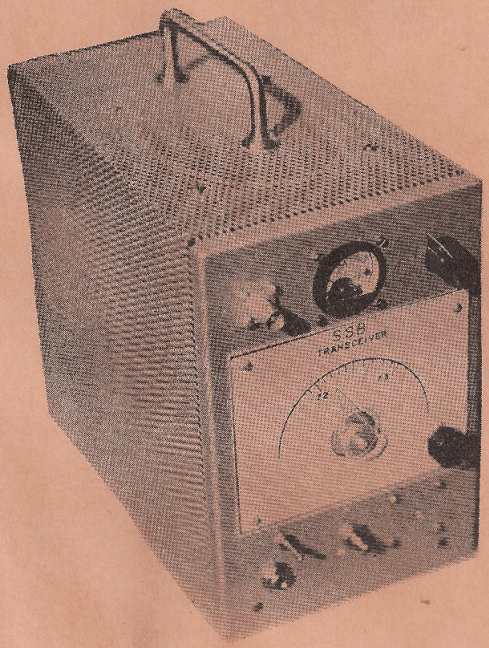
$3.00

A SSB TRANSCEIVER
from the
BC-453

a complete 40 meter SSB Transceiver built from the BC-453 Receiver



by
Ed Marriner W6BLZ

designed by
Ernie Mason W6IQY

a Western Radio Amateur publication

A

Forty Meter

SSB Transceiver Built

From The BC-453 Receiver

Model Two

by

Ed Marriner W6BLZ

Designed by Ernie Mason W6IQY and W6BLZ

From the Western Radio Amateur Library, comes a SSB Transceiver for the experienced constructor.

Price $3.00

Preface

There is still hope radio amateurs will again build their own equipment. With the advent of SSB, construction of home equipment essentially stopped. The reasons for this was little information and the terrific cost of filters and other components. Engineers who could simplify SSB gear for the amateurs, worked at it all day as a vocation and at night ceased to "tinker" at home. Despite the skeptics it doesn't take too much test equipment to construct SSB gear for the amateur.

Believe it or not, a SSB rig can be built from the BC-453, the 200-500 kcs band surplus receiver with nothing else but a VTVM and an R-F probe. Another 200-500 kcs receiver helps when tuning up the circuits. The rejections of the completed transceiver unwanted side band using the 85 kc. i.f. is down at least 20 db. This is equal to most phasing rigs and plenty good enough for amateur use. The low frequency oscillator makes it more desirable for mobile operation than the phasing type using a 5 mcs VFO.

I don't say everyone can build this rig, but I am sure with a little help the more technical amateur can make it go. Yes there are problems, many of them beside the print, open coils, wrong placing of parts and mistakes getting the original parts all back in the right place. Sometimes oscillations occur tuning the 200-500 kc receiver because of a poor 6K8. Low screen voltage on the 6AG7 may cause it not to mix properly. These mentioned are obstacles to the amateur constructor. So I cannot say, "this is a fool proof circuit anyone can build". "Cave Canem," you are on your own, be sure and send self addressed envelope if you must ask a question.

CONTENTS

ILLUSTRATIONS SCHEMATICS, ETC.

To the unknown Radio Amateurs who will always be in there pitching to simplify complicated radio gear for the rest of us!

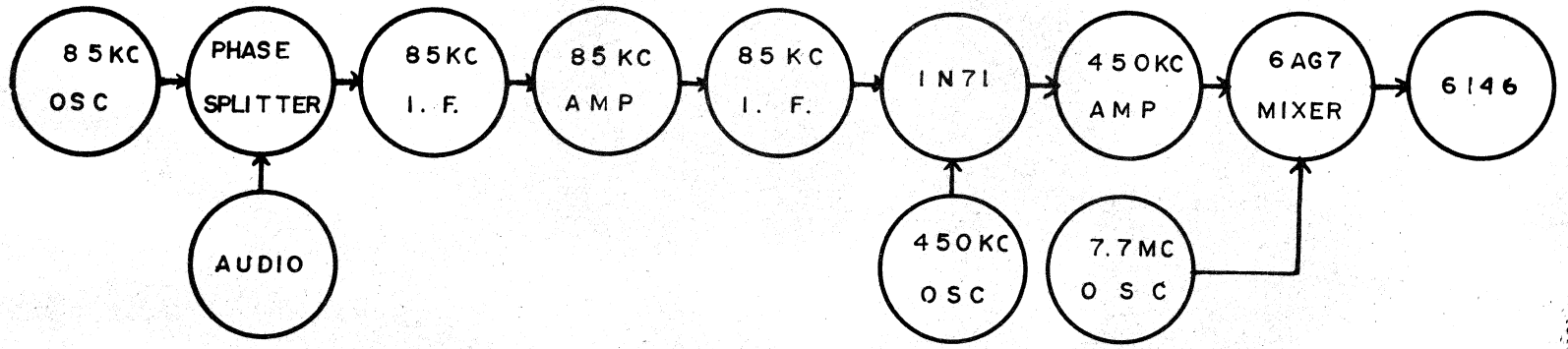
FIRST EDITION

FIRST PRINTING – APRIL, 1961

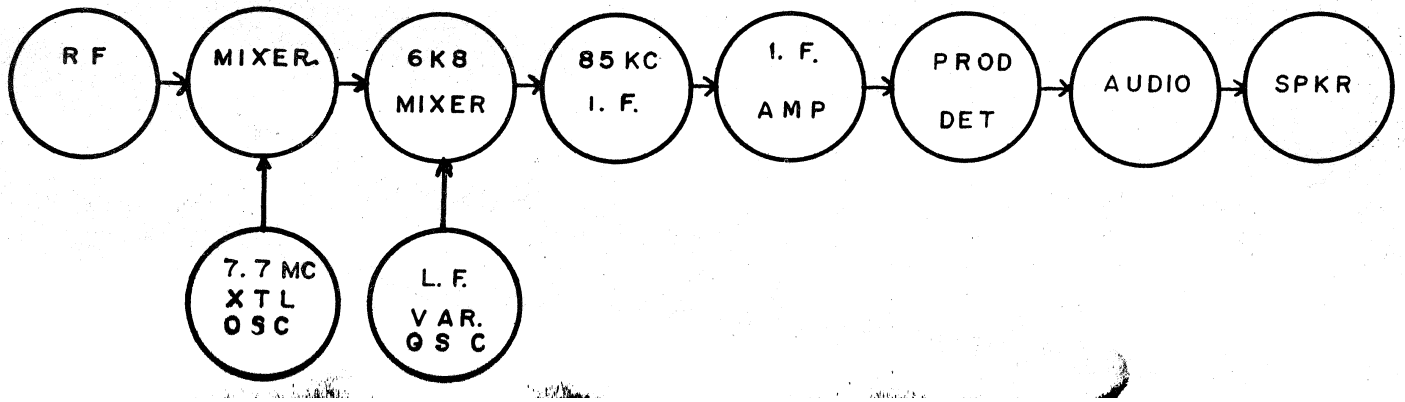
A 40 METER SSB TRANSCEIVER BUILT FROM THE BC-453 RECEIVER

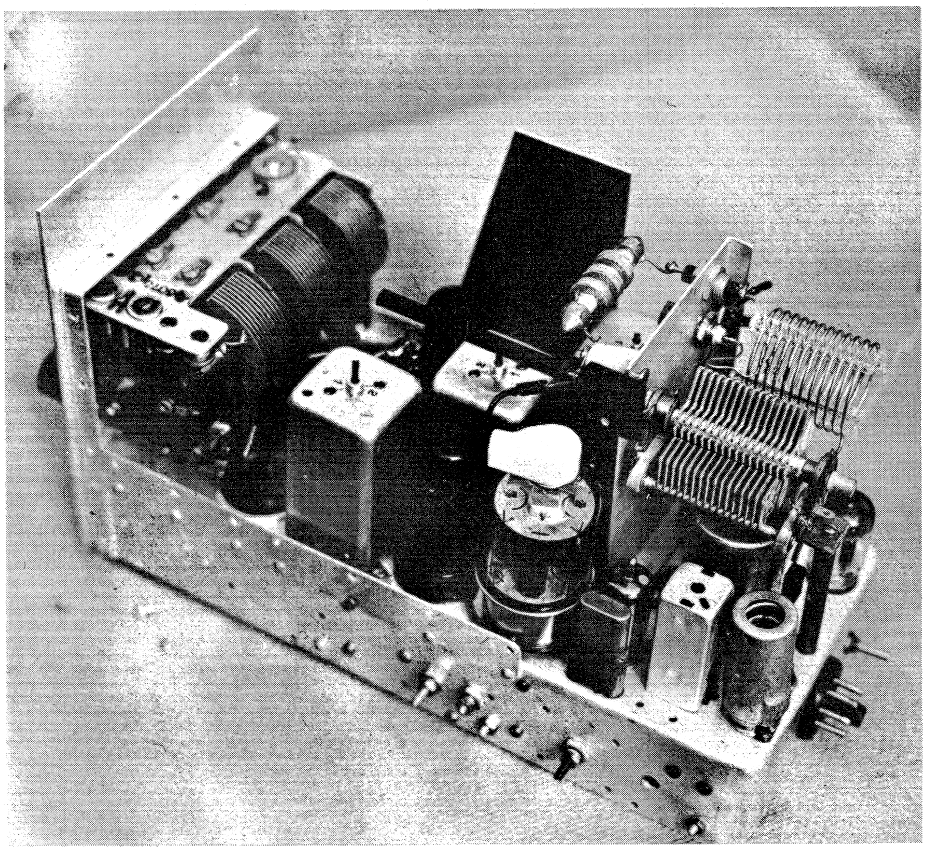
BLOCK DIAGRAM

TRANSMITTING POSITIONS



RECEIVING POSITION





VIEW SHOWING BRACKET BOLTED TO SIDE.
USING TWO FOR SUPPORT WHEN CHASSIS
TURNED OVER IN WIRING POSITION

DISCUSSION

This transceiver is an outgrowth of the original SSB transmitter worked out by W6DMN. The BC-453 receiver is now a SSB transceiver. W6IQY saw the possibility of making the BC-453 into a transceiver. After several years of "tinkering" and reducing parts, it has arrived at this semi-final form. It now uses one relay rather than the three expensive miniature ones used in Model One. Improvements are a continuing thing.

Essentially the unit consists of a very stable 85 kcs oscillator which has been moved up into the front compartment. This oscillator is very stable, and is fed into a 85 kc amplifier. The carrier is then balanced out and fed into the i.f. strip in which the coils were modified to use the whole coil in place of the tap. All of the 85 kc coils are modified to obtain more gain. The first and second coils are now connected back to back making them sharp enough to reject one side band when the 85 kc oscillator is tuned off to one side of the curve. The audio signal is modulated into the input of the i.f. by diode modulators. The signal is passed through the 85 kc i.f. and amplified by the 6AC7 and in turn mixed with the 450 kc variable oscillator in the 6K8. The signal is again amplified by the 6SK7 which has a ring modulator ahead of it to balance out the 85 kc signal which gave so much trouble in the earlier models. The signal from the 6SK7 which has been mixed with the 6AG7 signal of 7750 kcs now gives an output signal of 7200 kcs. The plate of the 6AG7 and the grid of the 6146 tuned circuits have enough rejection to separate the 7750 kc signal from the 7200-7300 kc amateur band to drive the 6146 plate current to 150 ma.

The 7750 kcs crystal was used so that the BC-453 tunes the top of the dial or 500 kcs end. This will give more separation to the images. On 80 meters, the tuned circuits are more selective, however by changing the circuit to 3500 kcs crystal oscillator and the 6AG7 plate and 6146 grid coils, the set can be used on 80 meters. Rather than complicate switching in this model, circuitry for 7mc was shown only.

I might mention if FT 243 crystals are used, it would be wise to use a tuned crystal oscillator circuit to increase the output, rather than the Pierce circuit shown. The crystals in the metal can seem to be more active in the Pierce circuit. The R-F output of the crystal controlled converter oscillator used for the transmitter injection should be at least 6 volts.

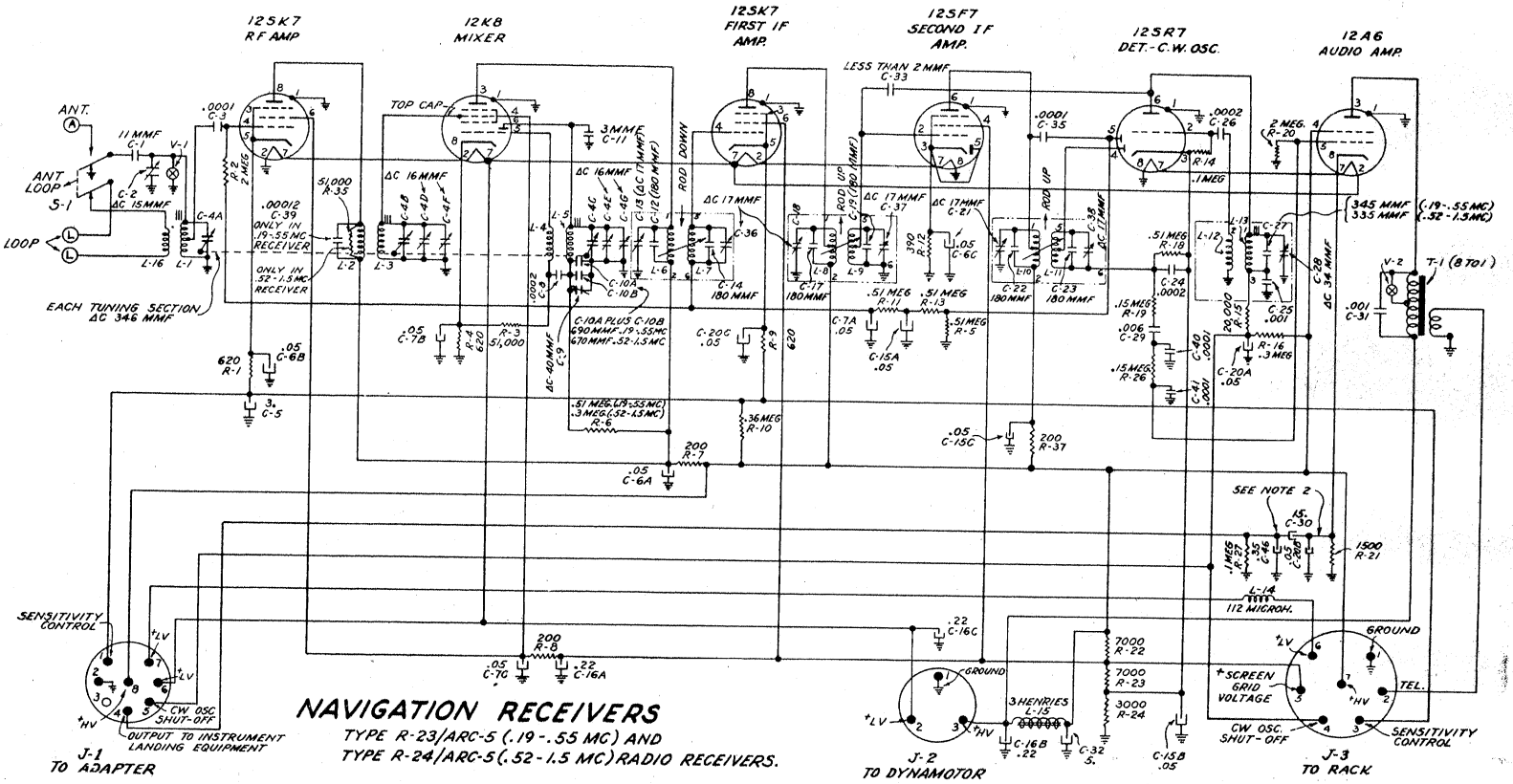
On receive, the crystal controlled converter is fed into the 6K8 mixer through the 85 kcs i.f., 6AC7 amplifier, and on into the product detector and audio stages. AVC is used by controlling the 6BZ6 with rectified audio voltage. It is possible to do away with the R-F tube and feed the AVC into the i.f. amplifier. There are many modifications that can be made to the circuit, but will not be discussed here as with such great possibilities one would never finish the first model. If you do experiment and find better circuits we will compile them for later information.

There should be more of these receivers available as time goes on, because they are doing away with the low aircraft range beacons, which these were used for.

NOTES:

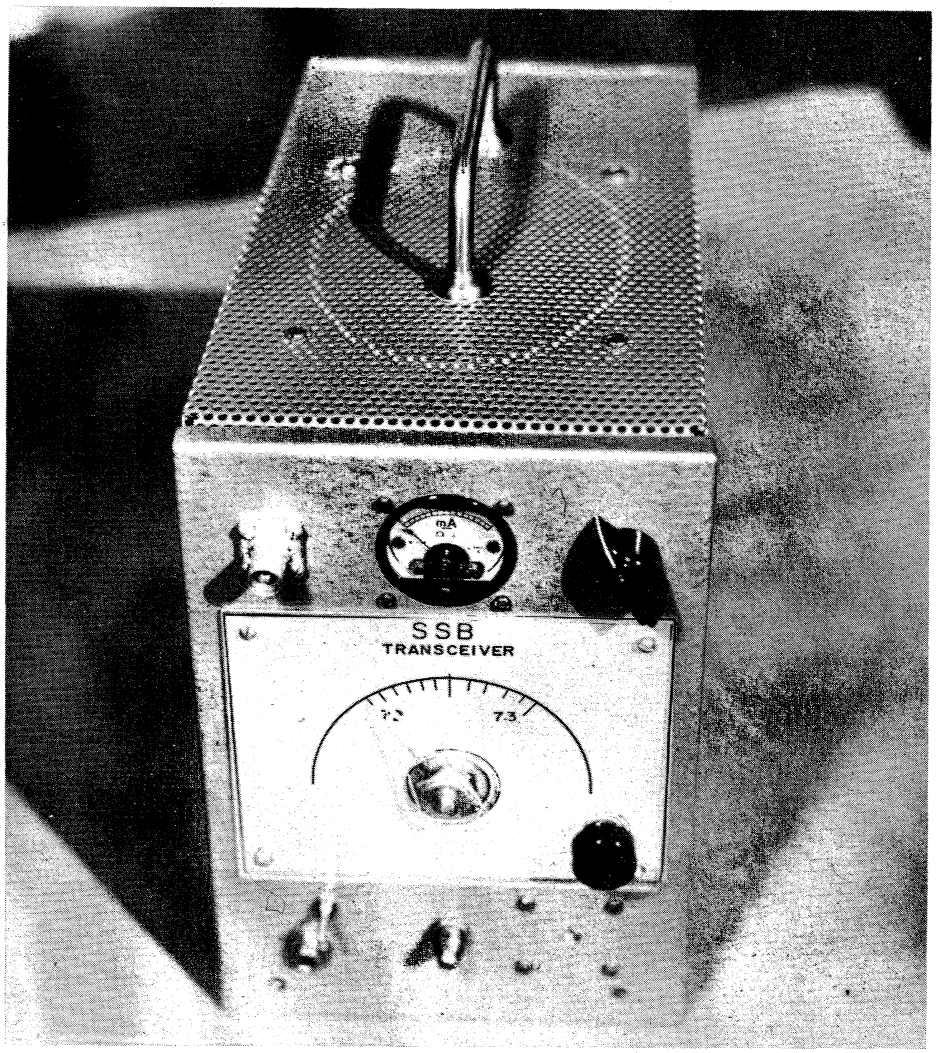
1. CAPACITANCE VALUES ARE IN MICROFARADS UNLESS INDICATED AS MICROMICROFARADS BY MMF.
   RESISTANCE VALUES ARE IN OHMS UNLESS INDICATED AS MEGOHMS BY MEG.

2. C-46 NOT IN EARLY PRODUCTION UNITS. A 1000 OHM RESISTOR R-28 WAS CONNECTED BETWEEN R-21 AND C-30 IN EARLY PRODUCTION UNITS. C-20B WAS .01 MFD. IN EARLY PRODUCTION UNITS.



NAVIGATION RECEIVERS

TYPE R-23/ARC-5 (.19 - .55 MC) AND
TYPE R-24/ARC-5 (.52 - 1.5 MC) RADIO RECEIVERS.



"THE LITTLE SSB RIG"

4 x 6 SPEAKER ON TOP

FIG. 1

Cabinet: California Chassis Co. LTC-468. Write Mr. H. P. Balderson, 5445 E. Century Blvd. Lynwood, California.

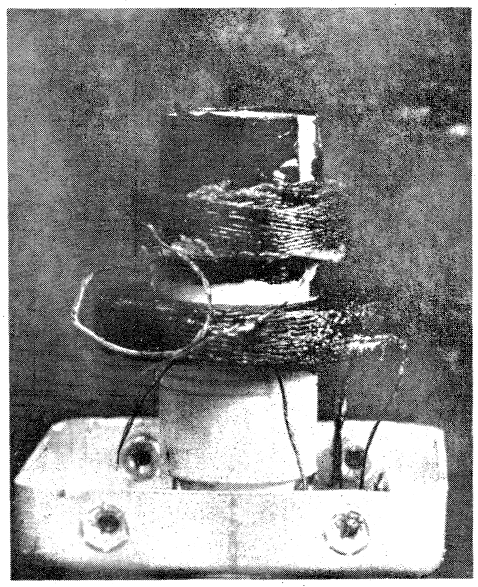
CONSTRUCTION

The construction of this SSB transceiver does require more than the average amateur technical ability to construct. The constructor should be familiar with the original BC-453 print. All BC-453 circuits are not exactly the same. For instance the Army model does not have the one antenna input coil and it will be necessary to take an old 455 kc i.f. coil and peel enough wire from the center to slip it over the present coil. You could scramble wind 100 turns of wire on the coil in place of the i.f. coil, it is not too critical. Some of the receivers have the antenna coil already wound on and that can be used. Fig. 2 shows the location of the coil inside the can. Wind your coil on in the same direction as the one already wound on the form.

The first step in the construction is to remove all of the parts from the BC-453. When you do this place all of the parts in a can and make sure especially to mark the oscillator parts which will be used again. Make drawings of the wires going from the tuning condenser to the coil pins.

1. When all of the parts have been removed, file off the front panel rivets to obtain a smooth surface. Also cut out a square hole at the bottom even with the chassis but leave the screw holes to fasten the panel. The panel can be made from 16 ga aluminum until you get a cabinet.

Finish the chassis by boiling it in a solution of "Drano" for 5 minutes. Work the black deposit off with a stiff brush. Then dip or wipe the chassis with Di-Chromate. This will leave a bright chassis. Sometime the BC-453 must really be scrubbed with "Paint Stripper" to get the varnish off. Lacquer thinner, liquid sandpaper does not always work. If not stop in a auto paint shop for some Monsanto Paint Stripper. This is the delux treatment and scrubbing everything with steel wool and lacquer thinner works satisfactory.

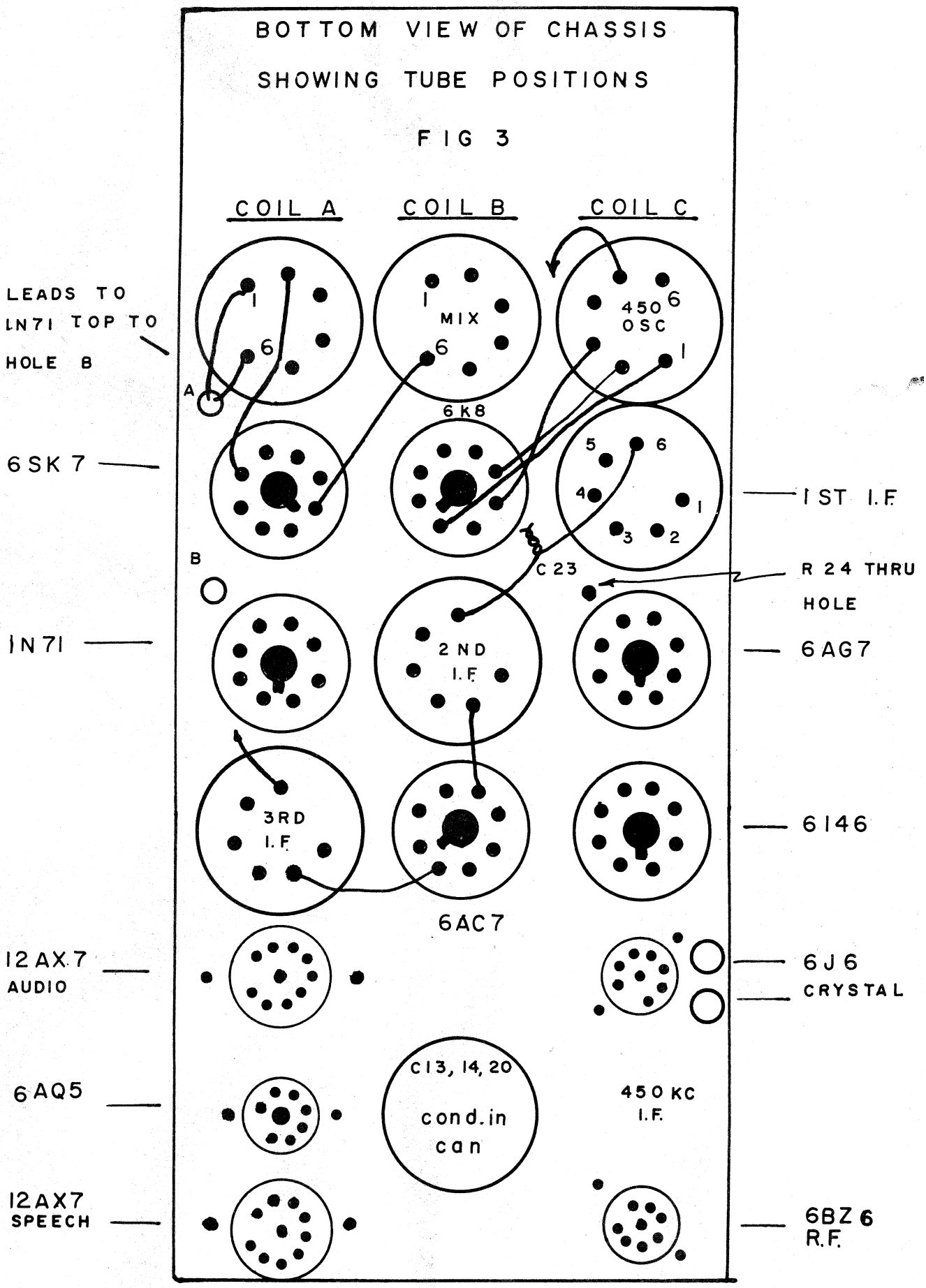


NOTE HOW WINDING HAS BEEN ADDED TO COIL "A" OR 100 TURNS

CONNECT SO WINDINGS GO SAME DIRECTION.

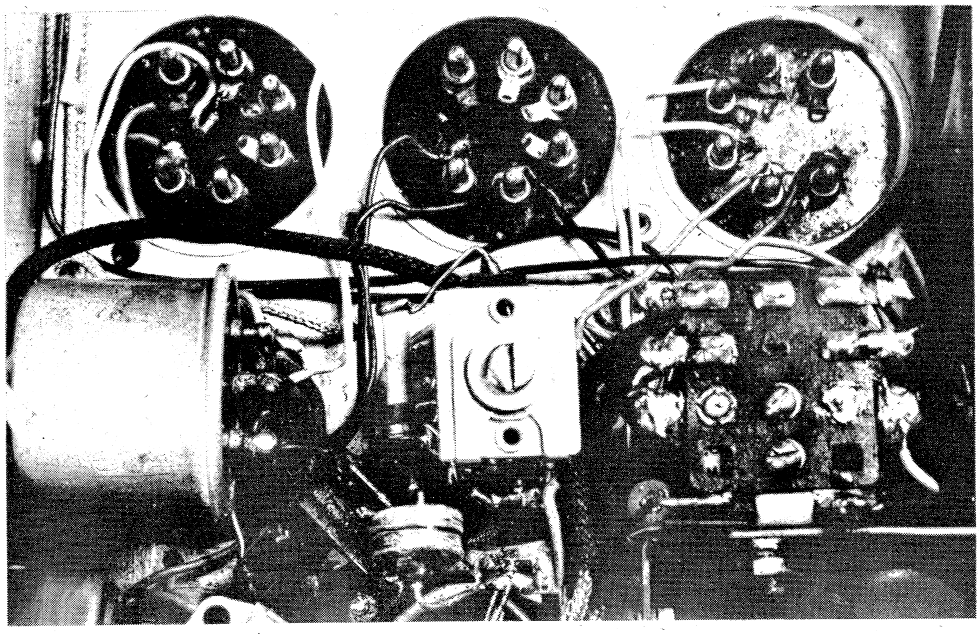
LITZ WIRE CAN BE CLEANED WITH STRIP EASE REMOVER

FIG 2


BOTTOM VIEW OF CHASSIS
SHOWING TUBE POSITIONS
FIG 3
COIL A
COIL B
COIL C
LEADS TO
1N71 TOP TO
HOLE B
6SK7
1N71
12AX7
AUDIO
6AQ5
12AX7
SPEECH
MIX
450
OSC
6K8
2ND
I.F.
3RD
I.F.
6AC7
C13, 14, 20
cond. in
can
450 KC
I.F.
C 23
R 24 THRU
HOLE
1ST I.F.
6AG7
6146
6J6
CRYSTAL
6BZ6
R.F.

COIL "A" COIL "B" COIL "C"

AMP MIX OSC



CLOSE VIEW OF COILS A, B, C,

FIG 4

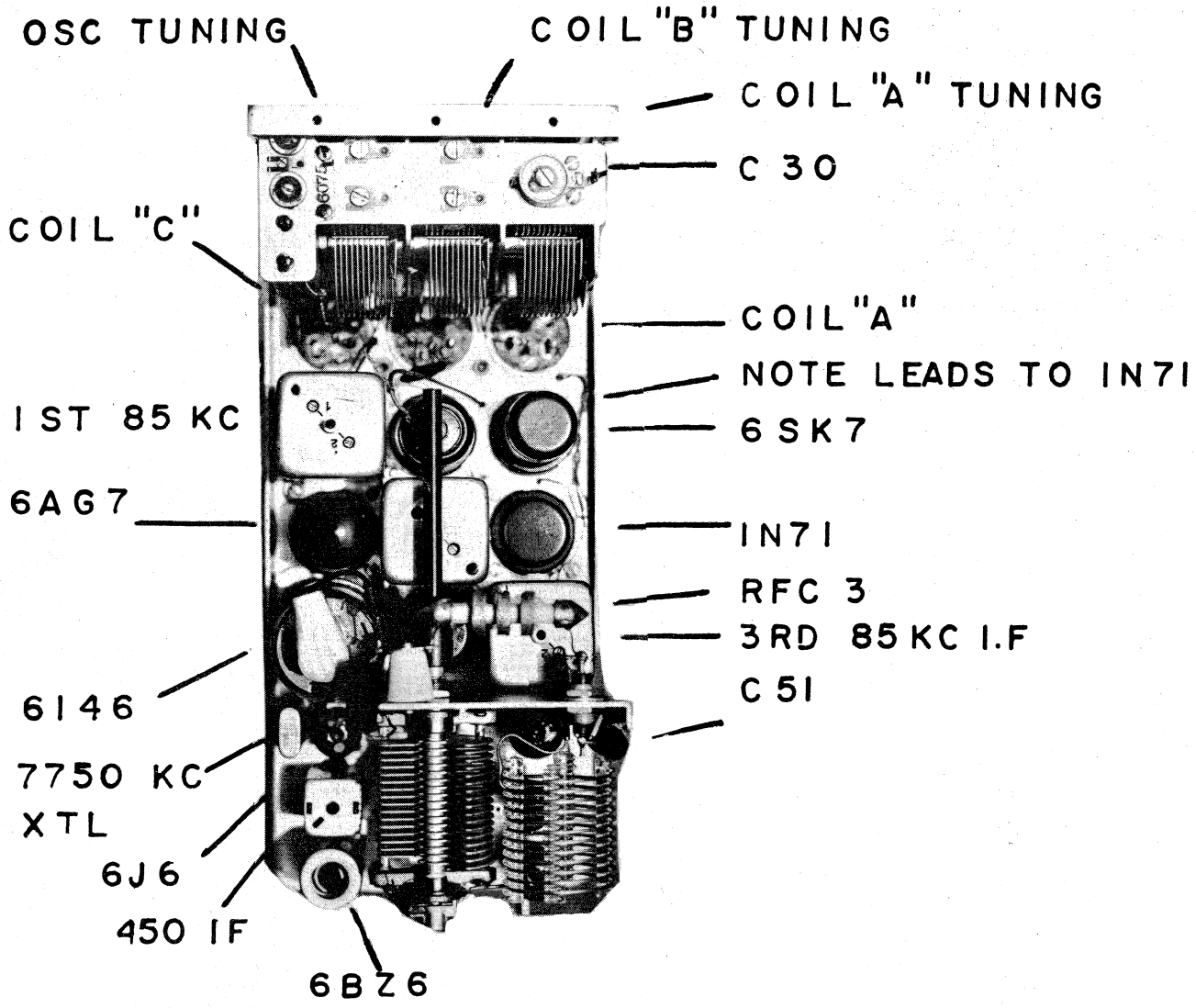

OSC TUNING
COIL "B" TUNING
COIL "A" TUNING
C 30
COIL "C"
COIL "A"
NOTE LEADS TO IN71
1ST 85 KC
6SK7
6AG7
IN71
RFC 3
3RD 85 KC I.F
C 51
6146
7750 KC
XTL
6J6
450 IF
6BZ6

FIG 5

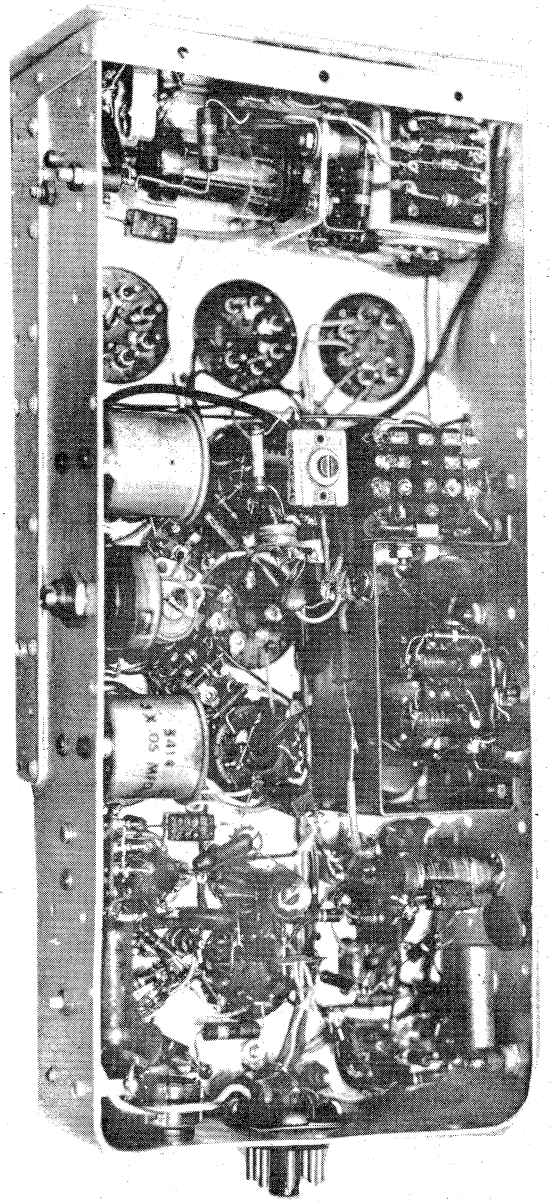


FIG. 6

PHOTO TAKEN BEFORE 85 KC SLUG INSTALLED IN FRONT COMPARTMENT

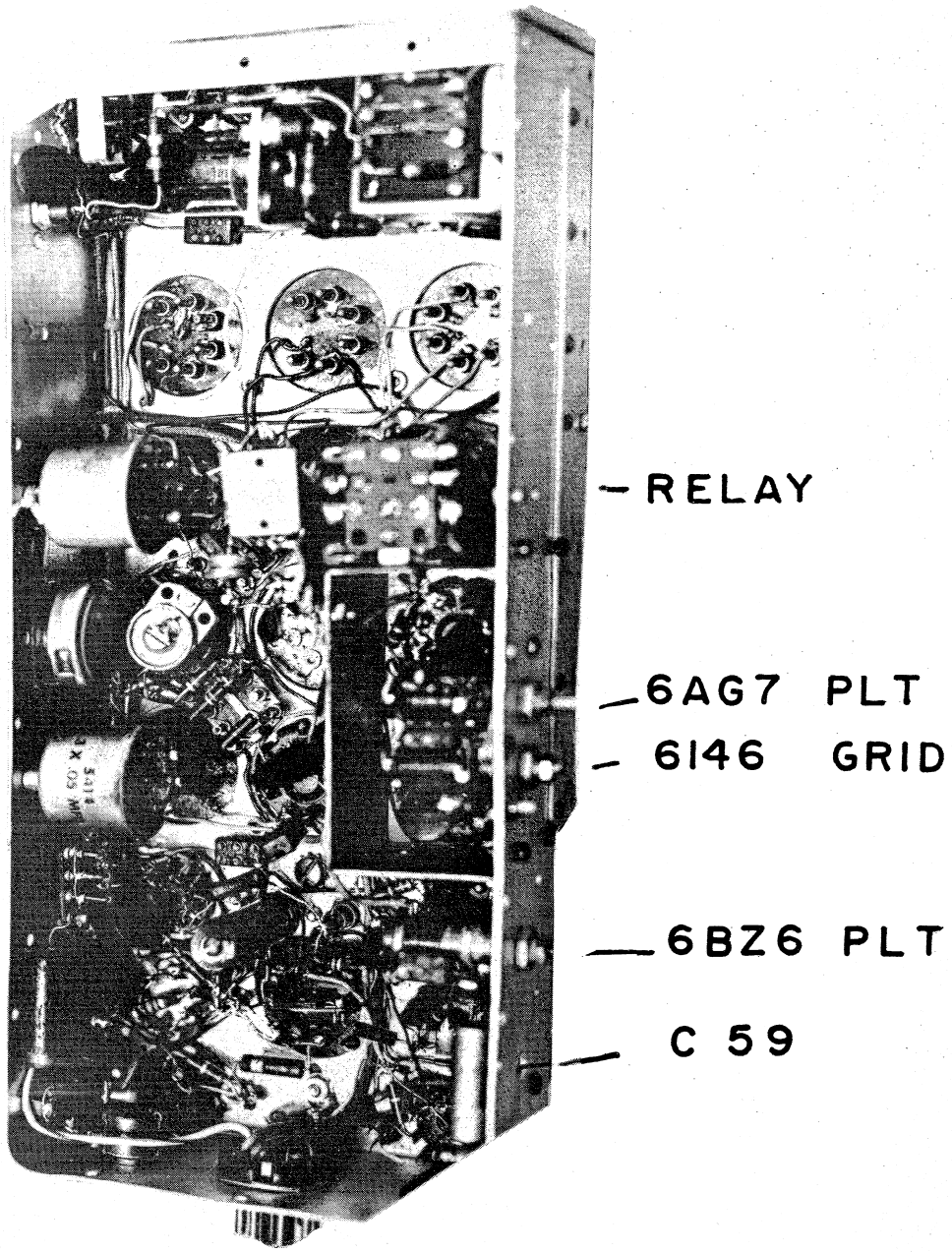


FIG. 7

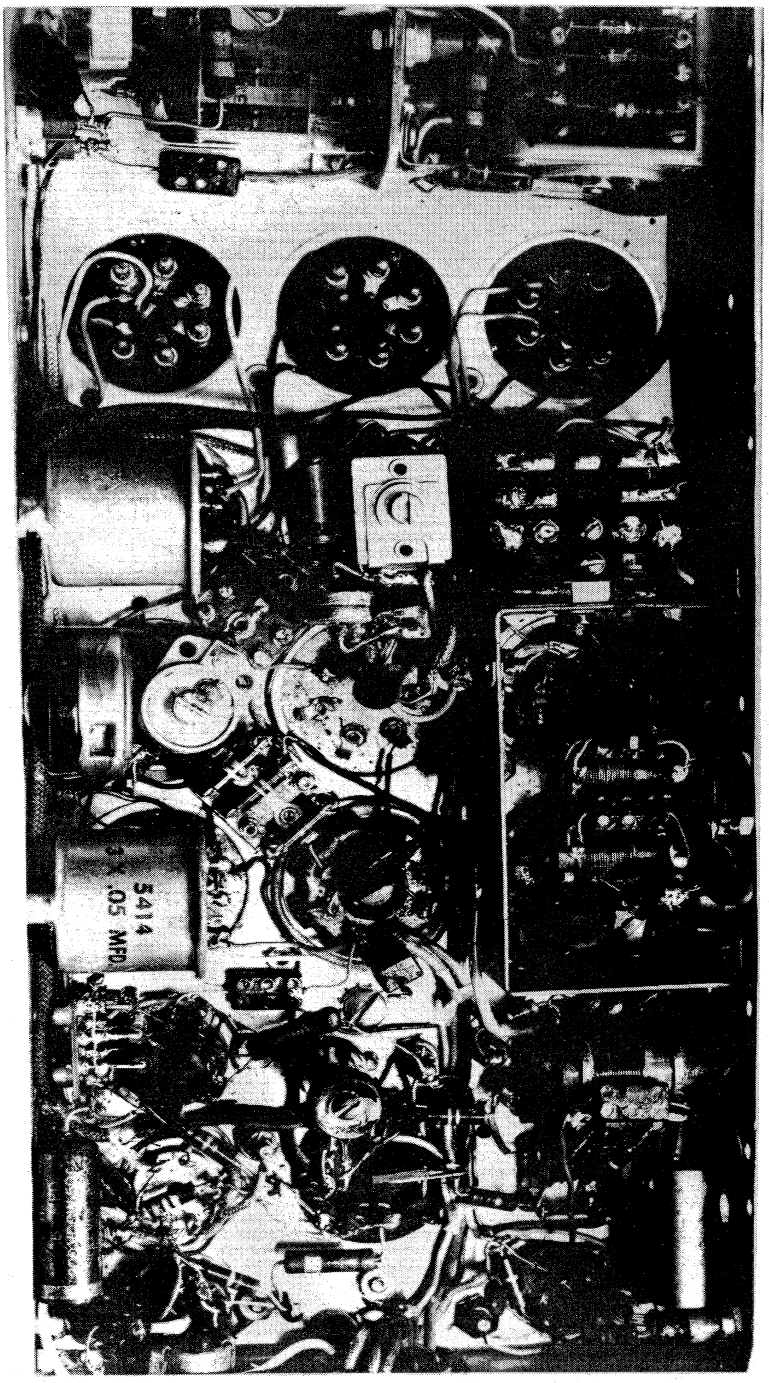


FIG 8

2. Once the chassis and the tube sockets are cleaned you are ready to continue. The tube sockets can be scrubbed with MEK (methyl-ethel-keytone) or flux remover so they will look like new. Parts and holes should be mounted to conform with Fig. 3.

3. The 85 kc BFO coil has to be moved up into the front compartment. First open the can and set the condenser at half capacity. Mark the shaft with a prick pin or paint to indicate this point. The initial tuning will be accomplished at mid band. Assemble can after marking panel. Also leave out the two bottom screws so the can may set lower down in the chassis. On top of the can fasten a terminal board made from 1/8 inch thick micarta with terminal pins driven in holes but not far enough to short to the can. These items will have to be found in surplus stores or ordered through your local radio store. The micarta can be mounted by tapping out the top two screws to 4-40. Before you install the can, carefully unloosen screw holding the coil and slip the lead of a .01 mfd condenser under it and tighten without breaking the inside lead which might happen as the ceramic form turns. The condenser slips around terminal #3 on the coil as shown in Fig. 11. These terminals should be ground off enough to clear the plug in coil cans.

Oscillator and Microphone Section Construction

1. A good place to start the wiring is with the microphone amplifier tube socket located in the extreme back left hand corner of the chassis. (Fig. 10). The microphone gain control is located at the back of the chassis and in operation should not be turned farther than necessary to prevent RF feedback. Note the 30 uufd condenser used on the grid to by-pass RF (C-10, 9). Without these there is a possibility of oscillation.

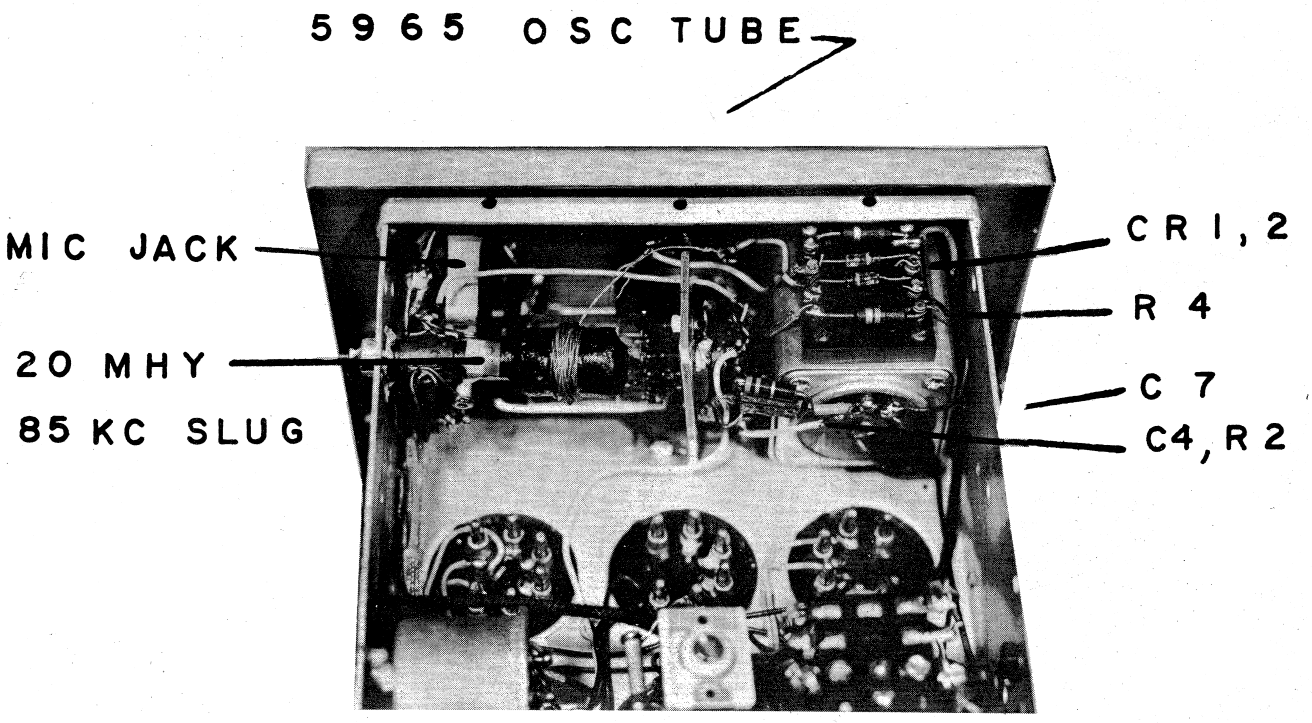
Mounting of C-11 is at the back of the chassis on the left side. (Fig. 10). Shielded wire is run from the capacitor to RFC-1 and C-12 (Fig. 10) which are mounted on a terminal lug fastened to the copper metal shield bracket.

2. The 85 kc oscillator assembly parts should be retained so that the oscillator will function on 85 kcs. The can is opened up and the condenser set at half capacity so the the i.f.'s can later be tuned to mid frequency. When mounting the can to the panel more space can be gained by leaving out the two lower screws in the can. A terminal board can be made from micarta with pins to mount CR-1 and CR-2 along with R-4. The condenser is adjusted from the front panel by a screw driver. It is possible to put a shaft on the condenser but seldom worth it. Condenser C-7 was wound around the center screw holding the 85 kcs coil. Be careful not to twist the coil and break the leads. In some models the screw is on insulation instead of metal and the condenser will have to be grounded elsewhere.

The balance potentiometer is mounted on the front panel. A 1000 ohm pot was used so that the diodes are not loaded and more output is obtained. More carrier suppression can be obtained by experimenting, sometimes by putting a small condenser on either side of the pot to ground and adjusting it for a null. This may not be worth the extra effort unless large amounts of stray capacity are in your wiring.

The 85 kc oscillator tube the 5965 gives more gain than the 12AX7 and found to work better. The tube is mounted horizontal on a metal bracket made to fit between the balance pot and the plug in coils. The terminals at the coil can be nipped a little if they touch the can coils which plug in. (Fig. 9).

Shielded wire is run back from the microphone jack. Small brown covered grid wire with the cloth removed works the best. This shielded wire is also used going to the product detector from C-1 and junctions of CR-1,2 over to the relay. It is important to keep the 85 kc signal from by-passing the filter coupling into the wiring.



OSCILLATOR & 85KC AMP.

NOTE HOW 50 TURNS OF WIRE ARE WOUND ON SLUG GOING TO BALANCE POTENIOMETER ON PANEL.

FIG 9

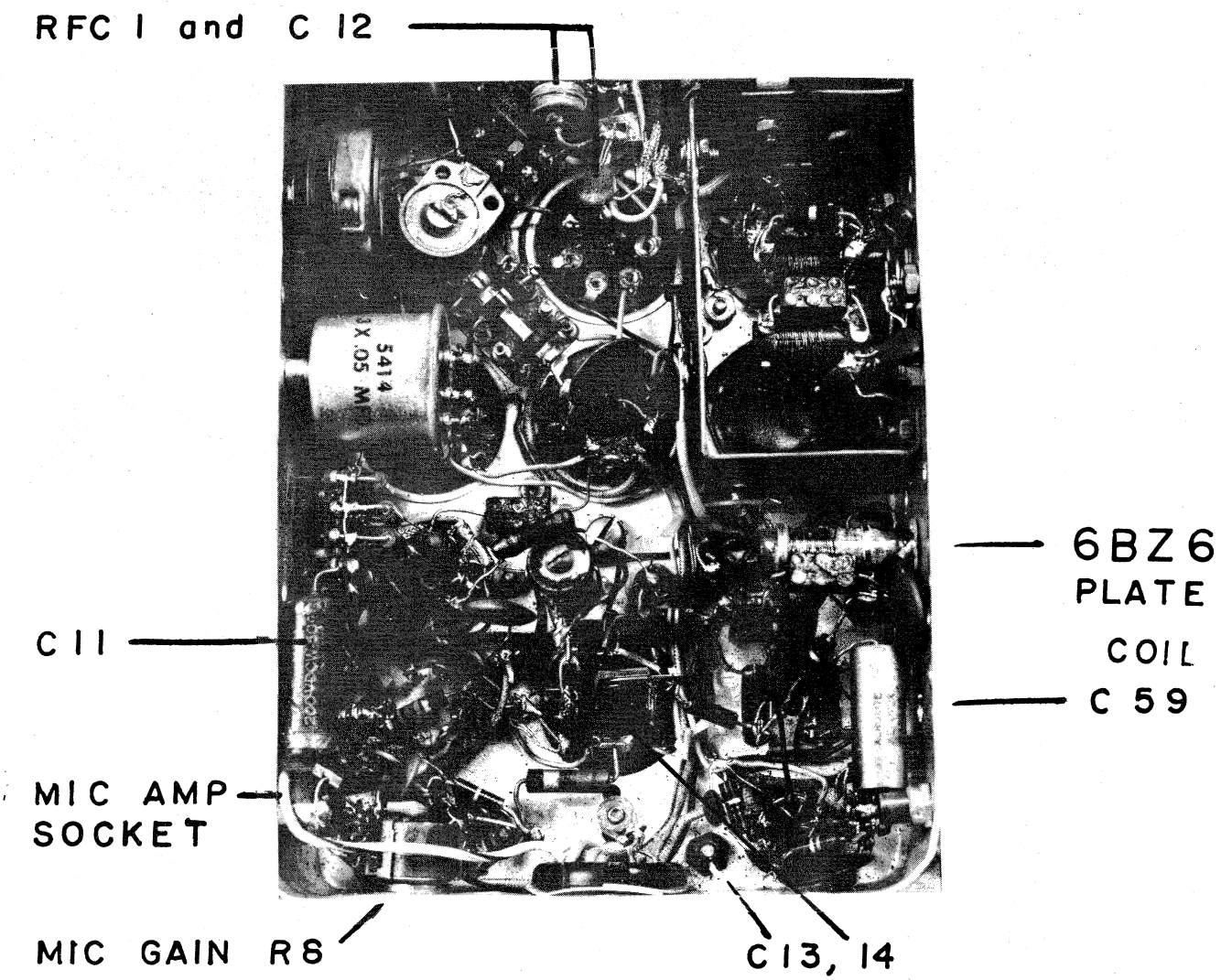

RFC 1 and C 12
6BZ6
PLATE
COIL
C 59
C 11
MIC AMP
SOCKET
MIC GAIN R8
C 13, 14

FIG. 10

Oscillator and Microphone Amplifier Parts List

CR-1 and CR-2	1N34 or any good diodes that will fit in space.
RFC-1	.5 mhy 50 ma.
C-1	5 uufd silver mica.
C-2	.01 disk ceramic.
C-3	15 uufd silver mica.
C-4	200 uufd silver mica. Use original part.
C-5	.01 disk ceramic.
C-6	condenser inside of 85 kc osc can. set at mid capacity for tuning if's.
C-7	.01 or .02 disk ceramic.
C-8	.01 disk ceramic.
C-9	30 uufd not critical. R-F by pass.
C-10	30 uufd not critical. R-F by pass.
C-11	.5 mfd 150 volt
C-12	.002 mfd disk ceramic.
R-1	-
R-2	100 k 1/2 watt use original part.
R-3	1 K balance potentiometer.
R-4	100 K 1/2 watt.
R-5	22k 1/2 watt.
R-6	1 K 1/2 watt.
R-7	220 K 1/2 watt.
R-8	1 megohm / 250 K not critical.
R-9	1 meg 1/2 watt.
R-10	3300 ohm 1 watt.
	85 kc amplifier coil tuned with 150 uufd to hit 85 kc. TV replacement part. Miller #6315 20 mhy iron slug. Wind 50 turns #30 covered wire over it to supply R-F. to diodes.

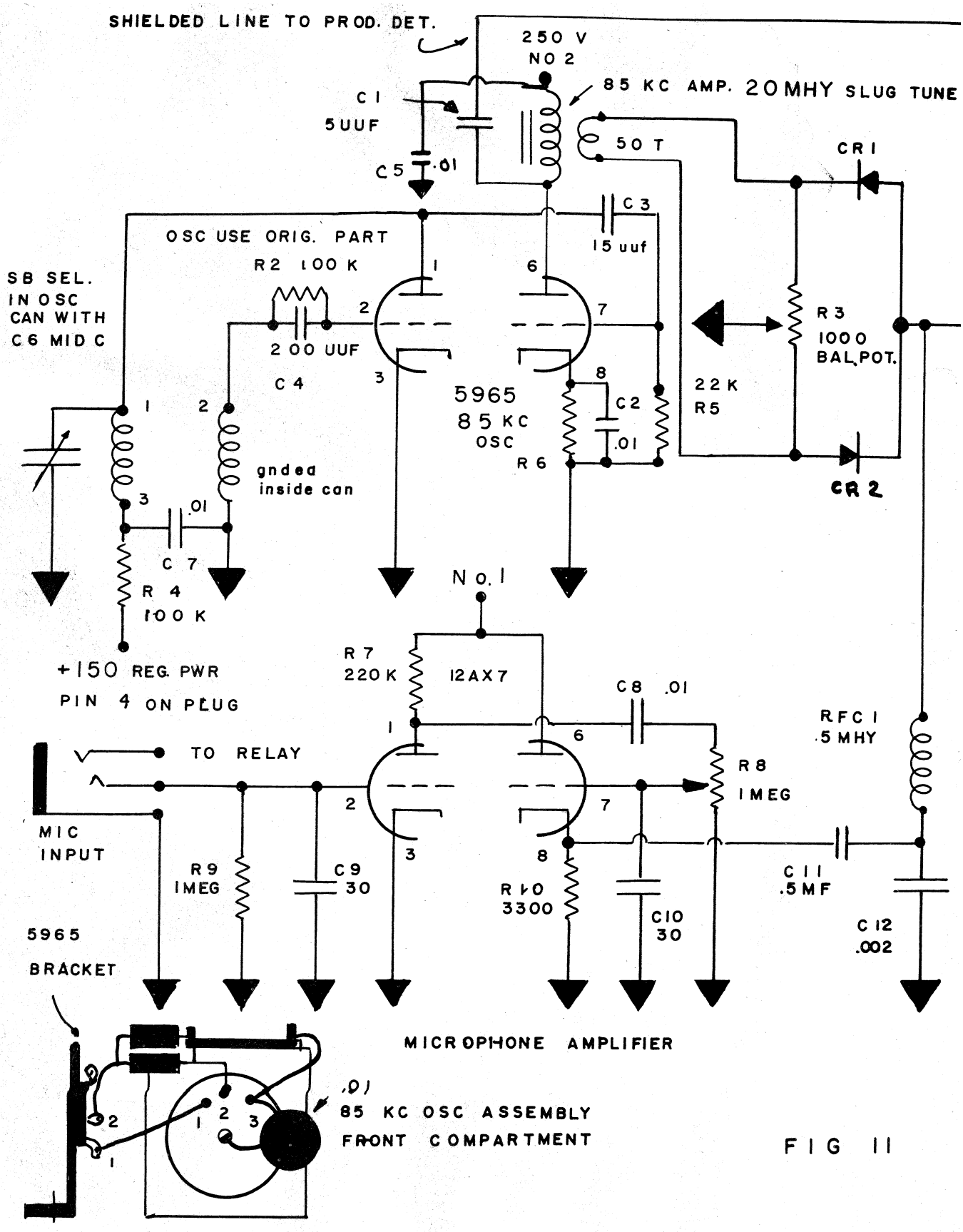

SHIELDED LINE TO PROD. DET.
250 V
NO 2
85 KC AMP. 20 MHY SLUG TUNE
C 1
5 UUF
C 5 .01
50 T
CR 1
C 3
15 uuf
OSC USE ORIG. PART
R2 100 K
SB SEL.
IN OSC
CAN WITH
C6 MID C
2 00 UUF
C 4
5965
85 KC
OSC
R 6
C2
.01
22 K
R5
R 3
1000
BAL. POT.
CR 2
gnded
inside can
.01
C 7
R 4
100 K
+150 REG. PWR
PIN 4 ON PLUG
N o. 1
R 7
220 K
12AX7
C8 .01
RFC 1
.5 MHY
TO RELAY
R 8
1 MEG
MIC
INPUT
R9
1MEG
C9
30
R10
3300
C10
30
C 11
.5 MF
C 12
.002
5965
BRACKET
MICROPHONE AMPLIFIER
.01
85 KC OSC ASSEMBLY
FRONT COMPARTMENT

FIG 11

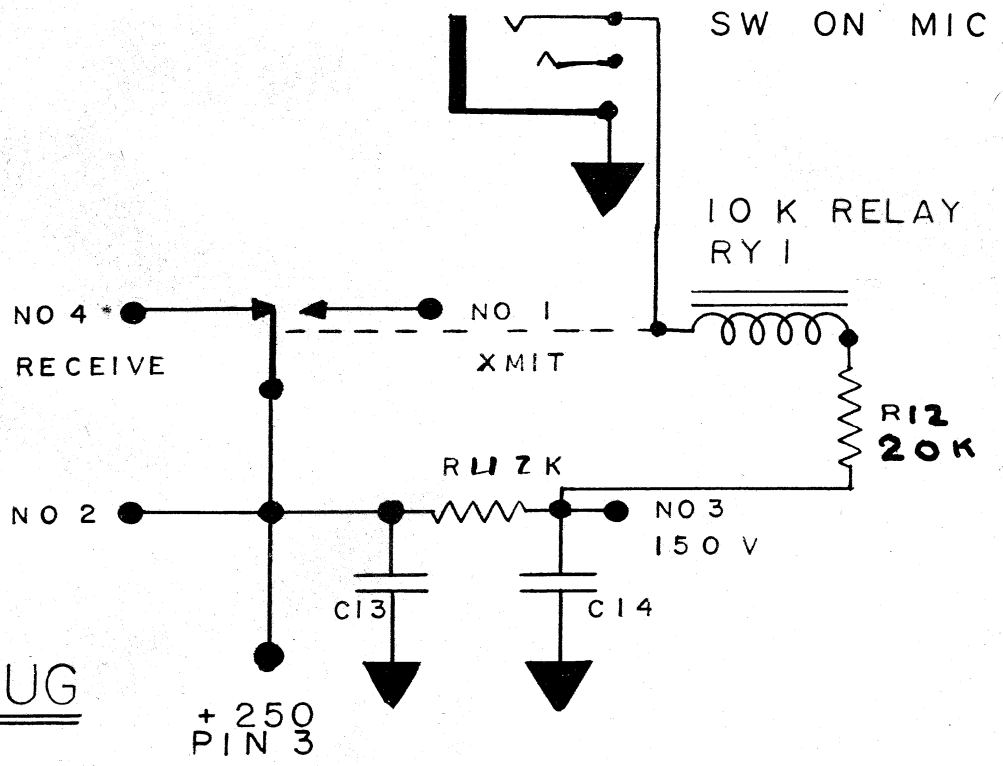
Power Input Connections

For power input the old mica plug is removed by nipping the edge with wire nippers and pulling out. The hole is punched to take a male 8 prong plug. Condenser C-13 and C-14 is a can containing four condensers. Three filter and one 20 mfd low voltage for the by-pass on the audio cathode. This condenser fits in the old motor plug hole and is short enough so that the final tuning condenser will mount on top of it.

Parts List

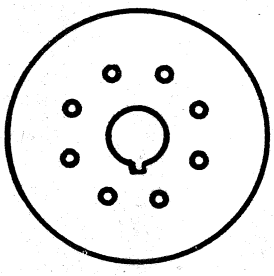
R-11	7 K ten watt. Part of original circuit.
R-12	20 K 1 watt. Adjust relay so that it will just close, this value may vary.
C-13, C-14	Mallory Type FP short can. 10-10 mfd. The other 10 mfd 450 v can be used for filtering. The 20 mfd low voltage can be used for cathode by-pass on the 6AQ5 audio. N16-C-22997.
Relay-1	10,000 ohm Leach type 227-S3E double arm, double throw. Only one side show in this Fig. The other contacts are used to switch the 85 kcs.

FIG 12



PWR PLUG

1 GND
2 GND
3 +300
4 +150 REG
5 -50 BIAS
6 560 HV
7 6.3
8 6.3



PLUG AND POWER INPUT CIRCUIT

R12 ADJ. UNTIL RELAY CLOSES

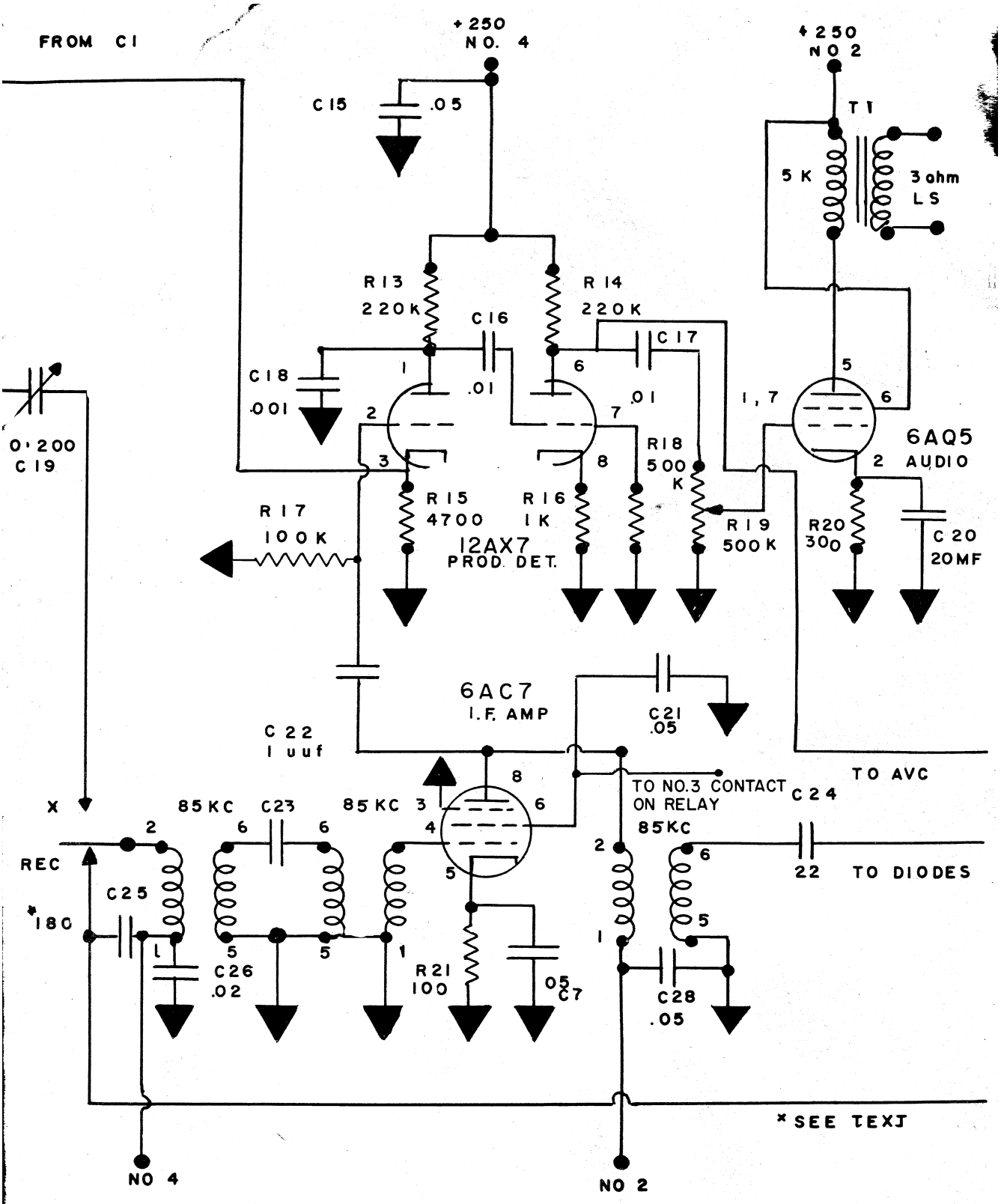
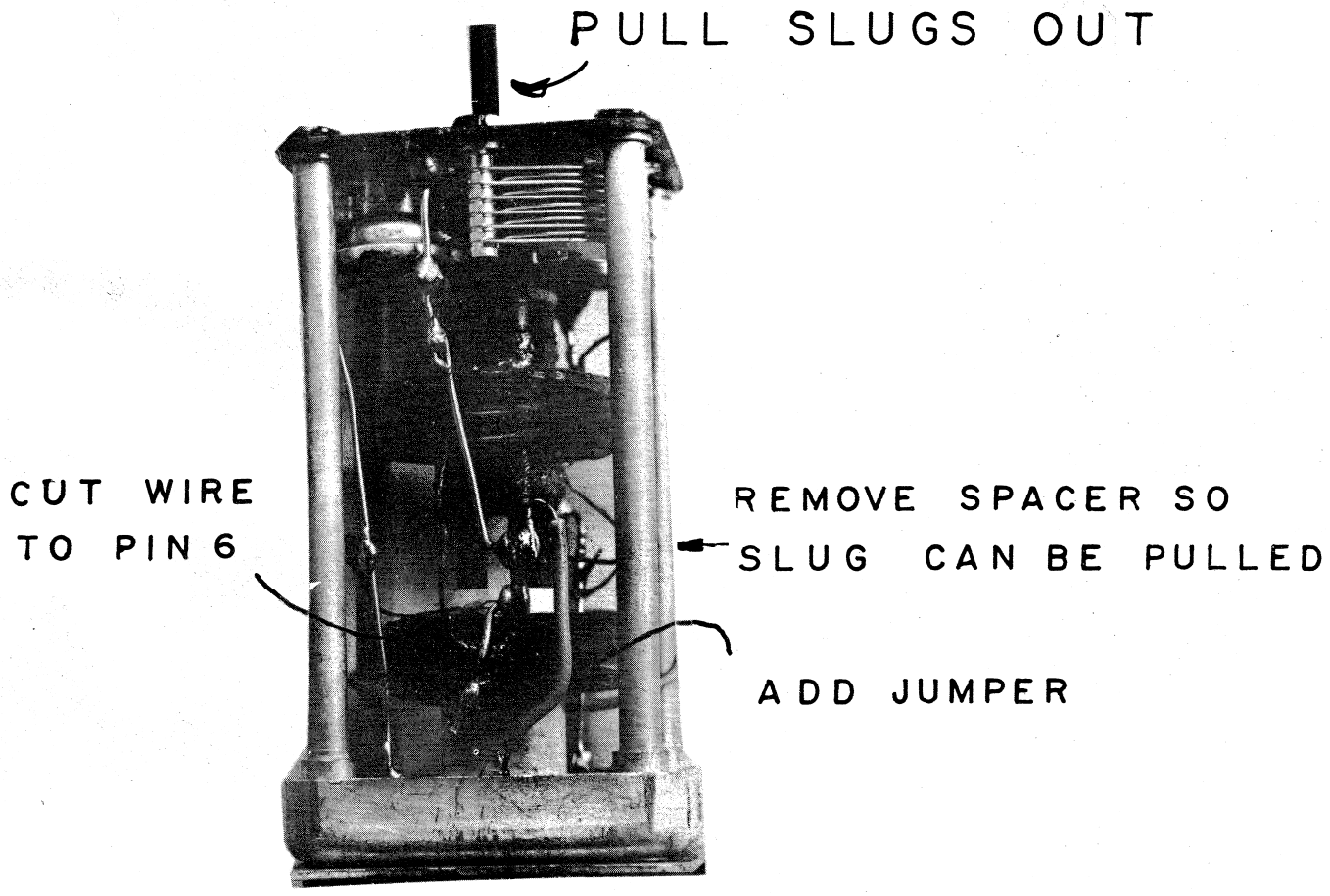

FROM C1
+250 NO. 4
+250 NO 2
C15 .05
T1
5 K
3 ohm LS
R13 220k
R14 220K
C16
C17
C18 .001
.01
.01
1, 7
6AQ5 AUDIO
0-200 C19
R18 500 K
R15 4700
R16 1K
R17 100K
12AX7 PROD. DET.
R19 500k
R20 300
C20 20MF
6AC7 I.F. AMP
C21 .05
C22 1 uuf
TO AVC
TO NO.3 CONTACT ON RELAY
C24
X
85KC
C23
85KC
85KC
REC
C25
180
C26 .02
R21 100
.05 C7
C28 .05
22
TO DIODES
*SEE TEXT
NO 4
NO 2

FIG 13



MODIFIED 85 KC I.F. COIL

PINS NUMBERED CLOCKWISE LIKE A TUBE SOCKET.

FIG 14

Discussion

Audio, Product Detector, I.F. Amplifier

For selectivity of the I. F. cans we pull the slugs out as far as they will go by removing the little plastic stop inside. We are going to put the coils back to back coupled very lightly to raise the "Q".

A few alterations will be necessary. First call pin one just like a tube socket going in a clockwise direction instead of the original numbering. This will be more convenient. The first i.f. can must now be pulled out and modified as shown in Fig. 14. We will use the whole coil on all the coils except on the lead going to the grid of the 6AC7. Here is the only tap we use and it is necessary to prevent the tube from oscillating. All BC-453's are different and some do not tap the coils. In our case, check the individual coils so that you use the whole coil.. The first i.f. coil has a further modification than the rest because during transmit there is so much capacity from tuning of C-19 the coil won't tune. Thus you will have to clip the little 180 uufd condenser and bring it out to pin 3. If you have an old model bring the wire out one of the holes so the 180 uufd capacitor can be connected to the relay contact and switched between the receive and transmit positions as indicated in the schematic Fig. 13.

Please examine the coil carefully. Our pin 5 will be ground and so should the rotor of the condensers which were not drawn in the circuit in order to simplify the drawing. The variables are not touched. Pins 6 of the first and second i.f. cans are connected together with a couple of pieces of small plastic intercom wire and twisted to make a 1 uufd coupling capacitor.

Note that the secondary of the second coil, pin 2 is the only tap we use, in all the rest the whole winding is used. The other modification can be accomplished by cutting the wire to pin 6 and jumpering the little mica insulator. Check this and trace carefully by pulling on the wires with tweezers to determine that you are across the whole winding coming out on pins 5 and 6. The third i.f. is not modified if there are not taps.

Audio

Use shielded wire to the audio gain control on the front of the chassis. If the audio goes into oscillation, reduce the value of the 500 K potentiometer or try a series 47 K 1/2 watt resistor going from pin to C-17 with a 470 uufd on each side of it.

I.F.

Keeping in mind the 85 kc i.f. is your filter and you don't want signals sneaking around them. Thus keep the wiring short and as clear as possible from the twisted leads.

Parts List:

Audio, Product Detector, I.F., Amplifier

Loud Speaker: Jensen 4 X 6 Model 46J6 3.2 ohm voice coil. Will fit and clear in top of cabinet.

R-13	**220 K**	**1/2 watt**
R-14	**220 K**	**1/2 watt**
R-15	**4700**	**1 watt**
R-16	**1K**	**1/2 watt**
R-17	**100 K**	**1/2 watt**
R-18	**500 K**	**1/2 watt**
R-19	**500 K**	**Potentiometer**
R-20	**300 Ohm**	**1 watt**
R-21	**100 Ohm**	**1/2 watt**

C-15	**.05 mfd in original can**
C-16	**.01 Disk ceramic**
C-17	**.01 Disk ceramic**
C-18	**.001 Disk ceramic**
C-19	**Compression type - 0-200 uufd**
C-20	**20 mfd 50 volt - FP can**
C-21	**.05 mfd in original can**
C-22	**Made by twisting 5 turns of hook-up wire**
C-23	**Made by twisting 5 turns of hook-up wire**
C-24	**22 uufd ceramic**
C-25	**180 inside I.F. can. See text**
C-26	**.02 Disk ceramic**
C-27	**.05 mfd in original can**
C-28	**.05 mfd in original can**

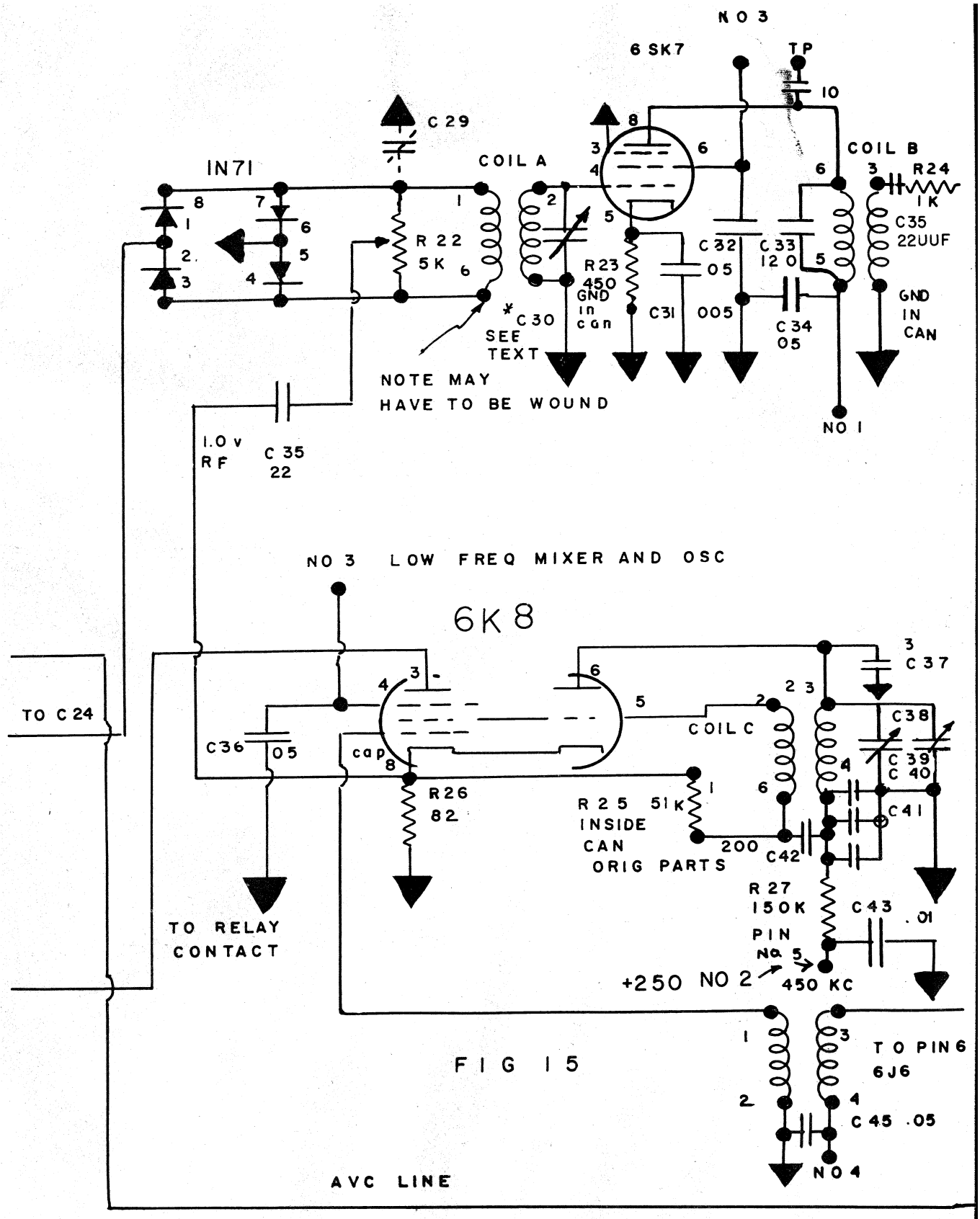

NO 3
6 SK7
TP
10
C 29
COIL A
COIL B
IN 71
R 22
5K
R23
450
GND
in
can
C30
SEE
TEXT
NOTE MAY
HAVE TO BE WOUND
C32
05
C33
120
C31
005
C34
05
R24
1K
C35
22UUF
GND
IN
CAN
NO 1
1.0 v
RF
C 35
22
NO 3 LOW FREQ MIXER AND OSC
6K8
TO C 24
C36
05
cap
R26
82
TO RELAY
CONTACT
COIL C
R 25 51K
INSIDE
CAN
ORIG PARTS
200
C42
C37
C38
C39
C 40
C41
R 27
150K
C43
.01
PIN
No 5
+250
NO 2
450 KC
TO PIN 6
6J6
C 45 .05
NO 4
AVC LINE

FIG 15

Low Frequency Mixer and Oscillator Assembly

This is the part where getting the original parts back is important. On Coil "A" some of the receivers do not have an antenna coil and it will be necessary to either wind 100 turns on the coil form or peel the insided out of an old i.f. coil and slip over and hold with wax.

A small trimmer is mounted from either side of the potentiometer to ground. Trying it on one side and then on the other and tuning you may be able to reject the carrier more. R-24 is located by the 6AG7 grid in a hole. The wire is carried on top side of the chassis to coil "B". C-34 can also be soldered on topside.

In the oscillator assembly R-25 is already inside the can. These oscillator parts are all the original assembly parts and should be put back as such. R-27 was reduced to 150 K from 500 K and the C-43 added.

The lead from the 450 kc i.f. to the grid cap is shielded wire. It would be a good idea to put a cap over the top of the tube to help prevent any BDC station pick-up. Keep leads short and as near the original as possible going from the 6K8 tube over to the coils.

Be careful tuning the 450 kcs i.f., the ferrite cups tend to break off the wire if turned too far. Stagger somewhat to get a band pass effect.

When you fasten the panel on, make sure that the screw going into the condenser is not too long or it will touch the oscillator trimmer and short it out and you will spend hours trying to locate the trouble.

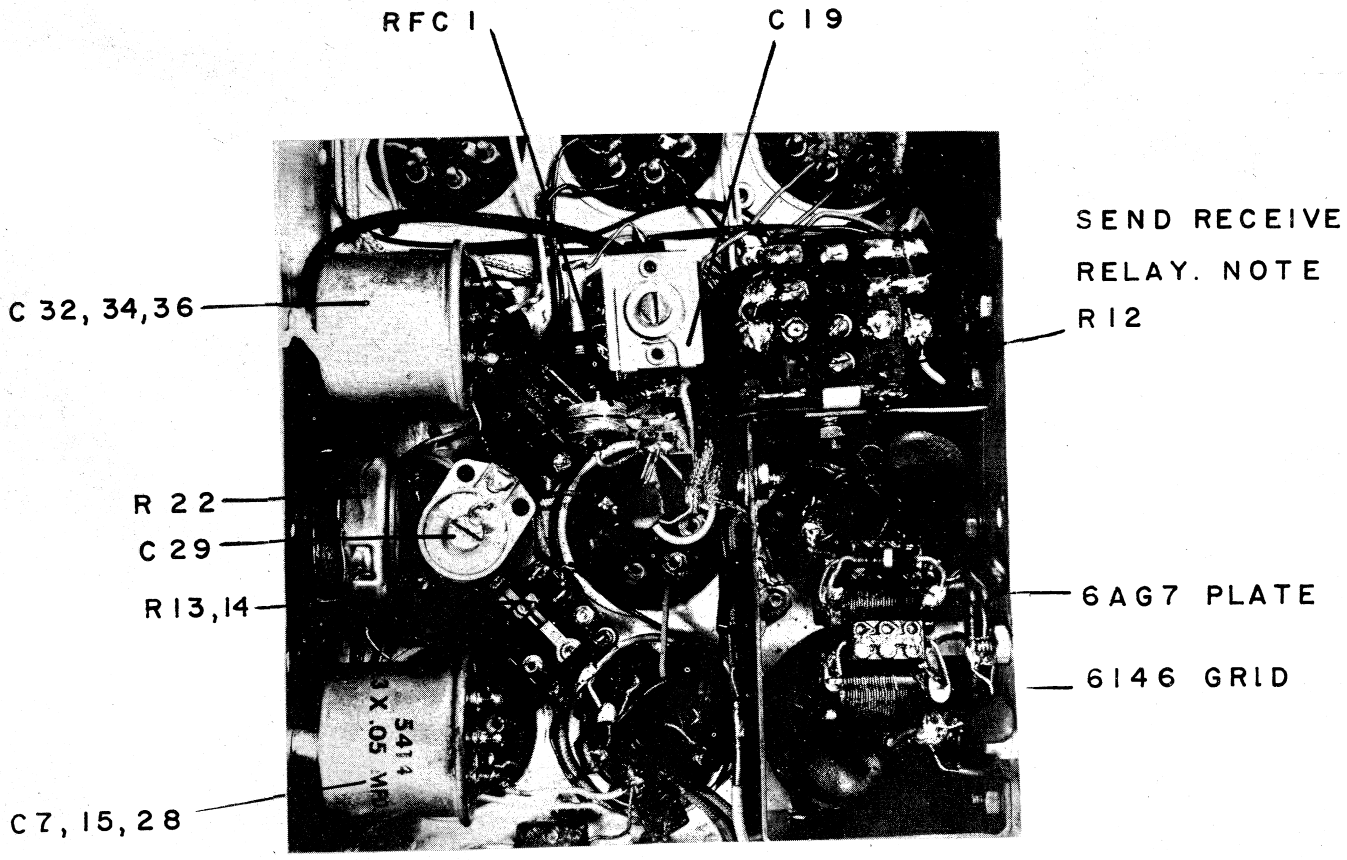

RFC 1
C 19
SEND RECEIVE RELAY. NOTE R12
C 32, 34,36
R 22
C 29
R 13,14
6AG7 PLATE
6146 GRID
C7, 15, 28

FIG 16

Low Frequency Mixer and Oscillator Parts

1N71	Diode, plug in unit
R-22	5 K Potentiometer
R-23	450 ohm 1 watt
R-24	1K 1 watt
R-25	51K Already inside can of osc.
R-26	82 ohms 1/2 watt
C-29	0-50 uufd ceramic trimmer experimentally mounted either side of balace pot for more carrier rejection.
C-30	0-50 uufd ceramic trimmer mounted on top of main tuning condenser, can be seen in photo. Screws tapped into top of condenser.
C-31	.005 mfd disk
C-32	.05 mfd original can
C-33	120 uufd may not need. Original part. Depends whether coil will peak.
C-34	.05 original can
C-35	22 uufd ceramic
C-36	.05 original part in can
C-37	3 uufd original part
C-38	All part of main tuning condenser assembly never removed.
C-39	
C-40	
C-41	All original parts of tuning assembly.
C-42	200 uufd original part
C-43	.01 disk
	450 kcs I.F. coil. Miller input type 12C1 slug tuned.

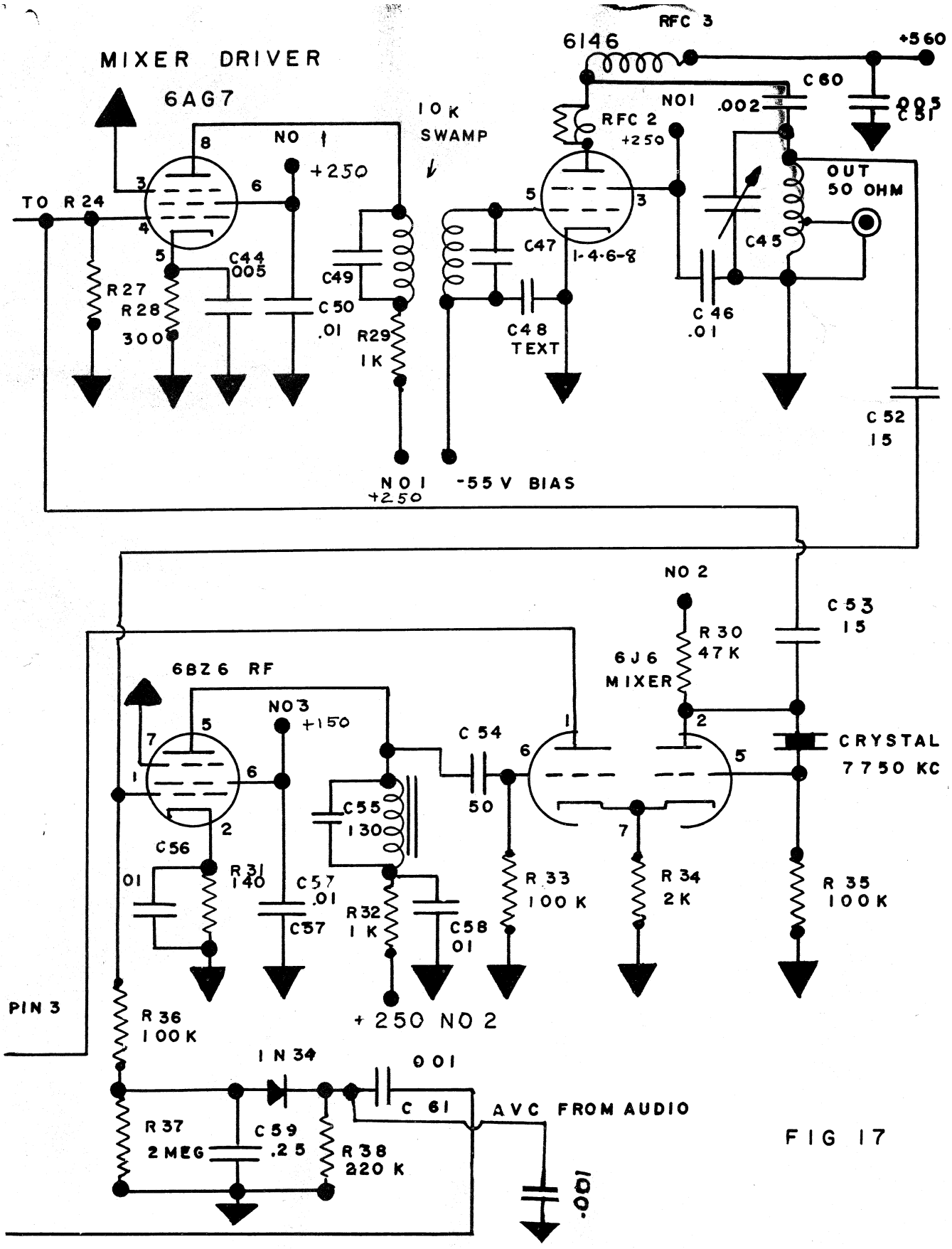

MIXER DRIVER
6AG7
TO R 24
R27
R28
300
C44
005
C50
.01
NO 1
+250
10K
SWAMP
C49
R29
1K
NO 1
+250
-55 V BIAS
6146
RFC 3
+560
C60
.002
C51
.005
RFC 2
+250
NO1
C47
1-4-6-8
C48
TEXT
C45
OUT
50 OHM
C46
.01
C52
15
NO 2
C53
15
R30
47K
6J6
MIXER
6BZ6 RF
NO3
+150
C54
50
C55
130
C56
01
R31
140
C57
.01
C57
R32
1K
C58
01
R33
100K
R34
2K
R35
100K
CRYSTAL
7750 KC
PIN 3
R36
100K
+250 NO 2
1N34
001
C61
AVC FROM AUDIO
R37
2MEG
C59
.25
R38
220K
.01

FIG 17

Discussion 6146 Final and 6AG7 Mixer

On most models constructed the 6146 has not needed neutralizing. If it is necessary a neutralizing condenser can be run from the plate to the bottom of the grid coil. C-48 will have to be changed to 330 uufd or varied so that the tuning range of the neutralizing condenser is in range.

No particular discussion is needed here except that the 6AG7 will not mix and put out enough drive for the 6146 unless there is 240-250 volts on the screen. The grid should have a shield to prevent feedback or pick-up from the plate. R-27 can be increased to 100 K if the 6AG7 appears stable. It is sometimes necessary to put a 10,000 ohm resister across the slug to prevent oscillation. It is best to use as much capacity as possible across the slug at least 100 uufd. The grid and plate coils are mounted as close as possible together with out the parts touching each other. The 50 ohm output tap can be found using a 50 ohm resistor and sliding the tap back and forth for maximum output.

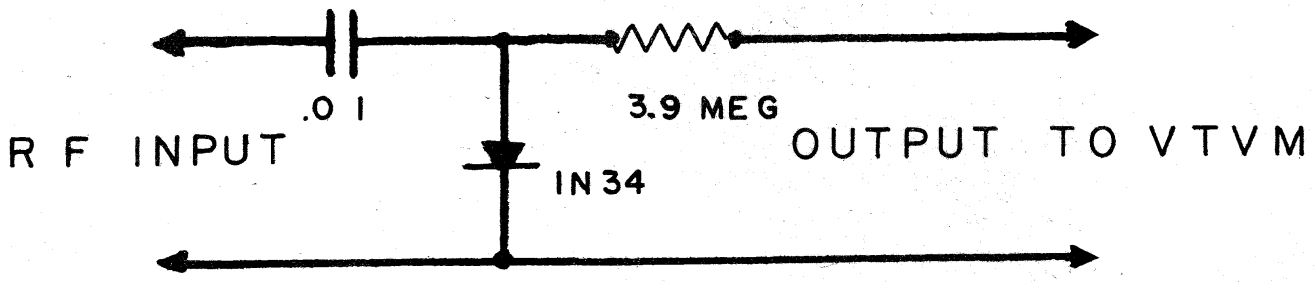
If you see more than 600 volts on the 6146 increase the break down voltage of C-52.

The converter section is standard. The crystal oscillator with a metal can type crystal puts out at least 6 volts. If a FT 243 type crystal is used it would be recommended that a tuned plate circuit oscillator be used. Make the lead to the mixer short as possible so that you have as much RF (3-6 volts) as possible.

Audio AVC seems to work much better than taking it from the I.F. as the previous model did. This way we can get up to 15-30 volts avc bias voltage. If possible get a high back resistance diode so that the voltage leaks off slowly. You can watch this on a V.T.V.M. If there is too much avc you can bypass it to ground by adding another .001 mfd across R-38. R-34 can be reduced if tube does not draw too much current. Otherwise you will have to increase the wattage of R-30 and this seems to work best with 2 K in the cathode. C-55 and the slug resonate at 7.2 mc by use of the grid meter. Exact values are not given because of the variation of wiring an slugs.

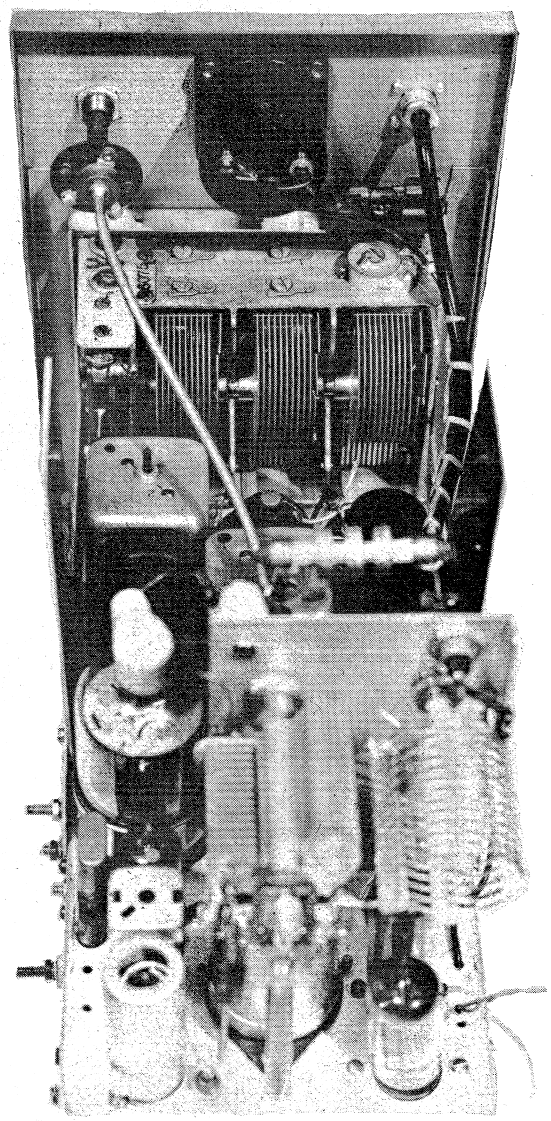
Final Amplifier Parts List

RFC-3	2.5 mhy 125 ma.	
RFC-2	5 turns #18 wound on 2 watts 50 ohm res.	
	Final Tank Coil: 11turns #1008 Air Dux 1 1/4" dia.	
	Final Grid Coil: 3-16" slug approx 25 turns #26 use about 100-150 uufd to tune.	
	Mixer Tank: Same as above.	
R-27	10 K	1/2 watt
R-28	300 ohms	1/2 watt
R-29	1 K	1/2 watt
R-30	47 K	1/2 watt
R-31	140 ohms	1/2 watt
R-32	1 K	1/2 watt
R-33	100 K	1/2 watt
R-34	2 K	1/2 watt
R-35	100 K	1/2 watt
R-36	100 K	1/2 watt
R-37	2 meg.	1/2 watt
R-38	220 K	1/2 watt
C-44	.005 disk	
C-45	140 variable. Type MC not critical.	
C-46	.01 disk	
C-47	100 to 150 Silver mica top resonate slug to 7 mc.	
C-48	.01 disk If 6146 neutralized use 330 uufd here.	
C-49	100-150 uufd to resonate slug.	
C-50	.01 disk	
C-51	.005 disk	
C-52	15 uufd Silver mica 600 volts.	
C-53	15 uufd Silver mica.	
C-54	50 uufd Silver mica.	
C-55	130 uufd Silver mica to resonate slug.	
C-56	.01 disk	
C-57	.01 disk	
C-58	.01 disk	
C-59	.25 mfd metalic.	
C-60	.002 mfd 1600 volt mica.	
C-61	.005 disk	



ALL RF VOLTAGES MADE USING THIS PROBE AND A HEATHKIT VTVM.

FIG 18



VIEW SHOWING FIG 19
PANEL INSTALLED WITH FLEX TUNING SHAFT

Troubles

6AG7 not mixing:

If the injection from the 7750 kc crystal oscillator is 3 volts or over and there is 5 volts from the 6SK7 amplifier and all else appears to be ok the trouble could be low screen voltage on the 6AG7. It takes 250 volts to mix enough drive to the 6146. This appears to be critical, 225 volts won't work.

6146 appears to go into oscillation on voice peaks:

This can be caused from R-G getting back into the audio wiring. Check and see that you by-passed the microphone grid and gain control grid to ground. Keep the microphone gain as low as possible to prevent this. The 6146 may have to be neutralized but so far, in the models constructed it hasn't needed it.

6AG7 mixer oscillating:

Put shield between grid and plate coil and keep the injection condenser outside the shield. Doesn't take much pick-up on any grid wire to make it take off when getting energy back from the plate.

Dead audio in receiver:

Apply antenna to 85 kc I.F. strip, local BC station should come in. Better to use a generator if you have one.

450 kc oscillator not working:

Check for grid voltage and apply antenna to grid cap of 6K8. BDC stations will come in all across the dial if it is not mixing. 6K8 should have 100 volts on the plate.

If signal has AC modulation:

Try replacing 85 kc oscillator tube it may have a sagging grid.

If switching from send to receive you have a hang up of signal, you've got a 20 mfd condenser on the wrong side of the relay contacts. It should switch clean.

450 kc oscillator not oscillating:

Check 4-40 screw holding panel and tuning condenser. Many times putting in the screw it will touch the trimmer condenser and short it to ground.

Audio oscillations as audio gain advanced:

Put a filter in series with audio input. A series 47 k resistor with 470 uufd on each side of it between pin 6 and C-17 or from pin 1 to C-16. Try more decoupling in power supply lead to a point ahead of C-15. And also try isolating R-13 and R-14 by decoupling. A 250 k pot will also stop oscillation in place of the 500 k shown. Improper output transformer is another cause.

Tune Up Procedure

1. The first thing to do is make sure you set the 85 kc oscillator condenser C-6 at half capacity.

2. Solder a 15 uufd capacitor on to the plate of pin 8 of the 6AC7 and connect your R-F probe. Turn the microphone gain down.

3. In transmit position and a little carrier unbalance, peak the i.f.'s working back and forth several times. The i.f. tuning capacitors will be in just about closed position. You might examine them.

4. Now peak C-30 on top of the main tuning condenser. Then peak C-19 the 0-200 uufd condenser all for maximum output. Now balance out the carrier with the front panel control.

5. Put the probe on pin 8 of the 6SK7 and null the 2 K potentiometer R-22. It may be easier to disconnect the 85 kc and peak this control for 450 kc.

6. Peak the 6AG7 and 6146 coils, while tone inserted.

7. In receiver position detune 85 kc oscillator condenser to either one sideband or the other until you receive clear SSB. Your transmitter will now be ready to transmit.

8. The receiver is tuned by peaking all coils for maximum signal, and stagger tuning the 450 kc i.f. can, which generally doesn't need much tuning.

9. Keep microphone goin control low as possible to keep regeneration and distortion down.

Misc voltage readings.

12AX7 Product Det. and first audio. Fig 13.

Plate	pin 1	pos 150	plate	pin 6	pos 90
Grid	pin 2		grid	pin 7	
Cath	pin 3		fil	pin 4-5, 9	6.3 v a.c.

5965

Oscillator - Amp. 85 kc Fig. 11

Plate	pin 1	pos 150 regulated.	Plate	pin 6	pos 250
Grid	pin 2		Grid	pin 7	
Cath	pin 3	gnd	Fil	4-5, 9	6.3 v

6K8 Osc. Mixer Fig 15

Plate	pin 3	pos 250	
	pin 4	pos 120	
	cap		
	pin 8		R-F 1.5 volts 450 kc.
plate	pin 6	pos 250	
grid	pin 5		
fil	pin 2-7		

6AC7 Fig. 13

plate	pin 8	pos 250	
grid	pin 4		1.0 volts R-F.
screen	6	pos 120 v	
fil	pin 2-7		6.3 volts

6AQ5 Audio

plate	pin 5	pos 250
screen	pin 6	pos 250
cath	pin 2	
grid	pin 1,7	
fil	pin 3-4	6.3

6J6 Fig. 17

plate	pin 1	pos 250 v			
grid	pin 6				
cath	pin 7	pos 12 v			
plate	pin 2	pos 100	R-F	5 volts	7.7 mc
grid	pin 5	pos 250			
fil	pin 3-4	6.3			

6BZ6

```
plate   pin 5   pos 250
screen  pin 6   pos 120
cath    pin 2   pos 1.5
grid    pin 1
fil pin 3-4     6.3
```

6AG7

```
plate   pin 8   pos 250       R-F peak to 30 volts talking.
screen  pin 6   pos 250
cath    pin 5   pos 9
grid    pin 4                 R-F peaks to 5 volts when talking.
fil     pin 2-7 6.3 v         3 volts steady from 7.7 mc osc.
grid    pin 3-1
```

6146

```
plate           pos 650 under load.
screen          pos 250   pin 3.
grid                      pin 5.    peaks to 30 v R-F when talking.
fil pin 2-7     6.3 volts
```

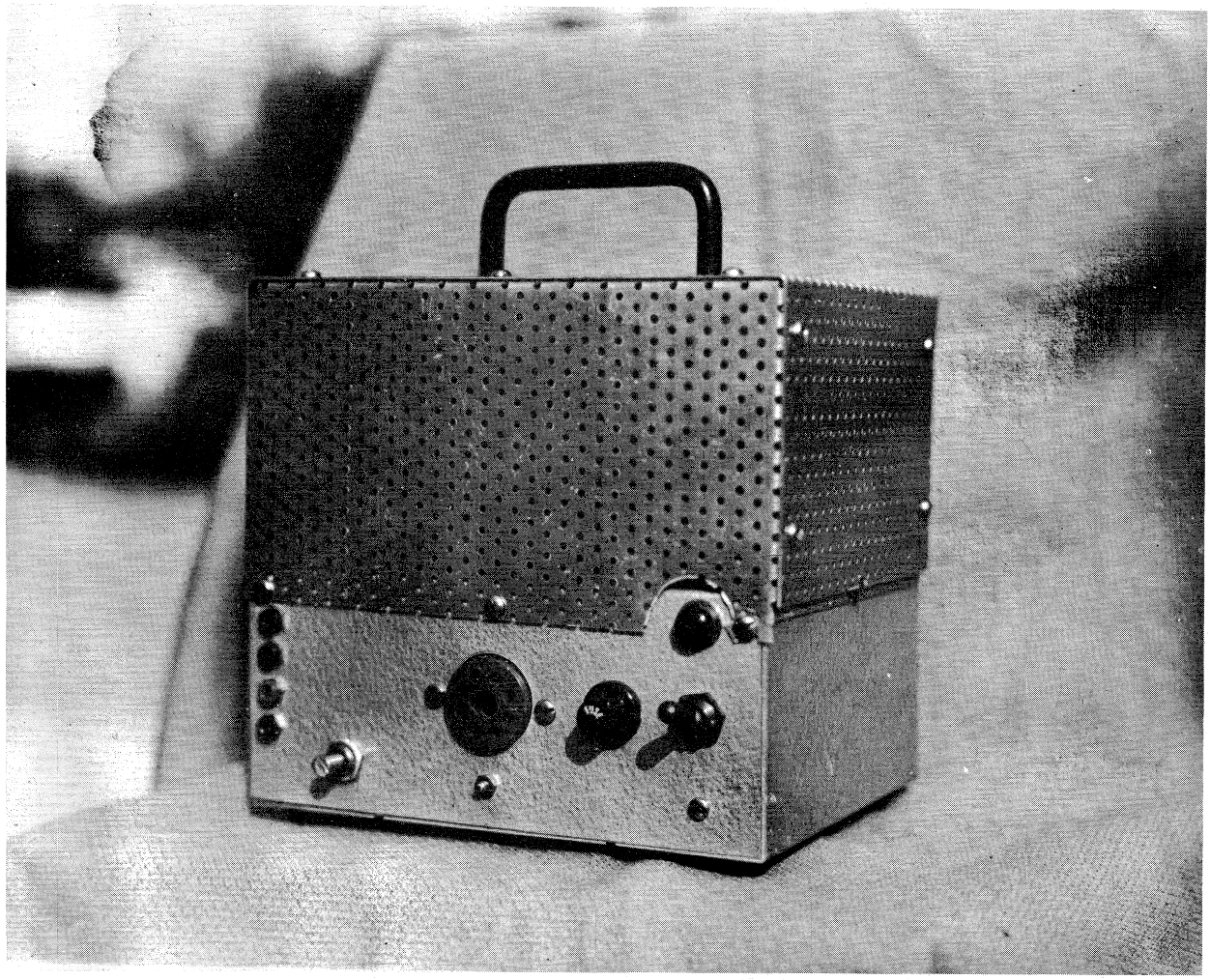
Power supply voltage receive position.

```
pos     740
pos     250
pos     150 reg.
-60 bias
```

Xmit position

```
pos     650
pos     240
pos     150 reg.
-60
```

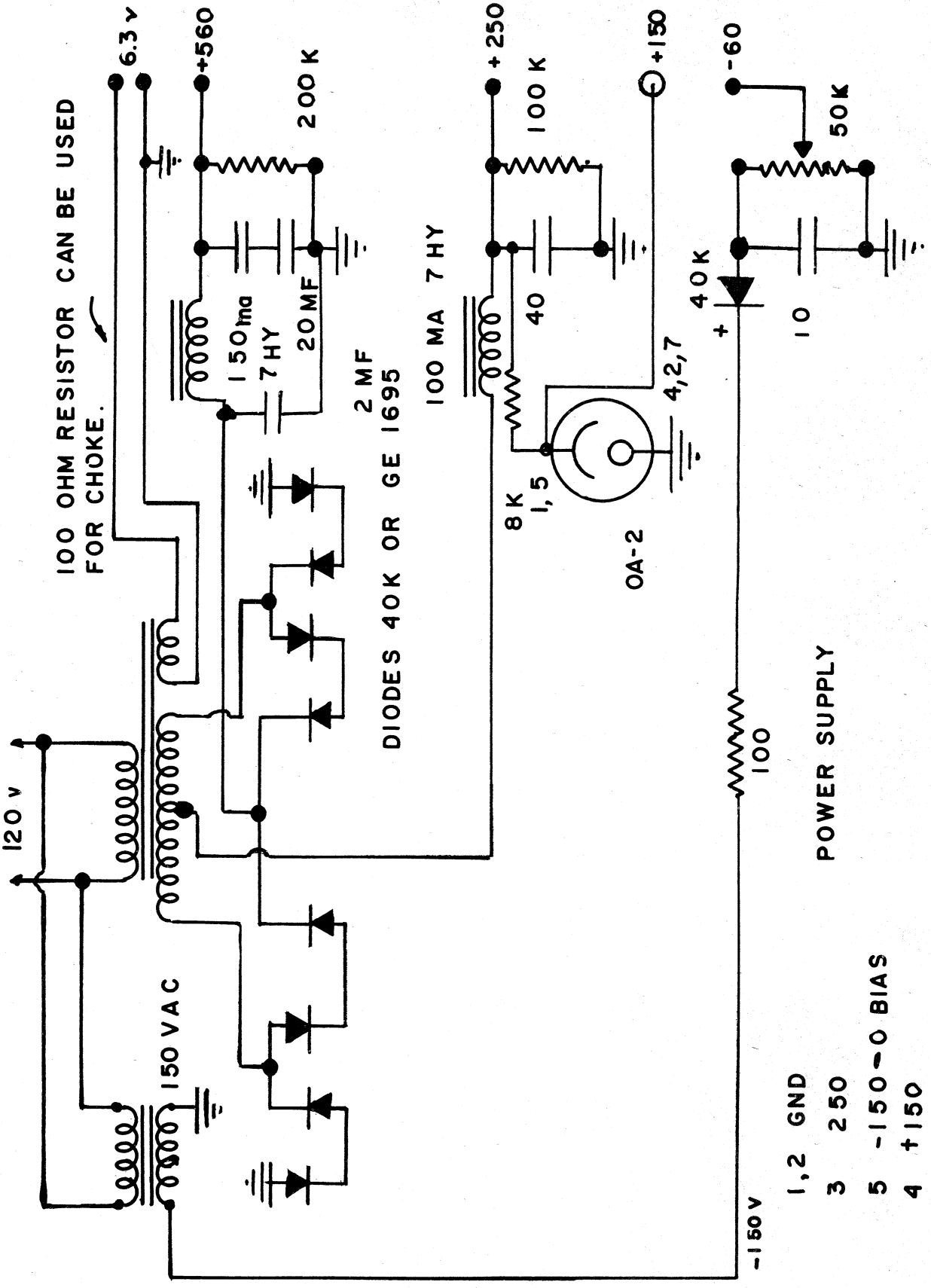
6SK7 pin 8 plate R-F 9 volts when talking.

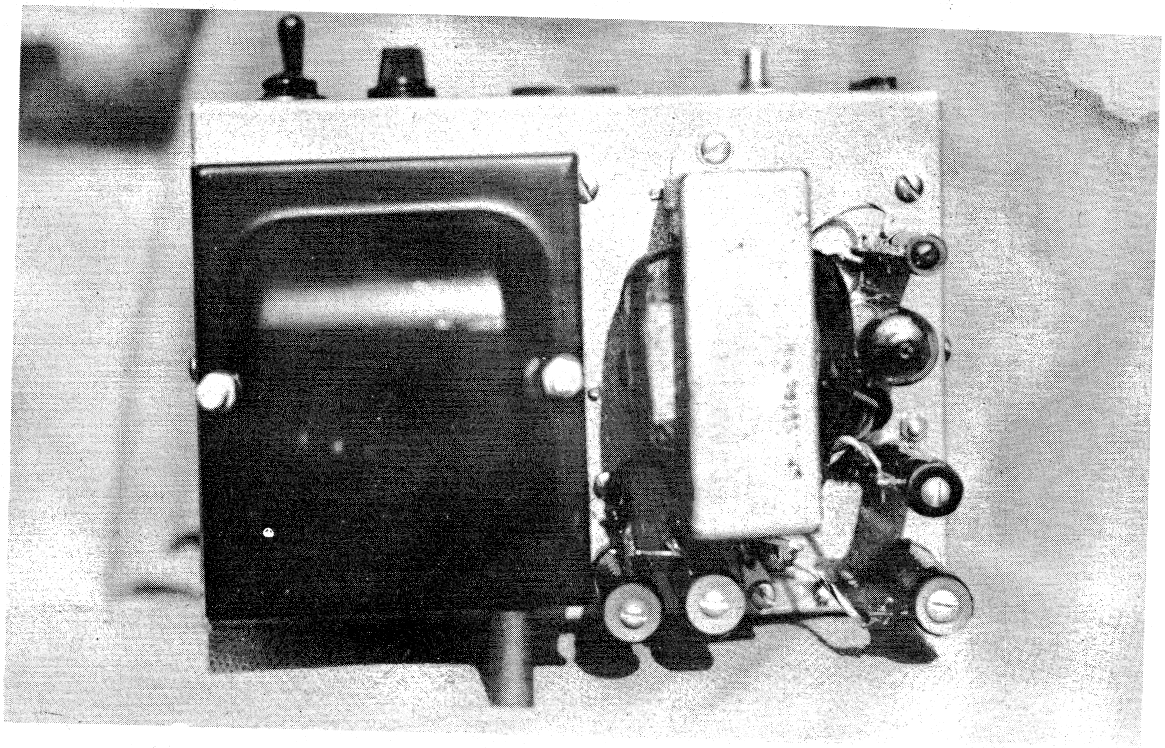


POWER SUPPLY

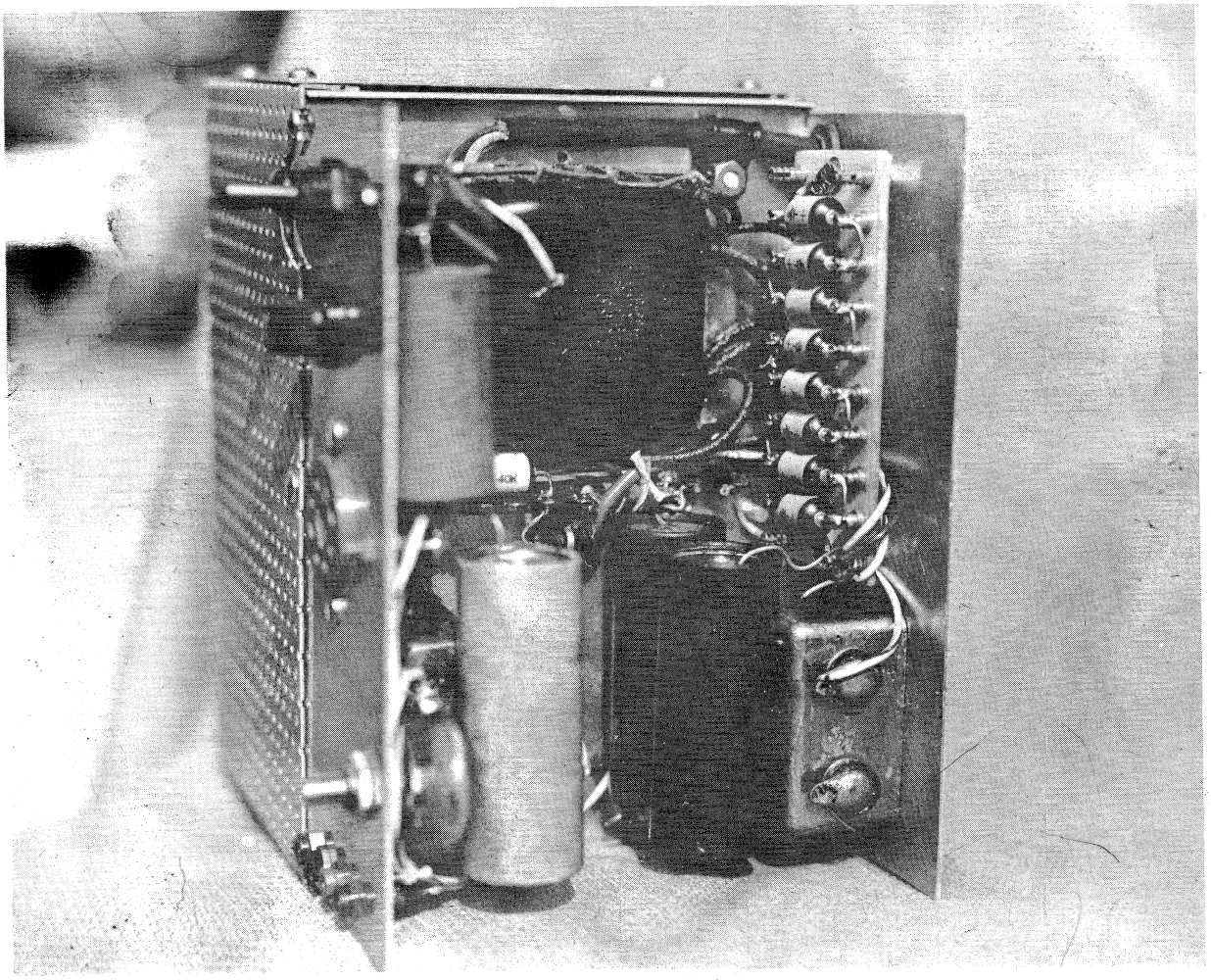
Power Supply

Power Transformer:	**270-0-270 210 ma 6.3 volts 5 amps.**
Choke	**Stancor 150 ma 7 hy. A 100 ohm 10 watt resistor may be used for the high voltage filter if you are short on space.**
Diodes	**40 K or F-4 Sarkes-Tarzian diodes.**
Capacitors	**Blue Beaver 40 mfd in series. 450 volts.**
Bleeder	**Two 100 K 20 watt in series.**
Low Voltage Supply:	**250 volts.**
Capacity	**40 mfd 450 v.**
Bleeder	**100 K 20 watt.**
Choke	**100 ma 7 hy.**
Regulator tube	**0A-2**
Resistor	**8000 ohms 10 watt.**
Bias	**Stancor PA 8421 150 v @ 30 ma or PS-8415 125 v 15 ma.**
	40 K diodes or GE 1695
Capacity	**10 mfd 250 v**
Potentiometer	**50 K**
	Chassis LMB box #145. Use one large enough to make parts mounting easy. This one is packed.


100 OHM RESISTOR CAN BE USED FOR CHOKE.
6.3 v
+560
200 K
150 ma
7 HY
20 MF
2 MF
DIODES 40K OR GE 1695
100 MA 7 HY
+250
100 K
+150
-60
50 K
40
8 K
1,5
4,2,7
OA-2
40 K
10
120 v
150 VAC
100
-150 v
POWER SUPPLY
1,2 GND
3 250
5 -150-0 BIAS
4 +150
6 +560
7, 8, FIL

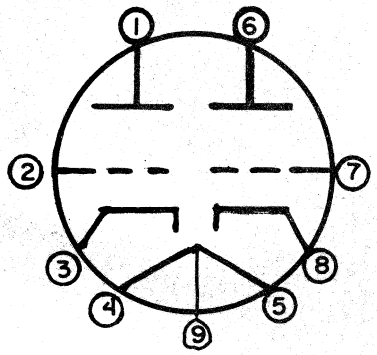


TOP VIEW POWER SUPPLY

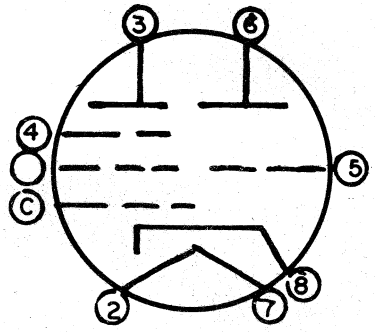


BOTTOM VIEW POWER SUPPLY

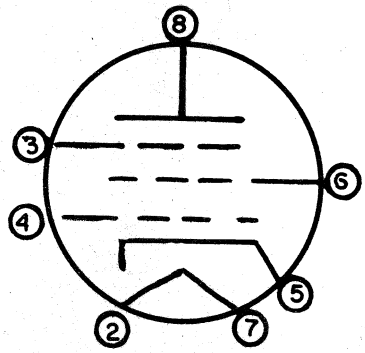
12AX7
5965



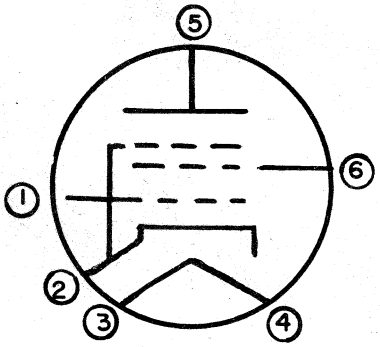
6K8



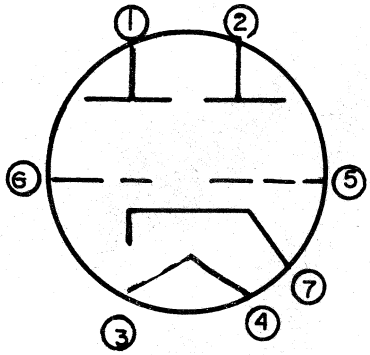
6AC7



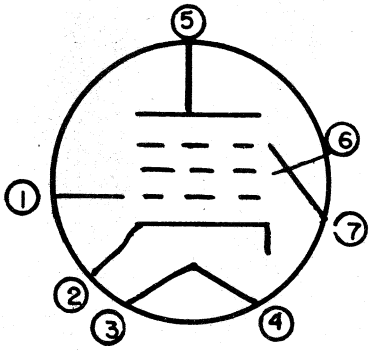
6AQ5



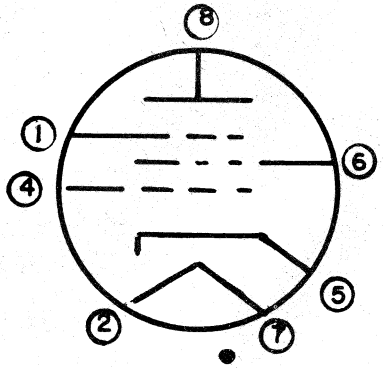
6J6



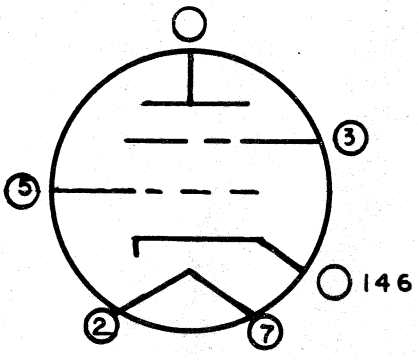
6BZ6



6AG7



6146

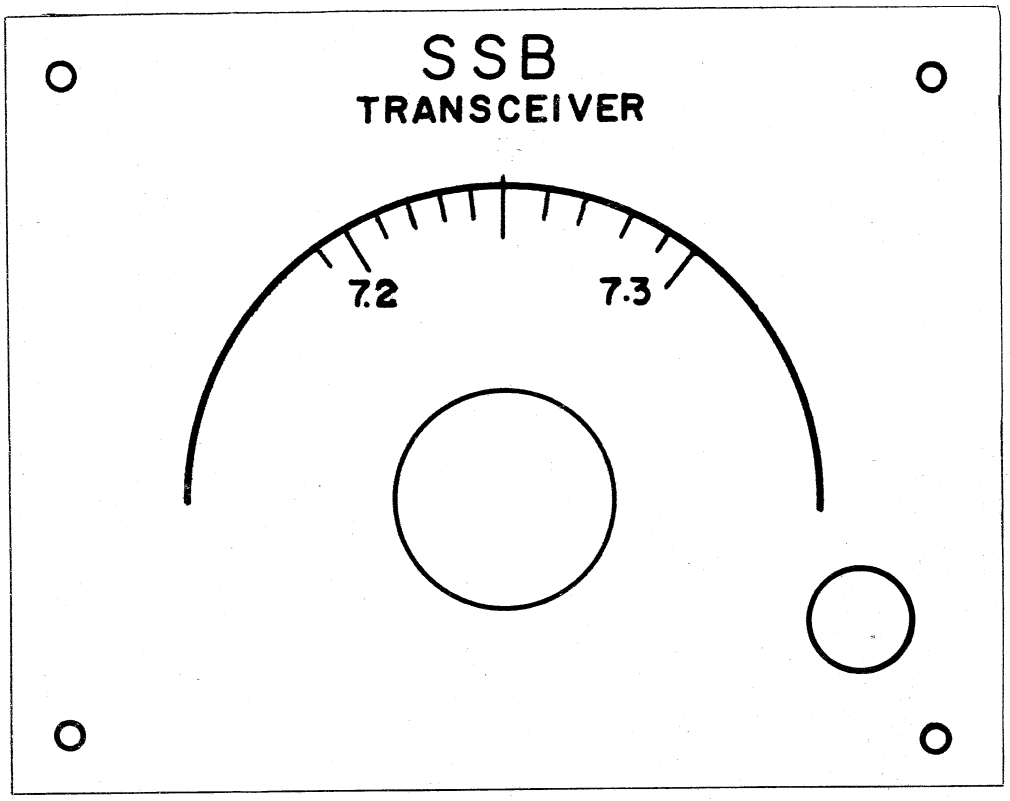


To constructors: Fill out book registration card. If you get this transceiver on the air, send us a picture of you and the rig and win a free one year subscription to WESTERN RADIO AMATEUR MAGAZINE.

Name----------Call----------

Address----------

Any correspondence send a self addressed stamped envelope to W6BLZ 528 Colima St., La Jolla, California.



Addendum I

by Dean Billing / WA6IKJ

30 December 2008

The construction booklet for A SSB Transceiver from the BC-453 represents a great deal of effort by Ed Marriner to document Ernie Mason's design. For that I am eternally grateful, because I doubt that Ernie would have ever done it. But there are a number of oddities and quirks that should be pointed out lest someone think I took liberties with the original document. Maybe I can head off a few questions, although I would be glad to answer any email queries others might have.

Be advised that I have made every effort to insure that the text in this electronic version of the booklet has exactly the same spelling, syntax and punctuation that Ed Marriner typed back in 1961.

- **page 10, it is ironic that the booklet always references the BC-453, a component of the SCR-274-N Army Air Corps system, but the schematic is for the R-23, a component of the Navy ARC-5 system.**
- **page 12, typo: delux, s/b: deluxe**
- **page 25, note about 85 kc amplifier coil "... tuned with 150 uufd ...". The 150 uufd capacitor is not shown on the schematic on page 26.**
- **page 37, description of C-29, typo: balace, s/b: balance**
- **page 44, procedure 9, typo: goin, s/b: gain**
- **page 49, power supply, there is a capacitor on the input side of the 7 HY choke in the 560 volt power leg that appears to be labeled "2 MF" under it, but it not listed in the Power Supply parts list on page 48. The 100 ohm resister in the bias leg is not in the parts list either.**
- **page 52, tube diagrams are missing the 6SK7 and the OA-2.**

Addendum II

by Dean Billing / WA6IKJ

15 December 2008

In Memoriam

Ernest H. Mason

Born: 27 May 1919 - Irondale, Missouri
Died: 17 October 2000 - San Diego, California

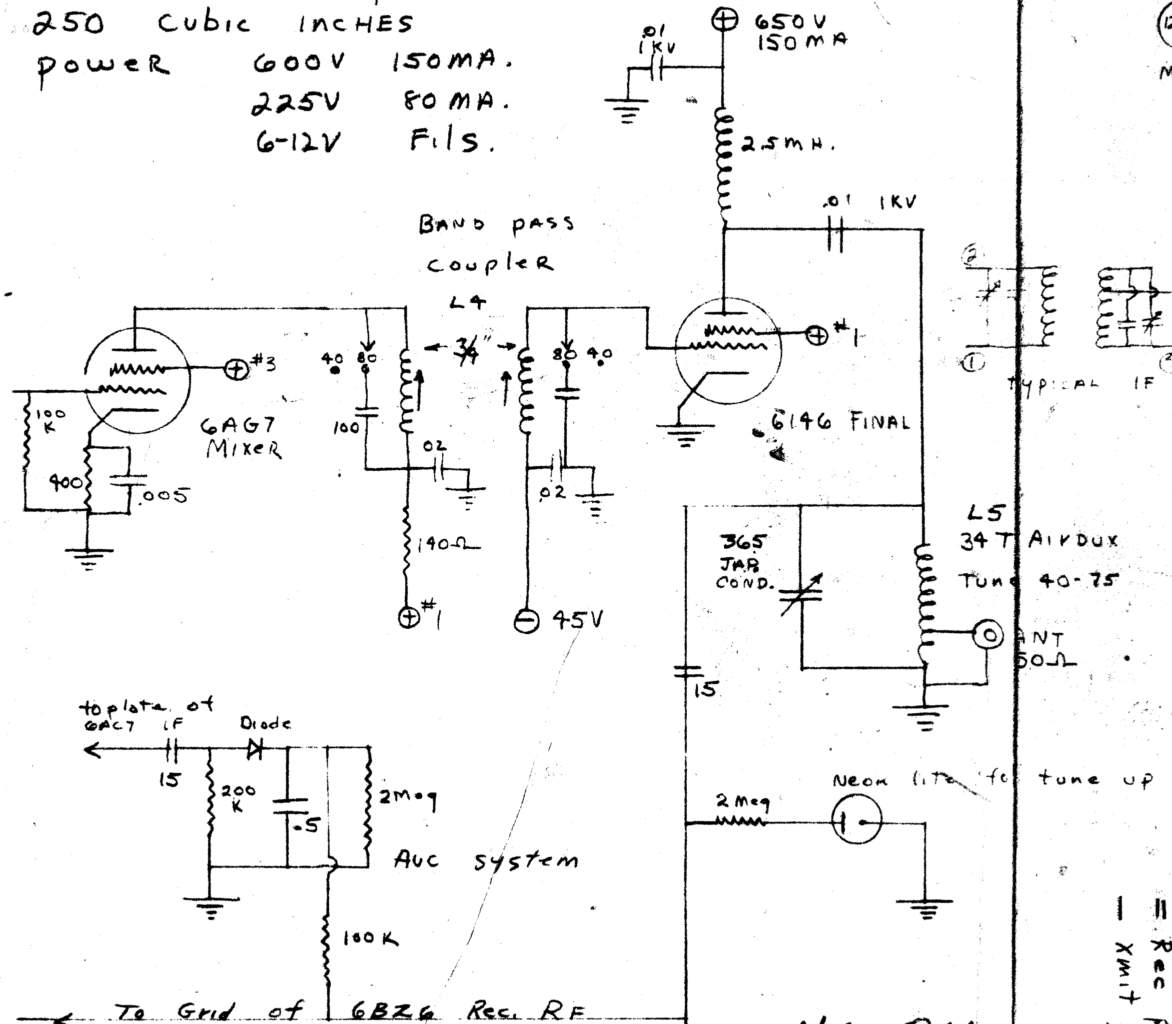
I knew Ernie Mason, W6IQY (SK), for many years. I lived next door to him when I was about 3 years old in 1947. Our families stayed in touch

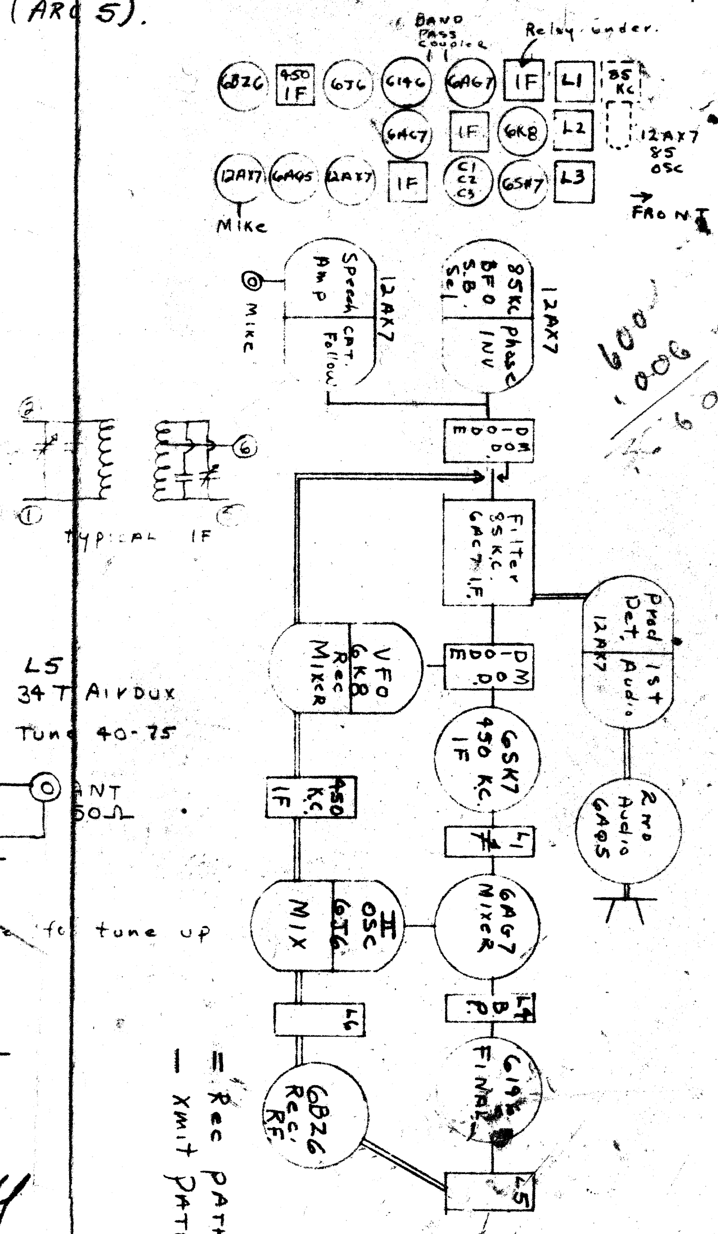
throughout his life. He encouraged me to get my amateur radio license in 1960 and lent me equipment. When I was in high school, about 1961 or 1962 I attempted to build one of the SSB transceivers that he designed using the BC-453. It was a later version of the one that is described in this booklet, probably version 3. I know that there were at least three versions of the transceiver with many minor variations. Ernie was an inveterate tinkerer.

The schematic fragment on the next page is in Ernie's handwriting and appears to be from version 1, or an early version 2, of the SSB transceiver design. It does not match the schematic in this booklet. Notice that it says it is a revision in 1960 and it is a version with one relay. I believe that the diode in the AVC circuit is drawn backwards.

PAGE 2 of 2. W6IQY

Mobile S.S.B TRANSCIEVCR FROM BC 453 (ARC 5).
40-80 Meter BAND Single VFO CONTROL
30DB Selectable Side BAND
60 WATTS out put.
250 cubic inches
power 600V 150MA.
225V 80MA.
6-12V Fils.





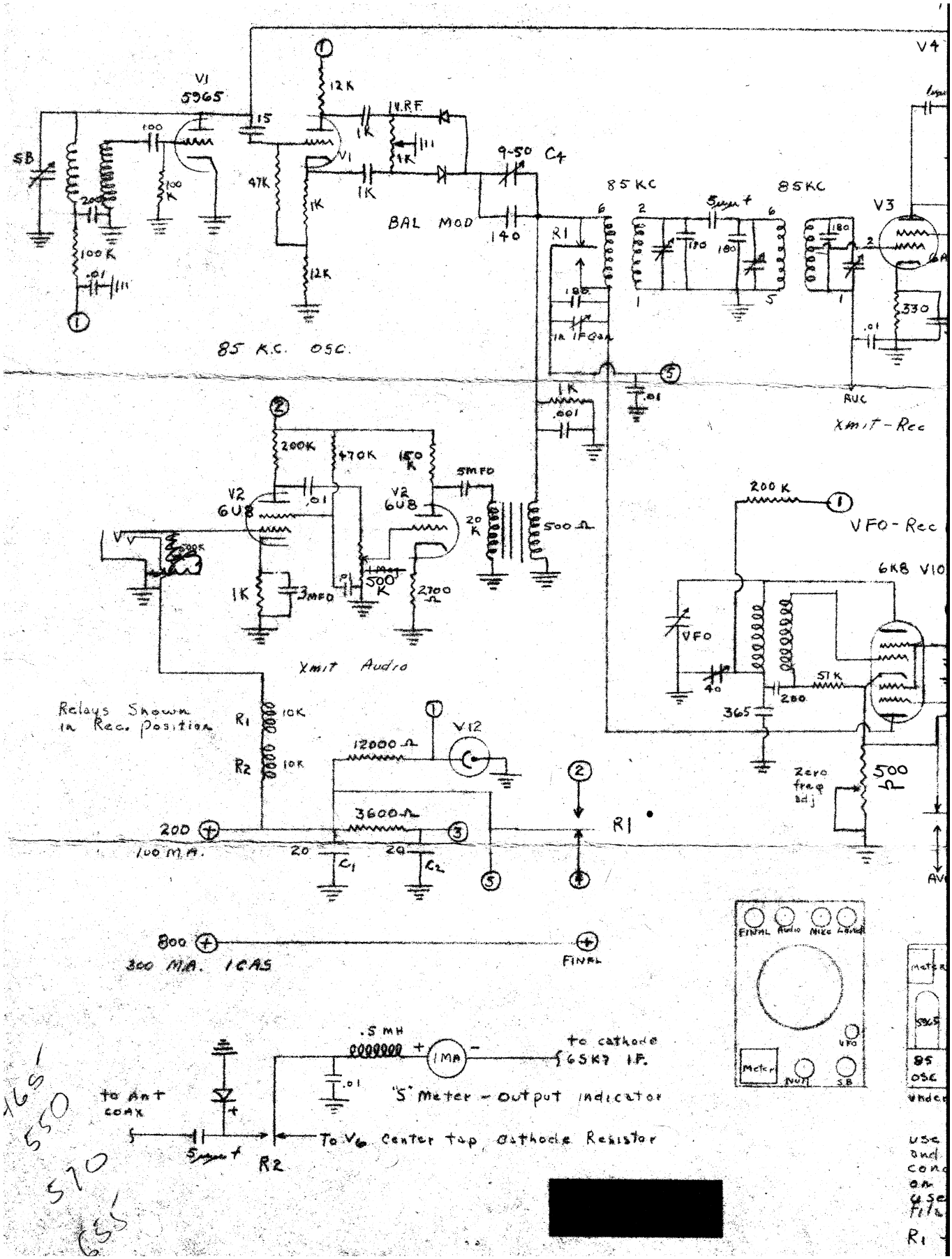
W6IQY

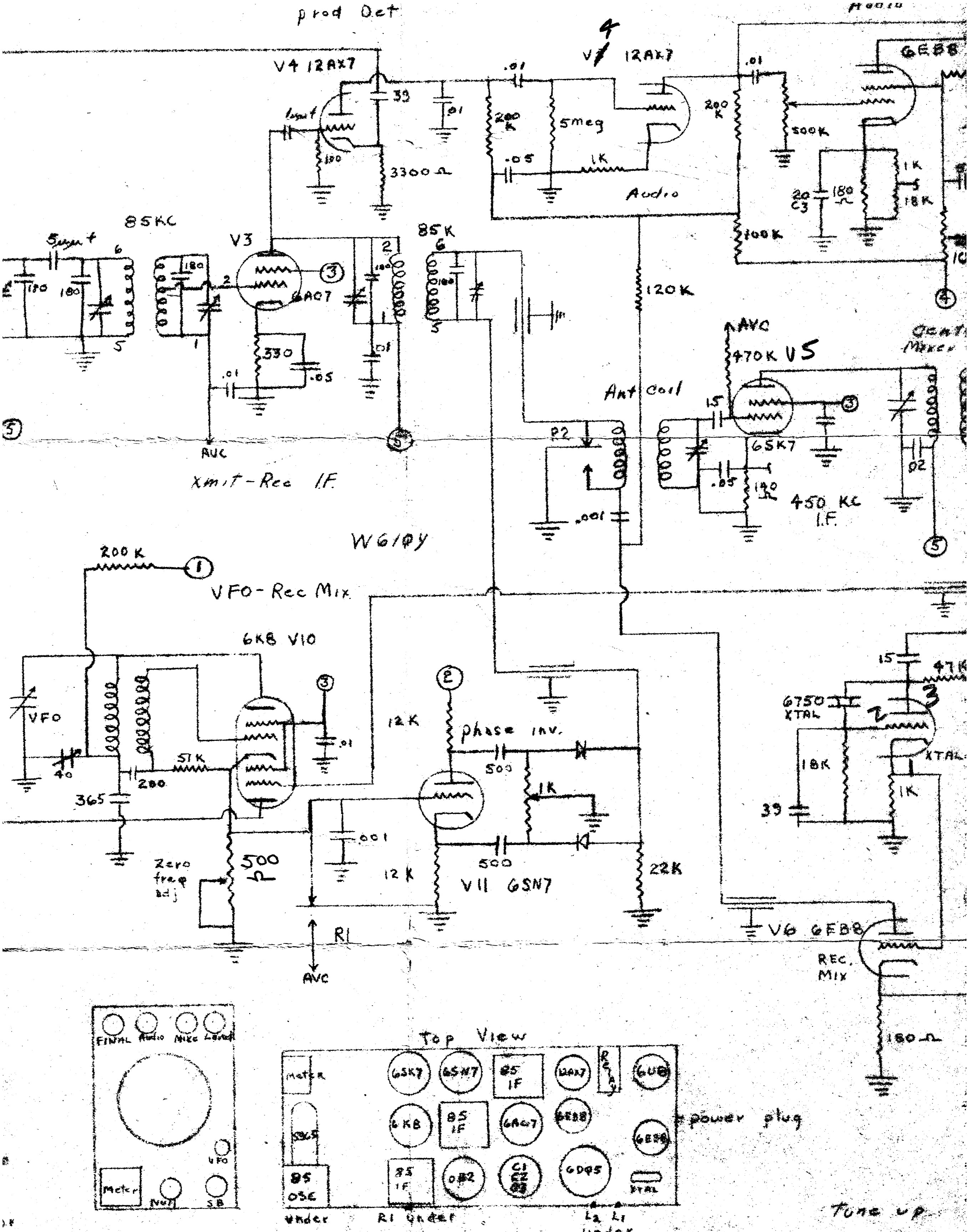
Revised July 27 1960 (to use 1 relay)

600
.006
60
200000
2.500K
600=

Version 3 Of The SSB Transceiver From A BC-453

The version of the transceiver that I attempted to build in high school was the later version that used a 6DQ5 in the final. One of the interesting features was the clever use of the 6DQ5 final as the RF amplifier in the receiver. Also the carrier oscillator and balanced modulator was greatly simplified. It is also interesting to note that Ernie went back to using multiple relays in this version. This was easy for him because he was using surplus IBM Electronic Accounting Machine wire contact relays. Ernie was the IBM San Diego Field Service Manager.


V1
5965
12K
1K
1K
1K
47K
1K
12K
100
100K
.01
100
K
SB
.01
BAL MOD
9-50 C4
140
85 KC
85KC
V3
330
.01
RUC
Xmit - Rec
85 K.C. OSC.
200K
470K
150 K
5MFD
V2
6U8
V2
6U8
20 K
500 Ω
1K
3MFD
500 K
2700
Xmit Audio
200 K
VFO - Rec
6K8 V10
VFO
40
51K
280
365
Zero freq adj
500 Ω
Relays Shown in Rec. Position
R1 10K
R2 10K
V12
12000 Ω
3600 Ω
200
100 MA.
20
C1
20
C2
R1
800
300 MA. ICAS
FINAL
.5 MH
1MA
to cathode 6SK7 I.F.
.01
"S" Meter - output indicator
to Ant coax
To V6 Center tap Cathode Resistor
R2
FINAL
Audio
Meter
Null
S.B.
VFO
meter
5965
95 OSC
use
R1

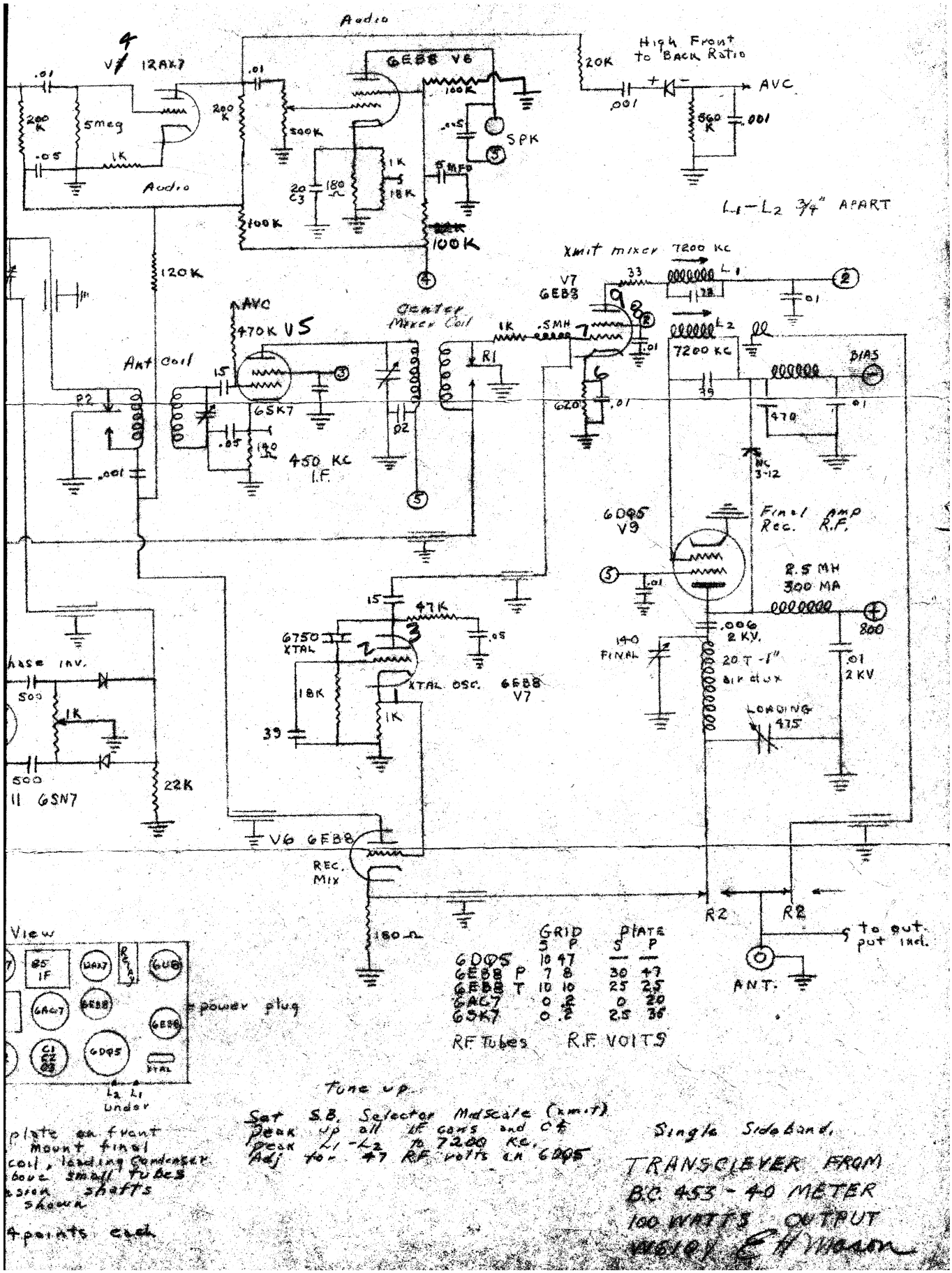


Tune up

Set S.B. Selector
Peak up all IF
Peak L1-L2 to
Adj for 47 RF

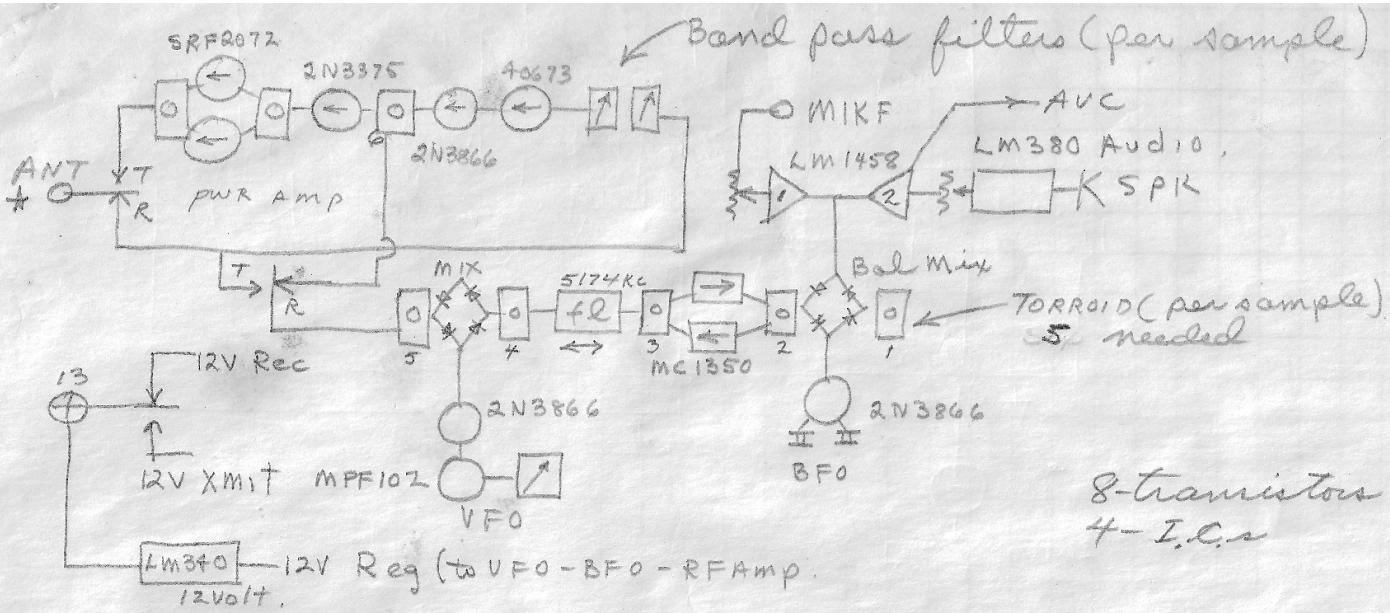
use 6½" patch plate on front
and rear panels. Mount final
condenser, final coil, loading condenser
on back plate above small tubes
use flex. extension shafts
filaments NOT shown

R1 - R2 have 4 points each


Audio
V1 12AX7
6EB8 V6
High Front to Back Ratio
AVC
SPK
L1-L2 3/4" APART
Xmit mixer 7200 KC
V7 6EB8
Center Meter Coil
Ant coil
470K V5
6SK7
450 KC I.F.
7200 KC
BIAS
Final Amp Rec. R.F.
6Q05 V9
2.5 MH 300 MA
800
.006 2 KV.
20 T - 1" air dux
LOADING 475
140 FINAL
.01 2 KV
6750 XTAL
XTAL OSC. 6EB8 V7
Phase Inv.
11 6SN7
V6 6EB8 REC. MIX
180 Ω
R2
R8
to output ind.
ANT.
GRID S P
PLATE S P
6Q05 10 47
6EB8 P 7 8 30 47
6EB8 T 10 10 25 25
6AC7 0 .2 0 20
6SK7 0 .2 2.5 36
RF Tubes R.F. VOLTS
Tune up.
Set S.B. Selector Midscale (Xmit)
Peak up all IF cans and C4
Peak L1-L2 to 7200 KC.
Adj for - 47 RF volts on 6Q05
Single Side Band.
TRANSCEIVER FROM
BC 453 - 40 METER
100 WATTS OUTPUT
View
power plug
L2 L1 under
plate on front
Mount final
coil, loading Condenser
above small tubes
4 points each

A Later IC SSB Transceiver

Ernie designed many SSB transceivers. His widow, Joye, gave me two later tube multiband transceivers that he had designed and built. Unfortunately I have no documentation, nor schematic diagrams for them. However I did receive some rough schematics for a clever solid state SSB transceiver in the box that contained the transceivers. Unfortunately they are not dated so I have no idea when he designed it.



8-transistors
4-I.C.s

* Must work into hi Q tuned ant. (such as mobile) or Low pass filter must be installed.

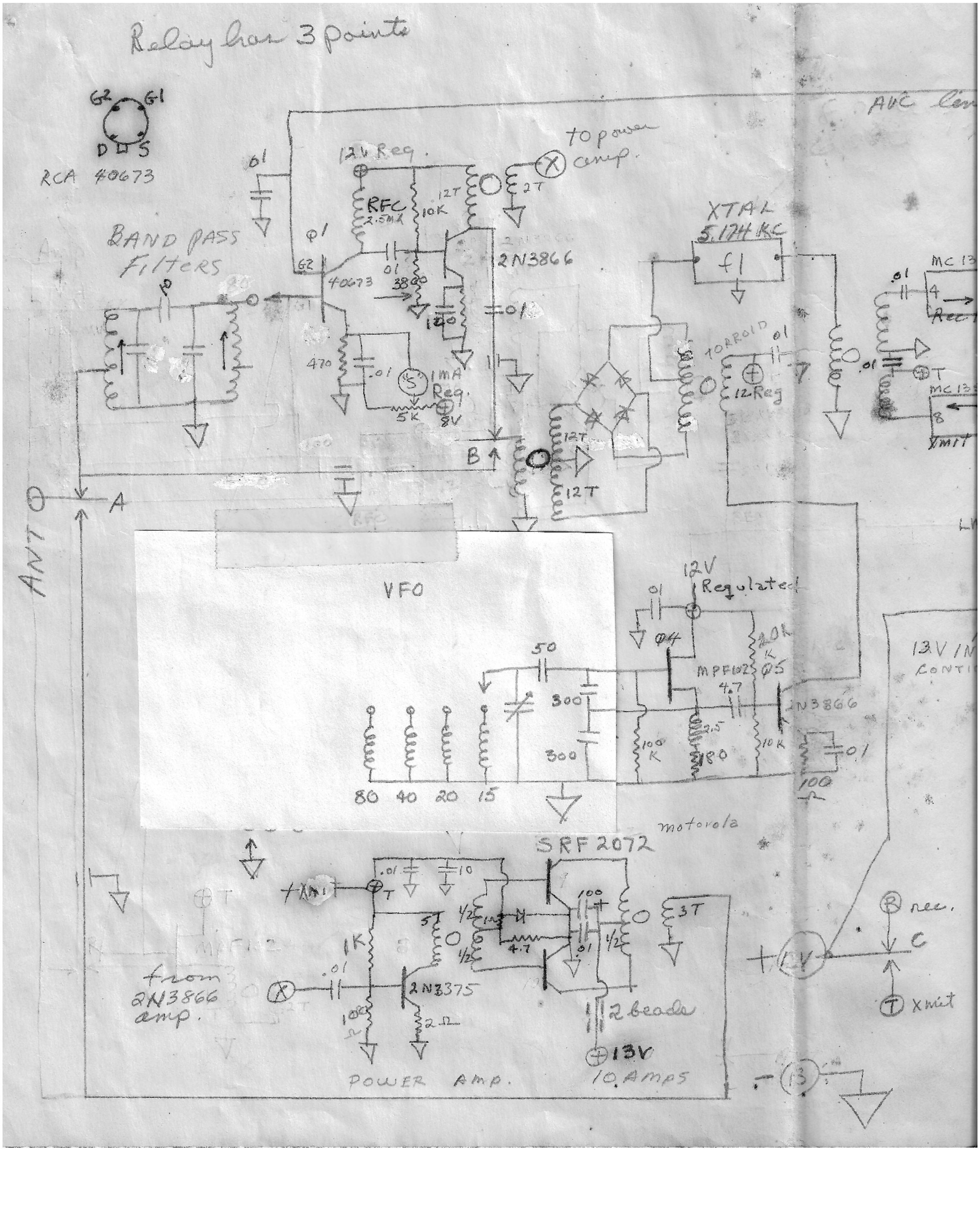
use good diodes in two balanced mixers.

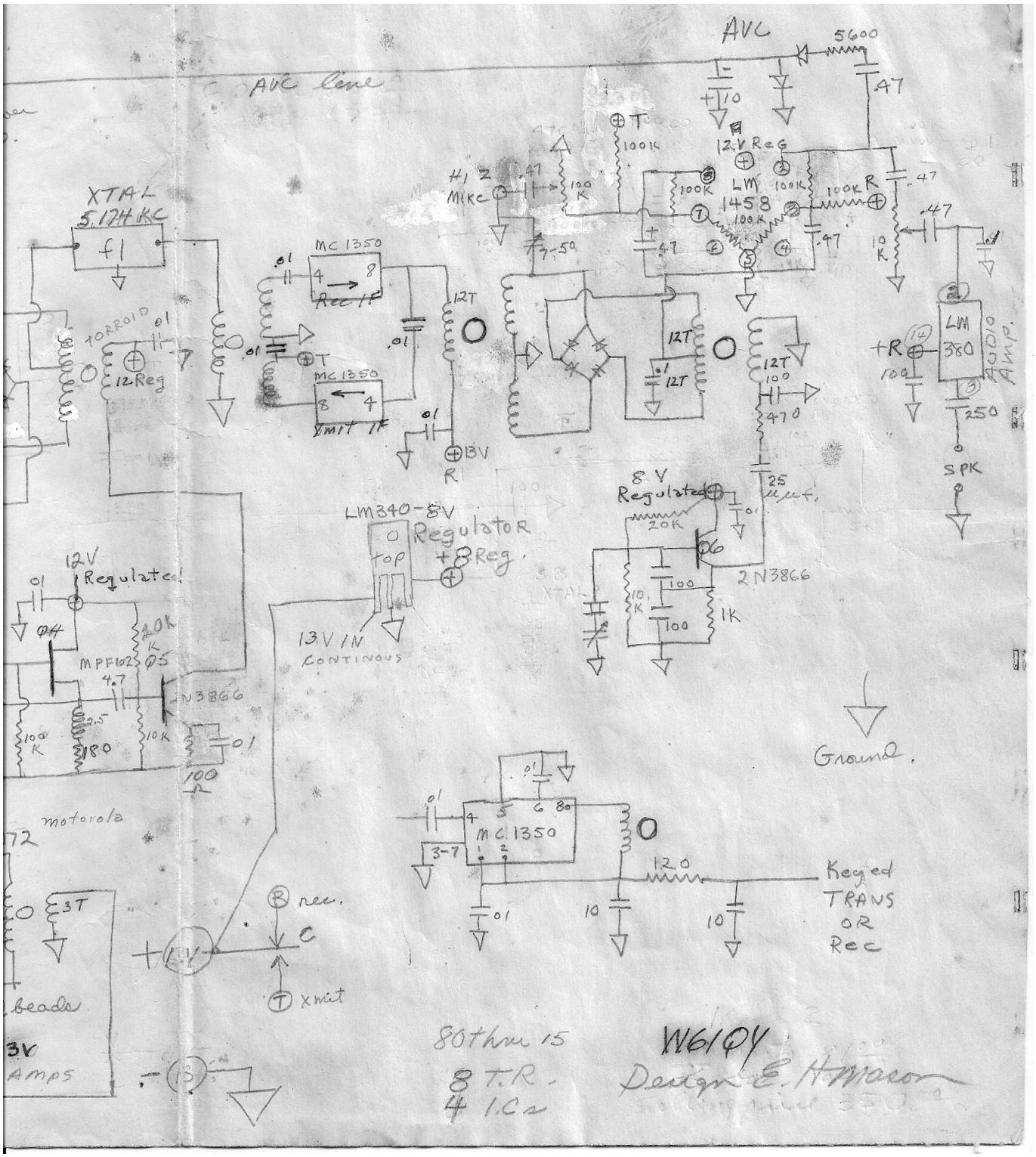
relay has three points - picked with press to talk.

FILTER	5174	
BAND	V.F.O	
80 -	8974	9174
40	12374	12474
20	9026	9176
15	16076	16326

W6IQY

Design E.H. Mason


Relay has 3 points
G2 G1
D S
RCA 40673
BAND PASS Filters
12V Reg.
RFC 2.5MH
10K
12T
2T
TO power amp.
2N3866
40673
470
1MA Reg.
5K
8V
XTAL 5.174 KC
f1
TORROID
12 Reg
ANT
A
B
12T
VFO
80 40 20 15
50
300
300
12V Regulated
Q4
MPF102
Q5
4.7
2N3866
100 K
180
10K
100
motorola
SRF 2072
from 2N3866 amp.
1K
2N3375
2 beads
13V 10 Amps
POWER Amp.
3T
rec.
Xmit
C
13V
AVC


AVC
AVC line
5600
.47
10
T
100K
12V Reg
MIKC
.47
100K
LM 1458
100K
100K R
.47
.47
10K
XTAL
5.174 MC
f1
MC 1350
Rec IF
.01
12T
.01
TOROID
12 Reg
MC 1350
Xmit IF
.01
13V R
12T
12T
12T
100
470
LM 380
AUDIO AMP.
+R
100
250
SPK
8 V Regulated
20K
.01
25 μμf.
2N3866
100
10K
100
1K
LM340-8V
Regulator
top
+8 Reg.
13V IN
CONTINOUS
12V Regulated
.01
Q4
MPF102
4.7
10K
Q5
2N3866
100K
2.5
380
10K
.01
100
Ground.
motorola
.01
.01
MC 1350
3-7
120
Keyed
TRANS
OR
Rec
10
10
R rec.
C
T xmit
3T
beads
3V
Amps
80 ohm 15
8 T.R.
4 I.C.s
W6IQY
Design E. H. Macon