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<u>How to Build the SPACE MAGNET Shielded Ferrite Loop</u>

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The theory of the shielded ferrite loop was covered in a previous paper titled "The Shielded Ferrite Loop: Principles and Practice".

Since writing the above article, considerable experience has been obtained with the large size cores and additional or revised information will be detailed briefly. The actual number of turns with the shield in place turns out to be about 102 using a 12" x 0.6" imported rod with a permeability of 400. This is more than twice the estimated number and the computed performance increases accordingly. On the other hand, the "Q" is not quite as good with the imported rod as with a 12" x 1" domestic rod with its permeability of 120 (and its cost of $20). The "Q", however, affects the signal-to-noise only as the square root and the actual performance is demonstrably better with the $5 imported rod.

Measurements in a shielded room show quite constant nulling over the band of 60 db. The spaced winding employed is equivalent to a box loop in this respect. Another 10 db or more can be achieved by concentrating the winding in a co-planar configuration in the manner of a spiral loop. The signal-to-noise performance drops considerably, however, and the spaced winding is recommended for general use. It is essential to keep in mind the facts that nulling is very imperfect with sky wave propagation anyway, and that the nulling performance obtained under controlled conditions may be all but ruined by re-radiation from nearby conductors in the home.

Before proceeding with the constructional details, a word about the pre-amplifier. By all means use one. Not only will gain be added but more importantly, the signal-to-noise ratio will be improved significantly, as well. Additionally, the isolation of the loop tuned circuit from the antenna tuned circuit, produced by the transistor, will permit the selectivity of each to contribute algebraically to the reduction of unwanted signals in the manner of a conventional tuned R.F. stage. It is not generally recognized that the use of a loop with the pick-off coil connected to the ant.-ground terminals directly is essentially two tuned circuits connected in parallel. If the two were perfect identical transformers, no additional selectivity would be provided by the loop, the inductance would merely be halved and the capacitance doubled. There is a mitigating effect, however, in the fact that the transformers are far from perfect and the resulting leakage reactance does provide a small isolation between circuits but far from that provided by a transistor.

This pre-amp uses transistors rather than FETs and the choice was not difficult but because of the publicity that the latter have received in the popular press, there is a general feeling among members that, if you want to be "with it," an FET is a must.

A basic problem with the FET is stability. An amplifying device has to be unilateral or effective amplification is impractical. A similar high impedance device to the FET is the vacuum tube and for this application, the 6BA6 would be a possible choice. It has a plate-to-grid feedback capacitance of .003 picofarads and it was made this low because it bloody-well had to be. A typical FET, on the other hand, has a drain-to-gate capacitance of .8 picofarads- 250 times greater! So they tell you to neutralize- but neutralizing high impedance circuits 250 times is harder than balancing three billiard balls one on top the other! The transistor has a feedback capacitance of 2 picofarads but its input impedance is only a couple of thousand ohms instead of megohms and the feedback is therefore at vacuum tube levels.

Much has been said and written about the fact that an FET can handle many times the input signal, without overload, than can a transistor. Sure it can; but it has to in order to break even. The reason is that optimum noise figure at one megacycle dictates an input impedance of 65,000 ohms for the FET and 260 ohms for the transistor. This means that a much larger signal has to be applied to the FET than to a transistor. By taking the square root of the above figures, it can be shown to be about 16 times higher. Assuming the FET can handle approximately 700 millivolts, rms, and the transistor, 26 millivolts; there would still be an FET advantage in signal handling capability of 700/26x16 or 1.66. However, this cannot be realized in practice except at one frequency. The reason is that the tuned loop impedance and the required FET impedance for optimum noise figure vary in opposite directions as the frequency changes. For further information on this, consult the reference in the next paragraph. As a matter of fact, most FET designs are not optimized for noise figure at all and the FET is merely connected to the top of the loop which has an impedance of about 500,000 ohms at one megacycle. Under these conditions, the FET, to break even, now has to handle 26 x the square root of (500,000/260) or about 1.14 volts. Actually, therefore, the transistor input can handle 1.14/.7 or 1.64 times that of the FET before clipping occurs. Perhaps it should be emphasized that this conclusion applies to the broadcast band and not to FM.

Perhaps the overriding consideration favoring the FET in the minds of most members is the 6 db loss of "Q" that results when the loop is matched to a transistor input. This loss is <u>not</u> necessary because it only occurs when maximum gain is realized. We are not interested in maximum gain but rather in maximum signal-to-noise ratio or best noise figure. This requires a considerably unmatched condition and with a typical A.C. beta of 100, only a 10% loss of "Q" will result from the transistor. Any member who is interested in pursuing this in greater detail is directed to "Noise in Transistors" by F.N.H. Robinson appearing in "Wireless World" for July, 1970. One would be fortunate, indeed, to so successfully neutralize an FET that effective dynamic loading does not exceed 10% on the side of resonance where the feedback is negative.

Perhaps I should have mentioned earlier that two FETs in a cascode connection, which, when packaged in one unit, is called a double gate FET, do have an effective feedback capacitance of .02 picofarad. This is a considerable improvement over a single unit but the feedback is still 7 times higher than a tube. It is also expensive, draws a lot of current and is easily damaged; so why use it? The total annual production of FETs is miniscule compared with that of bipolar transistors - and for good reason.

The constructional details that follow are based on experience derived from the construction of several samples in response to members who were either too busy or did not feel quite up to performing the construction themselves. While this turned out to be a rather difficult way to "make a buck," the experience was useful in finalizing a design that is dependable. In anticipation of possible further requests, ten additional samples have been produced which have served to point-up the basic reproducibility of the design so that if reasonable care is used in construction, satisfactory results can be assured.

As can be seen from the photographs, three wood pieces are necessary. I used 3/4" plywood but if this is not available, by all means improvise rather than buying a sheet of the stuff. The base is a 10" x 10" square with a centrally located hole 5/8" in diameter that does not quite go all the way through. The hole accommodates a 4½" section of ½" rigid copper pipe.

One of the 3" x 3" blocks of similar plywood is cemented and nailed to the base and also has a through 5/8" hole. The copper pipe is inserted in the small block and pushed down until it seats near the bottom of the base. It is cemented in this position. A 3/8" hole is drilled through the previously undrilled section of the base to permit the passage of the output leads. Four rubber feet are attached to the bottom of the base to permit the passage of the output cable. The remaining 3" x 3" wood block is cemented to the underside of the platform carrying the loop. It, too, has a centrally drilled hole (5/8") and this acts as the bearing for the rotating superstructure. The assembly will look better if the wood pieces are painted. I initially spray-painted the base with dull aluminum lacquer and the smaller pieces with bright penny copper.

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The platform mentioned above is a piece of phenolic 12" x 3" x 3/16". In order to make room for the pre-amp, the loop is not centrally located but is mounted 1 3/4" from the front on cork blocks. These blocks measuring 4" x 5/8" are cut from sheet cork 3/8" thick such as is sold by Montgomery Ward for decorative purposes. The cork acts as a resilient cushion for the rather brittle ferrite rod and is non-hygroscopic as well. The best way to cut the cork is with a finishing blade on a table saw but if this is not available, use a razor blade. The cork may tend to flake off. To prevent this, apply a coat of polystyrene Q-Dope which will hold it together and, at the same time, secure the cork pieces to the phenolic board. The holes for the nylon cord used to fasten the loop should now be drilled using a small drill. They are spaced one inch down each side of the cork spacers with the holes on one side being midway between those on the other. While you are at it, drill a ¼" or 3/8" hole in the exact center of the phenolic platform to allow the output leads to pass down the copper pipe.

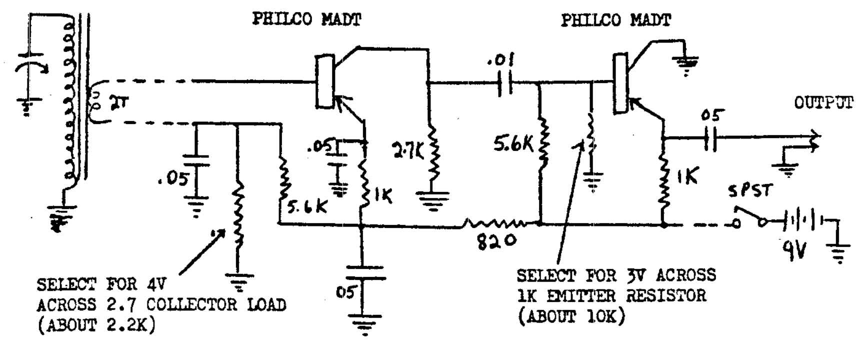
It is now time to wind the loop. As has been reported in DX Monitor previously, the rods for this purpose are available from this laboratory for $5, plus postage. With a pencil, put a mark every 1/8" down one of the flat sides, making a total of 96 marks. Concerning the wire, I have been using #22 solid; but since there is a tendency, with the shield in place, for the loop to want slightly more turns than the pencil marks provide, #24 wire might be preferable as the inductance per turn will be slightly higher. Regarding the use of litz, I have found no improvement of any significance using 15/44, though again, the slightly higher inductance per turn proves useful. On order, I have some 220 strands of #44 litz coming in soon and full information on the use of it will be available by the time this appears in print. If interested, write for additional details.

The loop is best wound by first unreeling about 20 feet of wire and fastening the spool end in a vise or some such. By running the extended length through a cloth held in your hand, the wire can be straightened. Attach the loose end of the wire to one end of the rod by wrapping around a ¼" x 3" length of electrical tape. Since it has been found that most loops tend to bottom out at 550 kc/s rather than 530 or 535 when one turn every eighth inch is used, try winding the first 10 turns closer together so they occupy only 5 marks and then proceed winding one turn per pencil mark until the last 5 marks are approached (remembering to leave room for the tape at this end also) and congest the final 10 turns as at the start. You will find it most convenient to wind by rotating the rod, while keeping the wire taut, holding one end of the rod in each hand, and thus slowly moving toward the fixed source as the winding progresses. The 2-turn secondary will be added later. After finishing the winding, tape down the end and paint the entire winding with polystyrene Q-Dope.

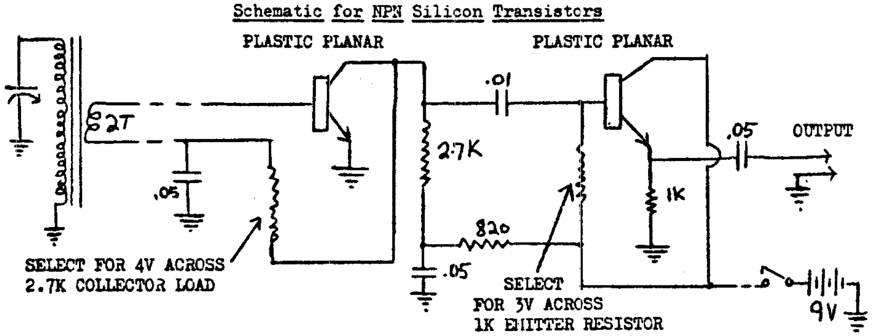
The loop can now be mounted to the cork supports using nylon dial cord or similar material. The cord is simply laced through the holes with the cord secured in each hole as your proceed by pushing a toothpick to wedge the cord and breaking off the ends flush with the board. When this is completed, apply a drop of glyptal to the bottom of each hole.

Now it is time to construct the transistor pre-amp. It is built on a piece of copper clad textolite 1½" x 3½". Two alternate schematics are shown; one for PNP germanium transistors, such as the Philco MADT and one for NPN silicons, such as the plastic packaged planar types manufactured by Fairchild, G.E., Motorola, and T.I. The primary difference in the two schematics, aside from the polarity, is the method of stabilization employed. If you use the NPN silicon types, collector stabilization is best without back bias resistors. This is necessary because of the high offset voltage of silicon (0.6 volt). The use of emitter stabilization with a stiff bias, as used for germanium, would quickly result in unsatisfactory performance as the battery voltage drops with use. The board shown in the photograph is the PNP version, using Philco MADTs, the first real high frequency transistor. If you are building the NPN version, use the same general layout, but modify the wiring accordingly. If you are wondering about the phantom resistor tying down the loose end of the .05 output capacitor on the emitter of the second transistor it is merely an improvised terminal support and can have any value in the megohm range. It will be noted that no value is given for the biasing resistors. This is because individual units vary widely in beta and it is best to adjust for the particular unit you are using.

Schematic for PNP Germanium Transistors



Schematic for NPN Silicon Transistors



The first transistor is a grounded-emitter voltage amplifier that produces all the gain (about 40 db). If you have a beta checker, use a transistor with a beta of around 100 in this slot; otherwise, take pot luck. The second transistor is an emitter follower to provide a low impedance drive for the output cable.

The tuning capacitor is the antenna section of a Mitsumi polyvaricon having a maximum capacitance of about 180 picofarads. Most of these gangs have a shaft detail that is difficult to use. Edlie Electronics sells one (39¢) that has a long enough shaft. However, the shaft diameter is only 0.2" and it must be built-up to .25" with a split bushing. If you have an old pot in your junk pile and if you are lucky, a portion of the outer shaft may work as the bushing when split with a hack saw. Another irksome matter is the mounting in that the threads are non-standard. One solution is to use a 4/40 tap being careful not to run the tap in so far as to damage the plates. A simpler solution for the home constructor is to merely cement the gang to the board with glyptal or silicone cement.

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The output end of the circuit board is mounted to a right angle aluminum or brass bracket. The bracket is mounted by a wood screw that passes through the phenolic board and fastens in the wood block below. Consult the photograph of the completed assembly for the exact manner of positioning this board. The bracket mounts 5" from the end of the phenolic board nearest the gang and should position the circuit board about 3/8" from the front edge of the phenolic.

In order to prevent capacitance feedback of the amplified signal to the loop winding a shield plate is positioned between the circuit board and loop as shown. It is formed from a piece of aluminum 2½ x 2½". Making a near right angle bend ½" from one end it can be mounted by the same screw that holds the circuit board mounting bracket. The side of the shield facing the circuit board should be covered with vinyl electrical tape in order to avoid accidental grounding of components.

It is now time to apply the secondary winding to the loop. It consists of 2 turns located at the center of the rod and interwound between the turns of the tank winding. The kind of wire used is not too important. If you have litz, it will be easier to handle and the covering will allow twisting without the danger of a short circuit developing. Hookup wire is another possibility. The ends may be fastened down temporarily with tape and Q-Dope applied. When this has dried, remove the tape and solder the leads to the circuit board. The leads had best be twisted but before doing so make sure you know which lead is which. The one nearest the circuit board should be connected to the base of the first transistor while the one furthest away connects to the bias source. Do not run the leads between the circuit board and the shield. A small amount of stray feedback always exists and it is important that this be positive rather than negative. Accordingly, make sure this winding is wound in the same direction as the main winding and that it is properly connected as noted above.

Attach an 8" length of hookup wire to the B+ junction point on the circuit board. Connect an 11" piece of hookup wire to the point where the rotor of the poly-varicon is grounded (center terminal). Incidentally, if your board happens to have copper on both sides, make sure both sides are strapped together in this vicinity, also. Now connect the loop wire nearest the gang to the stator terminal marked ANT. The oscillator section is not used.

There is one more thing to do before forming the shield and that is to connect the output leads. These leads are subject to considerable flexing as the loop is rotated, so it is important that these connections be made carefully. Pending possible revisions as life test experience may indicate, it is suggested that 21 strand hookup wire (#20 AWG), such as Belden 8507-100 be used. It has held up so far without incident. Attach an 8" length of lead to the output terminal and connect a similar one to ground at the point where the output terminal support resistor grounds. Run these leads through the center hole in the phenolic board. Cut a small piece of aluminum, 1" x 2½", and drill a hole at each end. Cover the area between the holes with vinyl tape and attach it by brass wood screws to the wood bearing support after drilling through holes in the phenolic. This plate is positioned to cover the output leads to act as a strain relief. Additionally, the plate is grounded via solder lug to the circuit board with a piece of bus wire to shield the output lead from the loop winding.

Let me describe the remaining procedure (do not do it yet). The two leads are passed down the copper pipe. A third wire is soldered to the top of the pipe using a large iron and acid core flux, if necessary. A steel strain relief plate otherwise identical to the one used above is required at the bottom of the wood base and is positioned to captivate the leads immediately as they leave the copper pipe. The two ground wires are soldered to the steel plate. Connection to the receiver is made by a suitable length of 50 ohm coax cable. Another conventional strain relief positions one end of this so that the connection of the two hot leads can be effected. The shield of the coax connects to the steel plate.

All of the above is mentioned in order to emphasize the complication involved to perform the simple task of connecting the output of the pre-amp to the receiver. It would be so much simpler to merely use several feet of single conductor shielded phono pickup arm cable, such as Belden 8431-25. Only one simple strain relief at the pre-amp board would be required. It would not be necessary to ground the support pipe. The only reason for not specifying the above at this time is lack of life test experience. By the time this appears in DXM, considerably more experience will have been recorded and, if you are interested in employing this simpler construction, drop me a line and up-to-date information will be supplied.

The shield is constructed by forming a 20 mil sheet of aluminum, 12" x 10 5/8" into the form shown by the photograph. Each side is 3", leaving a 13/16" overhang on the bottom. This is slit 1 5/8" from the center and the outside portions folded under the phenolic board as shown. Before forming, drill 4 holes to take 6/32 machine screws ¼" from the outside edge of each of the folded under lips. On the unfolded area, drill two holes on each side to pass #4 round head wood screws, 7/8" from the center line.

It is also necessary to drill the following holes on the front face. A ½" hole, 1" from the edge and 1" down is punched to take the SPST on-off switch. Another hole ¼" down and 3½" over to pass the battery snap leads is required. The size of the hole will depend on the size of the rubber grommet you use to protect the leads from the aluminum edge. The 2" vernier dial must also be mounted. This is a Japanese import that is available at most of the catalog houses. An oversize 3/4" hole should be punched 2¼" over and 1¼" down to accommodate the hub while the mounting screw holes had best be left until later to see how the gang shaft lines up.

The battery holder is made from a 2 5/16" x 2 3/16" piece of aluminum as shown in Figure 1 and formed as shown by the photograph. It has two holes drilled on the lip for 4/40 machine screws and should be mounted (eventually) as shown in the photo, which brings the first screw about 2 1/8" from the edge.

To bend up the shield and battery holder a forming brake is useful but an acceptable job can be done with pieces of wood and a vise, if done carefully. When the shield is completed, spring it over the phenolic board, mark with a pencil the outline of the mounting holes on the phenolic board and drill out for 6/32 brass mounting screws and attach with lock washers and nuts. A solder lug should be mounted under the nut nearest the on-off switch. Connect the long ground wire to this lug and also the negative (black) lead on the battery clamp. The red lead of the battery clamp goes to one terminal of the on-off switch and the B+ lead from the circuit board to the other. The battery, of course, is the 9 volt (Eveready #916) size used in transistor pocket portables.

Since the pre-amp circuit board is mounted at only one point, it is now possible to rotate it slightly until it centers the best it can with the dial mounting hole. Set the dial at the extreme to make the set screw available from the near end. Turn the gang to the corresponding extreme. With the aid of the split bushing, the dial can be attached to the gang. The remaining holes can now be drilled for mounting the dial. Make sure the dial turns easily without binding or slipping and that the line-up is right so that the dial covers its complete 180° travel.

There is only one more thing to do before making the output lead connections, described earlier, and that is to provide a stop limiting the total rotation to 360°. A hole is drilled in the copper pipe ¼" below the wood bearing to take a 4/40 screw. A ½" long screw is attached by pushing it through from the inside, leaving the head inside and the nut outside. A small hole is drilled in the underside of the wood bearing, 5/8" from the center and a 4D finishing nail lightly tapped into the hole with a hammer. Length in excess of that required to get the job done can be removed with side cutters, if desired.

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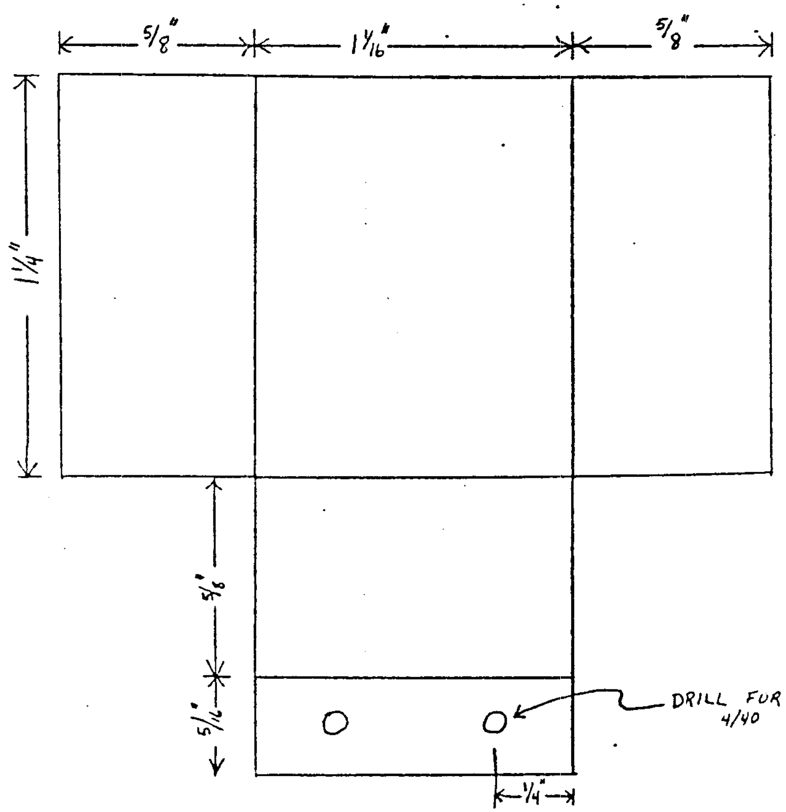
BATTERY CLAMP



It goes without saying that the prudent constructor will check out the pre-amp and loop circuits to the best of his ability before attaching the shield as constant removal of the shield to correct mistakes can rapidly prove irksome. A help in this connection is to drill a hole in the back of the shield so that the antenna trimmer of the gang can be reached with an insulated screw driver for setting the 1600 kc/s end frequency with the gang all out.

With the loop completed, it is well to observe and remember that the superstructure is not captivated. Accordingly, when moving the loop about, be sure and lift it by the base- not the shield. Also, when turning it upside down, hold it together with both hands. These precautions will prevent straining the output leads and the possibility of rupturing them.

Although the loop is classicially connected to the antenna-ground terminals of a communications type receiver, it will also be found possible to greatly improve reception with portable receivers by wrapping one turn around the receiver's loop or around the cabinet in the plane of the loop windings.

Should problems arise regarding availability of components or construction and operation of the loop, the writer will be glad to help in any way possible.

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Parts List - A

QUANTITY	DESCRIPTION		COST
1	10" x 10" base of 3/4" plywood	est.	.25
2	3" x 3" blocks, 3/4" plywood	est.	.05
1	4½" length ½" rigid copper pipe (may be obtained from large hardware store or plumbing supply house, about .40/lb.)		.15
1	piece phenolic board, 12" x 3" x 3/16" (9" x 24" sheets may be obtained from John Meshna $0.60 per sheet, shipping weight 2 lbs.)	est.	.25
1	Ferrite rod, 12" x 0.6", 400 perm. (may be obtained from Worcester Electronics, shipping weight 2 lbs.)		$5.00
x	20 feet #22 or #24 copper wire, enamel or soldereze insulation.	est.	.10
x	alternate wire for somewhat better Q. 220 strands #44 litz (est. $1.25) (may be obtained from New England Electric Wire Corp. for $8.95 lb. or Worcester Electronics 20'/ $1.25)		
2	pieces natural brown cork, 4" x 5/8" x 3/8" thick (may be obtained from Montgomery Ward- 53 B 5193 4 12" x 12" sheets for $2.89. Shipping Wt. 2 lbs.)	est.	.06
x	nylon cord, about 3 feet (hardware store)	est.	.05
x	electrical vinyl tape, about 1 foot	est.	.02
x	polystyrene Q-Dope. G.C. low loss coil coating (obtainable from any electronics store)	est.	.05
15	toothpicks	est.	.01
1	piece copper clad textolite, 1½" x 3½" (John Meshna sells 5½" x 7" pieces 3/$1.00)	est.	.07
2	high frequency transistors as described (if not available locally, Worcester Electronics can supply selected pairs of NPN silicon, G.E., Motorola, Fairchild, or T.I. for 50¢/pair, new, or Philco PNP removed from unused fire control boards, selected, for 30¢/pair)	est.	.30
1	Mitsumi Polyvaricon. Antenna section, only, is used and should be about 180 mmf. (may be obtained from Edlie Electronics or Worcester Electronics 3/$1.00)		.39
4	.05 mfd discaps, 50v		.20
1	.01 mfd discaps, 50v		.05
9	resistors, as specified, ½ or 1/3 watt		.27
1	5/16" x 5/16" right angle bracket, brass or 1/8th inch aluminum (sheet material may be obtained from large hardware store or aluminum supply house)	est.	.05
1	2½" x 2½" aluminum piece, 20 mil, folded as described (3' x 3' sheets obtainable at large hardware stores; 4' x 8' sheets obtainable at aluminum supply houses)		.03
x	hookup wire	est.	.10
1	4 foot length shielded phono pickup arm cable, Belden 8431-25	est.	.25

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Parts List - B

QUANTITY	DESCRIPTION		COST
1	strain relief bracket	est.	.03
1	12" x 10 5/8" aluminum piece 20 mil thick, folded as described (see $2\frac{1}{2}$" x $2\frac{1}{2}$" piece above for source)	est.	.55
1	SPST toggle switch (obtainable from Lafayette or Worcester Electronics)		.24
1	9 volt battery snap with 6" leads (Lafayette or Worcester Electronics)		.15
1	2" vernier dial (obtain from Lafayette or World Radio)		$1.19
1	bushing $\frac{1}{2}$" long, $\frac{1}{4}$" outside diameter, .2" inside dia. for adapting gang shaft to dial (may be made from copper tubing, $\frac{1}{4}$" soft, obtainable at auto supply store or large hardware store about 22¢/foot)	est.	.01
3	4D finishing nails	est.	.01
1	rubber grommet	est.	.03
1	2 5/16" x 2 3/16" piece 20 mil aluminum, formed as described for battery holder	est.	.03
1	solder lug		—
2	4/40 steel machine and nuts, $\frac{1}{4}$" length, round head		.04
4	6/32 brass machine screws and nuts, 3/8" length, round head and lock washers		.16
[illegible]	#[illegible] brass wood screws, round head, 3/4" length		.04
[illegible]	#6 steel wood screws, round head, $\frac{1}{2}$" length		.04
4	rubber mounting feet		.16
[illegible]	4/40 steel machine screw and nut, $\frac{1}{2}$" length, round head		.02
x	G.E. Glyptal household cement or DuPont Duco cement	est.	.05
1	9 volt battery, Eveready type 216 or equiv.		.48
x	lacquer for painting wood pieces	est.	.10
x	rosin core solder	est.	.05

Addresses of sources cited

John Meshna, Jr., P. O. Box 62, East Lynn, Massachusetts 01904
New England Electric Wire Corp., 365 Main Street, Lisbon, N.H. 03585
Edlie Electronics, Inc., 2700 Hempstead Turnpike, Levittown, L.I., New York 11756
World Radio, 3415 West Broadway, Council Bluffs, Iowa 51501
Lafayette Radio Electronics, 111 Jericho Turnpike, Syosset, L.I., New York 11791
Worcester Electronics Laboratory, R. D. 1, Frankfort, New York 13340

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Two pages Parts List

ATTACHED PHOTOGRAPH **The photograph which appears with this article was prepared from a set of three photographs. In having the finished photograph printed, your publisher was responsible for the top two of the three photos being reversed, upside down. The result: right is left; left is right. The correct view can be obtained by turning the photograph around and viewing it with a strong light in back. The pictorial, however, is accurate as printed; only the top two are reversed.**

January 30, 1971

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ERRATA and ADDENDA

Preamp —- (about 2.2K) should be (about 22K) for the first transistor biasing resistor on the PNP schematic. The photo is correct. Please be reminded that this is approximate and holds only for a beta range in the vicinity of 100. If a VOM is available, adjust a pot to obtain 4 volts across the 2.7K collector resistor and use a resistor as close as possible to the pot resistance.

The standard version of this loop, which is the one described, will handle a 50 millivolt/meter signal without overload. Strong signals than this must be handled by partial nulling. The deluxe version includes a local-distance switch which increases the signal handling capability to $\frac{1}{2}$ volt/meter. This feature may be added by inserting a 390 ohm resistor in the ground leg of the .05 capacitor bypassing the emitter of the first transistor. This decreases the gain to prevent overloading the receiver and at the same time adds 26 db of negative feedback to decrease the signal applied to the input of the amplifier by this amount. Two leads are attached to the resistor (one to each end) and connected to a SPST toggle switch. When the switch is "on," normal sensitivity is restored. The switch may be mounted 5/8" over and 7/8" down from the edge of the shield nearest the tuning dial.

Loop Winding In the article it was mentioned to use 1/8" pencil marks to space the turns but that this generally made the inductance slightly low and congestion of the first 10 and last 10 turns was suggested to alleviate. If you have a millimeter scale, make the marks every 3 mm instead of every 1/8" and it should come out right without congesting any turns.

Mention was made of 220 strand litz and this is now being used on the deluxe version. It will increase the performance slightly at the low frequency end of the band but otherwise will be no improvement over the specified solid wire.

Additional information on connecting the leads. Line 35, page 3, says 'Now connect the loop wire nearest the gang to the stator terminal marked ANT'. Apparently the other lead is ignored. It should be run along the back, between the cork and cord lacing and then looped over the ferrite rod and soldered to the point where the GND terminal of the gang is soldered. Make sure this lead, as well as the two turn winding, do not contact the winding on the rod as the high frequency coverage may be restricted by the added capacitance.

Miscellaneous The article mentions 10" x 10" square plywood for the base, but I have been using 8" x 8" and I think it looks a little neater. In the Parts List, the 2" vernier dial is priced at $1.19; at this writing, no more seem to be available at this figure. Better count on spending $1.59 to $1.65.

Output Cable On page 3, there is considerable discussion on the output lead to be used. I am now using Belden 8431 phono pickup arm cable $2\frac{1}{2}$' long. This is very flexible and holds up OK as long as the loop does not fall off the table or some such in which event it will break at the strain relief. This should be connected as follows: the braid of the cable should have a short piece of bus wire wrapped around it and soldered, and the end of this wire should be soldered to the ground plane of the preamp at this point where the output terminal support resistor grounds. The stranded inner conductor is connected to the output terminal of the preamp. The other end of the cable is prepared in the same manner with the inner lead connecting to the ANT terminal of the receiver. The bus wire on the outer braid should connect to the GND terminal of the receiver. It is particularly necessary to observe that this lead should not be connected to the floating A2 terminal. The A2 terminal, if your receiver has one, should be strapped to the GND terminal. With these connections made, check with a VOM, if you have one, to make sure the loop shield is conductively connected to the GND terminal of the receiver.

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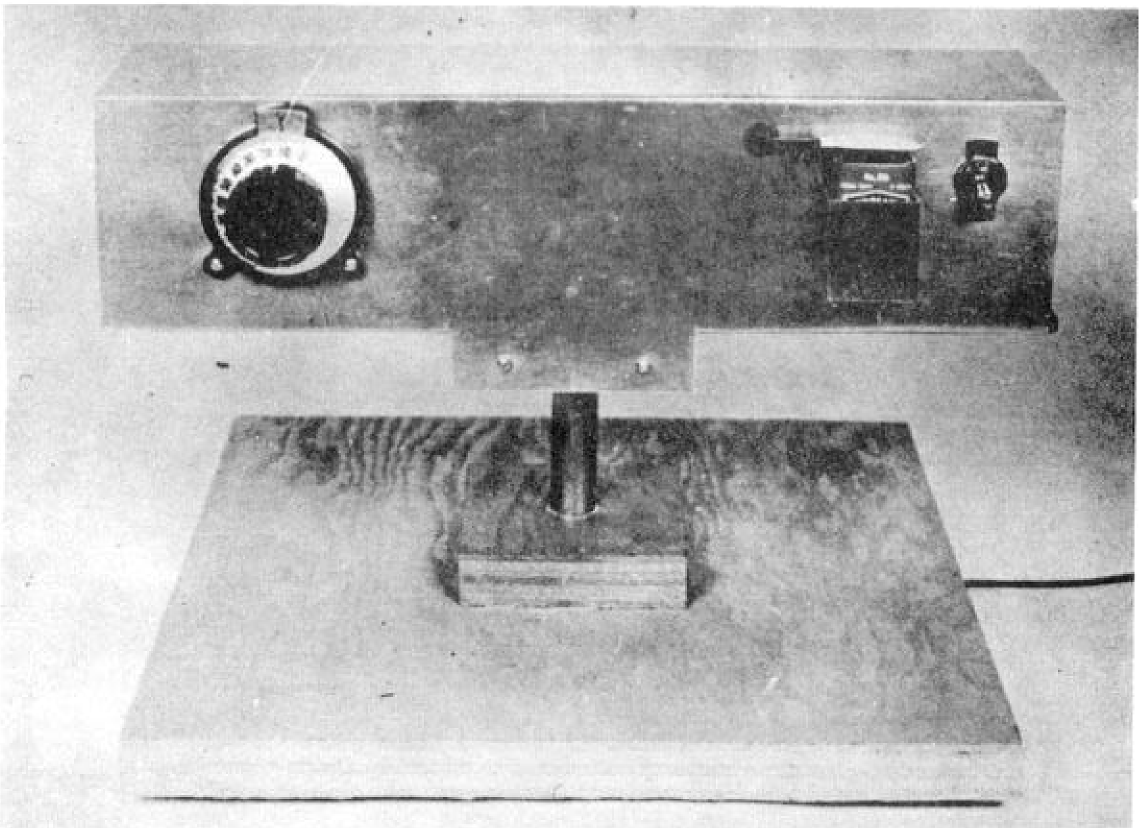

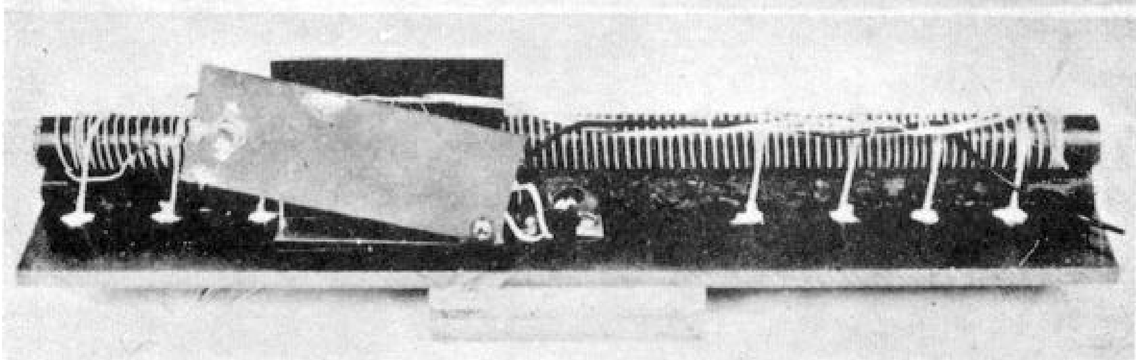

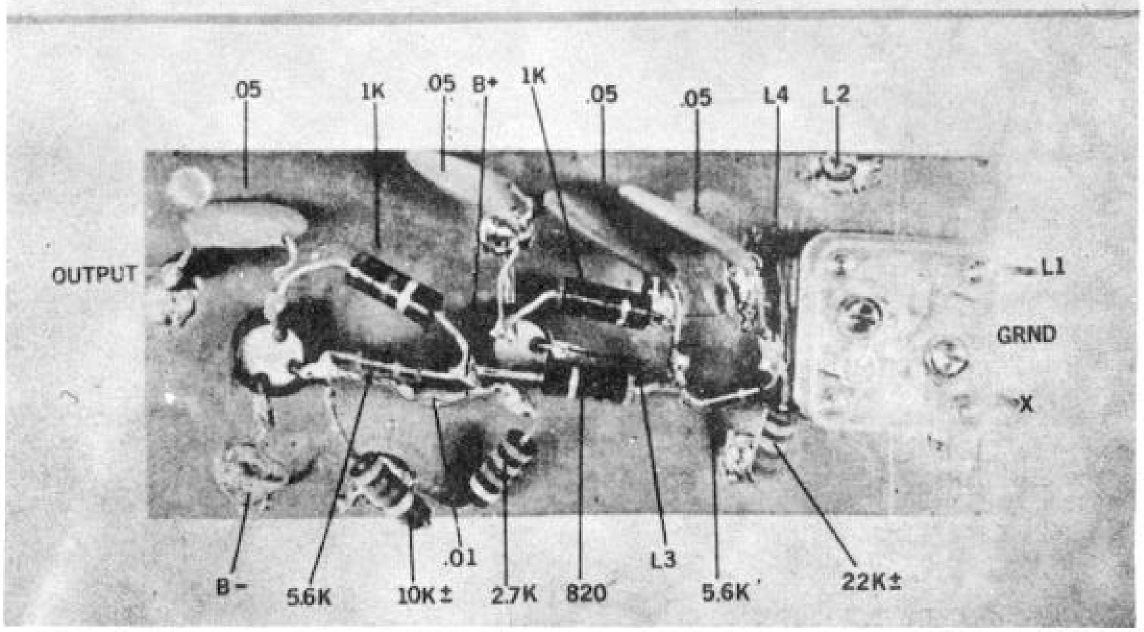
.05
1K
.05
B+
1K
.05
.05
L4
L2
OUTPUT
L1
GRND
X
B-
5.6K
10K ±
.01
2.7K
820
L3
5.6K
22K ±