# Patent Abstracts

These Patent Abstracts of recently issued patents are intended to provide the minimum information necessary for readers to determine if they are interested in examining the patent in more detail. Complete copies of patents are available for a small fee by writing: U.S. Patent and Trademark Office, Box 9, Washington, DC 20231.

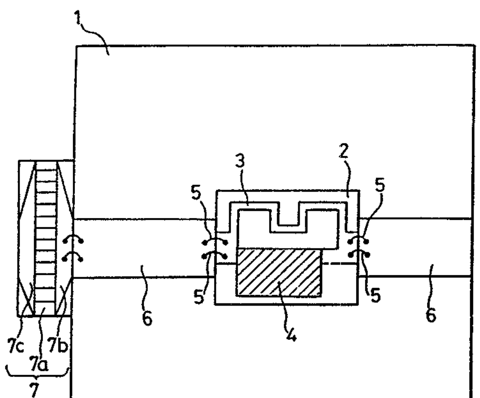
**5,233,310** Aug. 3, 1993

## Microwave Integrated Circuit

Inventor: Akira Inoue.
Assignee: Mitsubishi Denki Kabushiki Kaisha.
Filed: June 29, 1992.

*Abstract*—In a hybrid microwave integrated circuit in which an FET and an LC resonance circuit are integrated, the LC resonance circuit includes an inductor and a capacitor disposed on a substrate having a smooth surface which ensures that the dimensional precision of the inductor will be in a range of ± several microns when it is formed on the substrate. Then, the substrate, on which the LC resonance circuit is formed, is mounted on or buried in a high frequency signal transmitting substrate. Therefore, variation in resonant frequency of the LC resonance circuit are reduced, whereby deteriorations in characteristics, such as efficiency, output power and the like, are reduced. In addition, since the LC resonance circuit is reduced in the size and cost of the whole circuit are reduced.

**17 Claims, 10 Drawing Sheets**



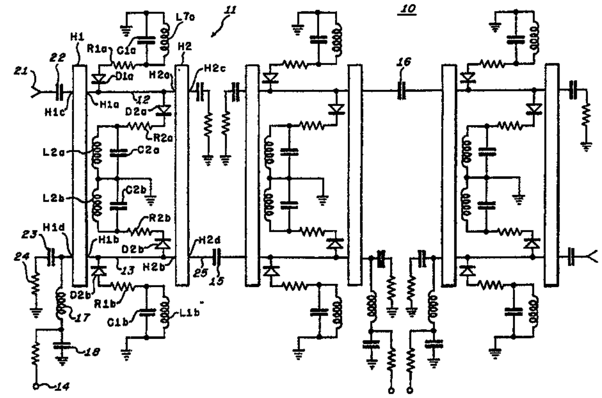

**5,233,317** Aug. 3, 1993

## Discrete Step Microwave Attenuator

Inventors: Kirk A. Snodgrass and Peter D. Bailey.
Assignee: Honeywell, Inc.
Filed: Oct. 3, 1991.

*Abstract*—A step attenuator comprises two branchline couplers with two coupling transmission lines therebetween. Attenuation is accomplished through switchable resistors, in series with switching diodes, shunted across the transmission lines. These resistors reflect and absorb incident power. Switching signals are provided to the diodes through the branchline couplers and the coupling transmission lines. The reflected power is absorbed by a matched termination at the port of the input branchline coupler that is isolated from the port at which the signal to be attenuated is coupled. Phase shift and insertion loss are minimized by tuning the series inductance inherent in the diode resistor combination with tuning capacitors in series therewith. These capacitors are by passed by low-susceptance inductors which provide a dc path to ground for the diodes.

**3 Claims, 4 Drawing Sheets**



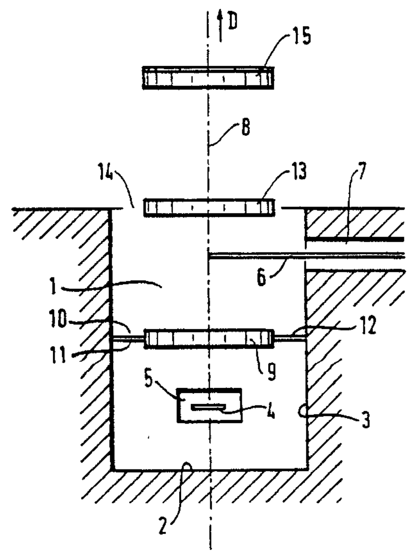
**5,233,364** Aug. 3, 1993

## Dual-Polarized Microwave Antenna Element

Inventors: Pascal Lefeuvre, Denis Michel, Jacques Bigou.
Assignee: Alcatel Espace.
Filed: June 9, 1992.

*Abstract*—A microwave antenna element suitable for constituting one of the elements of an array, the antenna element being capable of transmitting or receiving two orthogonally-polarized microwaves. The antenna element is constituted by a cavity containing two orthogonal excitation probes separated by a polarization-selective obstacle forming both a short-circuit plane for the microwave transmitted by the top probe, and also a patch for the microwave transmitted by the bottom probe. Another patch is common to both of the interlaced antennas. A third patch which is polarization-selective in the sense that it is transparent for the microwave transmitted by the bottom probe, may also be provided.

**4 Claims, 2 Drawing Sheets**



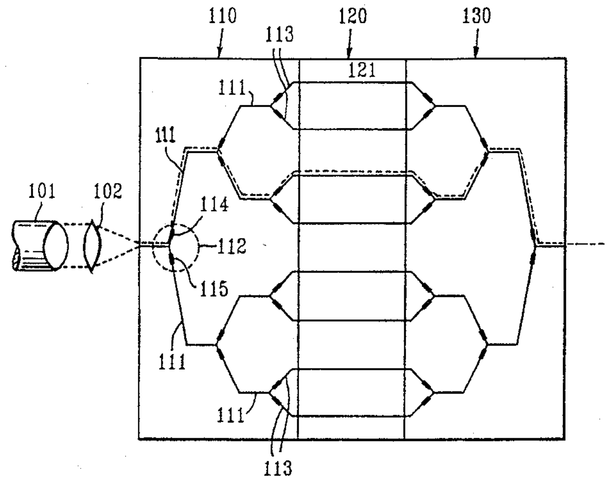
**5,233,453** Aug. 3, 1993

## Space-Division Switched Waveguide Array Filter and Method Using Same

Inventors: Kumar N. Sivarajan, David G. Steinberg, Franklin F. Tong.
Assignee: International Business Machines Corporation.
Filed: Apr. 29, 1992.

*Abstract*—This invention discloses a method and apparatus for providing high speed optical tuning. With this invention, light is spatially routed through a tree of optical switches interconnected by waveguides to a selected fixed tuned optical filter in an array of such filters. Each of the optical switches can be controlled by a binary signal thereby permitting digitally controlled optical filtering.

**9 Claims, 10 Drawing Sheets**



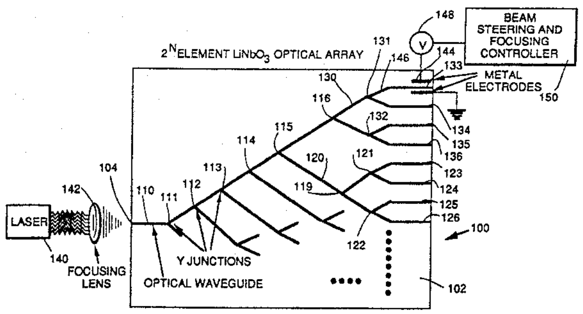

**5,233,673** Aug. 3, 1993

## Output Steerable Optical Phased Array

Inventors: Victor Vali, David B. Chang, Albert F. Lawrence.
Assignee: Hughes Aircraft Company.
Filed: Oct. 9, 1991.

*Abstract*—Optical phased arrays employing a large number of light emitters and optical phase delays between adjacent emitters to steer and focus an optical beam from the contributions of all the light emitters. The array can include a laser oscillator (22) as the light source, with the laser light being conducted via optical waveguides (26, 30 and 32) into optical fibers (34), with phase delays being effected by piezoelectric or electro-optic effects on the optical waveguides. The array can be used in a low cost display device for generating optical images or in an optical memory.

**20 Claims, 6 Drawing Sheets**



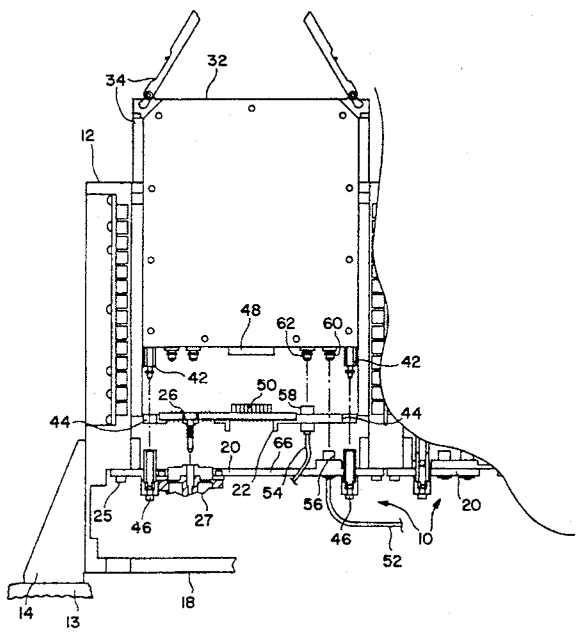

**5,234,348** Aug. 10, 1993

## Front Removable/Serviceable RF Backplane

Inventors: Francis X. Konsevich and Jose F. Olivas.
Assignee: TRW Inc.
Filed: May 21, 1992.

*Abstract*—An RF backplane for interconnecting a plurality of electronic components. The backplane is housed in a rack which is installed in a vehicle such as an airplane. The backplane includes a fixed frame fixedly mounted in the rack and at least one removable frame aligned with and removably attached to the fixed frame. Upon removal of the removable frame and electronic components attached thereto, complete access is afforded to the backplane and various components interconnected thereto without removal of the rack from the vehicle.

**20 Claims, 2 Drawing Sheets**



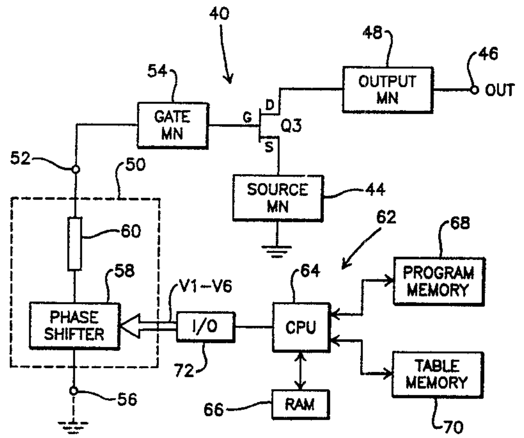

**5,235,293** Aug. 10, 1993

## Variable Frequency Microwave Oscillator Including Digital Phase Shifter as Tuning Element

Inventor: Gregory S. Mendolia.
Assignee: Hughes Aircraft Company.
Filed: June 30, 1992.

*Abstract*—A resonator (50) is connected in circuit with a negative resistance element (Q3, Q4) for producing oscillation at a resonant frequency of the resonator (50). A digital phase shifter (58) is incorporated into the resonant frequency in accordance with an applied digital signal. The resonator (50) can be connected in series with the negative resistance element (Q3), in which case the phase shifter (58) is connected as either a short-circuit or an open-circuit transmission line. Alternatively, the resonator (50) can be connected in parallel with the negative resistance element (Q4) in a feedback loop. An analog phase shifter (84) can also be provided in the resonator (50) for continuously variably setting the resonant frequency over the tuning increments of the digital phase shifter (58).

**20 Claims, 5 Drawing Sheets**



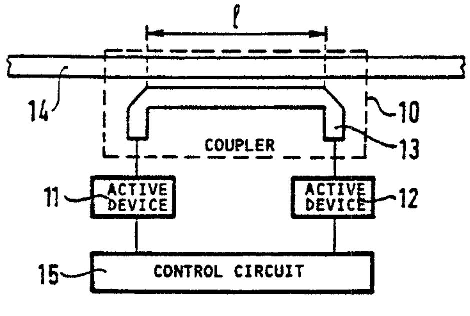

**5,235,295** Aug. 10, 1993

## Microwave Equalizer Suitable for Aerospace Applications

Inventors: Regis Barbaste, Joel Larroque, Albert Cerro, Florence Labarre.
Assignee: Alcatel Espace.
Filed: Oct. 10, 1991.

*Abstract*—A microwave equalizer is used in aerospace applications to correct the gain/frequency response of a microwave system, in particular in a given range of temperatures. To obtain a variation opposite to that of the microwave system by introducing absorption at the operating frequency, it comprises at least one microwave coupler one branch of which has an active device fitted at each of its two ends so that variation in the device parameters enables displacement of the absorption frequency and optionally power. The coupler(s) are coupled to a transmission line of the system and a control circuit.

**5 Claims, 3 Drawing Sheets**



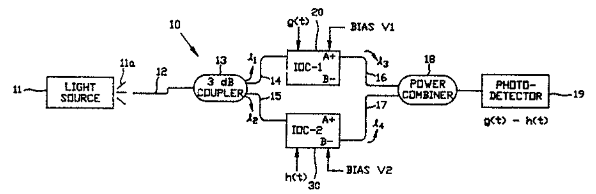

**5,235,455** Aug. 10, 1993

## Wide Bandwidth Differential Amplifier

Inventors: Mark H. Berry and Debra M. Gookin.
Assignee: The United States of America as represented by the Secretary of the Navy.
Filed: Feb. 21, 1991.

*Abstract*—A differential amplifier for gigahertz bandwidth electrical signals using fiber optics and integrated optical devices has a differential gain which is a function of the electrical to optical and optical to electrical conversion factors. The common mode rejection ratio of the differential amplifier at 1 GHz was greater than 30 dB and the common mode rejection ratio depended on the time difference between the differential amplifier inputs. A differential amplifier fabricated in accordance with this inventive concept could be used as an integrated module in radar and communications systems.

**11 Claims, 2 Drawing Sheets**



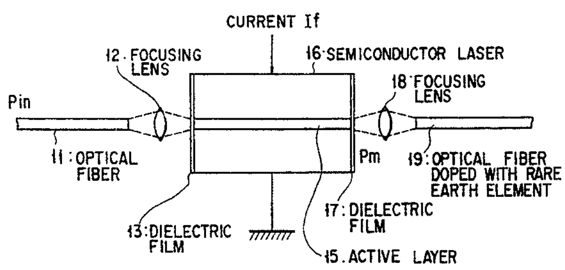

**5,235,604** Aug. 10, 1993

## Optical Amplifier Using Seminconductor Laser as Multiplexer

Inventor: Koyu Chinen.
Assignee: Kabushiki Kaisha Toshiba.
Filed: June 22, 1992.

*Abstract*—An optical signal emitted from a first optical is applied to a semiconductor laser through a focusing lens so as to propagate through an active layer of the semiconductor laser. In the semiconductor laser, the optical signal is multiplexed with the laser emission power to produce a multiplexed optical signal. The multiplexed optical signal is then applied to a second optical fiber doped with a rare earth element such as erbium to carry out pumping of the rare earth element of the second optical fiber, thereby amplifying the optical signal.

**7 Claims, 3 Drawing Sheets**




**5,237,288** Aug. 17, 1993

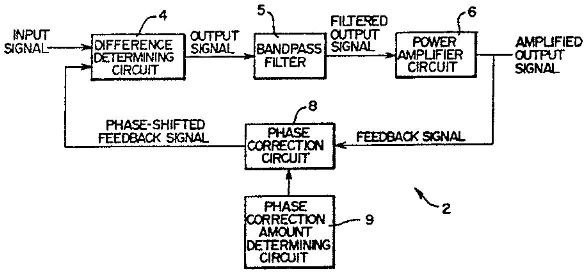
## RF Power Amplifier Linearization

Inventor: John F. Cleveland.
Assignee: SEA, Inc.
Filed: June 5, 1992.

*Abstract*—An apparatus for generating an amplified signal from an input signal. The apparatus comprises: (a) a phase-shifting circuit for shifting the phase of a feedback signal derived from the amplified output signal in response to a control signal; (b) a differencing circuit for generating an output signal based on the input signal and the phase-shifted feedback signal; (c) a filter for

filtering the output signal; and (d) a power amplifier for amplifying the filtered output signal to obtain the amplified output signal. The apparatus further comprises a CPU and DAC for generating a control signal corresponding to a control signal value associated with a frequency range including the operating frequency from a table associating predetermined control signal values with frequency ranges in the portion of the frequency spectrum in which the amplifier is designed to operate. Phase shift introduced by the filter is thus compensated for by the phase-shifting circuit to maintain negative feedback and thus system stability.

**17 Claims, 8 Drawing Sheets**



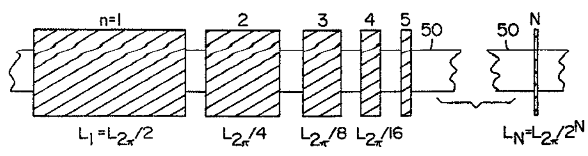

**5,237,629** Aug. 17, 1993

## Digitally Controlled Distributed Phase Shifter

Inventors: Vincent M. Hietala, Stanley H. Kravitz, Gregory A. Vawter.
Assignee: The United States of America as represented by the United States Department of Energy.
Filed: Mar. 19, 1992.

*Abstract*—A digitally controlled distributed phase shifter is comprised of N phase shifters. Digital control is achieved by using N binary length-weighted electrodes located on the top surface of a waveguide. A control terminal is attached to each electrode thereby allowing the application of a control signal. The control signal is either one or two discrete bias voltages. The application of the discrete bias voltages changes the modal index of a portion of the waveguide that corresponds to a length of the electrode to which the bias voltage is applied, thereby causing the phase to change through the underlying portion of the waveguide. The digitally controlled distributed phase shift network has a total phase shift comprised of the sum of the individual phase shifters.

**19 Claims, 3 Drawing Sheets**



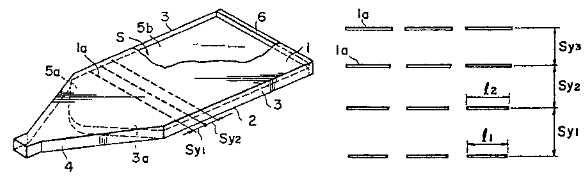

**5,239,311** Aug. 24, 1993

## Flat Slot Array Antenna

Inventors: Kunitaka Arimura, Akira Tsukada, Fumio Takenaga, Hiroshi Kasuga.
Assignee: Arimura Giken Kabushiki Kaisha.
Filed: Apr. 6, 1992.

*Abstract*—A flat slot array antenna as composed of a waveguide having a rectangular sectional shape, and a power feeder means connected to the waveguide at a power feed opening. A plurality of wave radiation slots are formed within one of the metallic plates forming the waveguide. The length of each slot is progressively increased toward a terminal end of the power propagation within the space of the waveguide within a range which does not exceed the resonance length of the slot, and the distance between the slots is progressively reduced toward the terminal end of the waveguide.

**34 Claims, 25 Drawing Sheets**



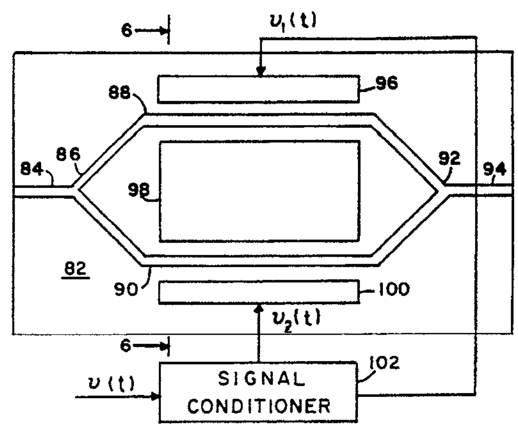

**5,239,401** Aug. 24, 1993

## Optical Modulator for Cancellation of Second-Order Intermodulation Products in Lightwave Systems

Inventor: Robert Olshansky.
Assignee: GTE Laboratories Incorporated.
Filed: Dec. 31, 1990.

*Abstract*—Optical communication methods and apparatus are disclosed for transmitting two or more optical signals with different optical carrier frequencies on a single optical fiber with high spectral efficiency. Each optical carrier is typically modulated with multiple modulated subcarriers. In one embodiment, an optical phase modulator provides cancellation of second order intermodulation products in each optical signal. thereby permitting the optical carrier frequencies to be spaced by $2f_{max}$, where $f_{max}$ is the maximum modulation frequency. In another embodiment, a single sideband optical phase modulator provides cancellation of second order intermodulation products and one signal sideband, thereby permitting the optical carrier frequencies to be spaced by $f_{max}$.

**22 Claims, 11 Drawing Sheets**



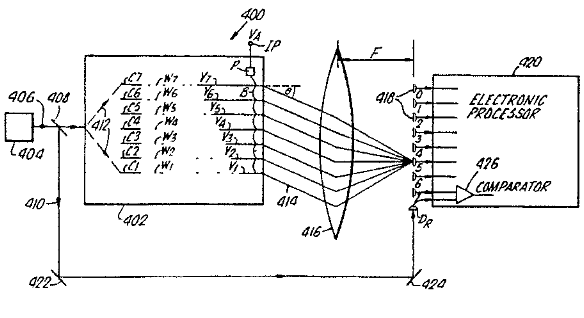

**5,239,598** Aug. 24, 1993

## Electro-optic Waveguide Device

Inventors: David R. Wight, John M. Heaton, Meirion F. Lewis, Christopher L. West.
Assignee: The Secretary of State for Defense in Her Britannic Majesty's Government of the United Kingdom of Great Britain and Northern Ireland.
Filed: Aug. 16, 1991.

*Abstract*—An electro-optic waveguide device (10) comprises an assembly of waveguides (30) connected to a common light input region (41) and forming a common far field diffraction pattern (44). The device (10) comprises an $n^+$ GaAs substrate (14) bearing a waveguide lower cladding layer (16) of $n^+Ga_{0.9}Al_{0.1}As$, which is in turn surmounted by a waveguide core layer (18) of $n^-GaAs$. The layer (18) has grooves (20) defining the waveguides (30), each of which has a respective Schottky contact (32). Each contact (32) is biased negative with respect to the substrate (14), which reverse biases the respective Schottky diode waveguide structure. The waveguide core layer (18) has electro-optic properties, and its refractive index varies with electric field. The phase of light emerging from each waveguide is therefore independently variable by means of its applied bias voltage. The waveguides (30) are arranged to provide output confined very largely to lowest order spatial modes, so that they produce a single far field diffraction pattern (44). Varying the set of bias voltages applied to the waveguides (30) produces output phase variation which changes the position of the diffraction pattern principal maximum (46) to produce beam steering.

**26 Claims, 17 Drawing Sheets**



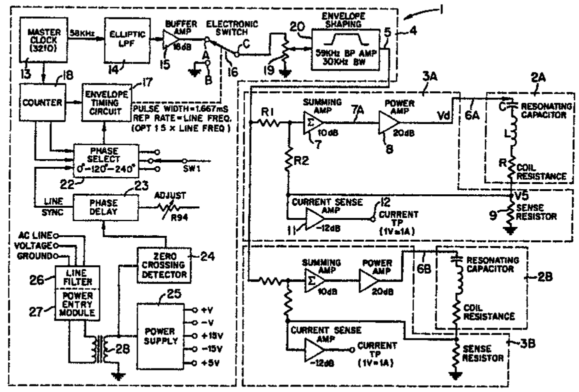

**5,239,696** Aug. 24, 1993.

## Linear Power Amplifier Utilizing Current Feedback

Inventors: Brent F. Balch and David Roberson.
Assignee: Sensormatic Electronics Corporation.
Filed: Oct. 15, 1991.

*Abstract*—A transmitter for an electronic article surveillance system having a power amplifier for forming a drive signal for causing a current to flow through an antenna. The magnitude of the current flowing through the antenna is sensed and, based upon the sensed current, the drive signal is continuously controlled.

**18 Claims, 2 Drawing Sheets**



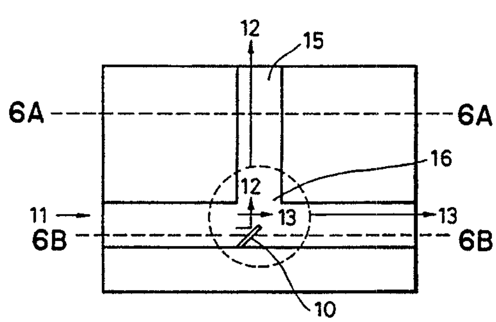

**5,239,600** Aug. 24, 1993

## Optical Device With an Optical Coupler for Effecting Light Branching/Combining by Splitting a Wavefront of Light

Inventors: Yuichi Handa and Mitsutoshi Hasegawa
Assignee: Canon Kabushiki Kaisha.
Filed: Oct. 16, 1991.

*Abstract*—An optical device includes a channel or three-dimensional light waveguide for propagating a light wave therethrough and an optical coupler for effecting at least one of branching and combining of the light wave by splitting a wavefront of a field distribution of the light wave. The coupler is produced by forming a portion whose reflection factor is different from the waveguide, extending in a vertical direction of the waveguide. The portion of different reflection factor is formed deep enough in the vertical direction to perform the splitting of the wavefront of the field distribution of the light wave with respect to at least a horizontal or lateral direction, or the portion of different reflection factor is formed at a flat portion of the waveguide.

**11 Claims, 17 Drawing Sheets**



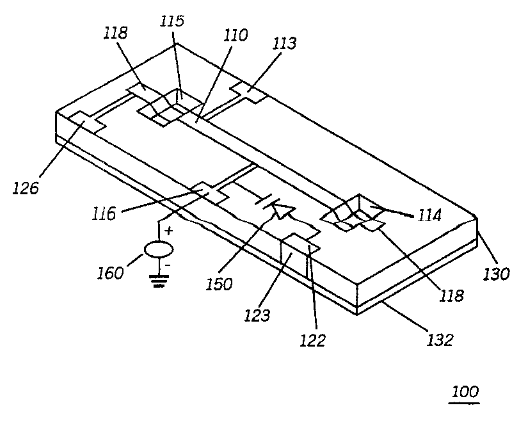

**5,241,291** Aug. 31, 1993

## Transmission Line Filter Having a Varactor for Tuning a Transmission Zero

Inventor: Dane E. Blackburn.
Assignee: Motorola, Inc.
Filed: July 5, 1991.

*Abstract*—A transmission line structure (100) is provided which includes a resonator (110) having open ends (118) disposed on a substrate (130). The first resonator (110) includes a control voltage terminal (116) which is positioned at a point along the length where a zero potential exists at resonant frequency. Transmission zero frequency is tuned by means of a varactor (150) which is coupled to the control voltage terminal and receives a control voltage for controlling the zero frequency.

**12 Claims, 2 Drawing Sheets**



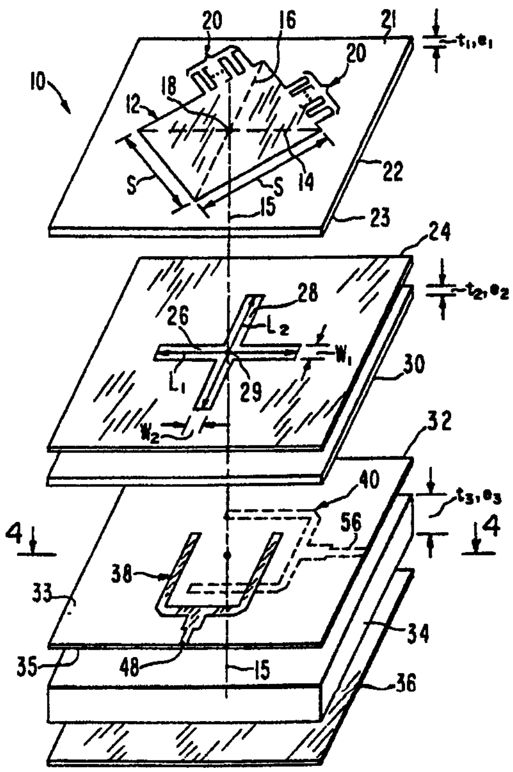
**5,241,321** Aug. 31, 1993

## Dual Frequency Circularly Polarized Microwave Antenna

Inventor: Chich-Hsing A. Tsao.
Assignee: Space Systems/Loral, Inc.
Filed: May 15, 1992.

*Abstract*—An aperture coupled microwave antenna (10) for processing circularly polarized signals. The antenna (10) comprises a first planar dielectric layer (22) upon which a conductive radiating patch (12) is mounted. Attached to the radiating patch (12) are tuning means (20, 72) for converting linearly polarized signals into circularly polarized signals. The tuning means preferably takes the form of conductive tuning stubs (20). Abutting an opposite face (23) of the first dielectric layer (22) is a conductive ground plane (24) having two orthogonal elongated apertures (26, 28). The radiating patch (12) is electromagnetically coupled, through the two elongated apertures (26, 28), to two input/output ports (48, 56) by two conductive feeding circuits (38, 40). Each of the feeding circuits (38, 40) interacts with only one of the elongated apertures (26, 28, respectively). The two feeding circuits (38, 40) and the elongated apertures (26, 28) are designed to operate in isolation. This allows the antenna (10) of the present invention to simultaneously process two signals having different frequencies.

**9 Claims, 4 Drawing Sheets**



**5,241,414** Aug. 31, 1993

## Fault Tolerant Optical Amplifier Arrangement

Inventors: Clinton R. Giles and Tingye Li.
Assignee: AT&T Bell Laboratories.
Filed: Aug. 21, 1992.

*Abstract*—For a group of optical amplifiers, pump beams from an array of lasers are mixed together to form a plurality of composite pump beams. Each composite pump beam is distributed to the pump port of a particular optical amplifier. The composite pump beam improves the reliability of each optical amplifier. Rather than having catastrophic failure of an optical amplifier occasioned by the failure of its pump laser, it is now possible to maintain full operation of the group of optical amplifiers even though one or more lasers fail.

**15 Claims, 2 Drawing Sheets**