Design of a 214 Mc. Yagi for CSC

Bridgland, C. J.; Bell, R. E.; National Research Council of Canada, Radio Section

Publisher's version / Version de l'éditeur:
https://doi.org/10.4224/21276389
PRA, 1941-11

SECRET

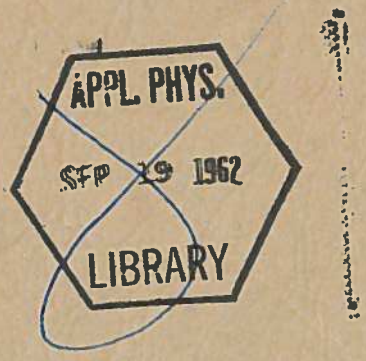
PRA-28

Copy No. 7

NATIONAL RESEARCH COUNCIL OF CANADA

RADIO SECTION

DESIGN OF A 214 MC. YAGI FOR CSC



OTTAWA

NOVEMBER, 1941

SECRET

ANALYZED

PRA-28

Copy No. 2

NATIONAL RESEARCH COUNCIL OF CANADA

RADIO SECTION

DESIGN OF A 214 MC. YAGI FOR CSC

OTTAWA

NOVEMBER, 1941

SECRET
PRA-28
COPY #___7

DESIGN OF A 214 MC. YAGI FOR CSC

INDEX

SECRET
PRA-28
COPY # 7

DESIGN OF A 214 MC. YAGI FOR C.S.C.

Altering the operating frequency of C.S.C. from 200 mc. to 214 mc. involved considerable change in physical dimensions of the antenna. An attempt was also made to improve the radiation pattern and matching circuit.

1. Dimensions:

The same relative dimensions with respect to wave length proved satisfactory, and the overall length and position of braces and fittings were altered to maintain symmetry. (See drawing of complete antenna, Dwgs. 122 & 123.) The length and position of the elements are:

One radiator - see Dwg. 119 of folded dipole

One reflector - 3/16" dia. - 70 cm. long - 35 cm. behind radiator.

Two reflectors - 3/16" dia. - 70 cm. long - 35 cm. above and below radiator.

Ten directors - 3/16" dia. - 59 cm. long, spaced 47.5 cm.

2. Matching Yagi to 70 ohm Coaxial

The original 200 mc. feeder system, using a SW-1C Yagi, 3/8" trombone filled with polystyrene beads, and 100 feet of V.J. Andrews 5/8" soft drawn coaxial cable, gave a power efficiency of 40%. Part of this loss could be traced to the use of a trombone perhaps 50% too long due to the polystyrene insulation, and part to the impedance match.

Any attempt to match the Yagi to a 70 ohm open wire line using a simple dipole radiator was unsatisfactory, due to the extremely low array impedance. Hence a folded dipole was used, and by varying the length an impedance of 140 ohms pure resistance was obtained. This arrangement was fed through the 70 ohm 5/8" coaxial line and a 100 ohm coaxial transformer in a quarter wave balancing sleeve. (The sleeve as used in experiments is shown in Dwg. 120. A suggested design for manufacture

is given in Dwg. 121.)

The match was checked using a length of 70 ohm slotted pipe and a thermocouple milliammeter. A standing wave ratio of 1.35 to 1 was obtained at 214 mc. Experiments proved the advisability of completely insulating the sleeve from the central metal support of the Yagi. Results of measurements on efficiency are as follows:

	Relative Voltage Efficiency
Sleeve completely insulated	100%
Grounded to frame at coaxial end	94%
Completely bonded to frame	88%

In addition, field strength patterns taken with the sleeve grounded in any way show a distinct distortion. The horizontal pattern with sleeve insulated is given in Dwg. 111, and those with sleeve grounded at one end and completely grounded in Dwgs. 117 and 118 respectively.

As opposed to the 40% power efficiency of the former feeder system, the redesigned feeder system appears to have very small losses.

3. Radiation Patterns

Horizontal and vertical radiation patterns of the final design (Dwgs. 111 & 112) indicated a forward-to-back ratio of better than 8 to 1. It was felt that variations in frequency would occur in practice, so horizontal radiation patterns for frequencies of 206, 210 and 218 mc. are given in Dwgs. 113, 114 and 115, respectively. In addition, the variation in standing wave ratio in the coaxial line has been plotted in Dwg. 116 over a large frequency range.

4. Conclusion

Both the folded dipole and the quarter wave sleeve offer a simpler and stronger mechanical construction than the previous feeder system. The array is quite satisfactorily matched and is not seriously affected by variation in frequency from 208 to 216 mc.

Time did not permit a thorough investigation of the effects of bonding the elements to the central metallic support, but no serious loss in efficiency was apparent.

5. List of Drawings:

Dwg. #111 - Yagi Horizontal Pattern at 214 mc.

#112 - Yagi Vertical Pattern at 214 mc.

#113 - Yagi Horizontal Pattern at 206 mc.

#114 - Yagi Horizontal Pattern at 210 mc.

#115 - Yagi Horizontal Pattern at 218 mc.

#116 - Variation with Frequency of Standing Wave Ratio in Coaxial Line.

#117 - Horizontal Pattern with Sleeve Grounded at Coaxial Line End - 214 mc.

#118 - Horizontal Pattern with Sleeve Completely Bonded to Frame - 214 mc.

#119 - Detail of Folded Dipole for 214 mc. Yagi.

#120 - Construction of Coaxial Sleeve.

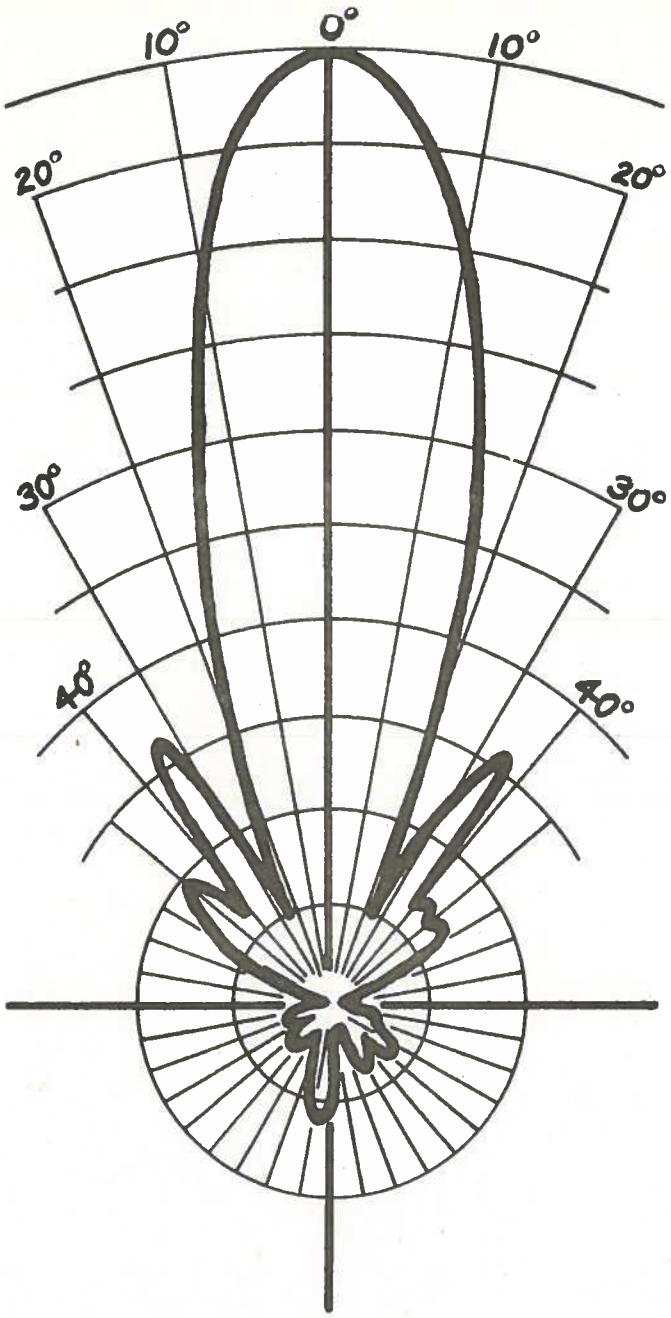
#121 - Proposed Design of Balancing Sleeve.

#122 - 214 Megacycle Yagi.

#123 - Pipe Support Detail.

C.J. Bridgland.

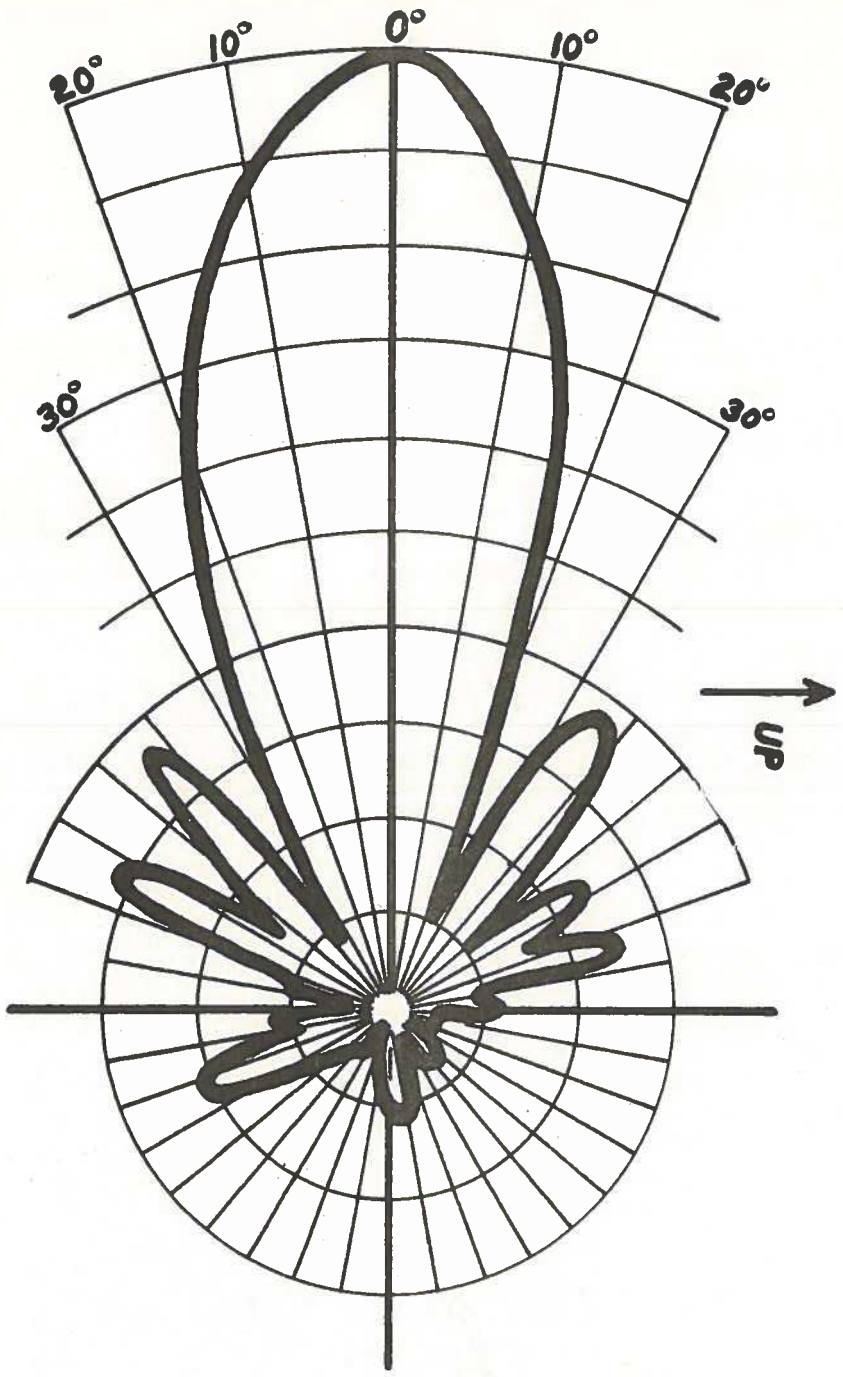
R.E. Bell.



Drawn by: R.E.B. Date: 10/11/41
Checked by: R.E.B. Date: 10/11/41
Eng. Approv. R.E.B.
NATIONAL RESEARCH COUNCIL - RADIO SECTION
OTTAWA - CANADA

NAME: YAGI HORIZONTAL PATTERN AT 214 M.C.

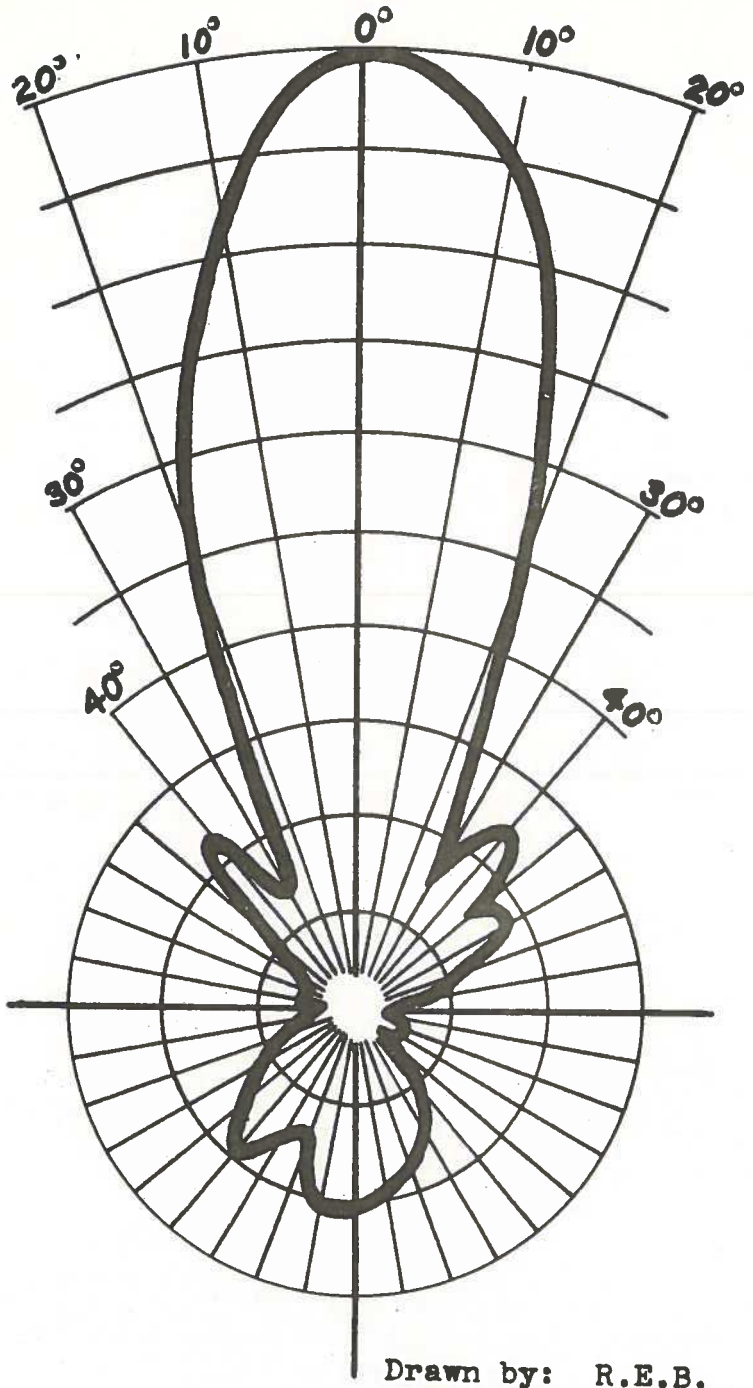
REF.#111



Drawn by: R.E.B. Date: 13/11/41
Checked by: R.E.B. Date: 13/11/41
Eng. Approv. R.E.B.
NATIONAL RESEARCH COUNCIL - RADIO SECTION
OTTAWA - CANADA

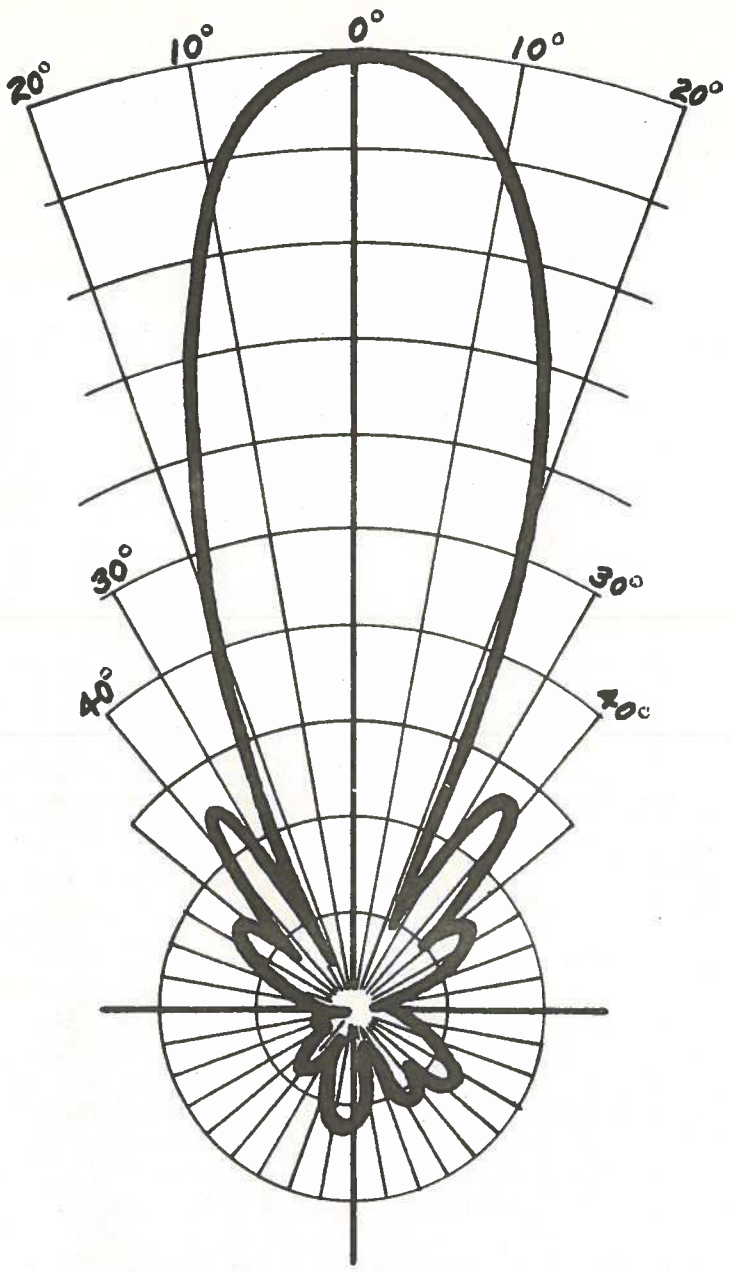
NAME: YAGI VERTICAL PATTERN AT 214 M.C.

REF.#112



Drawn by: R.E.B. Date: 21/11/41
Checked by: R.E.B. Date: 21/11/41
Eng. Approv. R.E.B.
NATIONAL RESEARCH COUNCIL - RADIO SECTION
OTTAWA - CANADA
NAME: YAGI HORIZONTAL PATTERN AT 206 M.C.

REF.#113

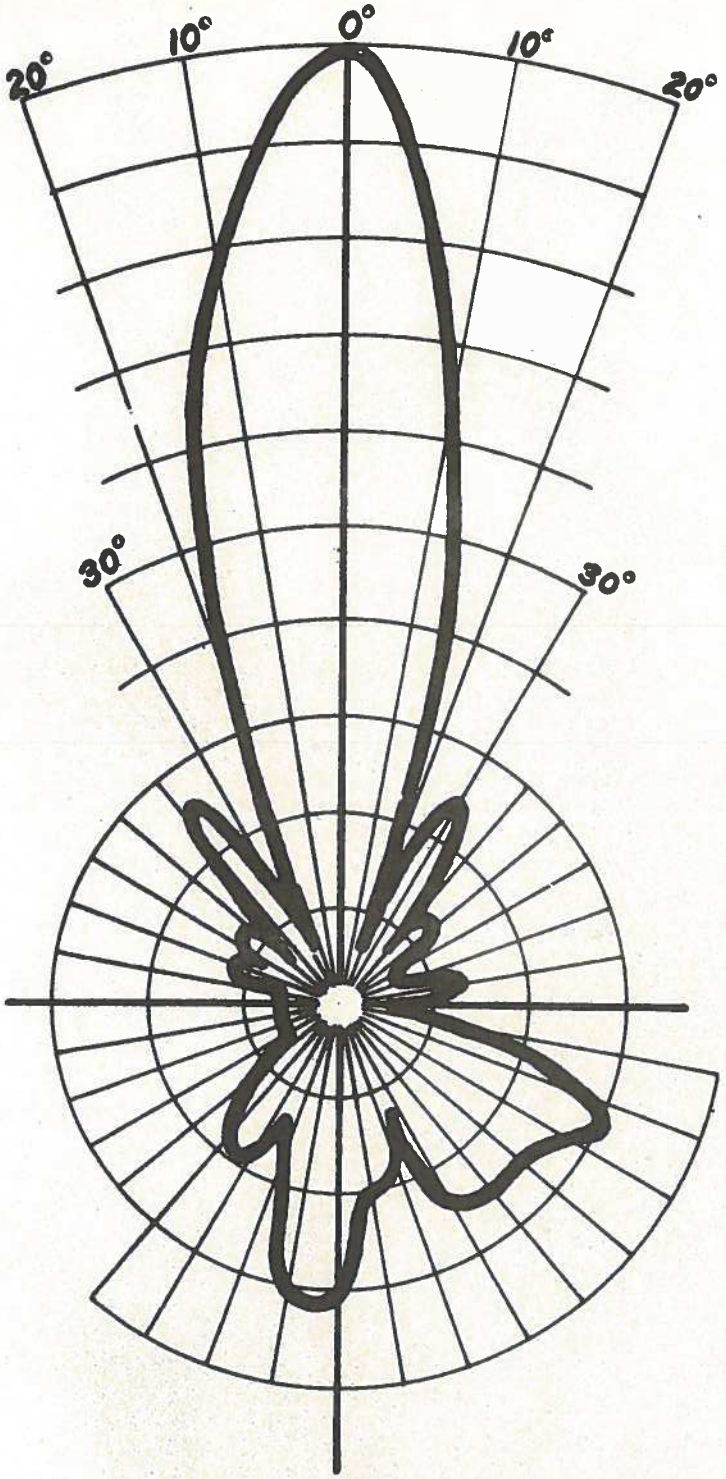


Drawn by: R.E.B. Date: 11/11/41
Checked by: R.E.B. Date: 11/11/41
Eng. Approv. R.E.B.

NATIONAL RESEARCH COUNCIL - RADIO SECTION
OTTAWA - CANADA

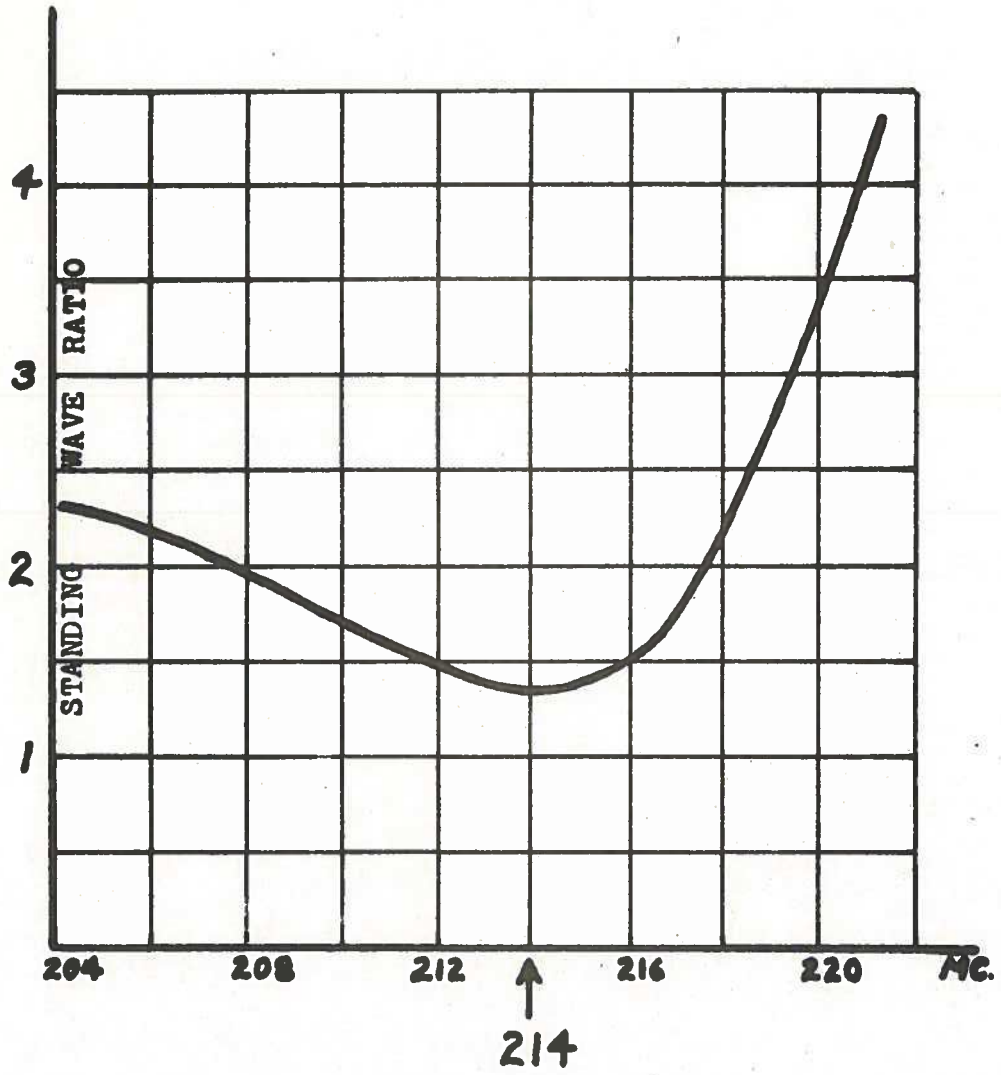
NAME: YAGI HORIZONTAL PATTERN AT 210 M.C.

REF.#114



Drawn by: R.E.B. Date: 11/11/41
Checked by: R.E.B. Date: 11/11/41
Eng. Approv. R.E.B.
NATIONAL RESEARCH COUNCIL - RADIO SECTION
OTTAWA - CANADA
NAME: YAGI HORIZONTAL PATTERN AT 218 M.C.

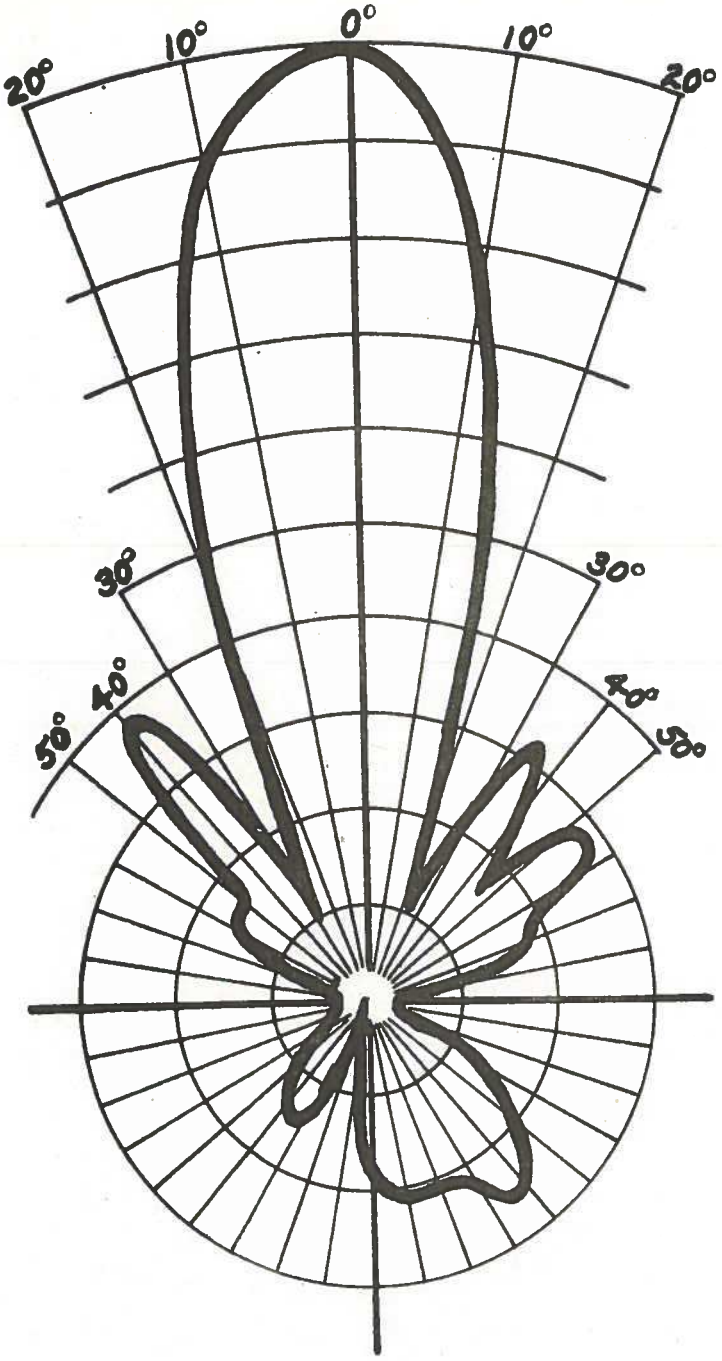
REF.#115



Drawn by: R.E.B. Date: 16/11/41
Checked by: R.E.B. Date: 16/11/41
Eng. Approv. R.E.B.
NATIONAL RESEARCH COUNCIL - RADIO SECTION
OTTAWA - CANADA

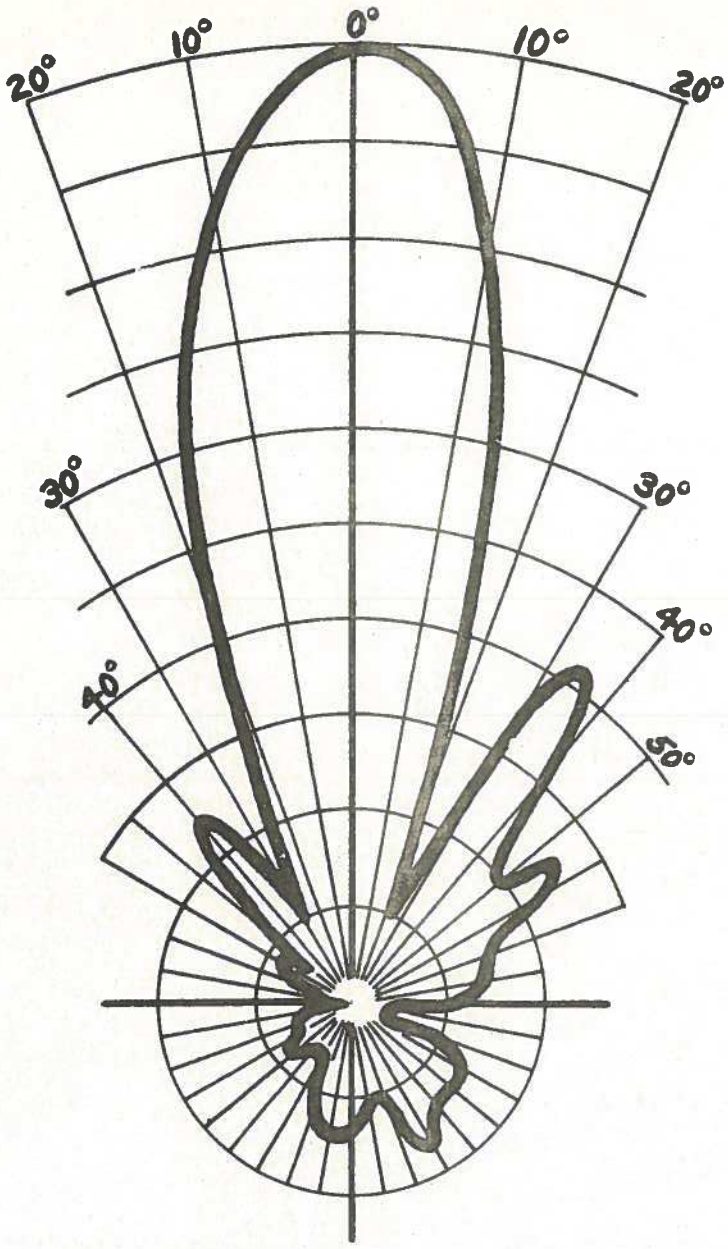
NAME: VARIATION WITH FREQUENCY OF STANDING WAVE RATIO IN COAXIAL LINE

REP.#116



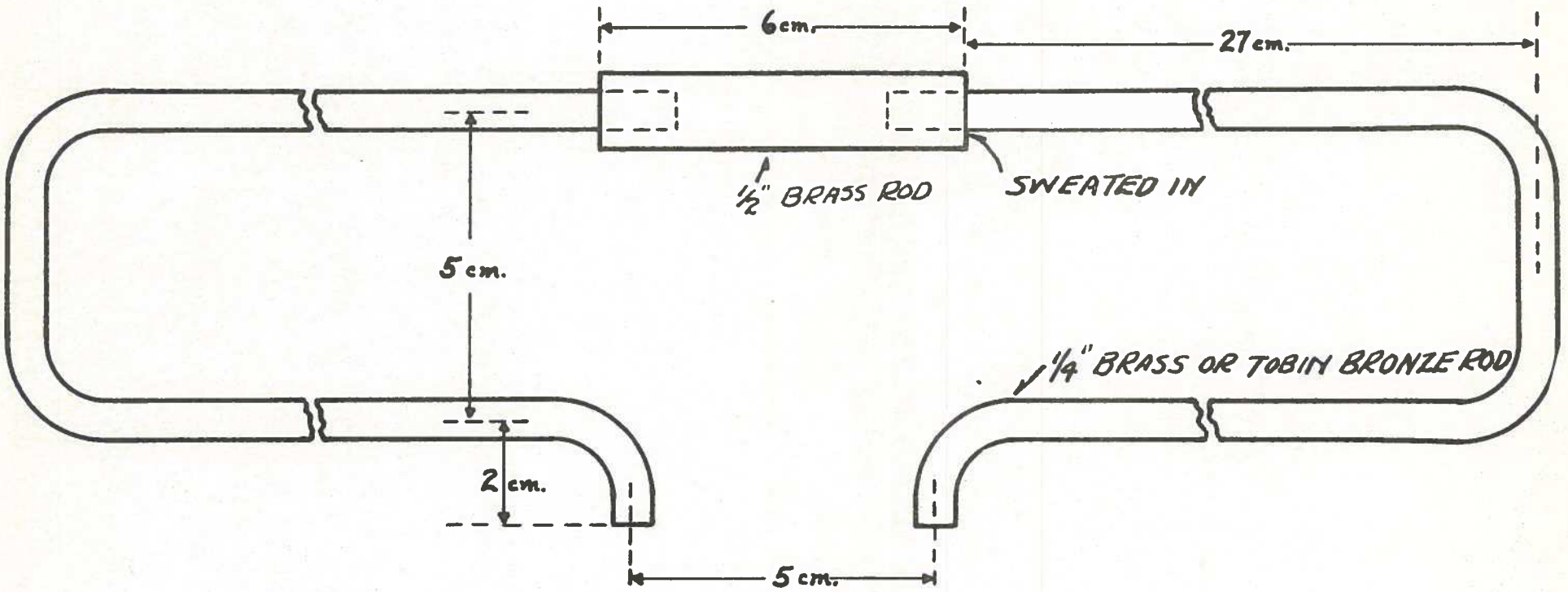
Drawn by: R.E.B. Date: 11/11/41
Checked by: R.E.B. Date: 11/11/41
Eng. Approv. R.E.B.
NATIONAL RESEARCH COUNCIL - RADIO SECTION
OTTAWA - CANADA

NAME: HORIZONTAL PATTERN WITH SLEEVE GROUNDED AT COAXIAL LINE END - 214 MC.
REF.#117



Drawn by: R.E.B. Date: 11/11/41
Checked by: R.E.B. Date: 11/11/41
Eng. Approv. R.E.B.
NATIONAL RESEARCH COUNCIL - RADIO SECTION
OTTAWA - CANADA
NAME: HORIZONTAL PATTERN WITH SLEEVE COMPLETELY BONDED TO FRAME - 214 M.C.

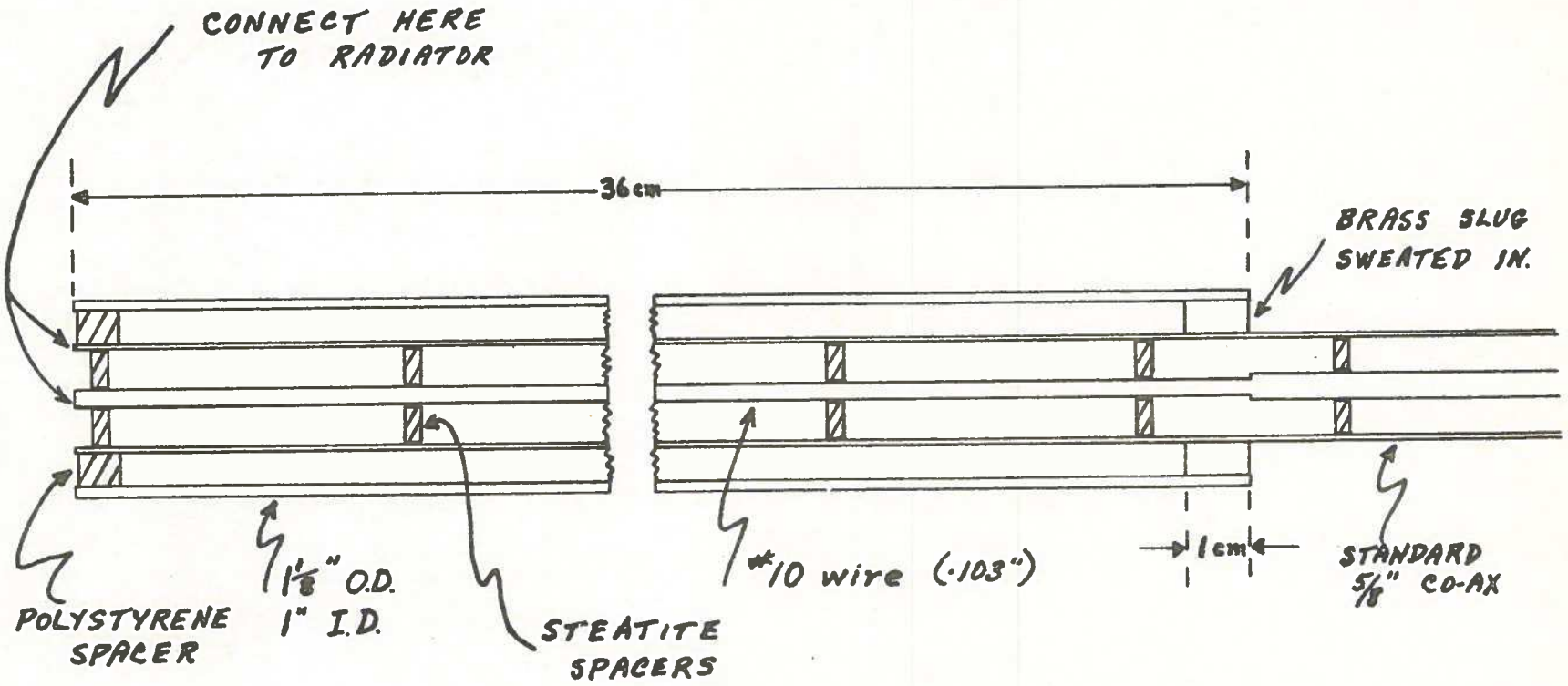
REF.#118



Drawn by: R.E.B. Date: 16/11/41
Checked by: R.E.B. Date: 16/11/41
Eng. Approv. R.E.B.

NATIONAL RESEARCH COUNCIL - RADIO SECTION
OTTAWA - CANADA

NAME: DETAIL OF FOLDED DIPOLE FOR
214 M.C. YAGI REF.#119



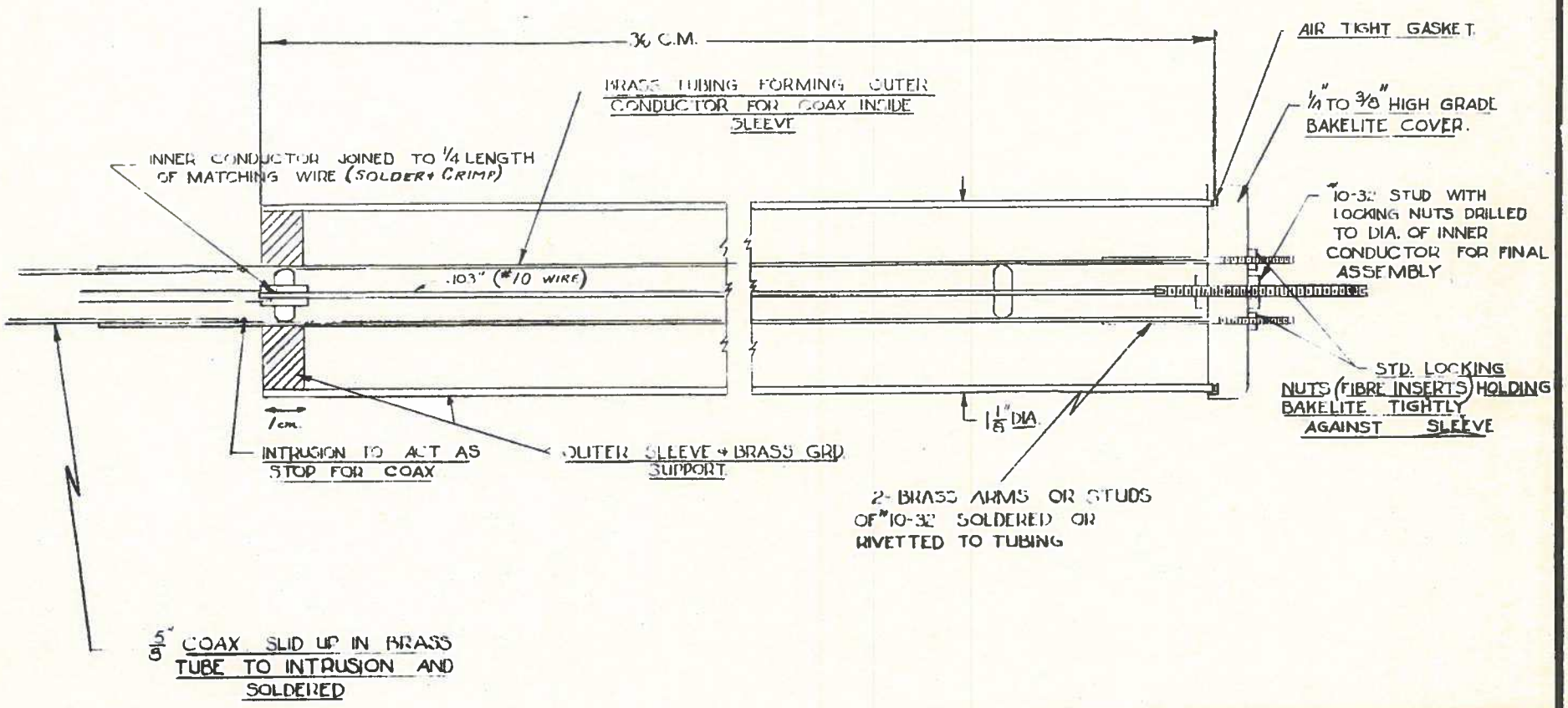
NOTE: Two sleeves are required for each installation. One on the antenna and one feeding the coaxial line at the transmitter and receiver.

Drawn by: R.E.B. Date: 21/11/41
Checked by: R.E.B. Date: 21/11/41
Eng. Approv. R.E.B.

NATIONAL RESEARCH COUNCIL - RADIO SECTION
OTTAWA CANADA

NAME: CONSTRUCTION OF COAXIAL SLEEVE

REF.#120

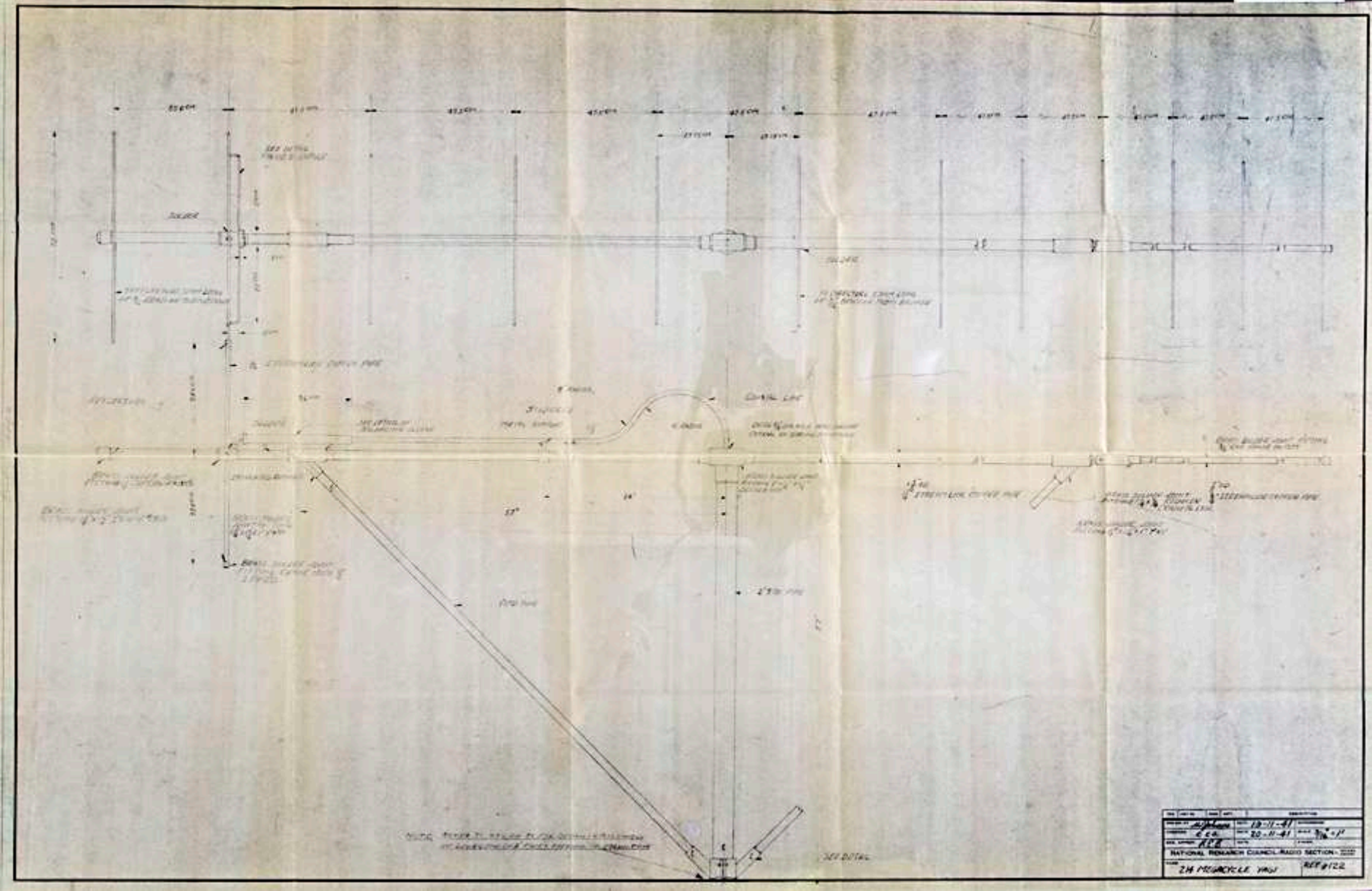


ITEM	PART NO.	QUAN.	MATL.	DESCRIPTION
DRAWN BY W.H.P.		DATE 18-11-41		SUPERSEDES
CHECKED C.E.A.		DATE 20-11-41		SCALE
ENG. APPROV. R.E.B.		DATE		FINISH.

NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

NAME PROPOSED DESIGN OF BALANCING SLEEVE

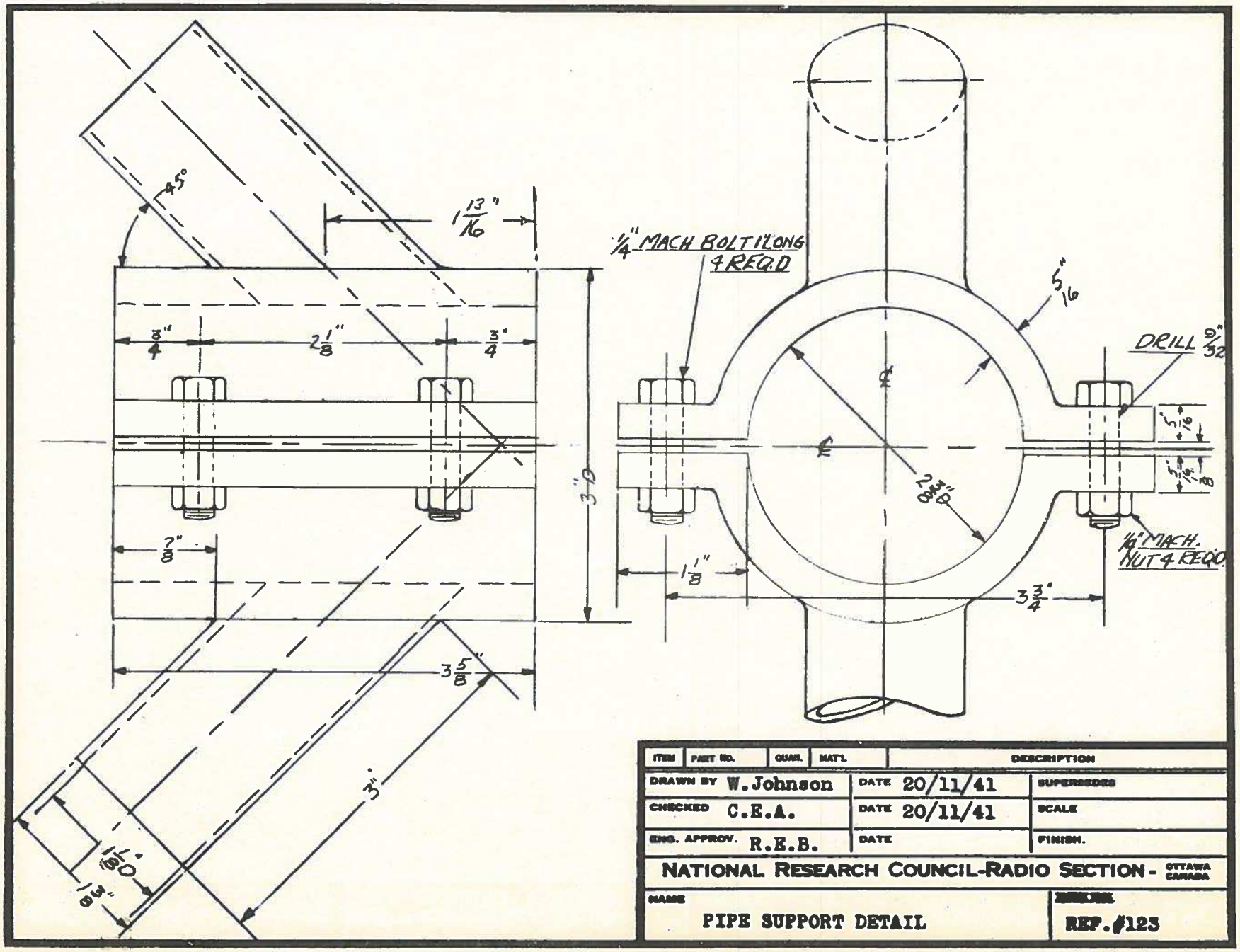
REP. # 121



NATIONAL RESEARCH COUNCIL-RADIO SECTION

ZH MISSILE YAGI

REF #122



ITEM	PART NO.	QUAN.	MAT'L	DESCRIPTION
DRAWN BY W. Johnson		DATE 20/11/41		SUPERSEDES
CHECKED C.E.A.		DATE 20/11/41		SCALE
ENG. APPROV. R.E.B.		DATE		FINISH.

NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

NAME: PIPE SUPPORT DETAIL

DRG. NO. REF. #123