another MRL Handbook...

5½ x 8½
24 pages
54 drawings

HB-5. "CRYSTAL SET CONSTRUCTION."

CONTENTS.

A FEW OF THE QUESTIONS ANSWERED IN HANDBOOK 5. Pages given.

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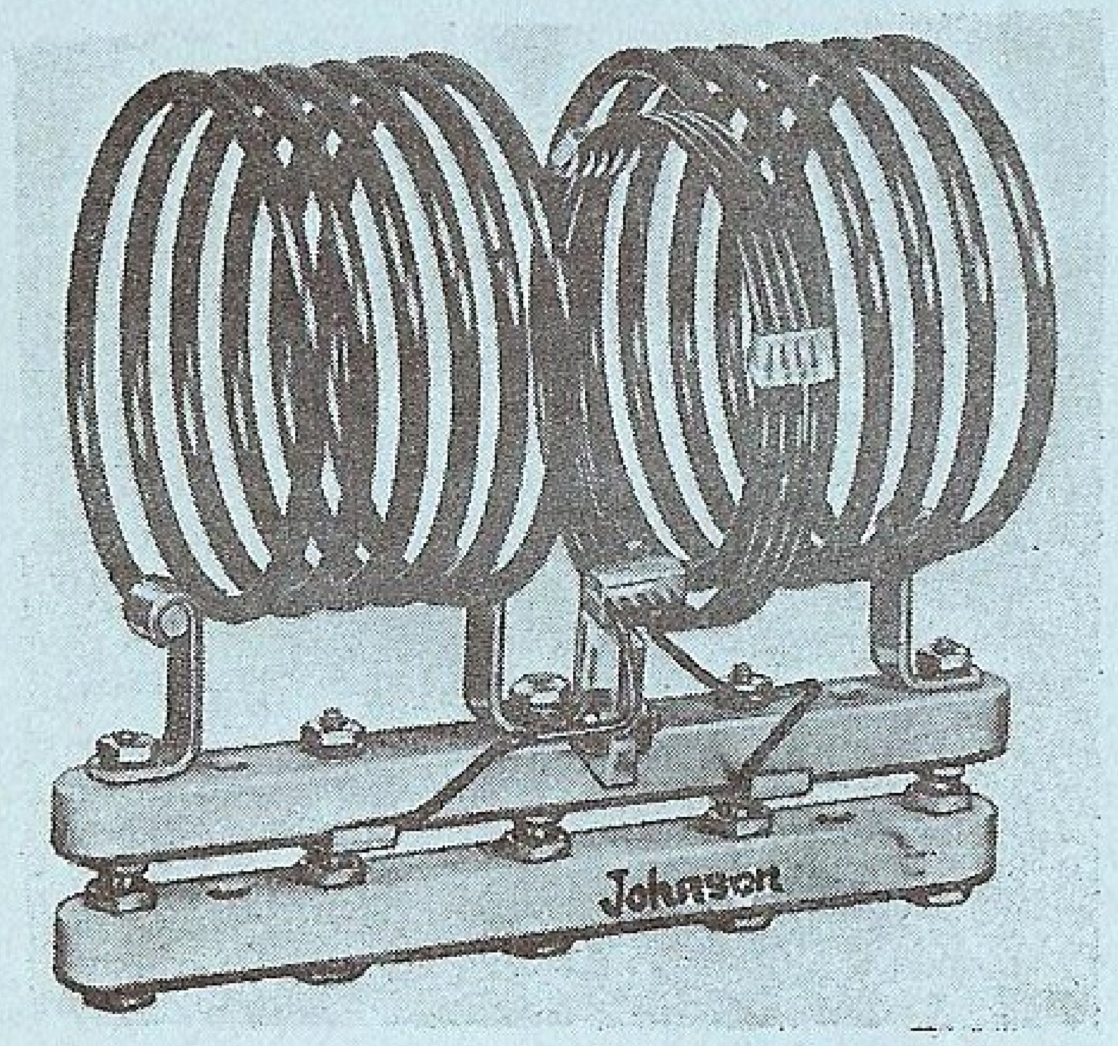
In the years we have been attending to the Experimenters' wants - thousands of questions pop up. Like most things - 15% of the questions are asked by 85% of the Fans. Many questions sound odd to an Old Timer - but are very serious when asked by a Beginner, or early Experimenter. Most elementary books don't really "begin" but start halfway up the ladder. This gives the Neophyte a lift. Even the Old Time Experimenter can find many suggestions of value. Every day a Beginner asks an Expert one that he can't answer!
Lots of pictures with symbols so you can recognize them later. Many diagrams and details.
All methods have been used over and over again by us - and Experimenters writing in. We'd like to pass it on to you. Same price and source as this one.

Rev. Bro. T., St. Benedict's College, Colombo, Ceylon, says: "As a teacher I appreciate your efforts to cater to newcomers in your HB-5. A gem of a production for beginners."
M.R., Valley Park, Mo.: "HB-5 is absolutely great. Could never find such info. before. Your books help me solve problems."
E.H., St. Louis, Mo.: "Read HB-5 cover to cover. Will study it over carefully next few days."

MRL HB-6. How to Make Coils.

another MRL Handbook... HB-6

How to Make COILS



By Elmer G. Osterhoudt

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by

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)

Litho. in U.S.A. by Modern Radio Laboratories

F O R E W O R D

About 1915, after reading a 10¢ booklet on the wonders of Wireless, I wound my first coil to receive code signals. It was about 200 turns #28 DCC wound on a broomstick. It was a beautiful coil - all painted with White Lead paint. (The paint was my own invention.) Hooked to a 10¢ Gernsback galena, phones and Aerial, I didn't even get a good click. The lead paint had shorted the coil, crystal and phones.

A neighbor boy (also named Elmer) came over to get his Galena to working - because I knew "all about Wireless!" I hooked up his unpainted coil and in came 6JG's powerful rotary spark about two miles away. This further convinced him that I knew "all about Wireless."

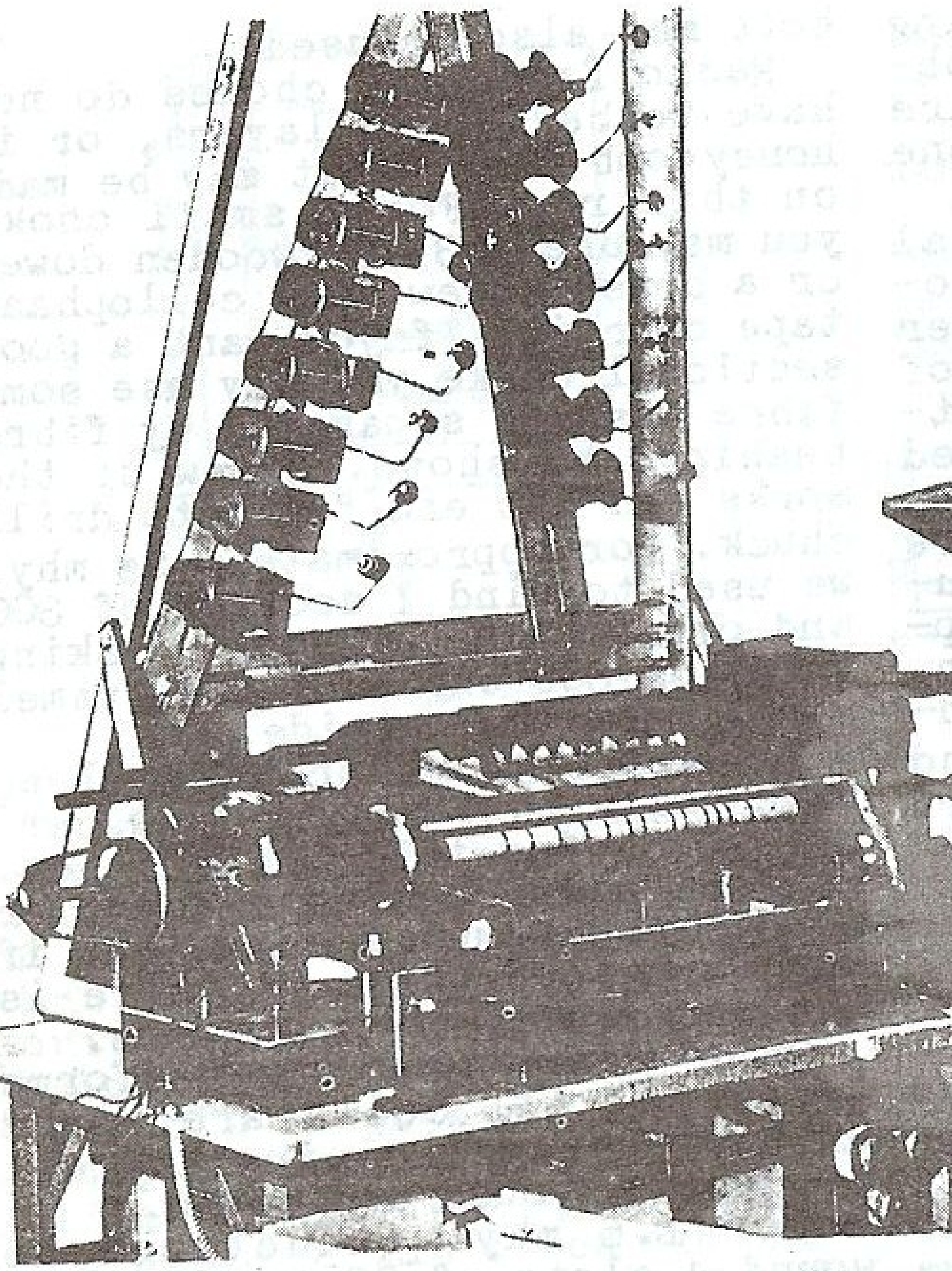
Over the intervening years hundreds of various kinds of coils have been constructed. And next to tubes - I believe coils are the most varied and interesting parts of a Radio. There are now so many types that some companies make a business of building coils alone.

One could never guess how many coils we have built in our shops - but like they say in the South - "an awful lot."

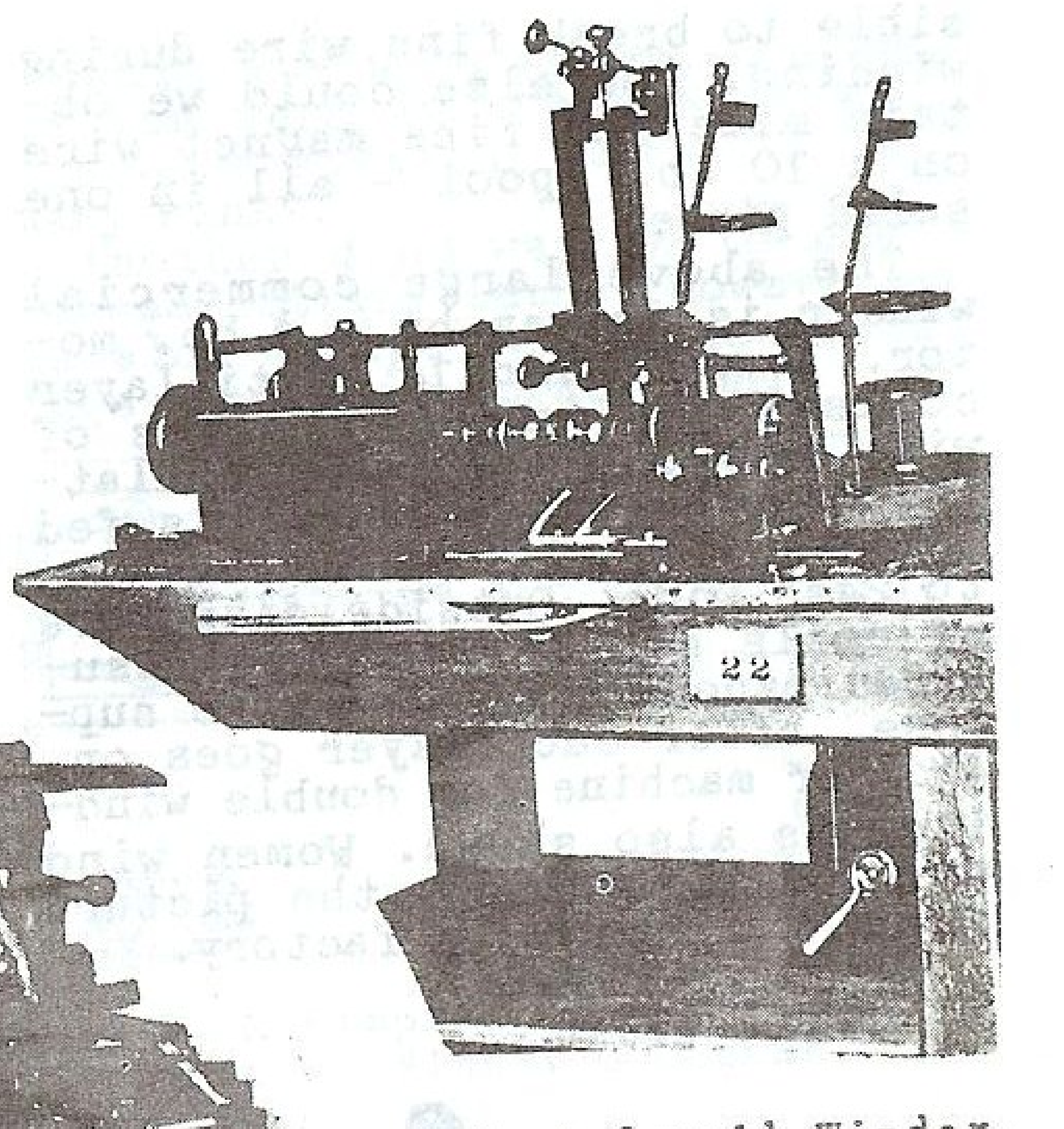
In 1932 I operated a small Radio service shop on 23rd Ave. in Oakland, Calif. Being a one-man shop I had to stick close to headquarters. During a period of Short wave experimenting I ran out of Bakelite tubing and coil forms. Rather than close up, I rigged some celluloid plug-in coils on tube bases. They worked so well that I made more of them - and a Jobber became interested in selling them. He got us hooked up with Don Wallace (W6AM) as our factory representative. Mr. Dickow, then editor of "Radio" (a magazine we miss) introduced us to two factory Reps. in New York and Chicago. Each Rep. covered 7 states. Well, we made plug-in coils all day and half the night - with no profit. After a couple of years we decided to sell them direct. Since then we have made oodles of coils. Incidentally, we also started Modern Radio Labs. in 1932.

There are many kinks to Coil building - but will pass some of them on to you. Possibly you are like us - you learn something new every day. Many buy them but others like to "wind their own."

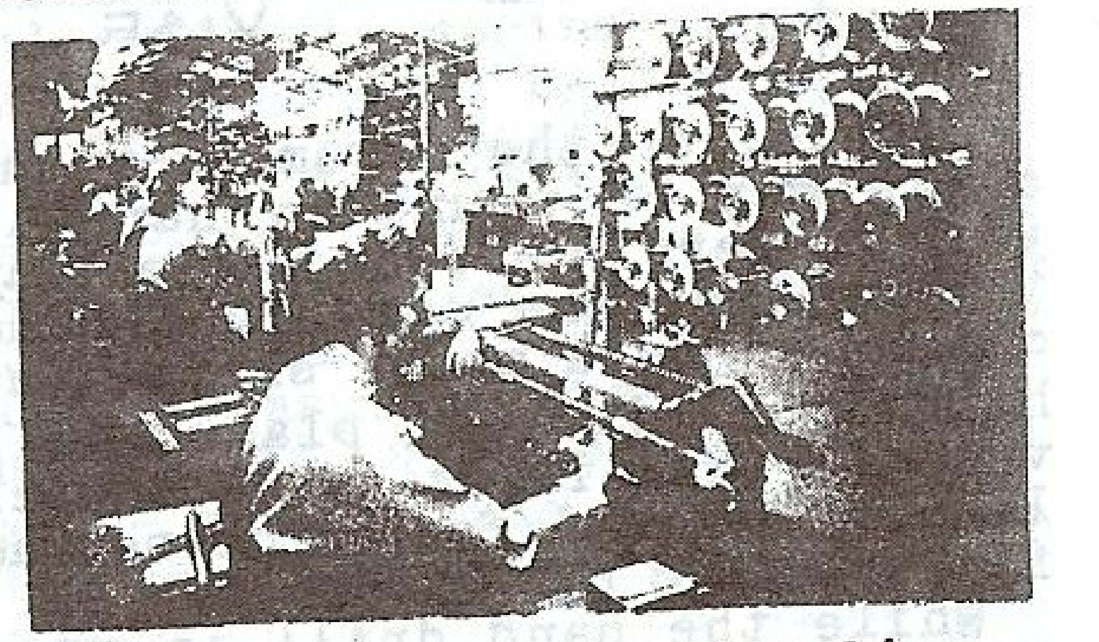
Would like to thank Mr. J.T. Crevelt, representing Insulation & Wires, Inc., S.F. for help in certain winding methods.



1-1. Multiple Winder for 14 Coils.



1-2. A 2-coil Winder.



1-3. Factory Production Line.

1. INTRODUCTION.

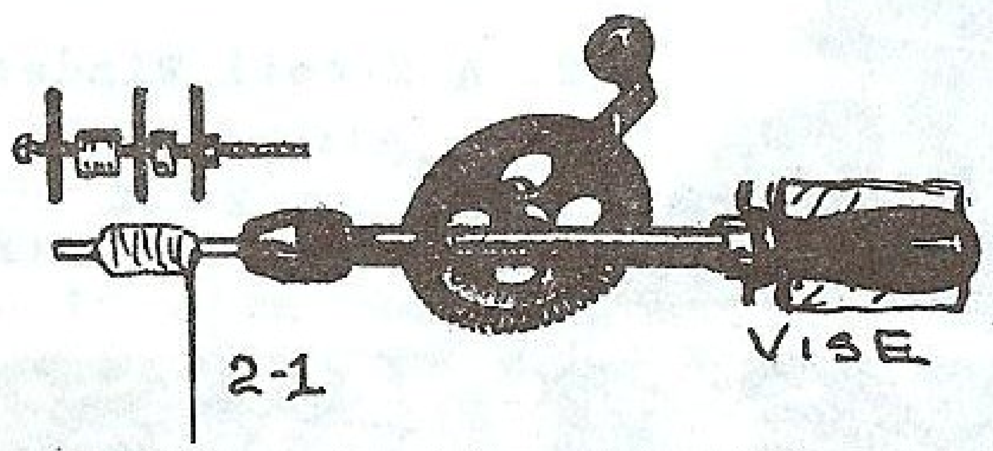
The subject of coils is an extensive one. In this Handbook we will try to cover the methods of winding coils that have come before us over many years. A companion Handbook will cover Coil Techniques that are interesting to the average Experimenter and builder. The methods of winding will be those useful to the Experimenter - instead of the commercial coil manufacturer.

The simplest coil is a jumble-wound - a hank of wire wound around your fingers - to make the simplest form of coil winder. Up from this - they proceed thru dozens of variations and complications to the harder forms of Honeycombs, produced by complicated machines.

We have run into some ingenious "Joe McGee" coil winders - even starting from an old sewing machine!Due to the cost of built machines, most companies design and make their own to their particular needs. Some large commercial winders run up into the thousand dollar class. Many intricate ones are now used for Honeycomb coils - with concentrated fields and space. Some can wind many multi-layer coils at a time; place thin layers of paper in between; and electronically control the tension of the wire automatically. The operator just swaps the coils and replaces wire and paper. A wire company tells us their electronic controls for tension are so accurate that it is almost impossible to break fine wire during winding. How else could we obtain miles of fine magnet wire on a 10 lb. spool - all in one solid piece?

The above large commercial winder is driven by a ½ hp. motor. It can wind 14 multi-layer coils at a time - in sizes of wire from #16 thru 42. Insulating paper between layers is fed onto the 14 coils at a time - up to 24½" wide. Outside diameters of coils may be 5½". The insulated paper is slitted - we suppose, after each layer goes on. Another machine for double windings is also shown. Women wind most of the coils - the picture shows a corner of a factory.

2. JUMBLE WOUND.



2-1

Jumble, or the scramble-wound coils may be wound by hand in your fingers - but an easier way is to mount the core in a hand drill, or on a motor shaft. The hand drill is then placed in a vise for stability. A gooseneck lamp is helpful for watching the fine wire go by.

While the hand drill is preferred for smaller windings, the motor is used for larger ones, like speaker fields, chokes, and other large coils. The old dynamic field coils used to run about 8 miles of fine wire on a form - so a hand drill is too tedious for this. Speakers today, due to better Alnico magnets, do not require as much wire.

For re-winding headphone magnets see details in Handbook 1.

Electro-magnets for bells, buzzers, etc. may be jumble-wound - however, layer-wound is better as more wire will go into the same space. Cores may be of stove-pipe wire bound with some plastic tape. An iron screw or a bolt may also be used.

Radio frequency chokes do not have to be single layers, or in honeycomb form - but may be made on this rig. For a small choke you may use a 3/16" wooden dowel or a brass screw with cellophane tape over it. If you want a good sectional choke you may use some fibre washers separated by fibre bushings as shown. Screw up the works and let end fit into drill chuck. For approximately 2½ mhy. we used to wind 1 section of 300 and one of 200 and 100 - making total of 600 turns of #34 enamel wire. Dope the outside.

An English author makes long wave coils this way, but we cannot vouch for their efficiency. We feel a large single-layer or honeycomb is much better. But if you want to experiment, here is the approximate data he uses.

On 1" diameter forms he forms ¼" slots. All coils are wound with #36 enameled wire and all is jumble-wound and doped.

For 1.6 mhy. inductance he wound 4 slots of 80 turns each. With a .0005 variable condenser it should reach about 1500 meter range; 2100 with a .001.

For 2.1 mhy. inductance he uses 4 slots of 92 turns each to reach 1700 m. with a .0005 and to 2500 meters with a .001.

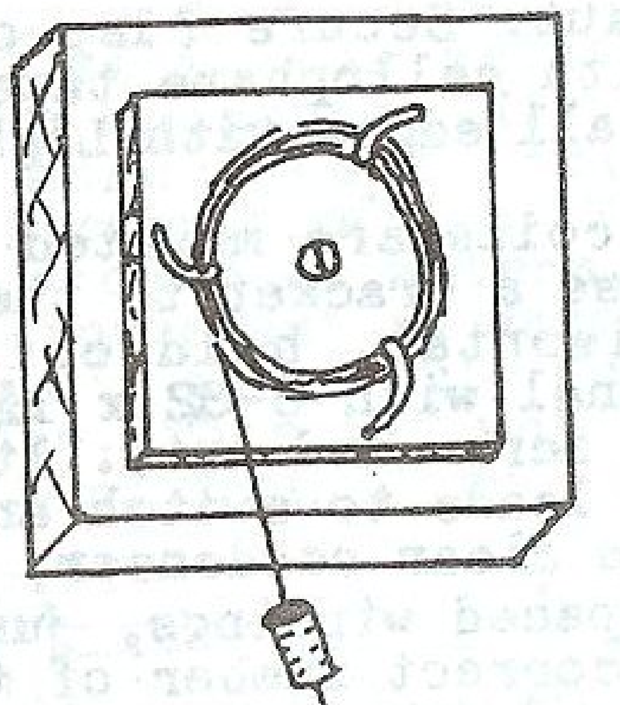
For 3. mhy. inductance he used 6 slots of 85 turns each to get 2000 meters with .0005 and 3000 with .001 variable. Ranges may vary with winding and size of the variable condensers.

Put Light Coil cement over all windings to make them rigid and weatherproof.

3. SOLENOID or SINGLE LAYER.

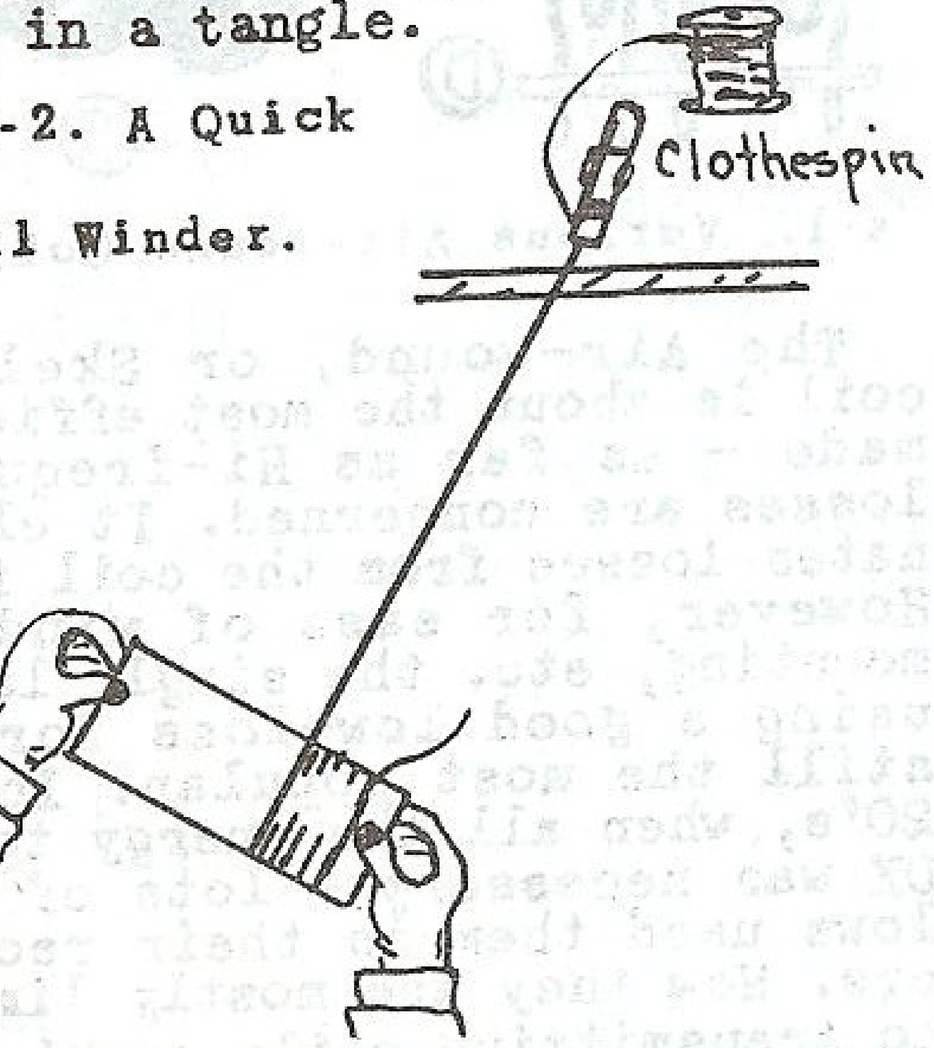
This tubular winding, if suspended in air, is the most efficient Radio coil we can devise. But, for ease of winding, mounting, etc. we add a little loss by winding it on a form. Most of the Radio coils you encounter will be wound in this manner. It is the easiest to build, next to the jumble windings.

3-1. We will first make a rig


3-1. How to Unreel a Hank.

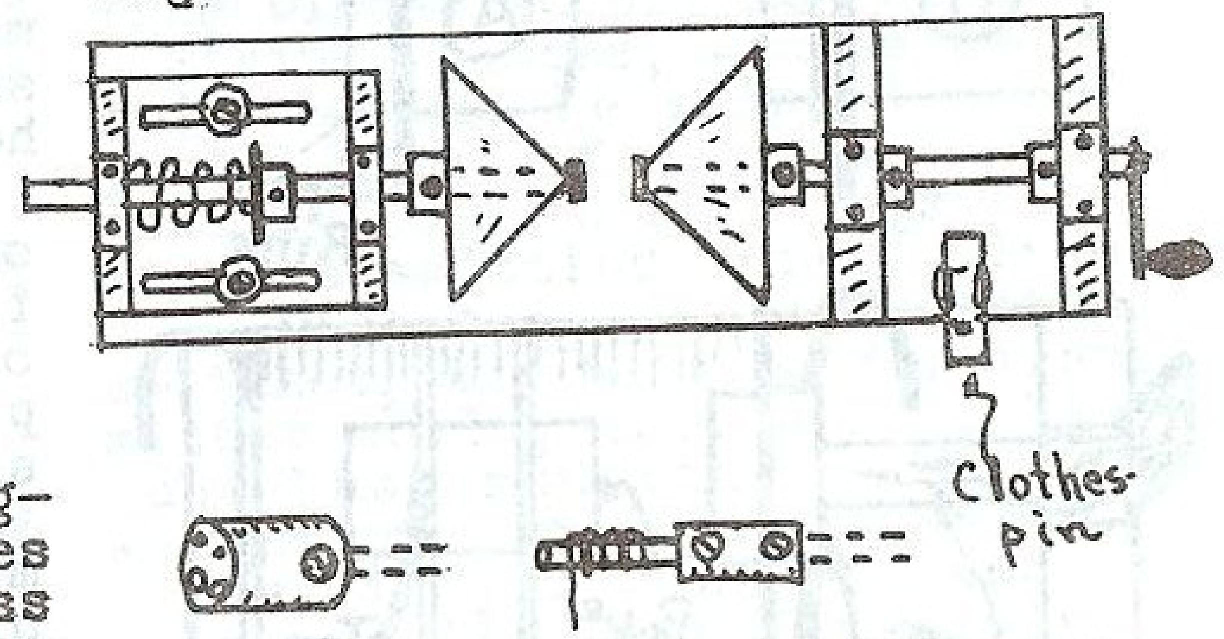
to hold hanks, or coils of magnet wire because most companies send wire in this manner, if less than ¼ lb. amounts. Use a piece of ½" plywood and center a pivot thru it. Mount 3 curtain supports, or screw hooks bent as shown, thru the plywood. When a wire coil is placed in the supports, the latter are twisted to hold the hank. Mount the pivot on a piece of 2x4 block for sufficient weight to hold it in place on the bench. Put a large, flat washer between the blocks so it runs easily but still able to keep the wire taut. The metal bushing also aids. You may then unwind the coil without it getting in a tangle.

3-2. A Quick Coil Winder.



3-2. A quick method of winding a coil, and still do a nice job, is to screw a clothespin to the bench to hold the wire. Stand off a good distance and keep feeding the wire around the form as you turn it. This will keep the wire straight and eliminate many kinks.

Another good way is to use a thread-cutting lathe. However it is slow except for spaced windings - when it works good.



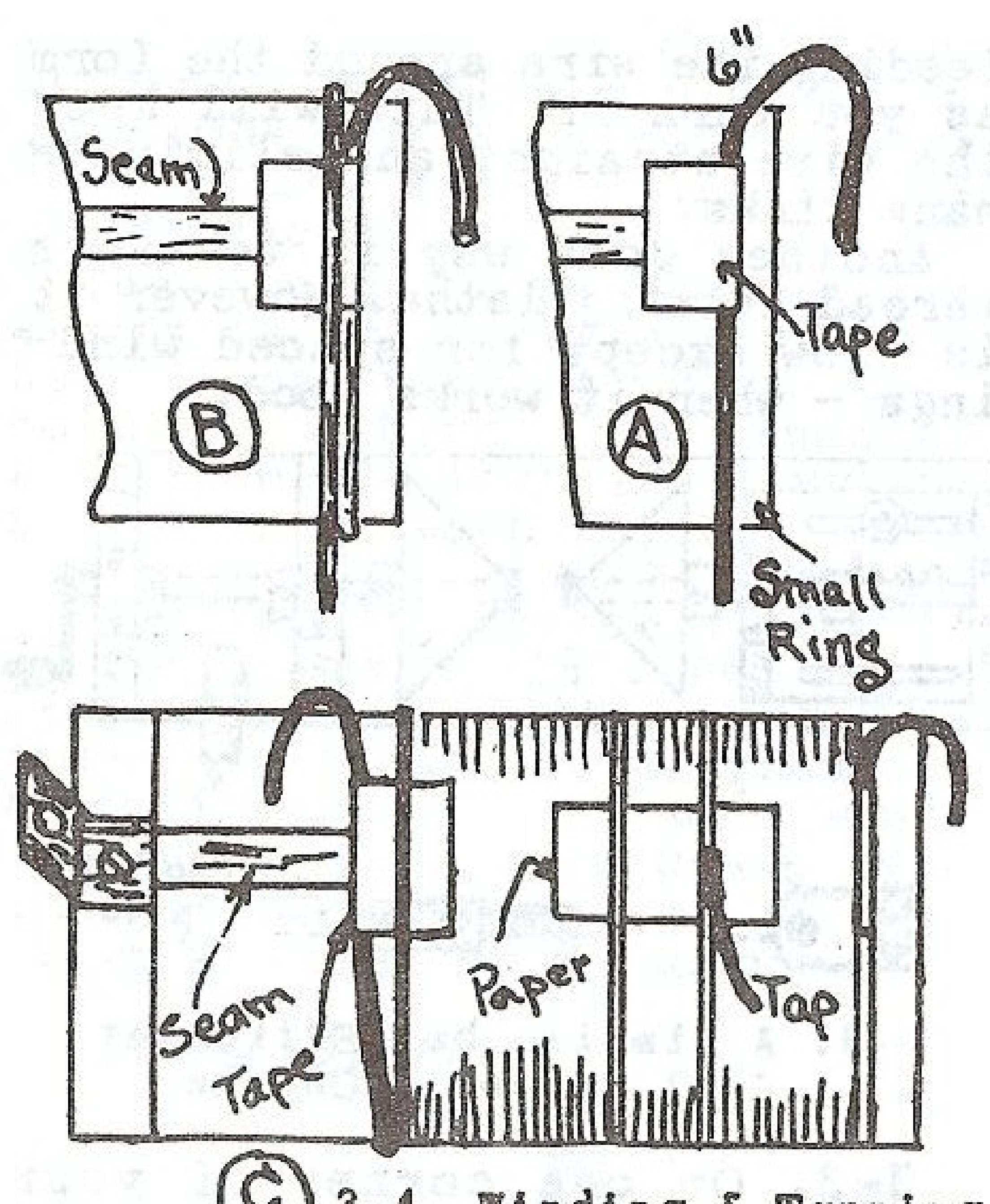
3-3. A Simple, but Efficient Coil Winder & Chucks.

3-3. On one corner of your bench you may rig up this coil winder. The drawing is self-explanatory. The part with the crank is stationary but the back end, with the spring is movable. Use a large open spring and collar to fit the shaft.

Place a form in the winder and adjust the tension - you will soon learn to get it right. After winding the coil use the clothes pin to grasp the wire before you cut it off. Then push the form back - closing the spring and it will quickly release the form. As you hold the wire with one finger- you will appreciate this arrangement.

You will find this winder to be very versatile. You may make all kinds of chucks for it. The ones for 4-5-6 prong plug-in coils may be made from wood. A ½ x ½ metal coupler may be used for winding wooden shafts when making chokes, etc. Winder may be used for transferring wire to a spool from a hank.

3-4. Shows best method of making Crystal set coils as well as details for making taps. Years ago it was a good idea to twist the turns for a tap - but anyone doing this will soon find that its not a good idea- as the wire usually breaks at the twist. You



3-4. Winding & Tapping Crystal Set Coils.

just sandpaper off the cotton insulation and solder on switch point leads. Use only cotton-covered wire for tapped coils. Enameled wire is too hard to clean up to solder. We have used This method for over 25 years.

Our 2XM celluloid forms are usually specified for most Xtal sets.It has been proven they are best for DX due to low-loss.

However, the winding specifications given here are also applicable to Bakelite, and other plastics,as their properties are very similar.

Cut 2 pcs. of friction tape 1" long. Then, 6" from end of wire, fold one piece over, as shown in A. Start winding at "hot" end, with the small ring, bringing 2nd turn up close to hold tape, as shown in B.

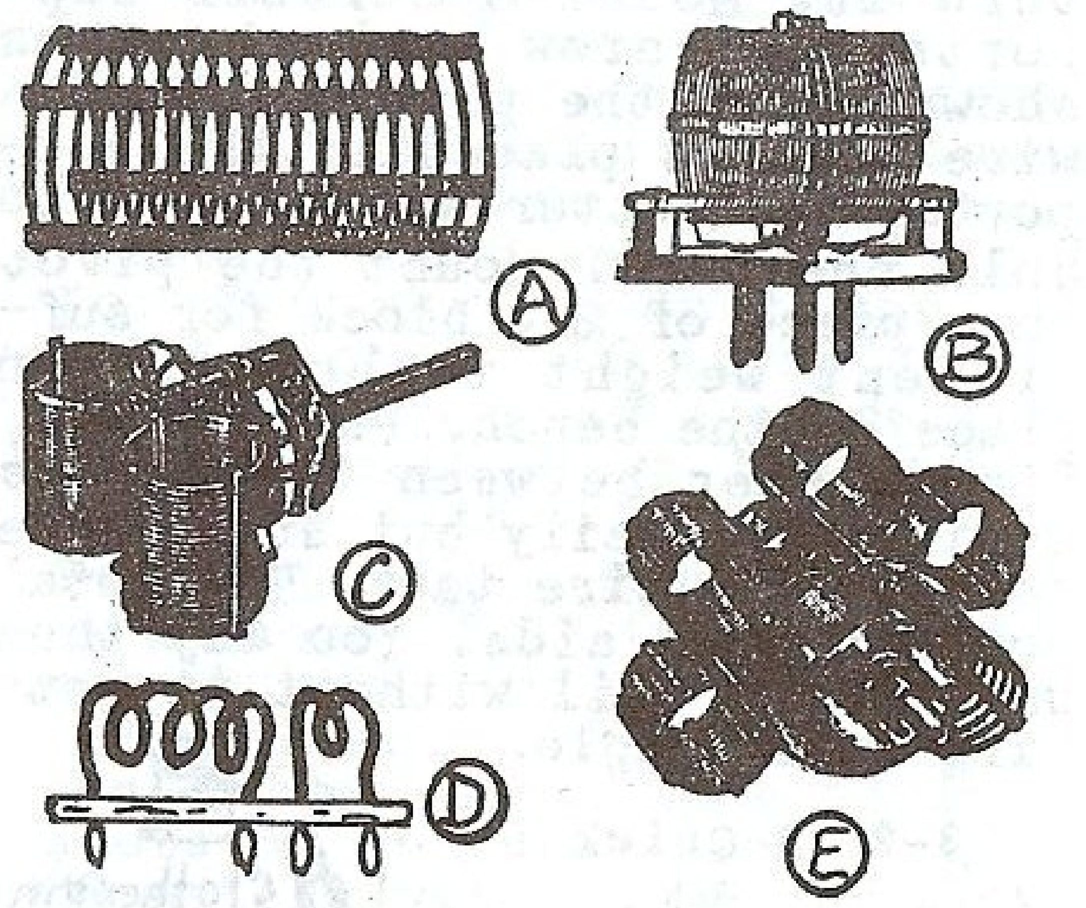
When making taps (C), slip a ½" strip of light cardboard under each turn to be tapped. Slip end of paper under turns for a neater job.

After end has been reached,cut wire 6" long for lead. Back off one turn, folding tape over wire as shown. Push tape under next to last turn, and pull tape and wire taut. Secure flap of tape down with cellophane tape. Then cement all edges with Light Coil Cement.

When coils are mounted vertically,use a bracket to the base. If horizontal, hold coil away from panel with 6-32 x 1¼" R.H. machine screw and nuts. It makes shorter leads to switch and also helps to clear condenser, etc.

For spaced windings, just wind on the correct number of turns & fasten end down. Then, run a pc. of string in between the turns, pulling turns over against the string - then remove string. You then dope it with Light Coil Cement all over. This will make a nice looking job.

4. AIR or SKELETON COILS.

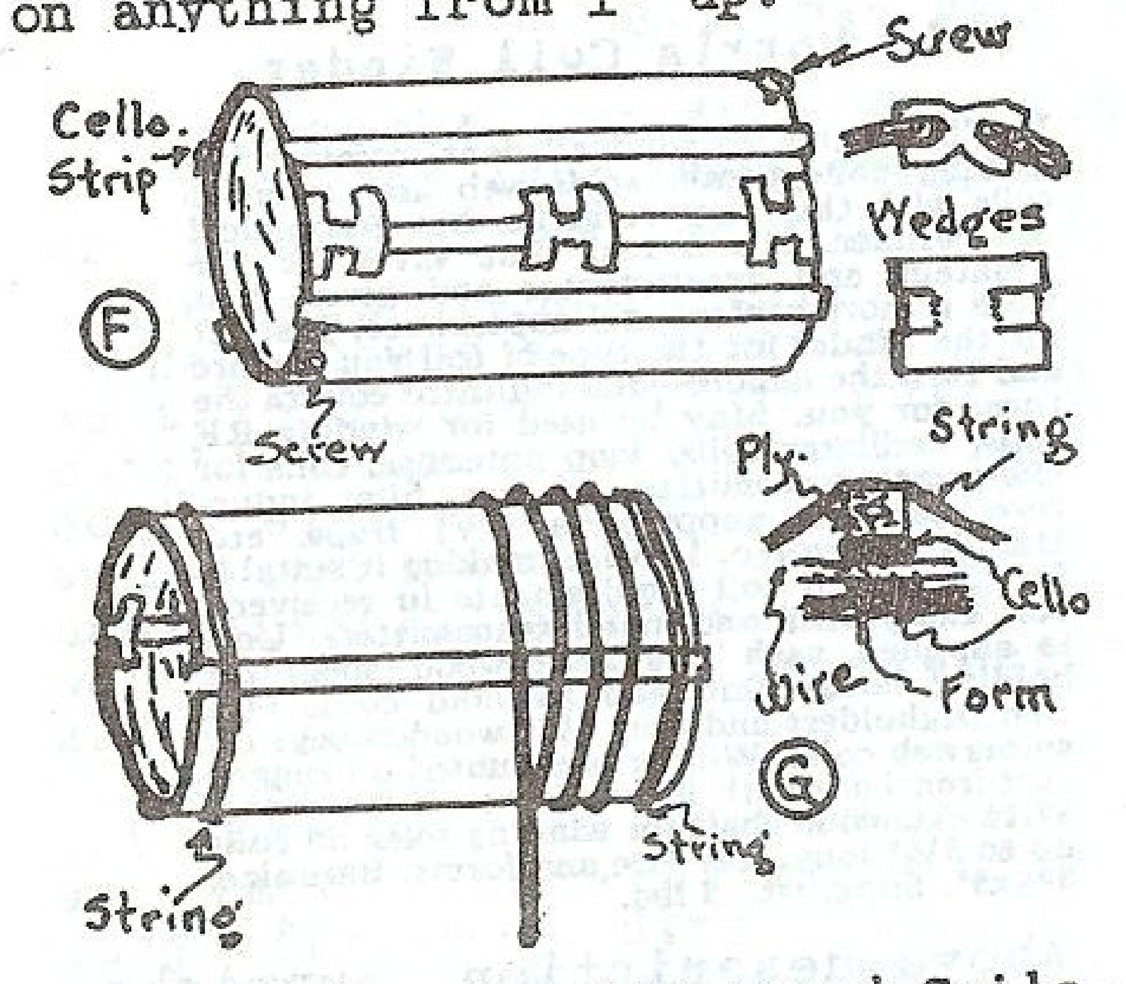


4-1. Various Air-wound Coils.

The Air-wound, or Skeleton coil is about the most efficient made - as far as Hi-frequency losses are concerned. It eliminates losses from the coil form. However, for ease of winding, mounting, etc. the single layer, using a good low-loss form is still the most popular. In the 20's, when all the energy to get DX was necessary - lots of fellows used them in their receivers. Now they are mostly limited to transmitting coils or Hi-frequency coils.

We used to make a lot of the transmitting type for a Chiropractor in San Francisco - where he used them in a fever machine.

His object wasn't as much in healing as it was selling the built-up machines. His office looked more like a Radio shop than a Doctor's office. They operated around 20 meters. So we had to figure out an easy way to make them - as we only got $1 to make them. This jig may be used on anything from 1" up.



4-2. Winder for Air-wound Coils.

(F) Get a piece of Bakelite tubing the approximate size of coil to be made. Mark it lengthwise on one side and slit it with a hacksaw. Make about 3 of the small wedges from heavy Aluminum and slit each as shown. Bend the center ones down to fit inside the form. Removing these wedges allows the form to collapse. Mount 2 RH machine screws up on nuts to hook the wire on when starting or completing.

(G) Now we'll wind some transmitting coils with #10, 12 or 14 tinned busbar - or enameled wire if you prefer. Cut 8 pcs. heavy Celluloid, or Plexiglas ¼" wide and long enough to cover form. Wrap a piece of string around the form at each end to hold it together solidly.Slip 4 of these strips under the string - evenly spaced around the form. Now slip it into the winder (3-3). Hook end of wire around screw at the right and wind on turns - hook screw on other end and cut off. Space wire evenly across.

Next paint several applications of Heavy Coil Cement over the wires and down onto the four Celluloid strips. Lay the other 4 over these- and hold them down with pieces of ¼" x ½" plywood. Wrap string around the outside of the wooden strips and fasten end down good. Go over the winding and true it up. Remove form from winder to dry 24 hours.

String, blocks, wedges and the coil may all be slipped off and you'll have a fine coil that may cost $1.50 with mountings. A & B are transmitting coils, altho C & E, with the decked inductance switches, may be used for transmitter coils, too. B coil has a tube base mounting, altho the system used at D is preferred.

Now, if you want to make receiver coils with finer wire - use 6 or 8 re-enforcing strips to make them more rigid. If the windings are spaced you may run a string in between and remove it before cementing. In case you want closewound coils - cement the strips a little ahead of the winding so the inner strip will be solid and secure.

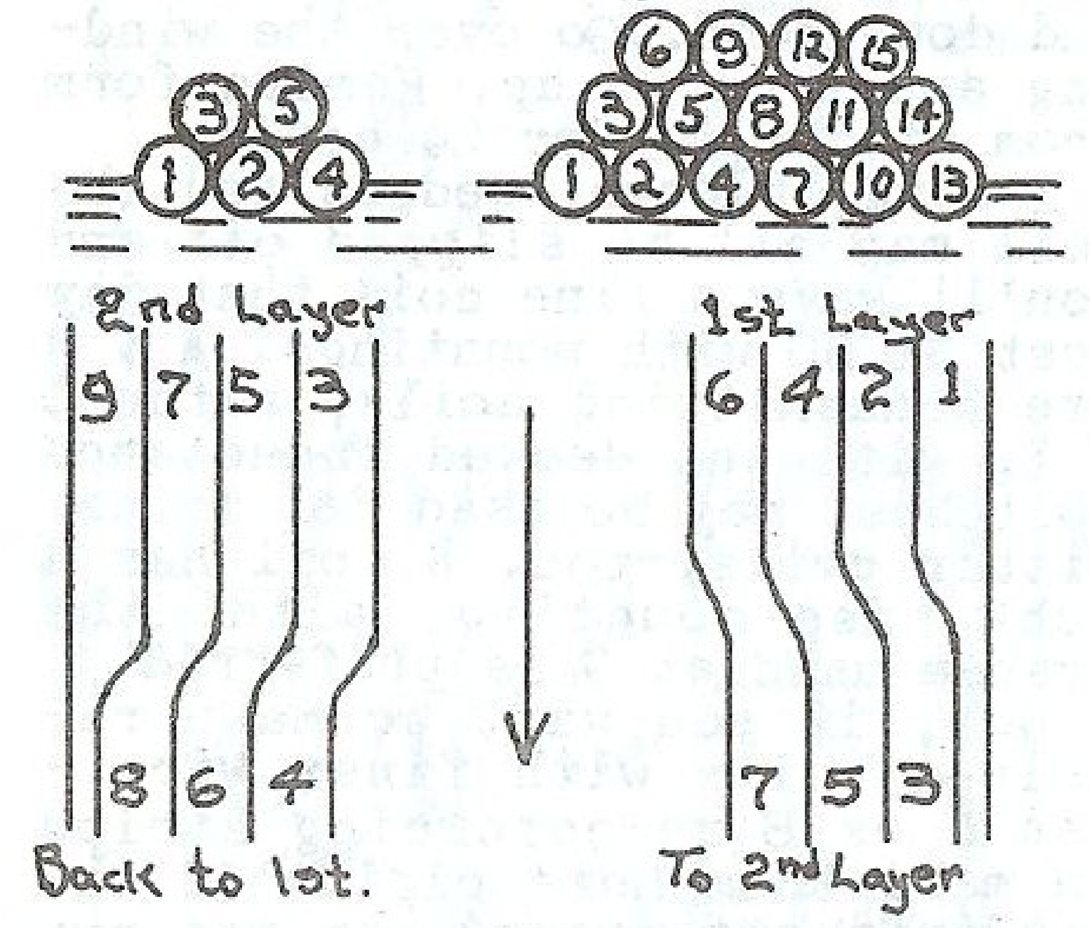
In early Radio days some Fans cut away part of a Bakelite form to skeletonize it- but it usually breaks. Besides, it was too much work for results obtained.

Ribbed plug-in coils are a form of skeleton coil but we always felt the sudden jog didn't help RF operation - so I'd stick to the round forms.

Now we come to the up-to-date round busbar coils in Fig. D. They are just bent around a form and slipped off. Usually their springiness will space them just right - about 1 turn apart. They are most used 3/8" to ½" in dia. Spec. for 144 mc. (2.1 meters) use 3 turns #12 tinned busbar over winding space 3/8" long on a form 3/8" in diameter. Primary may be 2 turns #20 solid Hookup wire held in place with Cellophane tape. Tunes by a butterfly condenser with rotor going to ground. For tuning HF coils they regularly use a tubular variable condenser 1 to 6 mmfd. to get a lower minimum capacity.

Other specs. for 108 mc. (2.8 meters) is 4 turns #16 tinned busbar on 3/8" dia. spaced one turn apart. Tuning of Hi-freq. circuits is a study by itself so will not be covered here.

5. BANK WOUND.



5-1. Bank Winding.

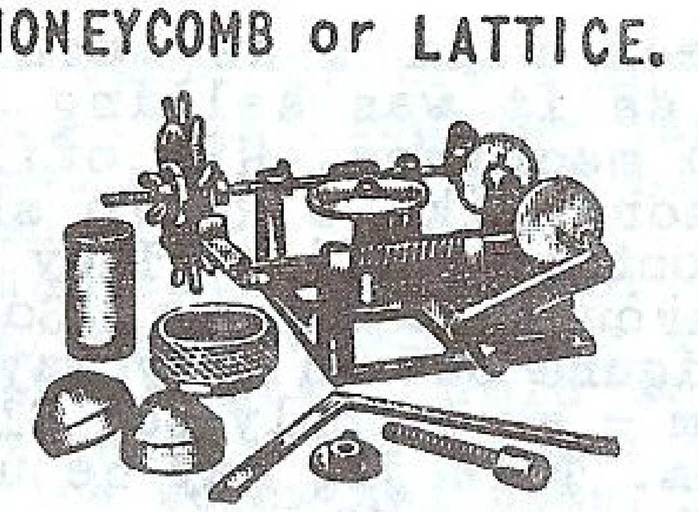
You will probably not make any Bank windings as Honeycombs are to be preferred, and easier to make. But this will give you an idea how it is done. The 2-layer bank has an effective resistance equal to about 10 times that of a single layer coil, so is not efficient on Broadcast bands.

To my memory, bank-wound coils were in use for long wave tuners before they discovered Honeycomb coils, which are more efficient. Our old long wave tuners at Sea had a beautiful job of banks.

If a tuning coil is wound like a transformer coil- one complete layer over the other - the difference between the voltage at the start and return is too high and makes for greater distributed capacity. By staggering the turns as shown much of the loss is overcome.

Don't attempt bank windings unless you can thread your form on a lathe as it is next to impossible to keep turns in place. Bend each turn back, as shown, using long-nosed pliers. Machine winders were probably used but we don't know the trick. Drawing shows position of turns. When it is completed dope it all over with Light Coil Cement.

6. HONEYCOMB or LATTICE.

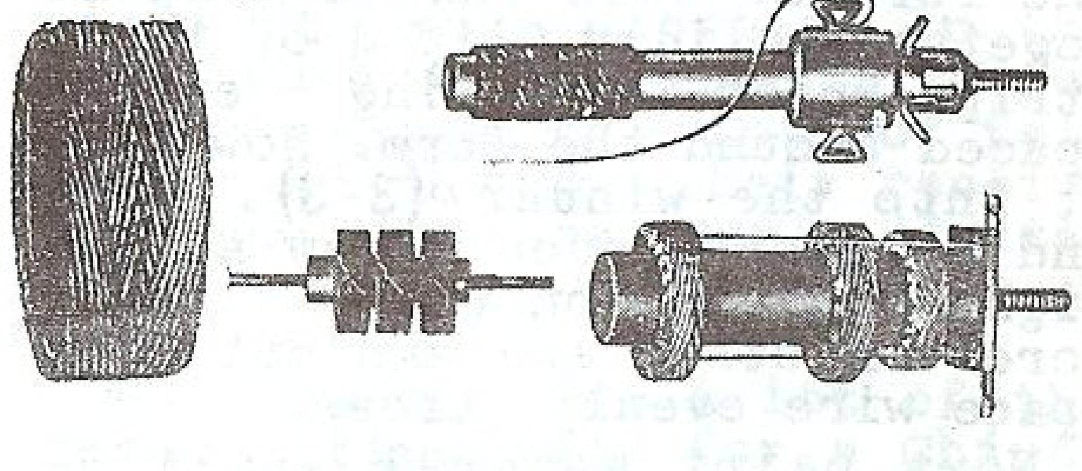


6-1. Morris Coil Winder.

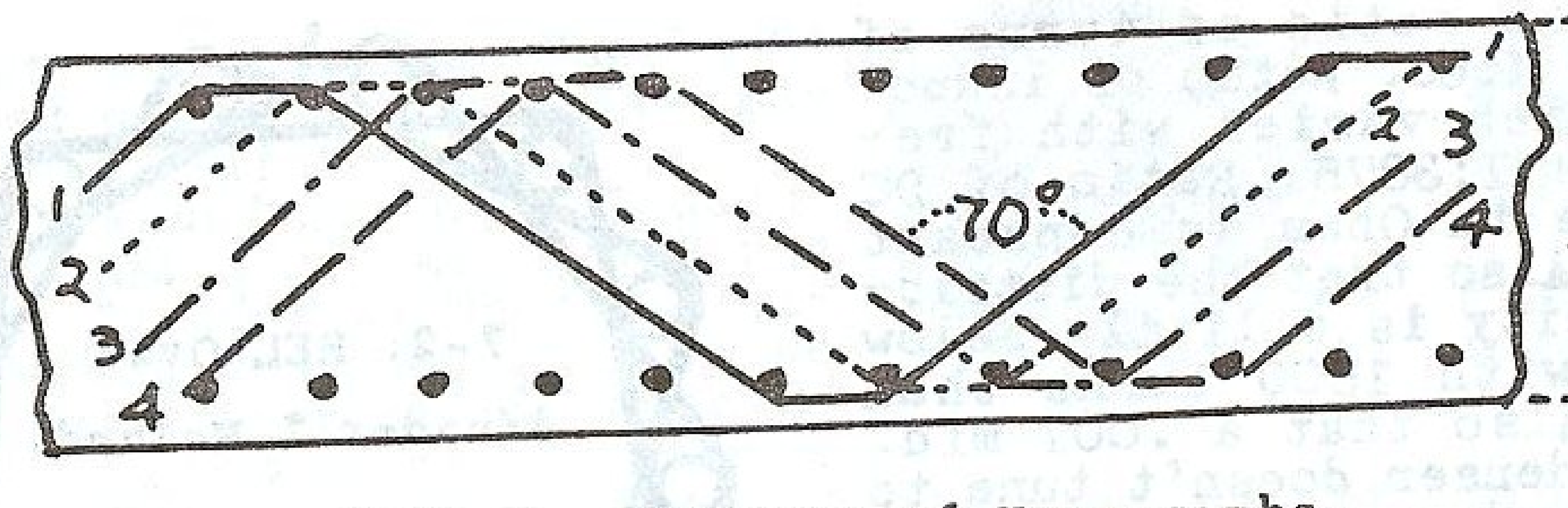
You'll be able to wind efficient, commercial-looking honeycomb, spiderweb and solenoid coils with this very versatile, but economical coil winder. It's a real time saver for the Amateur and experimenter and gives your work a more professional appearance. Just set up the winder for the type of coil you require and turn the handle—dial indicator counts the turns for you. May be used for winding RF coils, oscillator coils, loop antennas, coils for low-power transmitters, chokes, filter inductors, parasitic suppressors, TVI traps, etc. Handles up to No. 16 wire, making it suitable for almost all coil requirements in receivers, test equipment and small transmitters. Unit is supplied with two-piece wood spool for holding honeycomb and solenoid coils, plus cast pegholders and four 6⅛" wooden pegs for spiderweb coils. Winder is mounted on rugged cast-iron base with holes for bench mounting. With extension shaft for winding solenoid coils up to 3¼" long, less wire and forms. Base size, 4⅝x5". Shpg. wt., 3 lbs.

Above description, furnished by Allied, gives details of a small coil winder for the Experimenter. We use one of them but have changed many parts of it to do commercial work. It should be OK for single layer coils up to 1" or so in diameter. Its better to use one in (3-3) for coils around 2" or over in diameter.

The cam, on the shaft, feeds the wire back and forth to make Honeycomb coils.However, we have found that it requires a large, flat disc on each side so the wire piles up straight on the edges. After it is wound, the discs may be removed without collapsing the coil. Dip coil in Light Coil Cement and whirl it around on a string, or a motor, if you want to remove the surplus dope.



6-2. Some Types of Honeycombs.



6-3. Peg Winding of Honeycombs.

Honeycombs, or duo-laterals are used for long wave reception or IF amplifiers, as well as an inductance standard coil.

They occupy a minimum of space as a 1500 turn coil is only 3½" outside diameter. A single layer coil, with the eame inductance, would run about 25" long and be unmanageable. Standard coils are wound on a form 2" in diameter and 1" long.

The HC coil is a very efficient form of coil. When windings are laid alongside each other they offer more distributed capacity between turns. But duo-lateral coils space the wire about 2 to 3 times the wire diameter apart to lessen this unwanted effect. Due to slipping of wire, on a machine winder, this angle is straightened out to about 155 degrees. But, when you peg-wind it (6-3) it is reduced to 70 degrees, which makes for a better winding.

Get a piece of 1" thick soft Pine turned to 2" in diameter. On a piece of paper, draw a circle the size of the block and divide it UNEVENLY as shown. Lay the block over the circle and square up the divisions onto the block. Drive fine (#19) brads around the periphery. Use from #24 to 28 DCC, altho any fine wire is OK, but preferably DCC. It is easy to wind, once you get going. Paint edges and outside with Light Coil Cement. When dry remove the brads and slip it off and paint inside to make it more rigid to hold its shape.

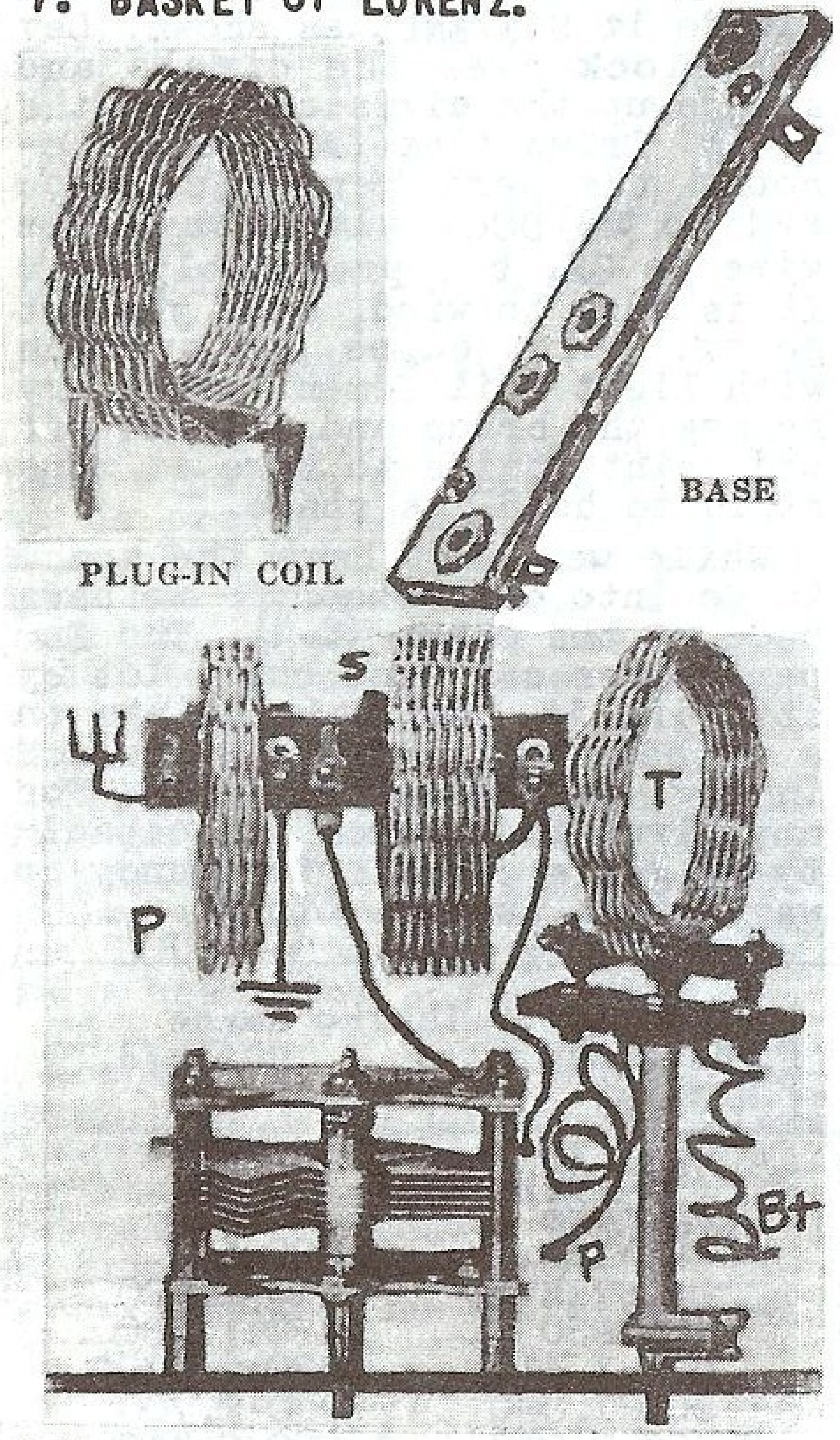
While we don't have the space to go into coil theory - we have made up the chart (6-4). The Experimenter can find out a lot by studying it. The main points in a tuned circuit are inductance in mhy. and capacity in mfd. For any given inductance and capacity we get a certain frequency or wavelength tuning point.

Turns DL or HC	Wire Size B&S	Induct. 800 cy. mhy.	Dist. Cap. mmfd.	Res. DC Ohms	Condenser Tuning Range .0005 mfd. Meters	Condenser Tuning Range .001 mfd. Meters.
25	24	.04	30	.42	120-245	120-355
35	"	.07	33	.5	160-335	160-480
50	"	.15	31	.88	220-485	220-690
75	"	.33	26	1.24	340-715	340-1,020
100	"	.56	24	1.68	430-930	430-1,330
150	"	1.3	17	2.56	680-1,410	680-2,060
200	25	2.31	16	4.44	900-1,880	900-2,700
250	"	3.67	15	5.65	1,100-2,370	1,000-3-410
300	"	5.35	17	7.11	1,400-2,870	1,400-4,120
400	"	9.62	13	10.7	1,800-3,830	1,800-5,500
500	"	15.5	13	12.4	2,300-4,870	2,300-7,000
600	28	21.6	14	27.8	2,800-5,700	2,800-8,200
750	"	34.2	14	35.3	3,500-7,200	3,500-10,400
1000	"	61.	13	50.	4,700-9,600	4,700-13,800
1250	"	102.5	11	67.	6,000-12,500	6,000-18,000
1500	"	155.	13	88.	7,500-15,400	7,500-22,100

6-4. Data on Honeycomb Coils.

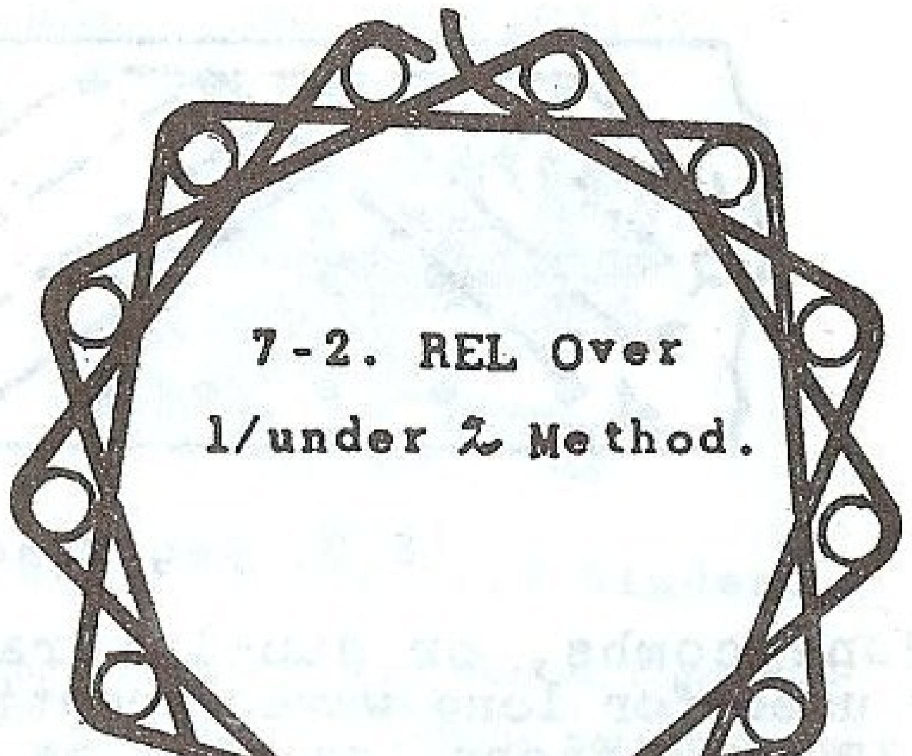
Note that ratio of turns of 25:1500 is 1:60. Ratio of inductance, which varies with frequency, is 1:3875. Ratio of DC resistance in Ohms is constant at 1:210. Also that the distributed capacity is a little below one/half with 1500 turns than with 25. Also that a .001 mfd. tuning condenser doesn't tune to twice as much as a .0005. These readings will vary with the type of condenser and different minimum tuning capacities, etc.

7. BASKET or LORENZ.



7-1. REL Basket Coil Adaptations.

Recently the Bureau of Standards proved the Basket-wound to be superior to most. Lorenz developed this coil to get away from distributed capacity effects. No adjacent turns are parallel unless they have 1 or 2



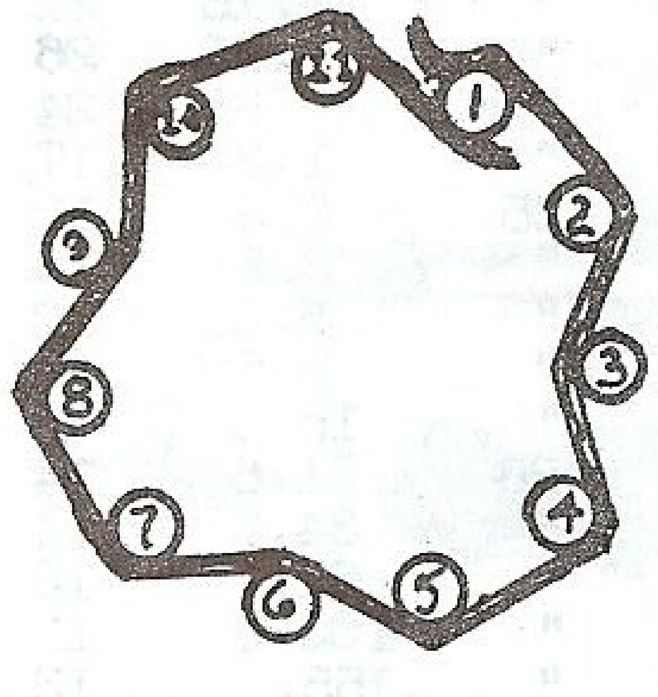
7-2. REL Over 1/under 2 Method.

turns of separation between. They have a much lower distributed capacity than single layer coils. They have low dielectric losses as no coil form is used in their makeup. In the 20's we carried on lots of interesting experiments with them.

(7-1) shows method, used by Radio Engineering Labs., of adapting these coils to various plug-in circuits by using Banana plugs and jacks.

This form of winding takes more wire than the single layer. Usually, to keep it rigid and increase efficiency, we use wire from #16 to #22 DCC. Taps may be easily made on them.

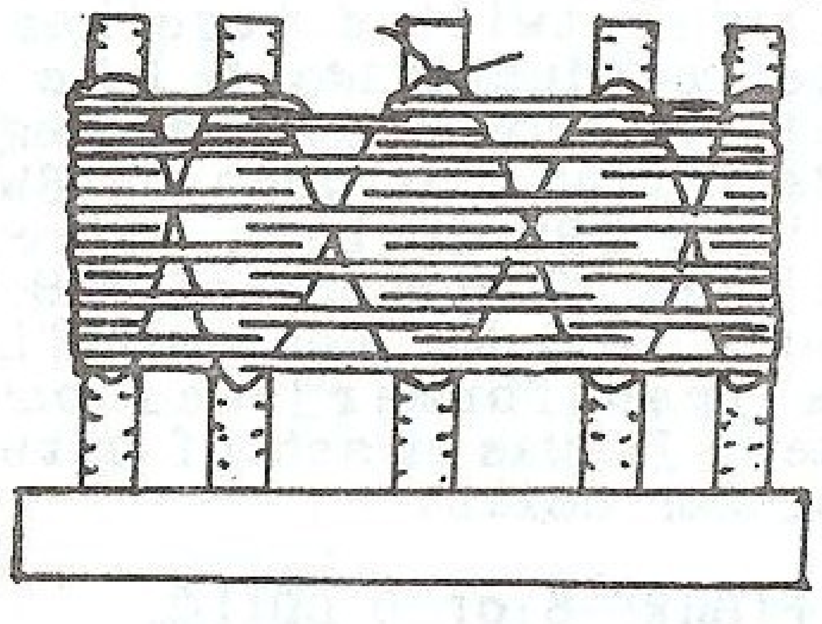
Winding is very interesting. The diameter usually runs about 2" to 2½" - but if larger they are hard to manage and tune. Turn a soft Pine block about 1" larger dia. than the circle to be used. Round is better as it is easier to lace. Draw a circle & divide it UNEVENLY. Drill holes



7-3. Over 2/under 1 Method.

for 3/16" or ¼" wooden dowels 2" long and drive them in. One may use 8d nails if desired.

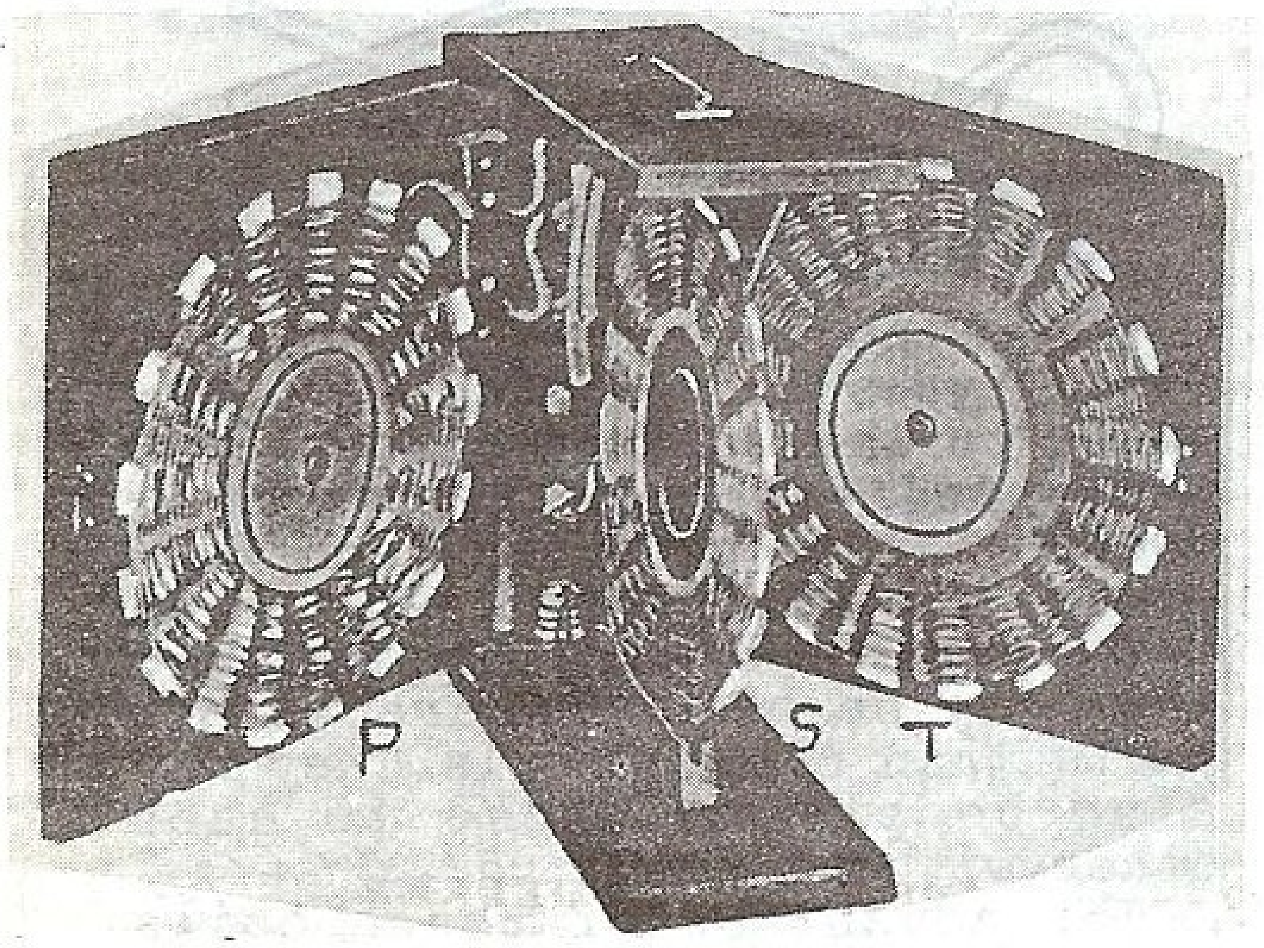
Lorenz wound his over 1/under 1 style. REL (7-1) and (7-2) use the over 1/under 2. They may also be wound over 2/under 2. We prefer the one in (7-3) over 2/under 1 which gives a neater winding. Results are claimed to be about the same with any type of winding - but you may experiment with them. In any but the over 1/under 1 method- there are 2 turns in between before they become parallel again, which decreases distributed capacity.



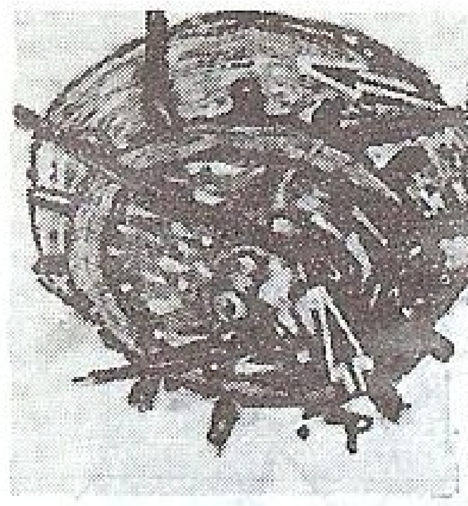
7-4. Lacing a Basket Coil.

When lacing, you may slip your coil up to make it easier. Thread darning needle with string and lace and tie ends (7-4). It may now be slipped off the pegs and mounted (7-1). Coil may also be doped at the cross points.

8. SPIDERWEB or PANCAKE.



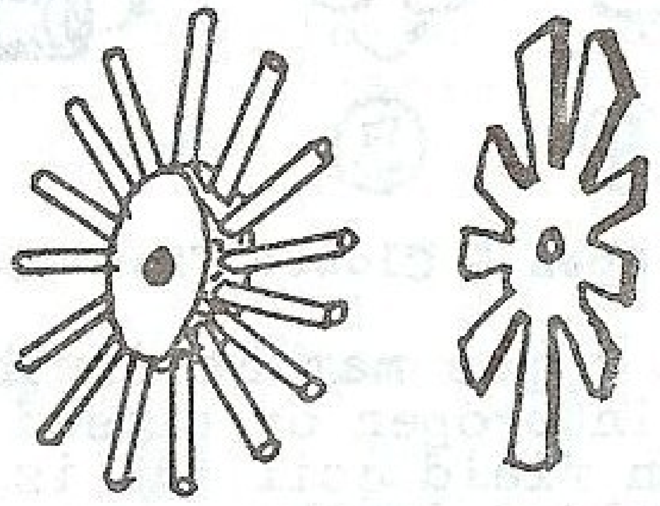
8-1. 1921 Variable Spiderweb Coupler with Primary, Secondary & Tickler.



8-2. Crosley Adjustable 2-coil Coupler. Portable Aerial.

Inductance of Spiderweb coils is not too great, so close coupling is usually required. The 1921 3-coil coupler (8-1) is still a good idea and will work very good. With it one may study inductance, coupling, regeneration, etc. when hooked up to a tube set. The correct coupling between primary and secondary may be obtained so it is very selective and still have ample volume. Regeneration may be controlled without the aid of a variable condenser. Reverse the tickler leads if no oscillation.

(8-2) Crosley made thousands of sets using sliding primaries and ticklers. One fellow, in Los Angeles, had exceptional World reception with a 2-tube using UV 199 tubes - but failed to bring in DX with 6 volt type. Many of present portables use Loops made like a spiderweb coil.

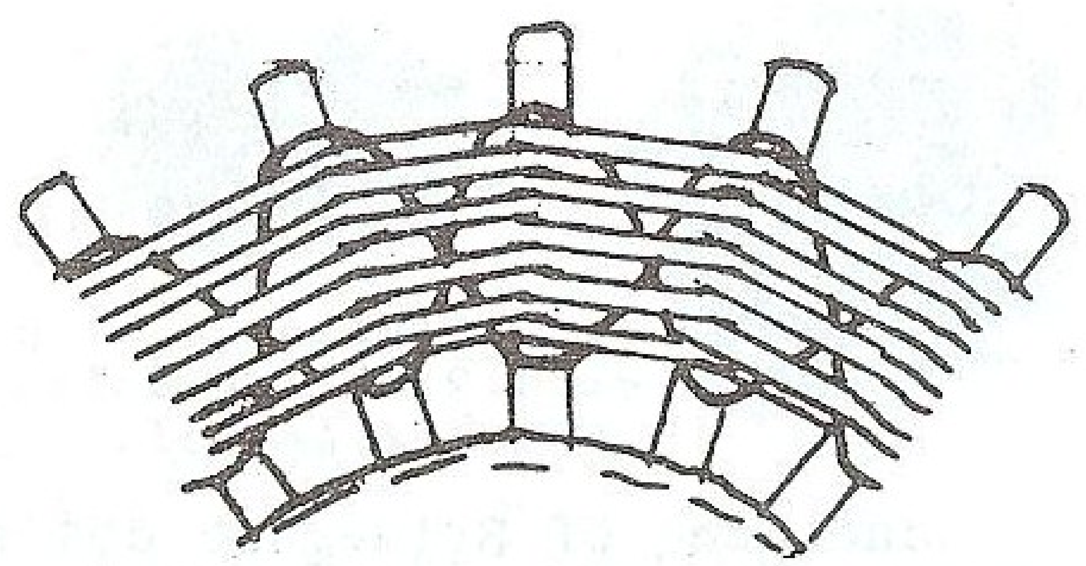


8-3. Spiderweb Forms.

Spiderwebs may be wound on a piece of Fibre, or heavy cardboard, or on a form of cylindrical pegs (8-3). Number of spokes must always be UNEVEN.

The flat Fibre form is usually over 1/under one style.

When wound on pegs, or on the machine (6-1) it is called Diamond weave. It may be wound over 1/under 1, or over 2/under 2 - the latter making a nicer coil. Pins are removable on the bought winder - or it may be made up



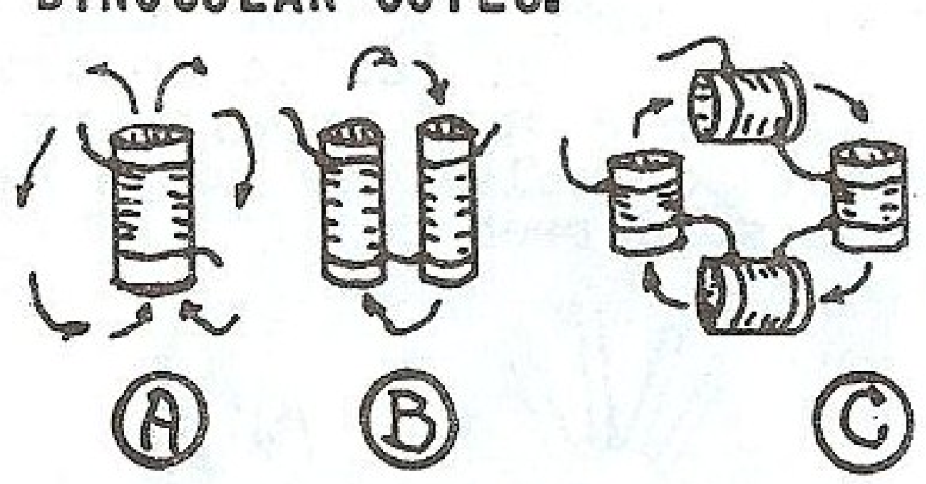
8-4. Lacing a Diamond Weave.

with a wooden center and dowels set in. Nails may also be used.

Primary or tickler, or both, may be interwound with the secondary. If too much wire, turns may be removed. Lace the winding (8-4) like Basket-weave coils. Pins may then be removed and coil doped, if desired.

There is another difference between basket weave and spiderweb coils. The basket is really a single layer coil - while the spiderweb is a multi-layer of 1 turn per layer.

9. BINOCULAR COILS.



9-1. Open & Closed Field Coils.

Coil types may be further divided into open or closed field. An open field coil (A) is usually shielded in the large commercial sets, due to its large magnetic field. This is to prevent inter-stage coupling and local interference pickup. The grid end acts like a separate Aerial. To get away from some of the effects of shielding, some companies have used closed field type of coils in the past.

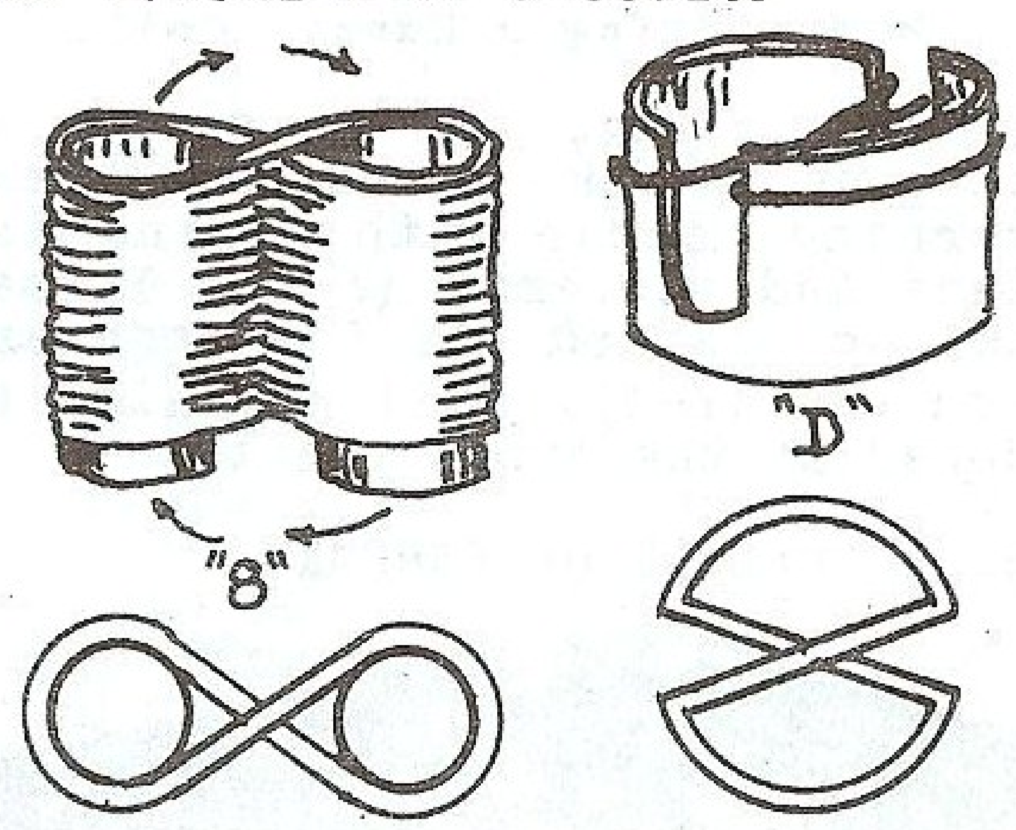
(C) shows 4 coils placed for a still more effective closed effect. Primary, of several turns, goes around each coil. They are wound in the same direction. Each coil is about 1½" in diameter and length.

The binocular coil (B) is a form of closed field, being a coil split in half. It is more efficient than the Fig. 8 or D. Windings are in the same direction, but hooked together at one end only. They are usually of a small diameter - about 1" but may be 2" or 3" long. Leave at least ½" space between with no metal. The primary may be wound around the coil in any position that works best for selectivity.

The old Grebe DX set used to have these coils- all wound with silk covered Litzendraht wire. It is many fine strands of enameled wire twisted together for better conductivity & less skin effect on broadcast and longwave bands. It is not good on SW. If you have #32-38 Litz. wire you will have 32 strands of #38 En.

About 1930 the Benjamin "Lekeless Transformer" was on the market. It was a set of airwound binocular coils.

10. FIGURE 8 or D COILS.



These coils are also closed field types and similar in operation to that of the binoculars. Stray magnetic coupling is reduced because they aid each other on the inside and oppose on the outside field. Therefore, they may be placed nearer other parts than single coils. They may also be placed close to each other without coupling.

The advantage of these coils over the binoculars is that the leads come out at opposite ends. When they come out at the same

ends, as the binoculars, the capacity effects are increased.

The "Fig. 8" coils are wound on forms about the same size as the binoculars, but may be separated a little more.

The "D" coil is wound on a 2" Bakelite form that has a slot sawed as shown.

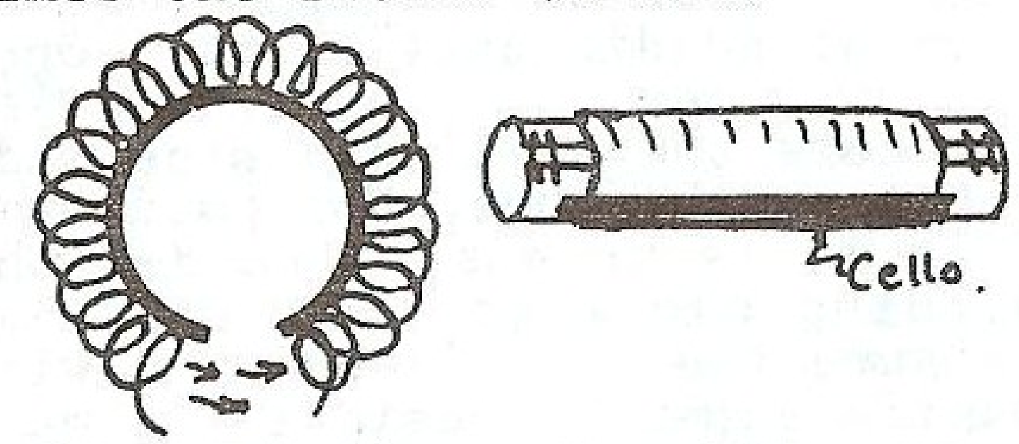
In our experience we haven't seen any of these used in commercial sets. This may probably be due to the fact they are hard to wind. But the Experimenter may give them a whirl.

11. TOROID or DOUGHNUT

Toroid means "ring" but has no connection with the bull ring!

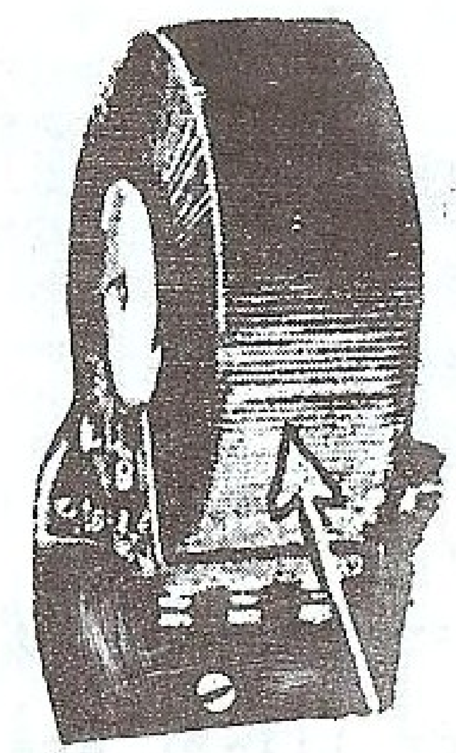
This is the nearest approach to no resistance, no capacity circuit, when wound this way. The round, doughnut shape concentrates the field inside the winding with very little field on the outside of the coil - so it slightly resembles a single turn winding. In a multi-stage receiver this gets away from the squealing due to coupling. They may be placed in any position on the chassis.

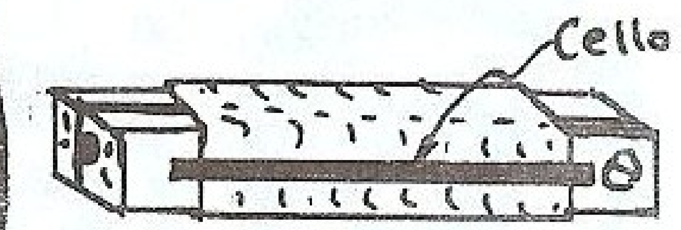
It takes a larger number of turns than a solenoid, so you should figure about half as many again - which may be removed if too much. Best ratio of inductance and resistance is when the outside radius is equal to 2.6 times the inside radius.



11-1. Winding a Round Toroid.

To wind a Toroid (11-1) use a collapsible form (4-2) but 1" in diameter and 6" long. Wrap it with #24 DCC and fasten down the ends. Do not dope it. Cut a strip of celluloid about ¼" wide and with Heavy Coil Cement stick it down lengthwise of the coil. When dry remove the whole winding and bend it with the celluloid strip



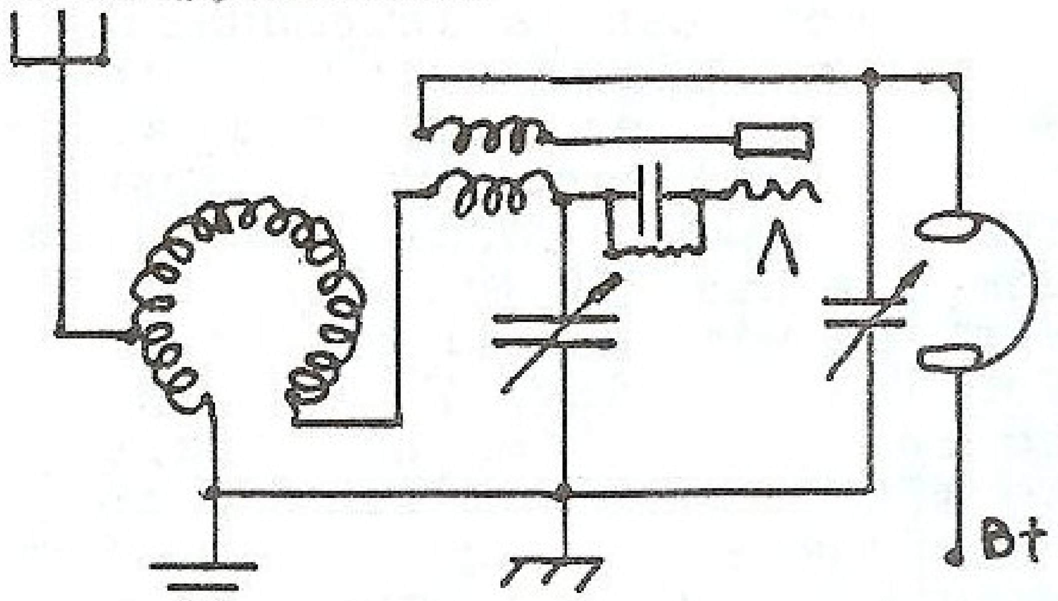


11-2. Winding a Square Toroid.

on the inside. If you wish to further re-enforce it - put some Cellophane tape around the outside diameter.

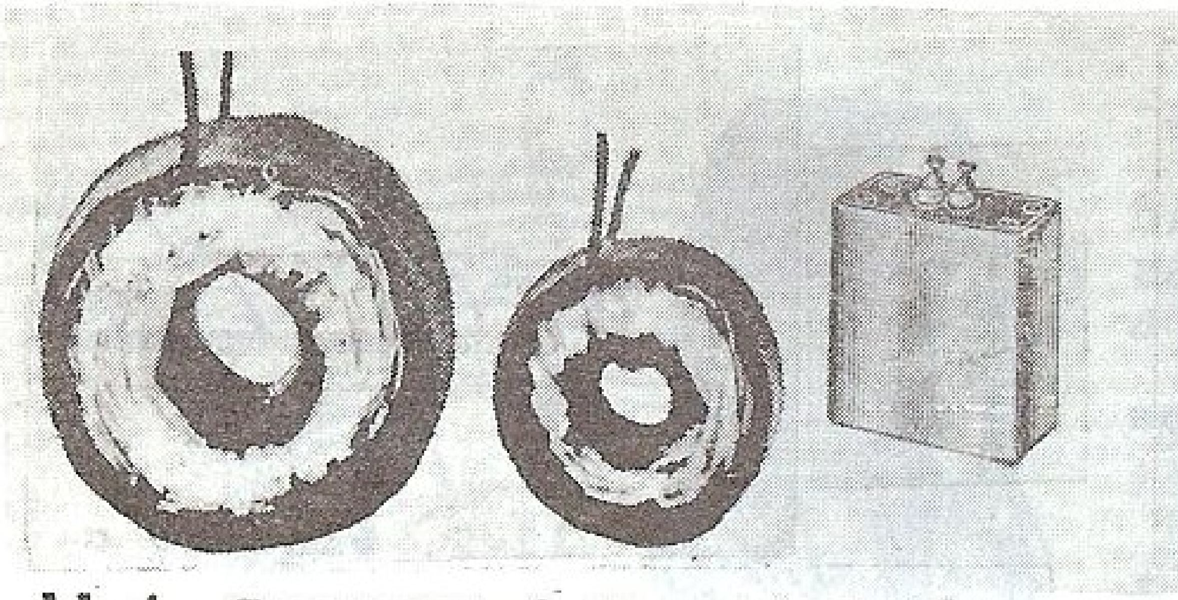
If you prefer a square coil (11-2) use a piece of soft Pine, 1" square and 6" long. Saw it diagonally lengthwise as shown. It can then be collapsed. Many old sets used this square coil.

Interwind the Antenna primary of about 15 turns on the ground side of the first coil. For the other TRF stages wind about half as many primary turns between the secondary. To use a Toroid in a regenerative detector circuit, due to its concentrated field, one must wind 10 turns in series with the coil (11-3) and 10 over this for the tickler - about 1" in diameter. Reverse tickler if no oscillation.

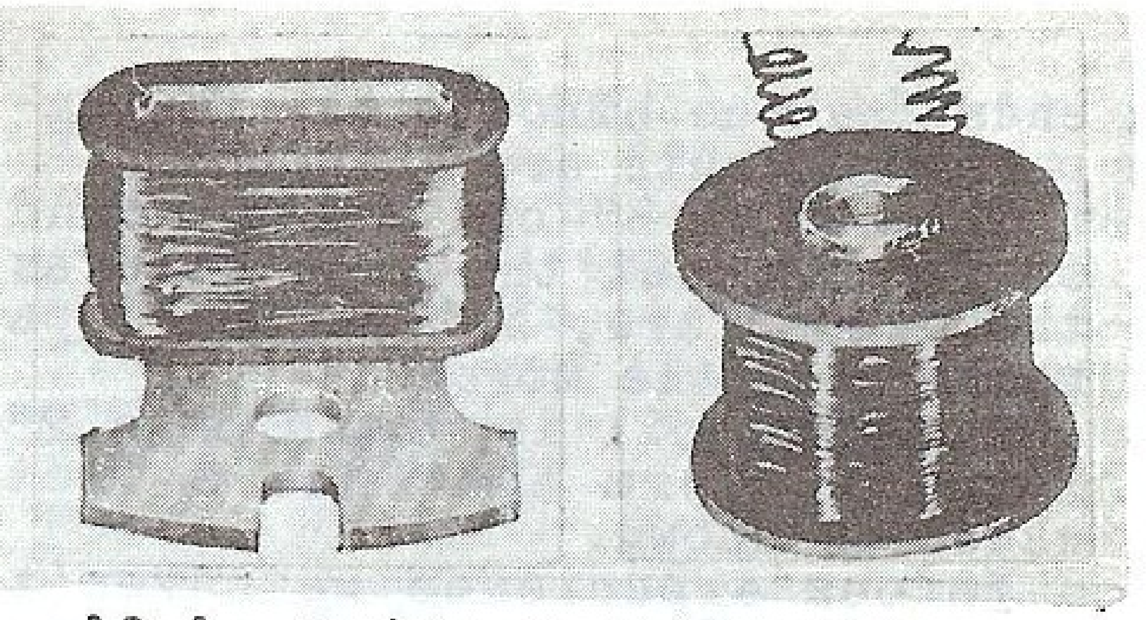


11-3. Toroid Using Regeneration.

In 1926 many sets used Toroids e.g., Infradyne, Eusonic, etc. We built up a Bremer-Tully kit, with these coils, and got excellent DX reception so know they work OK. However, modern mfrs. claim the resistance is too high for the value of inductance obtained, so are seldom used now. But, if you want to build up a



11-4. Commercial Toroid Coils.



12-1. Jumble Wound Magnets.

quiet set that doesn't squeal & gives good tone,use these coils.

Commercial Toroids (11-4) are now in style - and mostly used as low-freq. filters peaking at around 3M to 25M cps. As filters some of them are using as many as 12 in series. Extreme low hum pick-up is had due to the concentrated field. Inductance is almost independent of frequency, temperature, vibration, etc. Made in sizes from 1 mhy. up to 25 henries inductance. Cores may be 3/8" to 1-1/16" thick of pressed Molybdenum-permalloy dust. May develop a "Q" up to 200.

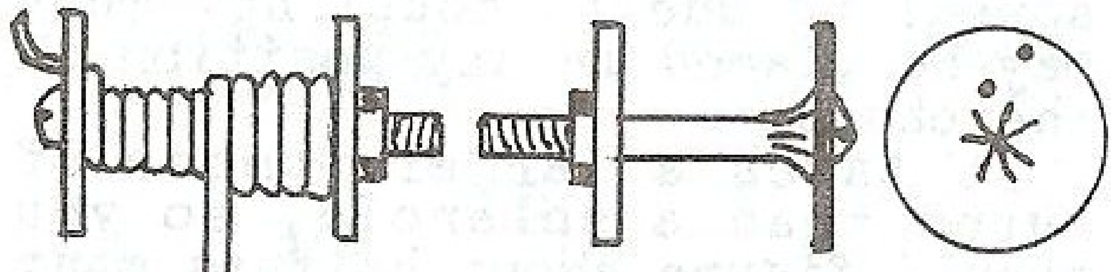
The trick with commercial Toroids is the winding.A guide ring snaps around the core. Within this ring a pre-wound shuttle of fine wire revolves around the core. Previously they made them in 2 sections but now wind full 360 degrees.If wire is wound on bobbins and slipped over the core much loss is introduced.

The machines may run up to $6000 each so most companies build their own. Many companies are now making Toroids.One local company has 180 machines in operation with an output of 5-10M Toroids per day. Wire sizes up to #40 altho some are using up to #50 (ouch!). Sizes of coils run from ½" o/d up to 2¼". Commercial coils are usually sealed hermetically.

12. MULTI-LAYER.

Magnets may be jumble-wound like Earphone coils (12-1) when wound with fine wire. The method (2-1) may be used with a hand drill. A slow winder is better as wire breaks easily. Be sure the winding is well insulated from the core. Insulation is usually heavy manila paper held down with Cellophane tape.

Before starting to wind get a few inches of small stranded insulated wire to use as a lead & solder to fine wire. If the big wire isn't used the fine will be broken soon. Likewise, when finishing off - use another piece of stranded lead and tape down all around. You may then handle the magnet roughly. #40 enameled runs about 1 ohm per foot, or 5600 Ohms per mile. Figuring the size of wire from a guage and the resistance you can figure length of wire needed from the chart (12-5).

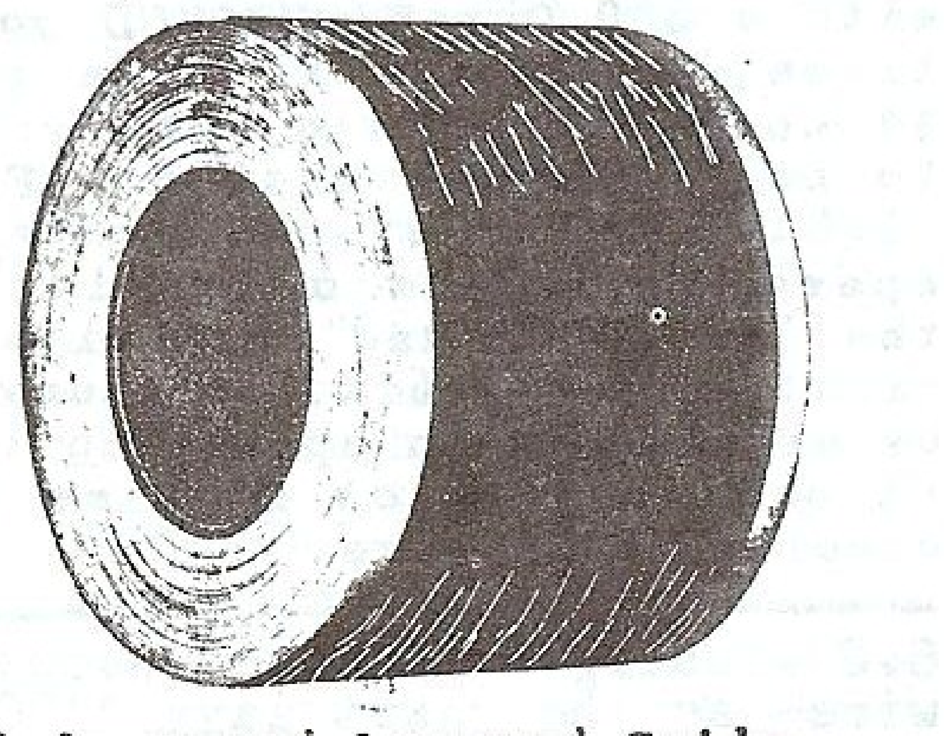


12-2. Layered Magnets & Forms.

Magnets may be wound on a form and the iron core slipped inside - or wound directly on the core. If one uses an iron screw for the core the winding can be made right on the core. For good magnets it is necessary to get the winding close to the core. But be sure the core is covered with manila paper.In designing a magnet you figure the winding to be the same thickness as the core. This is because the efficiency is decreased if too much wire is put on.When winding magnets with heavier wire (12-2) you just run it back and forth in layers. You will get more on this way. Bells and buzzers use about #26 enameled wire now. For more pull use finer wire.From the table (12-5) you can see how much wire will

go in a given space by checking turns per square inch. The measurement is on one side of the magnet from the core out. With heavier wire no insulation is used between layers (12-2).

For magnet end pieces you may use close-fitting fibre washers. Another good way is to cut some heavy fibre (fish paper) (12-2) circles for the ends. Slit the centers as shown with a razor blade and bend inside to the core. Several thicknesses may be used if desired. Wrap thread around these tips and secure to the shaft. Paint with Heavy Coil Cement. Wrap manila paper around the core and hold down with Cellophane tape. Many cheap bells, buzzers, etc. are made thus.



12-3. Round Layered Coils.

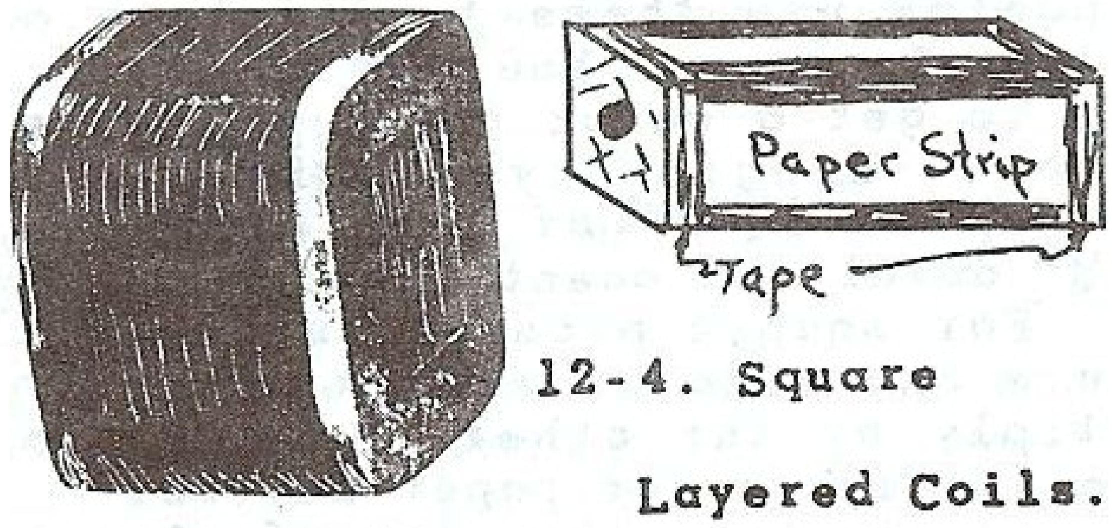
Round layered coils (12-3) may be wound on a cardboard,or fibre form held in a regular winder (3-3). You may fit fibre ends onto the form, or use the method (12-2) but using heavier fibre. If you do this you'll get a nice smooth winding surface for your fine wire.

Before starting to wind, get a small length of fine stranded wire for a lead, to solder onto the fine coil wire. If you are going to wind transformer coils, cut a lot of strips of waxed paper for inter-laying, and long enough to lap a little. Wind the wire tight as possible without breaking. If you jump over some now and then it won't matter. When you reach 1/8" from the far edge run another strip of paper in and start back. Finish off with the usual stranded lead.

To finish the winding wrap it tight with plastic Electrical tape. Never use adhesive tape as the Zinc oxide may short the hi-voltage windings. Windings may be dipped in paraffine or other wax, if desired. Transformer varnish may also be used and put winding in the oven to dry. This goes for any good magnet.

If you break a fine wire- just sandpaper ends and solder together again.Some companies fold a tiny piece of paper across the joint to make it easier to wind over - and protecting against corrosion. This latter is the main reason fine windings usually break down. Any acid in the paste will start it to work.

If you are making center taps for hi-voltage secondaries, use a stranded lead again, but insulate it well. If you don't it will blow thru. Tape it down to the winder until you have finished the other half of winding.



12-4. Square Layered Coils.

(12-4). For a square coil for transformer windings, you may use a collapsible block (11-2) that has a hole in each end for centering - that is quicker. If block is a little small it may be built up by wedges to make it turn true. If block is solid you may slip 4 strips of cardboard between block and form.Tape them at the ends. They may then be pulled out when done. The same type of fibre end pieces may be made for square coil forms if you have a little patience.

When re-winding a transformer be sure you get your measurements of the core window correct or you won't get the windings in without squeezing.We never could re-wind one in the same space as the original. It seemed impossible to get the wire as tight or

No. B&S	Ts. Inch Lineal En. DCC		Ts. Inch Square Enamel	Res. 1000' Ohms	Cur. Car. m.a.
10	9	8	84	1.	6900
12	12	10	131	1.6	4400
14	15	13	198	2.6	2700
16	18	16	306	4.1	1700
18	23	19	454	6.5	1100
20	29	23	725	10.3	680
22	37	30	1070	16.5	430
24	46	35	1570	26.2	270
26	58	42	2300	41.6	170
28	72	48	3350	66.2	110
30	90	55	4660	105.2	67
32	113	62	6250	167.3	42
34	143	70	8310	266.	26
36	175	77	10,700	423.	17
38	224	83	-	672.	10
40	282	89	-	1069.	6

12-5. Properties of Coil Wire.

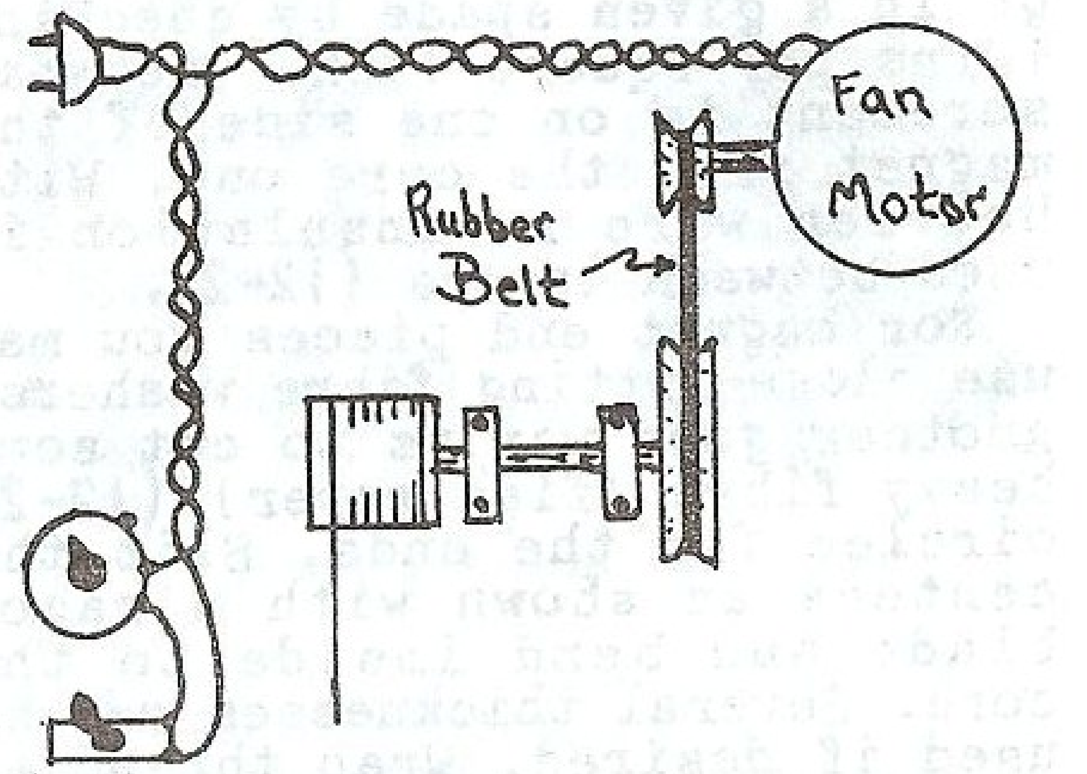
This chart is approximate as sizes, insulation, etc. of different manufacturers vary. Odd sizes omitted, altho many companies use these to fit into a certain space. You can figure.

To get a quick check on turns for a single layer coil, just wrap about ½" of wire around a ¼" dowel and count them.

For square measure just measure one side of window and multiply by the other. Be sure to allow extra for paper layers.

If you know the size of wire & resistance of a hi-voltage winding you can approximate the number of feet needed for a certain winding. If half is out you just measure what is left.

Figuring amps. just set decimal point over 3 places (thousandths), i.e., 6900 m.a. is 6.9 amperes.



12-6. Another Fine Wire Winder.

We have used a winder similar to this for some time in making jumble-wound chokes, multi-layer coils, etc. It is a fan motor with a 500 Ohm WIREWOUND potentiometer and switch in series. It connects with a rubber belt to help keep wire tight. For a right-handed person, place the speed regulator and switch on the left side and wind with the right hand. A suitable chuck can be arranged.When operating right it can save a lot of time when winding small wire.

close together as a machine.

In designing, or re-winding transformer windings refer to the chart (12-5) for current carrying capacity of wires. It's best to take the size larger, if possible, to prevent heating up. Hi-voltage secondaries are always fine wire as the amperage needed is low. 110 v. primaries are a little larger wire. Much larger wire is used for the filament windings, usually about #14-22.You can see that a 1 amp. 6.3 winding would need about #18 wire- as the chart says 1100 ma. so there is a little leeway. The average audio transformer runs about #34-40 enameled. Unless an audio transformer winding is broken on top it doesn't pay to re-wind them now.

You will see power transformers rated at 40 ma. so you can figure they are wound with about #32 enameled wire for secondary. 15 ma. would be about #36 enam.

If you are building a welder you will use large wire for the secondary. Here amperage is more important, so you may experiment with wire around #10 or larger & draw a good fat spark. When a transformer heats up it is usually because the wire is too small. A friend of mine, in Los Angeles, had built up a big power transformer business. But, he wanted to revolutionalize the receiver business and build a tiny power transformer. After he had sold thousands of them they

all started burning up- as a result he went broke.

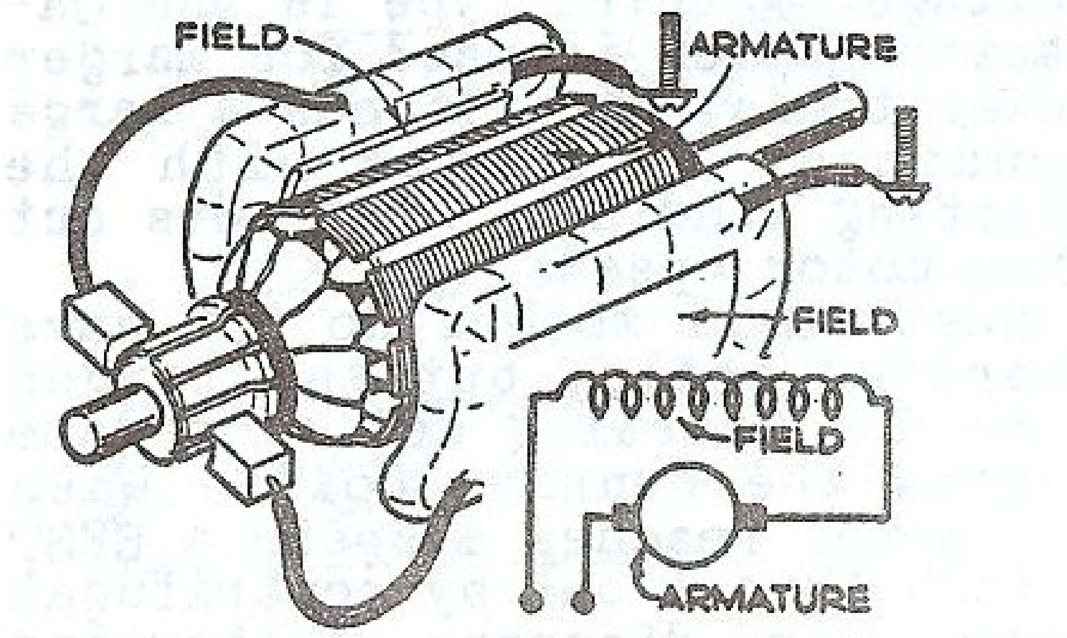
Windings are proportional in turns only - and the length of the wire has nothing to do with voltage step up or down. Number of turns control voltage; size of wire determines current, or amps. Take off an outside filament winding of a power transformer and count the number of turns. Divide this by voltage of winding in use. This will give U Turns Per Volt (TPV), which is the controlling factor in figuring number of turns. If you have 50 turns for a 5 volt winding, you have 10 TPV. So, this ratio will hold thruout the transformer - primary or secondary. So, if we have 10 TPV we can figure 110 volt winding will take 1100 turns; 500 volt secondary will require 5000 turns, etc. All you have to figure now is size of wire, to carry the current required, and wire that will fit into the transformer window.

When all final windings are done, cover with plastic Electrical tape and insulate in wax, or transformer varnish. The laminations are then slipped in - being careful not to injure the windings, or you are in trouble! Be sure all leads are insulated from the core. This is often accomplished by strips of fish paper or spaghetti on the leads.

Most power transformers have a static shield between primary & hi-voltage secondary. This is grounded to the laminations. It gets rid of many line noises.

You will note the laminations are usually coated with a varnish. This is done to separate them a little by giving them an air gap between laminations. It keeps down hysteresis, or current lag losses. A solid iron core heats up badly. In variable voltage transformers the core may be varied, or brass slid into the air gap to change voltage output.The usual method of voltage control is by tapping the primary. This raises the ratio between primary and secondary & thereby increases output voltage of the transformer. Transformers is a big subject and cannot be covered at length here.

13. ARMATURE and FIELD COILS.



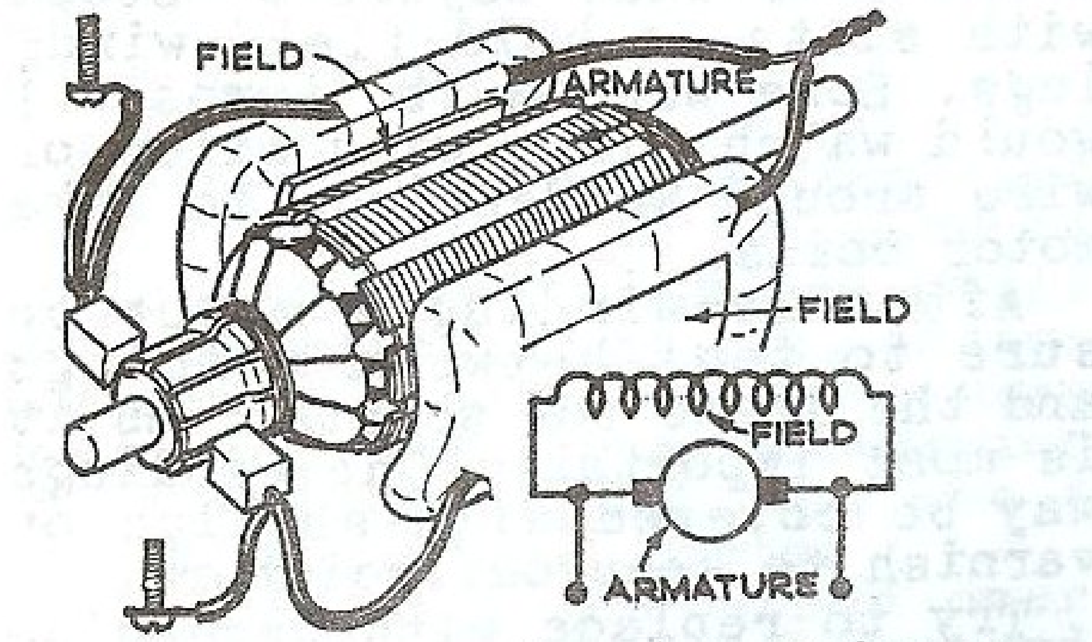
Popular Science.

13-1. Series Universal Winding.

While a discussion of the big subject of motors is not intended, you may often run into some of this work. A motor is not burned out unless insulation is charred. This may be caused by a short between coils or between a coil and frame. If motor fails to start it may be an open circuit in a coil or between brush and commutator.

In testing motors a growler is generally used. But, we find an HF buzzer and battery to work OK - as various tones may be had for different conditions. A low resistance Ohmmeter is also very effective - one that will test around 1 to 5 ohms.

There are dozens of different types of motors in use. The most used is the small Universal (1) AC-DC type. It is quick starting and runs fans, drills, mixers, etc. in the household.It is also called a series motor as field and armature are in series. A



Popular Science.

13-2. Shunt Winding.

less used type is the shunt motor (2) with field and armature in parallel. Its starting torque is less and operates at lower voltage. A third type is the Capacitor which is used for larger power tools, etc. It has a large condenser in series with the starting winding - that cuts out when motor speeds up.

Most small motors do not have starting coils, but the larger ones do. Starting coils operate across the running coils. When the motor reaches a speed a SPST switch throws out by centrifugal force - and disconnects starting coil. The counter emf., generated by the motor, then prevents the motor windings from burning out when running.

It is a good idea to make a sketch of the windings and their connections before removing a coil from field or armature. Most field and armature coils are skein wound. Count the number of turns and drive finishing nails in a board, the same shape as the old coil.

When we replace windings in an armature or between field poles in a larger motor, it become more difficult. Remove the bad winding and then replace one turn at a time - poked down with a stick. Be sure fish paper insulation next to laminations is good or it may short. For larger motors the windings are wound on wooden pegs, bunched and forced into slots, but you probably won't run into these motors.

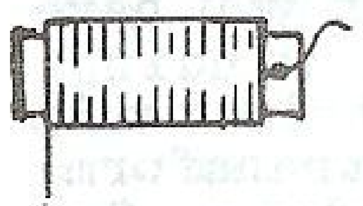
I used to "stack stator" laminations in the U.S.Motor Co., of Los Angeles. These are large, round varnished layers of steel with slots to hold field windings. Some were 3 ft. across. I would watch girls wind miles of wire around wooden pegs to make motor coils.

After re-winding a motor be sure to test between windings and the frame for shorts - as it is most important. The windings may be covered with shellac or varnish to keep out moisture.

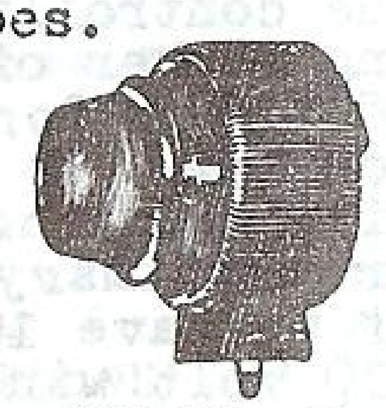
Try to replace with same size wire as original. An expert may fit it in the space easier.

14. BUCKING COILS.

May also be called non-inductive coils as they have no inductance value. Self induction is caused by circular lines of force cutting the conductor and mutual induction the cutting of adjacent turns. If two adjacent conductors have current running in opposite directions the magnetic fields will oppose each other. Additions of iron cores do not increase the inductance. There are several types.



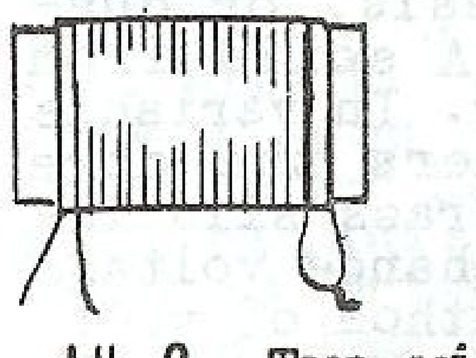
14-1. Flat Bucking Coils.



50 Watt Rheostat

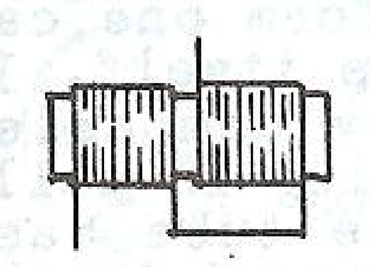
14-1. This type has a flat winding on a fibre strip. It may also use flat wire. It has practically no center so the turns buck each other on the opposite side. Used in commercial meters, bridges, resistances, phone apparatus, etc. where inductance value is not desired. We use a ½" strip of fibre and wind resistance wire around it - being careful to spacewind the bare wire. Resistance wire may often be purchased with insulation. We have tried winding DCC wire on a strip for variable inductance but it didn't work, as it has no tuning effect. Most modern volume controls now use a carbon path as a variable resistance as no inductance is involved.

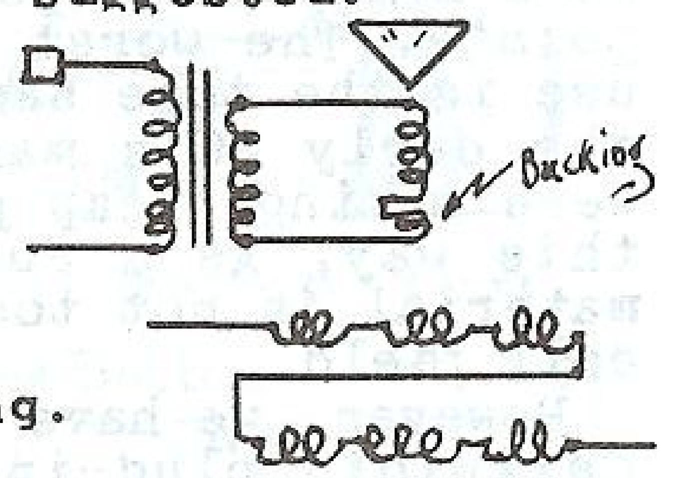
Bucking coils may be a part of a winding or a separate winding on the same form. One may classify them into double winding or a 2-coil winding.



14-2. Double Windings.

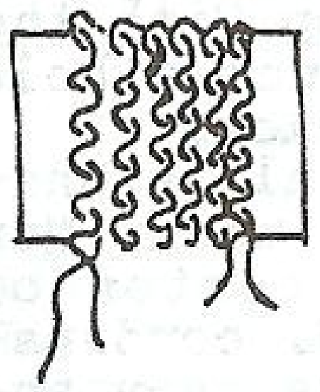
14-2. Two wires are wound on at once, keeping them close up. The finished ends may be hooked together and used as one coil. Or, they may be made into two coils with current flowing in opposite directions. No need to fold the wire before winding as it used to be suggested.





14-3. 2-Coil Bucking.

14-3. Instead of interwinding, you may wind two coils placed end to end, or one winding over the other to get the same bucking effect. Our Crystal set #43 (HB-17) reverses one coil to get more selectivity. It is not necessary to wind these coils in opposite directions - just reverse connections on one coil. Along this line, when a tickler doesn't oscillate it is a bucking coil until you reverse the leads. Two RF chokes connected as shown will also buck one another. Some old speakers used a few turns as a bucking coil in the voice coil winding to take out hum. No doubt bucking coils could be worked into the cathode circuit of a humming amplifier.

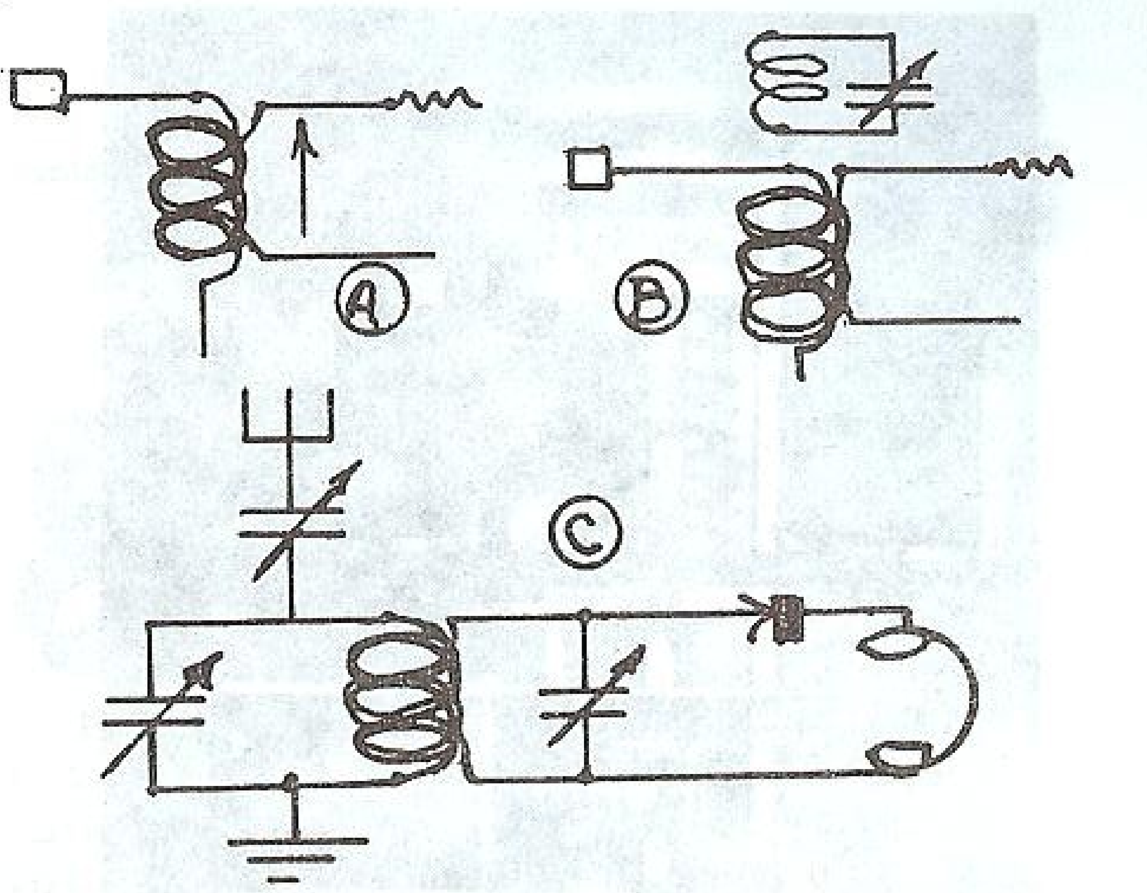


14-4. Twisted Pair.

14-4. Another bucking, or neutralizing effect may be had by twisting the wires before winding. Filament leads are often twisted to remove, or neutralize hum, like the lamp cords. Likewise, try twisting your TV leadin to reduce local interference.

15. BIFILAR.

Also means "unity wound." The word "filar" means thread; bifilar is 2-thread. Filament is a thread that turns. A double coil winding (14-2) is also called a Bifilar coil, as two wires are wound together.



15-1. Bifilar Coil Applications.

The only winding method is to wind both wires at once, side by side, close up.

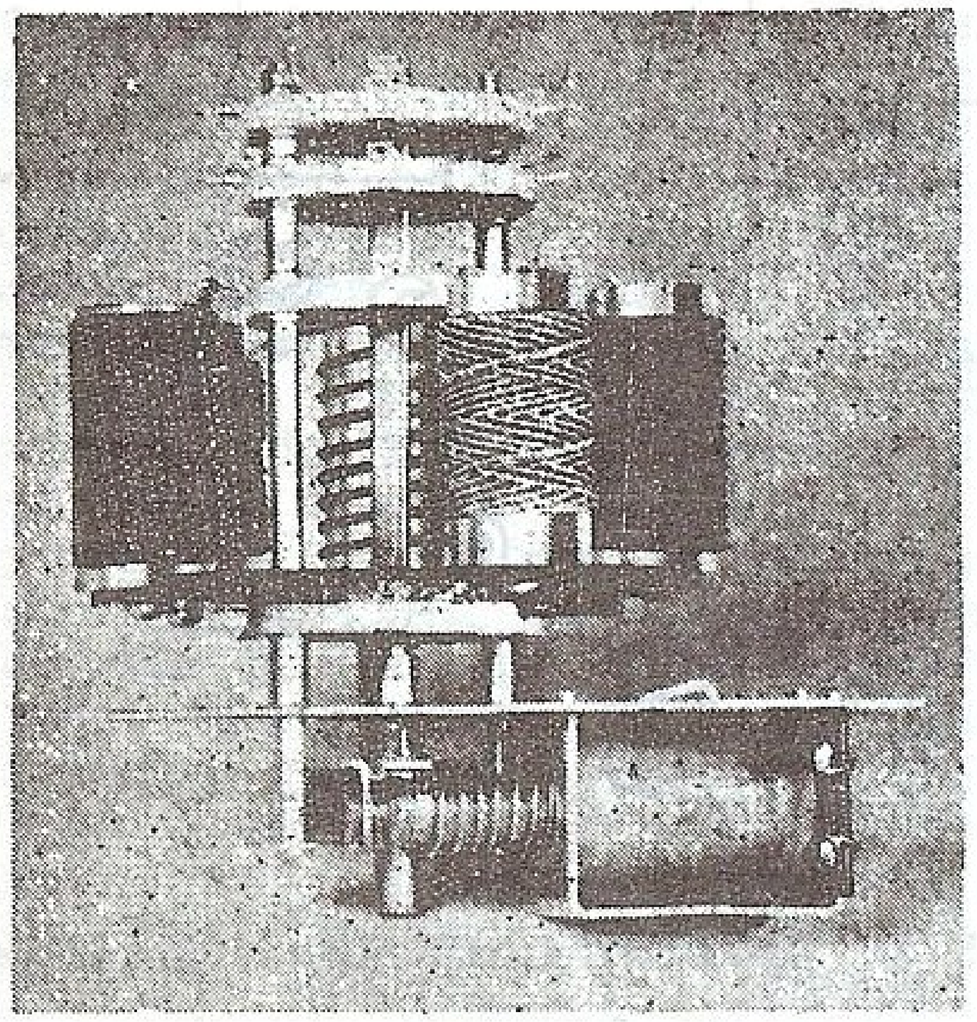
When one winding is used for the primary and the other for the secondary we have as tight coupling as possible, next to a direct coupling. This gives the greatest transference of energy. It is currently used in TV video IF amplifiers here and in Australia. A wide bandwidth and low resistance to the signal is the result. Without a primary and a secondary tuning condenser they may be slug-tuned (A) to the same IF frequency. Also, another "booster trap" may be placed alongside, on the same powdered iron core, to tune with a variable condenser (B).

A good tunable Crystal set may be built around a Bifilar coil (C). It is both primary and secondary tuned. The Antenna condenser may be added for more selectivity. Cond. are .00035.

16. PLUG-IN COILS.

In this "lazy push-button age" some people don't go for plug-in coils. However, they are still much superior to any coil changing device we can use. Our space doesn't permit a wide discussion of their merits, but here are a few of their good points.

(1) They are preferred over tapped coils due to the dead-end unused portion of the coil which reduces sensitivity. A plug-in



16-1. Coto-Coil Switch Unit. Was used for remote switching of band coils by an electro-magnet stepping switch. Various combinations of poles & contacts were available. -"Radio Today."

coil is working at top efficiency as concerns inductance to capacity ratio.

(2) All coils, switches, wiring, etc. that are close to the coil are detrimental to DX work. The only example to the contrary is the old Scott superhet. that mounted coils in a radial position. All the coils rotated to make contacts, being controlled from the panel. It cannot be adapted to a small chassis due to space needed. Even so, plug-ins were superior. Brush contacts may also give trouble. The one plug-in is always working at its highest efficiency.

(3) Leads may be shorter with plug-ins. With a little planning the coil socket can be arranged so grid leads are very short. On an inductance switch some leads must necessarily be long.

(4) Each coil may easily be removed and changes made to the tickler, etc. without dismantling the set. If there is too much regeneration a turn may be removed.

No doubt the Banana plug and jack deals (14-1 B & D) are the most efficient types of plug-in coils. But the tube base types are much easier to build and may be handled with less care.

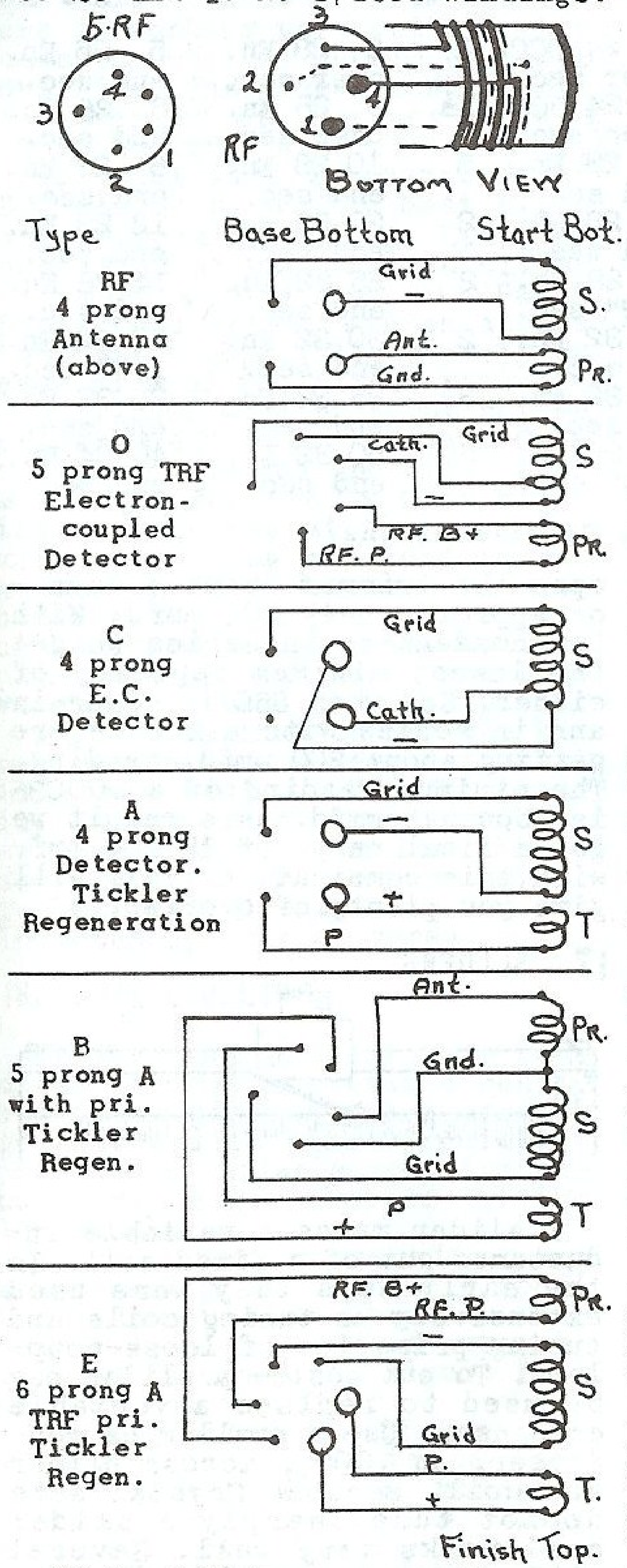
Ribbed plug-in forms are not desired - we think there is too much loss at the jogs in the rib points. The worst form one can use is the tube base itself. In the early 30's many companies were making cheap plug-in coils this way. As a rule tube base material is not too good in the coil field.

However, we have made our thin Celluloid plug-in forms since 1932 and the DX reports are terrific. Just no end to them. But, we use only ½" of the tube base, and only as a support. The winding is placed far above it on the thin Celluloid. A ¼" hole is also drilled in the 4 prong to reduce loss between prongs. Thick Celluloid has some loss but when you use it as a thin form (we use .015") it is ideal. At one time we used thinner material, but the present is more sturdy. Regardless of opinions, they are very sturdy - hundreds of them have been in use for years. New low-loss plastic forms are also very efficient.

Another good advantage is the ease in winding. With a Bakelite form you must drill a hole when you reach the end of winding and it may break insulation. With the Celluloid you just punch a hole with a safety pin up close.

Our secondaries are all standard. The 20-40-80-160 meter Ham bands come near the center of dial, using .00014 mfd. condenser. Additional windings vary according to use.

The 20 and 40 meter coils are space-wound - about 1 wire diameter apart, which is correct. From 80 on up to long wave the windings are close-wound. On all coils the secondary is wound on first. Our windings rotate around the base- so you can rarely make a mistake in base connections. In the coil diagrams (16-2) the bottom of the coil is shown at the top of diagram to make it easier to follow. The winding table (16-4) shows best sizes of wire but near sizes may be substituted. The word "up" means from bottom edge of base to start of winding. "To" means end of winding, and applies only to 20 and 40 m. spaced windings.



16-2. Coil Base Connections.

Use the solenoid winder (3-3), with appropriate chuck for the coil base. Winding tables are OK for standard 1-3/8" diameter coil forms. Very little difference between 1¼" in diameter.

The types shown are our own but they are the main types one may put to use. You may substitute 5 prong for 4 in case you cannot obtain the latter.

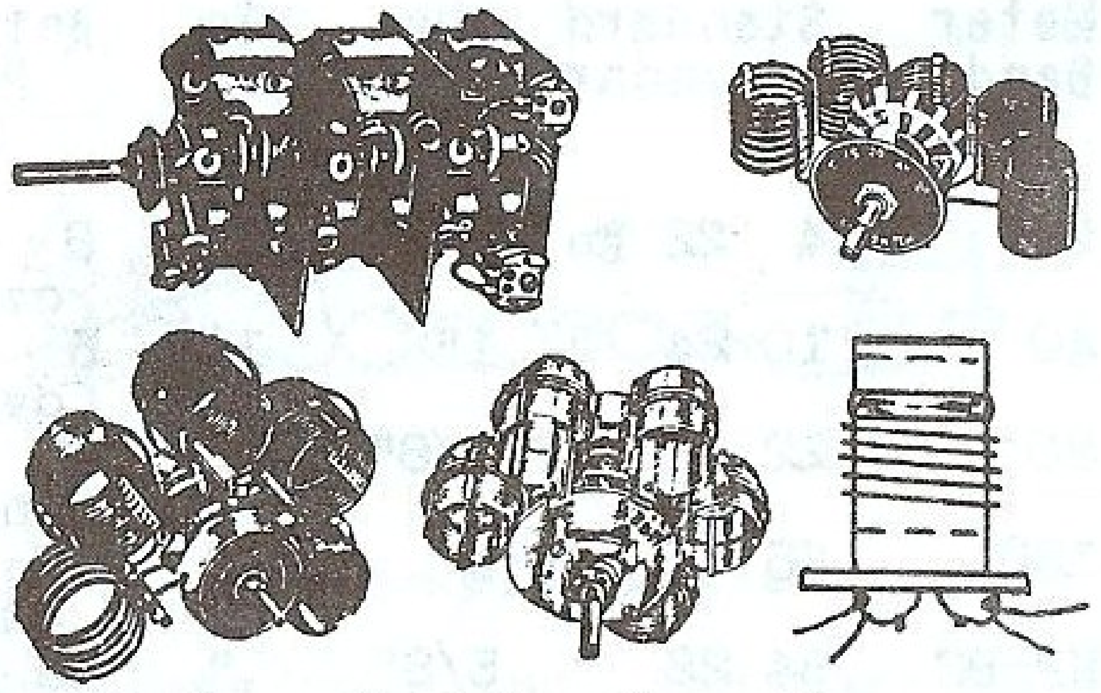
You'll notice again the (16-2) shows bottom of coil base as you hold it in your hand. Top of the page shows start of coil winding and on down. The only way, we could think of, to make it easy.

Wind on the 20 and 40 meter band secondary windings, space & cement down with Light Coil cement. Let them dry before making taps for O or C coils, or adding other windings.

On the Long Wave coils you'll have to be careful to get the winding compact as we have to put on 350 turns of fine wire.

If you want to build coils for frequencies higher than 15 meters, you should use smaller diameters as ½", etc. Otherwise you'll have only a turn or so. Refer to (4-1) for coils for HI-frequency ranges.

When coils like C and O are tapped the circuit is called Electron-coupled (E.C.). Be sure to use no smaller than #24 busbar on this tap as it has a lot to do with regeneration. When making the tap slip a piece of light cardboard 3/16" wide under the turn to be tapped. Scrape insulation with a knife and solder on. Punch hole thru coil and



16-3. Multi-band Coil Assemblies. See how crowded the coils and parts are, and the effect on good coil operation. Compare with the simplicity of a plug-in.

Meter Band.	Standard Secondary	Up From Base	To	Ant.-Ground Primary B-RF	E.C. Tap C-O	H-F R.F. Primary E-O	Tickler A-B-E
20	4 22 En.	1"	1¼"	3 24 DCC. over sec.	1	3 28 En. over sec.	5 26 En. end sec.
40	10 24 "	1"	1½"	5 24 DCC over sec.	1½	5 28 En. over sec.	6 26 En. end sec.
80	22 " "	7/8"	end	10 28 En. end sec.	2	10 28 En. end sec.	6 26 En. end sec.
160	65 " "	½"	"	12 28 En. end sec.	2	20 32 En. end sec.	12 28 En. end sec.
HF-BC	84 28 "	5/8"	"	13 28 En. 1/8" sec.	2	25 32 En. end sec.	14 28 En. end sec.
BC	120 32 "	"	"	15 32 En. ¼" sec.	2	30 32 En. end sec.	20 32 En. 1/8" sec.
LF-BC	170 34 "	"	"	15 32 En. ¼" sec.	3	35 32 En. end sec.	25 32 En. end sec.
Long Wave	350 " "	3/8"	"	20 28 En. 1/8" sec.	5	50 32 En. end sec.	40 34 En. end sec.

16-4. Coil Winding Specifications.

pull thru correct pin.

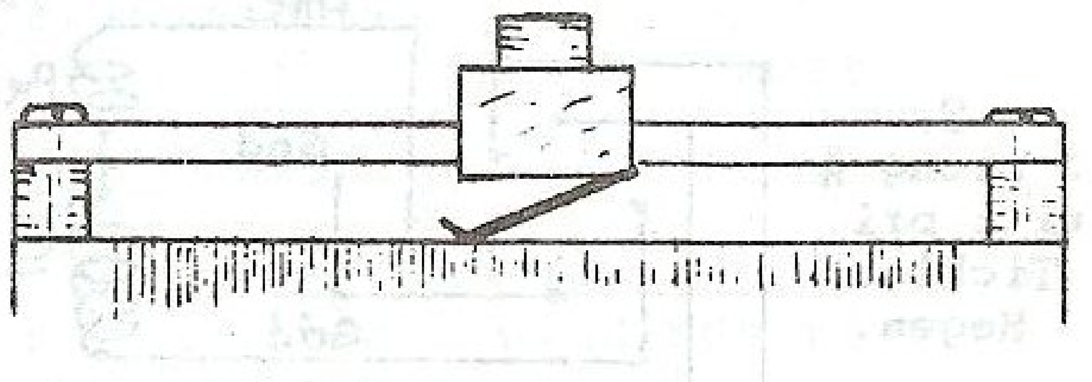
On all except B and E the primaries are wound at the top of the coil. Primaries of the types B-E-O-RF are put on after winding the 20 and 40 meter secondaries. For 80 meters up to Long Wave we prefer to wind them on before the secondaries as they are all close-wound. This makes it easier to make the Pri./Sec. connection on the B coils at the same time. For some of the larger coils it may be necessary to drill a #50 hole thru the base of the form to get on the additional primary.

On RB and B coils, that couple to the Aerial and Ground circuit it may be necessary to separate them a little more if you have local interference. If in the far country you may push them up close to secondary.

If hard to control regeneration, or too many squeals, take a turn or so off the tickler. We recently cut our HF-BC tickler winding from 20 down to 14- with much smoother operation.

Because it is hard, or too expensive, to get a .00014 (140 mmfd.) midget variable we have substituted an easy to get 350 mmfd. (.00035) and a 25-280 mmf. trimmer in series. It doesn't make too much difference about the trimmer size, just so it is small. On our coil specs. we may open the trimmer about ½ turn - or approximately 200 mmfd. With two condensers in series we get the lowest minimum capacity of either. So, when 350 is clear in and in series with a 200 we are getting about 200 mmfd. reading. The minimum reading of a .00035 is about 15 mmfd. As a result we get a final range of 15-200 mmf. with this combination. This will give you plenty of overlap.

17. SLIDERS.



A slider makes a variable inductance out of a fixed coil. In the early days they were used extensively as tuning coils and tuning primaries of loose-couplers. To cut costs- a slider may be used to replace a variable condenser. Use a small mica condenser, as .0001, across slider and coil. Because Crystal sets do not tune sharply a slider coil works very well. Several sliders may be used on the same coil. One may go to Aerial; one to tuning condenser and another to crystal or to grid condenser of a tube set for selectivity.

A Bakelite form is usually preferred but we have reports of our Celluloid forms with 3 sliders as working very well.In this case the contact should be light but firm. The diameter shouldn't be over 2" or you may miss a station during a turn.

The best wire is enameled but DCC can be used. The best sizes are between 20 and 28. Leave about 3/4" at each end so slider can make a good contact. Paint Light Coil cement strips across the coil - especially a strip on each side of the slider path.

Many rods were ¼" - but now we prefer 3/16" square brass. Center punch the rod and drill with #34 drill for 4-40 x 3/4" binding head screws at the end. Any kind of bushing can hold it up. A thin, stiff Phosphor bronze brush contact is best.Use a file or sandpaper to make the contact path.Dust off and touch a little vaseline to make a smooth path.

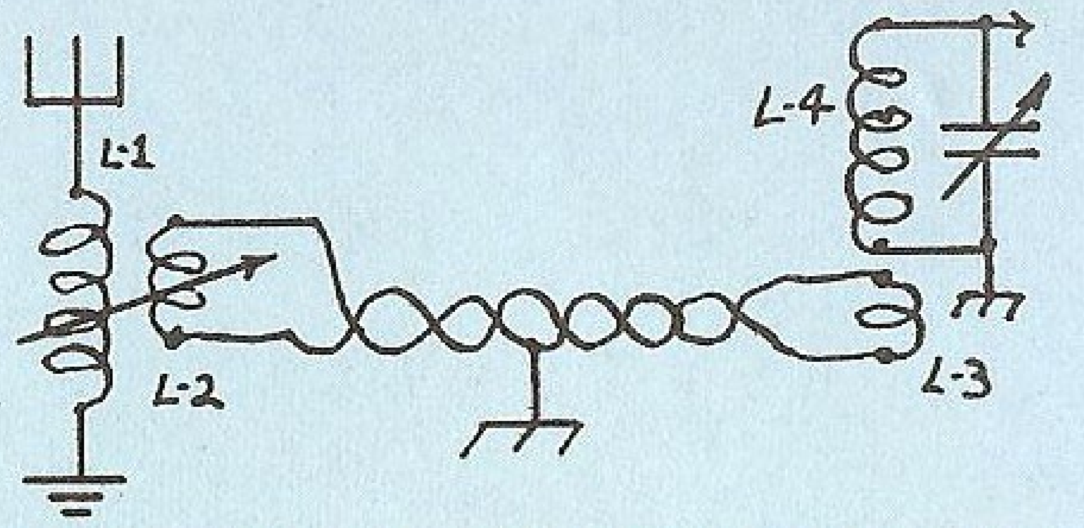
A good combination for the Experimenter is a slider coil that is tuned with a .00035 across it. You may then obtained a balanced ratio between inductance and capacity for perfect tuning. You may have Hi-capacity and Lo-inductance, or vice versa.

18. LINK COUPLING.

Many recent writers have made claim to this peculiar circuit, but it originated years ago. It is also called Link Circuit. It provides a variable coupling between two coils that do not inter-couple.

It can provide one with very sharp tuning. It is mostly aperiodic because no shunted condenser is used - and it automatically transfers the signal from one coil to the other.

One may break the link on one side and hook a variable condenser in series - the more capacity, the more coupling. Also, a variable resistor may be used, the more resistance, the less coupling we get. A slider coil may also be used- the more turns the more coupling, etc. If we shield the two sets of coils we

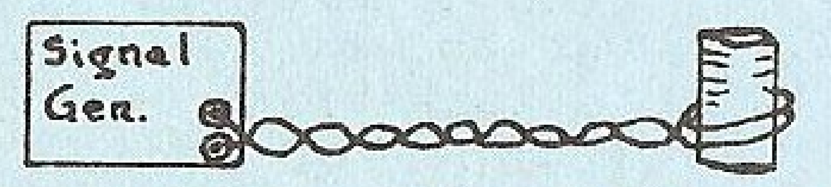


18-1. Link-Coupled Pre-selector.

get less coupling, and more selectivity as a result.

Pre-selector 18-1. Here is a novel rig to freeze out those bothersome stations. L-1 may be 20 turns #28 DCC on a 2" form. Inside this is a rotor 1½" in diameter controlled from panel, and wound with 8 turns #28 DCC. L-4 is a plug-in coil, or an RF secondary of tube set. On the ground side of this coil we wind L-3 of 10 turns for the 160-BC bands; 7 for the 80 m.; and 5 for the 20-40 meter. The link is just twisted together, and may be made from flexible hookup wire. The grounding of one side of the link adds coupling.

Link coupling is used extensively in transmitters to get sharper tuning. It is most effective in connecting from a signal generator. In most signal generators the output is coupled thru a condenser. This tends to give a tuning effect - and bring in plenty of harmonics. It also overloads the circuit on test. But, with a couple of turns around a plug-in coil,twisted together and ends hooked to output



18-2. Link from Signal Generator.

of generator (18-2) we have a most efficient control. The signal is nice and sharp and not too strong. Harmonics are more easily distinguished. The loop coil may be slid up and down.

Our #42 Crystal set uses this link coupling very effectively.

You can readily think of many combinations - and find the one that is best for your location.