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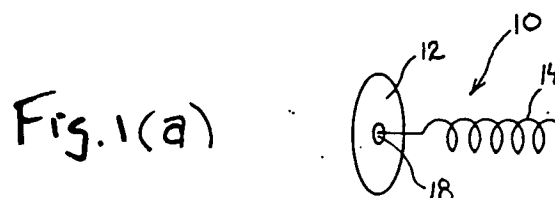
(71) Applicant: **SUMITOMO ELECTRIC INDUSTRIES, LTD.**  
**5-33, Kitahama 4-chome, Chuo-ku**  
**Osaka-shi, Osaka 541(JP)**

(72) Inventor: **Shiga, Nobuo, c/o Yokohama Works**  
**Sumitomo Elec. Ind., Ltd., 1, Tayo-cho,**  
**Sakae-ku**  
**Yokohama-shi, Kanagawa(JP)**

(74) Representative: **Patentanwälte Grünecker,**  
**Kinkeldey, Stockmair & Partner**  
**Maximilianstrasse 58**  
**W-8000 München 22 (DE)**

(54) **Antenna receiving apparatus.**

(57) A receiving apparatus for receiving microwave communications which includes a helical radiator (14) attached to a capacity plate (12). A down converter is integrated onto the back side of the capacity plate (12). Such a receiving apparatus is smaller in overall size when compared with a similar conventional helical antenna where the down converter is produced separately from the antenna.



## BACKGROUND OF THE INVENTION

### Field Of The Invention

The present invention relates to antenna receiving apparatus, in particular a helical antenna with a down converter constructed on the back side of the antenna capacity plate.

### Related Art

In today's society there is a rapid development of information network systems. The demand for satellite communication systems is increasing. Frequency bands for these systems are expanding into ever higher frequency ranges. Multitudes of businesses and homes are now receiving satellite broadcasting. Satellite broadcasting and receiving has become common on a national and international scale.

The advancement of high frequency field effect transistors and schottky barrier field effect transistors (MESFET), using compound semiconductors such as GaAs and HEMTs, have given rise to devices with excellent noise characteristics. Recently, these advances have prompted the realization of a down converter configured with MMICs (microwave monolithic integrated circuit) capable of converting high frequencies to lower frequencies. The down converter configuration is of small size, reduces cost and yields high performance.

A down converter is constituted by a first stage RF amplifier, a mixer, an oscillator, an IF amplifier, and so on. The MMIC form of a down converter drastically reduces the necessary space required to mount a down converter within an electronic device.

### SUMMARY OF THE INVENTION

The technique for connecting a helical primary radiator of a helical antenna and an MMIC down converter has not been closely examined. A helical antenna and a down converter are presently manufactured as separate, independent components connected to each other in a final production step. When connecting these components, it is impossible to minimize the overall size of the combined, but separate components even though the MMIC down converter is of a relatively small size.

In light of the above discussion, it is an object of the present invention to provide a receiving apparatus wherein a helical antenna is combined with a down converter such that the down converter circuitry is formed directly on the surface of the helical antenna's capacity plate. The down converter components comprise standard MMICs consisting of an RF amplifier, mixer, oscillator circuit,

etc. Accordingly, the present invention combines a parabolic antenna and a down converter constituting a receiving apparatus substantially the same size of a hyperbolic antenna alone. Thus, extra space for a down converter is not necessary.

### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1(a) is a view showing a helical antenna in schematic outline form.

Figure 1(b) is a side view of a helical antenna and relative dimensions in schematic outline form.

Figure 2(a) is a front plan view of the capacity plate.

Figure 2(b) is a back plan view of the capacity plate with down converter circuitry.

### DETAILED DESCRIPTION OF THE INVENTION

Figure 1(a) and 1(b) are views showing a helical antenna of the present invention. Figure 1(a) is a schematic outline view of a helical antenna, and Figure 1(b) is a side view of the same showing the dimensions thereof. It is well known that a helical antenna 10 is constituted by a capacity plate 12 and a helical radiator 14. One helical rotation about the helical radiator 14 is equal to about one wave length of the frequency to be received. The helical antenna 10 has features enabling it to be easy to design and low in manufacturing costs. It is also well known that the general design of a helical antenna has dimensions as shown in FIG. 1(b): where  $\lambda$  is equal to the wave length of the received frequency, D is selected to be not smaller than  $1.0 \lambda$ ; d is selected to equal  $0.33 \lambda$ ; g is selected to be  $0.5S$ ; and S is selected to equal  $0.29 \lambda$ . The gain of the antenna is saturated with a number of helical radiator turns equaling approximately 15.

Figure 2(a) and (b) show the front and back surfaces of the capacity plate 12 respectively. The capacity plate 12 consists of a dielectric material, possibly ceramics, which is covered entirely by ground pattern 16 on the front surface except for a central portion 18 which is where contact is made with the helical conductor (see also FIG. 1(a)). A circuit is formed with a metal, such as gold, on the back surface of the capacity plate (FIG. 2(b)). Down converter components in the form of MMICs or the like are mounted to the circuit creating a complete down converter. The helical radiator 14 (FIG. 1(a) and (b)) is passed through a bore in the central portion 18 (FIG. 2(a) and (b)) of the dielectric material and electrically connected to a microstrip line 20 in the circuit. Microstrip line 20 is connected to a high frequency (RF) amplifier 22. The output terminal of the RF amplifier 22 is connected to one input terminal of a mixer 24, whose output terminal is connected to an IF amplifier 26. An

oscillation circuit 28 is connected to the other input terminal of the mixer 24. The oscillation circuit 28 cooperates with a dielectric resonator 30 to constitute a local oscillation circuit. Furthermore, the reference numeral 32 represents a chip inductor, 34 a chip capacitor, 36 a chip resistor, 38 a source line and, 40 a ground pattern. The above MMIC components and associated circuitry constitute the down converter.

It is noted that the capacity plate 12 need not necessarily be circular.

### Claims

1. A receiving apparatus comprising:
  - a helical radiator; and
  - a capacity plate having a bore at a central location thereof, a front side to which the helical radiator is mated at the bore, a back side, and a circuit which is electrically connected to the helical radiator.
2. The receiving apparatus of claim 1, wherein the circuit is etched onto one side of the capacity plate.
3. The receiving apparatus of claim 1, wherein components of the circuit are MMICs.
4. The receiving apparatus of claim 3, wherein the circuit comprises a down converter.
5. The receiving apparatus of claim 4, wherein the down converter comprises an RF amplifier, a mixer, a microstrip line, an IF amplifier and a ground plane.
6. The receiving apparatus of claim 1, wherein the capacity plate is constructed of a dielectric material.
7. The receiving apparatus of claim 6, wherein the dielectric material is ceramic.
8. The receiving apparatus of claim 1, wherein the circuit is on the back side of the capacity plate.
9. The receiving apparatus of claim 1, wherein the capacity plate is generally circular.
10. The receiving apparatus of claim 1, wherein the helical radiator has fifteen turns.
11. The receiving apparatus of claim 10, wherein one helical rotation of the helical radiator is equal to approximately one wavelength of a frequency to be received.
12. The receiving apparatus of claim 10, wherein the diameter of the helical antenna is .33 multiplied by the wave length of a frequency to be received.
13. The receiving apparatus of claim 1, wherein the circuit is connected to the helical radiator at the bore.
14. The receiving apparatus of claim 1, wherein the front side of the capacity plate is a ground plane.
15. The receiving apparatus of claim 9, wherein the capacity plate has a diameter of at least one wave length of a frequency to be received.
16. The receiving apparatus of claim 1, wherein the helical radiator and capacity plate are sized and arranged so as to receive microwave radiation.

Fig. 1(a)

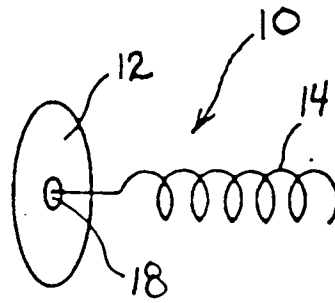
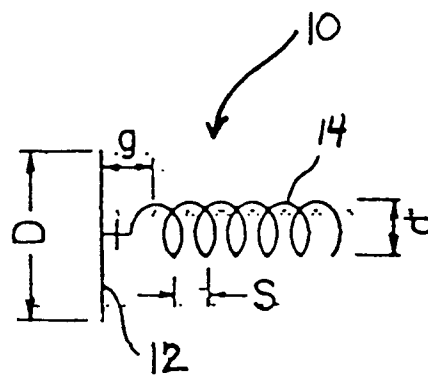
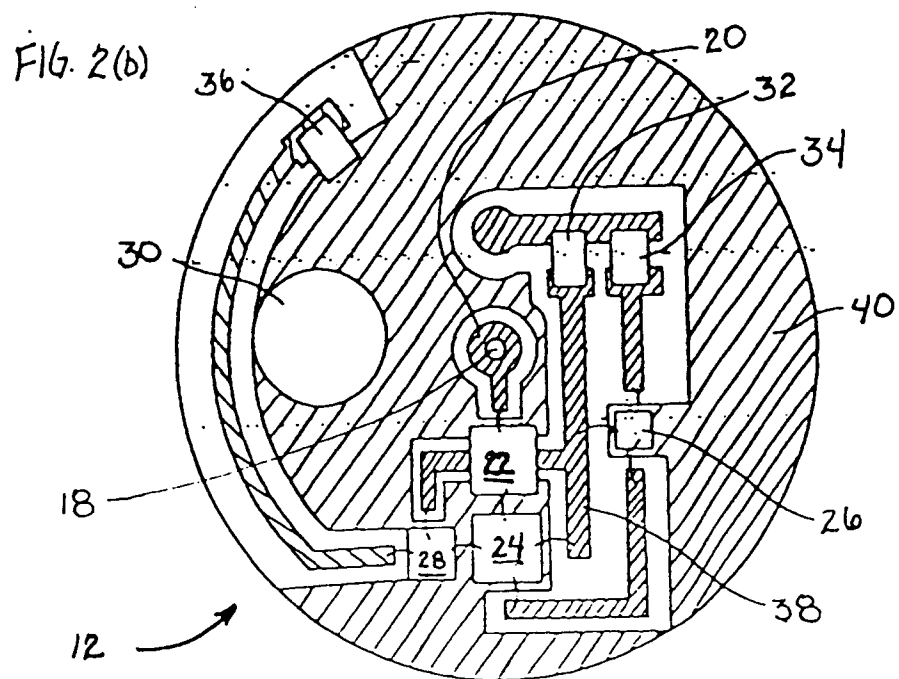
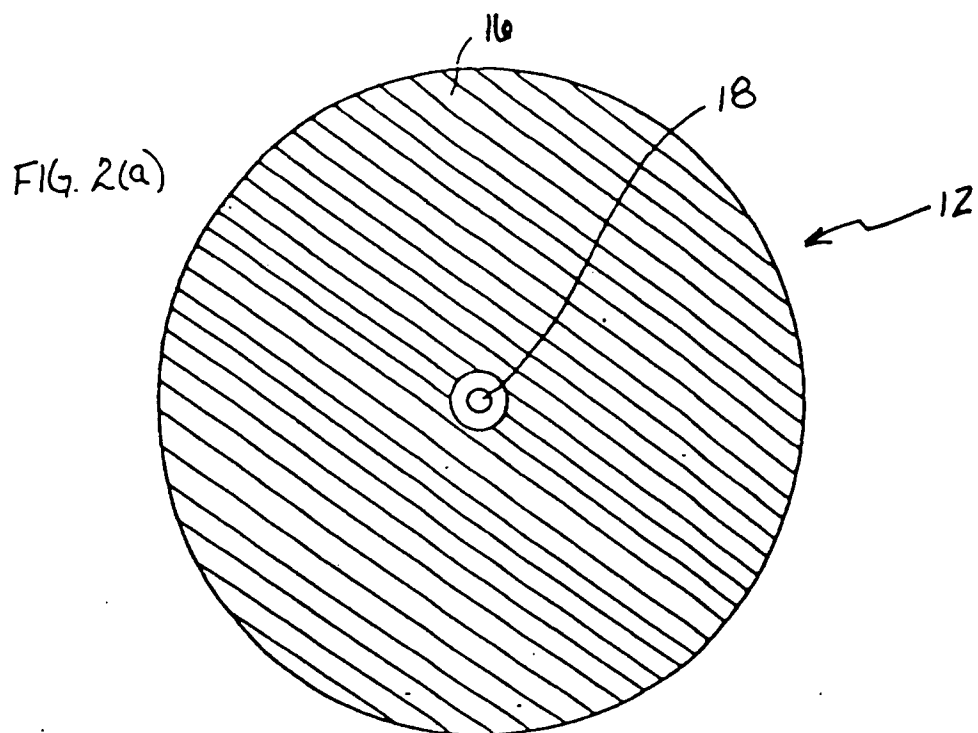


Fig 1 (b)







European Patent  
Office

## EUROPEAN SEARCH REPORT

Application Number

EP 92 11 2050

### DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	PATENT ABSTRACTS OF JAPAN vol. 10, no. 58 (E-386)(2115) 7 March 1986 & JP-A-60 210 012 ( SHARP ) 22 October 1985 * abstract *	1,2,13, 16	H01Q1/24 H01Q11/08
Y	---	3-5	
Y	CONFERENCE PROCEEDINGS 15TH EUROPEAN MICROWAVE CONFERENCE September 1985, PARIS, FRANCE pages 706 - 710 OHTA ET AL. 'New Ku-Band low noise converter directly coupled with helical antenna' * page 706, paragraph 2 - page 707, paragraph 3; figure 3 *	3-5	
A	EP-A-0 149 400 (THOMSON-CSF) * claims 1-10; figures 3-5 *	1	
A	FR-A-2 603 743 (AISIN SEIKI) * the whole document *	1,9-12	TECHNICAL FIELDS SEARCHED (Int. Cl.5)  H01Q H03D
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 09 NOVEMBER 1992	Examiner ANGRABEIT F.F.K.
<b>CATEGORY OF CITED DOCUMENTS</b>  X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document  T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document			