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(54) **SPATIALLY SELECTIVE UHF NEAR FIELD MICROSTRIP COUPLER DEVICE AND RFID SYSTEMS USING DEVICE**

(75) Inventors: **Boris Y. Tsirline**, Libertyville, IL (US); **Clive P. Hohberger**, HIghland Park, IL (US); **Robert Gawelczyk**, Chicago, IL (US); **Daniel Donato**, Mundelein, IL (US)

Correspondence Address:
BABCOCK IP LLC
24154 LAKESIDE DRIVE
LAKE ZURICH, IL 60047 (US)

(73) Assignee: **ZIH CORP.**, Hamilton Parish (BM)

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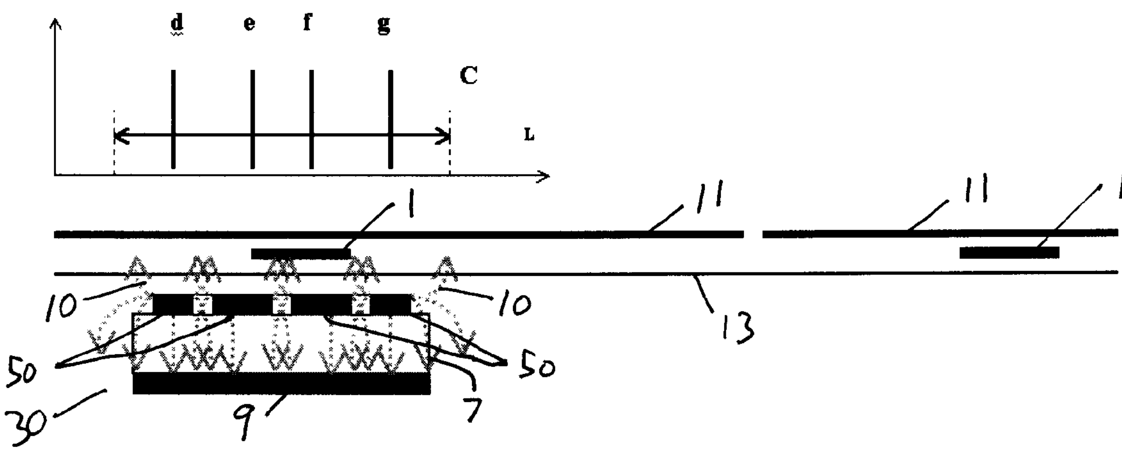
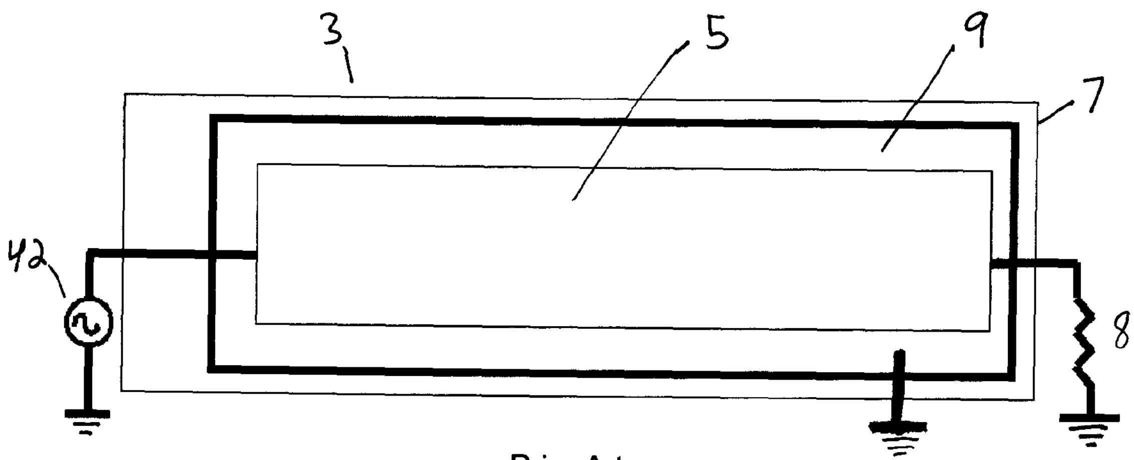
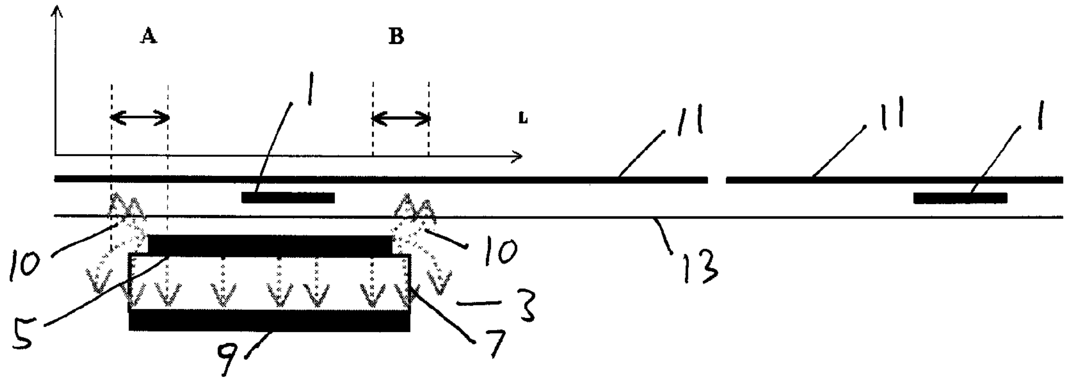
(57) **ABSTRACT**

A system having a UHF RFID transceiver is adapted to communicate exclusively with a single electro-magnetically coupled transponder located in a predetermined confined transponder operating region. The system includes a near field coupling device comprising a plurality of lines connected in parallel with an unmatched load. The near field coupling device may be formed, for example on a printed circuit board with a plurality of electrically interconnected traces and a ground plane. The system establishes, at predetermined transceiver power levels, a mutual electro-magnetic coupling which is selective exclusively for a single transponder located in a defined transponder operating region. Also included are methods for selective communication with the transponder in an apparatus such as a printer-encoder.

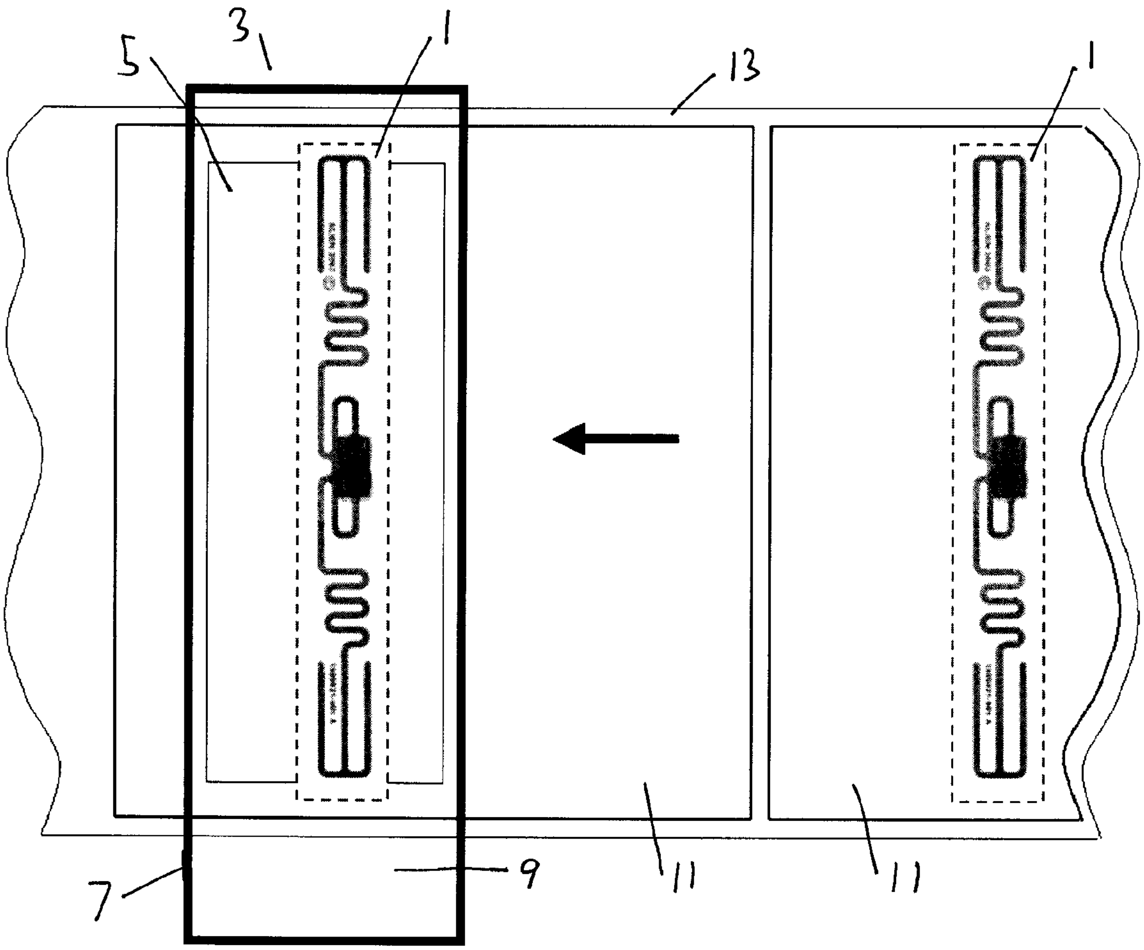




Prior Art
Figure 1



Prior Art
Figure 2a



Prior Art
Figure 2b

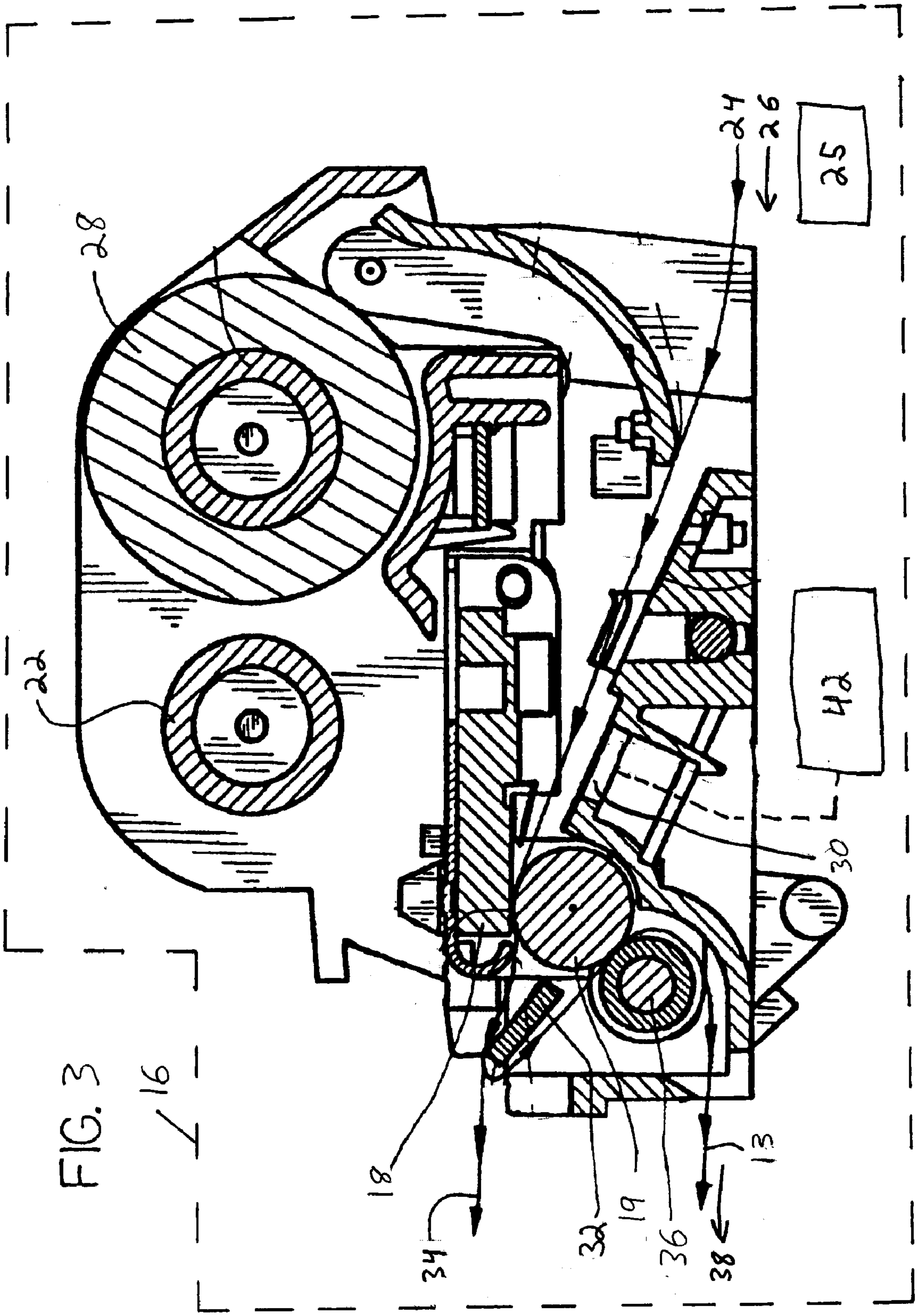


FIG. 3

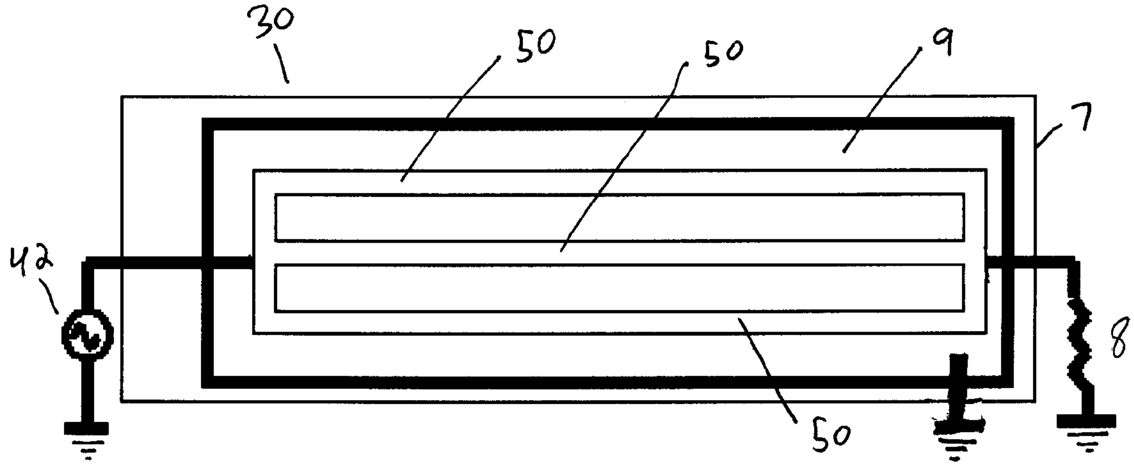


Figure 4a

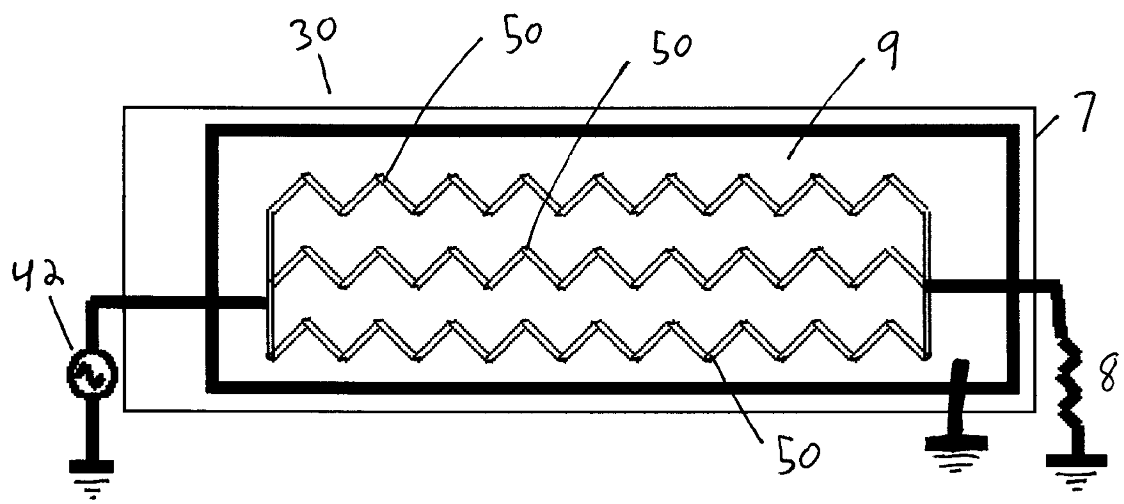


Figure 4b

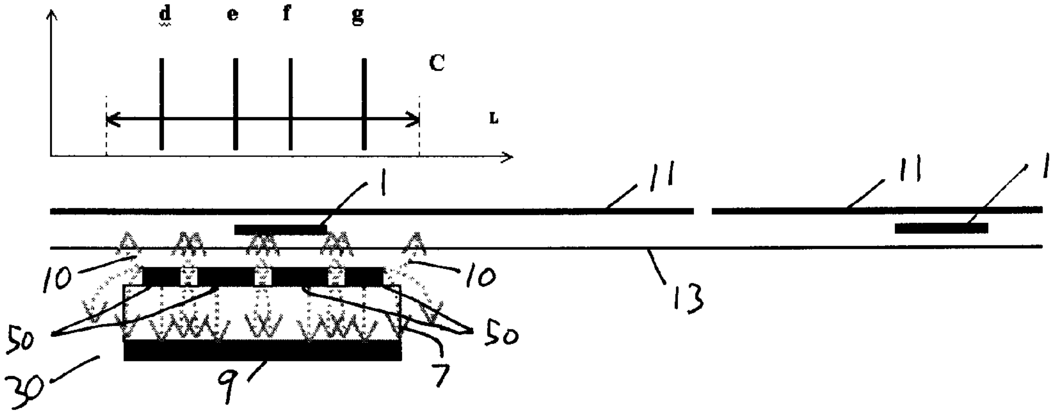


Figure 5a

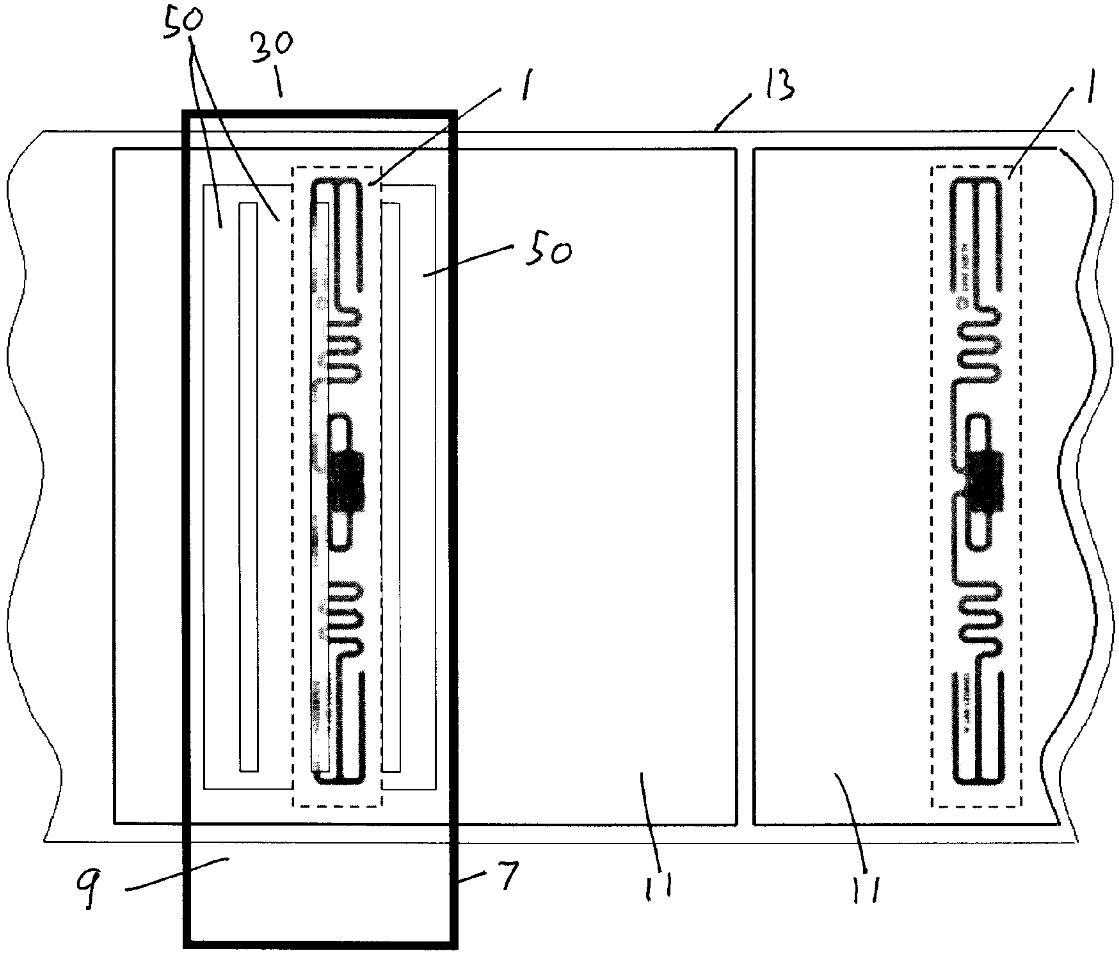


Figure 5b

SPATIALLY SELECTIVE UHF NEAR FIELD MICROSTRIP COUPLER DEVICE AND RFID SYSTEMS USING DEVICE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation-in-part of U.S. Utility Patent application No. 10/604,996, filed Aug. 29,2003 and hereby incorporated by reference in the entirety.

BACKGROUND OF INVENTION

[0002] 1. Field of the Invention

[0003] The invention relates to RFID systems, operable with a variety of different dimensioned electro-magnetically coupled transponders, working at close proximity, to an RF transceiver antenna that is spatially selective for an individual transponder located in a predetermined transponder operating region to the exclusion of other adjacent transponders, and its application to printers-encoders or other systems utilizing such in UHF RFID systems.

[0004] 2. Description of Related Art

[0005] UHF radio frequency identification (RFID) technology allows wireless data acquisition and or transmission from and or to active (battery powered) or passive transponders using a backscatter technique. To communicate with, i.e., "read" from and or "write" commands and/or data to a transponder, the transponder is exposed to an RF electro-magnetic field by the transceiver that couples with and energizes (if passive) the transponder through electro-magnetic induction and transfers commands and data using a predefined "air interface" RF signaling protocol.

[0006] When multiple passive transponders are within the range of the same RF transceiver electro-magnetic field they will each be energized and attempt to communicate with the transceiver, potentially causing errors in "reading" and or "writing" to a specific transponder in the reader field. Anti-collision management techniques exist to allow near simultaneous reading and writing to numerous closely grouped transponders in a common RF electro-magnetic field. However, anti-collision management increases system complexity, cost and delay response. Furthermore, anti-collision management is "blind" in that it cannot recognize where a specific transponder being processed is physically located in the RF electro-magnetic field, for example, which transponder is located proximate the print head of a printer-encoder.

[0007] One way to prevent errors during reading and writing to transponders without using anti-collision management is to electrically isolate a specific transponder of interest from nearby transponders. Previously, isolation of transponders has used RF-shielded housings and/or anechoic chambers through which the transponders are individually passed for personalized exposure to the interrogating RF field. This requires that the individual transponders have cumbersome shielding or a significant spatial separation.

[0008] RFID printers-encoders have been developed which are capable of on-demand printing on labels, tickets, tags, cards or other media with which a transponder is attached or embedded. These printer-encoders have a transceiver for on-demand communicating with the transponder on the individual media to read and/or store data into the attached transponder. For the reasons given, it is highly desirable in many applications to present the media on rolls or other format in which the transponders are closely spaced. However, close spacing of the transponders exacerbates the task of serially communicating with each individual transponder without concurrently communicating with neighboring transponders on the media. This selective communication exclusively with an individual transponder is further exacerbated in printers-encoders designed to print on the media in or near the same space as the transponder is positioned when being interrogated.

[0009] When transponders are supplied attached to a carrier substrate, for example in RFID-attached labels, tickets, tags or other media supplied in bulk rolls, Z-folded stacks or other format, an extra length of the carrier substrate is required to allow one transponder on the carrier substrate to exit the isolated field area before the next transponder in line enters it. The extra carrier substrate increases materials costs and the required volume of the transponder media bulk supply for a given number of transponders. Having increased spacing between transponders may also slow overall printer-encoder throughput.

[0010] When transponders of different sizes and form factors are processed, the RF shielding and or anechoic chamber configuration will also require reconfiguration, adding cost, complexity and reducing overall productivity. In certain printer-encoders it is desired to print on transponder-mounting media in the same transponder operating region in which the transponder is being read from or written to. This may be very difficult to accomplish if the transponder also must be isolated in a shielded housing or chamber.

[0011] UHF transponders may operate in, for example, the 902-928 MHz band in the United States and other ISM bands designated in different parts of the world. For example, in **FIG. 1 a** conventional one-half wavelength "Forward Wave" microstrip prior art coupler **3** consisting of a, for example, rectangular conductive strip **5** upon a printed circuit board **7** having a separate ground plane **9** layer configured for these frequencies. One end of the conductive strip **5** is connected to transceiver **42** and the other end is connected through terminating resistor **8** to ground plane **9**. The conductive strip **5** as shown in **FIG. 1** has a significant width due to RF design requirements imposed by the need to create acceptable frequency response characteristics. This type of prior art coupler **3** has been used with UHF transponders that are relatively large compared to the extent of prior art coupler **3**.

[0012] As shown by **FIGS. 2***a* and **2***b*, recently developed transponders **1**, designed for operation at UHF frequencies, have one dimension so significantly reduced, here for example a few millimeters wide, that they will be activated upon passage proximate the larger prior art coupler **3** by electro-magnetic power leakage **10** concentrated at either side edge of the conductive strip **5** of prior art coupler **3**. In **FIG. 2A**, the two leakage regions "A" and "B" defined by electro-magnetic power leakage **10** are small and relatively far apart, increasing system logical over-head and media conveyance positioning accuracy requirements. If the transponders **1** were placed close together, then multiple transponders **1** might be activated by the physically extensive one-half wavelength "Forward Wave" microstrip prior art coupler **3**.

[**0013**] Thus the minimum required spacing of these transponders **1** to isolate them, and thus the minimum size of media **11** (assuming that they are embedded one per label or media **11** on carrier substrate **13**) must be large relative to the size of the microstrip coupler **3**. This creates issues for media suppliers by limiting the available space on the media **11** for transponder **1** placement and significantly increasing the necessary accuracy of the transponder **1** placement within and or under the printable media **11** and along the liner or carrier substrate **13**. This also reduces the cost advantages of using the narrow dimensioned transponder(s) **1** within media **11**, as the media **11** must be much larger than the transponder **1** to achieve adequate RF isolation.

[**0014**] Competition in the market for such "integrated" printer-encoder systems as well as other RFID interrogation systems has focused attention on the ability to interrogate with high spatial selectivity any transponder from a wide range of available transponders having different sizes, shapes and coupling characteristics as well as minimization of overall system, media size and transponder costs.

[**0015**] Therefore, it is an object of the invention to provide a device, systems and methods that overcome deficiencies in such prior art.

BRIEF DESCRIPTION OF DRAWINGS

[**0016**] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with a general description of the invention given above, and the detailed description of the embodiments given below, serve to explain the principles of the invention.

[**0017**] **FIG. 1** is a top view of a prior art microstrip forward wave coupler.

[**0018**] **FIG. 2***a* is a simplified cut-away side view of a transponder-coupler structure using a prior art forward wave coupler as shown in **FIG. 1**, illustrating schematically locations where coupling with a narrow dimensioned transponder supplied in-line with other transponders on a carrier substrate may occur.

[**0019**] **FIG. 2***b* is a partial cut-away top schematic view of the prior art forward wave coupler and carrier substrate with embedded transponders of **FIG. 2***a*.

[**0020**] **FIG. 3** is a side schematic view of a media printer according to one embodiment of the invention having an improved RFID interrogation system.

[**0021**] **FIG. 4***a* is a top view of a coupler according to one embodiment of the invention.

[**0022**] **FIG. 4***b* is a top view of a coupler according to another embodiment of the invention.

[**0023**] **FIG. 5***a* is a simplified cut-away side view of a transponder-coupler structure using a coupler according to the invention, illustrating schematically the spaced apart areas where coupling with a narrow dimensioned transponder supplied in-line with other transponders on a carrier substrate may occur.

[**0024**] **FIG. 5***b* is a partial cut-away top schematic view of the coupler according to the invention and carrier substrate with embedded transponders of **FIG. 5***a*.

DETAILED DESCRIPTION

[**0025**] The present invention concerns apparatus and method which enables an RFID transceiver (sometimes termed herein an "interrogator") to communicate selectively and exclusively with a single UHF transponder **1** when one or more other similar transponders are in close proximity, without the need for physical isolation or cumbersome shielded housings or chambers.

[**0026**] The invention is useful in the reading and or data loading of UHF transponders, for example on an assembly line, in distribution centers or warehouses where on-demand RFID labeling is required, and in a variety of other applications. In many applications a transponder or a number of transponders are mounted or embedded on or in a label, ticket, tag, card or other media carried on a liner or carrier. It is often desirable to be able to print on the media before, after, or during communication with a transponder. Although this invention is disclosed here in a specific embodiment for use with a direct thermal or thermal transfer printer, it may also be used with any type of spatially selective RFID interrogation device or other types of printers using other printing technologies, including inkjet, dot-matrix, and electro-photographic methods.

[**0027**] In some applications a print station may be at a distance from the RFID transceiver; in others it may be necessary to accomplish the print function in the same target space occupied by the transponder when it is being interrogated.

[**0028**] **FIG. 3** illustrates by way of example only an implementation of the invention in a thermal transfer media printer **16** in which both printing and transponder communication are accomplished, but at different locations in the media printer **16**. The media printer **16** includes a printhead sub-assembly comprising a conventional thermal print-head **18** and platen roller **19**, as in a direct thermal printer for printing on thermally-sensitive media. A web **24** of media **11**, such as labels, tickets, tags or cards, is directed along a feed path **26** under the printhead **18** where on-demand printing of text, bar codes and/or graphics takes place under control of a computer or microprocessor (not shown). After being printed, the media **11** follows a media exit path **34** and may be peeled off the underlying carrier substrate **13** at a peeler bar **32**. The liner or carrier substrate **13** for the media is guided out of the media printer **16** by a roller **36** where it exits the printer along a carrier exit path **38**.

[**0029**] When a thermal printer is configured for use as a thermal transfer printer, a ribbon supply roll **28** delivers a thermal transfer ribbon (not shown for clarity) between printhead **14** and the media on web **24**. After use, the spent ribbon is collected on a take-up reel **22**.

[**0030**] In accordance with an aspect of the present invention, the media printer **16** includes a transceiver **42** for generating RF communication signals that are fed to a frequency and spatially selective microstrip near field coupler **30** located proximate the media feed path **26**. As will be explained and illustrated in detail hereinafter, the system (including transceiver **42** and near field coupler **30**) forms a near field pattern in the location of a transponder operating region C (see **FIG. 5A**). The system is configured to establish at predetermined transceiver power levels a mutual coupling which exclusively activates and communicates with a single transponder **1** located in the transponder operating region C.

[**0031**] As labels or other media **11** with embedded transponders **1** move along the media feed path **26** through transponder operating region "C", data may be read from and or written to each transponder **1**. Information indicia then may be printed upon an external surface of the media **11** as the media passes between the platen roller **19** and the printhead **18** by selective excitation of the heating elements in the printhead **18**, as is well known in the art. When the media printer **16** is configured as a direct thermal printer, the heating elements form image dots by thermochromic color change in the heat sensitive media; when the media printer **16** is configured as a thermal transfer printer, then ink dots are formed by melting ink from the thermal transfer ribbon (not shown for clarity) delivered between printhead **18** and the media on web **24** from ribbon supply roll **28**. Patterns of printed dots thus form the desired information indicia on the media **11**, such as text, bar codes or graphics.

[**0032**] Media conveyance is well known in the art. Therefore the media conveyance **25** portion of the printer that drives the media with transponders along the media feed path **26** is not described in detail.

[**0033**] The near field coupler **30** according to the invention and its manner of operation will now be described with reference to **FIGS. 4***a***-5***b*. One embodiment of the near field coupler **30** is configured for use, for example, with UHF RFID transponders. The RFID transponders **1** may be bulk supplied on a carrier substrate **13** attached to or embedded within label, ticket, card or tag media **11**.

[**0034**] The near field coupler **30** comprises an array of lines **50**, as shown for example in **FIGS. 4***a* and **4***b*. The near field coupler **30** may be configured as a segment of unmatched line **50** upon a dielectric substrate, for example a printed circuit board **7**, having a ground plane **9** formed on a spaced apart isolated layer, for example the reverse side of the printed circuit board **7**. One end of the array of lines **50** is connected to the transceiver **42**; the other end is connected to the ground plane **9** by means of terminating resistor **8**.

[**0035**] Rather than operating as a standing wave radiating antenna, or magnetic field generating coil, the near field coupler **30** according to the invention operates as a one half wavelength unmatched transmission line with, for example, a 15 ohm characteristic impedance that is terminated by a R=50 ohm terminating resistor **8**. Signals generated by the transceiver **42** passing along the transmission line generate a near field effect emanating from the transmission line edges that couples with a transponder **1** passing through the transponder operating region. Another description for the near field effect is "leaky", as discussed in "Leaky Fields on Microstrip" L.O. McMillian et al. Progress in Electromagnetics Research, PIER 17, 323-337, 1997 and hereby incorporated by reference in the entirety. Because the near field effect is extremely local to the transmission line and degrades at an exponential rate with increasing distance from the transmission line, the resulting transponder operating region of a single transmission line is very narrow. According to the invention, the prior rectangular conductive strip is therefore replaced with an array formed by a plurality of commonly fed and terminated, i.e. electrically parallel, line(s) **50**, as shown for example in **FIGS. 4***a* and **4***b*. The plurality of line(s) **50** therefore creates an array of leaky edges as shown in **FIG. 5***a*; each leaky edge creating an electro-magnetic power leakage **10** at several points within transponder operating region C. The resulting line array has similar overall width to the prior solid microstrip coupler **3** and may be similarly tuned, by adjusting the length, spacing and dielectric properties between the line(s) **50** and the ground plane **9** as well as the number of line(s) **50** and or individual line widths, shapes and inter-spacing, to adjust the overall array as an integrated single electrical structure to have the desired frequency response characteristics and generate a combined near field effect corresponding to a desired transponder operating region.

[**0036**] As shown by **FIGS. 5***a* and **5***b*, the overall transponder operating region C resulting from a near field coupler **30** according to the invention is substantially uniform. Preferably, the distance between the coupler **30** and the web **24** is selected for critical coupling. That is, the distance is selected to be that which delivers maximum power short of being so close to the web **24** that the passing transponder(s) **1** causes the effective impedance of the coupler **30** to unacceptably vary.

[**0037**] In some applications, for example the modification of an existing printer configuration to add RFID read / write capability, the coupler **30** may be placed close to the web **24** due to available space and or other design considerations such as placement of the transponder operating region C proximate the printhead **18**. Where the coupler **30** and the web **24** are at a close proximity to one another an impedance mismatch may occur as electrical interaction with passing transponder(s) **1** varies the effective impedance of the coupler **30**. Impedance mismatch will decrease coupling range for a given output power and with significant impedance variances may cause narrow null gaps in the operational region C, for example as illustrated by d, e, f, and g in **FIG. 5***a*, between the individual fields emitted by each line **50**.

[**0038**] Simplified logic added to the media transport system may be used to move the media **11** forward a small increment, for example 1-2 millimeters if a transponder **1** in the transponder operating region C falls upon a null gap and transponder communications is lost.

[**0039**] The null gaps and the ability to control their presence by manipulating the location of the coupler **30** with respect to the web **24**, are evidence of the extremely local field concentrations produced by the near field effect and the precision with which the transponder operating region may be configured to have a wide area with sharply defined boundaries. These characteristics make the near field coupler **30** useful for eliminating precision transponder placement requirements for media suppliers, complex transponder location and tracking logic in media supply systems, as well as any requirements for shielding or increased transponder placement tolerance requirements. Further, the increased transponder operating region C provided by the present invention allows users increased freedom to place embedded transponder(s) **1** in media **11** at desired locations, for example to avoid the printing degradation that may occur when the printhead encounters a media surface irregularity due to the presence of a RFID transponder **1**.

[0040] The array of lines **50** of the near field coupler **30** may be formed by a plurality of straight line(s) **50** as shown in **FIG. 4***a*. To further tune the near field produced by the line(s) **50**, a zig-zag or wiggle may be applied to each line **50**, as shown for example in **FIG. 4***b* to further reduce the appearance and/or depth of the field strength gaps d, e, f and g. For the purpose of this specification, "zig-zag " is defined as a characteristic of a line having an overall length characteristic, but a plurality of direction changes internal to the overall length of the line. The direction changes may, for example, be sharply defined or occur as smooth curves.

[0041] Alternatively, a simplified transponder **1** read and or write system may be formed without printing capabilities by positioning a near field coupler **30** coupled to a transceiver **42** proximate a media conveyance **25** moving sequential transponders **1** through a transponder operating region C. This structure is also useful where the media **11** is unprinted, or printed upon at another location.

[0042] The near field coupler **30** is not limited to a dual plane structure. For example, the near field coupler **30** may be co-planar, i.e. the ground plane and the array of lines **50** may be located, electrically isolated from each other, in the same plane of a printed circuit board but on different traces. Also, the lines **50** need not be co-planar, but may form a 3-dimensional structure. For example, the lines **50** may be on multiple layers of a printed circuit board or formed as a wire frame of lines **50** without use of printed circuit board technology.

[0043] Obviously, at some exaggerated transceiver power level, certain transponders **1** outside the transponder operating region C may be excited. However, by this invention, at appropriate power levels in the range of normal transponder read and write power levels the mutual coupling created will be highly selective for the transponder **1** in the transponder operating region C. By mapping and then applying only the required power levels for a range of both different transponder **1** types and positions within the transponder operating region C, energy consumption and potential RF interference generation may be minimized.

[0044] The spatially-selective near field property and the lack of any other shielding requirements of the near field coupler **30** according to the invention allows the economical addition of a compact, spatially-selective transponder communication module in devices such as printer-encoders.

[0045] Because the near field coupler **30** may be configured to be selective exclusively for a single transponder located in the transponder operating region C, it is now possible by this invention to use a web **24** of media having transponders which are closely spaced on the web **24**, as shown for example in the figures of this specification. Prior to this invention it was extremely difficult to communicate with just one electro-magnetically-coupled UHF transponder, which may have a wide number of different physical configurations, in a closely spaced series of transponders without simultaneously activating adjacent transponders.

Table of Parts

1	transponder
3	prior art coupler
5	conductive strip
7	printed circuit board
8	terminating resistor
9	ground plane
10	electro-magnetic power leakage
11	media
13	carrier substrate
16	media printer
18	printhead
19	platen roller
22	take up reel
24	web
25	media conveyance
26	feed path
28	ribbon supply roll
30	near field coupler
32	tear bar
34	media exit path
36	roller
38	carrier exit path
42	transceiver
50	line

[0046] Where in the foregoing description reference has been made to ratios, integers or components having known eqivalents then such equivalents are herein incorporated as if individually set forth.

[0047] While the present invention has been illustrated by the description of the embodiments thereof, and while the embodiments have been described in considerable detail, it is not the intention of the applicant to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details, representative apparatus, methods, and illustrative examples shown and described. Accordingly, departures may be made from such details without departure from the spirit or scope of applicant's general inventive concept. Further, it is to be appreciated that improvements and/or modifications may be made thereto without departing from the scope or spirit of the present invention as defined by the following claims.

1. A printer including a transceiver adapted to communicate with transponders, comprising:

a printhead;

a media conveyance adapted to transport a series of discrete media to said printhead and through a transponder operating region, at least some of said media including a transponder;

a near field coupler configured to generate a near field effect to couple with the transponder for data transfer; the near field coupler having a plurality of lines electrically interconnected in parallel, and a spaced away ground plane.

2. The printer defined by claim 1 wherein the near field coupler is formed as traces on a printed circuit board.

3. The printer defined by claim 1 wherein the near field coupler has a characteristic impedance and the near field coupler is terminated by a terminating resistor having a different characteristic impedance.

4. The printer defined by claim 1 wherein the plurality of lines are arranged parallel to each other.

5. The printer defined by claim 1 wherein at least one of the plurality of lines has a zig-zag configuration.

6. The printer defined by claim 1 wherein said printhead is positioned and configured to print on or adjacent said transponder while it is still in said transponder operating region.

7. The printer defined by claim 1 wherein said printhead is positioned and configured to print on or adjacent said transponder when it is outside of said transponder operating region.

8. The printer defined by claim 1 adapted to feed a web of spaced transponders through said transponder operating region, and wherein said printer communicates with a transponder located in said transponder operating region but concurrently not with another transponder located outside of said transponder operating region.

9. The printer defined by claim 1, wherein the near field coupler is positioned at a minimum distance relative to the transponder whereby the presence of the transponder does not vary a characteristic impedance of the near field coupler.

10. A system comprising an RFID transceiver and adapted to communicate exclusively with a single transponder located in a predetermined transponder operating region, said system comprising:

a near field coupler having a spatially selective near field property extending into the transponder operating region;

the system configured to establish at predetermined transceiver power levels a mutual coupling which is selective exclusively for a single transponder located in said transponder operating region.

11. The system defined by claim 9 wherein the near field coupler has a plurality of electrically parallel lines.

12. A method of establishing communication between a transceiver and a single transponder located in a predetermined confined transponder operating region, comprising:

generating a near field in an transponder operating region which varies in response to a radio frequency input signal; and

establishing at predetermined power levels of the transceiver a mutual coupling which is selective exclusively for a single transponder located in said transponder operating region.

13. The method defined by claim 11 including locating forming the near field with a coupler having a plurality of lines electrically connected in parallel.

14. The method defined by claim 12, further including the step of positioning the coupler at a distance from the transponder which does not significantly change a characteristic impedance of the coupler.

15. The method defined by claim 11 including transporting a web of labels through said transponder operating region, at least some of which labels have an RFID transponder, and wherein said method includes printing on said labels.

16. The method defined by claim 11, further including the step of incrementally advancing the transponder within the transponder operating region, if the transponder is located at a field strength gap of the transponder operating region.

17. A near field coupling device, comprising:

a plurality of lines electrically interconnected in parallel; a ground plane spaced away from the plurality of lines; and

a terminating resistor coupled to the lines, the terminating resistor selected not to match a characteristic impedance of the plurality of lines.

18. The near field coupling device of claim 15, wherein the plurality of lines are formed as at least a first trace on a printed circuit board and the ground plane is formed as a second trace on a printed circuit board.

19. The near field coupling device of claim 15, wherein at least one of the plurality of lines has a zig-zag characteristic.

20. The near field coupling device of claim 15, wherein the plurality of lines are spatially aligned coplanar and parallel to each other.

21. The near field coupling device of claim 15, wherein the length, width and interspacing of the plurality of lines is selected for a desired bandwidth.

22. A near field coupler for communication with an transponder located in a transponder operating region, comprising:

a near field coupler receiving an RF communication signal and configured to produce an array of spaced near field concentrations responsive to the RF communication signal, the spacing of said near field concentrations along a predetermined direction being significantly less than a smallest dimension of said transponder in said predetermined direction such that said transponder overlaps and is excited by a plurality of said field components when located in said transponder operating region.

23. The coupler of claim 22 wherein said near field concentrations are formed by lines configured in an array with a spaced parallel geometry.

24. The coupler of claim 23 wherein said lines comprise leaky edges formed in a microstrip coupler.

25. The coupler of claim 23 wherein said lines have a zig-zag configuration.

26. The coupler of claim 23 wherein said lines are formed as a trace on a printed circuit board having a separate ground plane.

27. A method for communication with a transponder, comprising the steps of:

a) positioning a transponder in a transponder operating region with a transponder axis oriented along a predetermined direction, the smallest dimension of said transponder in said predetermined direction being significantly less than a dimension of said transponder operating region in said predetermined direction;

b) with an RF communication signal, forming an array of near field concentrations in said transponder operating region, said near field concentrations extending transversely to said predetermined direction and spaced along said predetermined direction; andc) communicating with said transponder with said RF encoding signal,

d) the spacing of said near field concentrations in said predetermined direction being significantly less than said smallest dimension of said transponder in said pre-determined direction such that said transponder overlaps and is excited by a plurality of said near field concentrations when located in said transponder operating region.

28. The method of claim 27, wherein a plurality of transponders are individually communicated with by sequential passage through the transponder operating region via a media conveyance.

29. A method for communication with an transponder comprising the steps of:

positioning the transponder over a spaced array of near field concentrations of an RF communication signal, the spacing of said near field concentrations being such relative to the dimensions of said transponder that said transponder overlaps and is excited by a plurality of said near field concentrations.

30. A method for communication with an transponder comprising the steps of:

positioning the transponder over a parallel array of leaky edges having near field concentrations of an RF communication signal, the spacing of said near field concentrations being such relative to the dimensions of said transponder that said transponder overlaps and is excited by a plurality of said near field concentrations.

31. A method of adaptively communicating with an transponder comprising the steps of:

positioning the transponder contiguous with a pattern of spaced near field concentrations of an RF communication signal, the pattern having at least one undesired low energy zone within which transponder communication is not optimally performed,

exciting the transponder with the near field concentrations;

confirming valid communication;

if valid communication is not confirmed, moving the transponder a distance; repeating said exciting, confirming, and moving actions until a valid communication of the transponder is confirmed.

32. A method for communication with transponders having a range of sizes from smallest to largest, comprising the steps of:

a) with an RF communication signal, forming an array of spaced near field concentrations in a transponder operating region, the spacing of said near field concentrations being less than the smaller of the length and width dimensions of said smallest transponder such that all transponders in said range of sizes overlap and are excited by a plurality of said near field concentrations when located proximate said transponder operating region;

b) positioning proximate said transponder target sector a transponder having a size in said range of transponder sizes, and

c) communicating with said transponder.

33. A method for communication with a transponder, comprising the steps of:

with an RF communication signal, forming a near field concentration pattern in a transponder operating region larger than the transponder,

locating a transponder at a first position in said transponder operating region;

determining a first signal power level operationally effective to communicate with said transponder when located in said first position,

storing said associated first power level and transponder position;

positioning said transponder or a similar transponder in a second position in said transponder operating region;

determining a second signal power level operationally effective to communicate with said transponder when located in said second position,

storing said associated second power level and transponder position;

operationally communicating with a series of transponders located in said first and second positions in said transponder operating region using the stored first and second signal power levels respectively associated with the first and second positions of transponders in said transponder operating region.

34. The method of claim 33, further including the step of storing a type of the transponder.

35. For communicating with an RFID transponder located in a transponder operating region, a near-field microstrip coupler configured to produce an array of leaky edges oriented transverse to the transponder and spaced such that said transponder is excited by a plurality of said leaky edges when located in said transponder operating region.

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