# 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 USA.

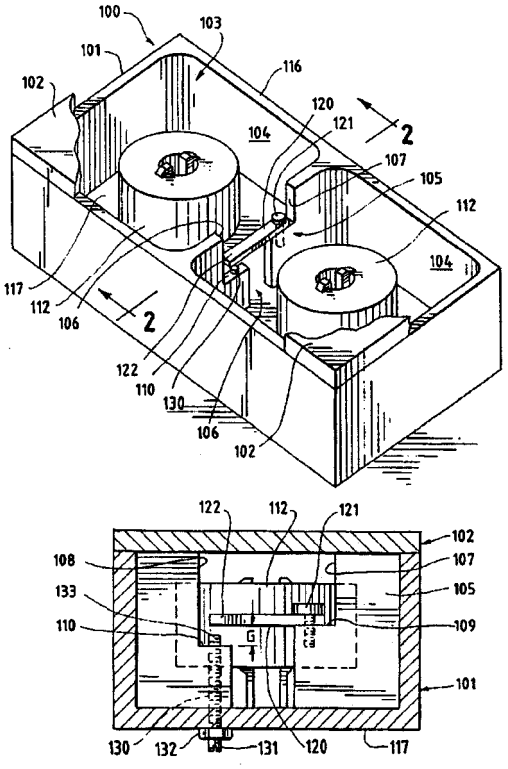
**6,353,373** March 5, 2002

## COUPLING MECHANISMS FOR DIELECTRIC RESONATOR LOADED CAVITY FILTERS

Inventors: Xiao-Pang Liang and Michael Butler.
Filed: May 3, 2000.

***Abstract*—**A dielectric loaded cavity filter having a housing and a cover and defining at least two adjacent cavities having respective dielectric resonators mounted therein and separated by a transverse partition defining a coupling window in the housing. In one form, the coupling window has two spaced opposing sidewalls confronting each other, and vertically offset shoulders intermediate their length. A conductive coupling strip is secured to the shoulder of one sidewall and extends across the coupling window and over the shoulder of the other sidewall. A tuning screw is secured by threading to the housing and has an outer free end accessible from the exterior of the filter, and an internal end disposed adjacent the coupling strip, whereby when the tuning screw is rotated, the internal end of the screw moves toward and away from the coupling strip in a direction perpendicular to the cover for tuning without requiring access to the coupling strip. In another form, no coupling strip is present and the tuning screw inner end confronts a shoulder of a sidewall.

**5 Claims, 2 Drawing Sheets**




Publisher Item Identifier 10.1109/LMWC.2002.804064.

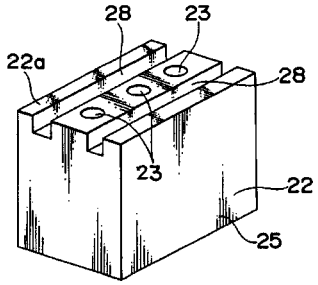
**6,353,374** March 5, 2002

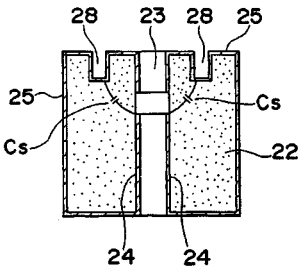
## DIELECTRIC FILTER WITH RECESSED END SURFACE

Inventors: Haruo Matsumoto, Yasuo Yamada, Yukihiro Kitaichi, Tadahiro Yorita, Hideyuki Kato, Tatsuya Tsujiguchi, Hisashi Mori, and Hitoshi Tada.
Assignee: Murata Manufacturing Co., Ltd.
Filed: June 8, 2000.

***Abstract*—**A dielectric filter, having a dielectric block with an outer surface including first and second end surfaces and a side surface extending between the first and second end surfaces; an external conductor disposed on the outer surface of the dielectric block, the external conductor substantially completely covering the outer surface; at least one hole extending through the dielectric body between the first and second end surfaces, the at least one hole having an inner surface; the at least one hole having a respective pair of internal conductors disposed on its corresponding inner surface and conductively connected to the external conductor respectively at the first and second end surfaces, a respective nonconductive portion at the corresponding inner surface being spaced from both of the end surfaces and thereby separating the corresponding pair of internal conductors and defining a respective capacitance between the corresponding pair of internal conductors; a predetermined portion of one of the first and second end surfaces of the dielectric block having a shape such that a first portion of the external conductor at the predetermined portion is closer to at least one of the internal conductors of the at least one hole, as compared with a second portion of the external conductor at a portion of the dielectric block other than the predetermined portion.

**20 Claims, 21 Drawing Sheets**



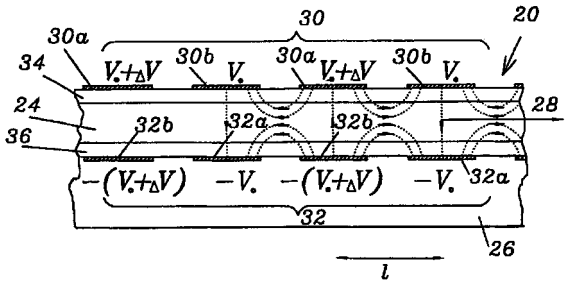

**6,353,690** March 5, 2002

## ELECTRICALLY ADJUSTABLE DIFFRACTION GRATING

Inventor: Mykola Kulishov.
Filed: February 16, 2000.

***Abstract*—**A diffraction grating for a waveguide or for externally incident light. The grating includes a substrate and an electrooptic structure extending over it. The electrooptic structure may include a waveguide having a propagation axis. A first and a second electrode structure are provided on either side of the electrooptic structure so that an electric field is generated in the electrooptic structure when a potential is applied to the electrodes. The first electrode structure has an interdigitated configuration defining a plurality of fingers. In use, respective potentials $V_0$ and $V_0+\Delta V$ are applied to adjacent fingers. The diffraction grating induced in the electrooptic structure by the periodic electric field advantageously has a refractive index adjustable by varying $V_0$ and $\Delta V$ and a spatial periodicity adjustable by varying $\Delta V$.

**20 Claims, 11 Drawing Sheets**



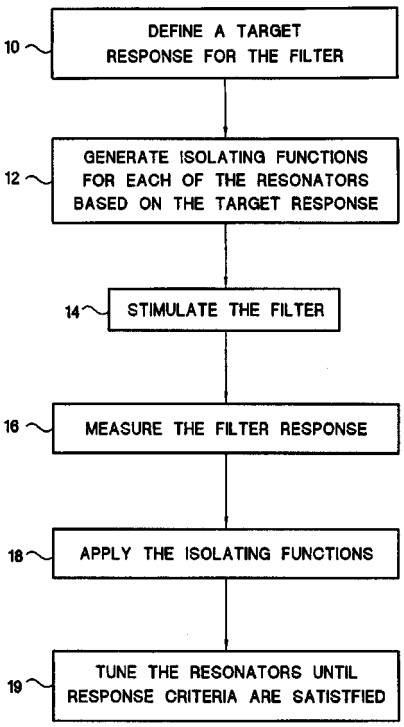

**6,356,163** March 12, 2002

## TUNING METHOD FOR FILTERS HAVING MULTIPLE COUPLED RESONATORS

Inventors: Joel P. Dunsmore and Thomas B. Fetter.
Assignee: Agilent Technologies, Inc.
Filed: January 29, 1999.

***Abstract*—**A tuning method for filters having multiple coupled resonators isolates the characteristics of each resonator, enabling a specified filter response to be achieved by adjusting the resonators according to response criteria. A target frequency response is defined for the filter and a target time domain response is computed based on the target frequency response. From the time domain response, a gating function is generated for each of the resonators. A stimulus signal is provided to the filter and the response to the stimulus signal is measured. The gating functions are then applied to isolate the characteristics of each resonator. Each resonator is adjusted according to response criteria chosen to achieve a specified filter response when the response criteria are satisfied.

**13 Claims, 9 Drawing Sheets**



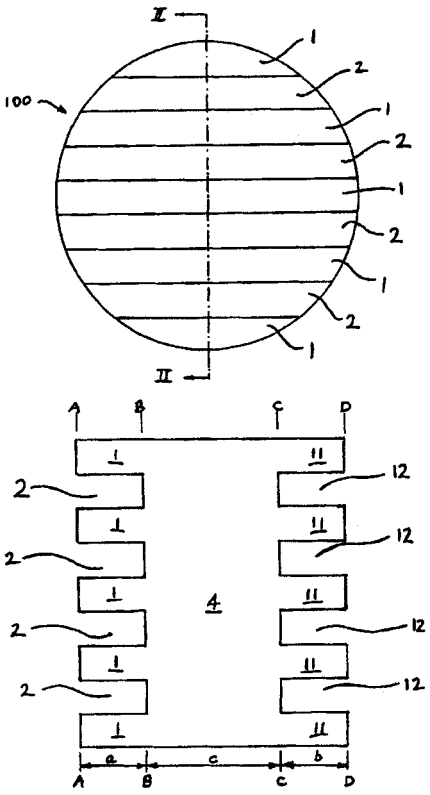

**6,356,164** March 12, 2002

## QUARTER WAVE PLATE POLARIZER WITH TWO PHASE-SHIFTING PORTIONS

Inventor: Charles A. Rowatt.
Assignee: Alenia Marconi Systems Limited.
Filed: January 12, 2000.

***Abstract*—**A right circular cylindrical body of an isotropic dielectric such as a cross-linked styrene copolymer, has respective pluralities of mutually parallel grooves formed in its axial end faces, spaced apart by an intermediate portion whose dimension c is a half wavelength. The axial lengths a, b of the grooves are such that when a wave passes through the body, a quarter wavelength phase difference is produced between a component of a wave having its E-vector parallel to the grooves and a component of the wave having its E-vector orthogonal to the grooves. Alternatively the plate may consist of two or more discrete bodies whose grooves are dimensioned to produce a total differential phase shift of one quarter wavelength.

**10 Claims, 4 Drawing Sheets**




**6,356,168** March 12, 2002

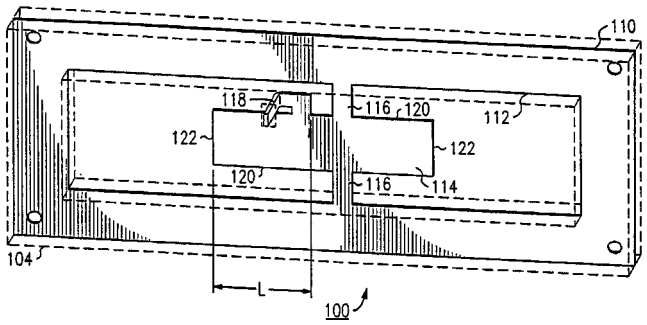
## SHEET-METAL FILTER

Inventors: Ron Barnett, Zhengxiang Ma, Louis Thomas Manzione, Richard F. Schwartz, and Hui Wu.
Assignee: Avaya Technology Corp.
Filed: September 21, 2000.

***Abstract*—**A high-frequency, e.g., microwave, filter (**100**, **300**, **400**) is made, e.g., stamped or etched, from a single sheet (**110**, **310**, **410**) of electrically conductive material, e.g., a metal plate or a printed circuit board. The sheet defines a frame (**112**, **312**, **412–413**), one or more resonant filter elements (**114**, **311–315**, **411–415**) inside of the frame, one or more supports (**116**, **316–317**, **416**) connecting each resonant filter element to the frame, and a flange (**118**, **318**, **418**)

on one of the resonant filter elements. The flange serves as an electrical contact to the filter; another flange (**317**, **417**) on another element, or the frame itself, serves as a second contact. An electrically conductive housing (**104**, **304**, **404**) encapsulates both faces of the sheet.

**12 Claims, 5 Drawing Sheets**



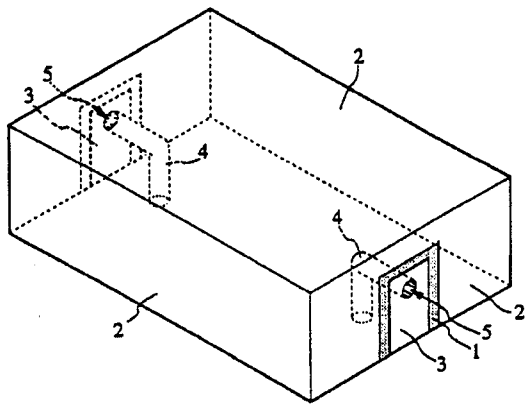

**6,356,170** March 12, 2002

## DIELECTRIC WAVEGUIDE RESONATOR, DIELECTRIC WAVEGUIDE FILTER, AND METHOD OF ADJUSTING THE CHARACTERISTICS THEREOF

Inventors: Shigeji Arakawa and Kikuo Tsunoda.
Assignee: Murata Manufacturing Co., Ltd.
Filed: October 31, 2000.

***Abstract*—**A conducting film is formed on a dielectric block in a dielectric waveguide resonator, and a through-hole is formed in the dielectric block. The unloaded Q is set by selecting the outside dimensions of the dielectric block. The resonance frequency is set by selecting the size and location of the through-hole as well as the outside dimensions of the dielectric block. A terminal electrode is formed on the outer surface of the dielectric block, for example at an end surface. A coupling hole is formed in the dielectric block and a coupling electrode is formed on the inner surface of the coupling hole. One end of the coupling electrode is connected to the terminal electrode and the other end of the coupling electrode may be connected to the conducting film formed on the outer surface of the dielectric block, for example at a side surface. The coupling electrode is nonlinear, preferably L-shaped. The above structure allows an increase in the degree of freedom in the design of the characteristics including the resonance frequency and unloaded Q of the dielectric waveguide resonator. The invention also provides a dielectric waveguide filter with a simple coupling mechanism whereby it is possible to couple to an external circuit without having to use an additional member and without electromagnetic leakage.

**28 Claims, 21 Drawing Sheets**



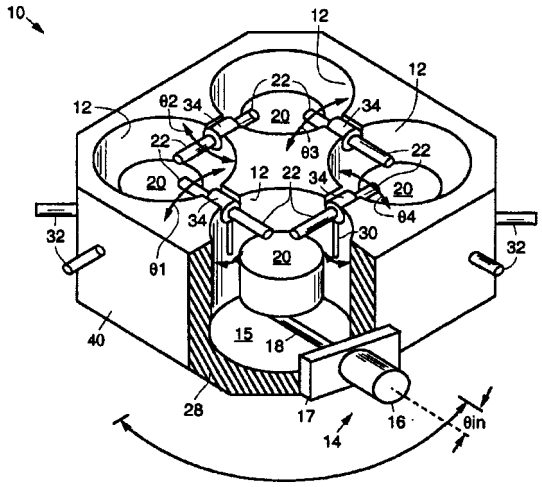

**6,356,171** March 12, 2002

## PLANAR GENERAL RESPONSE DUAL-MODE CAVITY FILTER

Inventors: Slawomir J. Fiedziuszko and George A. Fiedziuszko.
Assignee: Space Systems/Loral, Inc.
Filed: March 27, 1999.

***Abstract*—**An electromagnetic cavity filter is formed by at least two cavities having electrically conductive walls. Each cavity is the equivalent of two filter poles because two orthogonal modes of electromagnetic radiation can resonate within each cavity. Characterizing vector tuning elements are coupled to each of the cavities that are each aligned along respective axes. The tuning elements are used to provoke derivative orthogonal modes and determine the degree of coupling between orthogonal modes. One or more intercavity couplers interconnect the cavities and are rotated at arbitrary angles that are different from the axes of the characterizing vector tuning elements. Electrically adjacent and nonadjacent modes of proximate cavities can be coupled, permitting elliptic filter functions. Electrically nonadjacent modes are coupled by means of an iris interconnecting the two cavities. Electrically adjacent modes are coupled by means of an electrically conductive probe penetrating each of the cavities. A dielectric resonator may be disposed within each cavity to reduce the physical size of the cavity while preserving its electrical characteristics. Input and output coupling elements, coupled to selected cavities may be disposed at locations that are angularly rotated with respect to a corresponding characterizing vector tuning element by a selectable angle that varies between 0 and $\pm 180$ degrees.

**18 Claims, 4 Drawing Sheets**



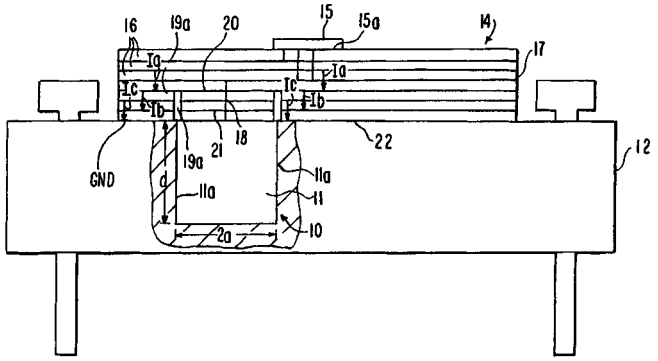

**6,356,172** March 12, 2002

## RESONATOR STRUCTURE EMBEDDED IN MECHANICAL STRUCTURE

Inventors: Markku Koivisto, Olli Salmela, Hans Somerma, and Kalle Jokio.
Assignee: Nokia Networks Oy.
Filed: December 29, 1999.

***Abstract*—**An assembly for supporting a substrate of an integrated circuit and forming a cavity resonator with the substrate. The assembly includes a baseplate in which a cavity for the cavity resonator is integrally formed. A substrate is mounted over the cavity resonator in the baseplate and an excitation coupling extends into the cavity of the cavity resonator.

**30 Claims, 3 Drawing Sheets**



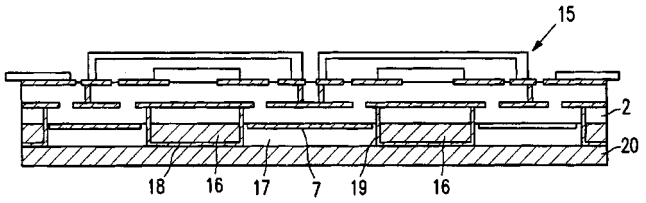

**6,356,173** March 12, 2002

## HIGH-FREQUENCY MODULE COUPLED VIA APERTURE IN A GROUND PLANE

Inventors: Koichi Nagata, Kenji Kitazawa, Shinichi Koriyama, Shigeki Morioka, Takanori Kubo, Hidehiro Minamiue, Masanobu Ishida, Akira Nakayama, and Naoyuki Shino.
Assignee: Kyocera Corporation.
Filed: May 28, 1999.

***Abstract*—**A high-frequency module in which a plurality of cavities are formed on the surface of a dielectric board, internal high-frequency signal transmission lines are connected to high-frequency devices in the cavities and are located in the cavities, the internal high-frequency signal transmission lines being electromagnetically coupled to the external high-frequency signal transmission line, and the high-frequency devices in the cavities are connected to each other relying on the electromagnetic coupling through the external line. The high-frequency module enables high-frequency signals to be transmitted among the high-frequency devices with a small loss. The module has a very simple structure, and is cheaply produced, and offers an advantage that it can be easily obtained in a small size.

**9 Claims, 6 Drawing Sheets**



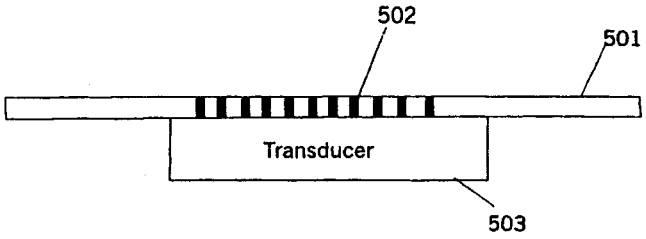

**6,356,684** March 12, 2002

## ADJUSTABLE OPTICAL FIBER GRATING DISPERSION COMPENSATORS

Inventors: David Brian Patterson and Brian Charles Moore.
Assignee: General Dynamics Advanced Technology Systems, Inc.
Filed: April 14, 2000.

***Abstract*—**Adjustable optical fiber grating dispersion compensators. The invention provides a fully tunable dispersion compensator with a wide dynamic range. Dispersion compensators according to the invention are based on uniform fiber Bragg grating technology. Individual gratings are tuned so that the gratings, which normally operate in reflection mode, operate in transmission mode with the frequency of interest falling just outside a reflection band edge. Gratings are combined to provide broadband, or multiple-wavelength dispersion. Tuning is provided via transducers coupled to the gratings. A control system can be connected to the transducers to provide a control signal so that the frequencies of the gratings can be dynamically tuned. The control system operates by measuring signals from opto-electronic detectors. The signals are used to determine a fractional spectral power transmitted through a filter. The fractional spectral power is related to the amount of dispersion present in the optical path of the network.

**26 Claims, 8 Drawing Sheets**



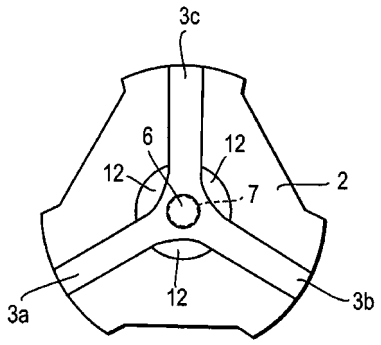

**6,359,526** March 19, 2002

## NONRECIPROCAL CIRCUIT DEVICE INCLUDING DIELECTRIC WAVE GUIDE AND A LOWER DIELECTRIC CONSTANT MEDIUM

Inventors: Katsuyuki Ohira, Hiromu Tokudera, and Yutaka Ishiura.
Assignee: Murata Manufacturing Co., Ltd.
Filed: August 10, 1999.

***Abstract*—**A nonreciprocal circuit device comprises a dielectric wave guide comprising a dielectric body with a center and with strips extending radially from the center in at least two directions and arranged between two conductor plates defining parallel conductor planes; a ferrite body arranged in the center of the dielectric strip; and a medium having a lower dielectric constant than the dielectric body arranged between at least a side face of the ferrite body and the conductor plates adjacent to the side face of the ferrite body. Grooves into which a dielectric strip is fitted are formed in the opposing surfaces of two conductor plates. The width of the dielectric strip is increased in the center of the dielectric strip and in the direction along the conductor planes of the conductor plates. At the widened location, a space is formed between the side walls of the grooves and the side faces of the ferrite sheets.

**12 Claims, 11 Drawing Sheets**




**6,359,528** March 19, 2002

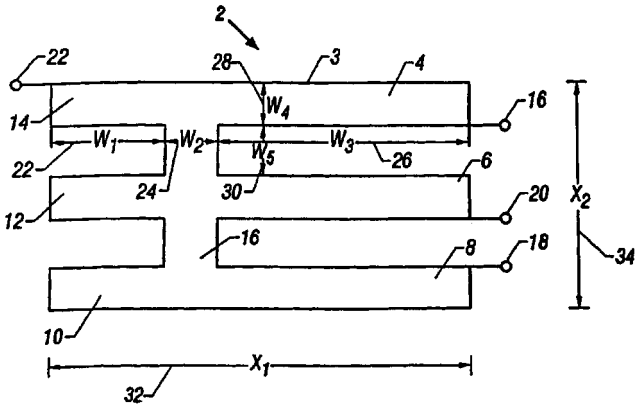
## SPACE-OPTIMIZED PRINTED BALUN

Inventor: Andy Dao.
Assignee: Atheros Communications, Inc.
Filed: March 9, 2000.

***Abstract*—**A printed balun satisfies performance requirements for operation at a desired operational frequency (e.g., $f = 5.3$ GHz) while minimizing space requirements on a circuit board. Segments of microstrip are connected at right

angles that define fingers whose dimensions can be tailored for operation at a desired operational frequency while minimizing the corresponding space required on a circuit board. Minimal separation between the fingers avoids undesirable internal interference. Mounted at the edges of distinct fingers are the necessary ports for operation of the balun including a single-ended port, an isolation port, and two differential ports.

**19 Claims, 4 Drawing Sheets**



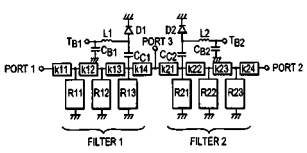

**6,359,529** March 19, 2002

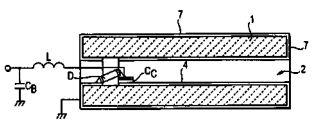
## FILTERING DEVICE COMPRISING FILTERS, EACH HAVING A RESONANCE LINE, A COUPLING ELEMENT COUPLED TO SAID RESONANCE LINE, AND A SWITCH FOR SHORT-CIRCUITING SAID RESONANCE LINE

Inventors: Kikuo Tsunoda and Hitoshi Tada.
Assignee: Murata Manufacturing Co., Ltd.
Filed: December 24, 1997.

***Abstract*—**The invention provides a filtering device of the transmission-reception switched type which can be constructed in a form with a reduced size at a low cost without having to use circuit elements such as a capacitor, a coil, and a transmission line forming a phase shift circuit which are not essential to the filtering device. Inner conductors serving as distributed-parameter resonance lines are formed in a dielectric block. There is provided a coupling line coupled with particular inner conductors. The open-circuited ends of these particular inner conductors are connected to an outer conductor via corresponding diode switches so that transmission and reception filters are switched from each other when either diode switch is selectively turned on.

**9 Claims, 17 Drawing Sheets**



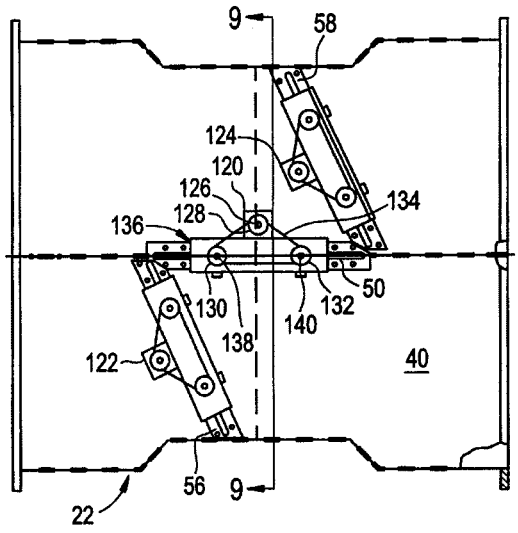
**6,359,530** March 19, 2002

## SWITCHING WAVEGUIDE DIRECTIONAL COUPLER AND METHOD

Inventor: Brett J. Grandchamp.
Assignee: General Signal Corporation.
Filed: March 24, 2000.

***Abstract*—**A switchable directional coupler in which a three position switch partitions the coupler into three distinct coupling paths among its four ports according to the status of a pair of quadrature phase input signals of amplitudes A and B. In one position with both input signals being active, the output signal has an amplitude of A+B. In a second position with only the input signal of amplitude A being active, the output signal has an amplitude of A. In the third position with only the input signal of amplitude B being active, the output signal has an amplitude of B.

**11 Claims, 5 Drawing Sheets**



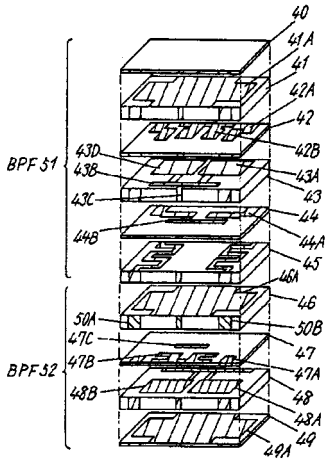

**6,359,531** March 19, 2002

## MULTILAYER FILTER WITH ELECTRODE PATTERNS CONNECTED ON DIFFERENT SIDE SURFACES TO SIDE ELECTRODES AND INPUT/OUTPUT ELECTRODES

Inventors: Yoshitaka Nagatomi, Naoki Yuda, Toshio Ishizaki, Shoichi Kitazawa, and Toru Yamada.
Assignee: Matsushita Electric Industrial Co., Ltd.
Filed: November 7, 2000.

***Abstract*—**A small multilayer filter, in which a phase shifter may be constituted without increasing overall size of the filter. The overall size may be reduced without deteriorating the characteristics. Above the open end of a plurality of strip lines **4**A provided on a dielectric layer **4**, a coupling sector **3**A of input/output pattern is placed to face it with a dielectric layer **3** interposed. An inductance **L1**, **L2** is formed by connecting a side electrode **7**A, **7**B with a continuity sector **3**B of input/output pattern; and said side electrode **7**A, **7**B with an input electrode **8**A, output electrode **8**B, respectively, by means of an electrode pattern **5**A.

**1 Claim, 12 Drawing Sheets**



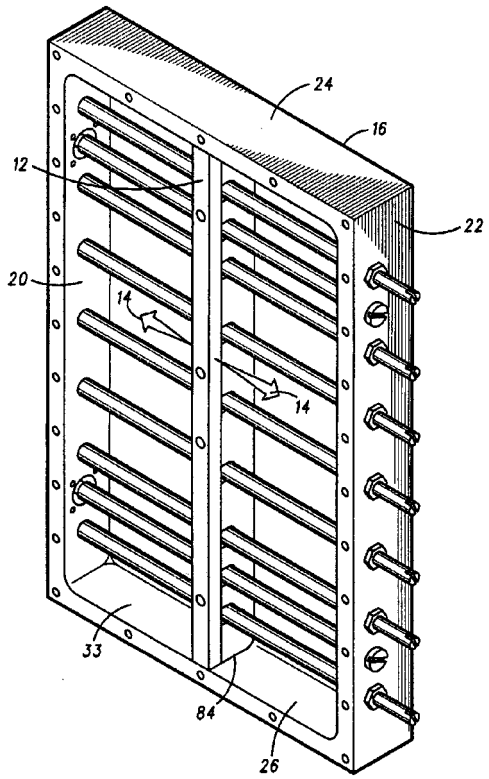

**6,359,533** March 19, 2002

## COMBLINE FILTER AND METHOD OF USE THEREOF

Inventors: Alan J. Merlock, Julie A. Adam, and Gregory A. Alms.
Assignee: Motorola, Inc.
Filed: March 7, 2000.

***Abstract*—**A radio frequency mechanical filter (**10**) of the resonant type employs a plurality of parallel spaced-apart resonators (**40**) disposed within a housing (**16**) defining a cavity. The resonators are supported at their first ends (**46**) to one wall (**20**) of the housing (**16**), with the remaining ends of the resonators being unsupported. A TEFLON support bracket (**12**) is disposed across the resonators (**40**) at points between the ends (**44**, **46**) of the resonators. In one form, the support bracket (**12**) is movable along the length of the resonators to change the center frequency and bandwidth response of the filter.

**18 Claims, 3 Drawing Sheets**



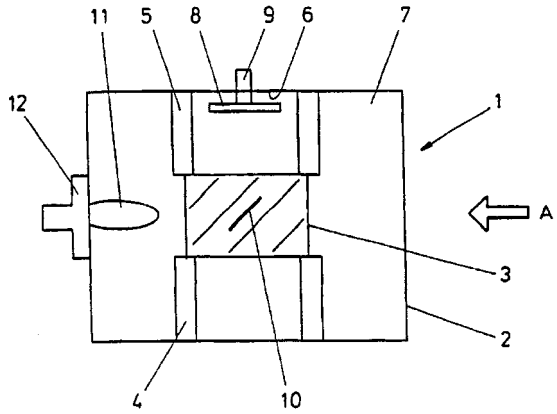

**6,359,534** March 19, 2002

## MICROWAVE RESONATOR

Inventor: Ian Charles Hunter.
Assignee: Filtronic Plc.
Filed: November 28, 1997.

***Abstract*—**A microwave resonator, particularly for use in cellular telecommunications, comprising a hollow electrical conductor defining a resonant cavity and a substantially cubic member located within the cavity. The substantially cubic member has a high dielectric constant compared with the remainder of the cavity.

**23 Claims, 3 Drawing Sheets**



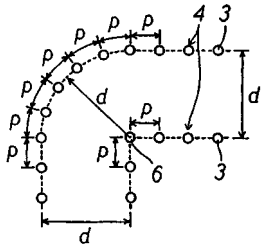

**6,359,535** March 19, 2002

## DIELECTRIC WAVEGUIDE LINE BEND FORMED BY ROWS OF THROUGH CONDUCTORS

Inventors: Takeshi Takenoshita and Hiroshi Uchimura.
Assignee: Kyocera Corporation.
Filed: February 3, 2000.

***Abstract*—**A high-frequency dielectric waveguide line comprising a dielectric substrate with two conductor layers on its two surfaces, and a plurality of rows of through conductors in the substrate connecting the two conductor layers. The distances between the through conductors in each row are not more than half of the wavelength of the signal transmitted in the transmission direction of the waveguide. The waveguide line has a branching portion where a first waveguide line having a width $d$ branches into second and third parallel waveguide lines both of width $d$. The portion of the waveguide at the branching point has a width of $A$, where $2d \leqq A \leqq 3d$. The first, second and third waveguide lines are connected without abrupt width enlargement. The branching waveguide line have small transmission losses for high-frequency signals.

**9 Claims, 21 Drawing Sheets**



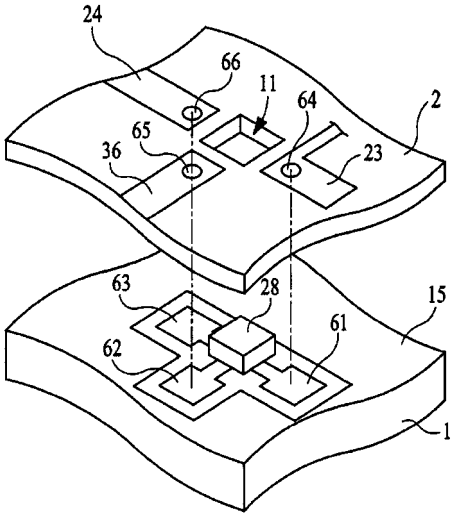
**6,359,536** March 19, 2002

## HIGH FREQUENCY MULTI-LAYER MODULE WITH ELECTRONIC COMPONENT RECEIVING APERTURE AND CONDUCTIVE VIA

Inventors: Koichi Sakamoto, Kenichi Iio, Sadao Yamashita, and Yohei Ishikawa.
Assignee: Murata Manufacturing Co., Ltd.
Filed: February 10, 2000.

***Abstract*—**An electronic module, comprising: a dielectric base plate having first and second opposing surfaces on which respective electrodes are disposed such that respective areas at the first and second surfaces are free of electrode material and aligned relative to one another to form a dielectric resonator; a first electronic component coupled to the base plate; and a first circuit sheet having first and second opposing surfaces, at least one aperture between the surfaces, and a conductor pattern disposed on the first surface, the first circuit sheet being disposed on the base plate such that: i) the first electronic component is at least partially received within the aperture; and ii) at least part of the conductor pattern is coupled to the dielectric resonator.

**4 Claims, 7 Drawing Sheets**



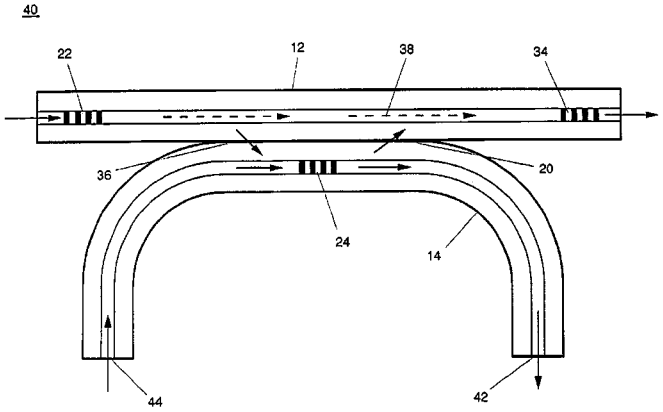

**6,360,038** March 19, 2002

## WAVELENGTH-SELECTIVE OPTICAL FIBER COMPONENTS USING CLADDING-MODE ASSISTED COUPLING

Inventor: Victor Grubsky.
Assignee: Sabeus Photonics, Inc.
Filed: May 12, 1999.

***Abstract*—**A wavelength-selective optical device for coupling of light at predetermined wavelength from one optical fiber waveguide to another using at least two gratings and cladding-mode assisted coupling is disclosed. The transfer of light is performed using intermediate coupling to one or more cladding mode of the waveguides. In the case when the fibers have physically different claddings, an arrangement for transfer of light from one cladding to another is required. The disclosed coupler has no back-reflection, small insertion loss, and very high channel isolation. The device can be used in wavelength-division multiplexing networks.

**44 Claims, 7 Drawing Sheets**



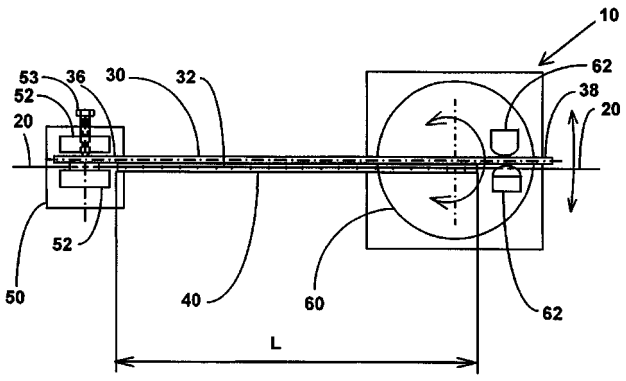

**6,360,042** March 19, 2002

## TUNABLE OPTICAL FIBER GRATINGS DEVICE

Inventor: Pin Long
Filed: January 31, 2001.

***Abstract*—**A tunable optical fiber grating device for tuning optical characteristic responses of an optical grating area of an optical fiber includes an elongated beam member defining a neutral plane with a first and a second ends and adapted to receive the fiber therealong. A securing member continuously secures the grating area all along the beam member between its ends and generally parallel to the neutral plane to allow for transmission of a bend of the beam member about the neutral plane to the grating area. A fixed support member has a screw for releasably securing the first end of the beam member within the neutral plane, and a mobile support member has a slotted element to slidably receive the second end of the beam member within the neutral plane. The mobile support member displaces the second end relative to the first end substantially perpendicularly to the neutral plane to bending the beam, thereby stretching or compressing the grating area for tuning the optical characteristic responses of the optical fiber depending on the direction of the bend.

**15 Claims, 4 Drawing Sheets**



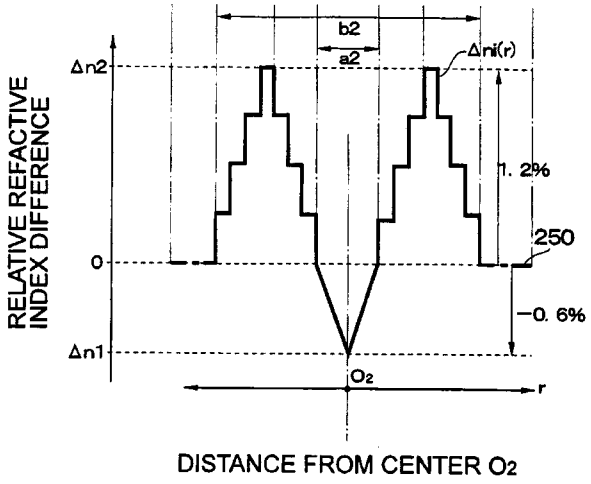
**6,360,046** March 19, 2002

## DISPERSION-SHIFTED OPTICAL FIBER

Inventors: Eisuke Sasaoka, Takatoshi Kato, Akira Urano, and Yoshio Yokoyama.
Assignee: Sumitomo Electric Industries, Ltd.
Filed: April 28, 2000.

***Abstract*—**The present invention relates to a dispersion-shifted optical fiber which comprises a structure for effectively eliminating the causes of deterioration in characteristics at the making stage thereof and is suitable for wavelength division multiplexing transmission. In the dispersion-shifted optical fiber according to the present invention, impurities to be added and the contents thereof are adjusted so as to reduce viscosity difference at each interface between individual glass regions. As a consequence of this structure, occurrence of structural irregularity and glass defect are effectively restrained in the vicinity of the interfaces between the regions.

**14 Claims, 4 Drawing Sheets**



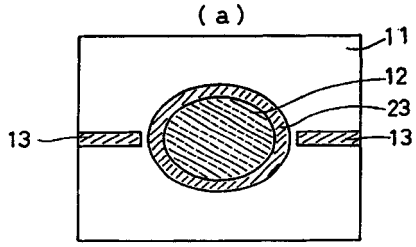

**6,360,111** March 19, 2002

## HIGH-FREQUENCY CIRCUIT ELEMENT HAVING A SUPERCONDUCTIVE RESONATOR WITH AN ELECTROCONDUCTIVE FILM ABOUT THE PERIPHERY

Inventors: Koichi Mizuno, Akira Enokihara, Hidetaka Higashino, and Kentaro Setsune.
Assignee: Matsushita Electric Industrial Co., Ltd.
Filed: October 8, 1999.

***Abstract*—**In a small transmission line type high-frequency circuit element that has small loss due to conductor resistance and has a high $Q$ value, an error in the dimension of a pattern, etc. can be corrected to adjust element characteristics. An elliptical shape resonator (**12**) that is formed of an electric conductor is formed on a substrate (**11***a*), while a pair of input–output terminals (**13**) are formed on a substrate (**11***b*). Substrate (**11***a*) on which resonator (**12**) is formed and substrate (**11***b*) on which input–output terminal (**13**) is formed are located parallel to each other, with a surface on which resonator (**12**) is formed and a surface on which input–output terminal (**13**) is formed being opposed. Substrates (**11***a*) and (**11***b*) that are located parallel to each other are relatively moved by a mechanical mechanism that uses a screw and moves slightly. Also, substrate (**11***a*) is rotated by the mechanical mechanism that uses a screw and moves slightly around the center axis of resonator (**12**) as a rotation axis (**18**).

**7 Claims, 5 Drawing Sheets**



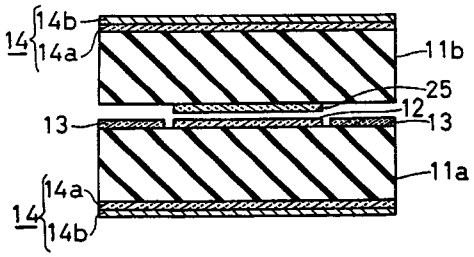

**6,360,112** March 19, 2002

## HIGH-FREQUENCY CIRCUIT ELEMENT HAVING A SUPERCONDUCTIVE RESONATOR TUNED BY ANOTHER MOVABLE RESONATOR

Inventors: Koichi Mizuno, Akira Enokihara, Hidetaka Higashino, and Kentaro Setsune.
Assignee: Matsushita Electric Industrial Co., Ltd.
Filed: October 8, 1999.

***Abstract*—**In a small transmission line type high-frequency circuit element that has small loss due to conductor resistance and has a high Q value, an error in the dimension of a pattern, etc. can be corrected to adjust element characteristics. An elliptical shape resonator (**12**) that is formed of an electric conductor is formed on a substrate (**11***a*), while a pair of input–output terminals (**13**) are formed on a substrate (**11***b*). Substrate (**11***a*) on which resonator (**12**) is formed and substrate (**11***b*) on which input–output terminal (**13**) is formed are located parallel to each other, with a surface on which resonator (**12**) is formed and a surface on which input–output terminal (**13**) is formed being opposed. Substrates (**11***a*) and (**11***b*) that are located parallel to each other are relatively moved by a mechanical mechanism that uses a screw and moves slightly. Also, substrate (**11***a*) is rotated by the mechanical mechanism that uses a screw and moves slightly around the center axis of resonator (**12**) as a rotation axis (**18**).

**7 Claims, 5 Drawing Sheets**



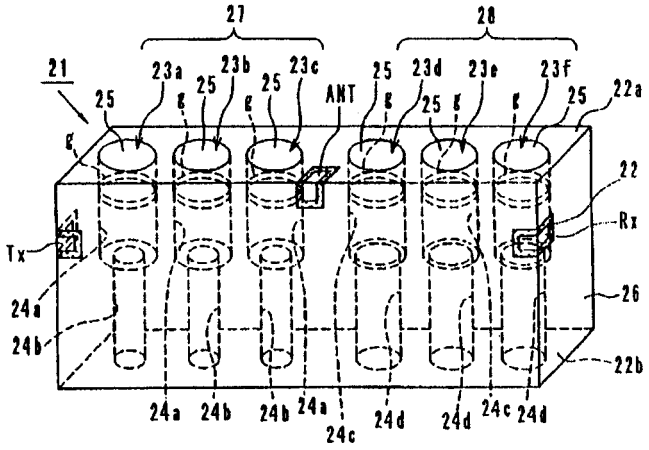
**6,362,705** March 26, 2002

## DIELECTRIC FILTER UNIT, DUPLEXER, AND COMMUNICATION APPARATUS

Inventors: Katsuhito Kuroda, Jinsei Ishihara, and Hideyuki Kato.
Assignee: Murata Manufacturing Co., Ltd.
Filed: September 28, 1999.

***Abstract*—**There provided a dielectric filter unit comprising: a dielectric block having a pair of opposing end surfaces; a plurality of resonator holes respectively passing through the pair of opposing end surfaces of the dielectric block and having a large-sectional area portion and a small-sectional area portion connected to the large-sectional area portion; an inner conductor disposed on the inner surface of each of the resonator holes; an outer conductor disposed on the outer surface of the dielectric block; at least one of the resonator holes constituting a first filter; at least one of the remaining resonator holes constituting a second filter; and the area ratio of the large-sectional area portion to the diameter of the small-sectional area portion of the resonator hole of the first filter being different from the area ratio of the large-sectional area portion to the diameter of the small-sectional area portion of the resonator hole of the second filter. In the above dielectric filter, the center frequency of each filter can be adjusted without altering the length in the axial direction of resonator holes, of the dielectric block of each filter.

**15 Claims, 9 Drawing Sheets**



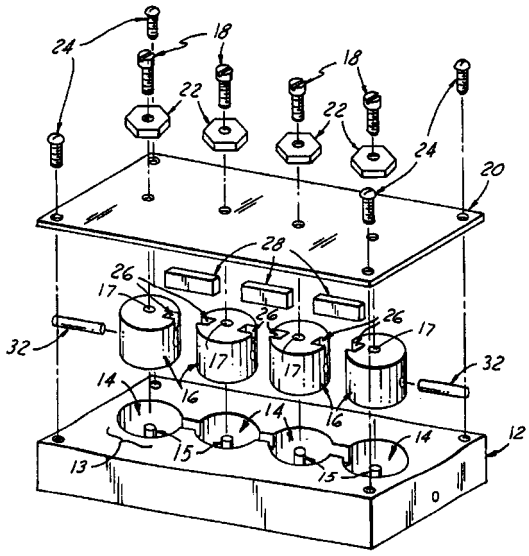

**6,362,707** March 26, 2002

## EASILY TUNABLE DIELECTRICALLY LOADED RESONATORS

Inventor: Victor S. Reinhardt.
Assignee: Hughes Electronics Corporation.
Filed: January 21, 2000.

***Abstract*—**A multi-resonator filter, including a housing, at least one resonating element, at least one high dielectric constant element, at least one fine tuning screw located above the at least one resonating element and secured in a housing cover by a locking nut, housing screws to secure the housing cover to the housing. Where at least two resonating elements and at least two high dielectric constant elements are present, at least two slots are located in the at least two high dielectric constant elements to allow the easy installation and removal of at least one high dielectric coupling bridge used to increase the coupling between resonator sections, and at least one coupling probe.

**18 Claims, 2 Drawing Sheets**



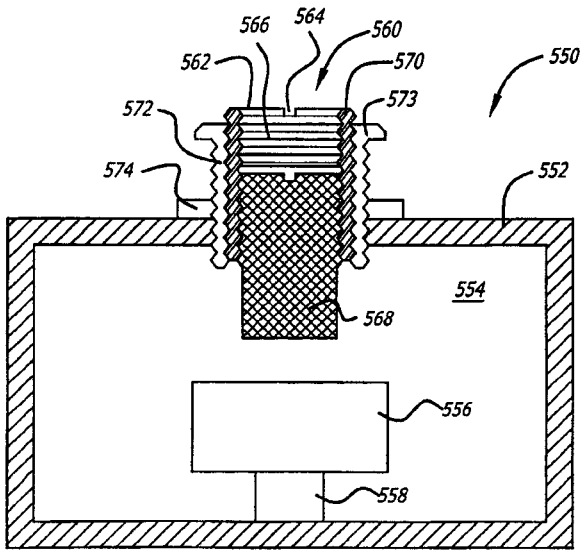

**6,362,708** March 26, 2002

## DIELECTRIC RESONATOR TUNING DEVICE

Inventor: Donnie W. Woods.
Assignee: Lucix Corporation.
Filed: July 14, 1999.

***Abstract*—**A temperature-compensating tuning device is disclosed for tuning and temperature stabilizing the resonant frequency of a dielectric resonator. The tuning device comprises a tuning element in the form of a cylindrical shaft, an inner sleeve coaxially around the tuning element and mating therewith by corresponding sets of threads, and an outer sleeve coaxially around the inner sleeve, and mating therewith by corresponding sets of threads. The outer surface of the outer sleeve may also include threads for mating with threads of a dielectric resonator enclosure. Rotation of the tuning element, inner sleeve and/or outer sleeve can move the tuning element in proximity to a dielectric resonator, which provides the resonant frequency tuning effect. The tuning element, inner and outer sleeves are made of temperature expanding material to cause the tuning element to move in proximity of the dielectric resonator with temperature changes to provide temperature stability to the resonant frequency.

**4 Claims, 9 Drawing Sheets**



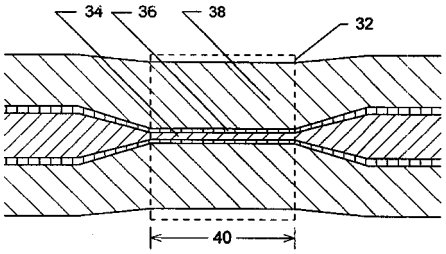
**6,362,916** March 26, 2002

## ALL FIBER GAIN FLATTENING OPTICAL FILTER

Inventors: Weiti Wu, Yu-Li Ko, and Gary Chung.
Assignee: Fiver Laboratories.
Filed: February 9, 1999.

***Abstract*—**An all fiber optical filter is formed by stretching an optical fiber. The all fiber filter includes a core, an inner cladding and an outer cladding. A core index of refraction is greater than an outer cladding index of refraction. The outer cladding index of refraction is greater than an inner cladding index of refraction. The all fiber optical filter attenuates a portion of an optical signal by transferring optical energy from the core to the outer cladding by evanescent coupling. The all fiber optical filter has a compact structure, which prevents bending and provides stable temperature performance. The all fiber optical filter is preferably used in Wavelength Division Multiplexing (WDM) systems for gain flattening of gain responses from Erbium Doped Fiber Amplifiers (EDFAs). Alternatively, the all fiber optical filter is used in other applications where optical filtering or attenuation is needed. The all fiber optical filter is manufactured by holding a length of an appropriate optical fiber between two clamps, heating the optical fiber, and stretching the optical fiber until a predetermined characteristic of the all fiber optical filter is achieved.

**12 Claims, 10 Drawing Sheets**



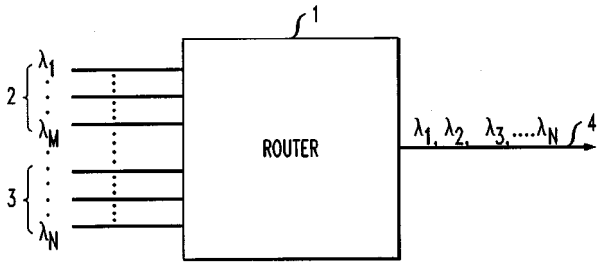

**6,363,181** March 26, 2002

## METHOD AND APPARATUS FOR WAVELENGTH-DIVISION MULTIPLEXING

Inventor: Andrew Roman Chraplyvy.
Assignee: Lucent Technologies, Inc.
Filed: September 15, 1999.

***Abstract*—**An apparatus and method for wavelength-division multiplexing employing an arrayed waveguide router and polarization-maintaining input fibers for coupling channels which experience four photon mixing to the router. The invention is useful in extremely dense wavelength-division multiplexing to reduce optical nonlinearity.

**2 Claims, 2 Drawing Sheets**



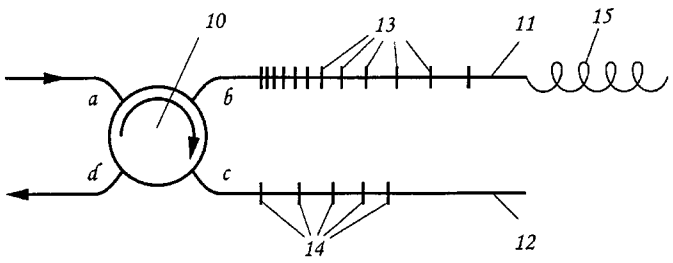

**6,363,187** March 26, 2002

## CHROMATIC DISPERSION COMPENSATION

Inventors: Julian A. Fells, Andrew J. Collar, and Howard N. Rourke.
Assignee: Northern Telecom Limited.
Filed: August 30, 1999.

***Abstract*—**An optical waveguide provided with a linearly chirped Bragg reflective grating can be employed as a device that provides linear dispersion compensation. The amount of the linear dispersion thereby provided can be rendered adjustable by adjustment of the magnitude of axial strain imposed upon the grating. If the chirp is purely linear, and if also, the strain is at all times uniform along the length of the grating, adjustment of the strain magnitude will have no such effect. This requires the presence of a quadratic chirp term, but such a term introduces its own transmission penalty. This penalty is compensated at least in part by causing the light to make a reflection in a further Bragg reflection grating whose quadratic component of chirp has the opposite sign to that of the other Bragg reflection grating, but a substantially matched modulus. The effect of the strain is to scale the effective pitch of the Bragg reflection grating by scaling its physical pitch. An alternative way of achieving a similar effect is to change the effective refractive index of the waveguide in which the grating is formed, for instance by changing its temperature.

**14 Claims, 6 Drawing Sheets**



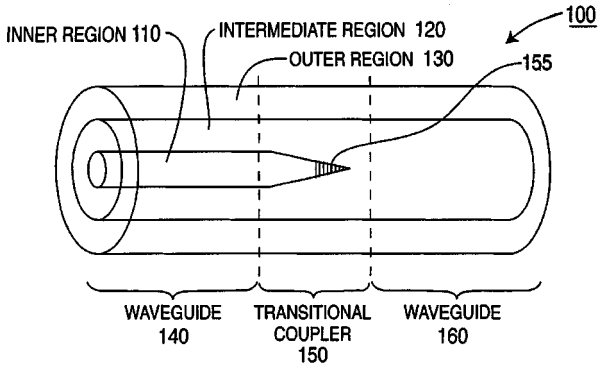

**6,363,188** March 26, 2002

## MODE EXPANDER WITH CO-DIRECTIONAL GRATING

Inventor: Gerard Argant Alphonse.
Assignee: Princeton Lightwave, Inc.
Filed: May 16, 2000.

***Abstract*—**An apparatus comprises a first waveguide, a second waveguide and a transitional coupler. The first waveguide is defined by a first material and a second material. The first waveguide has a core and a cladding. The first material is the core of the first waveguide, and the second material is the cladding of the first waveguide. The second waveguide is defined by a third material and a fourth material. The second waveguide has a core and a cladding. The third material is the core of the second waveguide, and the fourth material is the cladding of the second waveguide. A cross-section of the core of the second waveguide is larger than a cross-section of the core of the first waveguide. The transitional coupler has a first end integrally formed with and operationally coupled to the first waveguide, and has a second end integrally formed with and operationally coupled to the second waveguide. The transitional coupler includes a co-directional grating.

**23 Claims, 1 Drawing Sheet**



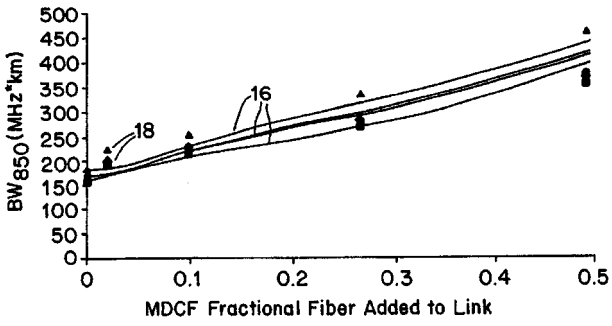

**6,363,195** March 26, 2002

## MULTIMODE FIBER LINK DISPERSION COMPENSATOR

Inventors: John S. Abbott, III, Greg E. Smith, and Carlton M. Truesdale.
Assignee: Corning Incorporated.
Filed: October 6, 1998.

***Abstract*—**Disclosed is a dispersion compensated multimode waveguide fiber link. The dispersion of essentially any wavelength can be compensated by adding a compensating waveguide fiber to the link, the compensating waveguide having a profile shape and a $\lambda_p$ wavelength which counters dispersion caused by the original waveguide fiber of the link. Analytical expressions relating the compensator waveguide profile and $\lambda_p$ to the original link and compensated profile and $\lambda_p$ are provided for the embodiment which includes a profiles.

**14 Claims, 2 Drawing Sheets**




**6,363,202** March 26, 2002

## MANAGEMENT AND CONTROL OF THE POWER LEVELS OF WAVELENGTH MULTIPLEXED OPTICAL SIGNALS

Inventor: Robert C. Goodfellow.
Assignee: Marconi Communications Limited.
Filed: September 8, 1999.

***Abstract*—**A system for individually controlling the power levels of a plurality of wavelength division multiplexed (WDM) optical signals in a single optical guide comprising a first plurality of individually controllable optical attenuators. An example of a suitable optical attenuator is a tunable fiber Bragg grating filter whose reflectivity characteristic varies with wavelength over an active region thereof. By tuning the filter, it is possible to control the reflectivity at a particular wavelength in the active region. The system may, in addition, comprise a second plurality of optical attenuators arranged so as to compensate for any power level distortion introduced by the first plurality. Optical circulators may be used to route signals into and between the pluralities of optical attenuators.

**29 Claims, 5 Drawing Sheets**