

Patent Abstracts

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5,276,410

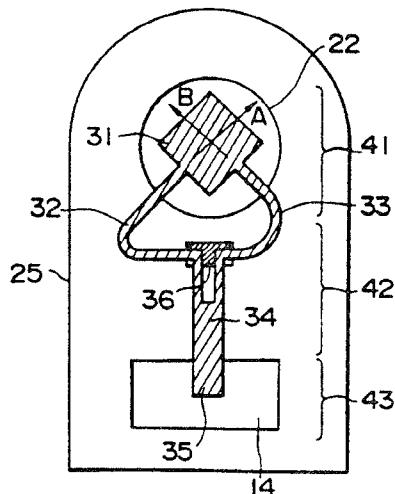
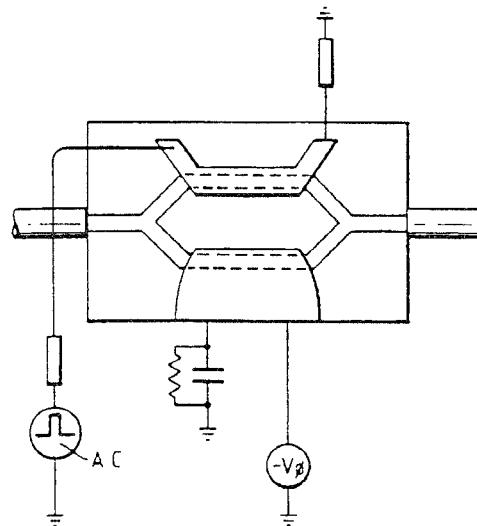
Jan. 4, 1994

Circular to Linear Polarization Converter

Inventors: Keiji Fukuzawa and Yoshikazu Yoshida.
 Assignee: Sony Corporation.
 Filed: June 2, 1992.

Abstract—A converter for converting circularly polarized waves in a round waveguide into linearly polarized waves in a rectangular waveguide has two probes and a transmission line pattern, all of which are formed of metal foil on a thin dielectric film board. The board is flexible and extends across the open ends of the two waveguides. The first probe has a square shape and the transmission line has two conductor arms connected to adjacent sides of the square. The other ends of the conductor arms are connected to the second probe with an impedance matching resistor formed on the film board between the two arms. One conductor arm is one-quarter wavelength longer than the other to convert from circularly polarized waveguide transmission to microstrip transmission.

17 Claims, 3 Drawing Sheets



5,276,744

Jan. 4, 1994

Electrooptic Device

Inventor: Robert N. Shaw.
 Assignee: BT&D Technologies Limited.
 Filed: Mar. 19, 1991.

Abstract—An electrooptic device, such as a Mach-Zehnder interferometer or a directional coupler, has a power-dissipating electrode structure and a ground plane electrode and is switchable between first and second distinct states by the application of respective first and second potentials to the power-dissipating electrode. Thermally induced instabilities are

minimized by biasing the ground plane electrode such that the first and second potentials are of substantially equal magnitude but of opposite sign. The power-dissipating electrode may be a travelling-wave electrode connected to a 50-ohm transmission line.

11 Claims, 2 Drawing Sheets

5,276,746

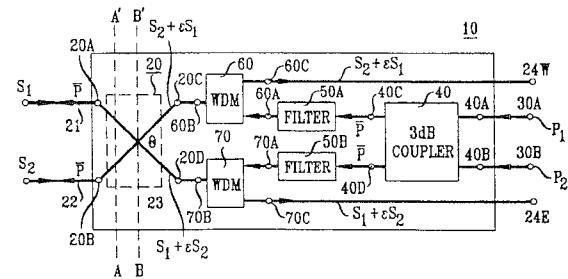
Jan. 4, 1994

Polarization-Independent Optical Tap

Inventors: Renen Adar, Charles H. Henry, Rudolf F. Kazarinov, Michele A. Milbrodt.
 Assignee: AT&T Bell Laboratories.
 Filed: June 24, 1992.

Abstract—In accordance with the invention, an integrated optic device useful as a low-level polarization-independent optical tap comprises a pair of optical waveguides intersecting at an angle of 10°–25° to provide a tap signal in the range –20 to –60 dB. In a preferred embodiment for use in a passive repeater for undersea cable, the device comprises fiber-matching waveguides of phosphorus silicate glass on an oxide covered silicon substrate with a boron and phosphorus silicate cladding. The waveguides preferably intersect at an angle of 13°–16°. The preferred repeater further comprises a 3-dB coupler for averaging the power provided by two external pumping sources and a pair of wavelength division multiplexers for applying the pumping power to the outputs of the tap.

11 Claims, 2 Drawing Sheets



5,276,747

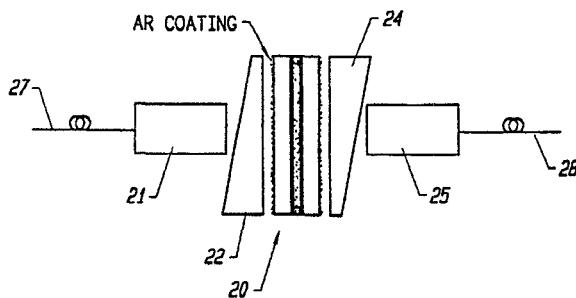
Jan. 4, 1994

Polarization-Independent Optical Switch/Attenuator

Inventor: Jing-Jong Pan.
 Assignee: E-Tek Dynamics, Inc.
 Filed: Jan. 21, 1993.

Abstract—An optical device that controls the strength of an optical signal from an input fiber to an output fiber responsive to a signal on a control terminal. The device has a first GRIN lens associated with the input fiber, a first birefringent polarizer, a liquid crystal cell, a second birefringent polarizer, and second GRIN lens associated with the output fiber. The liquid crystal cell, located between the first and second polarizers and, connected to a control terminal, controllably rotates the optical signal from the optical axis of the first polarizer toward the optical axis of the second polarizer responsive to the signal on said control terminal. The operation of the device is independent of the polarization of the optical signal in the input fiber. Furthermore, the device can be operated as an optical switch or an optical attenuator by suitably arranging the axes of the polarizers and liquid crystal cell.

21 Claims, 4 Drawing Sheets



5,276,749

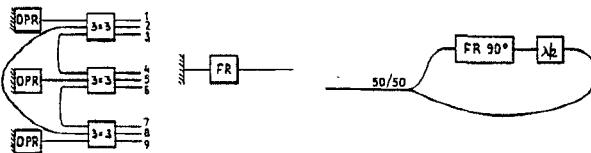
Jan. 4, 1994

Optical Reflective Star Device Having One or More Orthogonal Polarization Reflectors

Inventor: Mattijs O. Van Deventer.
 Assignee: Koninklijke PTT Nederland N.V.
 Filed: May 27, 1992.

Abstract—An optical reflective star device having a number of ports for distributing each signal fed to a port over the other ports. Said optical reflective star device is made up of a number of star elements and comprises a number of reflectors provided at reflection points in the reflective star device. At least one of the reflectors is an orthogonal polarization reflector

14 Claims, 1 Drawing Sheet



5,278,575

Jan. 11, 1994

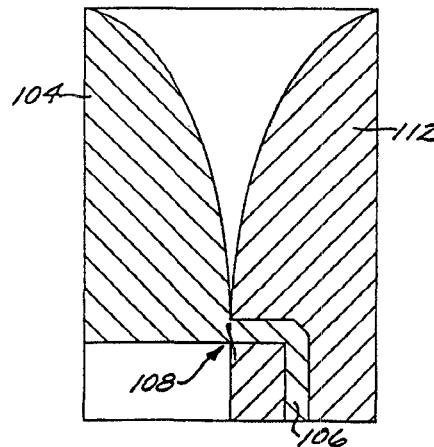
Broadband Microstrip to Slotline Transition

Inventor: Mike D. Thomas.
 Assignee: Hughes Aircraft Company.
 Filed: Sept. 26, 1991.

A broadband transition between microstrip transmission line and slotline transmission line. The geometry of integrating the two transmission lines results in a broadband microstrip shunt circuit across the slotline and a broadband slotline open circuit in the direction opposite of propagation on the slotline. This produces direct coupling between the two transmission

lines. The transition does not require any intermediate transmission line types between the microstrip and slotline, and no frequency dependent tuning stubs are used to produce the shunt circuits and open circuits required for coupling. The result is a broadband transition that can be fabricated using standard etching techniques and requiring no plated-through holes.

2 Claims, 3 Drawing Sheets



5,278,850

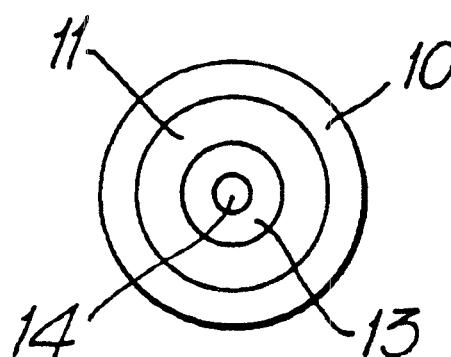
Jan. 11, 1994

Waveguiding Structure with Lasing Properties

Inventors: Benjamin J. Ainslie and Susan P. Craig-Ryan.
 Assignee: British Telecommunications.
 Filed: Dec. 16, 1992.

Abstract—Optical waveguides, e.g. fibers, for use as photonic amplifiers have a path region partly or, preferably, wholly composed as a silica/germania glass with 0.1–5000 ppm mole of Er^{3+} as a lasing additive and alumina to adjust the bandwidth, the Ge:Al mole ratio being more than 2.8, e.g. 1:0.001–0.25. It is surprising that low amounts of alumina have a useful and significant effect on the lasing bandwidth whereby frequency division multiplex is facilitated.

18 Claims, 1 Drawing Sheet



5,278,853

Jan. 11, 1994

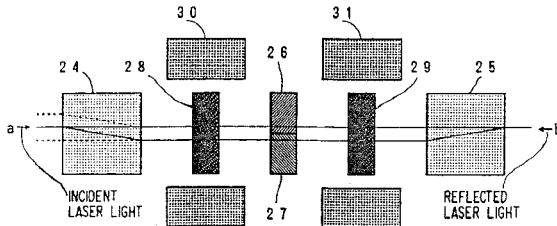
Optical Isolator

Inventors: Mitsuzo Arii, Kazushi Shirai, Makoto Sumitani, and Norio Takeda.
 Assignee: Mitsubishi Gas Chemical Co., Ltd.
 Filed: May 27, 1992.

Abstract—A high quality, small-sized polarization-independent optical isolator for use in an optical fiber communication system, wherein a pair of magnetooptic elements having Faraday rotation angle of 45 ± 5

are contained in permanent magnets and arranged between a pair of birefringent crystal plates for splitting and combining an optical path of a laser light, and two polarizers arranged in parallel as being bounded on the midpoint of separated optical paths are interposed between the pair of magneto-optical elements, whereby a degree of worsening the optical isolation can be kept minimum against variations of an environmental temperature and wavelength.

4 Claims, 5 Drawing Sheets



5,278,859

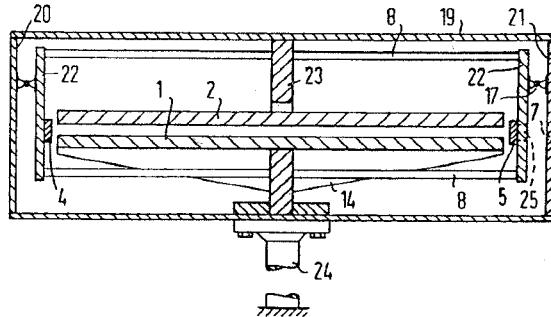
Jan. 11, 1994

Stripline Laser

Inventor: Karlheinz Arndt.
Assignee: Siemens Aktiengesellschaft.
Filed: Sept. 11, 1992.

Abstract—A stripline laser includes a housing having two sides. An exit window is disposed at one of the sides for a laser beam traveling in a given direction. Two metal electrodes are mutually spaced apart, defining a discharge gap therebetween. At least two mutually parallel bars having very low coefficients of temperature expansion retain two resonator mirrors at a precisely fixed mutual spacing. The electrodes are rigidly joined to the housing and to the bars in the given direction at only one location in a reference plane. The electrodes are secured at another location against motions relative to the housing running perpendicular to the discharge gap. A holder adjustably fastens an inclination of at least one of the mirrors relative to the discharge gap. The bars fix an axial position and an angular position of the at least one adjustable mirror relative to the reference plane. The reference plane is disposed at least approximately midway between the mirrors.

7 Claims, 1 Drawing Sheet



5,278,923

Jan. 11, 1994

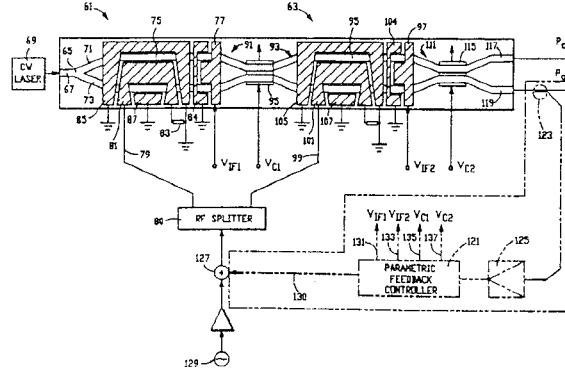
Cascaded Optical Modulation System with High Energy Linearity

Inventors: Moshe Nazarathy, Yishai Kagan, Yaron Simier.
Assignee: Harmonic Lightwaves, Inc.
Filed: Sept. 2, 1992.

Abstract—An optical modulation system having cascade-coupled electro-optic modulator stages in either dual tandem or split tandem configurations. An electrical splitter derives multiple electrical drives for the multiple stages from a single modulating input signal. The multiple drive signals are linearly related in magnitude and preferably induce simultaneous antiphase (180° out-of-phase) optical modulation in the tandem

stages. While a double Mach-Zehnder cascade configuration could be used, at least one modulator stage might instead be a balanced-bridge interferometer-type modulator having at least one directional coupler. At least one directional coupler in such a configuration may be a $\Delta\beta$ coupler. Application of bias voltages to the interferometer sections and to coupler sections by means of a parametric feedback loop is done in order to simultaneously enhance the linear modulation coefficient, minimize odd order distortions, and null the even order distortions that are associated with biased $\Delta\beta$ couplers.

38 Claims, 17 Drawing Sheets



5,278,924

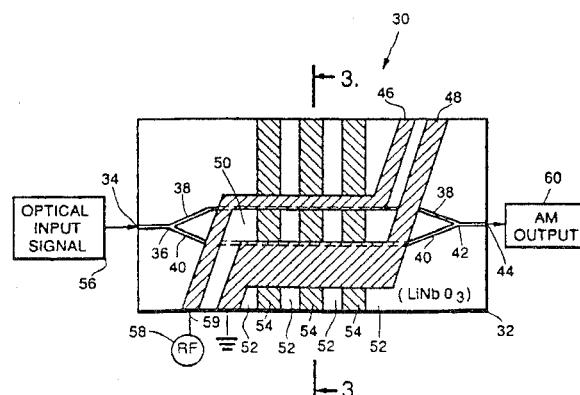
Jan. 11, 1994

Periodic Domain Reversal Electrooptic Modulator

Inventor: James. H. Schaffner.
Assignee: Hughes Aircraft Company.
Filed: Feb. 4, 1993.

Abstract—In accordance with the teachings of the present invention, an enhanced performance opto-electric modulator (30 or 70) is provided herein that compensates for phase velocity mismatches between optical modulation and an RF electric signal. The modulator (30) includes an optical waveguide (38, 40) formed in a substrate (32) and coupled to an optical input (56). An RF waveguide (46, 48) is formed on the substrate (32) for applying an electric field (59) to a modulation region (50) adjacent the optical waveguide so as to modulate an optical signal. The substrate (32) has a ferroelectric domain that includes periodically inverted and noninverted regions (54) and (52) that compensate for phase differences within the modulation region (50). In a preferred embodiment, the optical waveguide includes two substantially parallel optical waveguides (38) and (40) that have outputs combined to provide for an amplitude modulated (AM) optical output signal (60).

18 Claims, 3 Drawing Sheets



5,278,994

Jan. 11, 1994

Power Amplifier Saturation Detection and Correction Method and Apparatus

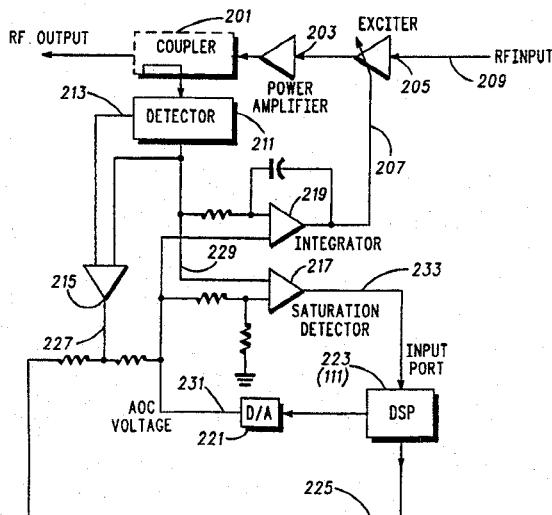
Inventors: Gregory R. Black and Alexander W. Hietala.

Assignee: Motorola, Inc.

Filed: June 3, 1991.

Abstract—A power amplifier controller detects saturation of the power amplifier (203) and corrects the automatic output control voltage (231) to avoid any further saturation. A detector (211) detects the power of the radio frequency (RF) output signal (211) and generates a signal (229) correlated to the detected power. Comparator (217) compares changes in that signal (229) to changes in the voltage of the AOC signal (231). The comparator (217) generates a signal (233) correlated to saturation of the power amplifier (203) for a DSP (223). The DSP (223) checks the status of this signal (233). Upon detecting saturation, an algorithm contained within the DSP methodically reduces the voltage of the AOC signal (231) until there is a change in the power of the RF output signal (211).

7 Claims, 5 Drawing Sheets



5,280,168

Jan. 18, 1994

Tapered Radial Transmission Line for an Optically Activated Hybrid Pulser

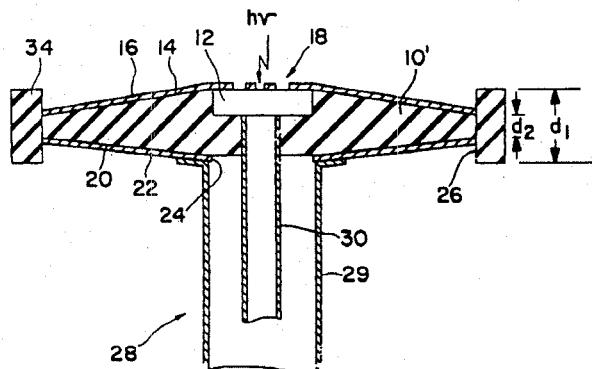
Inventors: Anderson H. Kim, Maurice Weiner, Louis J. Jasper, Robert J. Youmans.

Assignee: The United States of America as represented by the Secretary of the Army.

Filed: Nov. 25, 1991.

Abstract—The combination of a photoconductive switch coupled to an energy storage device wherein the switch is comprised of photoconductive semiconductor switch while the energy storage device comprises a tapered radio transmission line. A photoconductive semiconductor gallium arsenide switch is embedded in a circular disc of dielectric material having a thickness dimension that reduces linearly outward from the center, with upper and lower layers of continuous radial metallization configured in a circular pattern located thereon. The upper layer of metallization includes an apertured grid adjacent one surface of the switch, while the outer conductor of a coaxial output signal line is connected to the metallization layer on the opposite side with the inner conductor thereof passing through the dielectric layer to the undersurface of the semiconductor switch.

12 Claims, 2 Drawing Sheets



5,280,169

Jan. 18, 1994

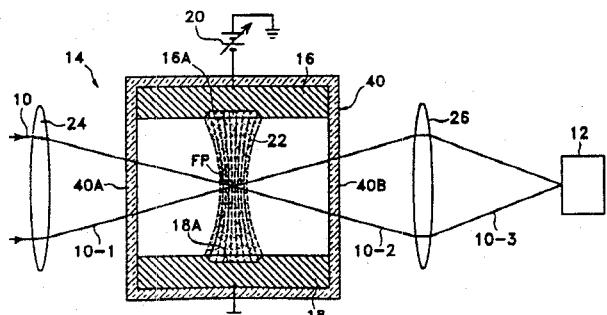
Method and Apparatus for Limiting Optical Radiation Intensity at an Optical Sensor Using Solid Particles Oscillating in an Electric Field

Inventors: Richard C. Honey, Robert A. Brown, Karen M. Nashold, Richard C. Adamo.

Filed: Dec. 22, 1992.

Abstract—Method and apparatus for limiting optical radiation to an optical sensor are disclosed for protecting the sensor against damage from high intensity optical radiation. A fixed electric field is established between a pair of spaced electrodes by connection of the electrodes to a DC voltage source. Small solid particles oscillate back and forth in the electric field between the electrodes. Incident optical radiation is focused at a focal plane at the oscillating solid particles, and energy transmitted through the oscillating particles is focused at the optical sensor. The transmittance of the particle-containing space is substantially constant for incident optical radiation intensity up to a threshold level below which the sensor is undamaged by the radiation. Above the threshold, oscillating particles are heated to a high temperature for vaporization, ionization, and thermal expansion thereof for increase scatter and absorption thereby limiting optical radiation to the sensor to an intensity below which damage to the sensor occurs.

19 Claims, 2 Drawing Sheets



5,280,297

Jan. 18, 1994

Active Reflect Array Antenna for Communication Satellite Frequency Re-Use

Inventor: Charles E. Profera, Jr.

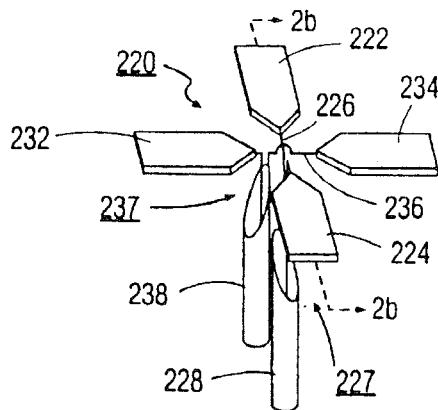
Assignee: General Electric Co.

Filed: Apr. 6, 1992.

Abstract—A antenna suited for a communications satellite includes two separately located, mutually orthogonally polarized feed antennas such as vertically and horizontally polarized linear horns. The horns feed an active reflector antenna array. The array includes a plurality of

mutually orthogonally polarized antenna elements such as crossed dipoles or square patch antenna with cross feeds for two independent orthogonal polarizations. The feeds of the antenna elements are coupled to amplifier modules. Each module includes a circulator for each polarization, coupled to a processor including a low noise amplifier, controlled phase shifter, variable gain amplifier, and power amplifier. The output of the power amplifier feeds the antenna element through the circulator. The large number of radiating elements allows high power using power amplifier with relatively modest capabilities. The phase shifters of each module independently control the reradiation phase of the vertical and horizontal signals, so that a collimated beam can be independently focused to the two feed points, one for each polarization.

20 Claims, 2 Drawing Sheets



5,280,382

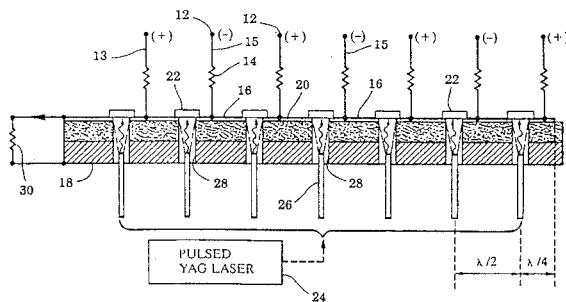
Jan. 18, 1994

Direct Current to Radio Frequency Pulse Generating System

Inventors: Johann M. Osterwalder and Trevor G. Hame.
Assignee: Hughes Missile System Company.
Filed: May 25, 1990.

Abstract—A circuit arrangement to convert high voltage direct current energy into radio frequency energy that includes photoconductive switch means that is periodically closed by a pulsed light source, such as a laser, to generate the radio frequency energy. A segmented transmission line that includes a plurality of photoconductive switches positioned a half-wavelength apart that are closed simultaneously by the laser may be used to generate the radio frequency energy. The photoconductive switches may also be connected in parallel and closed by time delayed light pulses to generate the radio frequency energy. The pulses generated may also be used to excite a resonator circuit coupled to a load to increase the duration of the high frequency oscillation and to shape (filter) the resultant waveform. Other configurations utilizing photoconductive semiconductor discs and annular metal electrode configurations that may be closed by light pulses are also illustrated.

19 Claims, 4 Drawing Sheets



5,280,383

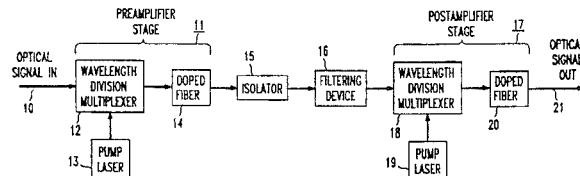
Jan. 18, 1994

Dual-Stage Low Power Optical Amplifier

Inventors: John F. Federici, Stuart A. Kramer, Gerald Nykolak.
Assignee: AT&T Bell Laboratories.
Filed: Dec. 2, 1992.

Abstract—A two-stage optical fiber amplifier requiring substantially reduced power comprises a pre-amplifier first-stage operating in the linear region within the small signal limits and a post-amplifier second-stage operating in a saturated regime providing significant gain compression. The pump power for the pre-amp stage is minimized, and all of the gain compression occurs in the second stage. Minimum pump power and the corresponding amplifier fiber length needed to achieve a predetermined optimum amount of small signal gain required in a given amplifier application may be achieved in variations of the design.

6 Claims, 4 Drawing Sheets



5,280,549

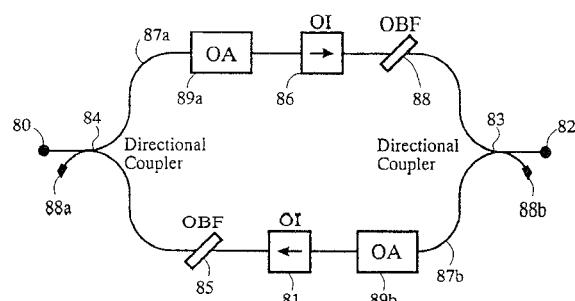
Jan. 18, 1994

Frequency-Dependent Optical Isolator

Inventors: Chris Barnard and Neil Teitelbaum.
Assignee: National Research Council of Canada.
Filed: Feb. 5, 1993.

Abstract—A frequency-dependent optical isolator is provided that allows two signals transmitted on a single optical fiber to be isolated in dependence upon their frequencies. A signal having a frequency f_1 propagates through the isolator in one direction from a first input/output port to a second input/output port and is prevented from propagating in the reverse direction. A signal having a frequency f_2 propagates through the isolator from the second input port to the first input port and is prevented from propagating in the reverse direction. After either of the signals propagates through the isolator from one input/output port to the other, the isolator prevents the respective signal from traveling backwards in a reverse direction through the isolator. The frequency dependent isolator may be used with an amplifier or may amplify one or more of the signals propagating through.

16 Claims, 5 Drawing Sheets



5,280,649

Jan. 18, 1994

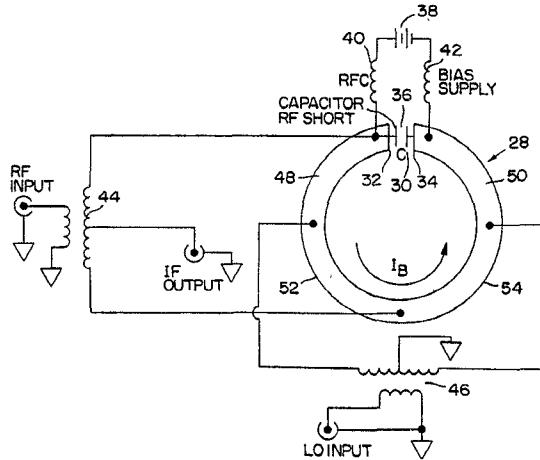
Superconducting Balanced Mixer

Inventor: Leon Riebman.
Assignee: AEL Defense Corp.
Filed: June 18, 1992.

Abstract—A superconducting nonlinear device includes a superconducting conductor, a current source associated with the conductor for

applying to the conductor a bias current, and a control device associated with the current source for selectively controlling the magnitude of the bias current. The nonlinear device according to the invention may be used in a number of circuit configurations, including a balanced mixer.

2 Claims, 5 Drawing Sheets



5,281,925

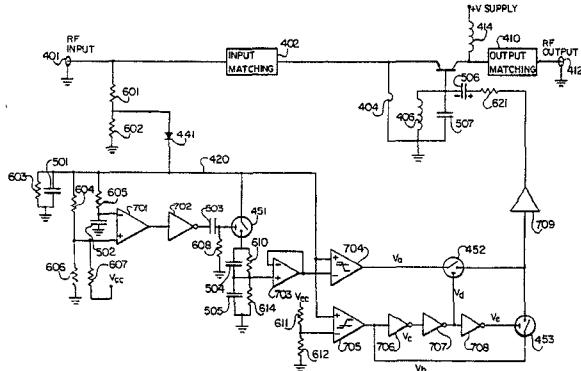
Jan. 25, 1994

RF Amplifier Providing Reduced Drive Response Rise Times and Fall Times

Inventor: Timothy P. Hulick.
Assignee: Acrodyne Industries, Inc.
Filed: Nov. 17, 1992.

Abstract—The normally slow rise time of a Class C bipolar transistor grounded base RF power amplifier is greatly enhanced by circuitry external to the amplifier transistor. Current is injected into the base of the transistor for the duration of the rise time, biasing it into Class A operation during this period. Then, after the base current injection, operation reverts to Class C to retain amplifier power efficiency. Finally, the normally slow fall time of the bipolar Class C RF power amplifier is greatly enhanced by reverse-biasing the base-to-emitter junction during the fall time. During this fall time, the amplifier is forced into its cutoff region by the applied reverse bias, as stored charge is pulled out of the base-emitter region of the transistor. In this manner, the power efficiency advantage of Class C power amplifiers may be retained, while adding the benefits of sharper output rise and fall times that would not otherwise be achieved.

12 Claims, 4 Drawing Sheets



5,281,928

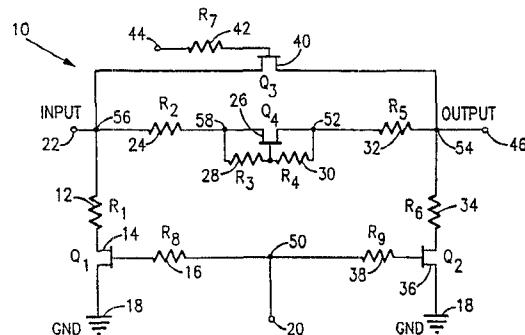
Jan. 25, 1994

Electronic Attenuator

Inventors: Shmuel Ravid, Alan R. Olsen, Gary E. St. Onge.
Assignee: M/A-Com, Inc.
Filed: Oct. 26, 1992.

Abstract—An electronic attenuator device is provided whose attenuation characteristics are substantially insensitive to variations in component element parameters and ambient temperature changes. Advantageously, an attenuator device made according to the present invention may be constructed at substantially reduced cost without loss of attenuation precision.

16 Claims, 2 Drawing Sheets



5,282,072

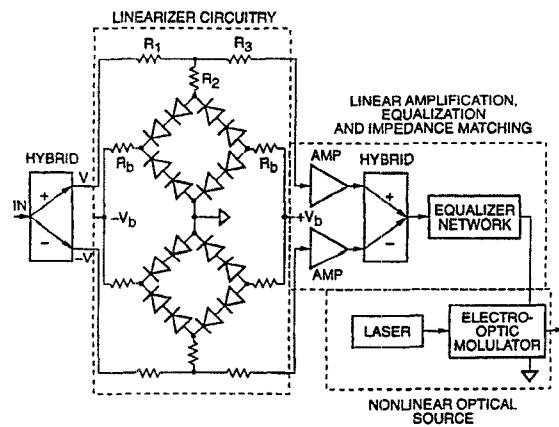
Jan. 25, 1994

Shunt-Expansive Predistortion Linearizers for Optical Analog Transmitters

Inventors: Moshe Nazarthy, Anthony J. Ley, Hans C. Verhoeven.
Assignee: Harmonic Lightwaves, Inc.
Filed: Nov. 19, 1991.

Abstract—This invention teaches new types of linearization circuits, exhibiting improved broadband suppression of nonlinear distortion. These realizations do not require the use of reactive elements such as transistors, eliminating the drawbacks of prior art realizations. The linearization circuits are particularly suitable for linearizing optical sources with odd wave voltage to light transfer characteristics, such as externally modulated CW lasers. The fundamental building blocks of the linearization circuits of this invention are novel nonlinear electrical one-ports with an expansive V-I characteristic, denoted as ENLOP (Expansive Nonlinear one-Ports). The ENLOP building blocks are further embedded in linear circuits.

65 Claims, 11 Drawing Sheets



5,282,076

Jan. 25, 1994

5,282,080

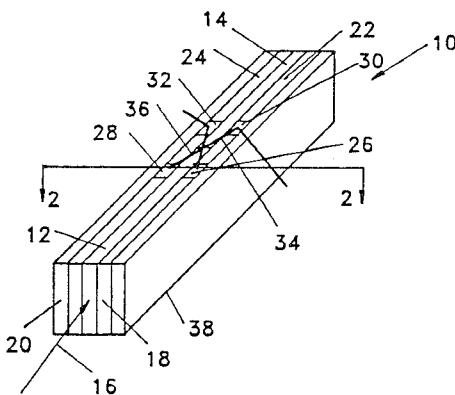
Jan. 25, 1994

Strain and Temperature Compensation in Electrooptic Modulators

Inventor: Frank J. Banks.
Filed: Jan. 4, 1993.

Abstract—A device for compensating for changes in temperature and strain in electrooptic modulators without altering the voltage field effects. Devices for modulating light intensity in response to a varying electrical signal are particularly useful with optical fiber information sensing systems. Such modulators basically receive a light signal, collimate and polarize the light, then pass it through a wave plate to cause circular polarization. The light signal then is passed through a modulator material that rotates the beam polarization in response to varying voltage signals imposed on the modulator. Unfortunately, changes in temperature and strain also change the state of polarization. I have now found that by transmitting the light signal through two equal crystals in series that are rotated 180° from each other, a uniform strain or temperature change will result in canceled polarization effects. Thus, effects of changes in temperature and/or strain are canceled without affecting the voltage field effects.

10 Claims, 1 Drawing Sheet



Surface Coupled Optical Amplifier

Inventors: Donald R. Scifres and David F. Welch.
Assignee: SDL, Inc.
Filed: Dec. 9, 1991.

Abstract—An optical amplifier with at least one high reflectivity facet oriented at a nonperpendicular angle to the amplifier's waveguide to couple light vertically through a top or bottom surface of the amplifier. Angled facets could be at just one end of the waveguide or at both ends of the waveguide. In the latter case, the facets can be approximately parallel to or perpendicular to each other for respective coupling to opposite or same sides of the amplifier. Multiple amplifiers can be formed end-to-end with v-grooves defining the angled facets or can be formed side-by-side with parallel waveguides. Waveguides can also branch to form a 1:2, 1:4 or 2:2 optical signal multiplier or optical switch depending on whether just one or all of the waveguide branches are electrically pumped. Fibers are coupled to the amplifier receiving and emitting surfaces. Angling the fiber end with respect to the surface prevents reflections from feeding back into the amplifier waveguide. The facets can also be oriented at an angle other than 45° to direct the light out of the surface at a nonperpendicular angle.

17 Claims, 7 Drawing Sheets

