Patent Abstracts

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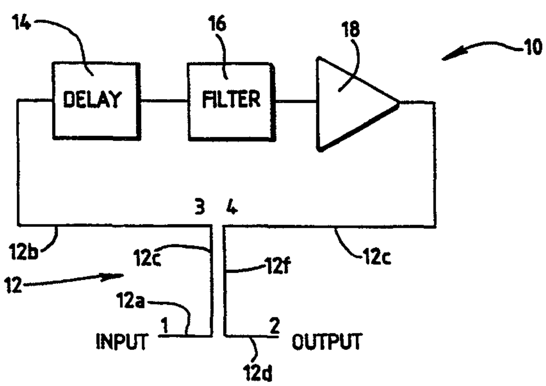
5,430,412 July 4, 1995

Amplifier with Lossless Feedback

Inventor: David A. Freer.
Assignee: Grayson Electronics Company.
Filed: Nov. 2, 1992.

Abstract—An amplifier, suitable for use in a limited band at microwave frequencies, incorporates a single lossless feedback coupling element between the input port and output port of the gain circuitry. The feedback element is formed of two coextending conductors of a length on the order of a quarter wavelength of the center frequency of the band. An input signal is coupled to the gain element through one of the feedback conductors. An output signal is coupled from the output port of the gain element through the other of the conductors of the feedback element. Relatively low closed loop gain, on the order of 10 dB, is achievable over the specified band at center frequencies on the order of 800–1000 MHz.

17 Claims, 4 Drawing Sheets



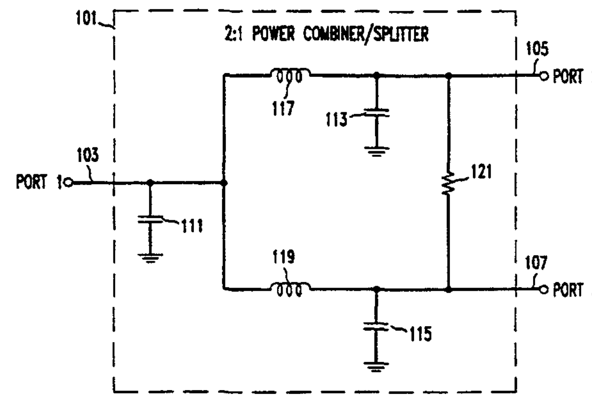
5,430,418 July 4, 1995

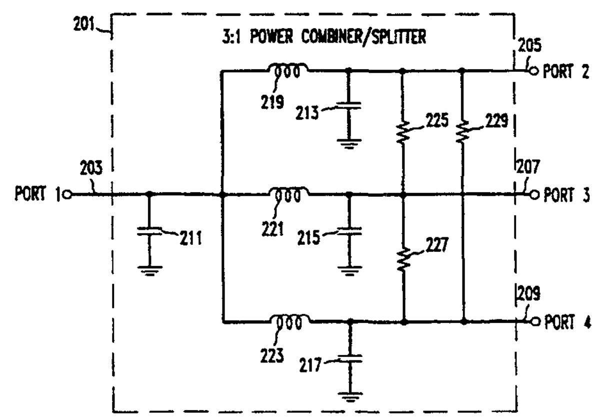
Power Combiner/Splitter

Inventor: James R. Blodgett.
Assignee: AT&T Corp.
Filed: Feb. 14, 1994.

Abstract—A passive electric power splitter/combiner comprising a first inductor (**117**) between an input terminal and a first output terminal, a second inductor (**119**) between the input terminal and a second output terminal, a first capacitor (**111**) between the input terminal and ground, a second capacitor (**113**) between the first output terminal and ground, a third capacitor (**115**) between the second output terminal and ground, and a resistor (**121**) between the first output terminal and the second output terminal. Embodiments of the present invention can be fabricated that have little loss other than the intrinsic split loss, exhibit a uniform impedance at all ports, and exhibit electrical isolation between the output ports.

11 Claims, 2 Drawing Sheets





5,430,572 July 4, 1995

High-Power, High-Gain, Low-Noise, Two-Stage Optical Amplifier

Inventors: David J. DiGiovanni, Joseph D. Evankow, Jonathan A. Nagel, Richard G. Smart, James W. Sulhoff, and John L. Zyskind.
Assignee: AT&T Corp.
Filed: Sep. 30, 1993.

Abstract—High output power, high gain, and low noise are achieved in a two-stage optical amplifier, suitable for use as a repeater for a long-haul lightwave communication system, in accordance with the principles of the invention, by employing a first amplifying stage having a signal gain sufficiently small to prevent self-saturation by amplified stimulated emission (ASE) that uses counter-propagating pump light to cause maximum inversion of the first stage amplifying medium. In an illustrative embodiment of the invention, EDFA's are used in each of two amplifying stages. The length of the EDFA in the first stage is short enough to ensure nearly complete inversion of the EDFA from pump light that counter-propagates with the signal. The counter-propagating pump light allows the invention to advantageously avoid

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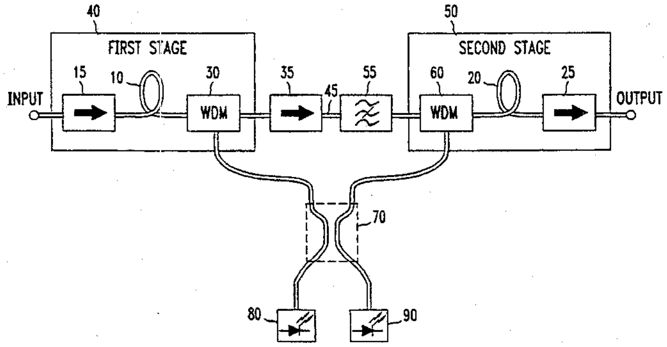
the significant noise figure penalty from the input loss associated with co-propagating pump light. And, noise figure is improved because complete inversion is achieved throughout the EDFA and at the input where the noise figure is most sensitive to inversion. The short length also eliminates self-saturation of the EDFA from ASE, which degrades the noise figure. However, the length, and hence the gain, of the EDFA in the first stage is long enough to provide sufficient gain so that the noise figure of the two-stage amplifier, as a whole, is determined primarily by that of the first stage. A second EDFA in the second stage of the amplifier may then be configured using co-propagating or counter-propagating pump light for additional signal amplification to provide the required output power and gain for long haul lightwave systems. Other aspects of illustrative embodiments of the invention include the use of passive optical elements including filers, isolators, and attenuators.

26 Claims, 4 Drawing Sheets



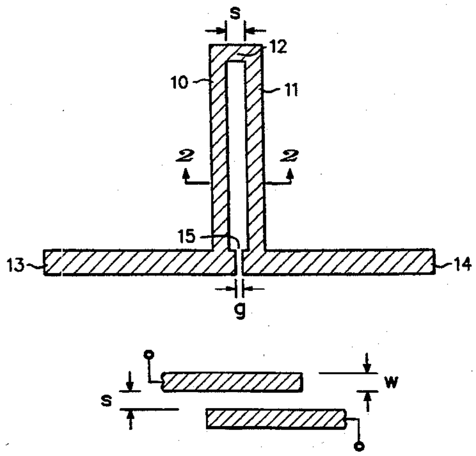
5,432,487 July 11, 1995

MMIC Differential Phase Shifter

Inventor: Michael Dydyk.
Assignee: Motorola, Inc.
Filed: Mar. 28, 1994.

Abstract—A microwave monolithic integrated circuit (MMIC) differential Schiffman phase shifter includes an input microstrip for receiving an input signal. First and second parallel microstrips produce a phase-shifted signal from the input signal. The first microstrip is coupled at a first end to the input microstrip and at a second end to an end microstrip. The second microstrip is coupled at a first end to the end microstrip. An output microstrip is coupled to the second microstrip at a second end of the second microstrip, and the input microstrip and the output microstrip are capacitively coupled. The output microstrip produces an output signal from the phase-shifted signal.

9 Claims, 2 Drawing Sheets



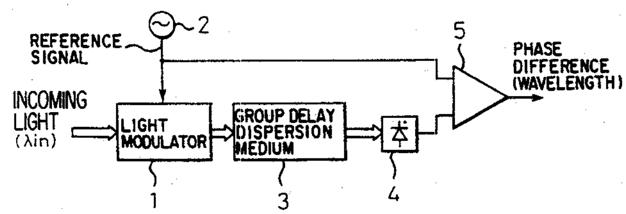
5,432,602 July 11, 1995

Light-Wavelength-Measuring Apparatus with Light Modulation

Inventors: Manish Sharma and Hiroyuki Ibe.
Assignee: Kabushiki Kaisha Toshiba.
Filed: Aug. 25, 1993.

Abstract—A small-sized, inexpensive light wavelength-measuring apparatus that has no mechanical movable sections, but which is capable of high-speed measurement and high measurement precision to improve in reliability. In the light wavelength-measuring apparatus, the intensity of incoming light is modulated by a light modulator in response to a reference signal supplied from a signal source and the modulation light is provided with a delay corresponding to the wavelength thereof through a group delay dispersion medium. The light is then converted into an electrical signal by a photoelectric converter, and a phase difference between the electrical signal and reference signal is obtained by a phase comparator, thereby measuring the wavelength of the incoming light.

9 Claims, 5 Drawing Sheets



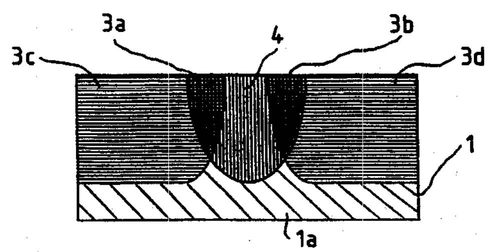
5,432,881 July 11, 1995

Optical Waveguide with Overlapping Diffusion Regions Containing Different Diffusion Materials

Inventor: Masaaki Doi.
Assignee: Nikon Corporation.
Filed: Feb. 7, 1994.

Abstract—A first region diffused with a first diffusion material containing at least one element and a second region diffused with a second diffusion material containing at least another element are formed in a substrate. At least part of the second region overlaps part of the first region. A region of the first region that does not overlap the second region has a refractive index higher than that of a region where the first region overlaps the second region and that of the substrate. The region of the first region that does not overlap the second region serves as a core for propagating a light beam. The region where the first region overlaps the second region and the region of the substrate not diffused with the first and second diffusion materials serve as a clad.

12 Claims, 13 Drawing Sheets



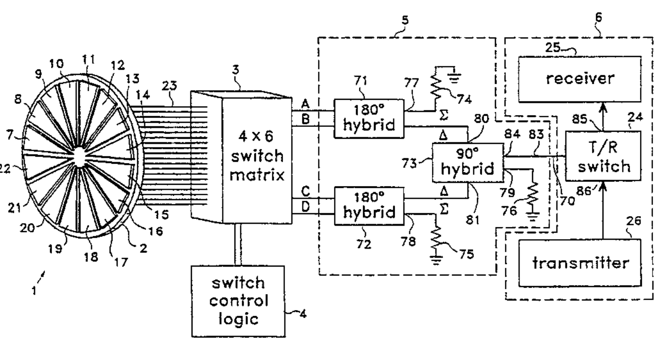
5,434,575 July 18, 1995

Phased Array Antenna System Using Polarization Phase Shifting

Inventors: Carl O. Jelinek, Daniel W. Drago, Jr., and Richard C. Dempsey.
Assignee: California Microwave, Inc.
Filed: Jan. 28, 1994.

Abstract—A circularly polarized phased array antenna system for both reception and transmission applications includes a plurality of planar radiating (or receiving) elements, a switching matrix for each radiating element, a beam-forming network, and a transmit/receive module. Each planar element includes $4 \times N$ radially disposed segments that may be selectively connected with the four modes of a circularly polarized signal such that two opposing segments function as the two respective arms of a dipole radiating element and two orthogonal such dipoles function as a crossed pair of dipoles for receiving or transmitting the circularly polarized signal. The switching matrix and the beamforming network cooperate to determine the polarization phase of the radiating element by commutating the four modes of the circularly polarized signal to any four orthogonal segments of the radiating element. The polarization sense may be changed between right-hand and left-hand circular either within the bandforming network, or by causing the switching network to reverse the two signal modes connected across one of the dipoles. If N is greater than 1, then by electrically connecting up to $N-1$ nearby segments to thereby increase the effective angle subtended by each arm, the bandwidth may be increased while still permitting the radiating element's polarization phase to be determined in increments equal to the angle subtended by one segment; by selectively using either an odd or even number of segments to define the effective angle subtended by each dipole arm, the relative phase of that element may be determined in increments equal to half the angle subtended by one segment.

20 Claims, 7 Drawing Sheets



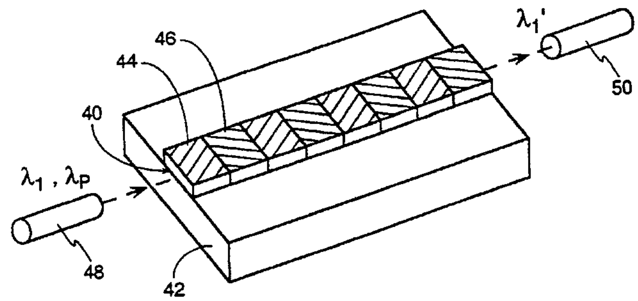
5,434,700 July 18, 1995

All-Optical Wavelength Converter

Inventor: Sung-Joo Yoo.
Assignee: Bell Communications Research, Inc.
Filed: Dec. 16, 1993.

Abstract—An all-optical wavelength converter comprising an optical waveguide of regions having differing nonlinear optical susceptibilities such that the regions are quasi-phase matched. An optical pumping signal is introduced in the waveguide, either input from the outside or is locally generated from a lasing active layer in the waveguide. Light having a first frequency is input to the waveguide and interacts with the optical pumping signal via the nonlinear susceptibility to create light having a second frequency. Each of the regions has a length of one coherence length. That is, the input light and the pump light fall out of phase by 180° in one coherence length. The modulation of the nonlinear susceptibility can be accomplished, by disordering the anisotropic material forming the nonlinear waveguide, by inverting the anisotropic crystal structure or by launching an acoustic wave onto the waveguide so that the compression of the material periodically varies the nonlinearities. Semiconductor quorum wells provide a high degree of nonlinearity, but lithium niobate and related materials can also be used.

15 Claims, 11 Drawing Sheets



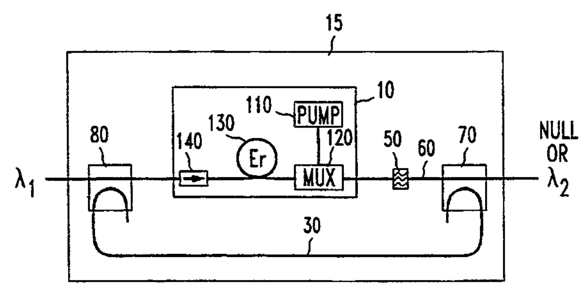
5,434,701 July 18, 1995

All-Optical Inverter

Inventors: Mohammad T. Fatehi, and Clinton R. Giles.
Assignee: AT&T Corp.
Filed: Dec. 17, 1993.

Abstract—An all-optical inverter device is achieved by employing an optical amplifier having a optical filter positioned in a feedback loop arranged so that an output signal of the optical amplifier having a first characteristic wavelength is inversely related to an input signal to the optical amplifier having a second characteristic wavelength.

30 Claims, 2 Drawing Sheets



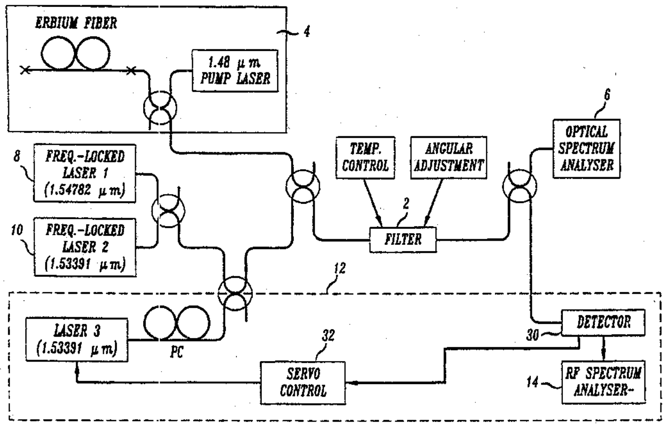
5,434,877 July 18, 1995

Synchronized Etalon Filters

Inventor: Yun C. Chung
Assignee: AT&T Corp.
Filed: Jan. 27, 1994.

Abstract—A method for synchronizing an etalon to a preselected set of optical frequencies includes the step of generating a transmission spectrum for an etalon having a characteristic free spectral range that is a function of its effective length. The optical frequencies for the transmission spectrum are provided by two optical reference frequencies, such as produced by a first and second frequency locked laser. The effective length of the etalon is set in relation to the optical reference frequencies.

23 Claims, 5 Drawing Sheets



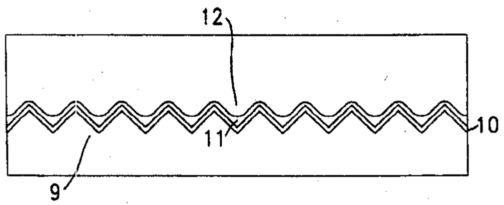
5,434,935 July 18, 1995

Integrated Optical Circuit Having One or More Waveguides Arranged on a Substrate

Inventor: Hans Kragl.
Assignee: Robert Bosch GmbH.
Filed: May 15, 1992.

Abstract—In an integrated optical circuit with waveguides applied on a substrate, a layer of high conductivity and a layer of lower index of refraction than the waveguides are arranged between the substrate and the waveguide cores. The circuit permits a favorable coupling of optoelectronic components arranged in the substrate with the waveguides, and it can be manufactured by well-known methods.

14 Claims, 3 Drawing Sheets



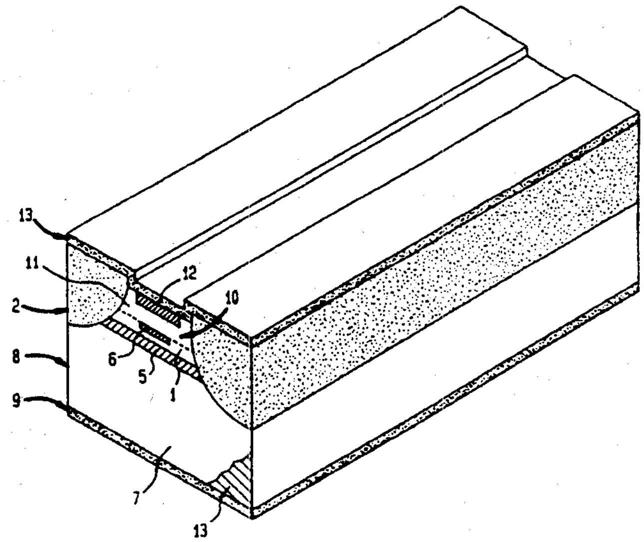
5,434,943 July 18, 1995

Nanosecond Fast Electrically Tunable Fabry–Perot Filter

Inventors: Andrew G. Dentai and Julian Stone.
Assignee: AT&T Corp.
Filed: Nov. 3, 1993.

Abstract—The present invention is directed at an electrically tunable filter for wavelength filtering of light. The filter comprises a substrate region, a waveguide region over the substrate, an upper region over the waveguide region, and current blocking regions adjacent to the waveguide region. The waveguide region comprises a semiconductor having a bandgap wavelength sufficiently different from the light for high peak transmission of the light. A waveguide rib layer may also be included in the waveguide region to channel the light through the filter. The current-blocking regions narrow the waveguide region to increase the current density. The present invention is also directed at a method of manufacturing the filter described above.

21 Claims, 3 Drawing Sheets



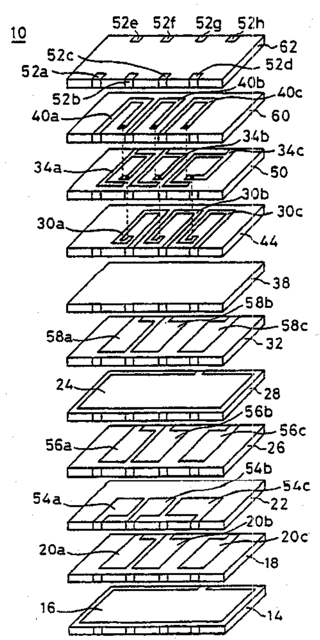
5,436,601 July 25, 1995

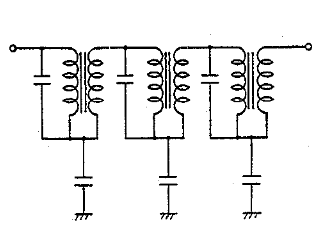
Laminated Delay Line

Inventors: Harufumi Mandai, Noboru Kato, and Akihiro Ochii.
Assignee: Muraka Manufacturing Co., Ltd.
Filed: Jan. 18, 1994.

Abstract—Earth electrodes are formed on two layers. A capacitor electrode is formed on a layer therebetween. A capacitor is formed by the capacitor electrode and the earth electrodes. Coil electrodes are formed, respectively, on a plural number of layers. The plural number of coil electrodes are connected through a through hole. An intermediate portion of the connected coil electrodes is connected to the earth electrodes to form a transformer. A delay line is formed by connecting the capacitor electrode and the coil electrodes via external electrodes.

9 Claims, 10 Drawing Sheets





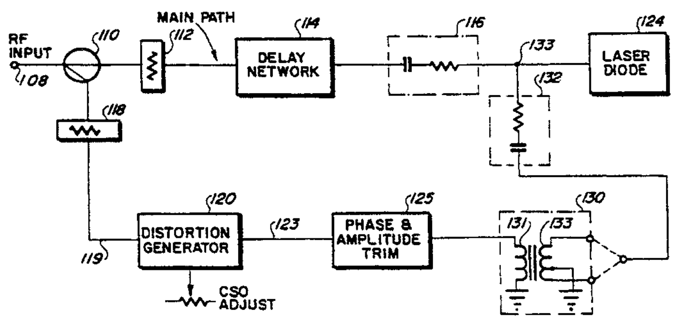
5,436,749 July 25, 1995

Method and Apparatus for Predistortion

Inventors: Rezin E. Pidgeon, Jr. and Heather H. Rand.
Assignee: Scientific-Atlanta, Inc.
Filed: Dec. 9, 1991.

Abstract—A predistortion circuit for an optical communications system includes a main path for an RF modulating signal and a predistortion path for a predistortion signal, which signals are combined to modulate a laser diode. The distortion path includes a distortion generator that generates a distortion signal that is substantially the same as the distortion generated by the modulation of the transmission system with the RF modulating signals. In one implementation, the distortion generator comprises a square law device that preferably is a field effect type device. The square law device operational characteristic closely mimics the major component of distortion in optical communications systems, composite second-order (CSO) distortion. In a second implementation, two square law devices are coupled in an antiphase arrangement to substantially cancel odd order distortion components from the distortion signal and to enhance even order distortion components, particularly CSO. Another implementation illustrates a dual output distortion generator that allows for the selection of either an in phase or inverted phase distortion signal to be able to compensate for sublinear and superlinear laser diode curves without a separate phase inverter. Still another implementation of the predistortion circuit provides for the independent amplitude adjustment of different bands of the CATV spectrum to permit compensation for different channel loadings, channel spacings, and channel amplitudes.

1 Claim, 5 Drawing Sheets



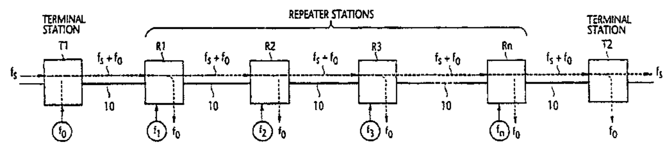
5,436,750 July 25, 1995

Optical Repeatered Transmission with Fault Locating Capability

Inventor: Toshibumi Kawano.
Assignee: NEC Corporation.
Filed: May 9, 1994.

Abstract—In an optical repeatered transmission system, an optical multiplex of a data signal and a supervisory signal is sent from a first terminal station. At an upstream repeater station, the optical signal is received and combined with excitation light energy supplied from a laser and amplified by an erbium-doped fiber with the excitation energy for transmission to a downstream repeater station. At the downstream repeater station, the optical signal is combined with excitation light energy supplied from a laser and amplified by an erbium-doped fiber with the excitation energy for transmission to a second terminal station. At the upstream repeater station, the supervisory signal is monitored. If it is determined to be lost, the excitation light energy of the station is modulated with a first fault-point indicating signal that is unique to the upstream repeater station and transmitted to the downstream repeater station instead of the optical multiplex signal. At the downstream repeater station, the supervisory signal and the first fault-point indicating signal are monitored. If both of these signals are determined to be lost, the excitation energy of the station is modulated with a second fault-point indicating signal that is unique to the downstream repeater station and transmitted to the second terminal station. If the supervisory signal and any of the fault-point indicating signals are not detected, an alarm is given indicating that a failure has occurred between the second terminal station and the downstream repeater station. If one of the fault-point indicating signals is detected, an alarm will be given indicating that a failure has occurred at a point identified by the detected fault-point indicating signal.

19 Claims, 4 Drawing Sheets



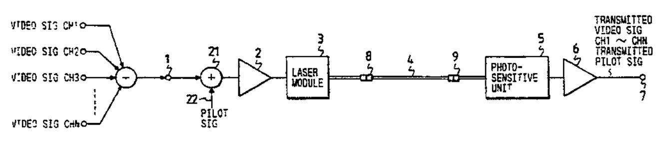
5,436,751 July 25, 1995

Analog Optical Transmission System and Optical Fiber Amplifier

Inventors: Jun Ohya and Toshihiro Fujita.
Assignee: Matsushita Electric Industrial Co.
Filed: Nov. 24, 1992.

Abstract—In an optical transmission system for transmitting a video signal by transmitting a laser light modulated with a video signal through an optical fiber, and for receiving and photoelectrically converting the received laser light, a pilot signal is added to the video signal by a summing amplifier. A frequency of the pilot signal is smaller than a bandwidth of the laser light, so that peak level of interference noise developed by multireflection at both ends of the optical fiber is decreased considerably. Moreover, in an optical transmission system for transmitting and receiving a video signal by modulating a laser light with the video signal through an optical fiber and for receiving and photoelectrically converting the received laser light, a polarizing control element is provided in the optical fiber by coiling the optical fiber, so that a signal laser light transmitted without multireflection has different retardation from a signal laser light with multireflection so that interference noise is reduced. Similarly, an optical fiber amplifier also employs the polarizing control element to reduce the adverse effect caused by the interference noise.

7 Claims, 4 Drawing Sheets



5,436,757 July 25, 1995

Optical Wavelength Converting Apparatus

Inventors: Yoji Okazaki, Hiroaki Hyuga, and Akinori Harada.
Assignee: Fuji Photo Film Co., Ltd.
Filed: Apr. 1, 1993.

Abstract—An optical wavelength converting apparatus comprises a fundamental wave source, which produces a laser beam serving as a fundamental wave, and an optical wavelength-converting device, which is provided with an optical waveguide constituted of a nonlinear optical material. The optical wavelength converting device converts a wavelength of the laser beam impinging upon and guided through the optical waveguide. The optical waveguide is provided with a plurality of periodic domain-inverted structures, which affect phase matching between the laser beam and wavelength-converted waves. Reflection of the fundamental wave or wavelength-converted waves from end faces of the optical wavelength converting device is thereby minimized, and a plurality of wavelength-converted waves having high intensities are obtained in a state combined with one another.

14 Claims, 4 Drawing Sheets