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PPI antenna for long range early warning

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PRA-86

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NATIONAL RESEARCH COUNCIL OF CANADA
RADIO BRANCH

PPI ANTENNA FOR LONG RANGE EARLY WARNING

OTTAWA

OCTOBER, 1943

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NATIONAL RESEARCH COUNCIL OF CANADA
RADIO BRANCH

PPI ANTENNA

FOR LONG RANGE EARLY WARNING

I. Requirements:

The PPI (LREW) was developed to provide an all-round looking early warning system on 90 mc. The considerations leading up to the choice of this frequency will be found in PRA-85*. It was required to obtain ranges of 150 miles with an azimuthal accuracy of ±1°. This meant that as narrow a beam width as possible was required, and as great a gain. To obtain raid handling capacity, the array was to rotate at a speed of approximately 4 r.p.m. Low angle coverage was to be accomplished by mounting the antenna on the top of a two-hundred foot tower. This latter fact made the problem of wind resistance of great importance.

II. Developed Array:

A bill-board type of array was developed using three collinear arrays as radiators, rather than the conventional stacks of dipoles. These collinears are stacked in a vertical array with the spacing between collinears equal to $\lambda/2$. The collinears consist of seven half-wave radiating elements, and operate at a frequency of 90 mc/s. The array is fed at the mid-point of the centre collinear. The upper and lower collinears are fed in phase by means of twisted $\lambda/2$ lines, (1/4" tubing at 2-inch spacing i.e. $Z_o = 330$ ohms). A parasitic reflector is inserted 25 cms. behind the centre element of each collinear. The reflector causes the centre element to be driven harder. This fact, accompanied by the natural power distribution along the array due to radiation, tends to minimize the side lobes.

To decrease the back to front ratio, the array was backed up by a screen composed of horizontal wires (#12 ga. copperweld) with approximately three inch spacing. This type of screen was chosen to minimize wind resistance. The phasing stubs of the collinears project back through the screen. Where a wire would interfere with the stub, the wire is cut and fastened to the gusset plates. The wire is then bonded to the adjacent ones.

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* NRC Report PRA-85, "Long Range Early Warning".

The impedance of the collinear stack, backed by the screen, is 165 ohms. This impedance is stepped up to 415 ohms. to match into the coupling ring system. This is done by means of $\lambda/4$ transformer. The transformer may be calculated and inserted. There are no other adjustments in the feeding of the actual array.

A schematic of the array is given in Fig. 1.

The radiation pattern of the array is given in Fig. 2. This pattern was taken while receiving on the array. The beam width at half-field strength is 18°, and the maximum size of minor lobes is 13%. The back radiation is of the order of 4% or less. As this antenna is to be used in conjunction with a T-R system, the effective pattern width is 12°, the minor lobes 1.6% in power, and the back radiation negligible.

The radiators are made of 5/16" brass tubing. The corners and "U" ends of the stubs, are made of 5/16" brass rod, turned down and then bent into shape. The radiating elements are supported by Johnson #65 type insulators. No insulation is placed nearer than 15 cm. from the high-voltage end of a radiating element. A third insulator is placed in the centre of the element for support. The exceptions to the latter are the centre elements, of which each half is supported by two insulators. The stubs are supported by three insulators, one on each side and attached to the frame, the third insulator is in the centre of the "U" portion of the stub.

The array is mounted upon a frame of 2" x 2" dressed oak, of dimensions 43'6" x 13'9" (Fig. 3). The frame is made in three sections for ease in assembling and erection. The horizontal reflector wires are held in place by means of specially constructed eye-bolts (Fig. 4). These bolts are attached to angle irons (Fig. 5), along the edges of the three sections. Additional support is given these angle irons by bolting adjacent ones together when the array is assembled.

A theoretical interference pattern of the array, mounted upon a two hundred foot tower, is given in Fig. 6. This pattern has been checked against actual flight tests. Data concerning these flight tests will be given in a forthcoming report PRA-94.[1]

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[1] NRC Report PRA-94, "Flight Tests for LREW".

III. Gap-Filling Using Elliptical Polarization:

In order to achieve partial gap-filling using only one antenna, it was decided to incorporate elliptical polarization (see PRA-73)[2]. This was accomplished by mounting eight full-wave dipoles, vertically polarized, on the same frame as the collinears. These dipoles are fed by means of half-wave lines 1/8" rod at 2" spacing $Z_o = 415$ ohms. A schematic of this array is given in Fig. 7. The centre dipoles are spaced at slightly less than half-wavelength, due to physical difficulties in mounting them. The dipoles are 32 cms. from the screen.

To eliminate back radiation vertical wires were added to the screen. These wires were interlaced with the horizontal wires forming a net of 3" mesh. These wires were supported and tightened in the same manner as the horizontal wires.

The pattern of the vertical portion of the array is given in Fig. 8. The beam width at half voltage is 16°, and the largest minor lobe is 20% in field strength, or 4% in power. The measured impedance of the array is 147 ohms.

To compensate for lesser gain on the vertical array, due to: (a) the smaller number of dipoles and, (b) the fact that over sea water the power radiated by the vertical elements is distributed over a larger volume of space due to the existance of some gap-filling, the vertical array is fed twice as hard as the horizontal array. The impedance of the vertically polarized array is transformed to 220 ohms. The two arrays are then joined by the proper phasing length of 415 ohm line. The combined array impedance is then transformed to 415 ohms to match into the coupling ring system.

As the first gap in the ground interference pattern occurs at 1 1/2° elevation, i.e. well under the Brewster angle for land, the use of elliptical polarization for gap-filling will not be effective at low angles looking over land. However, where reflection takes place over sea water, the Brewster angle is 2° approximately, and 40% gap-filling in the first gap should be realized. In this case, the maximum range on the bottom lobe will be less than that for horizontal polarization alone.

---

[2] NRC Report PRA-73, "Part I - The use of Elliptically Polarized
Radiation for Gap-Filling in the
Vertical Pattern of the Canadian
ZPI Antenna" and
"Part II- Comparison of Horizontally
Polarized and Elliptically
Polarized ZPI Antenna".

IV. Mechanical Support:

The frame is supported by a steel truss, Fig. 9, which is then bolted to an RWG turntable. This turntable provides the rotating mechanism for the array. A 5 h.p., 550 volt, 3-phase motor is used to drive the turntable, which rotates at approximately 4 r.p.m. The underpart of the turntable is bolted to a small five-foot steel tower on top of the larger tower. When the array was erected at the National Research Council Field Station, the array and truss were assembled on the ground and then raised as a complete unit to the top of the two hundred foot tower. See Photograph, Fig. 19.

V. Coupling Rings:

In order to obtain constant, balanced, feed conditions with continuous rotation use is made of inductive coupling rings. Details and the assembly of the system are given in Fig. 10. This system has been subjected to powers up to 300 KW without any indication of break down.

VI. Feeder System:

The feeder system originally consisted of shielded, balanced line, Z_o = 465 ohms. The coupling ring system was designed to match this line, and by means of adjusting the spacing between rings, a standing wave ratio of 1.1:1 was easily obtained.

Subsequent use was made of a coaxial feed, Z_o = 75 ohms. This line is terminated in a $\lambda/4$ balancing sleeve, followed by a $\lambda/4$ transformer to match into the coupling ring system. A 2 5/8" diameter coaxial line was used for the two-hundred foot run up the tower. This coaxial line was enlarged to 4" diameter at the bottom of the tower to accommodate a Westinghouse type spark gap system, and to fit the American transmitter then in use.

VII. Spark-Gap System:

The spark gap system consists of two 4" diameter "T" stubs, with 1/4" inner conductor. One stub is used for T-R, the other for anti-T-R. The system used is shown in Fig. 11. When the spark gap fires, it nullifies the effect of the condenser C, presenting an inductance in parallel with that of the shorted end of the T. These two impedances paralleled and then transformed, act together to give a high impedance across the line, preventing power from getting into the receiver.

When the gap is not firing, the effect of the condenser is to introduce a capacitance which resonates with the shorted end of the T. In the anti-T-R the resulting high impedance is transformed into a low impedance across the coaxial line. This is transformed into a high impedance across the T-R stub. On the T-R stub there is an additional tuning stub to which is attached the receiver line. When the gap on this stub is not firing, the condenser is tuned to resonate with the stub as above, and the load presented across the coaxial is dependent upon the characteristic impedance of the receiver line. The receiver line consists of 7/8" O.D. coaxial line coupled to the stub through a half-wave length of AS-48M telcothene cable.

To line up the spark gap system, a video line is run from the receiver to a test oscilloscope at the gap system. The condensers are then tuned until a maximum signal is obtained from a fixed echo. This tuning is fairly critical.

The above spark gap system is a direct modification of the Westinghouse system, except that in their system no use is made of an anti-T-R stub.

VIII. De-Icing:

De-icing of the screen is provided for by tieing all of the horizontal wires in parallel, and then current is passed through them from a specially designed transformer. The three sections of screen are bonded together by means of copper bus-bars 1" x 1/4". A 4 1/2 KVA transformer, with 110 volt primary was used at first but did not have a high enough power rating. Furthermore, the power slip rings (See Fig. 10) and brushes could not carry the high currents necessary for the primary. Corrective measures to be applied are to use a 9KVA transformer with a 220 volt primary. It is also planned to parallel two slip rings in each side of the line.

IX. Beam-Split:

In the earlier stages of development when operational policy was undecided, the problem of using beam split for accurate azimuthal determination was considered. A system using the horizontally polarized array was devised and tried experimentally. The system proved satisfactory up to limitations imposed by switching. No development was carried out on the switching problem as the idea of beam split was discarded because of (a) mechanical problems involved were very great and (b) subsequent tests showed that an azimuthal accuracy of ± 1° could be obtained with the array rotating continuously.

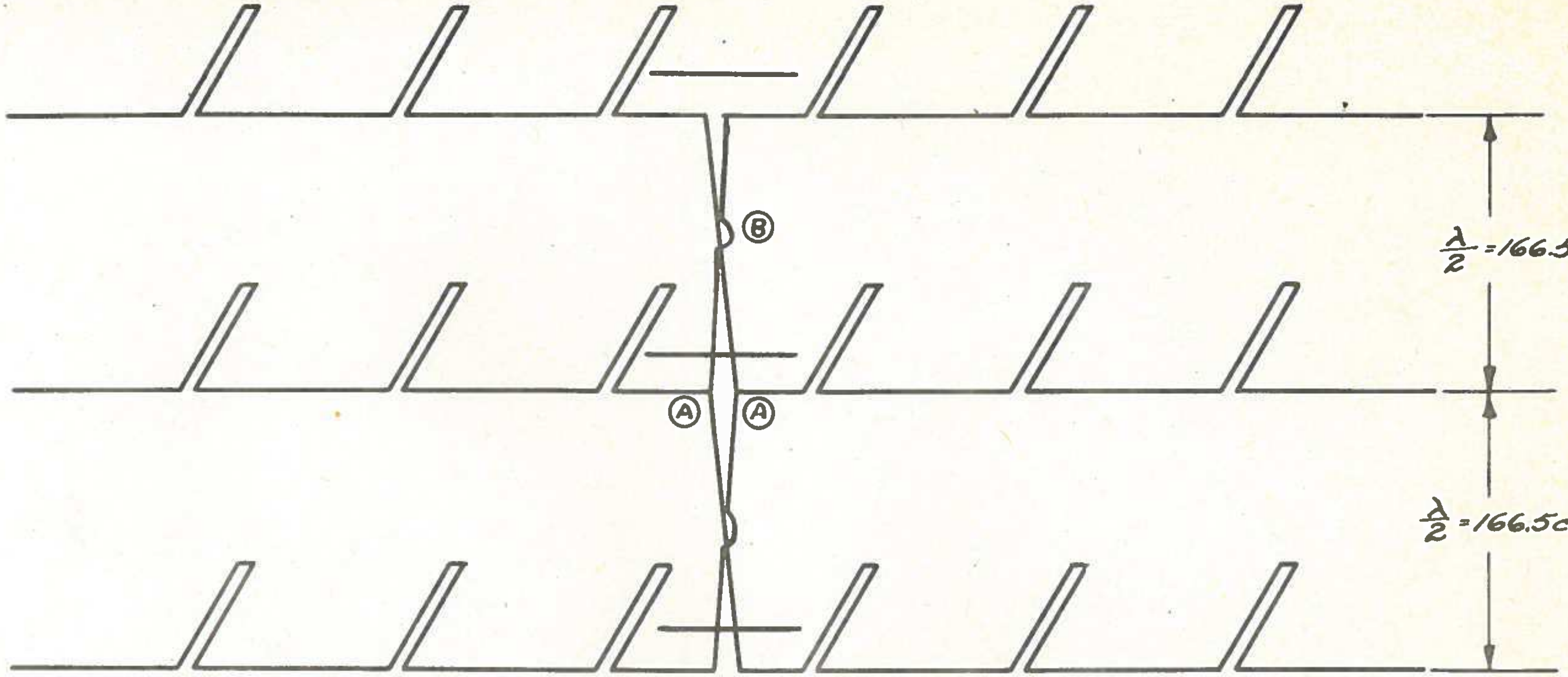
As a matter of interest the proposed system for beam split, together with patterns, are outlined in this report. Figs. 12 and 13 show a schematic of the system. Figs. 14 and 15 show the patterns obtained. The method of operation was to transmit from the centre of the array, and receive from the ends. Thus the array is split only on receiving.

To incorporate beam split would require a double coupling ring system in which use could be made of a small ring with lumped C for the receiving ring.

J. H. Bell.

OTTAWA

September 10, 1943.



SCHEMATIC OF HORIZONTALLY POLARIZED ARRAY
(OMITTING SCREEN)

Ⓐ-Ⓐ FEED POINTS

Ⓑ ~ 1/4" BRASS PIPE @ 2" $Z_0 = 330\Omega$

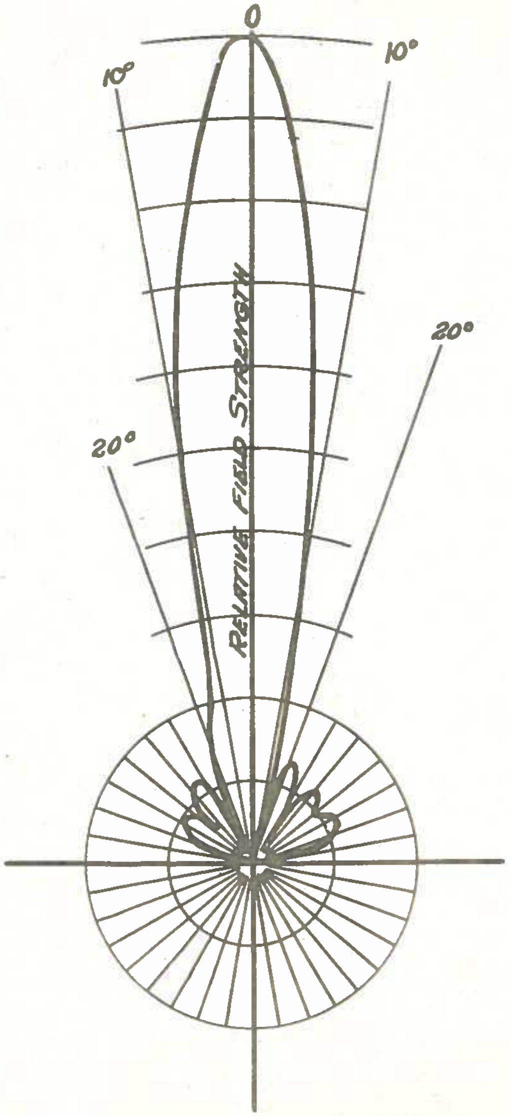
FIG. 1

ITEM	PART NO.	QUAN.	MAT'L	DESCRIPTION

DRAWN BY EH BELL	DATE JUNE 7, 1943	SUPERSEDES
CHECKED	DATE	SCALE ——
ENG. APPROV. J H Bell	DATE	FINISH.

NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

NAME HORIZONTALLY POLARIZED ARRAY SCHEMATIC	DWG. NO. P-A-FI. RL-350-A



HORIZONTAL RADIATION PATTERN
OF HORIZONTALLY
POLARIZED ARRAY (f = 90 mc/s)

FIG. 2

ITEM	PART NO.	QUAN.	MAT'L	DESCRIPTION

DRAWN BY E.H.B.	DATE JUNE 8, 1943	SUPERSEDES
CHECKED	DATE	SCALE —
ENG. APPROV. JHBell	DATE	FINISH.

NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

NAME ANTENNA PATTERN I	DWG. NO. P-A-FI RL-349-A

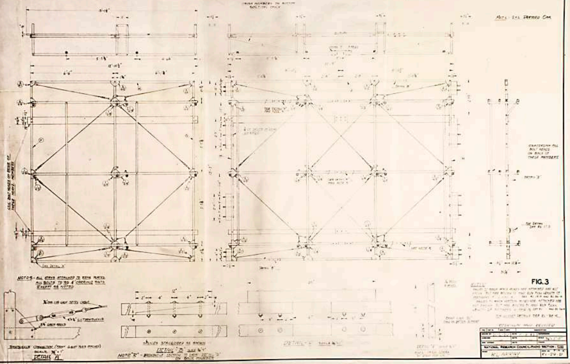


FIG.3

NOTES - ALL STAYS ATTACHED TO REAR PLATES.
ALL BOLTS TO BE 4" CARRIAGE BOLTS
EXCEPT AS NOTED

NOTE "R" - BREAKING SECTION TO SHOW DETAIL "D" ON BACK MEMBER

RECTANGULAR ARRAY REVISED

NATIONAL RESEARCH COUNCIL-RADIO SECTION

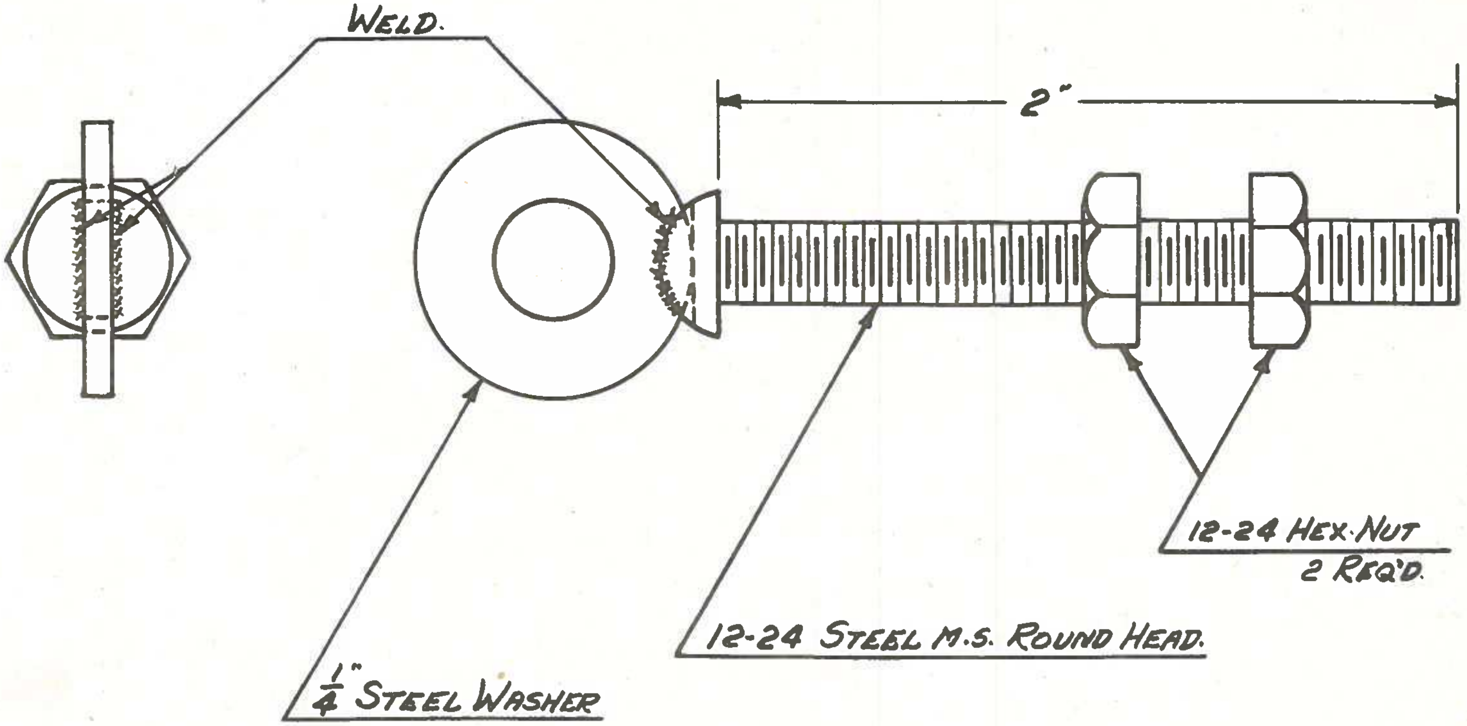


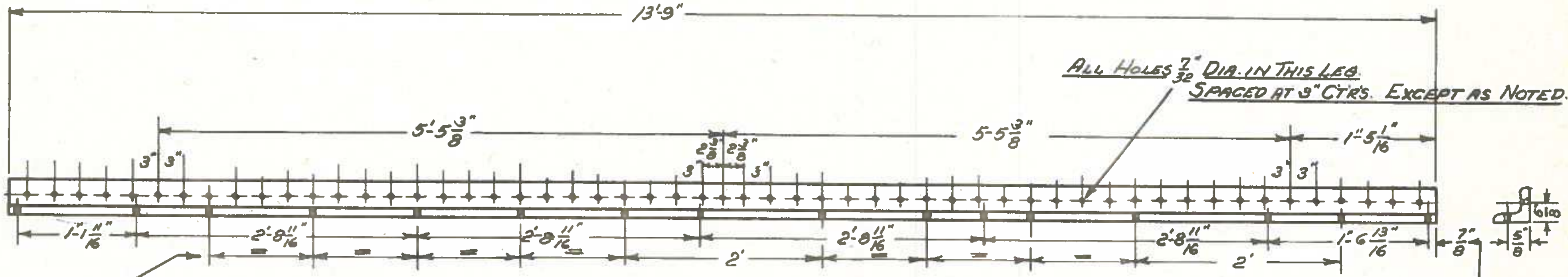
FIG. 4

ITEM	PART NO.	QUAN.	MAT'L	DESCRIPTION

DRAWN BY K.E.K.	DATE 27-4-42	SUPERSEDES
CHECKED	DATE 20-9-43	SCALE 2"=1"
ENG. APPROV. G H Bell	DATE	FINISH.

NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

NAME Screen Wire Holding Bolts.	DWG. NO. R.A-K. RL-36-A.



ALL HOLES 7/32" DIA. IN THIS LEG.
SPACED AT 3" CTR'S. EXCEPT AS NOTED.

∠9 HOLES 9/32" DIA.
SPACED AS SHOWN
AT 12" CENTRES.

7 HOLES 9/32" DIA. IN
SPACED AS SHOWN TO MATCH DRILLED
HOLES IN GUSSET PLATES OF ARRAY
FRAME ON RL-29-D.

3 - 1"×1"×1/8" L's REQ'D AS SHOWN
3 - 1"×1"×1/8" L's REQ'D OPPOSITE HAND

FIG. 5

REF. DWG. RL-36 A & RL-29 D.

REVISED - AUG. 21-43 - J.W. - 13 HOLES ADDED.

ITEM	PART NO.	QUAN.	MAT'L	DESCRIPTION

DRAWN BY C.E.A. TRACED BY D.C.	DATE 11/5/43	SUPERSEDES
CHECKED AS	DATE 20-9-43	SCALE N.T.S.
ENG. APPROV.	DATE	FINISH

NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

NAME Screen Wire Supporting Angles	DWG. NO. A-A-K. RL-35-B.

P.P.I. VERTICAL INTERFERENCE PATTERN – A. HEIGHT = 210 FT.

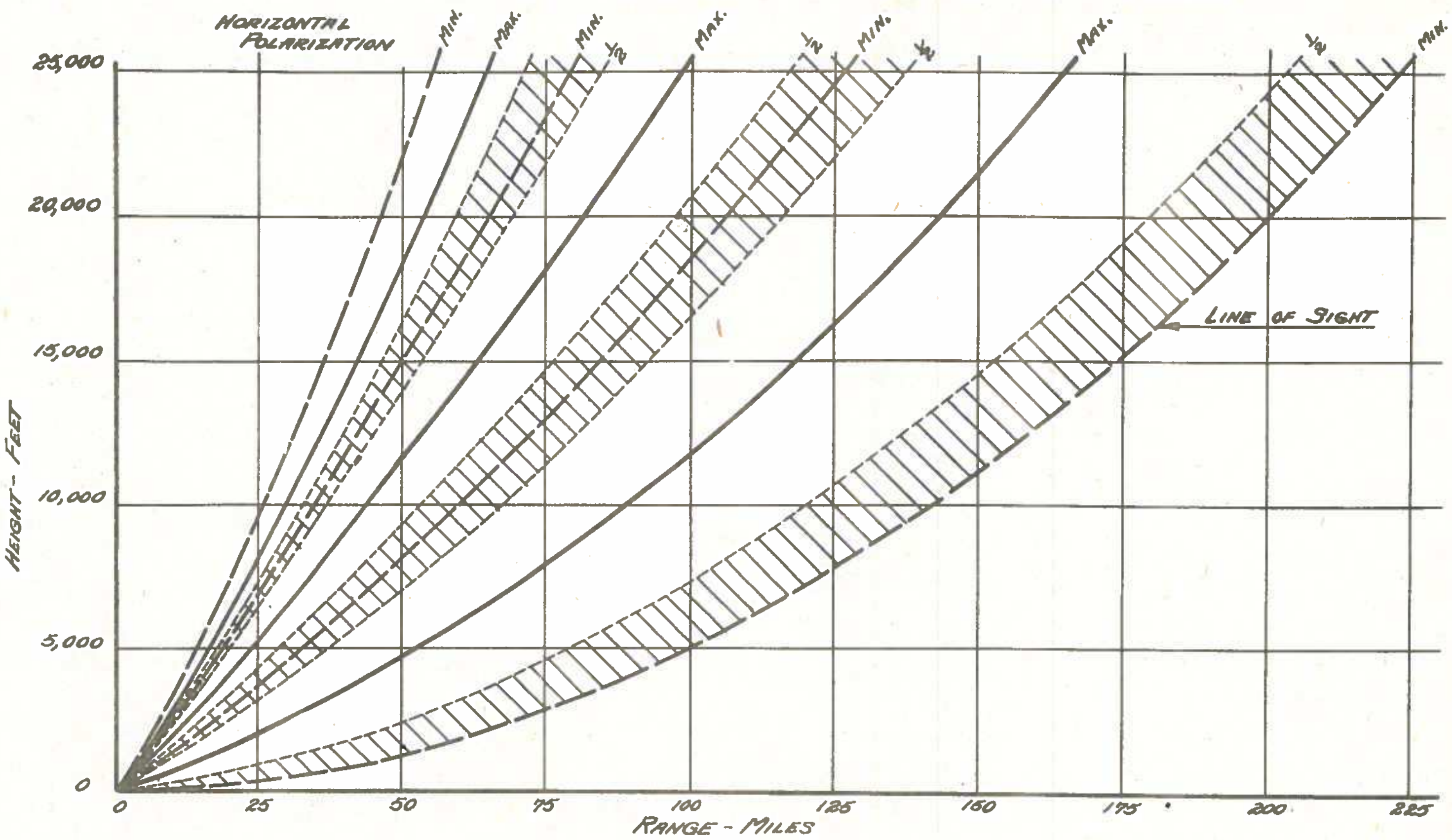


FIG. 6

LEGEND

MAXIMUM ————
½ FLD. STRENGTH - - - -
MINIMUM — — —

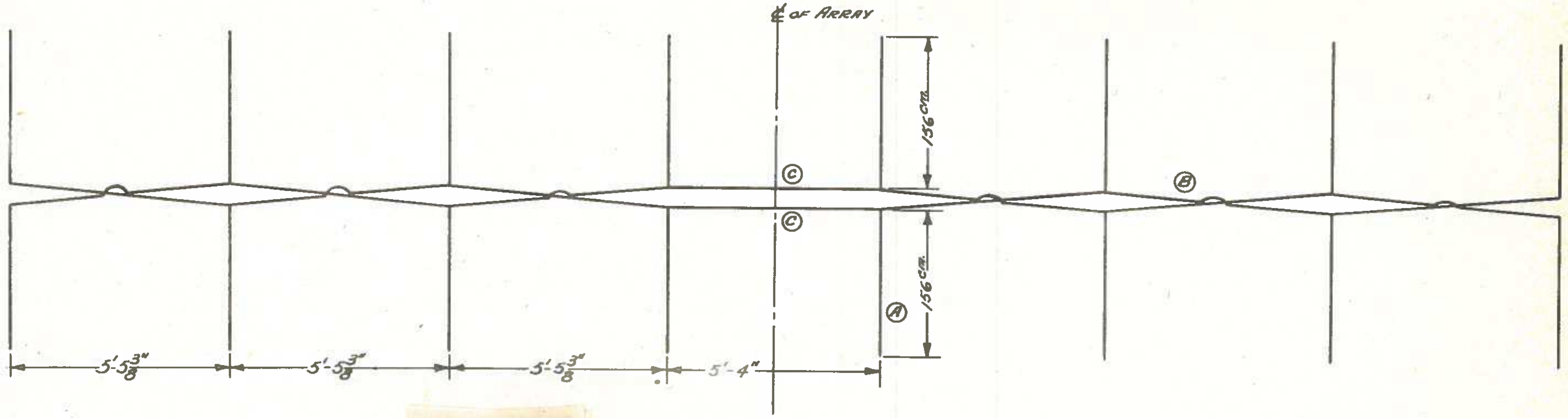
K = $\frac{4}{3}$ EARTH'S RADIUS

ITEM	PART NO.	QUAN.	MAT'L	DESCRIPTION

DRAWN BY E.N.B.	DATE June 7, 1943	SUPERSEDES
CHECKED	DATE	SCALE ——
ENG. APPROV. J. H. Bell	DATE	FINISH.

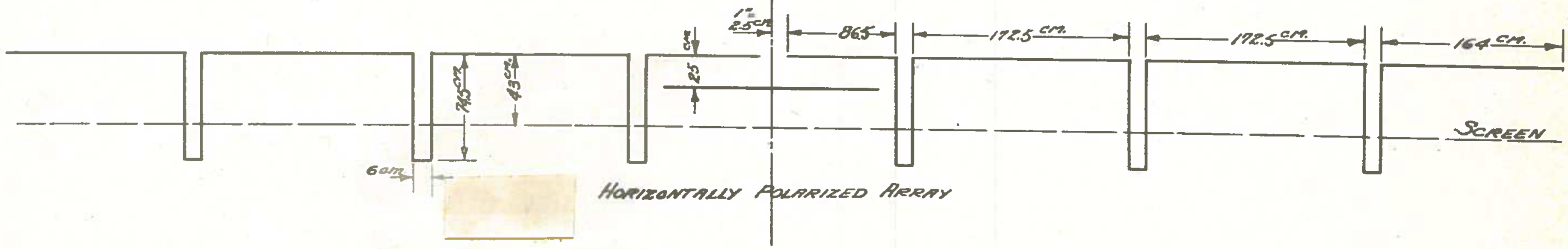
NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

NAME P.P.I. VERTICAL INTERFERENCE PATTERN	DWG. NO. P-A-FI RL-352-B



VERTICALLY POLARIZED ARRAY

NOTE: A = 5/16" BRASS PIPE
B = 1/8" BRASS ROD @ 2" SPACING
Z_0 = 415 OHMS
C = FEED POINTS.



HORIZONTALLY POLARIZED ARRAY

NOTE: CENTER REFLECTOR – 172 CM. LONG.

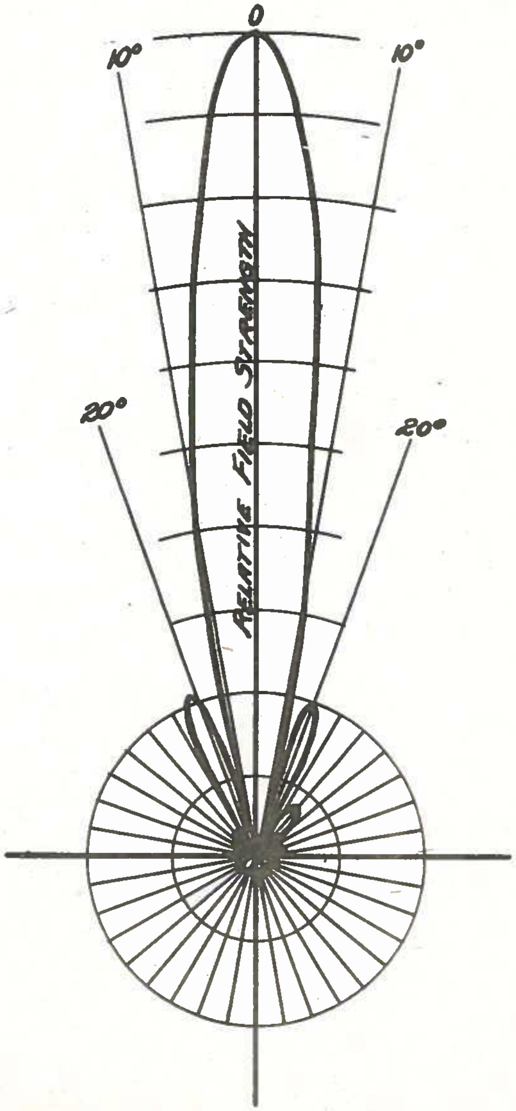
FIG. 7

ITEM	PART NO.	QUAN.	MAT'L	DESCRIPTION

DRAWN BY ENB
DATE JUNE 7, 1943
SUPERSEDES
CHECKED
DATE
SCALE —
ENG. APPROV. J. H. Bell
DATE
FINISH.

NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

NAME VERTICAL & HORIZONTAL ARRAY SCHEMATIC
DWG. NO. P-A-F2 RL-351-B



HORIZONTAL RADIATION PATTERN
OF VERTICALLY POLARIZED
ARRAY AT 90 MC/SEC.

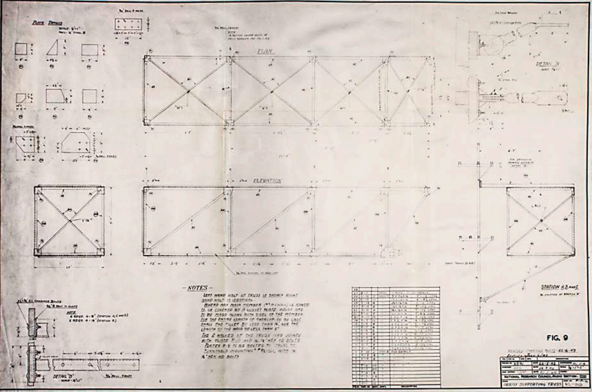
FIG.8

ITEM	PART NO.	QUAN.	MAT'L	DESCRIPTION

DRAWN BY E.H.B.	DATE June 8, 1943	SUPERSEDES
CHECKED	DATE	SCALE ———
ENG. APPROV. J.H. Bell	DATE	FINISH.

NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

NAME ANTENNA PATTERN II	DWG. NO. P-A-FI RL-348-A



-NOTES-

LEFT HAND HALF OF TRUSS IS SHOWN. RIGHT HAND HALF IS IDENTICAL.

WHERE ANY MAIN MEMBER ([illegible]) IS JOINED TO OR COVERED BY A GUSSET PLATE, WELDS ARE TO BE MADE ALONG BOTH SIDES OF THE MEMBER FOR THE ENTIRE LENGTH OF OVERLAP. IN NO CASE SHALL THE FILLET BE LESS THAN 1/4" NOR THE LENGTH OF THE WELD BE LESS THAN 2".

THE 2 HALVES OF THE TRUSS ARE JOINED WITH PLATE [illegible] AND 16-5/8" HEX HD BOLTS.

PLATES P-5 TO BE BOLTED TO TRUSS [illegible] TURNTABLE MOUNTING [illegible] WITH 1/2" HEX HD BOLTS.

NOTE
4 REQD. A-8" (STATION A, C AND D)
2 REQD. A-16" (STATION B)

DETAIL "B"

FIG. 9

REVISED [illegible] 22-6-43

NATIONAL RESEARCH COUNCIL, RADIO SECTION

ARRAY SUPPORTING TRUSS

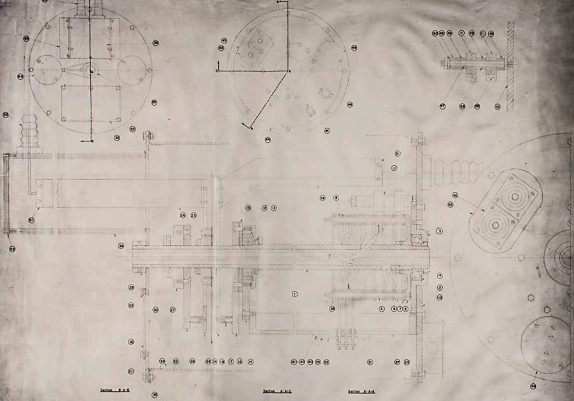
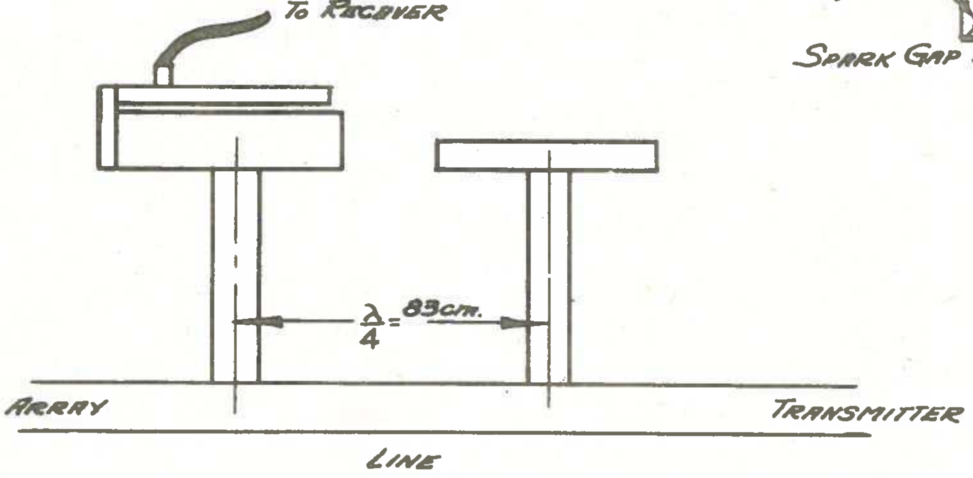


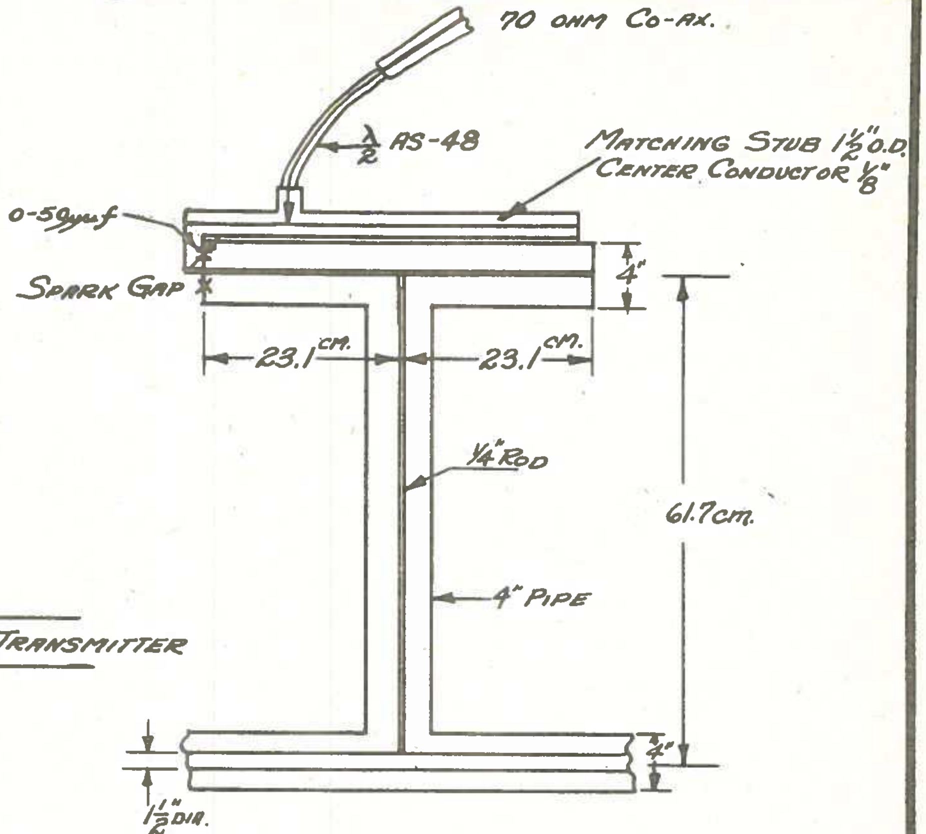
FIG. 10

56	R.E.L.	2	[illegible]	Bakelite Tube
55	No. 60	2	Porc'n	Johnson Standoff 5"
54	[illegible]	2	L. Iron	Angle Support for Con. Shld.
53	RL-71A	1	[illegible]	Gasket for Condenser Shld.
52		1	Bak'te	Top of Condenser Shield
51	RL-73A	4	Brass	Transformer Mount
50		3		Washers
49	R.E.L.	6	Bak'te	Spacers
48	R.E.L.	4	Carb.	Power Brush Contact
47	R.E.L.	2	Steel	Centre Shaft - Brush Mtg.
46		1		B-X Connector 1" Dia.
45		1		B-X Connector ¾" Dia.
44		4		Junction Box
43		1	Bak'te	Standoff Mounting Plate
42	No. 60	2	Porc'n	Johnson Standoff 5"
41	RL-[illegible]A	2	Bak'te	Slip Ring Wire Clamp
40	RL-[illegible]A	2	Bak'te	Slip Ring Wire Clamp
39	RL-[illegible]A	2	Iron	Slip Ring Clamp Cover
38	RL-[illegible]	1	Steel	Slip Ring Cover Plate
37	R.E.L.	1	Steel	Turntable
36	RL-[illegible]	1	Bak'te	Condenser Plate Shield
35	R.E.L.	1	Steel	Turntable
34	R.E.L.	1	Steel	Flanged Ring
33		4	Steel	Lockwasher
32	RL-[illegible]	1	Steel	Inspection Plate
31	RL-[illegible]	1	[illegible]	Inspection Plate Gasket
30	RL-[illegible]	1	Steel	Upper Cover Plate
29	RL-[illegible]A	1	Brass	Driving Dog
28	RL-[illegible]	1	Bak'te	Rotating Bakelite Plate
27	RL-[illegible]A	1	Brass	Flange
26	RL-[illegible]	1	Brass	Condenser Plate - Rotating
25	RL-[illegible]A	1	Brass	Coupling Ring - Rotating
24	RL-[illegible]	1	Brass	Faraday Shield
23	RL-[illegible]A	1	Brass	Collar for Faraday Shield
22	R.E.L.	1		Small Brush Mounting
21	R.E.L.	10	Bak'te	Bushing
20	RL-[illegible]	1	Brass	Upper Bearing Support
19	RL-[illegible]	1	Brass	Condenser Plate - Stationary
18	RL-[illegible]	1	Brass	Coupling Ring - Stationary
17	RL-[illegible]	[illegible]	Bak'te	Standoff
16	RL-[illegible]	1	Bak'te	Stationary Bakelite Plate
15	RL-[illegible]	[illegible]	Bak'te	Washer
14	RL-[illegible]	1	Brass	Upper Bearing Housing
13				[illegible]
12				Self-Aligning Bearing S.K.F.
11	R.E.L.	[illegible]	Steel	Lower Brush Mounting
10	RL-[illegible]	1	Brass	Bearing Plate Bottom
9	R.E.L.	[illegible]	Brass	Small Slip Ring
8	R.E.L.	[illegible]	Brass	Large Slip Ring
7	R.E.L.	[illegible]	Bak'te	Slip Ring Spacer
6	R.E.L.	[illegible]	[illegible]	Bakelite Tube
5	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	Brass	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]
1	[illegible]	1	Steel	[illegible]

COUPLING RING ASSEMBLY



Complete System



T-R System (Westinghouse)

Another System without Matching Stub is Used for R-T.

Used as RL-376-A.

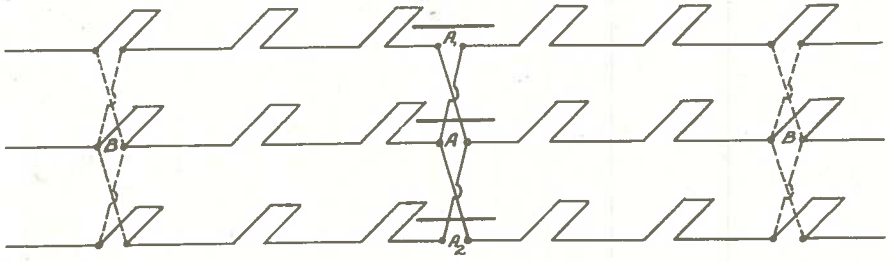
FIG. 11

ITEM	PART NO.	QUAN.	MAT'L	DESCRIPTION

DRAWN BY EHB	DATE June 18, 1943	SUPERSEDES
CHECKED	DATE	SCALE
ENG. APPROV. J. H. Bell	DATE	FINISH.

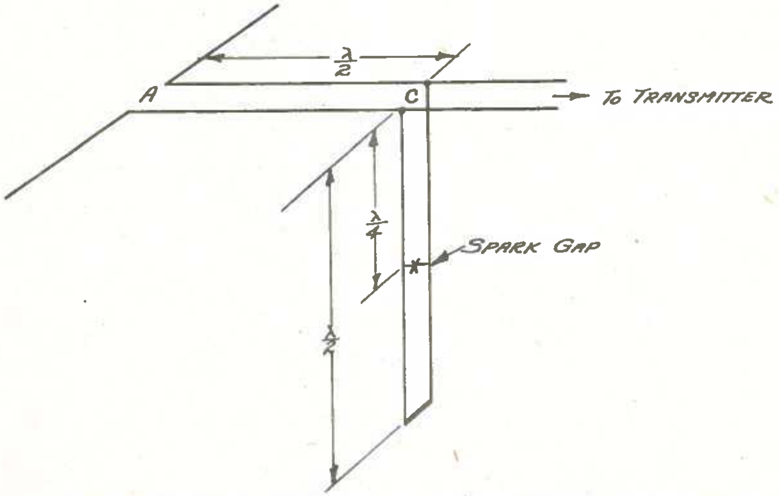
NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

NAME Spark Gap System	DWG. NO. T/R-L RLX-40-A

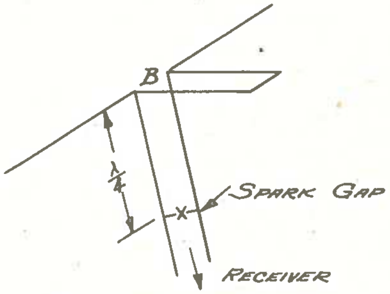


BEAM-SPLIT ON P.P.I.

NOTE: TRANSMIT AT POINT A; RECEIVE AT B.



NOTE: WHEN TRANSMITTING, SPARK GAP FIRES GIVING HIGH IMPEDANCE AT C.
WHEN RECEIVING, EFFECTIVE SHORT ACROSS C; HENCE A, HENCE A1, AND A2.
BEAM WOBBLE OBTAINED BY WORKING ANTENNA OFF FREQUENCY.



NOTE: WHEN TRANSMITTING, SPARK GAP FIRES GIVING HIGH IMPEDANCE ACROSS B. THUS ANTENNA BEHAVES NORMALLY.

FIG. 12

ITEM	PART NO.	QUAN.	MAT'L	DESCRIPTION

DRAWN BY E.H.B.	DATE SEPT. 3, 1943	SUPERSEDES
CHECKED	DATE	SCALE ___
ENG. APPROV. G.H. Gill	DATE	FINISH

NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

NAME BEAM-SPLIT SCHEMATIC	DWG. NO. P-A-L RL-372-B

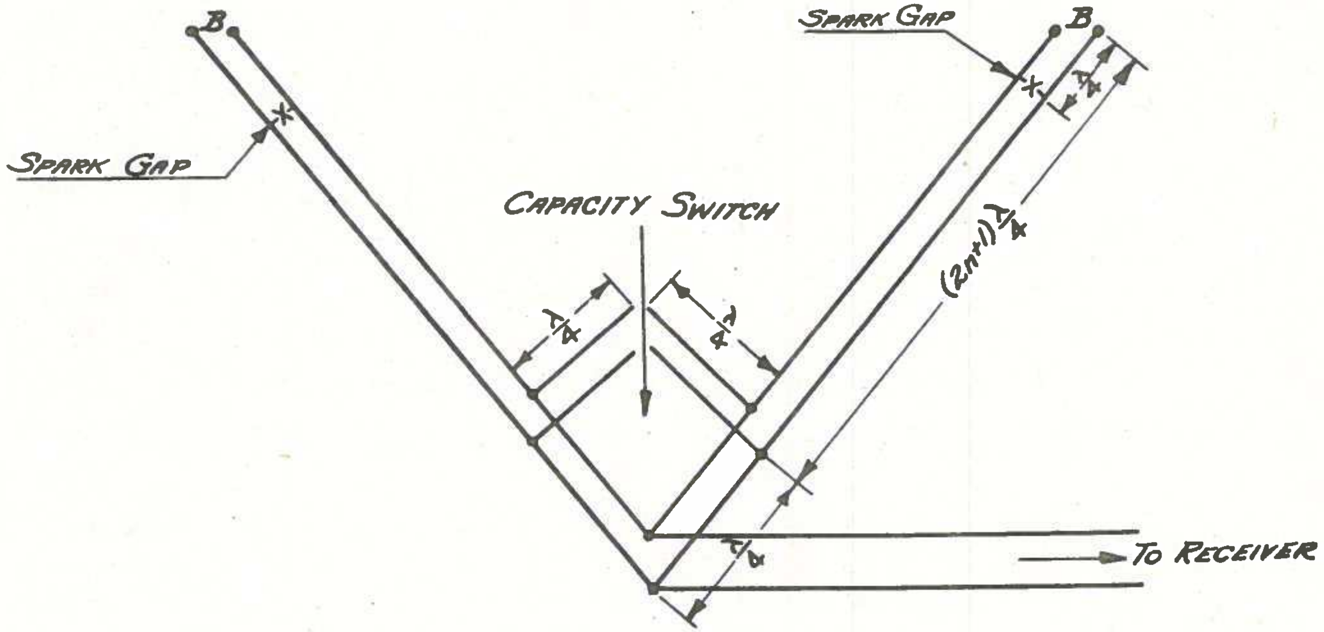


FIG. 13

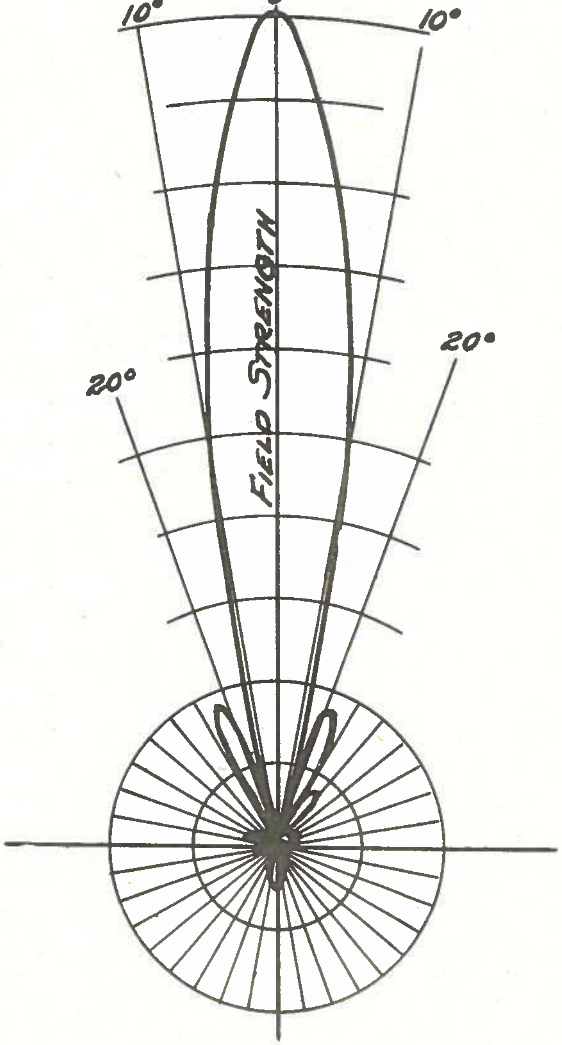
ITEM	PART NO.	QUAN.	MAT'L	DESCRIPTION

DRAWN BY EHB	DATE SEPT. 4, 1943	SUPERSEDES
CHECKED	DATE	SCALE —
ENG. APPROV. G. H. Bell.	DATE	FINISH.

NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

NAME SCHEMATIC OF RECEIVER LINES & SWITCHING SYSTEM

DWG. NO. D-A-L RL-373-A



HORIZONTAL RADIATION PATTERN OF ARRAY, MODIFIED FOR BEAM SPLIT, WHEN TRANSMITTING. (f = 90 mc/s.)

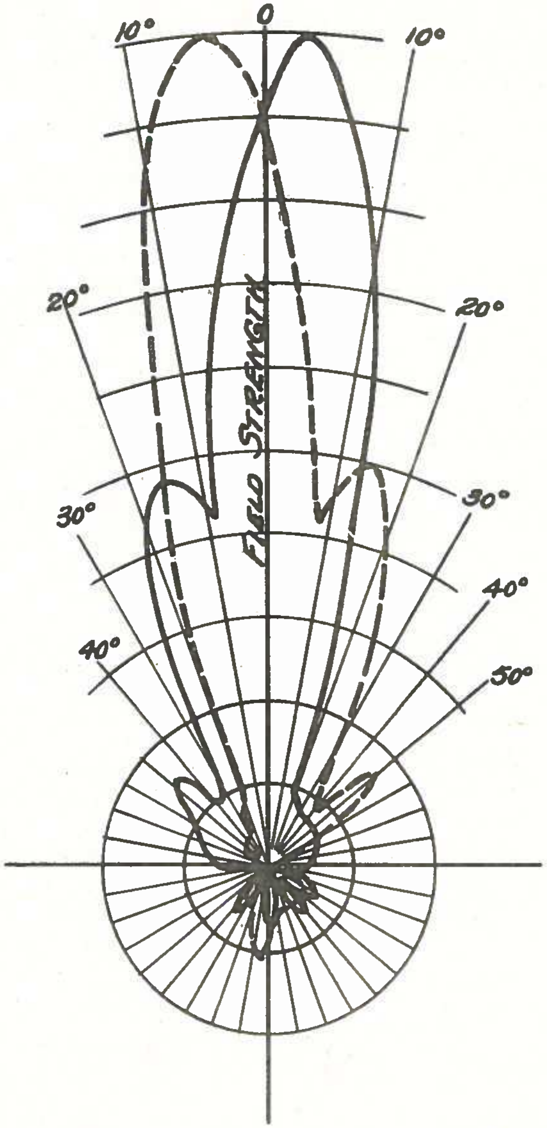
FIG. 14

ITEM	PART NO.	QUAN.	MAT'L	DESCRIPTION

DRAWN BY EHB	DATE Sept. 4, 1943	SUPERSEDES
CHECKED	DATE	SCALE —
ENG. APPROV. JH Bell	DATE	FINISH.

NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

NAME ANTENNA PATTERN	DWG. NO. P-A-FI RL-374-A



HORIZONTAL RADIATION PATTERNS SHOWING BEAM SPLIT OBTAINED BY RECEIVING ON EACH SIDE. (f = 90 mc/s.)

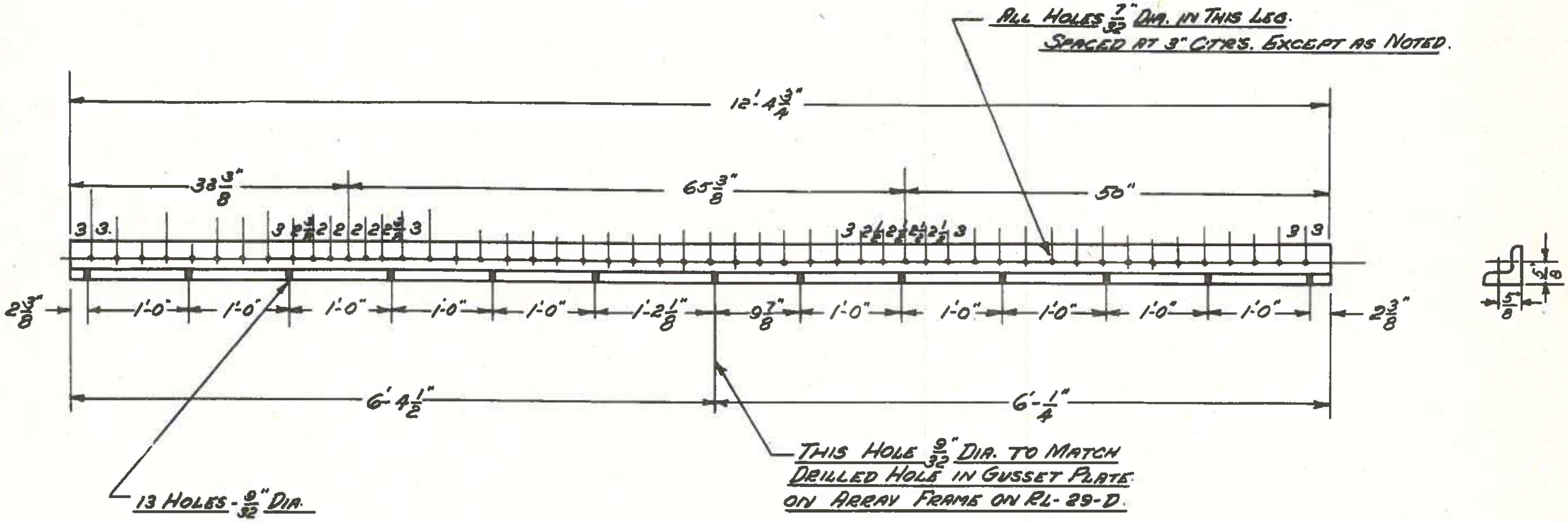
FIG. 15

ITEM	PART No.	QUAN.	MAT'L	DESCRIPTION

DRAWN BY E.H.B.	DATE SEPT. 8, 1949	SUPERSEDES
CHECKED	DATE	SCALE —
ENG. APPROV. J.H. Bell	DATE	FINISH.

NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

NAME ANTENNA PATTERN	DWG. NO. P-A-FI RL-375-A



ALL HOLES $\frac{7}{32}$" DIA. IN THIS LEG.
SPACED AT 3" CTR'S. EXCEPT AS NOTED.

13 HOLES - $\frac{9}{32}$" DIA.

THIS HOLE $\frac{9}{32}$" DIA. TO MATCH
DRILLED HOLE IN GUSSET PLATE
ON ARRAY FRAME ON RL-29-D.

2 REQ'D. AS SHOWN 1"×1"×$\frac{1}{8}$" L's.
2 REQ'D. AS SHOWN 1"×1"×$\frac{1}{8}$" L's.

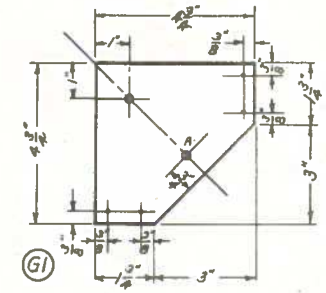
FIG. 16

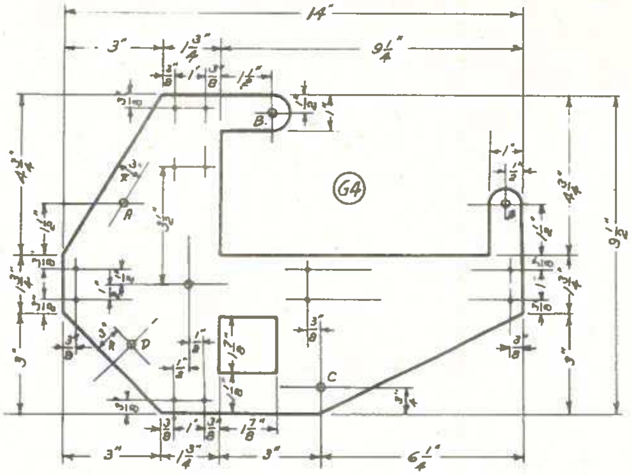
ITEM	PART NO.	QUAN.	MAT'L	DESCRIPTION

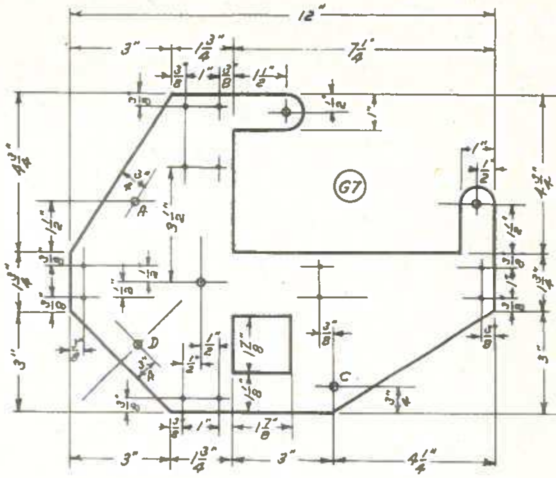
DRAWN BY J.W.	DATE 28/8/43.	SUPERSEDES
CHECKED	DATE 20-9-43	SCALE N.T.S.
ENG. APPROV.	DATE	FINISH.

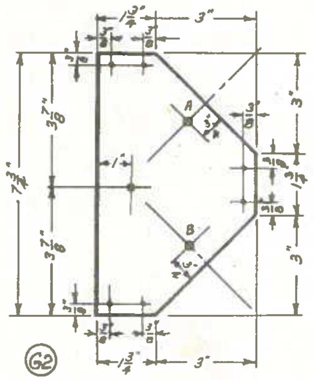
NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

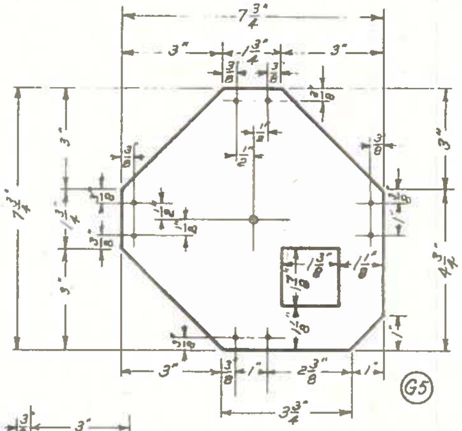
NAME SCREEN WIRE SUPPORT ANGLES	DWG. NO. R.A.-K. RL-371-B

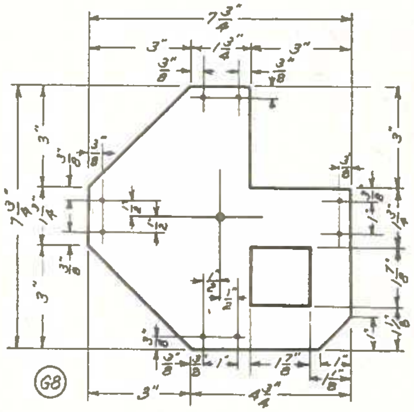


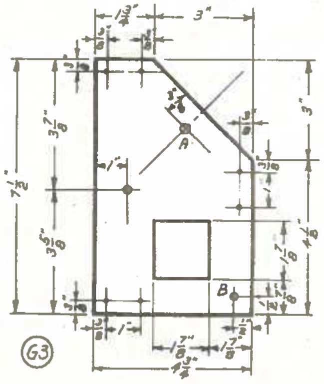


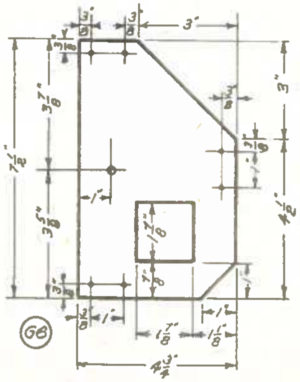




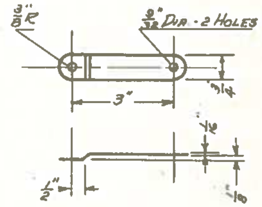








Gusset No.	1/4" Holes A	B	C	D	No. Reqd.
G 1	—	—	—	—	12
	0	—	—	—	12
G 2	—	—	—	—	36
	0	0	—	—	4
G 3	0	0	—	—	2
G 4	0	0	0	0	4
	—	—	—	—	2
G 5	—	—	—	—	6
G 6	—	—	—	—	10
G 7	0	0	0	0	6
G 8	—	—	—	—	6



0- Indicates 9/32" Drilled Hole

• — Indicates 9/64" or #27 Drilled Hole

Matl- 14 Gauge Steel

FIG.17

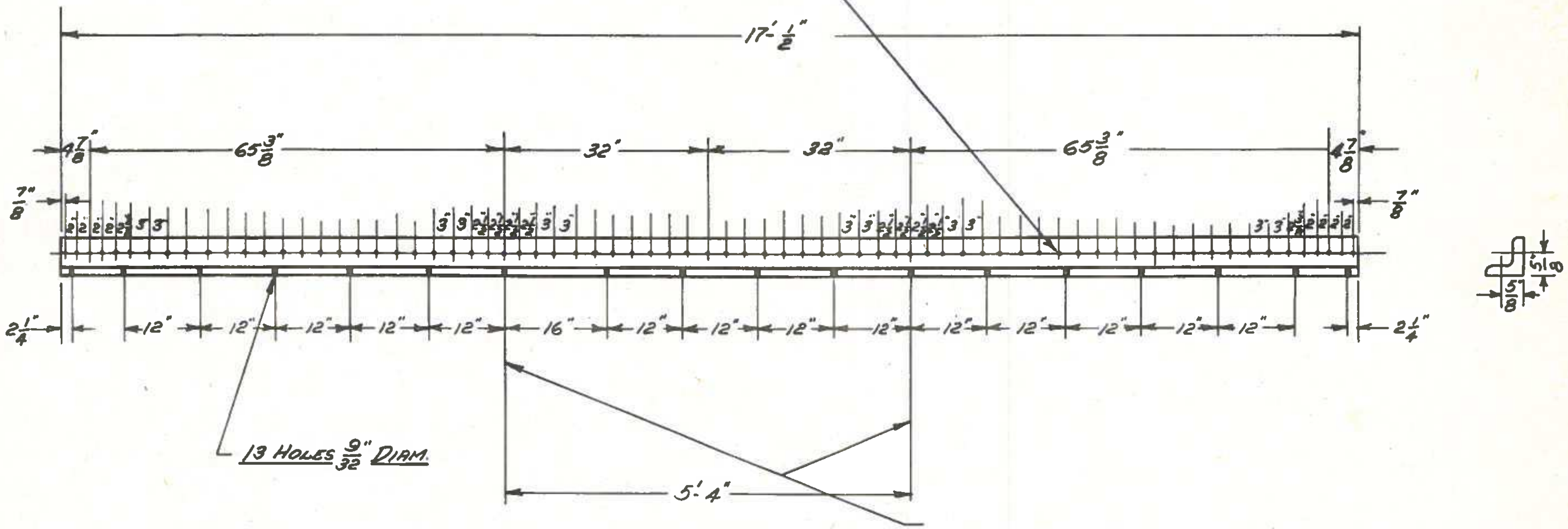
Item	Part No.	Quan	Mat'l	Description

Drawn by K.E.K Traced by J.C.	Date 16-8-43	Supersedes
Checked AS	Date AS -20-1-43	Scale 3/8"=1"
Eng. Approv.	Date	Finish

NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

Name GUSSET PLATES FOR ARRAY

Dwg. No. RL-30-C P.A.K



ALL HOLES 7/32" DIAM. IN THIS LEG.
SPACED AT 3" C.TRS. EXCEPT AS NOTED.

13 HOLES 9/32" DIAM.

THESE TWO HOLES TO MATCH
DRILLED HOLES IN GUSSET PLATE
ON ARRAY FRAME ON RL-29-D.

1 REQ'D:- AS SHOWN. 1"×1"×⅛" L's.
1 REQ'D OPP. HAND. 1"×1"×⅛" L's.

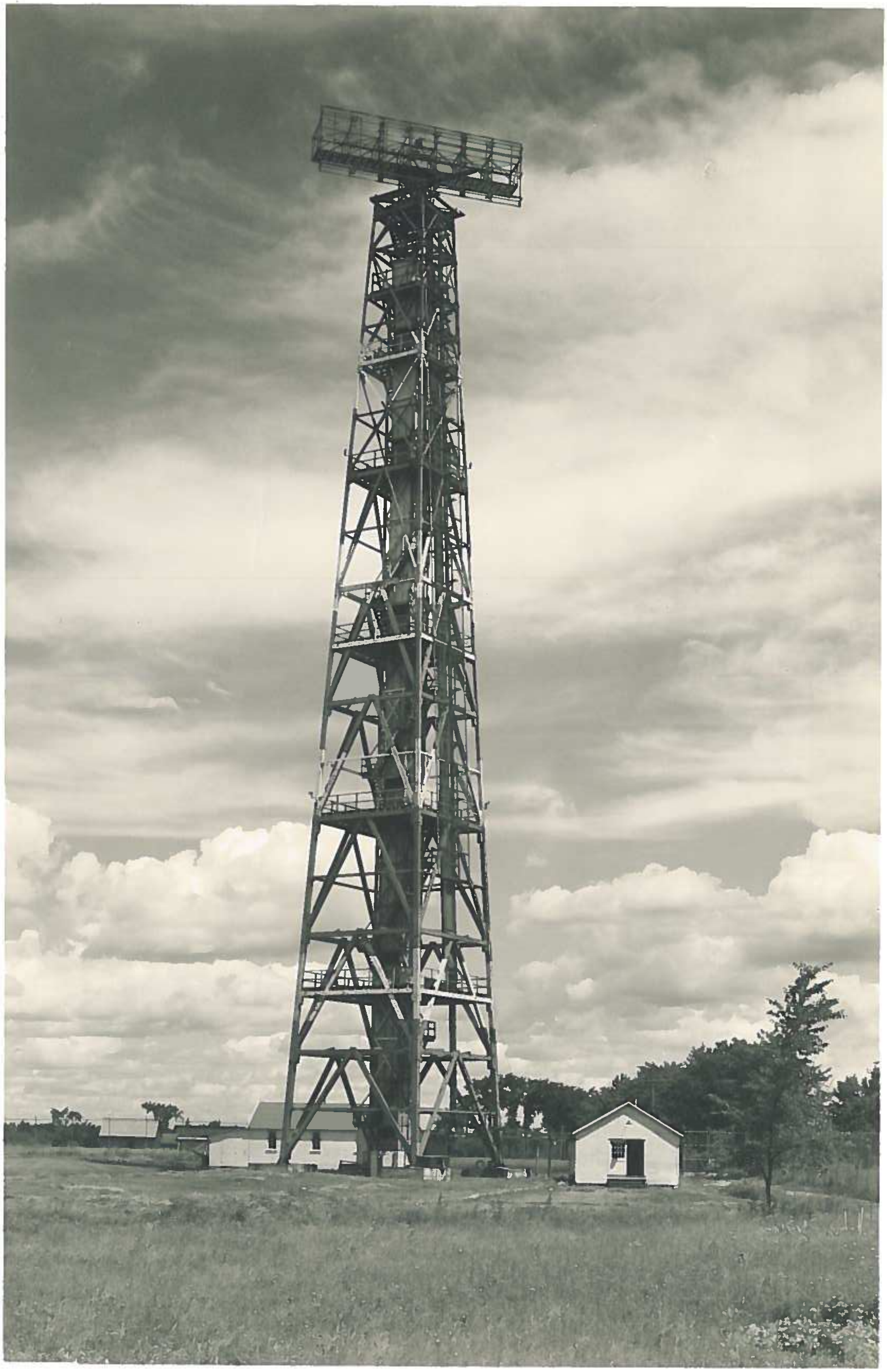
FIG. 18

ITEM	PART NO.	QUAN.	MAT'L	DESCRIPTION

DRAWN BY	J. W.	DATE	30/8/43.	SUPERSEDES	
CHECKED	A.S.	DATE	20-9-43	SCALE	N.T.S.
ENG. APPROV.		DATE		FINISH	

NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

NAME	DWG. NO.
SCREEN WIRE SUPPORT ANGLES	P-A-K. RL-370-B.



NRC
PHOTO
FIG. 19