

NOTES ON TRANSMITTER HUNTING AND RADIO DIRECTION FINDING  
=====

10 NOV 87 - (W8VR)

CONTENTS  
=====

	PAGE
CONDUCT OF A HUNT AND SOME RULES AND PROCEDURES	1
RDF AND HOMING, THE IMPORTANCE OF THE DIFFERENCE	3
HOW TO HANDLE MULTIPATH PROPAGATION PHENOMENA	4
EQUIPMENT AND TECHNIQUES FOR THE STARTING PHASE	6
EQUIPMENT AND TECHNIQUES FOR THE ENROUTE PHASE	9
THE CARE AND FEEDING OF SIGNAL-STRENGTH METERS	13
THOUGHTS ON THE HIGH IMPORTANCE OF ATTENUATORS	15
EQUIPMENT AND TECHNIQUES FOR THE END-GAME PHASE	16
MISCELLANEOUS	17

=====

THE FOLLOWING INFORMATION CONTAINS SOME OF THE PRESENT 'STANDARD RULES' FOR S.M.A.R.T. TRANSMITTER HUNTS, AND DISCUSSES SOME OF THE REASONS THEREFOR.

1. THE FOX WILL BE HIDDEN WITHIN 15 MILES OF THE STARTING SITE

A 15-MILE LIMIT HAS RESULTED IN HUNTS THAT LAST ROUGHLY TWO HOURS, AND WITH FINISHING TIMES RANGING FROM 20 MINUTES TO THE FULL TWO HOURS. THIS TIMING ALLOWS AFTER-DINNER STARTS, ENOUGH TIME FOR CHALLENGING HUNTS, AND STILL LEAVES TIME TO CONDUCT A CRITIQUE AT A LOCAL PUB, AFTER THE HUNT.

ONE LOCAL CLUB RUNS TRANSMITTER HUNTS IN WHICH THEIR FOX IS GENERALLY IN HIS CAR. NO WALKING OR PORTABLE R.D.F. GEAR IS NEEDED. THE HUNTS ARE VERY SHORT, AND MUCH BETTER SUITED TO A QUICKIE AFTER-THE-CLUB-MEETING ACTIVITY, (WHICH THEY ARE INTENDED TO BE), THAN TO SERIOUS HUNTING.

2. THE FOX WILL BE HIDDEN WHERE PUBLICLY ACCESSIBLE, AND WHERE NO PERMISSION OR ADMITTANCE FEES WILL BE REQUIRED TO GET TO THE FOX.
3. THE FOX WILL BE LOCATED NO MORE THAN 100 YARDS FROM A POINT OF ACCESS BY CAR.

THE FOXHUNT SHOULD NOT REQUIRE THAT THE HUNTERS DO ANYTHING BUT WALK. IF ATHLETIC PROWESS IS REQUIRED TO SCALE FENCES, SWIM RIVERS, OR LEAP OVER CROCODILE-INFESTED MOATS, THEN AN ADVANCE AGREEMENT IS INDICATED.

4. OPERATE ON A FREQUENCY OF \_\_\_\_\_ MHZ, WITH A BACKUP FREQUENCY OF \_\_\_\_\_ MHZ.

A BACKUP FREQUENCY SHOULD BE SPECIFIED FOR USE IN THE EVENT OF UNANTICIPATED INTERFERENCE ON THE MAIN FREQUENCY.

5. OPERATE WITH ANY COMBINATION OF EQUIPMENT, POWER LEVELS, AND ANTENNAS THAT HE MIGHT CHOOSE, EXCEPT THAT AT ALL TIMES HE WILL OUTPUT A SIGNAL READABLE AT THE STARTING SITE WITH A CONVENTIONAL FM MOBILE RECEIVER USING A 1/4 WAVE VERTICAL.

THE PURPOSE OF THIS IS TO ALLOW A LOST HUNTER TO RETRACE HIS STEPS AND START OVER AGAIN. HUNTS HAVE OCCURRED DURING WHICH AMBITIOUS FOXES HAVE REDUCED THEIR SIGNAL TO THE POINT WHERE COMMUNICATION WITH SOME OF THE HUNTERS WAS LOST. IF HUNTERS CANNOT RESTORE THE LINK, THEY HAVE NO OPTION BUT TO GIVE UP.

6. PROVIDE TEST TRANSMISSIONS BEGINNING 15 MINUTES PRIOR TO THE START OF THE HUNT.

THIS ALLOWS HUNTERS TO CHECK AND TUNE THEIR EQUIPMENT FROM A COMMON SITE. TUNE-UP TIMES SHOULD BE RESTRICTED TO JUST A FEW MINUTES PRIOR TO STARTING TIME, SO THAT HUNTERS STILL ON ON THEIR WAY TO THE STARTING SITE WON'T STUMBLE ACROSS THE FOX'S DEN.

7. EACH FOX WILL DEFINE WHAT CONSTITUTES THE "FIND".

ALL HUNTERS SHOULD KNOW THEIR TASK, WHETHER IT'S FINDING THE PERSON OF THE FOX, HIS TRANSMITTER, OR HIS ANTENNA.

8. THE FOX WILL TAKE A ROLL CALL OF PARTICIPANTS JUST BEFORE THE START OF THE HUNT.

THIS ALLOWS THE FOX TO WORK THE PARTICIPATING STATIONS, AND ALLOWS HIM TO CONDUCT ORDERLY STARTING AND SCORING.

9. TRANSMIT FOR A MINIMUM OF 45 SECONDS OUT OF EVERY 2 MINUTE PERIOD.

IT IS IMPORTANT THAT THE FOX NOT BE TOO COY. ESPECIALLY WHEN MOST OF THE HUNTERS ARE RELATIVE NOVICES AT HUNTING, THE FOX MUST NOT MAKE THE HUNT SO DIFFICULT AS TO DISCOURAGE HUNTERS

FURTHER, FREQUENT AND LENGTHY TRANSMISSIONS GO A LONG WAY TO ELIMINATE ANY ADVANTAGE ENJOYED BY USERS OF AUTOMATIC GEAR.

10. AT ONE HOUR INTO THE HUNT, PROVIDE A CLUE SUCH AS TO REDUCE THE SEARCH AREA BY 50%. DO THIS AGAIN AT 1 1/2 HOURS, AND AGAIN AT 2 HOURS.

THIS IS TO ASSURE THAT MOST HUNTERS WILL EVENTUALLY FIND THE FOX, TO GATHER THE STRAGGLERS FROM AROUND THE COUNTRYSIDE, AND TO PREPARE TO RETIRE TO THE PUB.

11. AT 2 1/4 HOURS INTO THE HUNT, DECLARE THE HUNT OVER, AND SECURE THE FOX'S STATION.

12. HUNTERS WILL BE ALLOWED TO USE ANY TYPES OF EQUIPMENT THAT THEY CHOOSE, EXCEPT THAT THEY MAY NOT USE DATA ACQUIRED FROM OUTSIDE THEIR CAR UNLESS IT COMES FROM THE FOX.

HUNTERS ARE NOT PERMITTED TO OBTAIN DATA FROM COLLABORATING STATIONS, PERSONS, OR REMOTE EQUIPMENT.

13. HUNTERS ARE GRADED ACCORDING TO THEIR ELAPSED TIME DURING A HUNT, AND THE FOX IS RESPONSIBLE FOR ALL TIMEKEEPING.

THERE ARE MANY WAYS TO SCORE A HUNT. COMMON METHODS INCLUDE DIRECT ELAPSED-TIME HUNTS, SUCH AS PRACTICED BY S.M.A.R.T., MILEAGE-ONLY HUNTS, AND COMBINATIONS THEREOF. WHATEVER THE SCORING SYSTEM, IT SHOULD BE KNOWN TO THE HUNTERS PRIOR TO STARTING.

=====

WHAT'S THE PROBLEM HERE ??

=====

A FUNDAMENTAL CONCEPT TO TRANSMITTER HUNTING IS THE DIFFERENCE BETWEEN "RADIO DIRECTION FINDING", AND "HOMING".

HOMING MIGHT BE CONSIDERED AS A SPECIAL CASE OF RADIO DIRECTION FINDING, AND IS ORIENTED TOWARD "HOW DO I GET THERE", RATHER THAN TOWARD "WHERE IS HE" OR "WHERE AM I".

A SHIP AT SEA, FOR INSTANCE, WILL TAKE A BEARING ON A STATION OF SOME KNOWN LOCATION, FOR PURPOSES OF DETERMINING THE POSITION OF THE SHIP, AND NOT NECESSARILY FOR LEARNING HOW TO TRAVEL TO THE STATION. AIRCRAFT OFTEN DO THE SAME.

A REQUIREMENT OF THE EQUIPMENT USED FOR THAT PURPOSE IS THAT THE THE BEARINGS HAVE HIGH RESOLUTION, AND BE QUITE ACCURATE.

HAMS, HOWEVER, WHEN SEARCHING FOR A HIDDEN TRANSMITTER, ARE LESS INTERESTED IN THEIR OWN LOCATION, OR EVEN IN THE LOCATION OF THE HIDDEN TRANSMITTER (THE "FOX"). THE QUESTION HERE IS, "WHICH WAY SHOULD I GO NOW, IN ORDER TO GET TO THE FOX'S LOCATION ?

WHILE THE DISTINCTION MAY SEEM SUBTLE ON FIRST GLANCE, ACTUALLY IT DRAMATICALLY SIMPLIFIES THE DEMANDS ON EQUIPMENT REQUIRED FOR SUCCESSFUL FOX HUNTING IN THE TYPICAL URBAN ENVIRONMENT.

CONSIDER THE HAM WHO AT THE START OF A FOX HUNT, GETS A RELIABLE INDICATION FROM HIS DIRECTIONAL ANTENNA, THAT THE FOX IS TO THE NORTHEAST. IS IT IMPORTANT TO KNOW WHETHER THE REAL BEARING IS 30 DEGREES ? 28 DEGREES ? 34.7 DEGREES ?

PROBABLY NOT! OUR FOXHUNTER IS PRACTICALLY ALWAYS LIMITED BY THE AVAILABLE STREETS TO GOING EITHER NORTH OR EAST, REGARDLESS OF THE PRECISION OR ACCURACY OF HIS BEARING DATA.

IN THIS CASE, OUR FOXHUNTER WILL LIKELY HEAD <NORTH> ON THE BEST AVAILABLE STREET, UNTIL SUCH TIME AS HE IS ABEAM OF THE FOX, AND AND HIS NEW BEARING DATA TELLS HIM TO GO <EAST>. HE WILL PROCEED <EAST> ON THE NEXT APPROPRIATE STREET UNTIL HE IS AGAIN ABEAM OF THE FOX, AT WHICH TIME HIS NEWER BEARING DATA WILL TELL HIM THAT THE FOX'S DEN IS EITHER TO THE <NORTH>, OR TO THE <SOUTH>. BY TAKING THE NEXT AVAILABLE STREET, AS SUGGESTED BY HIS LATEST RELIABLE BEARING TAKEN WHEN ABEAM OF THE FOX, THE HUNTER CLOSES IN ON HIS QUARRY WITHOUT EVER HAVING BEARING DATA OTHER THAN IN WHICH QUADRANT THE FOX LIES RELATIVE TO HIS OWN CAR.

-----

THINK CAREFULLY ABOUT THAT EXAMPLE. IT SHOWS QUITE CLEARLY THAT THE TYPICAL FOXHUNT REQUIRES VERY SIMPLE EQUIPMENT INDEED, AND IT SHOWS THE EASE WITH WHICH A BEGINNER CAN ENTER THE FOXHUNTING GAME.

-----

=====

IN YEARS PAST, HIDDEN TRANSMITTER HUNTING WAS CONDUCTED ON THE VARIOUS BANDS FROM 160 THROUGH 10 METERS. TODAY, HOWEVER, MOST AMATEUR GROUPS FIND THAT 2 METERS OFFERS THE BEST COMBINATION OF AVAILABILITY OF OPERATORS AND MOBILES, AS WELL AS ADVANTAGES IN THE EASE OF CONSTRUCTION AND PORTABILITY OF DIRECTION FINDING AND RELATED EQUIPMENT.

ACCORDINGLY, THESE NOTES WILL DEAL PRIMARILY WITH THE ISSUES OF OF 2-METER TRANSMITTER HUNTING. HOWEVER, WHEN FOXHUNTING ON THE 2 METER BAND, WE ENCOUNTER A PROBLEM PECULIAR TO VHF AND UHF.

IS IT DONE WITH MIRRORS ??

=====

RADIO DIRECTION FINDING (RDF) AT VHF AND AT UHF IS CONSIDERABLY DIFFERENT FROM RDF AT LOWER FREQUENCIES. THE VHF & UHF SIGNALS ARE OF SUCH VERY SHORT WAVELENGTH THAT THEY ARE EASILY REFLECTED BACK AND FORTH BY THE MANY AND VARIOUS CONDUCTIVE OBJECTS WHICH ARE IRRADIATED BY THE PROPAGATED R.F. THE REFLECTIONS GENERATED CAN COMBINE WITH EACH OTHER AND WITH THE DIRECT SIGNAL IN A VAST NUMBER OF PHASE AND AMPLITUDE RELATIONSHIPS. THE ACTUAL SIGNAL AS RECEIVED BY THE TRANSMITTER HUNTER, IS A RESULTANT COMPOSITE OF THE DIRECT-PATH SIGNAL AND THE VARIOUS REFLECTIONS.

IT'S MUCH LIKE SHINING A FLASHLIGHT AROUND IN A HALL OF MIRRORS, AND IT'S CALLED "MULTIPATH PROPAGATION".

REMEMBER THAT NAME !!! MULTIPATH PROPAGATION IS THE PHENOMENON THAT CAUSES VHF & UHF TRANSMITTER HUNTING TO BE SOMEWHAT HARDER THAN HUNTING AT LOWER FREQUENCIES. MULTIPATH PROPAGATION WILL BRING CONFUSION TO THE UNWARY; AND ALONG WITH IT'S ACCOMPANYING EFFECTS WILL ALWAYS GO A LONG WAY TOWARD SEPARATING THE WINNERS AND THE ALSO-RANS ON PRACTICALLY ANY VHF/UHF TRANSMITTER HUNT.

SO HOW DOES THE HUNTER DEAL EFFECTIVELY WITH MULTIPATH ? IT'S A MATTER OF PRACTICE, AND OF NOT ALLOWING THE EXCITEMENT OF A HUNT TO CAUSE YOU TO FORGET ABOUT ITS PRESENCE AND EFFECTS.

#### HINTS:

=====

1. TRY ALWAYS TO TAKE RDF BEARINGS FROM HIGH GROUND. THE DIRECT-PATH LINE-OF-SIGHT SIGNAL IS USUALLY STRONGER AND MORE RELIABLE THAN ANY COMBINATION OF REFLECTIONS.
2. TRY TO TAKE BEARINGS IN OPEN AREAS, AND AVOID AREAS OF HIGH REFLECTIVITY; SUCH AS THOSE NEAR LARGE BUILDINGS, OVERHEAD WIRES, TALL TREES, OTHER ANTENNAS, TRUCKS, OR ANY LARGE CONDUCTIVE SURFACE.

- =====
3. TAKE SEVERAL BEARINGS FROM ANY GIVEN LOCATION, AND BE SURE TO MENTALLY AVERAGE THE RESULTS. LIKE MOST DATA SUBJECT TO VARIATIONS, THE AVERAGE OF SEVERAL READINGS HAS A HIGHER PROBABILITY OF GOOD RELIABILITY THAN ANY THAN ANY ONE BEARING TAKEN ALONE.

TAKE BEARINGS IN AN OPEN AREA. FOR EXAMPLES, AN OPEN FIELD, OR A LARGE PARKING LOT WELL AWAY FROM MASSES OF PARKED CARS, WILL BE SUITABLE. TAKE A SET OF BEARINGS, EACH TAKEN SEVERAL FEET FROM THE OTHER. IF YOU ARE NOT QUITE CLOSE TO YOUR QUARRY, THEN LARGE DIFFERENCES IN THE BEARINGS INDICATE A STRONG REFLECTION ENVIRONMENT. MOVE TO A NEW LOCATION AND TRY AGAIN.

WHEN SEVERAL BEARINGS TAKEN A FEW FEET APART INDICATE THE SAME GENERAL DIRECTION, THEN ACCEPT THAT DATA. OF COURSE, IF THE HIDDEN TRANSMITTER IS QUITE CLOSE, THEN RAPIDLY CHANGING BEARINGS CAN BE REAL, AND BE A MEASURE THE ACTUAL PROXIMITY OF THE FOX.

4. IT IS POSSIBLE (AND OFTEN THE REAL SITUATION), TO HAVE RECEPTION OF REFLECTIONS ONLY; SHOULD THE DIRECT PATH FROM TRANSMITTER TO RECEIVER BE OBSCURED, PERHAPS BY A LARGE BUILDING, OR A HILL.

=====

SUPERHINT !!

<NEVER> ACCEPT ANY BEARING DATA TAKEN FROM ONLY ONE READING.

BEWARE OF REFLECTIONS !!!

=====

=====

CHESS PLAYERS CONSIDER THEIR GAME AS DIVIDED BETWEEN THREE MAJOR PARTS, CALLED THE OPENING, THE MIDDLE GAME, AND THE END GAME. ONE COULD LIKEWISE DIVIDE A HIDDEN TRANSMITTER HUNT INTO SIMILAR CATEGORIES WITH SIMILAR NAMES; AND FURTHER, COULD DEFINE CERTAIN EQUIPMENT AND TECHNIQUES SUITABLE FOR EACH PHASE OF THE HUNT.

WHICH WAY DO WE GO ?

=====

AT THE START OF THE HUNT, WE'LL NEED A RELIABLE INITIAL DIRECTION IN WHICH TO PROCEED (ASSUMING, OF COURSE, THAT OUR FOX WON'T BE HIDDEN SOMEWHERE AT THE STARTING LOCATION). OUR INITIAL BEARING WILL BE TAKEN WITH A <DIRECTIONAL ANTENNA> WHICH CAN RANGE FROM VERY SIMPLE TO QUITE SOPHISTICATED.

A SUITABLE ANTENNA FOR USE AT THE BEGINNING OF THE HUNT, SHOULD:

1. HAVE GOOD SENSITIVITY, IN CASE THE FOX'S SIGNAL IS WEAK.
2. HAVE A PATTERN WHICH WILL GIVE AN <UNAMBIGUOUS> BEARING.

A GOOD BEGINNER'S APPROACH TO THESE REQUIREMENTS MIGHT BE TO USE THE EXISTING MOBILE ANTENNA. MOST CAR INSTALLATIONS WILL EXHIBIT SOME DIRECTIONALITY, AND THE USER CAN EASILY LEARN THE PATTERN CHARACTERISTICS OF HIS PARTICULAR INSTALLATION AS FOLLOWS:

- A. SELECT A LARGE OPEN AREA FREE FROM ANY MAJOR REFLECTIONS.
- B. WHILE LISTENING TO A STRONG STEADY SIGNAL, TURN YOUR CAR SLOWLY IN A TIGHT CIRCLE WHILE WATCHING SIGNAL STRENGTH. BE CERTAIN THAT THE S-METER IS NOT PINNED. THIS IS QUITE IMPORTANT ! (SEE THE SECTION ON S-METERS).
- C. ANY PRONOUNCED PEAKS OR NULLS IN THE SIGNAL STRENGTH WILL PROVE USEFUL FOR DIRECTION FINDING PURPOSES, BUT BE SURE THAT THE PEAKS & NULLS ARE REPEATABLE AT DIFFERENT SITES, AND ARE THEREFORE A CHARACTERISTIC OF THE CAR, AND NOT A RESULT OF REFLECTIONS AT ANY ONE SITE.
- D. IF NO DISCERNIBLE PATTERN IS FOUND, YOU MIGHT CREATE ONE BY CORRUPTING THE SYMMETRY OF THE INSTALLATION. MOVE A MAG-MOUNT ANTENNA TO A FAR CORNER OF THE CAR, AND REPEAT THE TESTS; TRYING YET ANOTHER CORNER IF NEEDED.
- E. MAKE A SIMPLE DRAWING OF THE RESULTING PATTERN, AND KEEP IT IN YOUR FOXHUNTING NOTEBOOK.

YAGIS, QUADS, AND PHASED VERTICALS, ARE USEFUL ANTENNAS AT THE START OF THE HUNT. THESE ANTENNAS EXHIBIT GAIN, WHICH IS HELPFUL WHEN THE FOX IS S1, AND THEY (SHOULD) HAVE UNAMBIGUOUS PATTERNS.

THE MAIN (FORWARD) LOBE OF THE YAGI OR QUAD IS QUITE BROAD, BUT WE HAVE ALREADY NOTED THAT HIGH RESOLUTION FROM SHARP PEAKS OR NULLS ARE NOT NECESSARILY REQUIRED AT THE START OF THE HUNT.

NOTE THAT THE AVERAGE QUAD OR YAGI, AS WELL AS HAVING THE BROAD FORWARD LOBE, WILL SHOW A SUBSTANTIAL FRONT-TO-BACK RATIO. THIS F/B RATIO SHOULD BE AT LEAST 6DB FOR RELIABLE ELIMINATION OF ANY BIDIRECTIONAL AMBIGUITY; AND THE ANTENNAS SHOULD BE TUNED TO SHOW MAXIMUM F/B RATIO EVEN AT THE SACRIFICE OF SOME FORWARD GAIN. IF THE ANTENNA ALSO HAS SOME SHARP NULLS IN IT'S PATTERN, AND IF THE NULLS ARE WELL DEFINED AND NOT AMBIGUOUS, THEN THE ANTENNA COULD BE USEFUL LATER IN A HUNT, WHEN HIGHER PATTERN RESOLUTION CAN BE AN ADVANTAGE.

FOR THE PURPOSE OF TRANSMITTER HUNTING, ALL OF THE OLD ARGUMENTS AS TO WHETHER A YAGI OR A QUAD IS THE BETTER PERFORMING ANTENNA, CAN BE FORGOTTEN. HOWEVER, IT MIGHT BE WORTH NOTING THAT YAGIS, USED VERTICALLY AS IS GENERALLY DESIREABLE ON TRANSMITTER HUNTS, WILL EXTEND OVER 1/2 WAVELENGTH (APPROX. 40 INCHES) ABOVE THE THE ROOF OF A CAR. THE ONE-WAVELENGTH QUAD IS ONLY ABOUT 20 IN. ON A SIDE, AND WILL MOUNT CORRESPONDINGLY LOWER. RDF ANTENNAS ARE KNOWN TO LAST LONGER WHEN NOT HITTING THE TREES.

MOST LOCAL 2-METER ACTIVITY IS CONDUCTED WITH ANTENNAS THAT ARE VERTICALLY POLARIZED; AND THE FOXHUNTER WILL FIND THAT MANY, IF NOT MOST, FOXES, WILL DO THE SAME. A CONNIVING AND UNSCRUPULOUS FOX, HOWEVER, COULD WELL ATTEMPT TO CONFUSE HIS HUNTERS BY USING HORIZONTAL (OR OTHER) POLARIZATION. CROSS-POLARIZED ANTENNAS CAN RESULT IN A SIGNAL LOSS OF 15-20 DB, A VERY SUBSTANTIAL LOSS IF SIGNALS ARE WEAK, SUCH AS IN THE EARLY STAGE OF A HUNT. IT WOULD WELL PAY THE ASTUTE FOXHUNTER TO ARRANGE HIS ANTENNA MOUNTING SO THAT THE POLARIZATION CAN BE EASILY CHANGED, EVEN IN MID-HUNT.

=====

HINT:

AN OLD TV YAGI (LEGALLY ACQUIRED, OF COURSE), WHEN STRIPPED OF ITS VARIOUS BELLS AND WHISTLES, MAKES AN INEXPENSIVE SOLUTION TO THE PROBLEM OF GETTING GOOD INITIAL BEARINGS. CHANGE THE ELEMENT LENGTHS AND SPACINGS IN ACCORDANCE WITH THE RECOMMENDATIONS OF A MOST ANY ANTENNA HANDBOOK OR MANUAL. IF THE YAGI HAS A BALANCED CONFIGURATION, EQUIP IT WITH AN INEXPENSIVE BALUN AND A LENGTH OF COAXIAL LINE. SUITABLE BALUNS CAN BE FOUND AT RADIO SHACK.

AS WITH ANY ANTENNA, THE FOXHUNTER <MUST> TAKE TIME TO STUDY AND TO THOROUGHLY LEARN THE CHARACTERISTICS OF THE ANTENNA.

BEWARE OF REFLECTIONS !!!

=====

ANOTHER ANTENNA OF CONSIDERABLE INTEREST TO FOX HUNTERS, IS THE PHASED VERTICAL. USING 2 ELEMENTS, THIS ANTENNA OFFERS SOME GAIN OVER A 1/4 WAVE VERTICAL, AND OFFERS A SHARP NULL WHICH IS DESIREABLE LATER IN THE HUNT.



A DESIGN FOR A PHASED VERTICAL SYSTEM IS GIVEN IN THE MARCH, 81 ISSUE OF QST, AND IN SOME RECENT EDITIONS OF THE ARRL ANTENNA MANUAL. THIS TYPE OF ANTENNA CAN BE CONSTRUCTED IN ONE EVENING, USING SOME PVC TUBING AND OTHER HARDWARE-STORE BITS AND PIECES. IT HAS BEEN BUILT BY SEVERAL LOCAL FOXHUNTERS, AND IT WILL GIVE GOOD RESULTS WHEN PROPERLY TUNED. A SLIGHT SIMPLIFICATION OF THE ORIGINAL QST DESIGN BY KBIN, IS TO REPLACE THE PHASING LINES OF THE ORIGINAL DESIGN, WITH A SINGLE 3/4 WAVELENGTH SECTION. ONE ARRL PUBLICATION SHOWED THAT THIS ANTENNA, WHEN WELL TUNED, WAS MEASURED AS HAVING A NOTCH DEPTH OF -40DB. TESTING OF THREE LOCALLY-BUILT VERSIONS SHOWS ABOUT -20DB, AND FOR THE PURPOSE AT HAND, -20DB IS MORE THAN ADEQUATE.

=====

LITTLE KNOWN SECRET:

FOR BEST WEAK-SIGNAL CAPTURE AT THE START OF THE FOXHUNT, USE YOUR ALL-MODE RECEIVER IN THE SIDEBAND MODE. AN SSB RECEIVER HAS A MUCH NARROWER BANDWIDTH THAN CONVENTIONAL FM RECEIVERS, GIVES CORRESPONDINGLY LESS RECEIVER NOISE, AND A RESULTING IMPROVEMENT IN S/N RATIO. ALSO, A PRODUCT DETECTOR IS CAPABLE OF PRODUCING A HETERODYNE ON SIGNALS, EVEN WHEN THE SIGNALS ARE QUITE WEAK. THE COMBINATION OF THESE EFFECTS IS A RESULTANT 8-10DB IMPROVEMENT IN YOUR ABILITY TO GET BEARINGS ON VERY WEAK SIGNALS. WHAT WOULD YOU HAVE TO DO TO YOUR ANTENNA TO GET THAT MUCH GAIN ??

SUPERHINT:

BE <CERTAIN> TO TAKE SEVERAL BEARINGS, BEFORE STARTING A HUNT. IT'S HARD TO RECOVER FROM A BAD START, AND REMAIN COMPETITIVE.

BEWARE OF REFLECTIONS !!!

=====

=====

ANTENNAS FOR THE ENROUTE PHASE OF A FOX HUNT, WOULD IDEALLY HAVE SOMEWHAT DIFFERENT CHARACTERISTICS THAN THE ANTENNAS USED AT THE START.

WHILE ENROUTE, A GOOD ANTENNA SHOULD:

- A. HAVE ADEQUATE SENSITIVITY OR GAIN TO GET A USABLE SIGNAL.
- B. HAVE A SHARPER PATTERN, SO THAT DIRECTIONS CAN BE BETTER RESOLVED.
- C. BE MOUNTED ON THE CAR, AND BE OPERABLE BY THE NAVIGATOR WHILE THE CAR IS IN MOTION. THIS IS OF VITAL IMPORTANCE BECAUSE OF THE TIME SAVED. THE NEED TO STOP THE CAR AND GET OUT, EVERY TIME BEARINGS ARE DESIRED, CAN CAUSE MORE LOST TIME THAN ANY OTHER ONE FACTOR. IN FACT, MUCH OF THE SOPHISTICATED EQUIPMENT SEEN IN SOME TRANSMITTER HUNTS IS EFFECTIVE NOT BECAUSE OF ITS ACCURACY, OR ITS RESOLUTION, BUT BECAUSE IT IS AUTOMATIC, AND NO APPRECIABLE TIME IS LOST IN THE PROCESS OF TAKING BEARINGS.

THERE ARE SEVERAL ANTENNA TYPES WHICH MEET THE ABOVE CRITERIA, INCLUDING PHASED VERTICALS ALREADY DISCUSSED, AND THE SMALL LOOP.

THE SMALL LOOP IS ONE WHOSE DIMENSIONS ARE SMALL WITH RESPECT TO THE OPERATING WAVELENGTH. IT IS VERY ATTRACTIVE FOR FOXHUNTING APPLICATIONS BECAUSE OF ITS SMALL SIZE, CONVENIENCE OF USE, LOW COST AND EASE OF CONSTRUCTION, AND SHARP PATTERNS. SUCH LOOPS CAN BE DESIGNED AND CONSTRUCTED IN EITHER UNSHIELDED OR SHIELDED CONFIGURATIONS. GENERALLY SPEAKING, AN UNSHIELDED LOOP IS EASIER TO CONSTRUCT AND A SHIELDED LOOP WILL GIVE BETTER PERFORMANCE. THE PERFORMANCE IMPROVEMENTS OF THE SHIELDED LOOP ARE DUE TO ITS ABILITY TO REJECT CERTAIN TYPES OF FALSE BEARINGS CAUSED BY THE CAPACITIVE IMBALANCE INDUCED BY NEARBY CONDUCTIVE OBJECTS.

THE SMALL LOOP IS A BI-DIRECTIONAL ANTENNA, WITH A PATTERN THAT RESEMBLES 2 TANGENTIAL CIRCLES, THEREBY PRODUCING 2 BROAD PEAKS AND 2 SHARP NULLS. THE NULLS OCCUR WHEN THE HIDDEN TRANSMITTER LIES ON A LINE <PERPENDICULAR> TO THE PLANE OF THE LOOP, AND THE PEAKS OCCUR WHEN THE TRANSMITTER LIES ON A LINE CONTAINED WITHIN THE PLANE OF THE LOOP.

THE BROAD PEAKS OF THE LOOP ARE USEFUL WHEN THE SIGNAL IS WEAK, AND/OR WHEN ONLY A GENERAL DIRECTION IS NEEDED. THE SHARP NULLS ARE USEFUL WHEN SIGNALS ARE STRONGER AND/OR A HIGHER RESOLUTION

THE BIDIRECTIONAL PATTERN OF THE LOOP CAUSES AN AMBIGUITY OF 180 DEGREES. FOR EXAMPLE, A FOXHUNTER CAN SEE THAT THE TRANSMITTER LIES DIRECTLY TO NORTH OR SOUTH, BUT HE CAN'T TELL WHICH WAY IS CORRECT. THIS AMBIGUITY CAN BE RESOLVED IN AT LEAST 2 WAYS. ONE IS TO USE THE PROCESS OF TRIANGULATION, THE OTHER IS TO OUTFIT THE LOOP WITH A 'SENSE ANTENNA', WHICH SERVES TO MODIFY THE LOOP LOOP PATTERN FOR UNIDIRECTIONAL RESPONSE.

TWO DESIGNS FOR LOOPS ARE PRESENTED HEREIN; ONE SHIELDED AND ONE UNSHIELDED.

=====

THE UNSHIELDED LOOP NEEDS LITTLE COMMENT, OTHER THAN TO SAY THAT IS <MUST> BE TUNED TO RESONANCE AT THE OPERATING FREQUENCY. ONE WAY TO DO THIS IS TO CONNECT THE LOOP TO A RECEIVER, AND USE AN INSULATED TUNING TOOL TO PEAK THE RECEIVED SIGNAL. THE PEAK WILL BE QUITE SHARP, AND SHOULD OCCUR WITHOUT THE CAPACITOR AT EITHER EXTREME OF ITS CAPACITANCE RANGE. IF A TENDENCY TO PEAK SHOULD OCCUR AT MAXIMUM CAPACITANCE, THEN THE LOOP SHOULD BE MADE A BIT LARGER AND THEN RETUNED. THE OPPOSITE IS ALSO TRUE. SHOULD NO PEAKING EFFECT BE NOTED, THEN THE LOOP SHOULD BE INSPECTED, BOTH ELECTRICALLY AND VISUALLY. IF PROPERLY CONSTRUCTED, THEN CHECK THE RESONANT FREQUENCY OF THE LOOP USING A GRID-DIP METER, AND MODIFY THE LOOP SIZE AS APPROPRIATE. <ENLARGE> THE LOOP IF THE RESONANT FREQUENCY IS TOO <HIGH>, AND CONVERSELY. IF TUNING WITH A RECEIVER, MAKE SURE THAT THE SIGNAL IS WEAK, AND THE S-METER, IF USED, IS NOT PINNED.

THE SHIELDED LOOP IS TUNED IN MUCH THE SAME MANNER, EXCEPT THAT CARE IS NEEDED IN THE USE OF THE GRID DIP METER, SO AS TO NOT TO RESPOND TO THE HIGHER FREQUENCY (180 TO 250 APPROX.) PARASITIC RESONANCE CAUSED BY INCLUSION OF THE COUPLING LINK.

THE SHIELDED LOOP SHOWN OFFERS ADEQUATE SENSITIVITY FOR USE AT THE START OF THE HUNT, GIVEN REASONABLE SIGNAL STRENGTH FROM THE FOX, AND OFFERS GOOD ENOUGH DIRECTIONAL RESOLUTION TO BE USABLE THROUGHOUT THE HUNT.

THE FIRST SOLUTION TO THE PATTERN AMBIGUITY, TRIANGULATION, IS ACHIEVED AS FOLLOWS:

ASSUME THAT THE FOXHUNTER STOPS AT A PARKING LOT TO GET A NEW BEARING, AND AFTER TAKING <SEVERAL> TO ELIMINATE REFLECTIONS, HE CONCLUDES THAT THE FOX LIES EITHER TO THE NORTH OR TO THE SOUTH, BUT HE DOES NOT KNOW WHICH.

NOW ASSUME THAT THE FOXHUNTER MOVES TO THE EAST, AND CONTINUES TO TAKE BEARINGS, UNTIL HE IS CONVINCED THAT HE HAS RELIABLE BEARINGS IN ANOTHER DIRECTION. THE NEW BEARINGS WILL POINT TO EITHER TO THE NORTHWEST/SOUTHEAST OR TO NORTHEAST/SOUTHWEST. IF THE FIRST CASE, THEN HE NOW KNOWS THAT THE TRANSMITTER IS TO THE NORTHEAST, AND IF THE SECOND CASE, THEN SOUTHWEST.

```

FFF
FFF      <----- THE FOX
                                     east ---->

```

CONVERGENT BEARINGS ( yea! )

```

* north
* bearing
* <-----
*
* northwest bearing
* <-----
*
*
*
HHH      <----- THE HUNTER ----->
HHH      <----- #1 LOCATION #2 ----->
*
* south
* bearing
* <-----
*
* southeast
* bearing
* ----->
*

```

DIVERGENT BEARINGS ( boo ! )

NOTE: EVEN IF YOUR UNIDIRECTIONAL ANTENNA MAKES TRIANGULATION UNNECESSARY FOR RESOLVING DIRECTIONAL AMBIGUITY, IT IS STILL A VALUABLE TOOL FOR ESTIMATING THE DISTANCE TO YOUR FOX. WHEN CONVERGENT BEARINGS ARE DRAWN ON A MAP, THEIR INTERSECTION LIES AT THE LOCATION OF THE FOX. FOR A NEAT WAY TO MENTALLY ESTIMATE THE DISTANCE, ASK A SAILOR ABOUT 'DOUBLING THE ANGLE ON THE BOW'.

WHATS THAT YOU SAY ?? YOU FORGOT YOUR MAP AND COMPASS ?? GREAT !! I'LL BE WAITING FOR YOU AT THE FINISH LINE.

## TRIANGULATION

TRIANGULATION, WHILE EFFECTIVE, IS SOMEWHAT TIME CONSUMING, AND ALSO TEDIOUS. THE ADDITION OF A SENSE ANTENNA TO THE LOOP WILL PAY DIVIDENDS TO THE DILIGENT HUNTER. THE INCLUDED DRAWING SHOWS HOW TO DO IT. TO TUNE UP THE SENSE ANTENNA, PROCEED AS FOLLOWS:

1. TUNE THE LOOP AS PREVIOUSLY DESCRIBED (SENSE ANTENNA OFF)
2. SET THE LENGTH OF THE SENSE ANTENNA TO 18 INCHES.
3. IN AN OPEN AREA (NOT INDOORS), ORIENT THE LOOP SO THAT A STEADY SIGNAL SOURCE SUCH AS A LOCAL REPEATER, LIES ALONG A LINE WHICH IS CONTAINED <WITHIN> THE PLANE OF THE LOOP. TURN THE SENSE ANTENNA ON.

- =====
4. TUNE THE COUPLING CAPACITOR THROUGHTOUT ITS RANGE, WHILE LOOKING FOR A SHARP DIP IN THE INDICATED SIGNAL STRENGTH.  
SHARP DIP - GO TO STEP 7  
NO SHARP DIP - GO TO STEP 5
  5. ROTATE THE LOOP EXACTLY 180 DEGREES, AND THEN REPEAT THE TUNING PROCESS.  
SHARP DIP - GO TO STEP 7  
NO SHARP DIP - GO TO STEP 6
  6. INCREASE THE SENSE ANTENNA'S LENGTH BY ABOUT 0.25 INCHES.  
LENGTH STILL UNDER 22 INCHES - GOTO STEP 4  
LENGTH IS NOW OVER 22 INCHES - SOMETHING IS WRONG  
CHECK CONSTRUCTION
  7. CHECK WHETHER THE CAPACITOR LIES NEAR THE <MIDDLE> OF ITS CAPACITANCE RANGE, AND NOT NEAR AN END.  
NEAR MID-RANGE - GO TO STEP 8  
NEAR END-RANGE - GO TO STEP 6
  8. ROTATE THE ANTENNA SEVERAL TIMES TO CONFIRM THAT IT HAS A SHARP NULL WHEN THE SIGNAL IS ARRIVING ALONG A LINE WHICH IS CONTAINED WITHIN THE PLANE OF THE LOOP, AND A NOTABLY STRONGER SIGNAL WHEN THE LOOP IS ROTATED EXACTLY 180 DEG.  
  
ALSO CHECK THAT WHEN THE SENSE ANTENNA IS SWITCHED OUT, A NORMAL TWO-NUL LOOP PATTERN IS OBTAINED. REMEMBER THAT WHEN THE SENSE ANTENNA IS OUT, THE NULLS ARE EXPECTED TO LIE ON A LINE <PERPENDICULAR> TO THE PLANE OF THE LOOP.  
SATISFACTORY - GO TO STEP 9  
MURPHY AGAIN - GO TO STEP 1
  9. MARK THE LOOP WELL, SO THAT THE NULL AND PEAK DIRECTIONS ARE UNAMBIGUOUS, AND ARE VISIBLE EVEN IN THE DARK. YES, VIRGINIA, THERE <ARE> NIGHT TRANSMITTER HUNTS. BE SURE TO REMEMBER YOUR FLASHLIGHT.
  10. CONGRATULATIONS !! SOME PEOPLE HAVE NEVER ARRIVED HERE.

## THE S-METER

=====

THE SIGNAL-STRENGTH METER IS ONE OF THE MOST USEFUL TOOLS OF THE FOXHUNTER, AND MANY EQUIP THEIR RECEIVERS WITH AN EXTERNAL METER TO PROVIDE A LONGER SCALE, BETTER LINEARITY OF OPERATION, BETTER RESOLUTION OR READABILITY, OR PERHAPS TO JUST GET RID OF THE LED OR LIQUID CRYSTAL DISPLAYS IN COMMON USE TODAY.

WHILE S-METER READINGS ARE INVALUABLE TO THE ALERT HUNTER, THEY ARE PERILOUS FOR THE UNWARY; AND IMPROPERLY INTERPRETED S-METER READINGS CAN CAUSE THE FOXHUNTER TO GO COMPLETELY ASTRAY IN HIS ASSESSMENT OF DIRECTIONS OR DISTANCES.

FOR CONFIRMATION OF THIS, LISTEN AFTER ALMOST ANY FOXHUNT TO THE HUNTERS WHO SAY THINGS LIKE: 'WE WOULD'VE WON THIS HUNT, BUT WE HAD THIS S-9 SIGNAL ABOUT 5 MILES FROM HERE -- SO WE STOPPED AND BLEW ABOUT A HALF HOUR LOOKING -- WE THOUGHT HE WAS RIGHT THERE.

THAT LAMENT COMES FROM THE FOXHUNTERS WHO DON'T UNDERSTAND THEIR S-METERS, OR WHO HAVEN'T PRACTICED MUCH IN LEARNING TO USE THEM.

AN INTERESTING CONFIRMATION OF THE FAILURE OF SOME HAMS TO FULLY UNDERSTAND THEIR S-METER WAS HEARD ON A LOCAL REPEATER DURING AN INCIDENT OF REPEATER JAMMING. CONSIDER THIS: IT WAS ABOUT 5:30 IN THE EVENING, AND SEVERAL HAMS IN VARIOUS LOCATIONS WERE IN A ROUNDTABLE. WHEN THE JAMMER CAME ON THE AIR, THREE OF THE HAMS, AT 3 WIDELY SEPARATED LOCATIONS, SAID, 'I'M HERE NEAR THE CORNER OF A AND B STREETS -- AND I KNOW HE'S RIGHT HERE IN THIS AREA -- BECAUSE HE'S FULL STRENGTH ON MY S-METER'.

DOES A FULL-STRENGTH S-METER READING PROOVE THAT THE TRANSMITTER IS NEARBY? NOT NECESSARILY. FOR EXAMPLE, THE SIGNAL FROM THE S.M.A.R.T REPEATER WILL GIVE FULL STRENGTH METER READINGS IN A CONVENTIONAL RECEIVER AND ANTENNA INSTALLATION AS FAR AS 25 MILES FROM THE REPEATER SITE. THIS GIVES AN AREA OF S-9 METER READINGS WHICH CAN COVER NEARLY 2000 SQUARE MILES !!! ADMITTEDLY, THAT SIGNAL DOES COME FROM A POWERFUL TRANSMITTER AND A HIGH ANTENNA, BUT THE EXAMPLE IS MEASURE OF THE DEGREE TO WHICH THE UNWARY CAN BE FOOLED.

IT IS ALSO WORTH REMEMBERING THAT THE DESIGN OF THE FM RECEIVERS WE USE INCORPORATES LIMITER STAGES AND AGC FUNCTIONS, WHICH ARE SPECIFICALLY TO MASK VARIATIONS IN THE STRENGTHS OF THE INCOMING SIGNALS, AND WHICH TEND TO MAKE WEAK SIGNALS STRONGER. COUPLED WITH THE NONLINEARITIES OF MOST S-METER CIRCUITS, THE RESULTING READINGS ARE CONFUSING INDEED.

FINALLY, CONSIDER THAT A SIGNAL OF A CERTAIN STRENGTH WILL CAUSE YOUR S-METER TO PIN. NOW, CONSIDER THAT A SIGNAL ACTUALLY BEING RECEIVED IS 20DB STRONGER THAN THE FIRST SIGNAL. IT WILL REQUIRE A SIGNAL REDUCTION OF GREATER THAN 20DB FOR THE S-METER TO COME OFF THE PIN, AND A DIRECTIONAL ANTENNA WITH A F/B RATIO AS HIGH AS 20DB WHEN NULLED, WILL STILL LEAVE THE S-METER PINNED.

=====

WELL, LET'S STOP MALIGNING OUR HAPLESS S-METER, AND LEARN HOW TO DERIVE USEFUL INFORMATION FROM IT.

1. WHEN TAKING BEARINGS, OR WHEN ASSESSING DISTANCES, <ALWAYS> MAKE SURE THAT THE S-METER IS NOT PINNED. USE AN ATTENUATOR IN THE ANTENNA LINE TO WEAKEN STRONG SIGNALS BEFORE THEY GET INTO THE RECEIVER (SEE THE SECTION ON ATTENUATORS).
2. WHEN USING THE S-METER TO TAKE BEARINGS, OR TO HELP ESTIMATE DISTANCES, BE SURE THAT YOU AVERAGE SEVERAL READINGS. A DEAD SPOT OR A HOT SPOT CAN QUICKLY CORRUPT THE DATA.
3. FLUCTUATING SIGNAL STRENGTH IS <NOT> NECESSARILY PROOF THAT THE FOX IS IN MOTION. FLUCTUATIONS CAN BE CAUSED BY A MOVING REFLECTION FROM MOTOR VEHICLES SOMEWHERE IN THE PROPAGATION PATH, BY OVERHEAD AIRCRAFT, AND BY OTHER FACTORS.
4. PRACTICE ESTIMATING DISTANCES WITH YOUR S-METER. ADJUST YOUR ATTENUATOR TO A LEVEL WHICH ALLOWS THE S-METER TO READ ABOUT MID SCALE. WHAT POWER IS BEING TRANSMITTED ? WHAT KIND OF ANTENNA IS BEING USED. HOW HIGH IS IT ? HOW FAR AWAY ? TAKE ADEQUATE NOTES, AND CONTINUE TO DO THIS ON VARIOUS SIGS UNTIL YOUR NOTEBOOK CONTAINS ENOUGH DATA TO ALLOW YOU TO GET A GOOD FEEL FOR WHAT PAD (ATTENUATOR) LEVELS WILL GIVE MID-SCALE READINGS FOR VARIOUS CONDITIONS. NOW YOU HAVE A MEANS OF ESTIMATING DISTANCES BASED ON S-METER READINGS.
5. A WORD OF CAUTION. NEVER FORGET THAT FOXES, BY REPUTATION, ARE CUNNING AND DEVIIOUS. FOXES HAVE EVEN BEEN KNOWN TO MAKE CHANGES IN POWER LEVELS, ANTENNA TYPE, ANTENNA POLARIZATION AND ANTENNA PATTERN DIRECTION IN THE VERY MIDDLE OF A HUNT ! IT ALL WREAKS HAVOC WITH THE S-METER READINGS. BEWARE OF ANY SUDDEN CHANGE IN SIGNAL STRENGTH WHICH IS INCONSISTENT WITH YOUR RATE OF PROGRESS TOWARD THE FOX.

IF THE FOX CHANGES HIS POLARIZATION, YOU MIGHT SEE A 15DB TO 20DB CHANGE IN THE LEVEL OF THE RECEIVED SIGNAL.

IF THE FOX IS USING A HIGHLY DIRECTIONAL ANTENNA, SUCH AS A MULTI-ELEMENT BEAM, HE CAN GENERATE CONSIDERABLE CONFUSION AS HE ROTATES THE BEAM; OR AS THE HUNTER HIMSELF DRIVES INTO OR OUT OF A MAIN LOBE, THEREBY CAUSING THESE ANTENNA-RELATED EVENTS TO GIVE S-METER READINGS WHICH ARE MISTAKENLY THOUGHT TO BE GOOD DISTANCE INDICATORS.

## THE ATTENUATOR

WE HAVE MADE SEVERAL REFERENCES TO THE IMPORTANCE OF BEING ABLE TO ATTENUATE THE SIGNAL BEFORE IT ENTERS THE RECEIVER. LET'S NOW DISCUSS SOME OF THE WAYS IN WHICH THIS CAN BE ACCOMPLISHED.

A COMMERCIALY BUILT ATTENUATOR CAN BE OBTAINED, AND WHILE THEY ARE ORIGINALLY EXPENSIVE, THEY ARE OFTEN SEEN AT SWAPS. BE SURE THAT ANY ATTENUATOR YOU BUY IS AN RF ATTENUATOR. THOSE DESIGNED FOR AUDIO USE, ARE NOT SUITABLE.

A VERY SUITABLE ATTENUATOR CAN BE HOME-BREWED. CONSISTING OF A SMALL METAL BOX, A FEW SWITCHES, TWO CONNECTORS, AND A HANDFUL OF RESISTORS, THEY ARE EASY TO BUILD AND NOT COSTLY. DESIGNS ARE FOUND IN SEVERAL AMATEUR PUBLICATIONS. BE CAREFUL, HOWEVER, TO PAY CLOSE ATTENTION TO THE PHYSICAL LAYOUT OF PARTS. IN ORDER TO ACHIEVE BEST PERFORMANCE, THE STRAY CAPACITANCE BETWEEN SECTIONS MUST BE MINIMIZED. A MEASURE OF THE ATTENUATION DESIRED, IS THE FACT THAT THE DIFFERENCE BETWEEN A VERY WEAK SIGNAL (SUCH AS MAY BE THE CASE AT THE START OF THE HUNT), AND A VERY STRONG SIGNAL, SUCH AS AT THE FINISH, MIGHT EXCEED 100 DB.

A HOME-BREWED ATTENUATOR NEED NOT FOR OUR PURPOSES, BE ACCURATE, OR EVEN CALIBRATED. ONLY A LOGGING SCALE IS NECESSARY.

IF AN ATTENUATOR IS NOT READILY AVAILABLE, A CRUDE BUT WORKABLE SUBSTITUTE CAN BE HAD BY EQUIPPING THE RECEIVER WITH A TEMPORARY ANTENNA MADE FROM 19 INCHES OF COAT HANGER. AS THE SIGNAL GETS STRONGER, CUT AN INCH OR TWO OFF THE ANTENNA TO MAINTAIN DESIRED SIGNAL STRENGTHS. SINCE THE PROCESS IS IRREVERSIBLE, BE SURE TO CARRY EXTRA COAT HANGERS.

A LIMIT TO ANY ATTENUATION SCHEME WILL BE REACHED WHEN THE USUAL LEAKAGE INTO THE RECEIVER, EITHER BECAUSE OF LIMITATIONS OF THE ATTENUATOR, OR THROUGH LEAKAGE DIRECTLY INTO THE RECEIVER CASE, REACHES THE POINT WHERE THE S-METER IS PINNED AND THE ATTENUATOR IS FULLY IN. THIS WILL PLACE A LIMIT ON HOW CLOSE THE FOXHUNTER CAN GET TO THE FOX'S DEN AND STILL BE ABLE TO TAKE BEARINGS. YOU CAN GENERALLY SOLVE THIS PROBLEM WITH THE SHIELDING, FILTERING, AND BYPASSING TECHNIQUES FREQUENTLY USED IN TVI REDUCTION.

## HINTS:

KEEP A ROLL OF ALUMINUM FOIL HANDY. WRAP A COUPLE OF LAYERS AROUND THE OFFENDING RECEIVER OR HANDIE-TALKIE, MAKING SURE THAT THE FOIL IS WELL GROUNDED.

A USABLE REDUCTION IN RECEIVER SENSITIVITY CAN OFTEN BE HAD BY SIMPLY TUNING YOUR RECEIVER 5 KC OFF FREQUENCY. THIS CAN APPRECIABLY REDUCE THE S-METER READING.



=====

THE TIME COMES WHEN YOUR EFFORTS HAVE CHANGED THE STATUS OF YOUR FOX'S SIGNAL FROM LONG-PATH DX TO 9+ LOCAL. YOU HAVE ARRIVED AT THE END-GAME WHEN YOU CAN'T GET ANY CLOSER BY CAR. IT'S TIME TO GET OUT AND WALK. THE RF SEEMS TO BE EVERYWHERE, LIKE AT DAYTON.

THE LOOP ANTENNA, ESPECIALLY EQUIPPED WITH SENSE ANTENNA, IS AN EXCELLENT CHOICE. BE SURE THAT YOUR HT IS NOT OVERLOADED BY RF LEAKAGE. WRAPPING IT IN ALUMINUM FOIL, OR PERHAPS A FORM-FITTED SHIELDED CASE MADE FROM PRINTED CIRCUIT BOARD SCRAPS, WILL HELP.

HERE'S ANOTHER METHOD OF USING AN HT. WRAP THE HT IN FOIL, WITH A DUCKIE OR SHORT PIECE OF WIRE FOR AN ANTENNA. HOLD THE HT SO ITS BOTTOM IS AGAINST YOUR BELLY, AND THE ANTENNA POINTED AWAY FROM YOUR BODY. LOWER THE ANTENNA SO THAT IT POINTS DOWNWARD AT AN ANGLE OF ABOUT 45 DEGREES. NOW ROTATE YOUR WHOLE BODY THROUGH A 360 DEGREE CIRCLE. YOU SHOULD FIND A DISTINCT NULL WHEN YOUR BODY IS INTERPOSED BETWEEN THE HT AND THE HIDDEN TRANSMITTER. AN EARPHONE OR SPEAKER MIKE IS HELPFUL TO DISCERN THE SIGNAL NULL.

NOTE HERE (AND AT OTHER TIMES DURING THE HUNT, TOO), THAT A GOOD SUBSTITUTION FOR, AND AUGMENTATION OF YOUR S-METER, IS THE NOISE OF THE RECEIVER. IF A SIGNAL IS WEAK OR WELL ATTENUATED, CHANGES IN NOISE LEVEL AS A DIRECTIONAL ANTENNA IS TURNED, ARE SENSITIVE INDICATORS OF SIGNAL STRENGTH.

THE SIMPLE DIODE FIELD-STRENGTH METER IS A VALUABLE TOOL FOR THE FOXHUNTER. IT IS EASILY AND INEXPENSIVELY CONSTRUCTED, AND WILL ELIMINATE THE PROBLEMS OF RECEIVER OVERLOADS, WHEN WORKING CLOSE TO THE FOX. DESIGNS FOR DIODE FS METERS ARE IN MOST HANDBOOKS, AND A FEW IDEAS THEREON ARE INCLUDED.

THE UNITS CAN BE BUILT WITH THE ANTENNA AS A PART OF THE METER, OR CAN BE EQUIPPED WITH A CONNECTOR SO THAT YOUR LOOP (OR OTHER) DIRECTIONAL ANTENNA CAN BE USED EITHER WITH THE FS METER OR WITH OTHER EQUIPMENT, SUCH AS A MOBILE RECEIVER, OR A HANDIE-TALKIE.

A NICE ENHANCEMENT FOR THE FS METER, IS TO OUTFIT THE UNIT WITH A VOLTAGE-CONTROLLED AUDIO OSCILLATOR AS THE INDICATOR, INSTEAD OF THE CONVENTIONAL METER. THE AUDIO SIGNAL WILL GIVE SENSITIVE INDICATIONS OF SIGNAL STRENGTH CHANGES, AND WILL ELIMINATE NEED FOR THE USER TO KEEP HIS EYES GLUED TO A METER WHILE HE WALKS.

=====

EXHORTATION:

THE PROXIMITY OF THE TRANSMITTER, OR THE EXCITEMENT OF BEING NEAR THE FINISH, <DO NOT> EXCUSE FORGETTING ABOUT REFLECTIONS

=====

## =====

## THINGS YOU GOTTA HAVE

=====

1. A GOOD NAVIGATOR. FOXHUNTING IS A 2-MAN (AT LEAST) ACTIVITY. ONE PERSON SHOULD CONCENTRATE ONLY ON DRIVING, WHILE ANOTHER HANDLES ALL RADIO OPERATING AND DIRECTION-FINDING WORKLOADS. AS WELL AS BEING AN EFFECTIVE ARRANGEMENT, THE PRESENCE OF A NAVIGATOR WILL ENHANCE SAFETY SINCE THE DRIVER'S MIND CAN BE FREE TO CONCENTRATE ON HIS DRIVING.
2. A RECEIVER IN THE CAR, WITH AN ANTENNA WHICH HAS DIRECTIONAL CHARACTERISTICS, EVEN IF ONLY AN OFF-CENTER MAG-MOUNT
3. A PORTABLE RECEIVER OR FS METER, AND A DIRECTIONAL ANTENNA; IF YOUR HUNT RULES ALLOW THE FOX TO BE OUT OF HIS CAR
4. AN EFFECTIVE MEANS OF ATTENUATING SIGNALS

## THINGS YOU SHOULD HAVE

=====

1. AN EXTERNAL S-METER ON YOUR RECEIVER
2. MAP, COMPASS, FLASHLIGHT, NOTEBOOK
3. A SENSITIVE, MODERATELY DIRECTIONAL ANTENNA, FOR THE START
4. A DIRECTIONAL ANTENNA MOUNTED ON THE CAR, AND ACCESSIBLE TO THE NAVIGATOR WHILE THE CAR IS IN MOTION
5. AN AMPLIFIED DIODE-TYPE FIELD STRENGTH METER
6. A PORTABLE LOOP ANTENNA, EQUIPPED WITH SENSE ANTENNA

## THINGS WHICH WOULD BE NICE TO HAVE

=====

1. A FULLY AUTOMATIC DIRECTION FINDER, SUCH AS THOSE USING THE DOPPLER-SHIFT RDF PRINCIPLE, OR SUCH AS AN INTERFEROMETER. ACTUALLY, MANY DIFFERENT KINDS OF DIRECTION-FINDING SCHEMES LEND THEMSELVES TO AUTOMATIC OPERATION. CONTRARY TO MUCH OF THE COMMENT HEARD ON THE AIR, THE USE OF AN AUTOMATIC SYSTEM DOES <NOT> NECESSARILY PROVIDE GREATER ACCURACY, RESOLUTION, OR GUARANTEED TRANSMITTER HUNT WINS. IT DOES, HOWEVER, ALLOW THE BEARINGS TO BE TAKEN AUTOMATICALLY, AND THUS REDUCES THE WORKLOADS OF THE HUNTERS.
2. A VERY PORTABLE, VERY HIGH GAIN, AND NARROW PATTERN ANTENNA, FOR USE AT THE START OF A HUNT.

- =====
3. AN EVEN MORE PORTABLE, SHARP UNIDIRECTIONAL ANTENNA, FOR USE LATER IN THE HUNT.
  4. AN SSB RECEIVER, FOR WEAK-SIGNAL WORK.
  5. MORE TIME, MONEY, AND TECHNICAL EXPERTISE, FOR THE DESIGNING BUILDING AND USING OF RDF GEAR, AND A COMPLETE UNDERSTANDING OF "ANTENNAS", BY DR. JOHN KRAUS, W8JK

AND FINALLY, EVEN AT THE GREAT RISK OF GENERATING A WHOLE FLOCK OF EFFECTIVE COMPETITORS; I NOW GIVE TO YOU THE SIX BEST-KEPT SECRETS OF FOX HUNTING.

1. BEWARE OF THE REFLECTIONS
2. BEWARE OF THE REFLECTIONS
3. BEWARE OF THE REFLECTIONS
4. KEEP YOUR S-METER UNPINNED
5. KEEP YOUR S-METER UNPINNED
6. KEEP YOUR S-METER UNPINNED

=====

73 es gl -- de W8VR

=====

=====

AT A DISCUSSION EARLIER IN THIS YEAR, DRAWINGS OF A LOOP ANTENNA WERE HANDED OUT TO PARTICIPANTS. SEVERAL HAMS THEN ACQUIRED THE NECESSARY PARTS AND PROCEEDED TO BUILD THE LOOP. VIRTUALLY ALL OF THEM REPORTED THAT THE ANTENNA DID NOT OPERATE PROPERLY WHEN FIRST TRIED. IT APPEARS THAT HAMS BEING HAMS, AND THEIR JUNKBOXES BEING MORE CONVENIENT AND LESS COSTLY THAN THE PARTS STORE, EACH BUILDER HAD MADE PARTS SUBSTITUTIONS, HAD CHANGED THE PHYSICAL LAYOUT, AND HAD INCORPORATED WONDERFUL ENGINEERING IMPROVEMENTS.

SUCH RESOURCEFULNESS IS CERTAINLY LAUDABLE, BUT SEVERAL FACTORS SUGGEST, ESPECIALLY WHEN WORKING AT VHF/UHF, THAT ANY PROSPECTIVE CHANGE BE <CAREFULLY CONSIDERED> FOR ITS EFFECT ON THE REACTIVE BEHAVIOUR OF THE CIRCUIT. STRAY CAPACITANCE, STRAY INDUCTANCE, AND UNEXPECTED DIFFERENCES IN THE INDUCTANCE AND CAPACITANCE OF SUBSTITUTE PARTS AND CHANGED LAYOUTS CAN TAKE A MODIFIED CIRCUIT COMPLETELY "OUT OF TOWN" AT VHF.

FOR EXAMPLE, A PIECE OF ORDINARY 20 GAUGE HOOKUP WIRE, ONE INCH LONG, HAS AN INDUCTANCE OF ABOUT 20 NANOHENRIES. THE REACTANCE OF THAT WIRE, AT 146 MHZ. IS, THEREFORE, ABOUT 20 OHMS !! NOW, WHEN WORKING WITH ANTENNA CIRCUITS WHICH HAVE IMPEDANCE LEVELS IN THE LOW 10'S OF OHMS, YOU JUST CAN'T GO AROUND THROWING IN 20 OHMS HERE AND 20 OHMS THERE WITHOUT GETTING IN REAL TROUBLE.

THE SAME SORT OF THING HAPPENS IF ONE IS THE LEAST CARELESS WITH STRAY CAPACITANCE. AT 150 MHZ., A 10PF CAPACITANCE WILL HAVE A REACTANCE OF ABOUT 100 OHMS, WHICH AGAIN, IS FAR TOO LOW TO ALLOW TO CREEP INTO OUR CIRCUITS UNNOTICED.

SPEAKING OF CAPACITORS, THOSE USED FOR VHF WORK SHOULD BE EITHER CERAMIC OR SILVERED MICA DIELECTRIC. MOST OTHER CAPACITOR TYPES HAVE LOSSY DIELECTRICS AND/OR THEIR CONSTRUCTION INTRODUCES SO MUCH UNWANTED INDUCTANCE THAT THEY PERFORM POORLY, IF AT ALL.

IN SUMMARY, ALL LEAD LENGTHS IN VHF RF CIRCUITS MUST BE KEPT AS AND AS HEAVY AS PRACTICABLE; CAPACITORS MUST BE OF AN APPROPRIATE TYPE, AND LAYOUT CHANGES SHOULD BE STUDIED FOR THEIR CHANGES TO THE CIRCUIT REACTANCES.

9412

=====

A SIMPLE FORM OF DIODE FS METER IS SHOWN IN FIGURE 1. THE UNIT IS EASY TO BUILD, AND MAY BE CONSTRUCTED IN ANY SMALL METAL BOX, SUCH AS THE 'MINIBOX' MANUFACTURED BY THE BUD CO., OR THE BRAND SOLD BY RADIO SHACK.

TRY TO MAINTAIN THE LAYOUT OF PARTS SHOWN IN THE DRAWING. IF ANY DIFFICULTY IS ENCOUNTERED IN GETTING THE UNIT TO RESONATE ON THE 2-METER BAND, A GRID-DIP METER CHECK FOLLOWED BY A COIL CHANGE WILL USUALLY SOLVE THE PROBLEM.

THE MILLIAMMETER SHOULD BE AS SENSITIVE AS AVAILABLE. ORDINARY PANEL METERS WITH FULL-SCALE CURRENTS OF 100  $\mu$ a ARE GOOD, WITH 50 $\mu$ a OR EVEN 25 $\mu$ a BEING DESIREABLE. A 1ma (1000  $\mu$ a) METER CAN BE USED IN A PINCH, BUT THE OVERALL SENSITIVITY WILL BE LOW.

THE COIL IS WOUND FROM #12 OR #14 BARE COPPER, OR TINNED COPPER WIRE ON A 1/4 INCH DIAMETER FORM, AND THEN THE FORM IS REMOVED. 4-TURNS SHOULD PROVIDE RESONANCE ON 2-METERS. ADJUST THE COIL SO THAT THE SPACING BETWEEN THE TURNS IS ABOUT ONE WIRE DIAMETER.

CONNECTION TO THE COIL FOR THE ANTENNA AND THE DIODE SHOULD BE AT THE APPROXIMATE CENTER OF THE COIL. IF THE PARTS ARRANGEMENT MAKES ACCESS TO THE EXACT CENTER AWKWARD, THEN ERR A BIT TOWARD THE GROUND END OF THE COIL.

THE TUNING CAPACITOR CAN BE A COMMON 'APC' TYPE SURPLUS VARIABLE HAVING A MAXIMUM CAPACITANCE OF ABOUT 30 PF. CHECK TO SEE THAT THE ROTOR OF THE CAPACITOR IS GROUNDED TO THE SHAFT, AND VIA THE MOUNTING HARDWARE, TO THE ENCLOSURE. IF NOT, THEN PROVIDE THE NECESSARY GROUND WITH A SHORT (1/2 INCH, MAX.) LENGTH OF HEAVY WIRE FROM THE ROTOR TERMINAL TO THE BOX.

THE DETECTOR DIODE CAN BE A COMMON 1N34A. OTHER DIODE TYPES MAY BE USED, BUT THEY SHOULD BE GERMANIUM.

THE BYPASS CAPACITOR IS SPECIFIED AS A 1000PF (.001 UF) CERAMIC DISK TYPE.

=====

FIGURE 2 SHOWS AN EASY-TO-CONSTRUCT LOOP. WHEN PROPERLY TUNED, THIS LOOP HAS SURPRISINGLY GOOD SENSITIVITY, AND HAS VERY SHARP NULLS.

WHILE A UHF-TYPE CONNECTOR IS SHOWN, ANY CONVENIENT CONNECTOR MAY BE USED.

THE LOOP CAN BE MOUNTED DIRECTLY ON A HANDIE-TALKIE (SHIELDED !) OR MAY BE CONNECTED TO A HANDIE-TALKIE OR TO A FS METER WITH A LENGTH OF RG-58 CABLE. IF USING CABLE, USE THE POLYETHYLENE TYPE AND AVOID THE FOAM DIELECTRIC TYPE. THE LENGTH OF THE CABLE IS NOT CRITICAL, BUT INTEGRAL MULTIPLES OF 26.5 INCHES OFFER SOME ADVANTAGES.

THE LOOP SHOULD BE TUNED WITH A NON-CONDUCTING TUNING TOOL, SO THAT A SHARP PEAK IN THE RECEIVED SIGNAL OCCURS WITH THE TUNING CAPACITOR NOT AT AN EXTREME OF ITS RANGE. IF SUCH A PEAK NOT BE FOUND, THEN A CHANGE OF COIL DIAMETER IS NEEDED. THE GRID-DIPPER WILL UNCOVER ALL THE SECRETS.

IF USING THE LOOP ON DIFFERENT TYPES OF EQUIPMENT, IT MIGHT NEED TO BE RETUNED FOR EACH TYPE. BUT, WITH AN ANTENNA THIS SIMPLE AND INEXPENSIVE, IT'S PROBABLY EASIER TO JUST HAVE MORE THAN ONE.

FIGURES 3-5 DESCRIBE A SHIELDED LOOP THAT'S BEEN SUCCESSFUL AT SEVERAL LOCAL TRANSMITTER HUNTS. THE PURPOSE OF THE SHIELDING IS TO REDUCE CERTAIN TYPES OF LOOP ERRORS WHICH ARE INTRODUCED INTO LOOPS BY NEARBY CONDUCTIVE OBJECTS, INCLUDING THE OPERATOR.

THE ANTENNA PROPER IS MADE FROM A LENGTH OF RG-63. THIS COAX IS NOT THE EASIEST STUFF TO FIND, BUT IT'S PERFORMANCE IS WORTH THE EFFORT IN FINDING IT. IN A NUTSHELL, THE CAPACITANCE OF RG-63 IS VERY LOW COMPARED TO MORE CONVENTIONAL CABLE TYPES. THIS LOWER CAPACITANCE ALLOWS THE LOOP TO BE LARGER (MORE SENSITIVE!), AND STILL TUNE SUCCESSFULLY TO 2-METERS.

TO PUT NUMBERS ON THIS, RG-8 HAS A CAPACITANCE OF APPROXIMATELY 30 PF PER FOOT, & RG-11 HAS A CAPACITANCE OF ABOUT 17 PF/FOOT. RG-63, THOUGH, HAS A CAPACITANCE OF ONLY ABOUT 9.5 PF/FOOT.

A 31 INCH LENGTH OF COAX IS TERMINATED WITH UHF CONNECTORS IN THE CONVENTIONAL MANNER. AT THE CENTER OF THE CABLE, CUT THRU THE SHIELD (NOT THE CENTER CONDUCTOR), AND TAPE THE RESULTING GAP. THE LOOP PROPER, IS NOW FINISHED.

THE LOOP ENCLOSURE IS SHOWN IN FIGURE 3C. THE BOX IS AN ALUMINUM DIE CAST, AND IS APPROXIMATELY 1.5 WIDE, 3.5 LONG, AND 1 DEEP. THIS BOX IS MADE BY HAMMOND MFG., BUT A SIMILAR UNIT IS MADE BY BUD CO. BOTH BRANDS ARE FOUND IN NORMAL DISTRIBUTION CHANNELS. FIGURE 3C SHOWS THE INTERNAL CONSTRUCTION OF THE LOOP ENCLOSURE.

NOTE IN FIG. 3C, THAT THE 2-TURN COUPLING LINK IS INSERTED INTO THE CENTER OF THE COUPLING COIL.

THE GROUND CONNECTIONS SHOWN FOR THE TWO TRIMMER CAPACITORS MAY BE ACCOMPLISHED BY DRILLING 2 SMALL HOLES IN THE BOX, AND USING 4-40 HARDWARE AND SOLDERING LUGS.

ADJUSTMENT OF THIS LOOP IS THE SAME AS FOR THE UNSHIELDED LOOP, EXCEPT THAT <BOTH> CAPACITORS MUST BE ADJUSTED. FIND A PEAK SUCH THAT NEITHER CAPACITOR IS NEAR THE END OF IT'S RANGE; AND TO THE DEGREE POSSIBLE, SO THAT THE TWO CAPACITORS HAVE APPROXIMATELY THE SAME CAPACITANCE.

FIGURE 3D SHOWS THE ATTACHMENT OF A HANDLE, AND THE INSTALLATION OF A SENSE ANTENNA. THE PURPOSE OF A SENSE ANTENNA IS TO CHANGE THE LOOP PATTERN FROM BIDIRECTIONAL TO UNIDIRECTIONAL, AND HAS BEEN DISCUSSED IN ANOTHER SECTION.

FIGURE 4 SHOWS THE INSTALLATION OF THE COMPONENTS FOR THE SENSE ANTENNA. DETAILS OF THE COUPLING COIL, AND OF THE COUPLING LINK, HAVE BEEN OMITTED FOR CLARITY. NOTE THE USE OF DIRECT AND HEAVY LEADS IN THIS CIRCUIT.

THE SENSE ANTENNA ITSELF, IS EASILY FABRICATED FROM TELESCOPING LENGTHS OF BRASS TUBING (HOBBY SHOP), AND THE LENGTH UNCOMMITTED UNTIL THE TUNING PROCEDURE HAS BEEN SATISFACTORILY COMPLETED.

FINALLY. FIGURE 5 DEPICTS THE ELECTRICAL SCHEMATIC

=====

AS HAD BEEN DISCUSSED, SUBSTANTIAL PERFORMANCE INCREASES CAN BE HAD, IF THE DIODE FS METER (SNOOP BOX) IS EQUIPPED WITH A D.C. AMPLIFIER. FURTHER, THE SENSITIVITY REQUIREMENTS PLACED ON THE METER MOVEMENT CAN BE RELAXED, AND THE INEXPENSIVE 0-1 MA METER BECOMES WHOLLY ADEQUATE.

FIGURE 6 IS THE SCHEMATIC FOR SUCH AN AMPLIFIER.

THE PARTS LIST IS:

IC ..... TYPE 1458 OR EQUIVALENT  
 R1 ..... 20,000 OHMS 1/2 1/4 WATT METAL FILM  
 R2 ..... 1000 OHM CERMET OR WIREWOUND POT  
 R3 ..... 820 OHMS, 1/4 WATT CARBON COMP OR FILM  
 R4 ..... SEE TEXT  
 R5 ..... 1 MEGOHM POT, ANY TYPE  
 C1 ..... 1000 PF CERAMIC CAPACITOR  
 D1 ..... GENERAL-PURPOSE L.E.D. (POWER-ON INDICATOR)

R4 IS CALCULATED BY REQUIRING THE VOLTAGE ACROSS IT TO BE 1 MV, WHEN THE CURRENT THROUGH IT IS EQUAL TO THE FULL-SCALE CURRENT THE METER. FOR EXAMPLE, ASSUMING A 1 MILLIAMPERE METER:

$$R4 = V/I = 1\text{MV}/1\text{MA} = .001 \text{ VOLTS} / .001 \text{ AMPS} = 1 \text{ OHM}$$

POTENTIOMETER R2 IS THE OFFSET CONTROL, USED TO COMPENSATE FOR THE "OFFSET ERROR" OF THE OP AMP, AND IS ADJUSTED TO GIVE A ZERO METER READING IN THE ABSENCE OF SIGNAL.

SYSTEM SENSITIVITY IS ADJUSTED BY R5. NOTE CAREFULLY THE USE OF METAL-FILM RESISTORS & CERMET/WIREWOUND POTS IN CERTAIN PLACES. IT IS IMPORTANT THAT THESE RECOMMENDATIONS BE FOLLOWED, TO AVOID TEMPERATURE-INDUCED DRIFTS OF THE OFFSET-COMPENSATING SYSTEM.

THE INPUT FOR THE AMPLIFIER SHOULD BE CONNECTED IN PLACE OF THE METER DEPICTED IN FIGURE 1.



=====

FIGURE 7 SHOWS AN AUDIO INDICATOR FOR THE FIELD-STRENGTH METER.

THE BENEFIT OF THE AUDIO INDICATOR IS THAT IT ALLOWS THE USER TO DERIVE NEEDED BEARING DATA FROM HIS DIRECTIONAL ANTENNA, WITHOUT HAVING TO KEEP HIS EYES GLUED TO A METER. IT'S A BIG TIME-SAVER, BECAUSE THE FOXHUNTER DOES <NOT> HAVE TO STOP WALKING TO GET HIS BEARING INFORMATION.

THE HEART OF THE UNIT IS A CMOS PHASE-LOCK LOOP IC, ONLY PART OF WHICH IS USED. IT'S A TYPE 4046, AND IS COMMONLY AVAILABLE. THE PART USED IS THE VOLTAGE-CONTROLLED OSCILLATOR. WITH THIS UNIT, THE VOLTAGE FROM THE OUTPUT OF AN AMPLIFIED FS METER WILL CAUSE AN AUDIO TONE OF VARYING FREQUENCY.....THE STRONGER THE SIGNAL, THE HIGHER THE PITCH. IT'S A PLEASURE TO USE; AND WILL OPERATE FROM THE SAME 9-VOLT BATTERY THAT POWERS THE FS METER.

THE COMMENTS ON RESISTOR AND POT TYPES IN THE LAST SECTION ALSO APPLY HERE.

IC ..... 4046 CMOS PHASE-LOCK LOOP  
R1 ..... 150 OHMS  
R2 ..... 5K (VOLUME)  
R3 ..... 4700 OHMS  
R4 ..... 10K (FREQUENCY RANGE, FINE)  
C1 ..... .05 ANY TYPE (FREQUENCY RANGE, COARSE)  
SPKR ..... ANY TYPE, 8 OHMS TO 100 OHMS  
**Q1 ..... NPN TRANSISTOR**

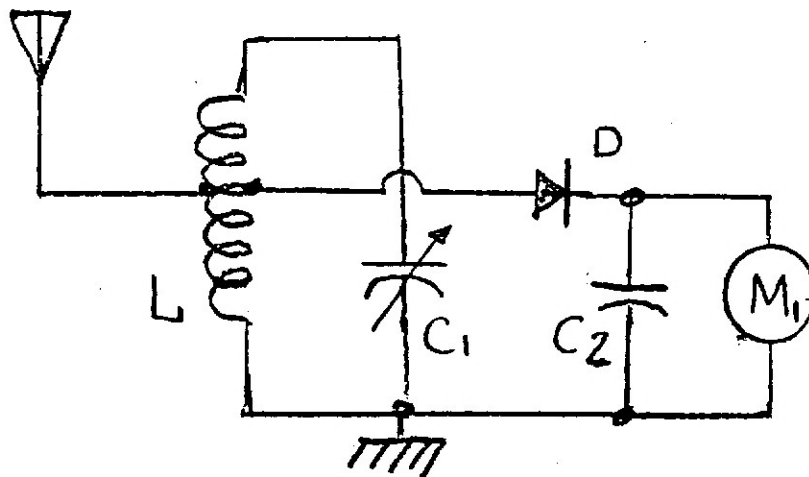
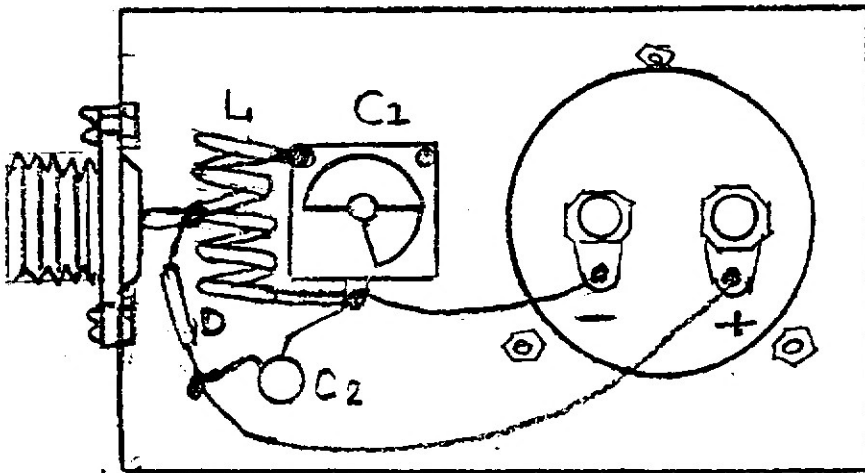
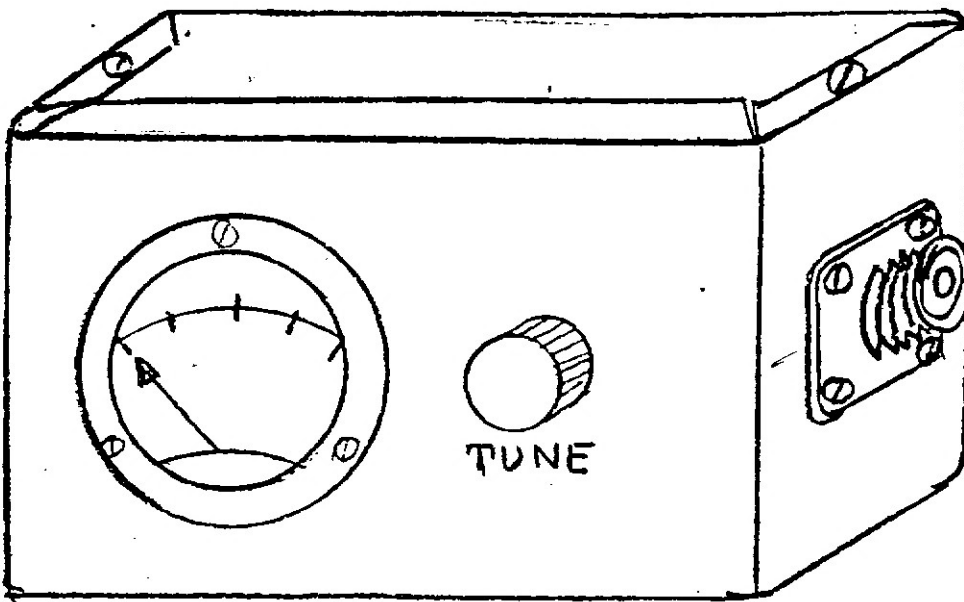
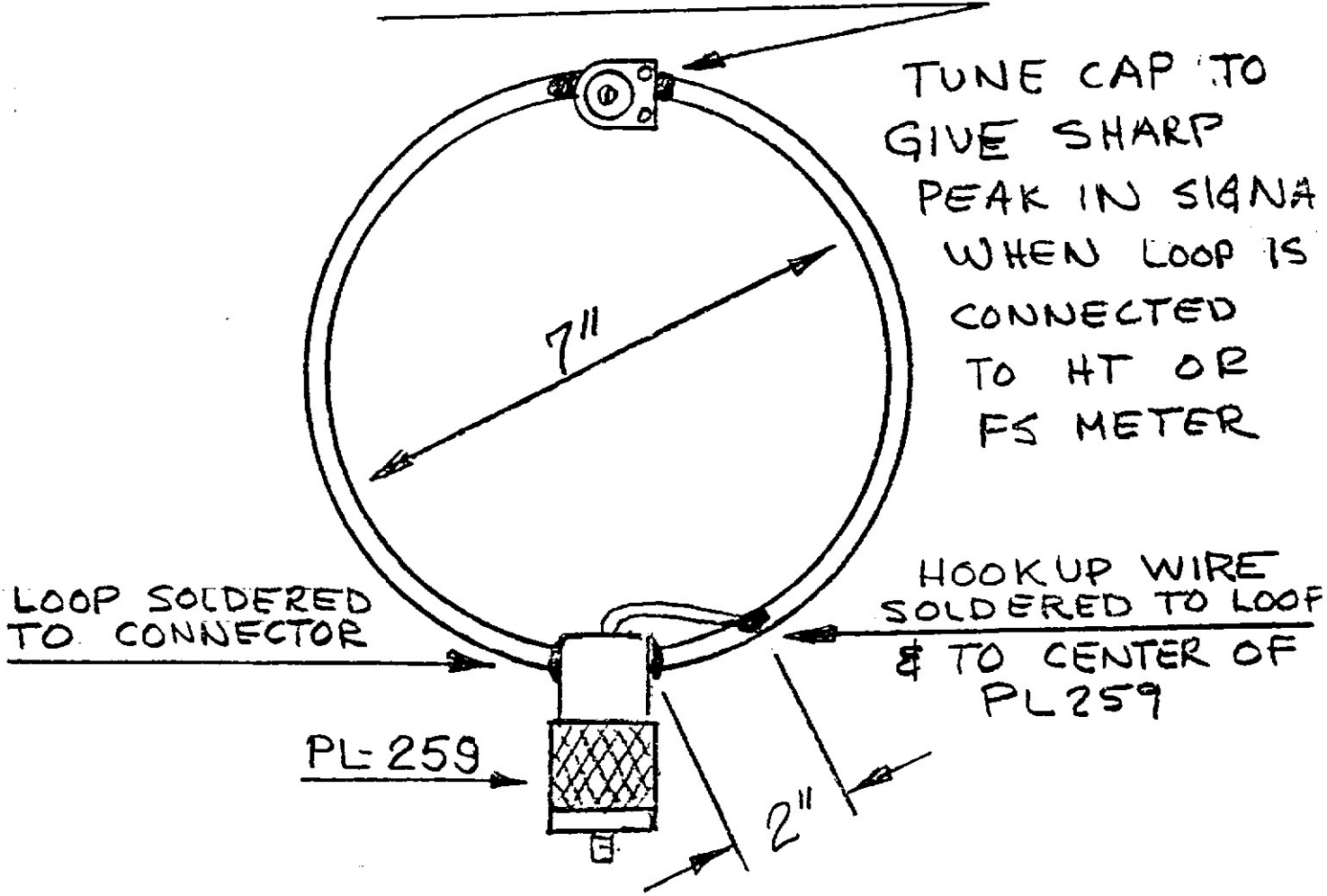


FIG 1

C(MAX)  $\cong$  20PF  
TRIMMER CAPACITOR

TUNE CAP TO  
GIVE SHARP  
PEAK IN SIGNAL  
WHEN LOOP IS  
CONNECTED  
TO HT OR  
FS METER



USE STIFF WIRE # 12 OR # 10 GA.  
OR USE RADIO SHACK UHF TV ANT.

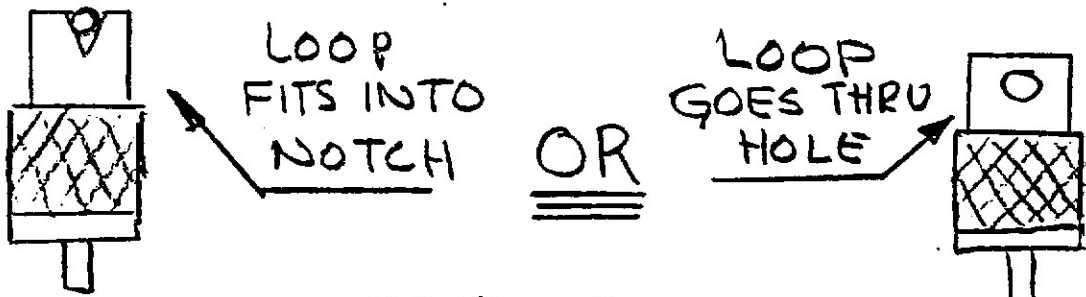
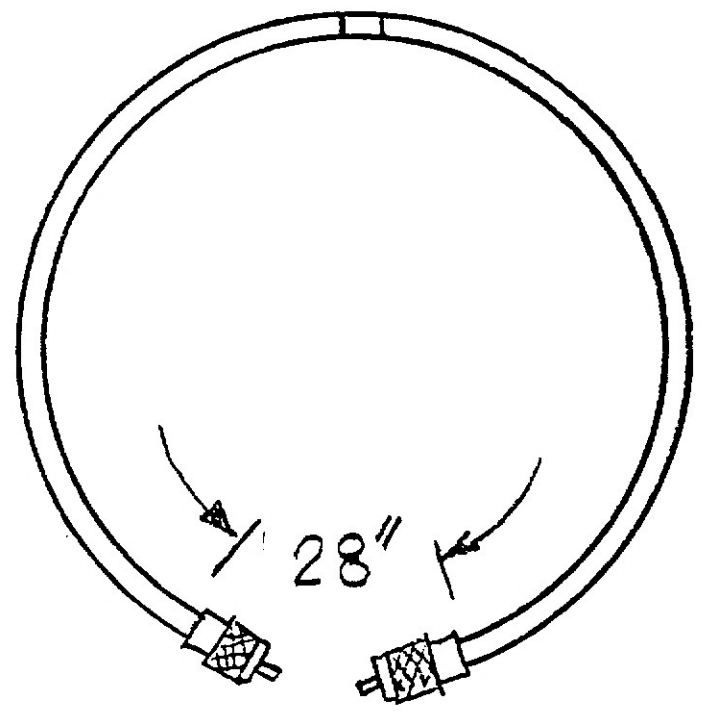
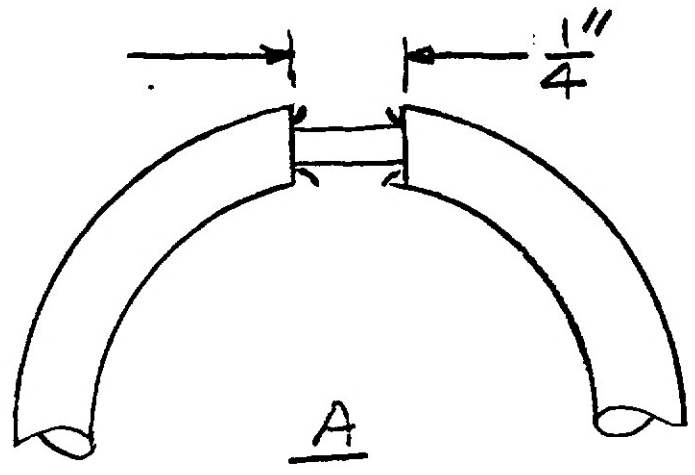


FIG 2



UHF CONNECTORS  
W/ STANDARD  
TERMINATION  
2-PLACES

FIG 3

2-TURNS  $\frac{1}{4}$ " I.D.  
#12 BARE CU.

2-TURNS #24 SOLID  
INSULATED WIRE  
 $\frac{3}{16}$ " I.D. & TWISTED  
LEADS

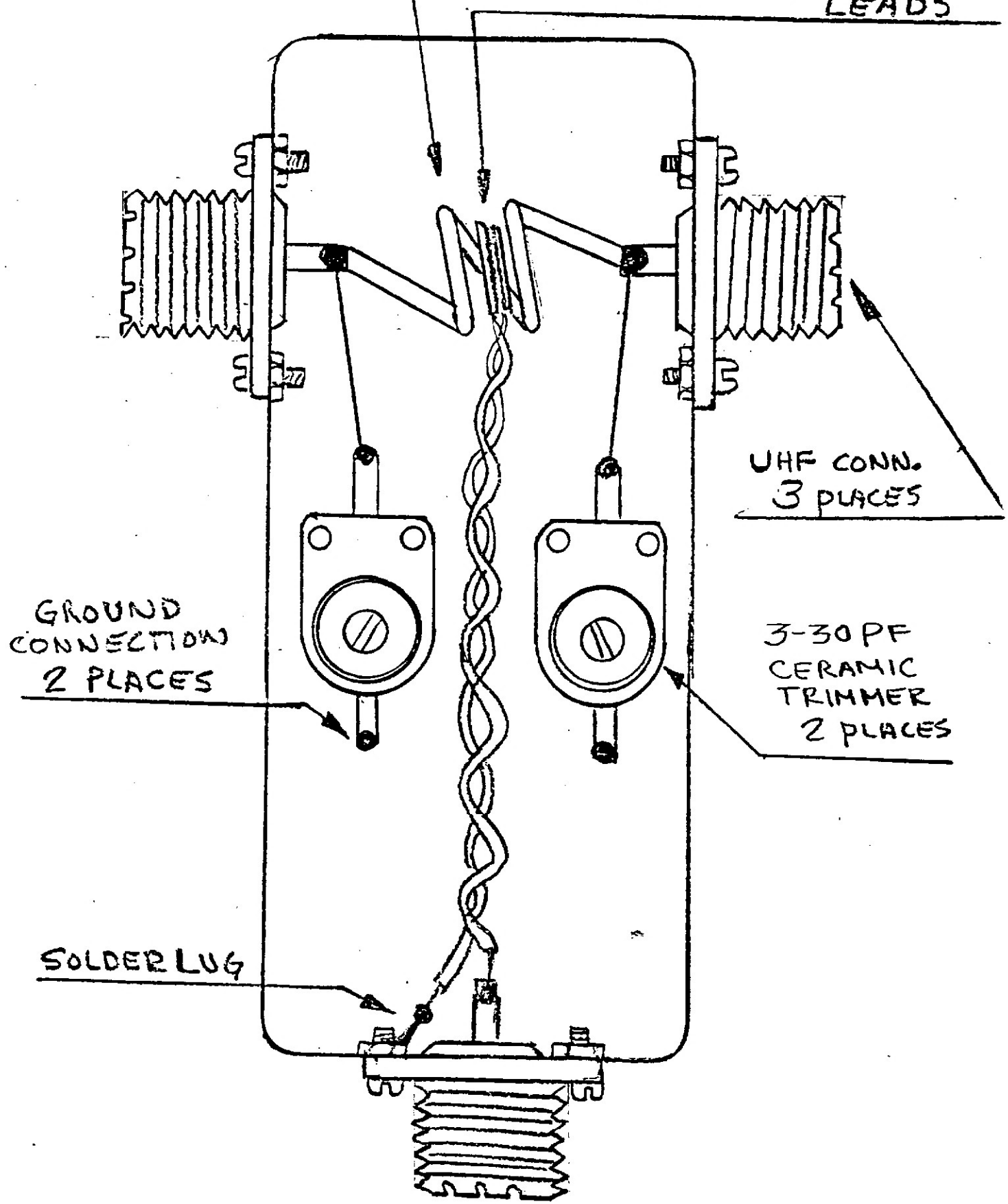
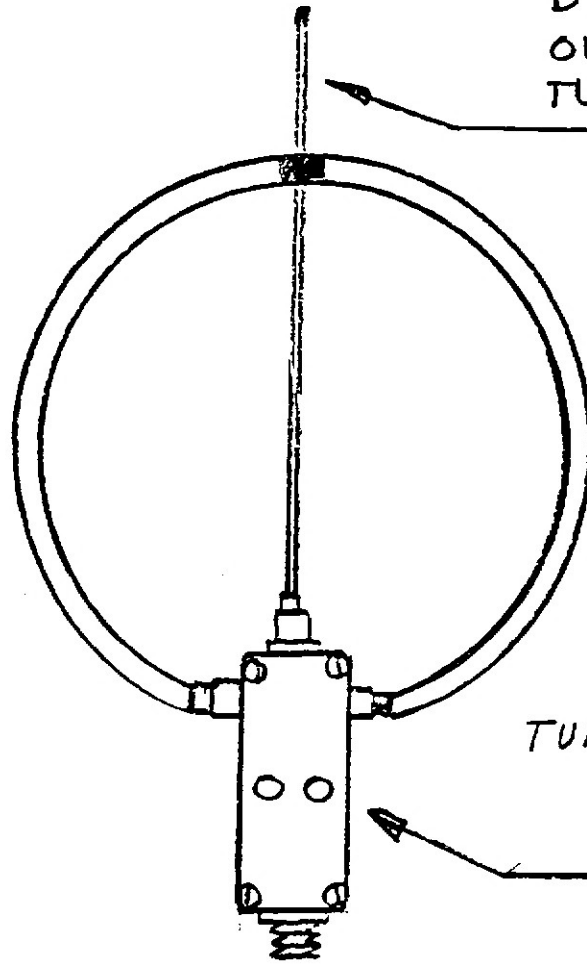


FIG 3C

BRASS ROD  $\frac{1}{8}$ "  
OR TELESCOPING  
TUBING 18"-22"



TUNING ACCESS  
HOLES  
 $\frac{1}{4}$ " DIA

PVC PIPE  $\frac{3}{4}$ "  
ANY LENGTH

COAX LENGTH  
IS  
ANY INTEGRAL  
MULTIPLE OF  
26.5"

UHF CONN.  
"SUPER GLUE" INTO PVC

RG58 POLY CORE  
(NOT FOAM)

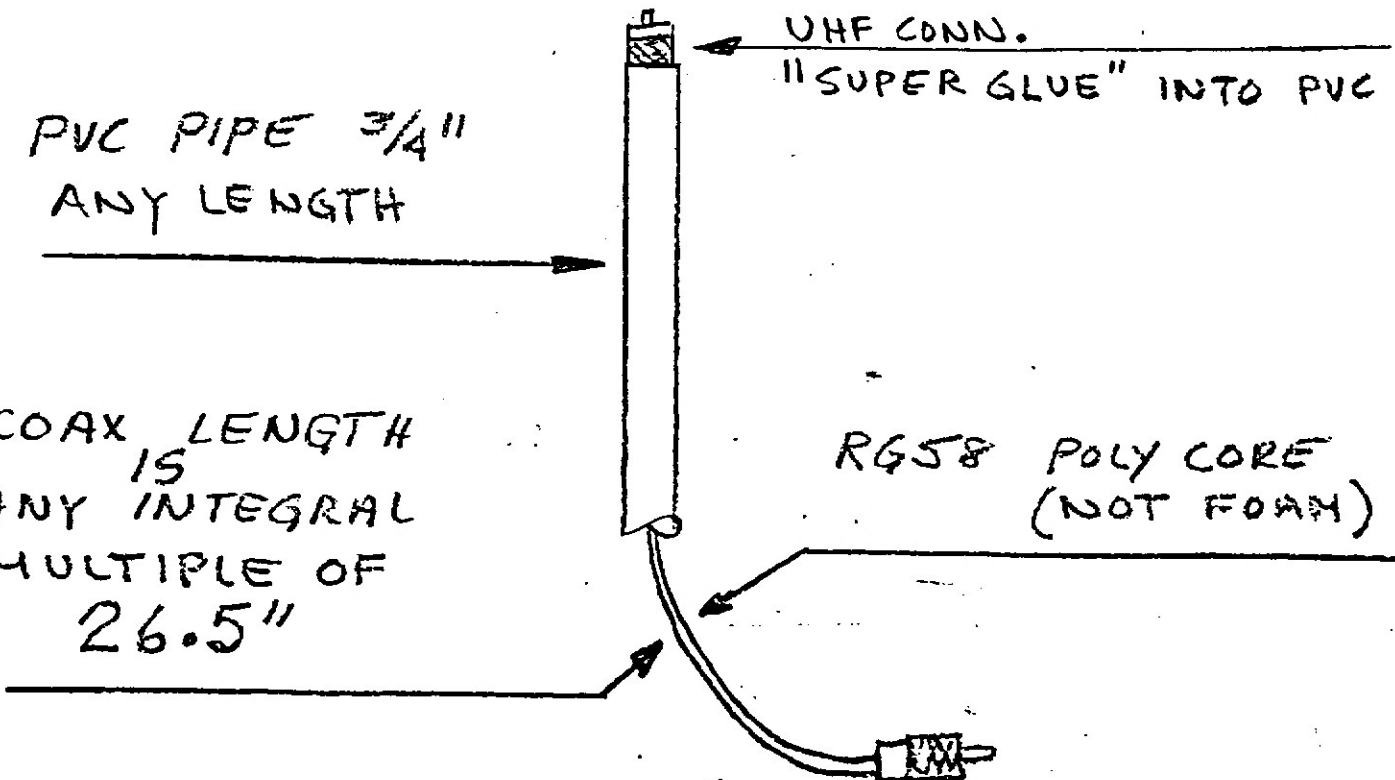


FIG. 3D

TO  
SENSE  
ANT.

LOOP  
←

LOOP  
→

SPST  
SLIDE SWITCH

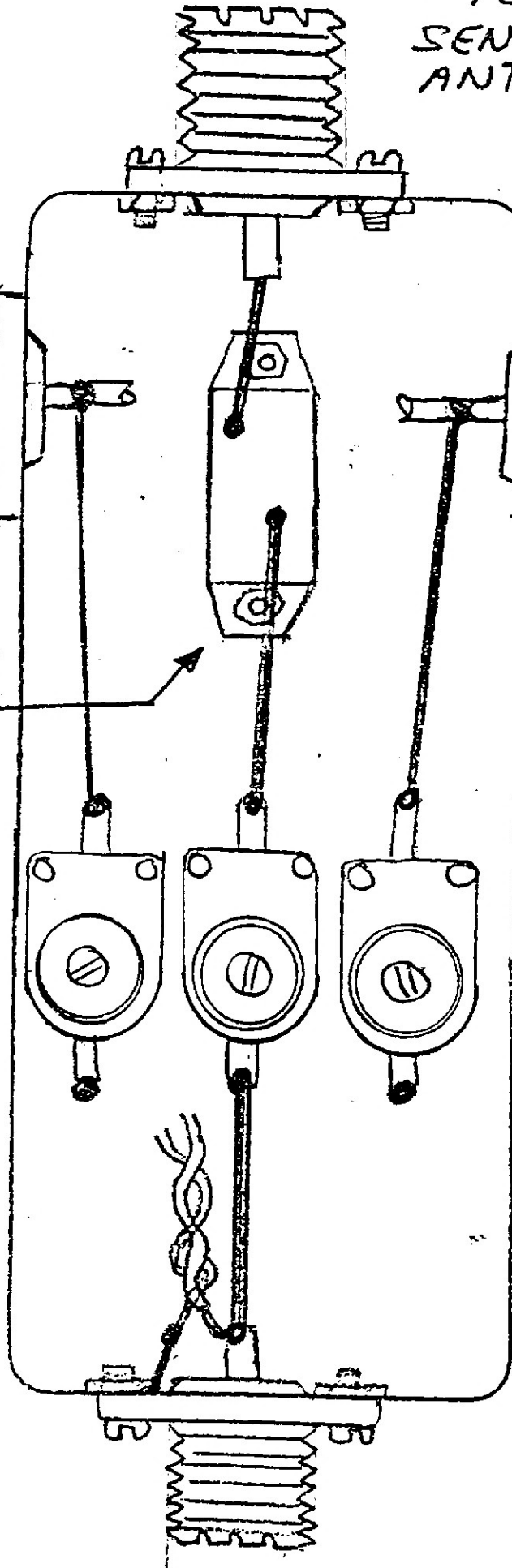


FIG 4

BREAK IN SHIELD  
(NOT) IN CENTER CONDUCTOR

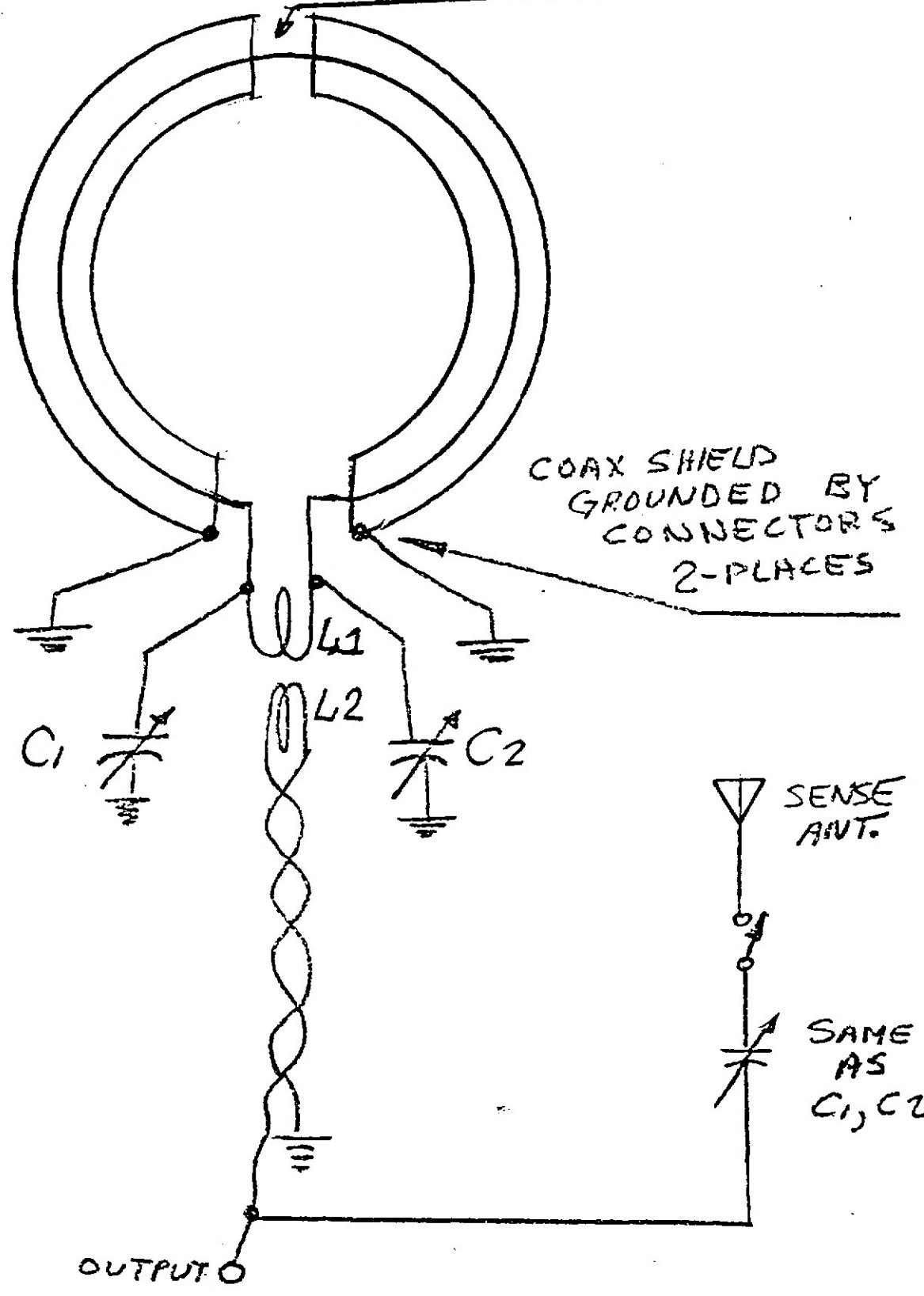


FIG 5



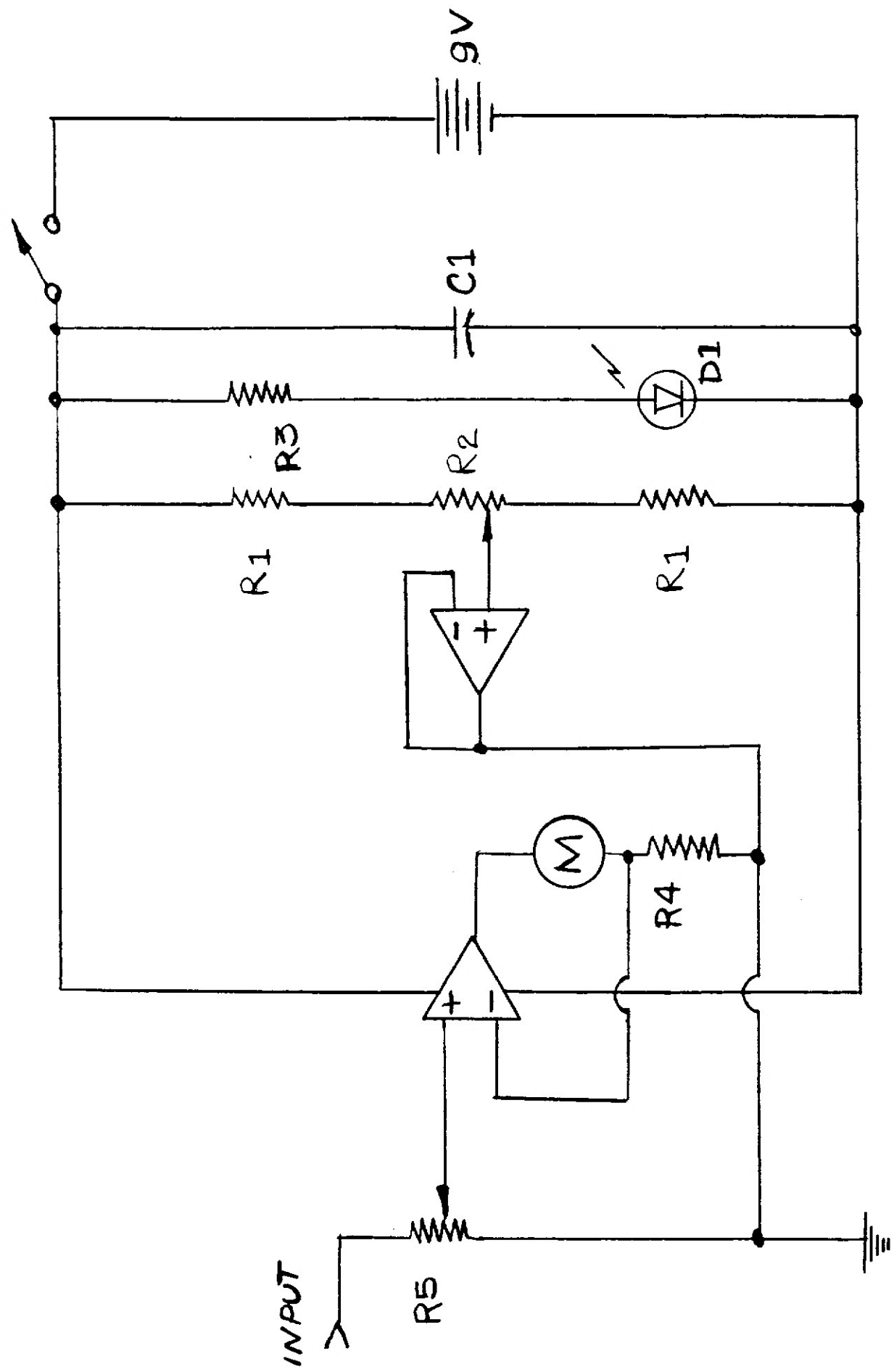
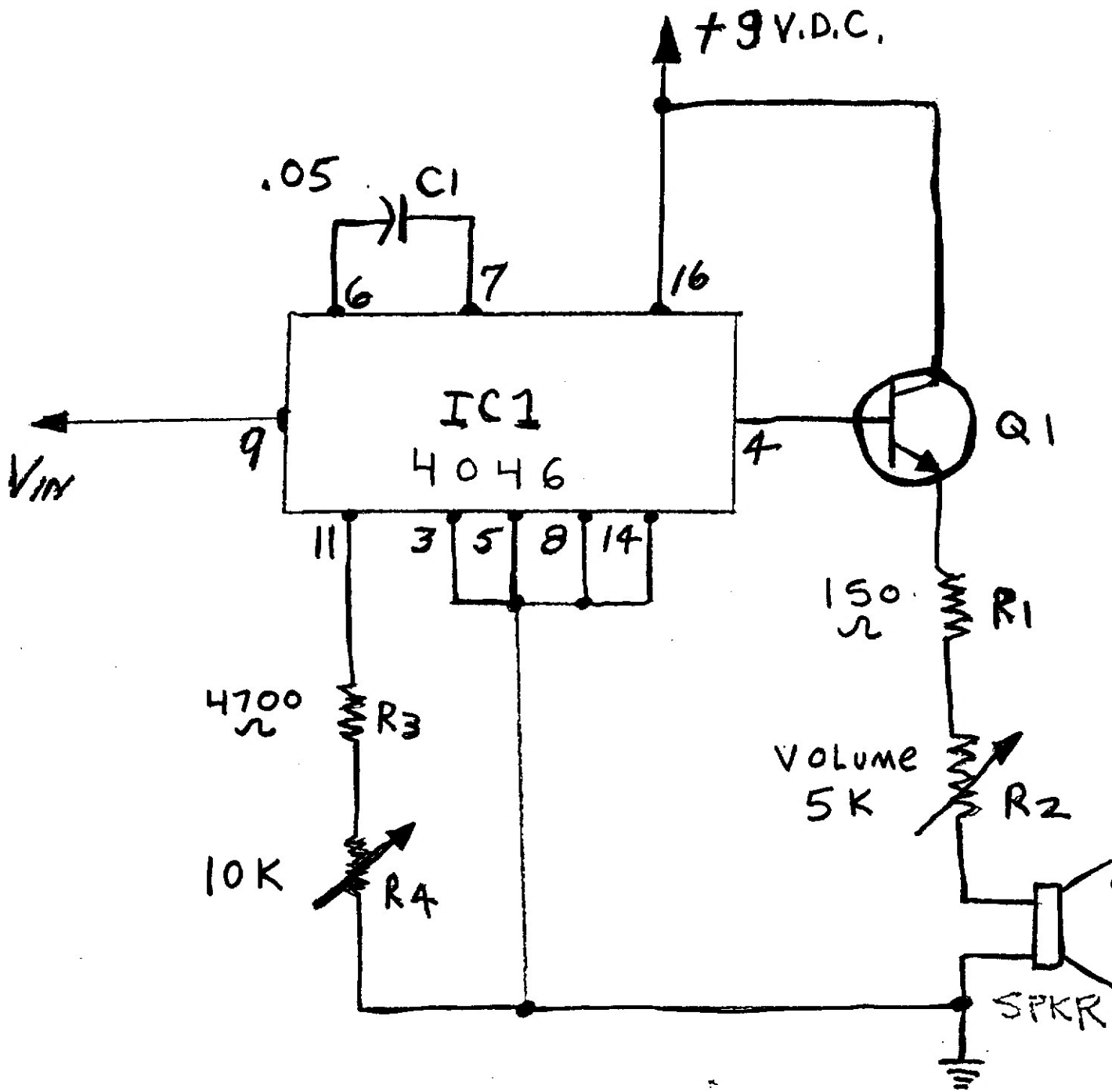


FIG. 6



AUDIO field STRENGTH INDICATOR

FIG 7