NRC crystal testing unit for 3000 Mc.: description of components and procedure for testing

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NATIONAL RESEARCH COUNCIL OF CANADA

RADIO SECTION

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NRC CRYSTAL TESTING UNIT FOR 3000 Mc.

OTTAWA

NOVEMBER, 1941

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NATIONAL RESEARCH COUNCIL OF CANADA

RADIO SECTION

N.R.C. CRYSTAL TESTING UNIT FOR 3000 MC. DESCRIPTION OF COMPONENTS AND PROCEDURE FOR TESTING

OTTAWA

NOVEMBER, 1941

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N.R.C. CRYSTAL TESTING UNIT FOR 3000 MC.

DESCRIPTION OF COMPONENTS AND PROCEDURE FOR TESTING

INDEX

N.R.C. CRYSTAL TESTING UNIT FOR 3000 ,MC.

DESCRIPTION OF COMPONENTS AND PROCEDURE FOR TESTING

I INTRODUCTION

This report describes equipment that has been used to determine the relative merits of different crystals as mixers at 10 cms. The comparison is made on the basis of the conversion factor, although relative noise may also be indicated if the crystal noise is above average. Absolute measurements of the conversion factor or noise are not possible with this equipment.

Referring to the block diagram (Dwg. 86) it is seen that the signal generator, whose output is variable and is monitored, is fed through an attenuator to the mixer unit. The Sutton tube local oscillator is also fed to the mixer unit. Associated with the mixer is the I.F. preamplifier. The output of this preamplifier is fed to the final I.F. amplifier, whose output meter is used to indicate crystal performance.

II DESCRIPTION OF COMPONENTS

1. Signal Generator (Dwg. 89)

A Sutton tube oscillator is used as the signal generator and a regulated power supply should be used with this tube. Since high output is not necessary, the tube can be run at as low a resonator current as will permit stable operation. The wavelength now in use is approximately 10 cm. Any wavelength in the range of the Sutton tube would probably be satisfactory. The pick-up loop for the monitor is set for optimum coupling. The loop for the signal to the mixer is set to pick up a very small signal - enough to give full scale reading on the output meter at the maximum signal-to-noise ratio of a good crystal. The whole unit should be completely shielded.

2. Local Oscillator (Dwg. 89)

A regulated supply is also recommended for the local oscillator. The loop is set for optimum coupling. In order to facilitate accurate tuning, one of the tuning plungers is driven by a large knob. The pick-up loop and cable must be insulated from the resonator, if resonator currents are to be measured.

3. Monitor (Dwg. 87)

The monitor used is a simple D.C. bridge circuit with 1/100 amp. Littlefuses in two of the arms. The fuse in one

of these arms is heated by R.F. from the signal generator, and the change of its resistance indicates the amplitude of the R.F. This fuse is set up in a concentric line fuse holder, as shown in the sketch. The line section is terminated in a tuning plunger which is plugged into the cable from the signal generator. This is placed in one arm of the bridge by means of a length of microphone cable fitted with Jones plug connections. The Littlefuses vary in resistance from about 120 ohms to 200 ohms. To facilitate balancing any fuse which may be placed in the fuse holder, four fuses with representative resistances - say 130, 150, 170 and 190 ohms - are placed in the balancing arm on a selector switch. A fairly rugged meter, while not necessary, is recommended. The switch S_2 can usually be left open, though it may be necessary to close it in order to obtain a more sensitive circuit when lining up the Sutton tubes. The circuit is balanced by adjusting the selector switch and the 1000 ohm potentiometer. The monitor can also be used to check the local oscillator when it is first turned on. The monitor is not used to measure the signal, but merely to indicate that t the same amount of signal is present for each test.

4. Attenuator

A length of Bell attenuator cable, about 15 feet, is employed as an attenuator. General Radio concentric cable connectors are used throughout.

5. Mixer (Dwg.91)

The mixer used is identical with that used on GL. A rack-and-pinion drive on the local oscillator injector will be found very helpful.

6. I.F. Amplifier

The I.F. preamplifier and the main I.F. amplifier are identical with those used on GL.(See last page of this report for list of drawings for I.F. amplifier.) It has been found necessary to use a four stage preamplifier. The crystal current meter is a 0-2.5 D.C. milliammeter. The output circuit requires a 0-250 D.C. microammeter and a dry cell with a rheostat to provide current to balance out the diode current. (See Dwg. 90)

III PROCEDURE FOR TESTING CRYSTALS

1. Initial Lining Up

With the amplifier gain reduced to zero, balance out the diode current. (See Dwg. 90) The reading of the meter at full gain indicates the extent of the amplifier noise. Use the monitor to check if both Sutton tubes are oscillating and to set the monitor loop of the signal generator and the loop in the local oscillator for optimum coupling. Adjust the signal loop so that it is certain a signal is being picked up. With a good crystal in place, adjust the injector for 0.6 ma. crystal current. Adjust the triple stub and tune the Sutton tubes for maximum signal-to-noise ratio on the output meter. Reduce the signal loop coupling when necessary to keep the meter on scale. When other adjustments are made, set the loop to give almost full scale reading for maximum signal-to-noise ratio on a good crystal. If it is not certain that the crystal used is a good one, some readjustment of the signal loop may be necessary.

2. Test

With the amplifier gain reduced to zero, balance out the diode current. The meter reading at full gain gives an indication of the amount of amplifier noise. With no voltage on the signal generator, adjust the local oscillator injector for 0.6 ma. crystal current. The reading of the output meter indicates the amount of noise in the amplifier and crystal. Apply voltage to the signal generator and adjust to standard monitor reading. Tune the local oscillator and note the increase in output. The greater the output, the better is the crystal. After working on a few crystals, good readings will be readily recognized. If the crystal does not give a satisfactory reading, take the capsule apart and put it together with a new contact point. Few crystals will fail to give a satisfactory test on the second try.

It is recommended that a good crystal be carefully selected for use as a standard. The crystal tester should be checked at regular intervals with this standard.

IV LIST OF DRAWINGS

The following drawings are attached to this report

85 - Block Diagram of Assembly

86 - Regulated Power Supply for Sutton Tube

87 - Monitor Bridge

88 - Fuse Holder with Tuning Plunger

89 - Signal Generator and Local Oscillator Connections

90 - Diode Current Balancing Circuit

91 - Triple Stub Assembly and Details

The following drawings are associated with, but are not attached to this report:

I.F. Preamplifier

RB-EX-273-33 - Circuit

NRC-RB-1150-37 - I.F. Shield Box

" " 1148-37 - Detail I.F. Shield

" " 1130-37 - I.F. Shielding

" " 1198-33 - I.F. Preamplifier Chassis

" " 1198-37 - " " "

Main I.F. Amplifier

NRC-RB-1150-37 - I.F. Shield Box

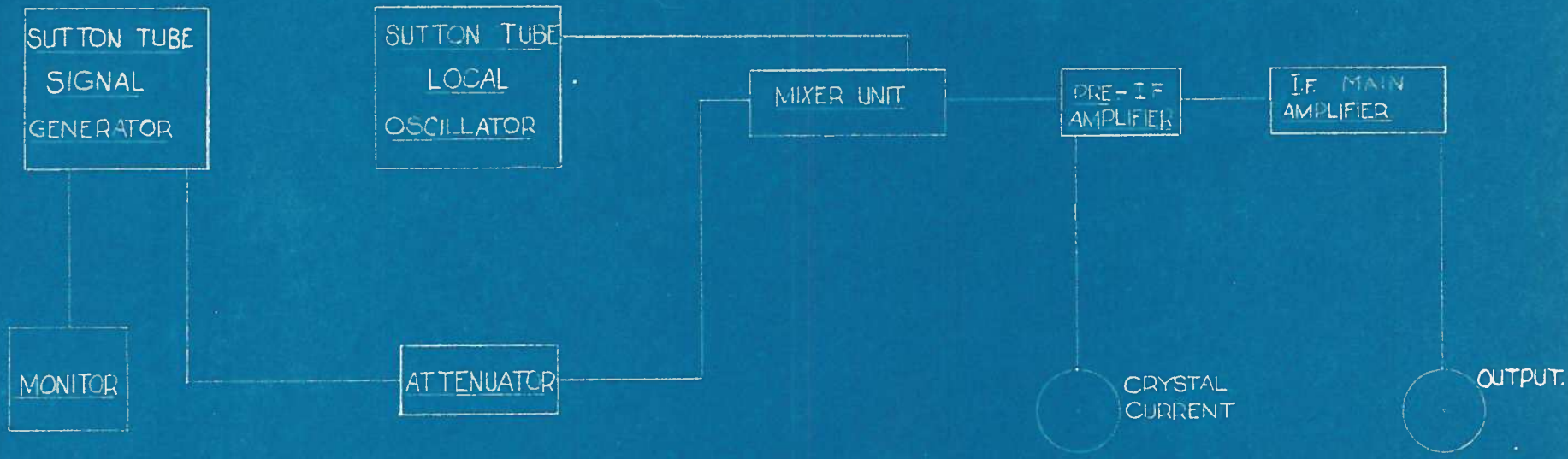
" " 1164-37 - Main Receiver Chassis Layout

" " 1172-37 - Main Receiver Circuit

" " 1173- 37 -Range I.F.

" " 1174-37 - Elevation and Azimuth I.F.

J.G. Retallack.



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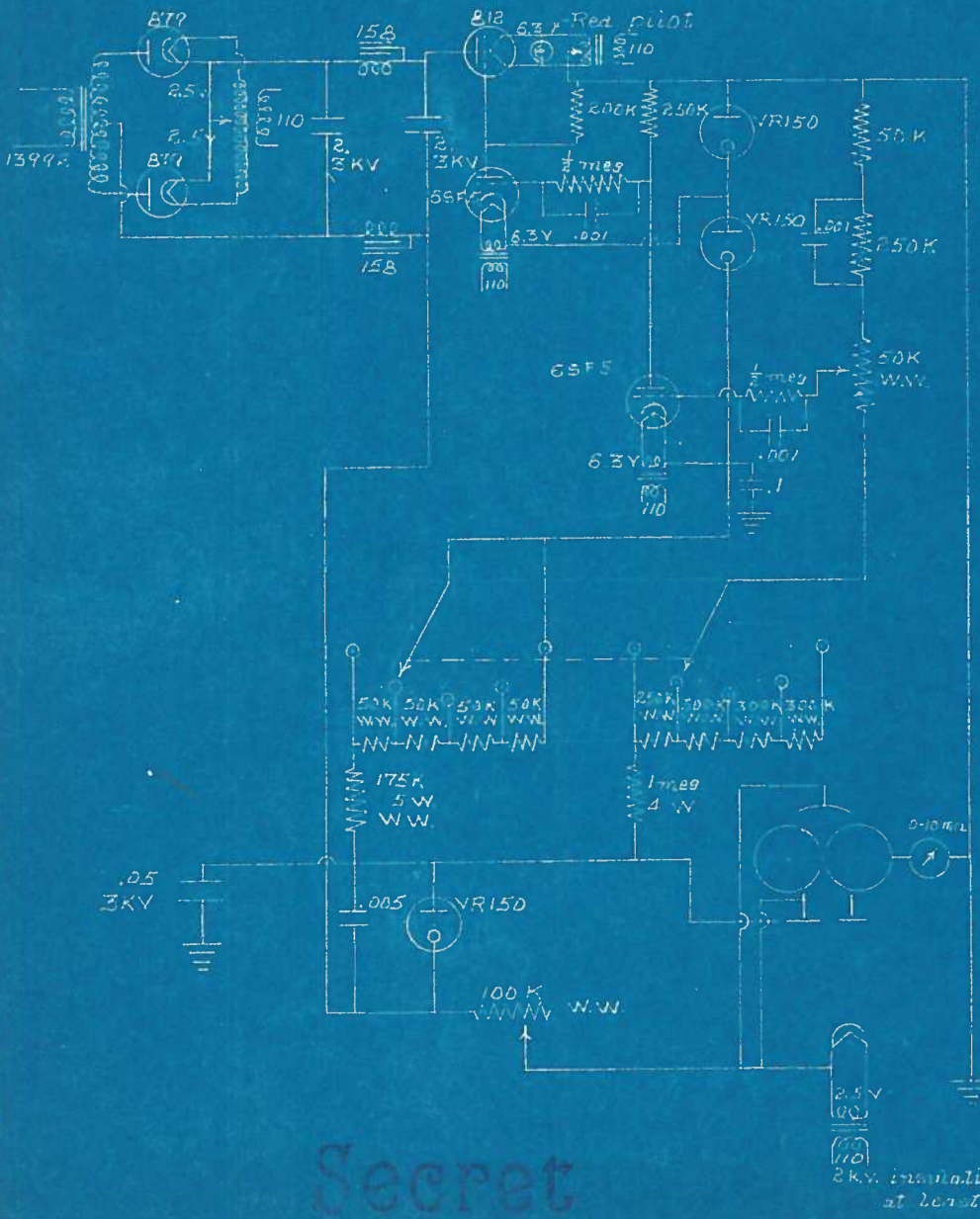
NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

NAME BLOCK DIAGRAM OF ASSEMBLY-N.R.C. CRYSTAL TESTING UNIT FOR 3000 M.C.

DRG. NO. Ref-85



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ENG. APPROV.	DATE	FINISH.		

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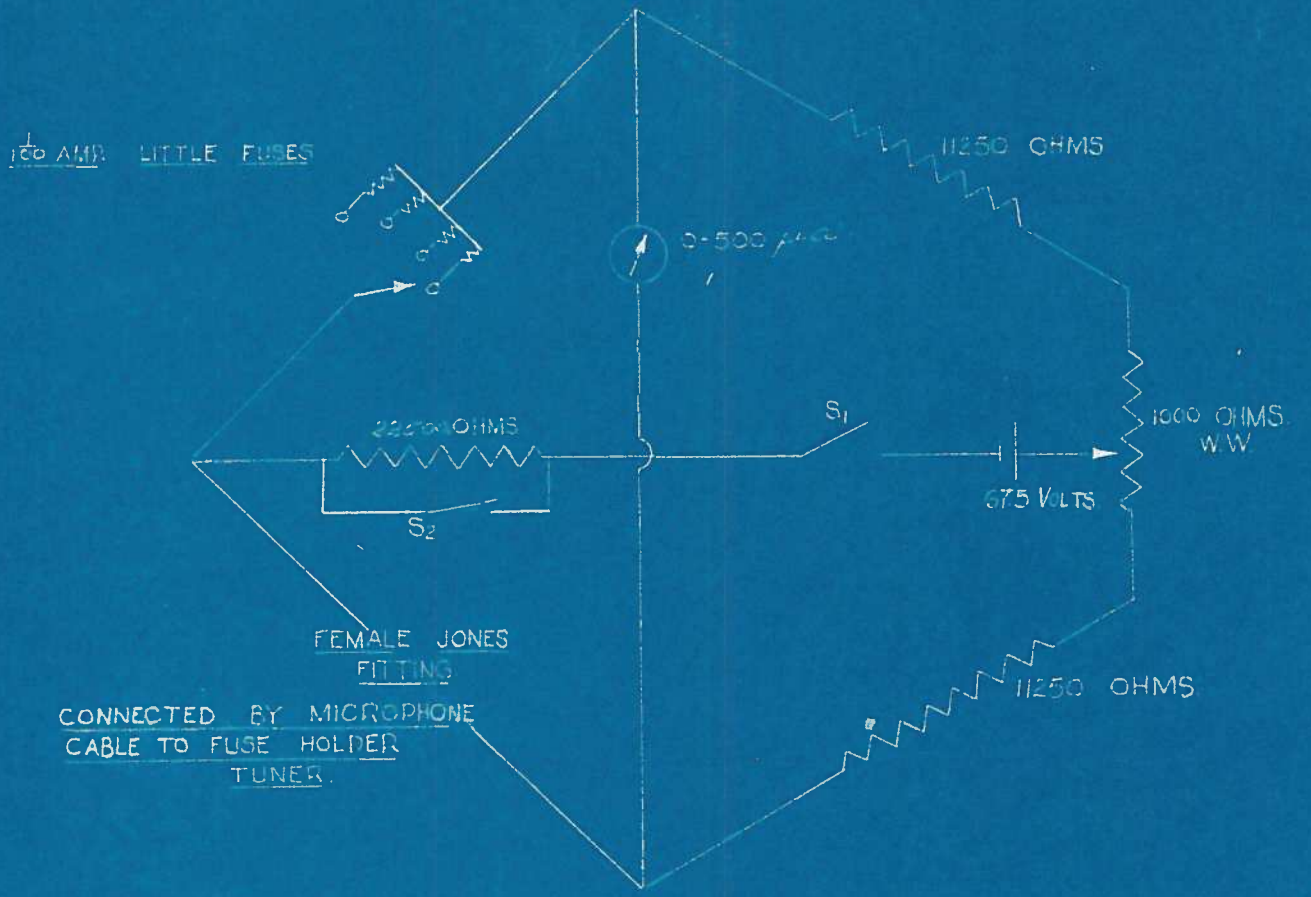
NAME REGULATED POWER SUPPLY FOR SUTTON TUBE - NRC CRYSTAL TESTING UNIT FOR 3000 MC. REF. NO. 86



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CHECKED [illegible]	DATE 6-11-41	SCALE		
ENG. APPROV. [illegible]	DATE	FINISH.		

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NAME MONITOR BRIDGE - N.R.C. CRYSTAL TESTING UNIT FOR 3000 MC.

REF. NO. 87

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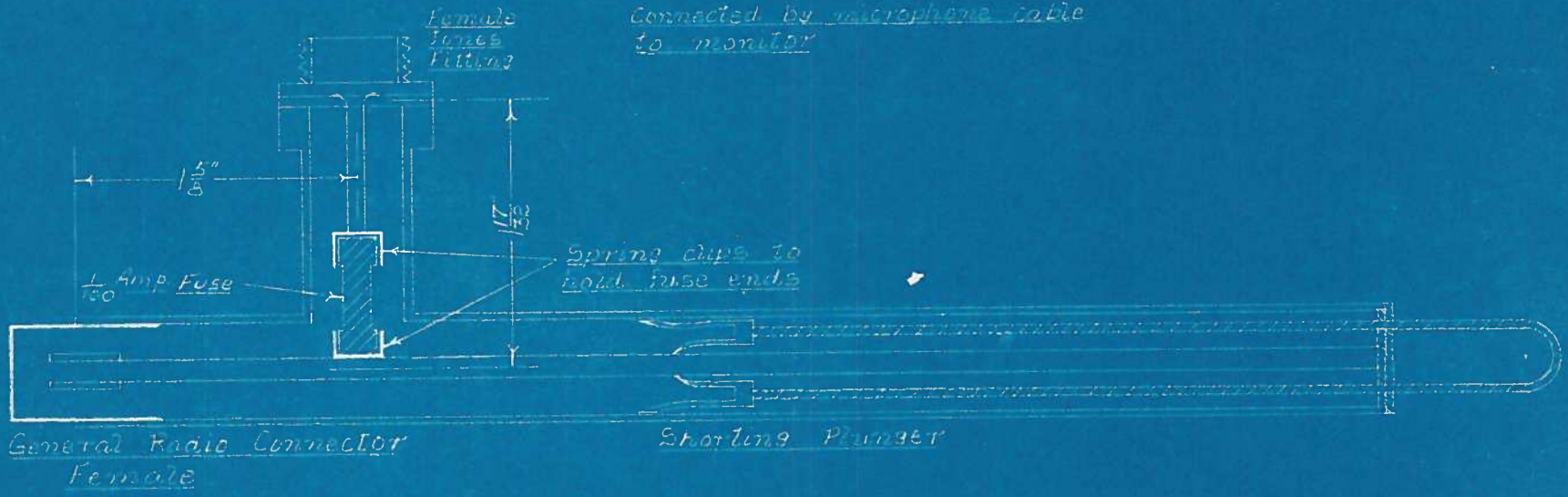

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NAME FUSE HOLDER WITH SHORTING PLUNGER - NRC CRYSTAL TESTING UNIT FOR 3000 Mc

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SIGNAL GENERATOR

TUNING PLUNGER

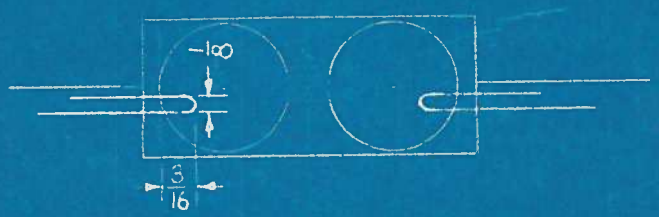
PICK UP LOOP SET FOR OPTIMUM COUPLING

LOOP SET FOR SMALL COUPLING

BELL ATTENUATOR CABLE TO MONITOR

BELL CABLE - SHORT SECTION TO ATTENUATOR

TUNING PLUNGER



LOCAL OSCILLATOR

TUNING PLUNGER

LOOP SET FOR OPTIMUM COUPLING

BELL CABLE TO L.O. INJECTOR

TUNING PLUNGER

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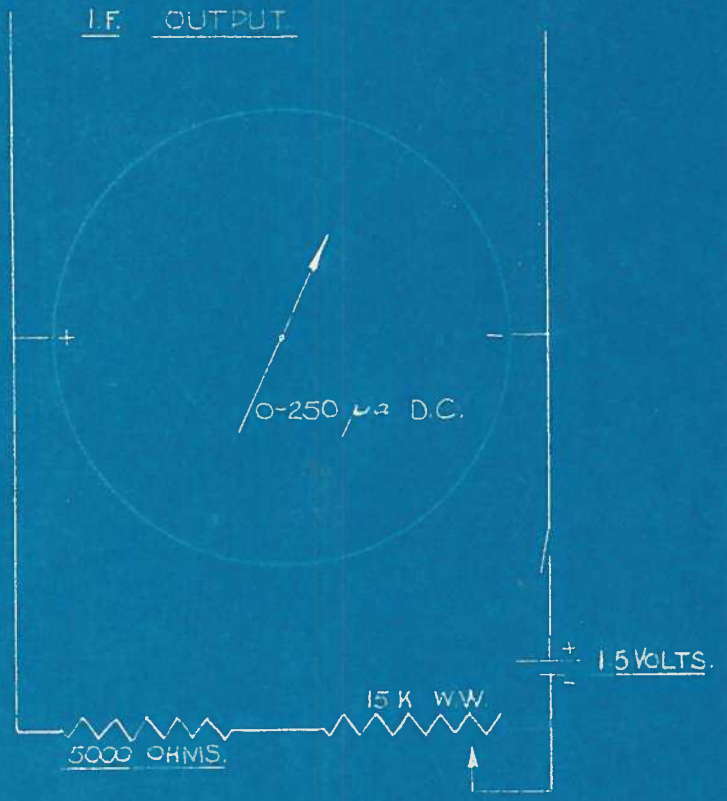
NAME SIGNAL GEN + LOCAL OSC. CONNECTIONS NRC. CRYSTAL TESTING UNIT FOR 3000MC.

REF. No. # 89



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NAME DIODE CURRENT BALANCING CIRCUIT - N.R.C. CRYSTAL TESTING UNIT FOR 3000 MC.

REF. NO. 90

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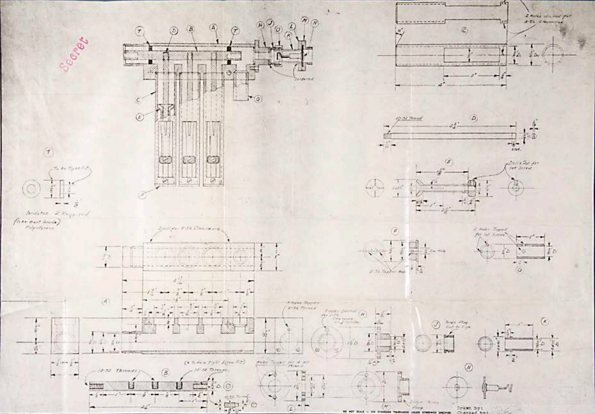

A	Make	One	G	Make	One
B	"	"	H	"	"
C	"	Three	J	Part of Brass Plug	
D	"	"	L	Make	One
E	"	"	M	Part of Jones Plug	
F	"	"	N	"	

O Part of Jones Plug

Drawing Corrected 7/9/41.
Detail "T" added 8/8/41.

DO NOT SCALE — USE STANDARD TOLERANCES UNLESS OTHERWISE SPECIFIED

FINISH

STANDARD TOLERANCES ON DIMENSIONS: INCHES FRACTIONAL DECIMAL

[redacted]

SAW MATERIAL

MATERIAL: BRASS — ALL PARTS SILVER PLATED.

PER M PIECES

EXPERIMENTAL NO.

Drawn by:
Checked by:
Eng. Approv. 6/11/4

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OTTAWA - CANADA

NAME: TRIPLE STUB ASSEMBLY AND DETAILS
REF. #91