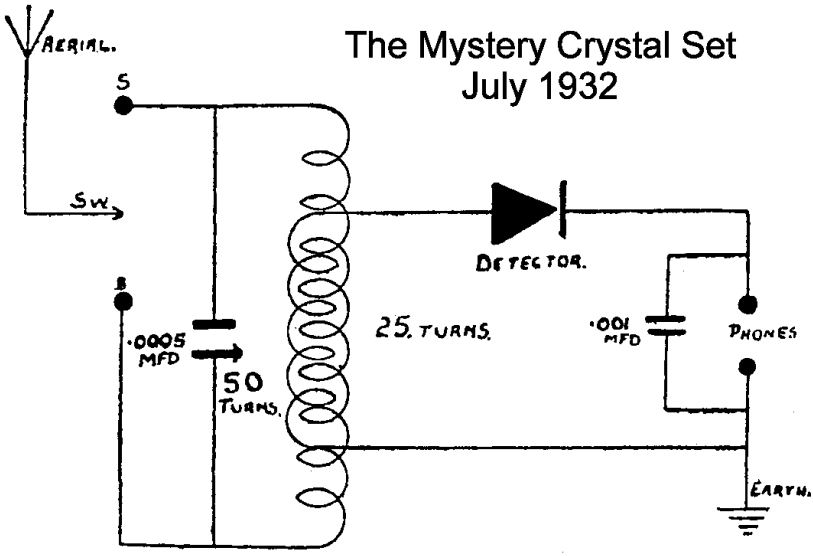
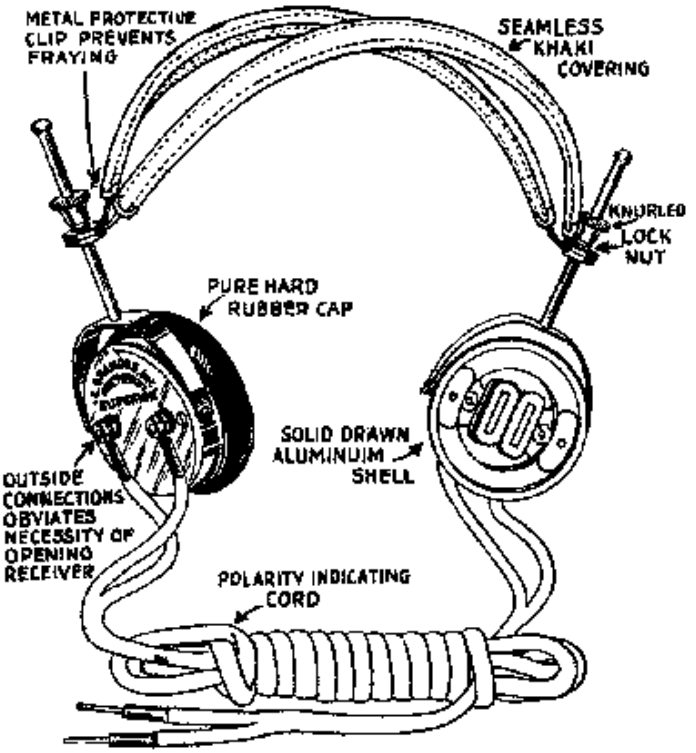
Pittsburgh Antique Radio Society

CLUB PROJECT

Constructing the 1932 'Mystery Crystal Set'





Showing the Exclusive Features of Brandes Superior Head Sets

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The Pittsburgh Antique Radio Society - 2011

Preface

A few months ago, I was asked by Chris Wells, PARS President, if I would be interested in “coming up” with a club “construction project”.

Something simple and safe, such as a regenerative receiver, low-voltage “Space Charge” receiver or self-powered crystal radio set.

One unique crystal radio design in particular has held my interest for several years now. I stumbled upon it on the Internet and have since wanted to build and experiment with it. That circuit is known worldwide as the “Mystery Crystal Set” of Australia.

First appearing in 1932, it has since captivated many radio enthusiasts. Countless Mystery Sets have since been constructed and variations of it have evolved. It has been studied, “reverse-engineered” and countless discussions and conversations have ensued over its simplistic, remarkable and unorthodox electrical circuit design and how it operates.

It is my sincere hope that PARS club members will also be intrigued by the Mystery Crystal Set radio, enough to want to build and experiment with one of their own creations.

Certainly, there are numerous ways that the Mystery Set circuit can be physically implemented – a few such versions are included herein.

It should prove quite interesting to see what variations club members come up with in their own unique designs and then to compare notes and performances.

I hope you find this project to be fun, exciting and able to transport you back to a much simpler time and the early magic of radio!

Joe Patrick - PARS member - 2011

Note: You will notice that two separate designs are included in this publication. One is for the “Mystery Crystal Set” and one is for the improved “Mystery Plus Crystal Set”. It’s your choice as to which one you decide to build.

Origin

Construction details of this crystal set were first published in the Australian Our Wireless Circle section of The Sunday Mail newspaper in Brisbane on July 3rd 1932. It proved to be very popular with the readers and a second construction article was published on July 17th 1932 along with readers letters and questions, and another on April 16th 1933.

Parts to construct a crystal set were relatively cheap and construction fairly simple so they were very popular at this time for people living close to radio stations. Your local radio dealer could construct the mystery crystal set for approx. 25 to 30 shillings ($2.50 to $3.00). At this time a cheap 4 valve radio (Radiola Junior) cost 24 Pounds 10 shillings ($49.00) approx. 6 weeks wages for a radio service man.

In 1932 there were only 4 radio stations in Brisbane, 4QG, 4BC, 4BK, 4BH and radio broadcasting in Brisbane was only seven years old, at the time there were a total of 17 radio stations in Australia

This circuit is unusual due to the earth connection being on the secondary side of the coil and only the aerial being connected to the tuned primary of the coil.

Note: When constructing my Mystery Crystal Set I found I got best selectivity when my aerial was connected to the capacitor moving plates and bottom of the coil. aerial connection, this appears to be the opposite to the connections shown in Figure 2. B.A. = Broad Aerial, S.A. = Sharp Aerial.

The three articles below are as they were published in 1932 and 1933 in Brisbane Australia. (The articles are as they were printed, so it is the wording of the 1930's.)

Ray Creighton – Historical Radio Society of Australia - South East Queensland Group

Proton's Mystery Crystal Set - July 3rd 1932

The Mystery Crystal Set
(by Proton.)
The Sunday Mail - Brisbane Australia July 3rd 1932

The Mystery crystal receiver is so called because I do not know just why it should be so good, and after trying it out for about a fortnight I am more amazed at the results than before. It is without a doubt the best crystal set that I have heard. Some of the Sunday Mail crystal receivers have attained Australia-wide fame, and it is quite a common occurrence to receive requests from readers in every State of the Commonwealth, asking for details of the Improved Interstate Crystal Set or the DX Crystal Set , but, this crystal set, to my mind, eclipses them all.

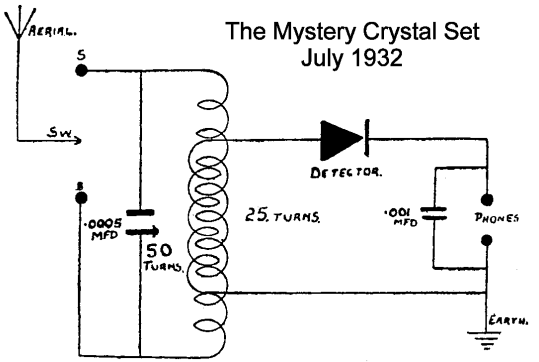


Figure 1

When you look at the diagram you will note that it is quite a different arrangement from that which you normally see in crystal circuits, but nevertheless it is a simple crystal receiver that will cost only a few shillings, and sufficiently selective to separate all the local stations without any overlap, and bring them in with enough volume to make the reception enjoyable. As compared with the Improved Interstate, this set is definitely superior. It tunes in the B stations with greater ease and with more volume, while 4QG's volume will surprise you as it did me.

The coil, like the whole circuit, is a most unusual arrangement, consisting of two coils wound together, turn to turn on the one former. The aerial coil, which is tuned has two aerial points without any earth

connection. The detection and output circuit is untuned, and has the receiver's earth connection, a very unusual arrangement.

THE COMPONENTS

The components necessary to build this freak crystal set are:

One piece of bakelite panel, 10 by 7 by 3/16 inch
One wooden baseboard, 9 by 7 by 1/2 inch
One .0005 mfd variable condenser
One 3 inch plain dial
One glass-enclosed crystal detector
Five terminals, NP type
One piece of 3 inch coil former, 3 inches long
1/4 lb of 24 SWG ((23 AWG) D.S.C (Double Silk Covered) coil wire
2 oz of 30 SWG (29 AWG) D.S.C (Double Silk Covered) coil wire
One coil of hook-up wire, solder and wood screws
One switch arm, two contact studs and one .001 mfd fixed condenser

CONSTRUCTION OF SET

The first constructional step is the winding of the coil. As this is a little unusual, I will endeavour to make it as simple as possible. Wind 12 turns of 24 gauge D.S.C wire on one end of the former, and, without breaking the wire, stop winding and punch two holes in the former, and thread the end of the 30 gauge wire through these holes to make it secure. Then continue the winding with both the 24 and 30 gauge wire so that, for the next 25 turns, the coil is so wound as to have a turn of the 30 gauge wire between each turn of 24 gauge wire. When 36 turns of 24 gauge wire, and 25 of the 30 gauge wire have been wound on, stop winding, and, without breaking the 24 gauge wire, break the 30 gauge wire, and secure it by punching two holes in the former and threading it through these. Now continue winding the 24 gauge wire for another 13 turns, and then securely fasten by punching a further two holes in the former, and the coil is complete.

The .005 mfd condenser is mounted on the centre of the panel, and the three inch dial is then fitted. The crystal detector is then mounted over the condenser, and the switch arm and the two studs is mounted under the condenser dial. The serial terminals are mounted on the left hand side of the panel along with the earth terminal, while the two

phone terminals should be mounted on the right hand side of the panel. The coil is mounted on the baseboard directly behind the .0005 mfd variable condenser.

The wiring up of the receiver is a very easy matter, as will be seen from the diagram, but to avoid any misunderstanding it should be noted that the 50 turn coil of 24 gauge wire is the tuned aerial coil, while the 25 turn 30 gauge wire coil is untuned and connects to the crystal detector and phone circuit.

OPERATION OF THE RECEIVER

The operation of this receiver is just as simple as the construction. The first point to note is that the switch and the two studs vary the selectivity, for when the switch arm is in contact with the stud S in the diagram, the set is very selective, and will tune in all four locals without any interference, but when the switch arm is in contact with stud B the receiver is much broader in its tuning and interference may occur, but the volume is greatly increased. The .0005 mfd condenser tunes in the various stations in the normal way. A point worthy of mention is the phone condenser. This condenser is usually omitted, but in this set it will be found to increase the volume quite considerably.

The Mystery crystal set is really a definite solution to the inexpensive crystal receiver selectivity problem and all readers who build up the set have an excellent receiver possessing excellent punch and selectivity.

Proton's Mystery Crystal Set - July 17th 1932

The Mystery Crystal Set
(by Proton.)
The Sunday Mail - Brisbane Australia July 17th 1932

ACTUAL WIRING DIAGRAM

The Mystery crystal set has proved most popular with constructors and some of the reports are really amazing, as the one published below indicates. A number of readers have written in asking for an actual wiring diagram, and this week, in response to their request, I am giving these details. In order to make the construction more simple , I have shown how to construct the set without the switch and studs by using two aerial terminals instead. This does not affect the receiver's efficiency, but it makes it easier to construct for those who have not the necessary drills and dividers. Now for a few hints. Firstly, if you desire to get the best results, build the set up in the manner instructed. Something else might work just as well, and on the other hand it might not, and everyone of the few components in the set have a definite purpose, even the most despised phone condenser improving the results. The receiver works better with a cats whisker type of detector than a permanent type. In some cases and indoor aerial is giving satisfaction, but this type is not always satisfactory for reception of all four local stations.

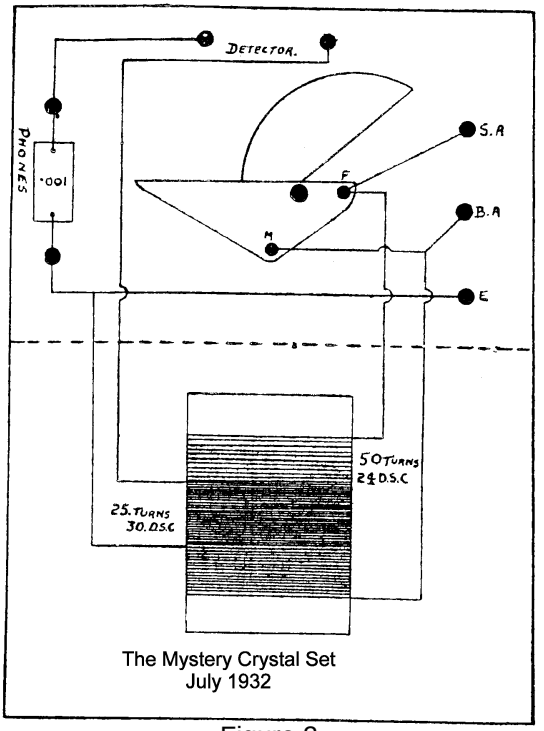


Figure 2

Proton's Mystery PLUS Crystal Set - April 16th 1933

Mystery Plus Crystal Set
Very Selective and Sensitive
(by Proton.)
The Sunday Mail - Brisbane Australia April 16th 1933

Those readers who study our ratio-query columns will no doubt have noted the large number of readers who have thrown down the gauntlet by asking me to improve the mystery crystal set. In a weak moment I accepted the challenge, and promised to see about it. This promise was made about three months ago, and last week a reader wrote in and frankly said," How about it?". Well, I have tried out about 10 Mystery variations since the original was first described and could not find anything better. On top of this, many interested readers sent along their ideas and suggestions, and still I was not satisfied that any improvement had been made.

Last week, however, the inevitable improvement came along - not from me, but from a man whom I do not even know, who told me how he had bettered that "cove" Proton's circuit. Of course, I was all attention and later tried his scheme out. Apart from the hard job I had to wind the coil, I was delighted and surprised to find what an improvement had been made.

Now the Mystery Plus from a volume aspect is about equal to the original Mystery, but the extra coil certainly does increase the selectivity to a most remarkable degree, and I venture to say that, with this new version, there should not be a suburb in and around Brisbane, that will not tune in at least three of the local stations without interference. In most suburbs all four stations will be tuned in quite free of interference, but I am aware that in a few districts one station cannot be tuned in at all on a crystal set.

The variation is really as very small one and those readers who own Mystery Crystal sets will not have much trouble in altering their sets to the Mystery Plus: because the Plus is only something that other Mysteries have not got - a coil.

Proton's Mystery PLUS Crystal Set - April 16th 1933 ... continued

THE COMPONENTS

Here are the components that you will acquire to construct the set. One bakelite panel 9 by 7 inches ; one wooden baseboard 9 to 7 by 1/2 inch; one .0003 m.f.d. variable condenser; one 3" plain dial; one glass enclosed crystal detector; one .001 m.f.d fixed condenser; one 3 1/2" inch length of 3" diameter tubing; one 1/4lb reel of 24 gauge D.S.C wire; one piece of empire cloth, 10 by 1 inches wide; four N.P. terminals, solder, and a coil of hook-up wire.

CONSTRUCTION OF SET

The construction of the receiver itself is quite straightforward. However, the coil is a little more difficult than usual, but I am sure that, if care is taken, very little trouble will be encountered. Firstly, wind 12

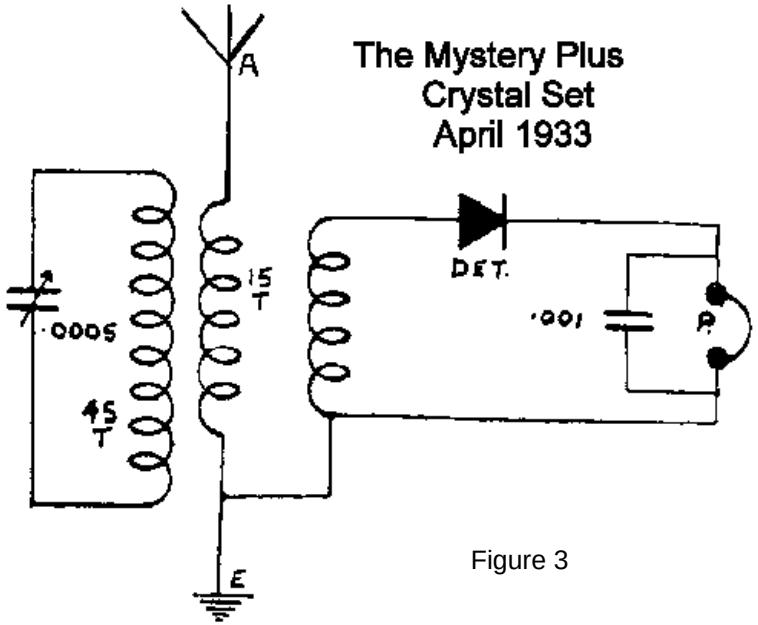


Figure 3

turns of 24 gauge D.S.C wire on one end of the former, and, without breaking wire, stop winding and punch too holes in the former and thread the end of the 30 gauge, through these two holes and make it secure. Then continue the winding with both the 30 gauge and the 24 gauge wire until 23 turns have been wound on, and then you will have

a turn of 30 gauge wire between each turn of 24 gauge wire. Now that you have 36 turns of 24 gauge and 25 turns of 30 gauge wire wound on, stop winding and without breaking the 24 gauge, break the 30 gauge. The punch two holes in the former at the spot, where the 25th turn of the 30 gauge wire ends, and thread the 30 gauge trough these to make it secure. No continue winding the 24 gauge wire for another nine turns. Now over the centre of the dual winding wind the empire cloth and secure it around the former tightly with Seccotine at the overlap of the cloth. Over the top of this strip of empire cloth wind 15 turns of 24 gauge wire and secure the ends by threading them thorough the cloth. The coil is then completed.

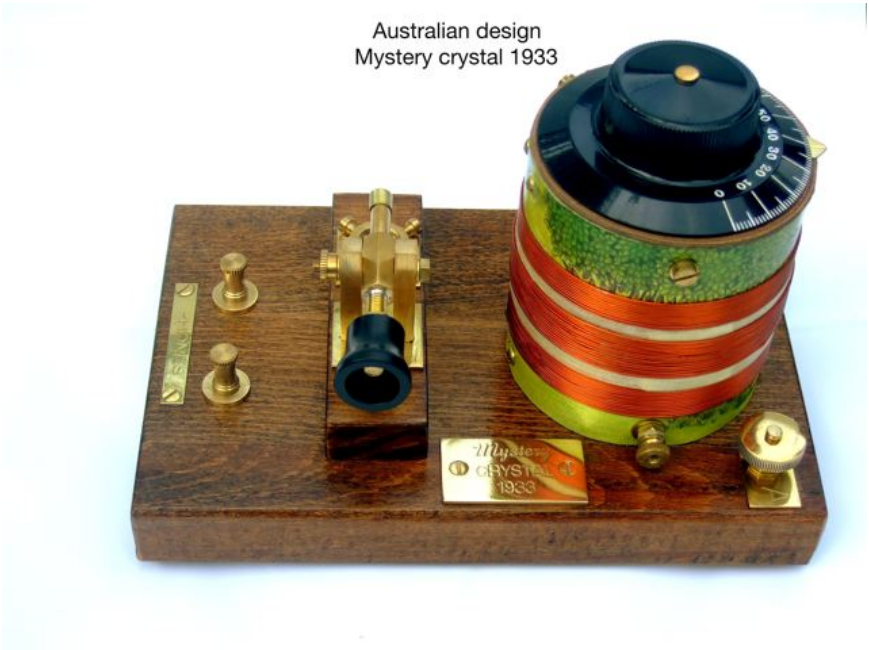
Now that you have completed the coil commence to mount the other component. The .0003 mfd turning condenser should be mounted in the centre of the panel, with the crystal detector in a horizontal along the top. The aerial and earth terminals are mounted on the left hand side of the panel, and the phone terminals are mounted on the right hand side of the panel The panel should then be screwed to the baseboard, and the coil mounted vertically behind the .003 mfd turning condenser, and the .001 mfd fixed phone condenser is mounted across the output terminals.

CARE NECESSARY WITH LEADS

When you have every thing in position commence wiring up from the diagram which should make everything quite clear. Care however, should be taken with the six leads from the coils, for if by mistake these should become reversed, the receiver will not operate successfully.

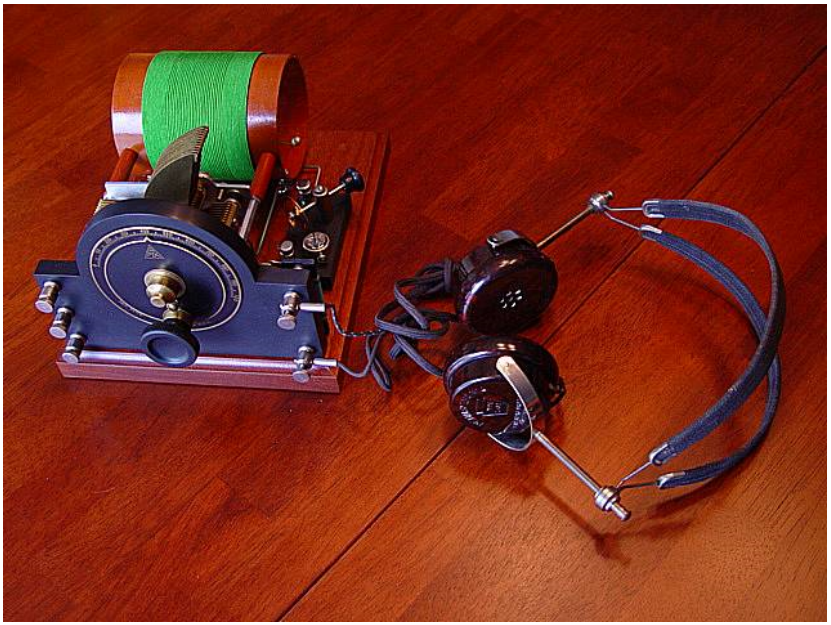
This receiver will be excellent to try out as an experiment over the Easter holidays, for all those crystal set enthusiasts who have built up Mystery crystal sets in their original forms will have very little difficulty in making the change over. Those readers who are trying out the Mystery for the first time will be surprised at its sensitivity and selectivity.

Mystery Set Examples



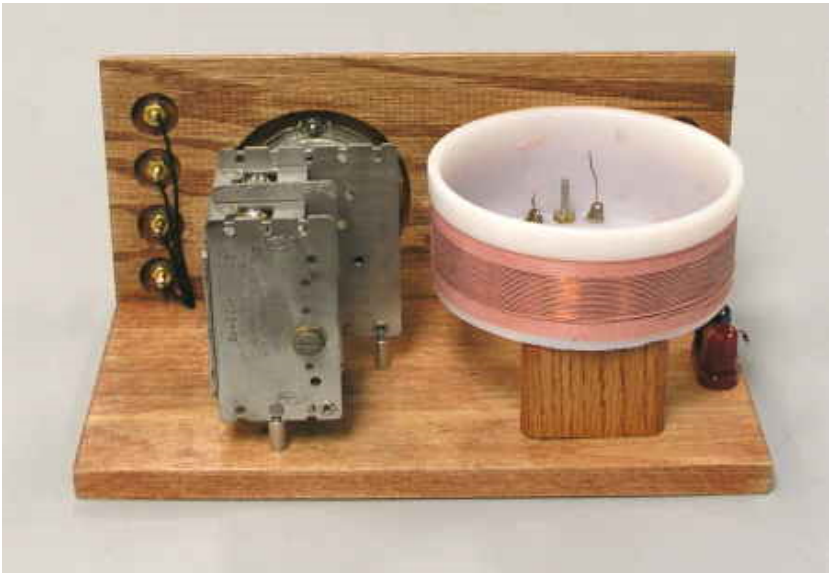
Another well-done example of the Mystery Crystal radio set done by Roy Frettsome - G4WPW - http://crystalradioclub.co.uk/g4wpw.htm

Mystery Set Examples



This is unquestionably the most beautiful implementation of the Mystery Crystal radio set that I have seen. Constructed by Michael R. Starcher - KB4YJ - http://oldradiobuilder.com/MCS.html

Mystery Set Examples



Mystery Crystal Set constructed by Jim of hobbytech.com

Mystery Set Examples

Mystery Crystal Set constructed by “Big Nick” of http://www.bignick.net/Morgan_Radio/Radio.htm

Mystery Set Comments

PRAISE FOR THE SET
(Letter from a Sunday Mail Reader July 17th 1932)
The merit of this receiver will be more readily appreciated after reading the letter from J E of Ashgrove:

I have successfully constructed your Mystery Crystal Set. As you already know, I have tried out a good few these last seven years. I used, on account of having a lot in hand, No 23 D.S.C wire for the 50 turn coil and 24 D.S.C for the 25 turn coil, using a .0015 mfd condenser between phones, having 120ft overall aerial. I met with amazing results. I bought in 4BG with wonderful punch. It was audible on the speaker (scientific type) two rooms away, on stud B, but when I switched on to stud A 4QG's volume decreased a bit, but I pulled in 4BK,4BC,4BH, and K4LW on the speaker. It was so strong that they could be heard 30ft from set.

• "I just finished building the Mystery Crystal set. It's really a good performer. The selectivity is excellent. I can separate all 5 local stations here with good volume. This one is definitely a keeper". – bjurin_y 23 Apr 2000

• "This set is an amazing performer. It has crystal clear reception, good sensitivity, and excellent selectivity". – Larry Soloman 2006

• "I just finished building the Mystery Crystal Radio and it is working very good. I am receiving 6 stations in the Hartford CT area. This really was a fun radio to build. I can't think of anything I've had more fun with over the years". – frangolden_2000

Mystery Set Comments ... continued

An Explanation of how the "Mystery Crystal Radio" Works
By Ben H. Tongue

The beauty if the Mystery set is that it provides an antenna decoupling capacitor (Cc) (made from the distributed capacity between the bifilar-ed windings), along with the effect of two different points for its connection to the tank; all without any specific physical capacitor or taps on the inductor. Further, the diode is effectively tapped 1/3 down on the tank for improved selectivity. The only downside to this arrangement is some loss caused by the probable relatively low Q of Cc.

When using the "Broad" antenna connection, the antenna-ground components are connected through Cc across the full tank. This arrangement puts a relatively large amount of antenna resistive loading on the tank. The loading results in as reduced selectivity, but stronger signal strength than one gets in the "Selective position. See Fig. 7.

When using the "Selective" antenna connection, the antenna-ground components are connected through Cc across only 1/3 of the tank coil turns. This results in a reduction to about 1/9 of the resistive loading by the antenna on the tank, compared to the loading in the "Broad" connection. See Fig. 14. This reduced loading increases the loaded circuit Q, and hence selectivity. The ratio of unloaded to loaded Q is reduced, thus reducing sensitivity.

For practical purposes the 'leakage inductance' between that part of the primary that is bifilar wound with the secondary is very low. To the extent that it is not zero, it and the leakage inductance between the outer turns of the primary and the inner bifilar-ed 25 turns can be considered to be an added "leakage inductance" in series with C2 in Fig. 7; and in series with C3 in Fig. 14. The main effect of this leakage inductance, compared to having none, is to somewhat lower the highest frequency than can be tuned. The low end of the tuning range will be extended a small amount.

See full article at: http://www.bentongue.com/xtalset/19mstry/19mstry.html

Mystery Set Notes

Two Ways To Connect The Antenna

The broadband antenna connection makes the radio much broader in tuning. Some interference may occur. However, volume is greatly increased. Use this connection when you are attempting to tune a station that you can't quite "catch" on the sharp tuning connection.

The sharp antenna connection will be very selective and will tune without interference. Use this when trying to receive DX or low power locals. Don't hesitate to experiment with both, one may work better than the other.

Of course you will want to hook up a 1N34 diode or a catwhisker galena crystal. You might even be surprised that instead of galena that iron pyrite (fools gold) will work better. Try other types of mineral crystals as well. One might just work better than the 1N34 diode.

For the variable capacitor a 365pf is suggested. A tuner from an old AM transistor radio will work in a pinch, at least until you get a 365pf variable capacitor from an electronic parts supplier. 400-500pf may be required to tune the whole AM band. It is suggested that you visit flea markets and yard sales for "junk" radios as a cheap, and plentiful source of electronic components. There is a certain satisfaction in actually building the radio with as little cost as it was designed to be built.

If you have built the set and are successfully listening to it you can see just how well the coil and circuit work. It's a definite solution to the selectivity problems that ordinary crystal sets have. You get both "umph" and selectivity. There is really no mystery in how this radio works. The coil steps down voltage and raises amperage which provides more output to the earphones.

There are two possible antenna coil connections without any ground. The crystal detector and output is untuned and is connected to the ground. This is not the usual setup is it? The coil and circuit receives local stations without overlap and with good volume. Its broadband will assist in tuning in the station that you want to capture. As always, this is a crystal set, results may vary due to local conditions and antenna/ground configurations. If you live on the doorstep of a radio transmitter you might get some overlap. Otherwise, you should be

Mystery Set Notes ... continued

quite pleased with the performance of this set. Many people in pre-depression England built these sets as the best crystal receiver of the poor working class radio listening public. Regular sets at this time when radio was relatively new were expensive and the times were hard.

Winding The Mystery Set Coil

Double Silk Covered (D.S.C.) wire is extremely difficult to find today. Therefore, the Mystery Set coil may be wound using solid, enamel-coated magnet wire.

The coil is wound on a low-loss insulated core that is approximately 3" long by 3.25" in diameter. It starts with 24AWG magnet wire that is anchored in two small holes and wound for 12 turns. Then, two more anchor holes are drilled and 30AWG wire is anchored in them. It then continues for 25 more turns with the 30AWG wire added along with the 24AWG wire. At the end of these 25 turns, the 30AWG wire is anchored in two more holes and the 24AWG wire continues for another 13 turns. This way the 24AWG wire has a total of 50 turns with 25 turns of 30AWG wire interleaved with the middle 25 turns of 24 gauge wire. The ends of the wires are coiled inside the core. Approximately 12" of wire ends should be included to allow the coil to be mounted and connected in the best possible position.

Dimensions:
Length of core: approximately 3" (76mm)
Length of coil: 1.5" (38mm)
Diameter: 3.25" (82.6mm)
Turns: 24AWG = 50, 30AWG = 25

Substituting Components and Materials

Some of the components, materials and values used in the original Mystery Crystal set design are no longer available. Approximate values and materials may be used in their place. Just use common sense when choosing substitutes and your design should work fine.

Pittsburgh Antique Radio Society- PARS

The Society is incorporated as a non-profit corporation. The Society is dedicated to the preservation and exhibition of historic-communications equipment and early electronic entertainment media, with an emphasis on the Pittsburgh area and related material. Members are encouraged to acquire, restore or replicate historic items and collect publications, recordings and other materials related to the history of communications and broadcasting.

For information: (www.pittantiqueradios.org)