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(54) Title: TEM LINE TO DOUBLE-RIDGED WAVEGUIDE LAUNCHER AND HORN ANTENNA

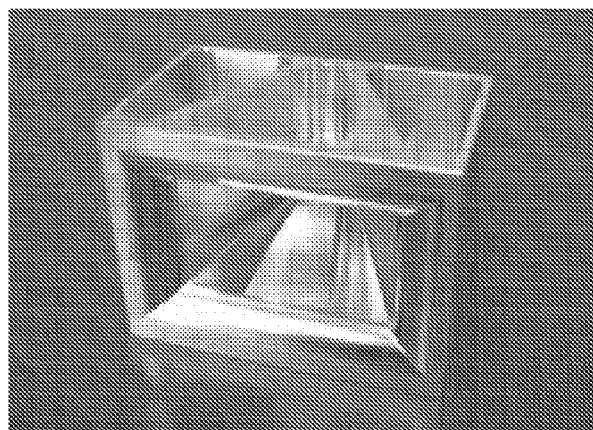


Figure 11. Photograph of the completed horn assembly.

(57) Abstract: A TEM line to double-ridged waveguide launcher and horn antenna are disclosed. The launcher uses multiple probes or one or more wide-aspect probes across the ridge gap to minimize spreading inductance and a TEM combiner or matching taper to match the impedance of the probes over a broad bandwidth. The horn uses a power-law scaling of gap height relative to the other dimensions of the horn's taper in order to provide a monotonic decrease of cutoff frequencies in all high-order modes. Both of these techniques permit the implementation of ultra-wideband designs at high frequencies where fabrication tolerances are most difficult to meet.



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 16/34573

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - H01Q 13/02; H01P 5/107 (2017.01)

CPC - H01Q 13/02, 13/0233; H01P5/107

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8): H01Q 13/02; H01P 5/107 (2017.01)

CPC: H01Q 13/02, 13/0233; H01P5/107

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

CPC: H01Q 5/00, 5/47, 13/0225, 13/0275, 13/04, 13/085, 19/08; H01P 5/08, 5/085, 5/103; G01R 1/24; IPC(8): H01Q 13/02; H01P 5/107 (2017.01); USPC: 343/772, 785, 786; 333/26, 34, 109, 113, 115, 116, 126, 254

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Patbase, Google Scholar, Google Web

Search terms used: TEM, transverse, electromagnetic, electric, magnetic, double, ridged, waveguide, backshort, impedance, match, combine, taper, wide, aspect, probe, launch, transition, couple, dc grounded, ac coupled, isolate, resistor,

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y -- A	MORGAN, "A 10-100 GHZ COAX TO DOUBLE-RIDGED WAVEGUIDE LAUNCHER AND HORN ANTENNA." arXiv preprint, March 2015, content uploaded 03 April 2015 (03.04.2015), pp 2-3 [online] <URL: https://www.researchgate.net/publication/274319721_A_10-100_GHz_Coax_To_Double-Ridged_Waveguide_Launcher_and_Horn_Antenna >	1-3, 6-10 ----- 4, 5
Y -- A	US 5,502,372 A (QUAN) 26 March 1996 (26.03.1996), col 3, ln 25-col 4, ln 5	1-3, 6-10 ----- 4, 5
Y	US 2014/0347073 A1 (BROWN) 27 November 2014 (27.11.2014), para [0023]-[0024]	9
Y	US 4,424,496 A (NICHOLS et al.) 03 January 1984 (3.01.1984), col 2, ln 14-26	10

 Further documents are listed in the continuation of Box C.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

23 February 2017

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 16/34573

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.: 18-21
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-10 drawn to a Transverse Electric and Magnetic (TEM) transmission line (TEM line) or quasi-TEM line to double-ridged waveguide launcher.

Group II: Claims 11-17, drawn to a horn antenna.

--please see continuation on extra page--

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-10

- Remark on Protest**
- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 16/34573

Continuation of Box No. III: Observations where unity of invention is lacking

The inventions listed as Groups I through II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Special Technical Features

Group I includes the special technical feature of a waveguide backshort, not included in the other group.

Group II includes the special technical feature of a radiating aperture, not included in the other group.

Common Technical Features:

The only technical feature shared by Groups I and II that would otherwise unify the groups, is double-ridged waveguide. However, this shared technical feature does not represent a contribution over prior art, because the shared technical feature is disclosed by US 3,528,041 A to Honda et al. (hereinafter Honda).

Honda discloses a double-ridged waveguide (col 1, ln 13-16: a length of doubly ridged rectangular waveguide that is dimensioned to support TE₁₀ mode propagation of electromagnetic waves).

As the common technical feature was known in the art at the time of the invention, this cannot be considered a special technical feature that would otherwise unify the groups.

Therefore, Groups I-II lack unity under PCT Rule 13.