

# Patent Abstracts

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6,344,780

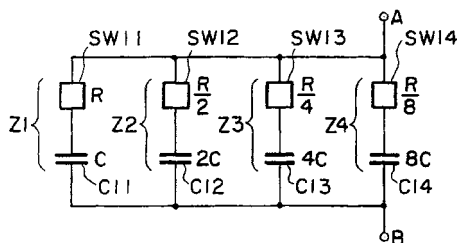
February 5, 2002

## IMPEDANCE ADJUSTING CIRCUIT

Inventors: Noriaki Dobashi and Zdzislaw Czarnul.  
Assignee: Kabushiki Kaisha Toshiba.  
Filed: September 15, 1999.

**Abstract**—An impedance adjusting circuit for setting accurate impedance ratio has a plurality of paths each having impedance adjusting section which is a serially connected switch element and impedance element. A synthesized impedance of an ON resistance of the switch element and impedance of the impedance element in each impedance adjusting section is set to have a predetermined proportional relation. This enables accurate trimming without generating peak level variation of frequency characteristic when applied to a filter.

7 Claims, 7 Drawing Sheets



6,345,136

February 5, 2002

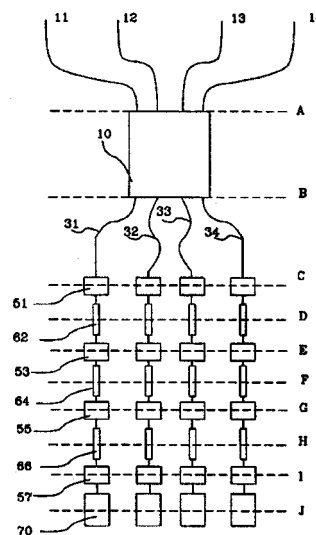
## TUNEABLE ADD/DROP MULTIPLEXER

Inventor: Torsten Augustsson.  
Assignee: Telefonaktiebolaget LM Ericsson (publ).  
Filed: September 21, 1999.

**Abstract**—The present invention relates to a tuneable add/drop demultiplexer. The add/drop multiplexer includes at least one  $N \times N$  MMI-waveguide (10), where  $N \geq 3$ , at least  $N$ -number of Michelson waveguides (31, 32, 33 and 34), at least one Bragg grating (62, 64 and 66) per Michelson waveguide (31, 32, 33 and 34) and at least one phase control element (51, 53, 55 and 57) in at least  $N-1$  number of Michelson waveguides (31, 32, 33 and 34). The Michelson waveguides (31, 32, 33 and 34) include said phase control elements (51, 53, 55

and 57) and said Bragg gratings (62, 64 and 66) and are coupled to at least one MMI-waveguide (10). Each Michelson waveguide (31, 32, 33 and 34) can be provided with a broadband reflection section (70). The invention also relates to a method for tuneable add/drop multiplexing, the use of a wavelength selective switch as a tuneable add/drop multiplexer and the use of a tuneable add/drop multiplexer as a wavelength selective switch.

34 Claims, 11 Drawing Sheets



6,346,864

February 12, 2002

## SAW RESONATOR FILTER AND DUPLEXER UTILIZING SH WAVES, SUBSTRATE EDGE REFLECTION, AND SUB-INTERDIGITAL TRANSDUCER PORTIONS

Inventor: Michio Kadota.  
Assignee: Murata Manufacturing Co., LTD.  
Filed: February 1, 2000.

**Abstract**—A SAW resonator filter which generates Shear Horizontal type surface acoustic waves includes a piezoelectric substrate, and first and second resonators arranged on the piezoelectric substrate. The first and second resonators include first and second interdigital transducers having electrode fingers, respectively. The first and second interdigital transducers are acoustically coupled to form a filter, and are divided into a plurality of sub-interdigital transducer portions, respectively. By dividing the interdigital transducers to have multiple sub-IDT portions, the effective electro-mechanical coupling coefficient is reduced, thereby enabling the bandwidth to be made narrower. Further, the improvement in the electrode structure allows for the filter to use a piezoelectric substrate having excellent temperature characteristics, so that it is possible to achieve a SAW resonator filter having a narrow bandwidth and superior temperature characteristics. Moreover, when an edge reflection type SAW resonator filter using SH-type surface acoustic waves is made, it is possible to provide a compact bandpass filter having low insertion loss and excellent selectability.

February 12, 2002

**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 a side surface of the dielectric block. 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 coupling electrode extends toward the conducting film formed on the opposite side surface and one end surface of the dielectric block. 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.

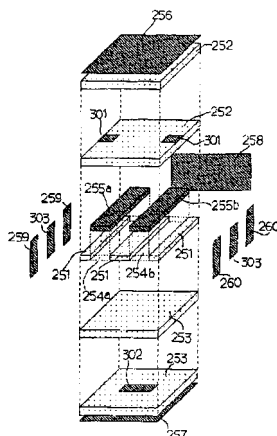
February 12, 2002

# DIELECTRIC LAMINATED DEVICE AND ITS MANUFACTURING METHOD

Inventors: Hideaki Nakakubo, Toshio Ishizaki, Toru Yamada, Hiroshi Kagata, Tatsuya Inoue, and Shoichi Kitazawa.  
Assignee: Matsushita Electric Industrial Co., Ltd.  
Filed: November 15, 1999.

**Abstract**—By using a method for manufacturing a dielectric laminated device, an opening is formed on a first dielectric sheet, a strip line and an input and output line including an input and output electrode are formed by burying electrode materials in said opening, the first dielectric sheet is laminated with the second and third dielectric sheets disposed above and below respectively to form a laminate, a first and second shield electrodes and a ground electrode are formed, an end of the strip line is connected to the ground electrode, the first shield electrode and the second shield electrode are mutually connected through the ground electrode, and the input and output electrode is exposed along the line direction of the strip line. By this constitution of the above dielectric laminated device, the mounting reliability of the dielectric laminated device can be further increased.

**2 Claims, 21 Drawing Sheets**



February 12, 2002

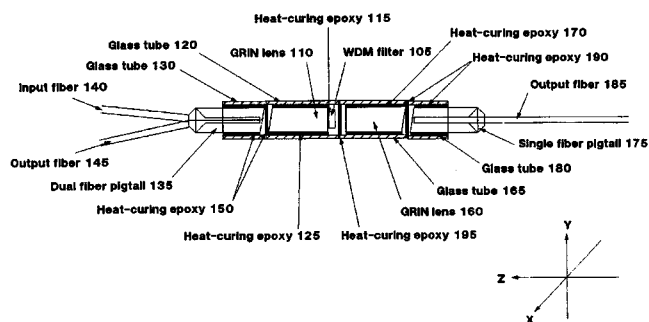
# LOW-COST WAVELENGTH DIVISION MULTIPLEXED (WDM) COUPLER WITH MORE FLEXIBLE AND PRECISE OPTICAL FAITH ADJUSTMENT

Inventor: Yu Zheng.  
Assignee: JDS Uniphase, Inc.  
Filed: May 6, 1999.

**Abstract**—The present invention discloses an improved wavelength division multiplexed (WDM) coupler. The WDM coupler includes a WDM filter attached to a first GRIN lens by applying a first heat-curing epoxy. The WDM coupler further includes the first GRIN lens inserted and fixed into a first holding tube by applying a second heat-curing epoxy. The WDM coupler further includes a second holding tube holding a dual fiber pigtail. The dual fiber pigtail is disposed at a first optimal position from the first GRIN lens to achieve a lowest reflection loss with the first and second holding tubes being in contact with each other. The dual fiber pigtail and the first and second holding tubes are fixed together by applying a third heat-curing epoxy. The WDM coupler further includes a second GRIN lens inserted and fixed into a third holding tube by applying a fourth heat-curing epoxy. The WDM coupler further includes a fourth holding tube holding a standard single fiber pigtail. To achieve a lowest transmission loss, the single fiber pigtail is disposed at a second optimal position from the second GRIN lens while the first GRIN lens is disposed at a third optimal position from the second GRIN lens. With the first, third and fourth

holding tubes being in contact with each other, a fifth heat-curing epoxy is applied to fix the third and fourth holding tubes together and a sixth heat-curing epoxy is applied to fix the first and third holding tubes together.

17 Claims, 4 Drawing Sheets



6,347,237

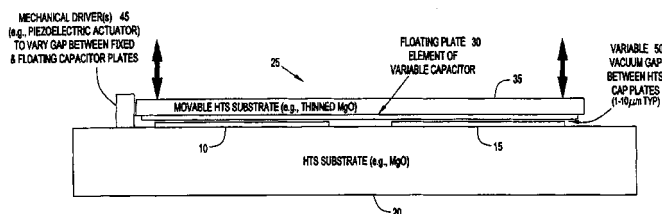
February 12, 2002

## HIGH TEMPERATURE SUPERCONDUCTOR TUNABLE FILTER

Inventors: Richard C. Eden, Balam A. Willemsen, and George L. Matthaei.  
Assignee: Superconductor Technologies, Inc.  
Filed: March 16, 1999.

**Abstract**—A tunable filter having a fixed substrate, a first and second plate comprising a high-temperature superconductor material on the fixed substrate, a movable substrate, a mechanical driver attached to the fixed substrate and the movable substrate, a floating plate comprising a high-temperature superconductor material on the fixed substrate wherein the floating plate, the first plate, and the second plate define a gap, and wherein the gap is varied by length changes in the mechanical driver is provided.

15 Claims, 8 Drawing Sheets



6,348,843

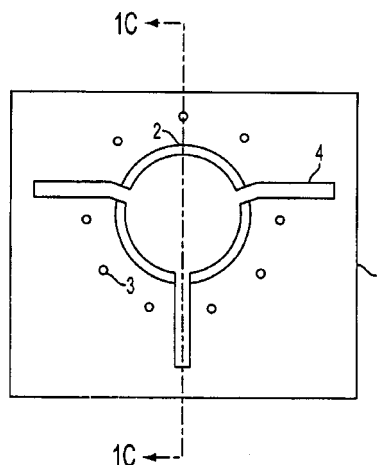
February 19, 2002

## METHOD OF REGULATING A HIGH FREQUENCY NONRECIPROCAL CIRCUIT ELEMENT

Inventors: Mitsuru Furuya, Osamu Myohga, and Yoshitsugu Okada.  
Assignee: NEC Corporation.  
Filed: May 24, 1999.

**Abstract**—A magnetic member 2 for nonreciprocal circuit is fitted in a first hole formed in a dielectric substrate 1 and at least one magnetic member 3 is fitted in a second hole formed in a portion of the dielectric substrate 1, which surrounds the first hole. An electrical conductor is printed on surfaces of the dielectric substrate 1 and the magnetic member 2 for nonreciprocal circuit to form a micro strip line 4. A grounding conductor 5 is formed on the other surface of the dielectric substrate 1. Changing the magnetization of the magnetic member 3 for frequency regulation can reversibly perform a regulation of the frequency characteristics of the nonreciprocal circuit.

5 Claims, 4 Drawing Sheets



6,348,844

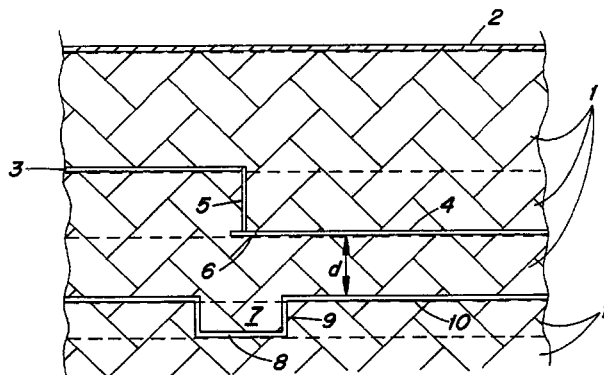
February 19, 2002

## TRANSITION BETWEEN SYMMETRIC STRIPLINE AND ASYMMETRIC STRIPLINE

Inventors: Björn Albinsson and Thomas Harju.  
Assignee: Telefonaktiebolaget LM Ericsson (publ).  
Filed: June 16, 2000.

**Abstract**—The present invention relates to an arrangement in multilayer printed circuit boards, with the aim of improving matching in transitions between symmetric striplines (3) and asymmetric striplines (4). The requirement of a coverpad (6) for contact between the via (5) and the asymmetric stripline (4) for dimension reasons among other things, results in matching problems. In order to avoid this problem, the earth plane (7, 10) nearest the transition is moved away in the proximity of the via (5).

8 Claims, 2 Drawing Sheets



6,349,157

February 19, 2002

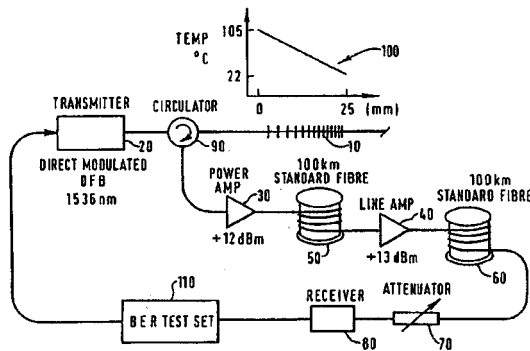
## DISPERSION COMPENSATION OPTICAL FIBER TRANSMISSION

Inventors: Richard Ian Laming, Martin Cole, and Laurence Reekle.  
Assignee: Pirelli Cavi & Sistemi S.p.A.  
Filed: May 15, 2000.

**Abstract**—A method of forming a chirped fiber grating having the steps of providing an optical fiber, impressing a nonlinear grating onto a portion of the optical fiber to define a nonlinear variation in the refractive index. The method

further comprising applying a temperature gradient to a portion of the optical fiber to provide a variation that acts against the nonlinear variation in the refractive index.

12 Claims, 13 Drawing Sheets



6,349,163

February 19, 2002

## DISPERSION COMPENSATING SINGLE MODE WAVEGUIDE

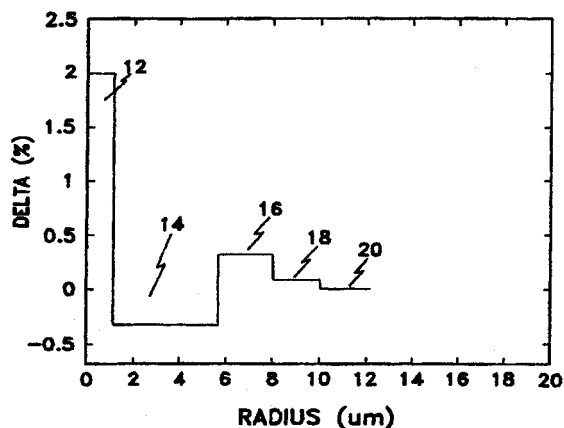
Inventors: A. Joseph Antos, George E. Berkey, Daniel W. Hawtof, G. Thomas Holmes, and Yanming Liu.

Assignee: Corning Incorporated.

Filed: November 8, 1999.

**Abstract**—A dispersion compensating single mode optical waveguide fiber designed to change the wavelength window of operation of a link from 1310 nm to 1550 nm. The dispersion compensating waveguide fiber is characterized by a core glass region refractive index profile comprised of at least three segments. The segment on the waveguide center has a positive relative refractive index. At least one segment, spaced apart from, the waveguide centerline has a negative relative refractive index.

12 Claims, 4 Drawing Sheets



6,349,165

February 19, 2002

## METHODS AND APPARATUS FOR CYLINDRICAL PACKAGING OF FIBER GRATINGS TO PROVIDE TEMPERATURE COMPENSATION

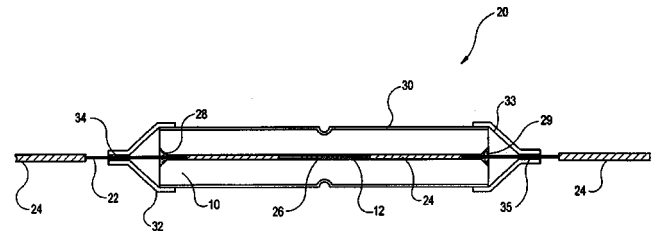
Inventor: William E. Lock.

Assignee: Corning Incorporated.

Filed: December 13, 1999.

**Abstract**—Passive temperature compensated packages for short-period fiber gratings and other optical components and techniques for forming the packages are described. In one aspect, a hollow tube having a negative coefficient of thermal expansion (CTE) encased in a cylindrical body is employed to form an athermalized cylindrical package. The hollow tube may also include slots for writing a grating onto an optical fiber disposed within the tube. In another aspect, end caps may be disposed on opposite ends of the cylindrical body.

10 Claims, 8 Drawing Sheets



6,351,198

February 26, 2002

## DIELECTRIC FILTER, DUPLEXER, AND COMMUNICATION APPARATUS

Inventors: Hideki Tsukamoto, Katsuhito Kuroda, Jinsei Ishihara, and Hideyuki Kato.

Assignee: Murata Manufacturing Co., Ltd.

Filed: November 16, 1999.

**Abstract**—The open faces of resonator holes of a dielectric filter are capable of being formed with high dimensional precision by a simple process, by which a coupling between resonators and an external coupling can easily be adjusted. In addition, a duplexer including the dielectric filter, and a communication apparatus including at least one of the dielectric filter and the duplexer are provided. The dielectric filter includes a dielectric block having protrusions on the upper surface of a substantially rectangular-parallelepiped base. Resonator holes are disposed by penetrating from the end faces of the protrusions to the lower surface of the base that opposes the end faces. External coupling holes are disposed by penetrating the opposing upper and lower surfaces of the base. An inner conductor is formed on the inner surface of each hole, and an outer conductor is formed on the substantially entire outer surface of the dielectric block except the end faces of the protrusions. Additionally, input and output electrodes separated from the outer conductor are formed at the openings of the external coupling holes on the lower surface of the dielectric block.

7 Claims, 3 Drawing Sheets

6,351,586

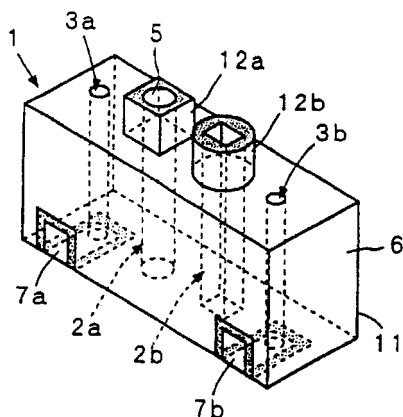
February 26, 2002

**WAVELENGTH DEPENDENT PHASE DELAY DEVICE**

Inventors: Mark F Krol and Yongqian Liu.

Assignee: Corning Incorporated.

Filed: December 29, 1999.



**Abstract**—A March-Zehnder device includes a delay element in one arm which delays propagation of light at a first wavelength relative to propagation of light at a second wavelength. The delay element may be made up of a grating having a period which causes coupling of the first wavelength from a first mode into a second mode. In another aspect, the invention includes a second grating positioned downstream from the first grating and having a period which causes coupling of the portion of light from the second propagation mode back into the first propagation mode. Also disclosed is an optical waveguide in which light at a wavelength  $\lambda$  can propagate in at least a first and a second mode. The waveguide has an effective index of refraction  $n_1$  with respect to the first propagation mode of  $\lambda$ , and an effective index of refraction  $n_2$  with respect to the second propagation mode. A grating formed in said waveguide and having a period approximately equal to  $(\lambda/2)(n_1 - n_2)$ .

5 Claims, 1 Drawing Sheet

6,351,585

February 26, 2002

**THERMALLY ADJUSTABLE OPTICAL FIBER GRATING DEVICE WITH PACKAGING FOR ENHANCED PERFORMANCE**

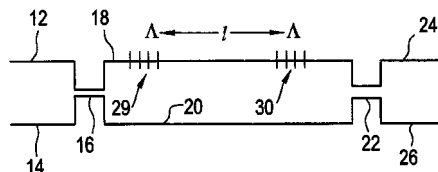
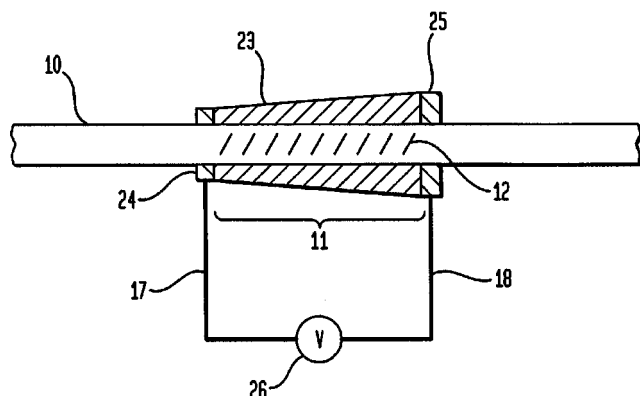
Inventors: Karl R. Amundson, Benjamin John Eggleton, Rebecca Jane Jackman, John A. Rogers, and Thomas Andrew Strasser.

Assignee: Lucent Technologies Inc.

Filed: February 2, 1999.

**Abstract**—This invention is predicated upon applicants' discovery that the performance of thermally adjustable fiber grating devices is enhanced by disposing them within a vessel for thermal isolation. The vessel is sufficiently larger than the fiber to avoid contact with the grating yet sufficiently small to isolate the grating from substantial air currents. Conveniently, the vessel is a cylindrical tube having elastomeric end seals. Advantageously microcapillary tubes passing through the elastomeric seals provide openings for the fiber to pass through the tube.

7 Claims, 2 Drawing Sheets



6,351,588

February 26, 2002

**FIBER BRAGG GRATING WITH CLADDING MODE SUPPRESSION**

Inventors: Vikram Bhatia, Adam K. Collier, Liang Dong, Marlene A. Marro, Gang Qi, Martin R. Swan, and David Lee Weidman.

Filed: September 17, 1999.

**Abstract**—An optical waveguiding fiber has a photosensitive core and a cladding that includes a photosensitive inner cladding region adjacent the core and an outer cladding region. The inner cladding region and the outer cladding region have substantially equal indices of refraction. The photosensitivity of the inner cladding region is sufficient to cause a modulation of the index of refraction of the inner cladding when exposed to ultraviolet light. In another aspect of the invention, the optical fiber includes a grating in the core, which extends radially into the inner cladding region. The core and the inner cladding region of the optical fiber are doped with concentrations of Ge and B sufficient to impart photosensitivity to the inner cladding region, and to result in an index of refraction in the inner cladding region substantially equal to the index of refraction of the outer cladding region.

11 Claims, 3 Drawing Sheets

