capella
Intelligent Subsystems

# FUJITSU NETWORK COMMUNICATIONS, INC., CORIANT OPERATIONS, INC., CORIANT (USA) INC., and CIENA CORPORATION

v.

# CAPELLA PHOTONICS INC.

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IPR2015-00726 (Patent No. RE42,368)[1]
IPR2015-00727 (Patent No. RE42,678)[2]

May 24, 2016

[1] Case IPR2015-01958 has been joined to this proceeding.

[2] Case IPR2015-01961 has been joined to this proceeding.

# Instituted Grounds

| Patent | | Claims | References |
|---|---|---|---|
| ’368 | 2 | 1, 2, 5, 6, 9-12, 15-21 | Bouevitch and Carr |
| | 3 | 1-4, 17, 22 | Bouevitch and Sparks |
| ’678 | 5 | 1, 9, 10, 13, 17, 19, 44, 53, 61, 64, 65 | Bouevitch and Carr |
| | 7 | 1-4, 19-23, 27, 29, 44-46, 61-63 | Bouevitch and Sparks |

# Outline

I. **Capella Invented a New Class of Optical Switches**

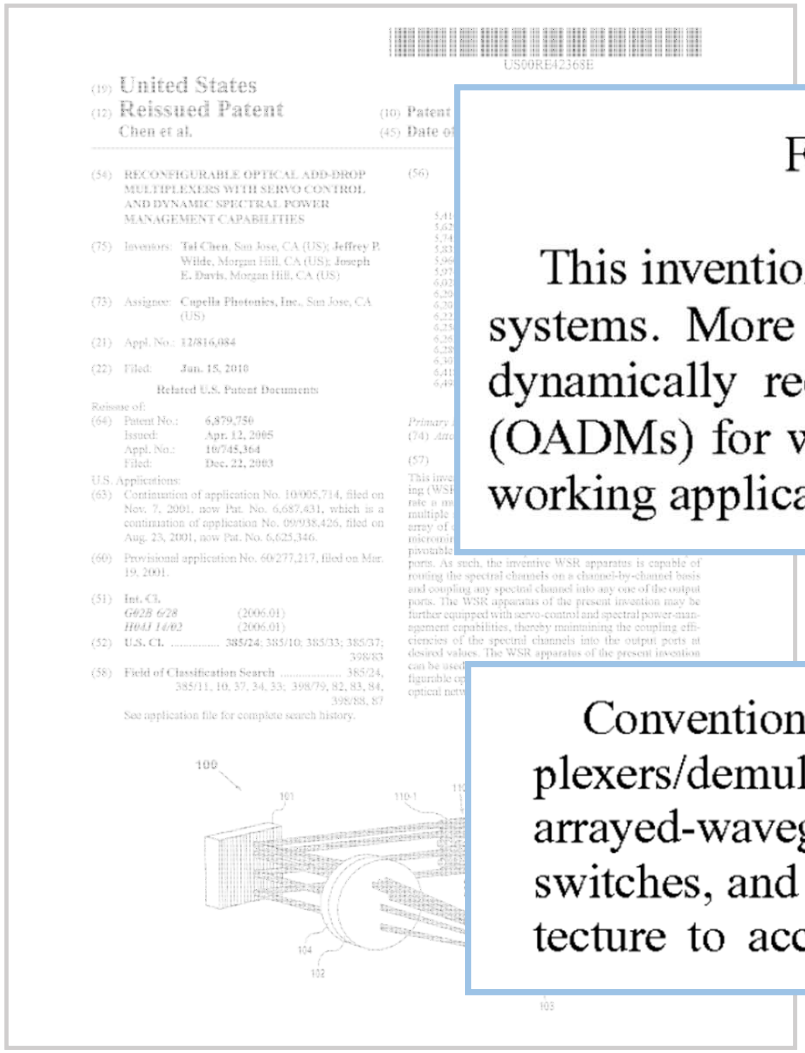
II. **No Motivation to Combine**

- Hindsight
- Changes the Principle of Operation

III. **Ports**

- Collimator Ports vs. circulators
- Disavowal / Disclaimer
- The ’217 Provisional

# Capella Invented a New Class of Optical Switches



US00RE42368E

(19) United States
(12) Reissued Patent
Chen et al.

(10) Patent
(45) Date of

(54) RECONFIGURABLE OPTICAL ADD-DROP MULTIPLEXERS WITH SERVO CONTROL AND DYNAMIC SPECTRAL POWER MANAGEMENT CAPABILITIES

(75) Inventors: Tai Chen, San Jose, CA (US); Jeffrey P. Wilde, Morgan Hill, CA (US); Joseph E. Davis, Morgan Hill, CA (US)

(73) Assignee: Capella Photonics, Inc., San Jose, CA (US)

(21) Appl. No.: 12/816,084

(22) Filed: Jun. 15, 2010

Related U.S. Patent Documents

Reissue of:
(64) Patent No.: 6,879,750
Issued: Apr. 12, 2005
Appl. No.: 10/745,364
Filed: Dec. 22, 2003

U.S. Applications:
(63) Continuation of application No. 10/005,714, filed on Nov. 7, 2001, now Pat. No. 6,687,431, which is a continuation of application No. 09/938,426, filed on Aug. 23, 2001, now Pat. No. 6,625,346.

(60) Provisional application No. 60/277,217, filed on Mar. 19, 2001.

(51) Int. Cl.
*G02B 6/28* (2006.01)
*H04J 14/02* (2006.01)

(52) U.S. Cl. ..... 385/24; 385/10; 385/33; 385/37; 398/83

(58) Field of Classification Search ..... 385/24, 385/11, 10, 37, 34, 33; 398/79, 82, 83, 84, 398/88, 87

See application file for complete search history.

(56)

(57)

> FIELD OF THE INVENTION
>
> This invention relates generally to optical communication systems. More specifically, it relates to a novel class of dynamically reconfigurable optical add-drop multiplexers (OADMs) for wavelength division multiplexed optical networking applications.

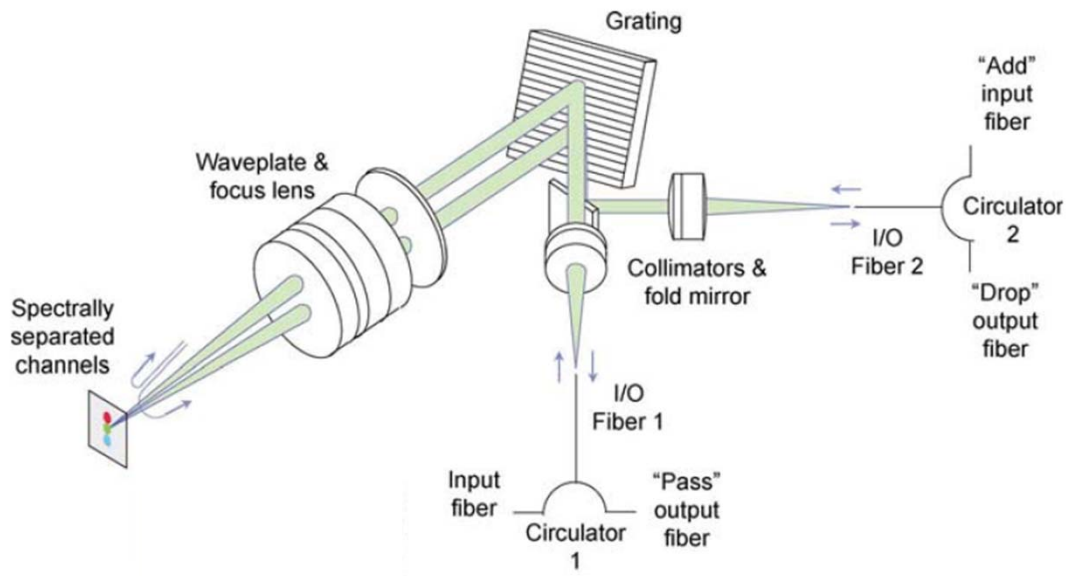
Ex. 1001, 1:22-28; '726 POR, pp. 4, 5; '727 POR, p. 5

> Conventional OADMs in the art typically employ multiplexers/demultiplexers (e.g, waveguide grating routers or arrayed-waveguide gratings), tunable filters, optical switches, and optical circulators in a parallel or serial architecture to accomplish the add and drop functions.

Ex. 1001, 1:59-63; '726 POR, p. 39; '727 POR, p. 39

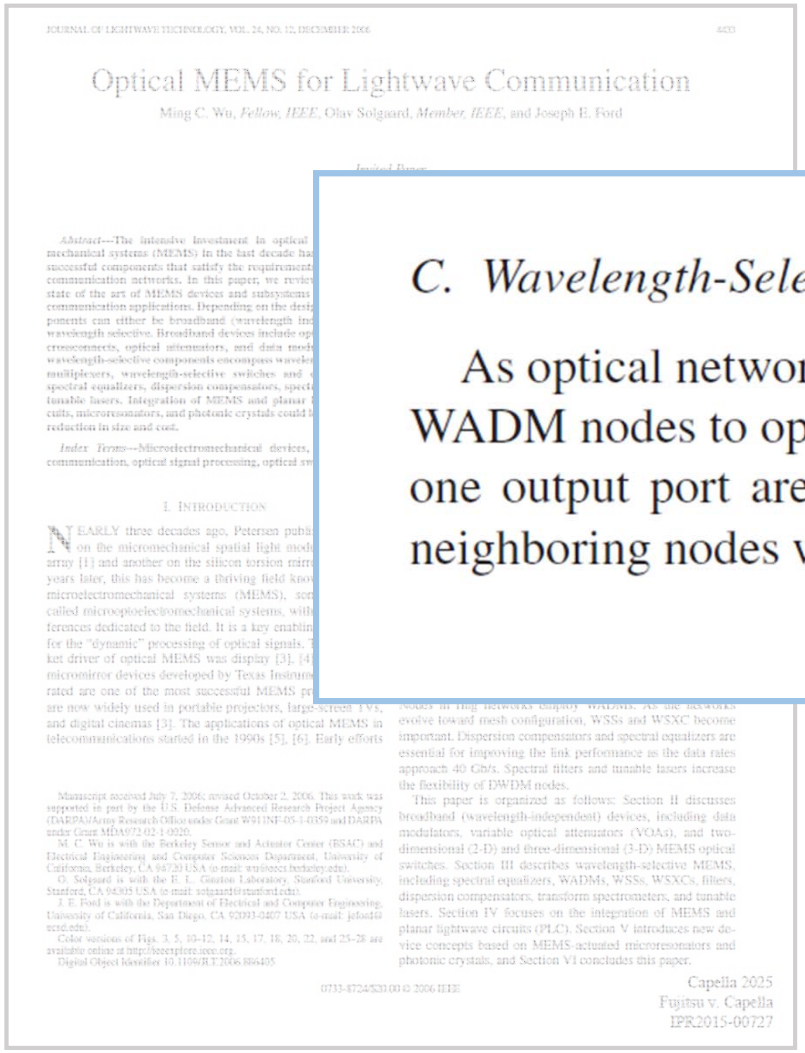
# Wavelength Add/Drop Multiplexers

## Dr. Ford's 2006 Paper




The most basic wavelength switch is the dynamically reconfigurable WADM, which is essentially a $1 \times 2$ or $2 \times 2$ optical switch operating independently on each wavelength channel.

# Wavelength-Selective Switches



Optical MEMS for Lightwave Communication

Ming C. Wu, *Fellow, IEEE*, Olav Solgaard, *Member, IEEE*, and Joseph E. Ford

Capella 2025
Fujitsu v. Capella
IPR2015-00727

**Dr. Ford's 2006 Paper**

*C. Wavelength-Selective Switches (WSSs)*

As optical networks evolve from a simple ring topology with WADM nodes to optical mesh networks, WSSs with more than one output port are needed to link the node to three or four neighboring nodes with each link carrying two-way traffic.

Ex. 2025, p. 4439; '726 POR, pp. 32-34; '727 POR, pp. 32-34

# Wavelength-Selective Switches

## Key Features of a WSS

(1) At Least Three Collimator Ports

(2) Diffraction Grating

(3) Switch ***Any*** Channel to ***Any*** Output Port

*'726 POR, pp. 13-14; '727 POR, pp. 13-15*

## Ford's 2006 Paper

(1) "*N* is larger than 2"

(2) Diffraction Grating

(3) "A large continuous scan angle is required to direct the output beam to any of the *N* output fiber collimators."

Ex. 2025, p. 4439; '726 POR, p. 14; '727 POR, p. 14

# The ’368 Patent Claims a WSS

## Key Features of a WSS

(1) At Least Three Collimator Ports

(2) Diffraction Grating

(3) Switch ***Any*** Channel to ***Any*** Output Port

*’726 POR, pp. 13-14; ’727 POR, pp. 13-15*

## Claim 1 of the ’368 Patent

**1**. An optical add-drop apparatus comprising

an input port for an input multi-wavelength optical signal having first spectral channels;

one or more other ports for second spectral channels; an output port for an output multi-wavelength optical signal;

a wavelength-selective device for spatially separating said spectral channels; **[**and**]**

a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable *in two dimensions* to reflect its corresponding spectral channel to a selected one of said ports *and to control the power of the spectral channel reflected to said selected port.*

# The ’678 Patent Claims a WSS

## Key Features of a WSS

(1) At Least Three Collimator Ports

(2) Diffraction Grating

(3) Switch ***Any*** Channel to ***Any*** Output Port

*’726 POR, pp. 13-14; ’727 POR, pp. 13-14*

## Claim 1 of the ’678 Patent

1. A wavelength-separating-routing apparatus, comprising:

a) multiple fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports;

b) a wavelength-separator, for separating said multi-wavelength optical signal from said input port into multiple spectral channels;

c) a beam-focuser, for focusing said spectral channels into corresponding spectral spots; and

d) a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being **pivotal about two axes and being** individually and continuously controllable to reflect **[[**said**]] corresponding received** spectral channels into **any** selected ones of said output ports **and to control the power of said received spectral channels coupled into said output ports**.

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- The '217 Provisional

# Hindsight

## Legal Requirement

Obviousness rationale is through hindsight if: (1) knowledge goes beyond the skill of the art at the time of the invention; and (2) knowledge is gleaned only from the applicant's disclosure

*In re McLaughlin*, 443 F.2d 1392, 1395 (CCPA 1971)
*'726* POR, p. 31; '727 POR, p. 31

## Evidence Shows

(1) Dr. Ford Incorrectly Assumes WSSs Existed at the time of the invention

(2) Fujitsu's rationale comes from the Capella patent

'726 POR, pp. 31, 34; '727 POR, pp. 31, 34

# Hindsight: Dr. Ford Assumes WSSs Existed

*Inter Partes Review of USPN RE42,368*
*Declaration of Joseph E. Ford, Ph.D. (Exhibit 1037)*

UNITED STATES PATENT AND TRADEMARK OFFICE

**Dr. Ford's Declaration**



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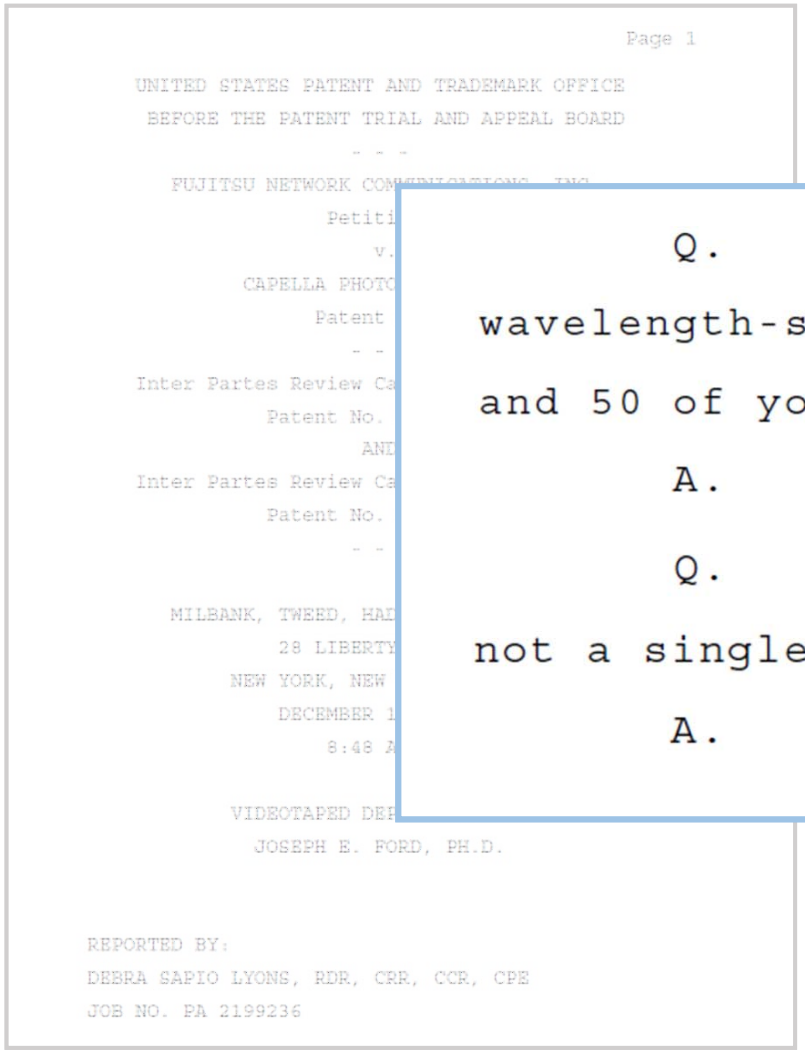
U.S. Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

Ford Dec., p. i; '726 POR, p. 31; '727 POR, p. 31

# Hindsight: Dr. Ford Assumes WSSs Existed



Page 1

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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FUJITSU NETWORK COMMUNICATIONS, INC.

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JOSEPH E. FORD, PH.D.

REPORTED BY:

DEBRA SAPIO LYONS, RDR, CRR, CCR, CPE

JOB NO. PA 2199236

**Dr. Ford**

Q. And you talk about wavelength-selective switches in Paragraph 49 and 50 of your Declaration; correct?

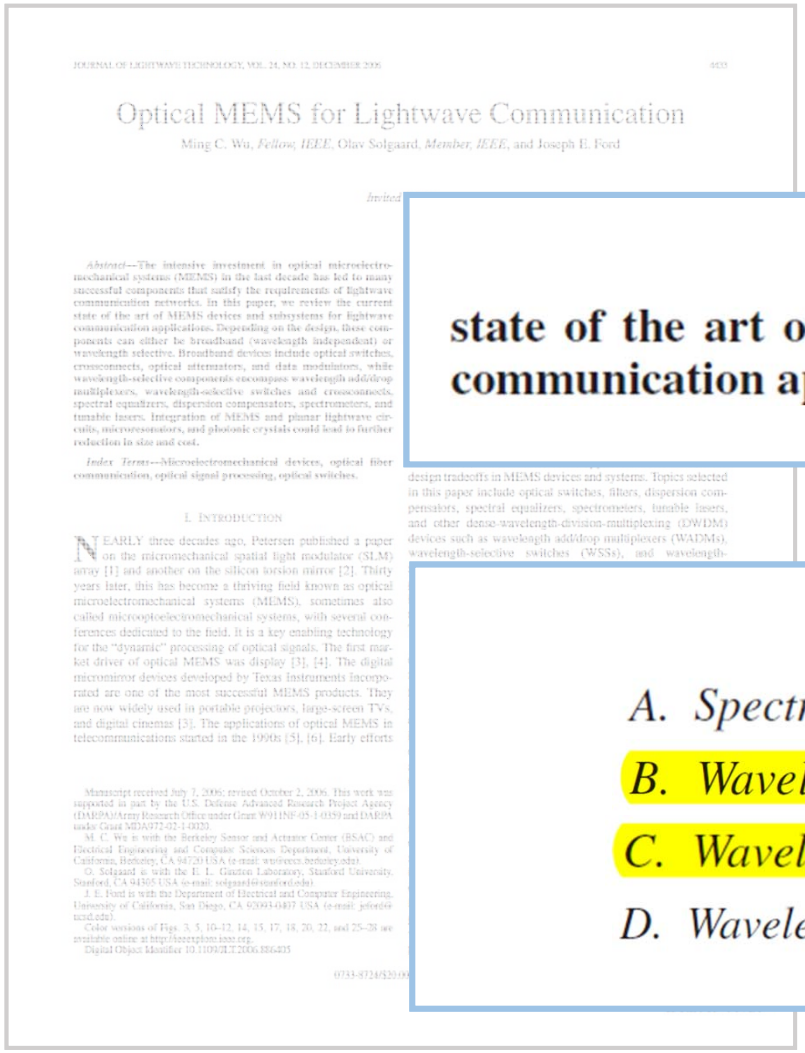
A. Yes.

Q. In Paragraphs 49 and 50 there's not a single citation.

A. That's true.

Ford Depo. Tr., 203:15-18, 204:3-5; '726 POR, p. 32; '727 POR, p. 32

# Hindsight: Dr. Ford Assumes WSSs Existed



Optical MEMS for Lightwave Communication

Ming C. Wu, *Fellow, IEEE*, Olav Solgaard, *Member, IEEE*, and Joseph E. Ford

*Abstract*—The intensive investment in optical microelectromechanical systems (MEMS) in the last decade has led to many successful components that satisfy the requirements of lightwave communication networks. In this paper, we review the current state of the art of MEMS devices and subsystems for lightwave communication applications. Depending on the design, these components can either be broadband (wavelength independent) or wavelength selective. Broadband devices include optical switches, crossconnects, optical attenuators, and data modulators, while wavelength-selective components encompass wavelength add/drop multiplexers, wavelength-selective switches and crossconnects, spectral equalizers, dispersion compensators, spectrometers, and tunable lasers. Integration of MEMS and planar lightwave circuits, microresonators, and photonic crystals could lead to further reduction in size and cost.

*Index Terms*—Microelectromechanical devices, optical fiber communication, optical signal processing, optical switches.

I. INTRODUCTION

NEARLY three decades ago, Petersen published a paper on the micromechanical spatial light modulator (SLM) array [1] and another on the silicon torsion mirror [2]. Thirty years later, this has become a thriving field known as optical microelectromechanical systems (MEMS), sometimes also called microoptoelectromechanical systems, with several conferences dedicated to the field. It is a key enabling technology for the "dynamic" processing of optical signals. The first market driver of optical MEMS was display [3], [4]. The digital micromirror devices developed by Texas Instruments Incorporated are one of the most successful MEMS products. They are now widely used in portable projectors, large-screen TVs, and digital cinemas [3]. The applications of optical MEMS in telecommunications started in the 1990s [5], [6]. Early efforts

design tradeoffs in MEMS devices and systems. Topics selected in this paper include optical switches, filters, dispersion compensators, spectral equalizers, spectrometers, tunable lasers, and other dense-wavelength-division-multiplexing (DWDM) devices such as wavelength add/drop multiplexers (WADMs), wavelength-selective switches (WSSs), and wavelength-

**Dr. Ford's 2006 Paper**

**In this paper, we review the current state of the art of MEMS devices and subsystems for lightwave communication applications.**

Ex. 2025, 4433; '726 POR, pp. 32-34; '727 POR, pp. 32-34

III. WAVELENGTH-SELECTIVE MEMS

A. *Spectral Equalizers*

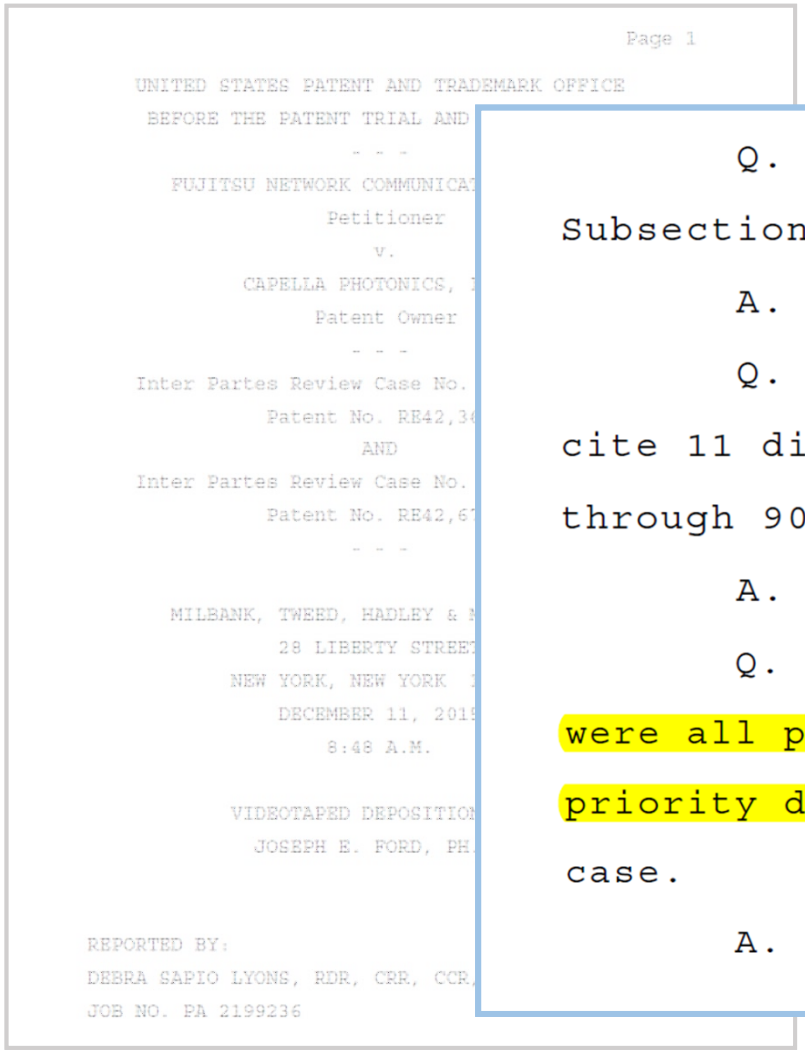
B. *Wavelength Add/Drop Multiplexers*

C. *Wavelength-Selective Switches (WSSs)*

D. *Wavelength-Selective Crossconnects (WSXC)*

'726 Ex. 2025, 4437-40; '726 POR, pp. 32-34; '727 POR, pp. 32-34

# Hindsight: Dr. Ford Assumes WSSs Existed


Page 1

UNITED STATES PATENT AND TRADEMARK OFFICE

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- - -

FUJITSU NETWORK COMMUNICA

Petitioner

v.

CAPELLA PHOTONICS,

Patent Owner

- - -

Inter Partes Review Case No.

Patent No. RE42,3

AND

Inter Partes Review Case No.

Patent No. RE42,6

- - -

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JOSEPH E. FORD, PH

REPORTED BY:

DEBRA SAPIO LYONS, RDR, CRR, CC

JOB NO. PA 2199236

**Dr. Ford's 2006 Paper**

Q. So there's like three columns of Subsection C; right?

A. Right.

Q. And in those three columns you cite 11 different references, References 80 through 90; correct?

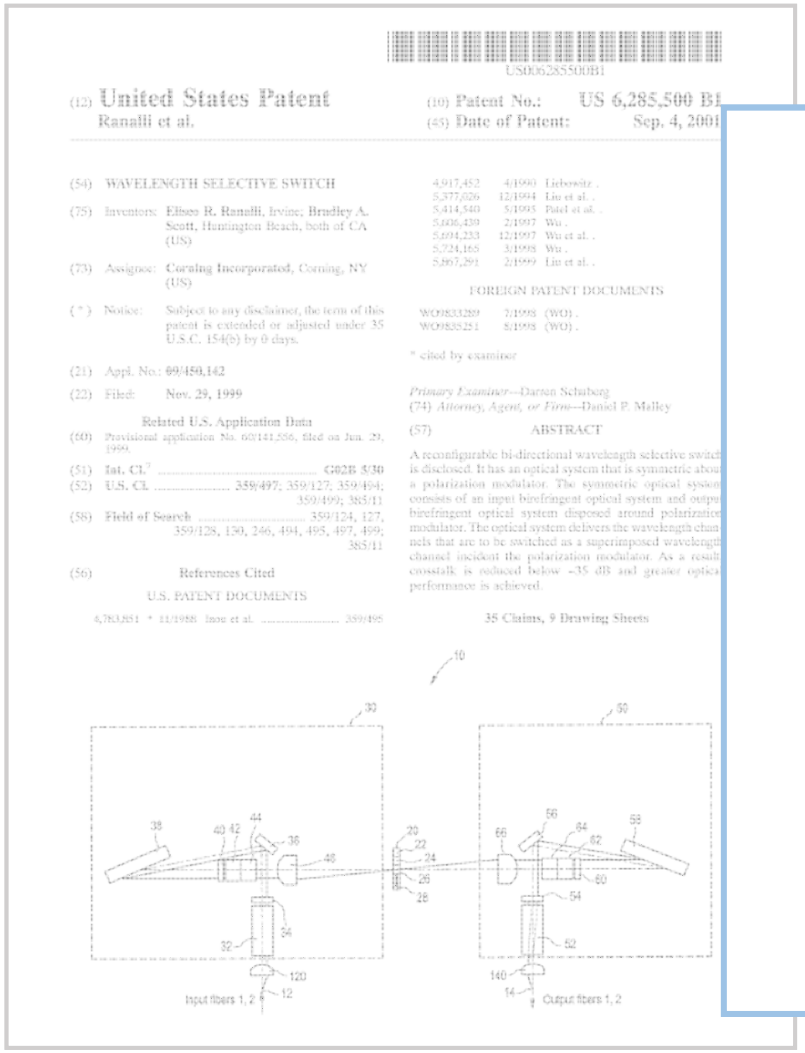
A. Let's see. Yes.

Q. So those References 80 through 90 were all published after the March 2001 priority date of the patents at issue in this case.

A. That's true.

Ford Depo. Tr., 202:13-19, 207:11-23;
'726 POR, p. 34; '727 POR, p. 34

# Hindsight: Dr. Ford Assumes WSSs Existed



US006285500B1

(12) **United States Patent**
Ranalli et al.

(10) Patent No.: US 6,285,500 B1
(45) Date of Patent: Sep. 4, 2001

(54) WAVELENGTH SELECTIVE SWITCH

(75) Inventors: Eliseo R. Ranalli, Irvine; Bradley A. Scott, Huntington Beach, both of CA (US)

(73) Assignee: Corning Incorporated, Corning, NY (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 09/450,142

(22) Filed: Nov. 29, 1999

Related U.S. Application Data

(60) Provisional application No. 60/141,556, filed on Jun. 29, 1999.

(51) Int. Cl.[7] ..... G02B 5/30

(52) U.S. Cl. ..... 359/497; 359/127; 359/494; 359/499; 385/11

(58) Field of Search ..... 359/124, 127, 359/128, 130, 246, 494, 495, 497, 499; 385/11

(56) References Cited

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4,783,851 * 11/1988 Inoe et al. ..... 359/495

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5,694,233 12/1997 Wu et al. .
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5,867,291 2/1999 Liu et al. .

FOREIGN PATENT DOCUMENTS

WO9833289 7/1998 (WO) .
WO9835251 8/1998 (WO) .

* cited by examiner

*Primary Examiner*—Darren Schuberg
(74) *Attorney, Agent, or Firm*—Daniel P. Malley

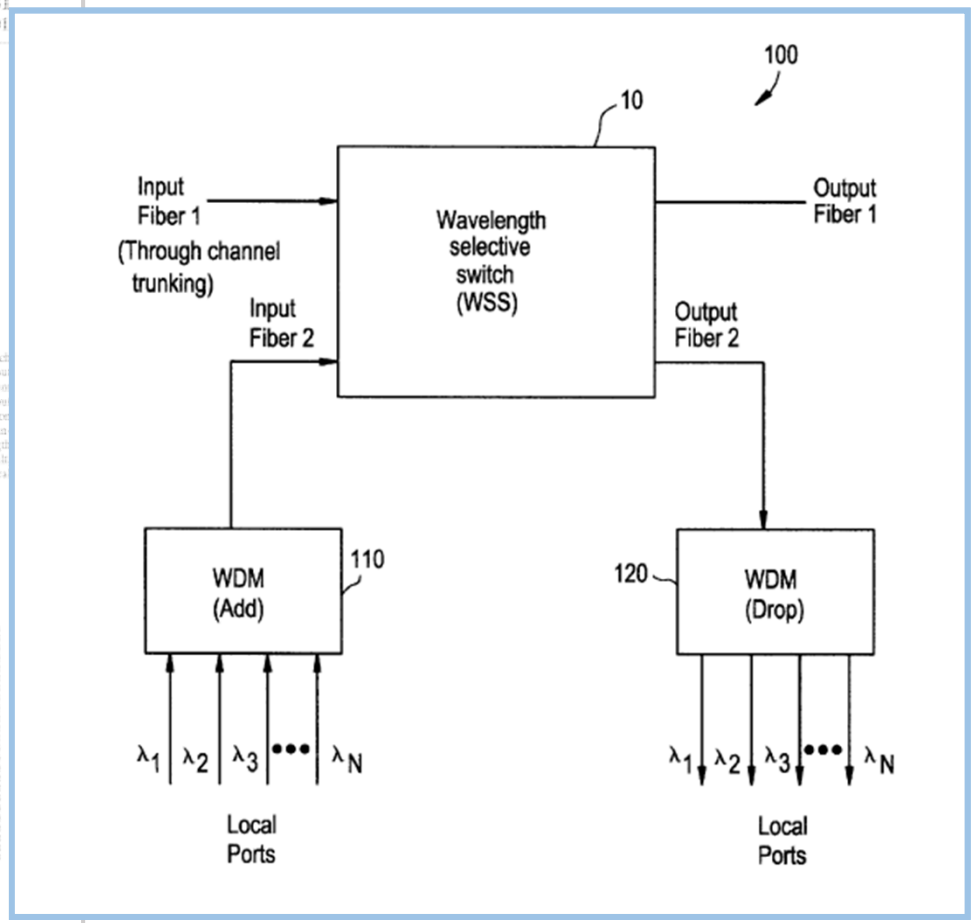
(57) ABSTRACT

A reconfigurable bi-directional wavelength selective switch is disclosed. It has an optical system that is symmetric about a polarization modulator. The symmetric optical system consists of an input birefringent optical system and output birefringent optical system disposed around polarization modulator. The optical system delivers the wavelength channels that are to be switched as a superimposed wavelength channel incident the polarization modulator. As a result crosstalk is reduced below −35 dB and greater optical performance is achieved.

35 Claims, 9 Drawing Sheets

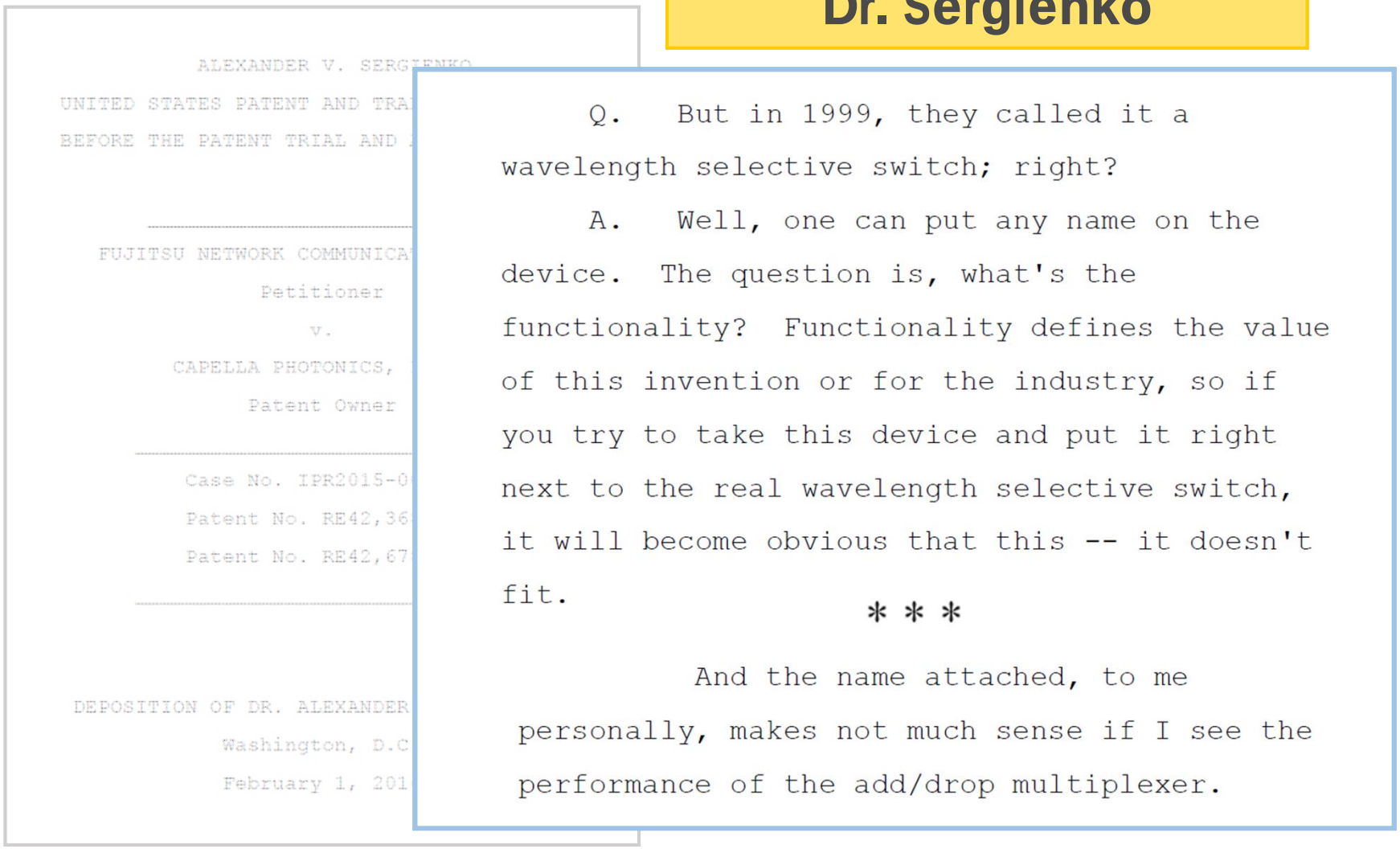


## Ranalli Reference




Ex. 1043, FIG. 10

# Hindsight: Dr. Ford Assumes WSSs Existed




**Dr. Sergienko**

Q. But in 1999, they called it a wavelength selective switch; right?

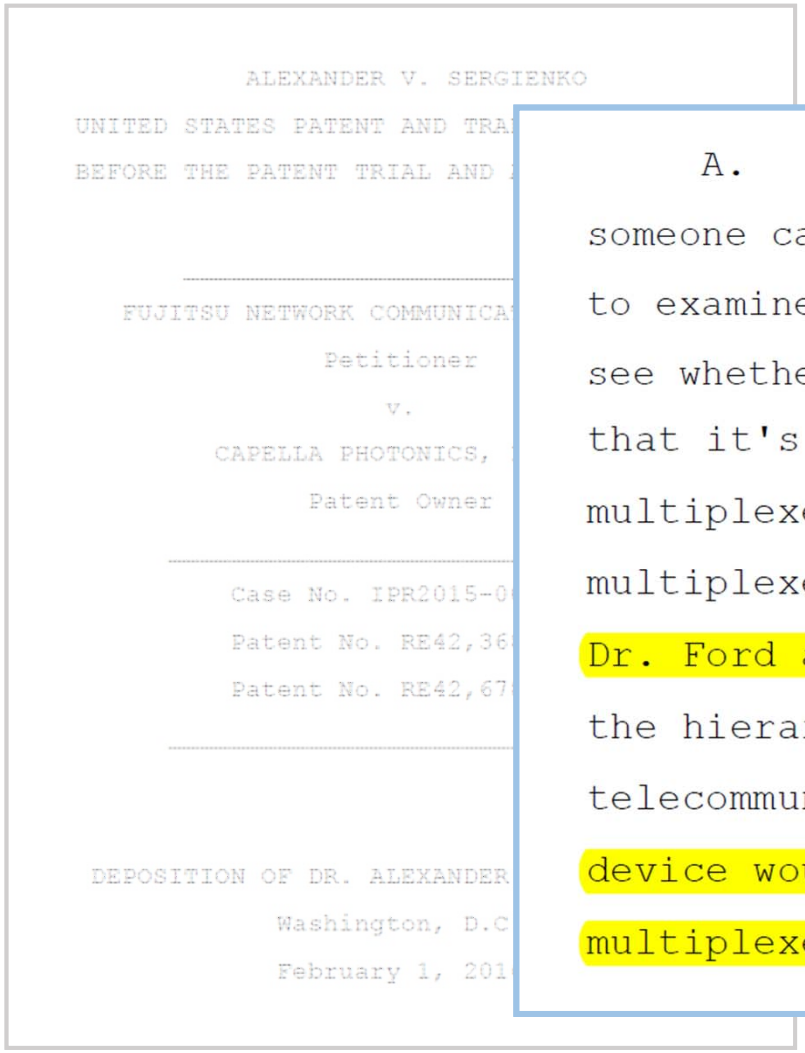
A. Well, one can put any name on the device. The question is, what's the functionality? Functionality defines the value of this invention or for the industry, so if you try to take this device and put it right next to the real wavelength selective switch, it will become obvious that this -- it doesn't fit.

* * *

And the name attached, to me personally, makes not much sense if I see the performance of the add/drop multiplexer.

Ex. 1040, 44:13-45:10

# Hindsight: Dr. Ford Assumes WSSs Existed


ALEXANDER V. SERGIENKO

UNITED STATES PATENT AND TRA

BEFORE THE PATENT TRIAL AND

FUJITSU NETWORK COMMUNICA

Petitioner

v.

CAPELLA PHOTONICS,

Patent Owner

Case No. IPR2015-0

Patent No. RE42,36

Patent No. RE42,67

DEPOSITION OF DR. ALEXANDER

Washington, D.C

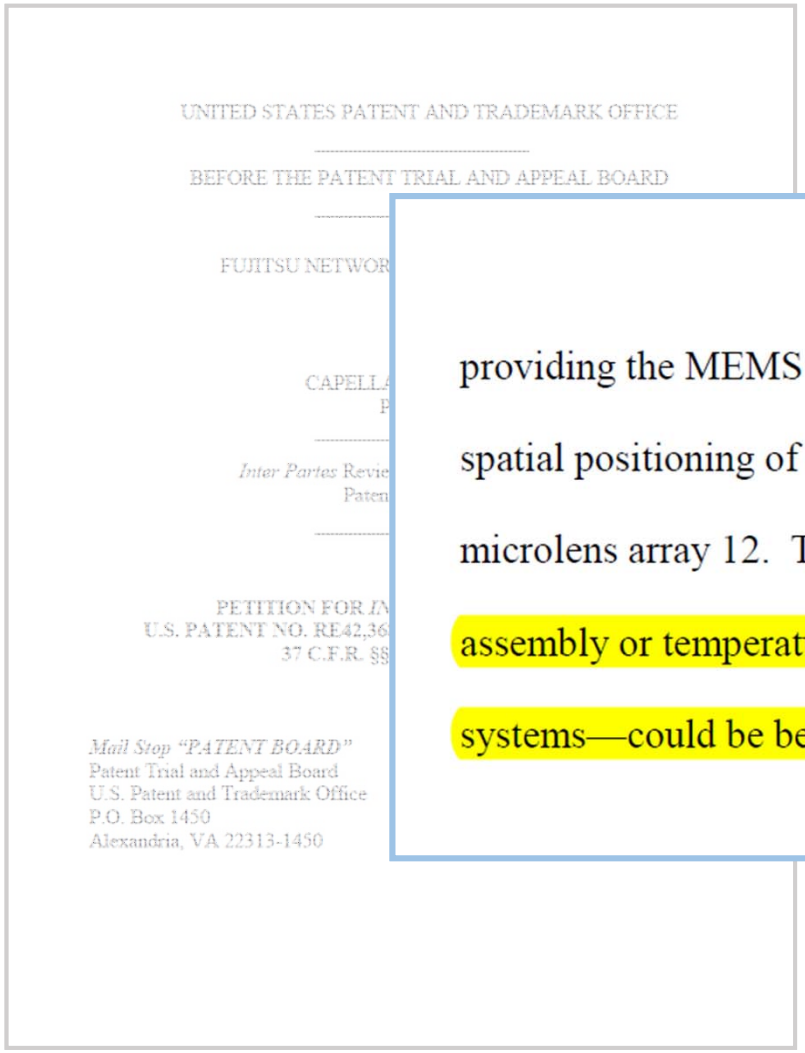
February 1, 201

**Dr. Sergienko**

A. This is not yes. I'm saying that someone can title the -- the patent. One has to examine the performance of this device and see whether it performs the functions of that it's not the wavelengths add/drop multiplexer. It is not a wavelength add/drop multiplexer following the definitions of Dr. Ford and his colleagues, who established the hierarchy of wavelength devices in telecommunication networks. I think this device would fall into the category of add/drop multiplexers.

Ex. 1040, 38:21-39:9

# Hindsight: Fujitsu's Rationale Comes from the Capella Patent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U.S. PATENT NO. RE42,36
37 C.F.R. §§

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P.O. Box 1450
Alexandria, VA 22313-1450

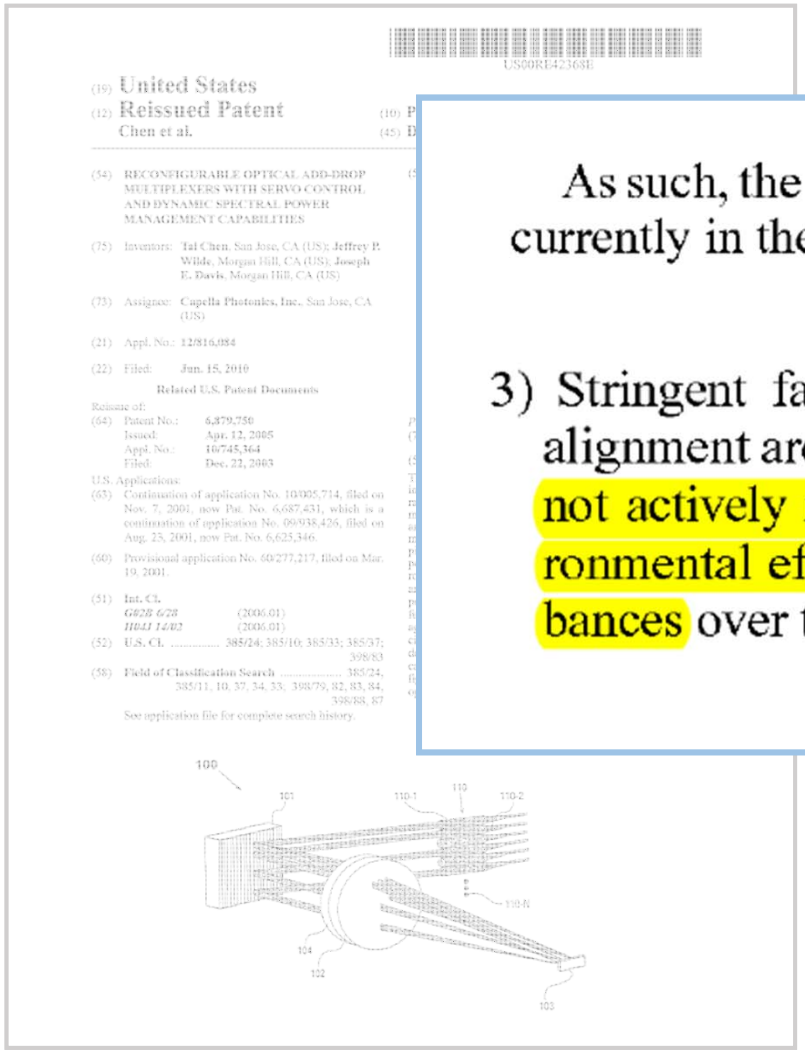
**Fujitsu**

Namely,

providing the MEMS mirrors of Bouevitch with two-axis tilt capability enables the spatial positioning of returning beams in both transverse directions at the face of microlens array 12. Thus, errors in system alignment arising, e.g., from imperfect assembly or temperature changes—well known problems in free space optical systems—could be better compensated.

'726 Petition, p. 26; '727 Petition, pp. 33, 45;
'727 Ford Dec., ¶¶ 155, 166

# Hindsight: Fujitsu's Rationale Comes from the Capella Patent



(19) United States
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(73) Assignee: Capella Photonics, Inc., San Jose, CA (US)

(21) Appl. No.: 12/816,084

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(60) Provisional application No. 60/277,217, filed on Mar. 19, 2001.

(51) Int. Cl.
*G02B 6/28* (2006.01)
*H04J 14/02* (2006.01)

(52) U.S. Cl. ..... 385/24; 385/10; 385/33; 385/37; 398/83

(58) Field of Classification Search ..... 385/24, 385/11, 10, 37, 34, 33; 398/79, 82, 83, 84, 398/88, 87

See application file for complete search history.

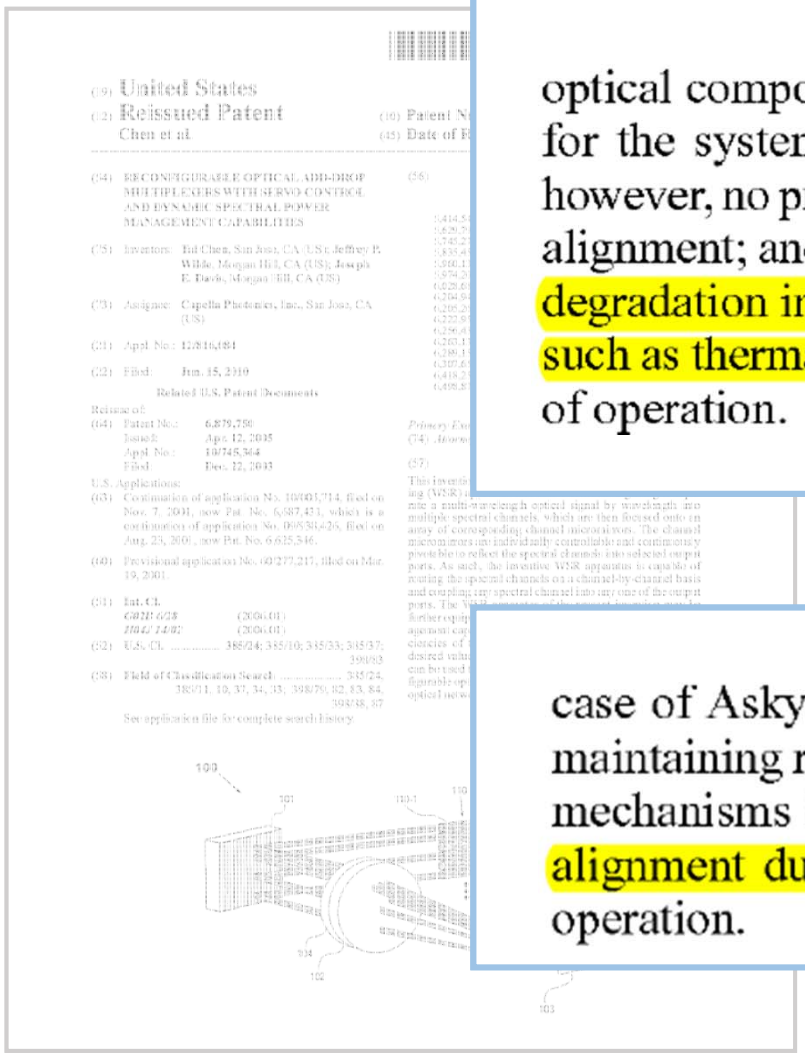


As such, the prevailing drawbacks suffered by the OADMs currently in the art are summarized as follows:

3) Stringent fabrication tolerance and painstaking optical alignment are required. Moreover, the optical alignment is not actively maintained, rendering it susceptible to environmental effects such as thermal and mechanical disturbances over the course of operation.

Ex. 1001, 3:20-21, 3:27-31; '726 POR, p. 35; '727 POR, p. 35

# Hindsight: Fujitsu's Rationale Comes from the Capella Patent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(54) RECONFIGURABLE OPTICAL ADD-DROP MULTIPLEXERS WITH SERVO CONTROL AND DYNAMIC SPECTRAL POWER MANAGEMENT CAPABILITIES

(75) Inventors: Ed Chen, San Jose, CA (US); Jeffrey P. Wilde, Morgan Hill, CA (US); Joseph E. Davis, Morgan Hill, CA (US)

(73) Assignee: Capella Photonics, Inc., San Jose, CA (US)

(21) Appl. No.: 12/816,681

(22) Filed: Jun. 15, 2010

Related U.S. Patent Documents

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(51) Int. Cl.
G02B 6/28 (2006.01)
H04J 14/02 (2006.01)

(52) U.S. Cl. ..... 385/24; 385/10; 385/33; 385/37; 398/83

(58) Field of Classification Search ..... 385/24, 385/11, 10, 37, 34, 33; 398/79, 82, 83, 84, 398/88, 87

See application file for complete search history.

(56)

(57)




Third, the constituent optical components must be in a precise alignment, in order for the system to achieve its intended purpose. There are, however, no provisions provided for maintaining the requisite alignment; and no mechanisms implemented for overcoming degradation in the alignment owing to environmental effects such as thermal and mechanical disturbances over the course of operation.

Ex. 1001, 2:57-64; '726 POR, p. 35; '727 POR, p. 35

Moreover, as in the case of Askyuk et al., there are no provisions provided for maintaining requisite optical alignment in the system, and no mechanisms implemented for combating degradation in the alignment due to environmental effects over the course of operation.

Ex. 1001, 3:14-19; '726 POR, p. 35; '727 POR, p. 35

# Outline

I. Capella Invented a New Class of Optical Switches

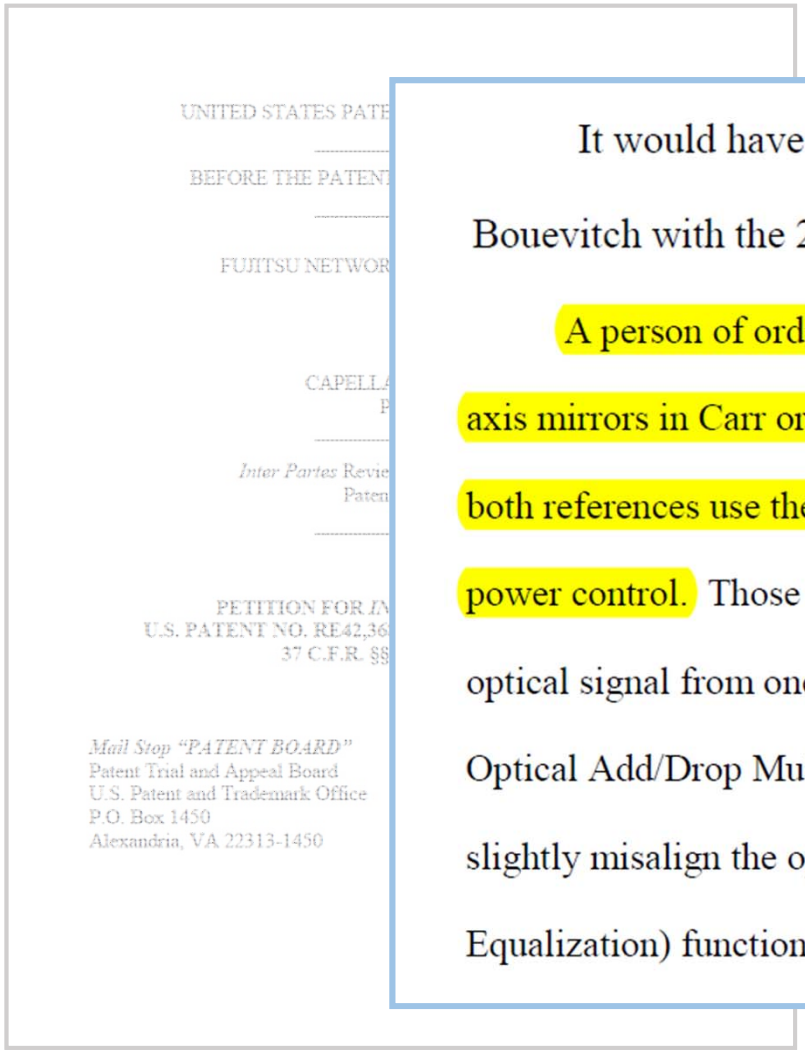
II. **No Motivation to Combine**

- Hindsight
- Changes the Principle of Operation

III. Ports

- Collimator Ports vs. circulators
- Disavowal / Disclaimer
- The '217 Provisional

# Petitioners' Fundamental Assumption


UNITED STATES PATE

BEFORE THE PATENT

FUJITSU NETWOR

CAPELLA

*Inter Partes* Revie
Paten

PETITION FOR *IN*
U.S. PATENT NO. RE42,36
37 C.F.R. §§

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Alexandria, VA 22313-1450

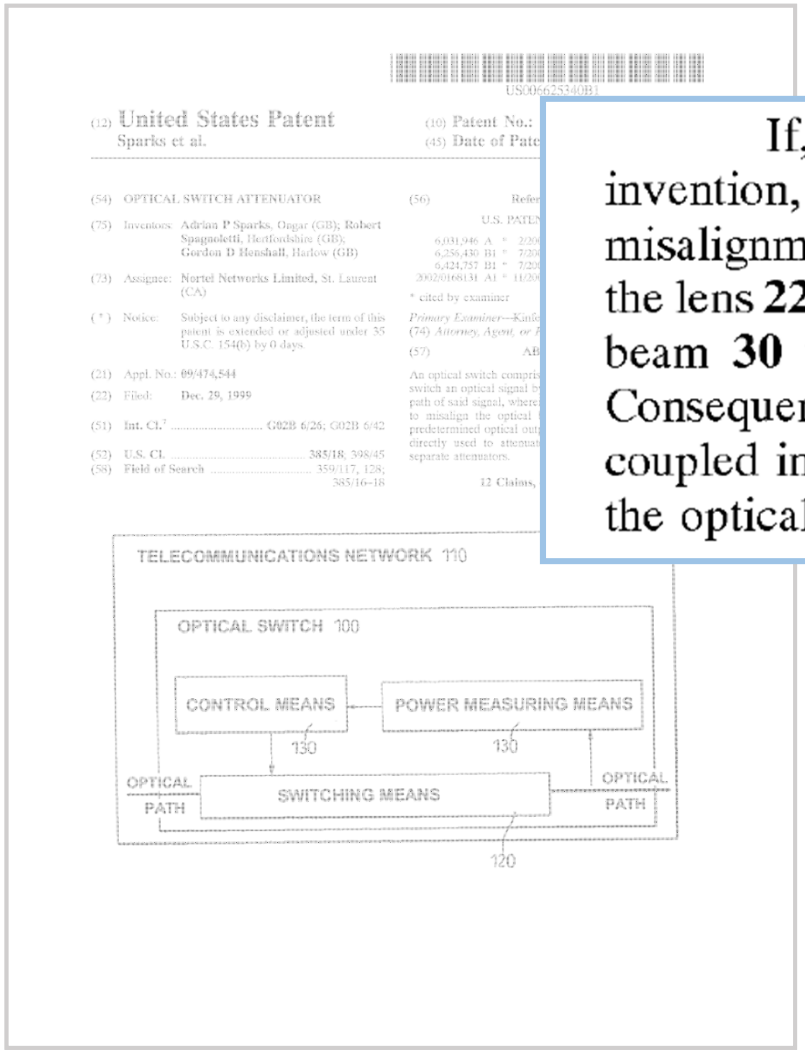
**Fujitsu**

It would have been obvious to combine the teachings of Figure 11 of Bouevitch with the 2-axis MEMS mirrors of either Carr or Sparks.

A person of ordinary skill in the art would have been motivated use the 2-axis mirrors in Carr or Sparks instead of Bouevitch's 1-axis mirrors in part because both references use the same operating principles for both optical switching and power control. Those principles are (1) tilting mirrors at large angles to switch an optical signal from one port to another for switching functions in a Configurable Optical Add/Drop Multiplexer (COADM), and (2) tilting at smaller angles to slightly misalign the optical signal to control power for DGE (Dynamic Gain Equalization) functions. *See* Pet. at 34–36, 53–54.

'726 Reply, pp. 4-5; '727 Reply, pp. 4-5

# Sparks Uses Misalignment to Control Power



US006253401B1

(12) **United States Patent**
Sparks et al.

(10) Patent No.:
(45) Date of Pate

(54) OPTICAL SWITCH ATTENUATOR

(75) Inventors: Adrian P Sparks, Ongar (GB); Robert Spagnoletti, Hertfordshire (GB); Gordon D Henshall, Harlow (GB)

(73) Assignee: Nortel Networks Limited, St. Laurent (CA)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 09/474,544

(22) Filed: Dec. 29, 1999

(51) Int. Cl.[7] ..... G02B 6/26; G02B 6/42

(52) U.S. Cl. ..... 385/18; 398/45

(58) Field of Search ..... 359/117, 128; 385/16–18

(56) Refer

U.S. PATE

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6,256,430 B1 * 7/20
6,424,757 B1 * 7/20
2002/0168131 A1 * 11/20

* cited by examiner

Primary Examiner—Kin
(74) Attorney, Agent, or F

(57) AB

An optical switch compri
switch an optical signal b
path of said signal, where
to misalign the optical
predetermined optical out
directly used to attenuat
separate attenuators.

12 Claims,



**Sparks**

If, in accordance with an embodiment of the present invention, the optical beam path is misaligned, e.g. either to misalignment of one of the mirrors **16, 26** or movement of the lens **22**, then FIG. **2***b* illustrates how only a portion of the beam **30** will be coupled into the optical fibre core **4***a*. Consequently, only the fraction of the beam profile **30** coupled into the output forms the output signal, and hence the optical signal is attenuated.

Sparks, 5:4-11; '726 POR, pp. 27-28; '727 POR, pp. 27-28

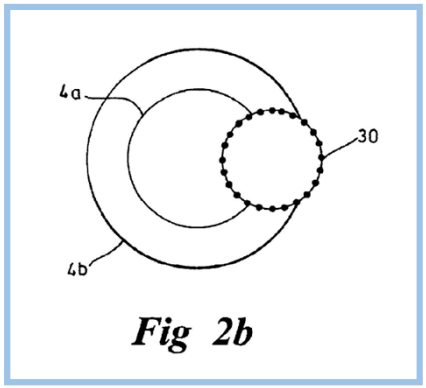
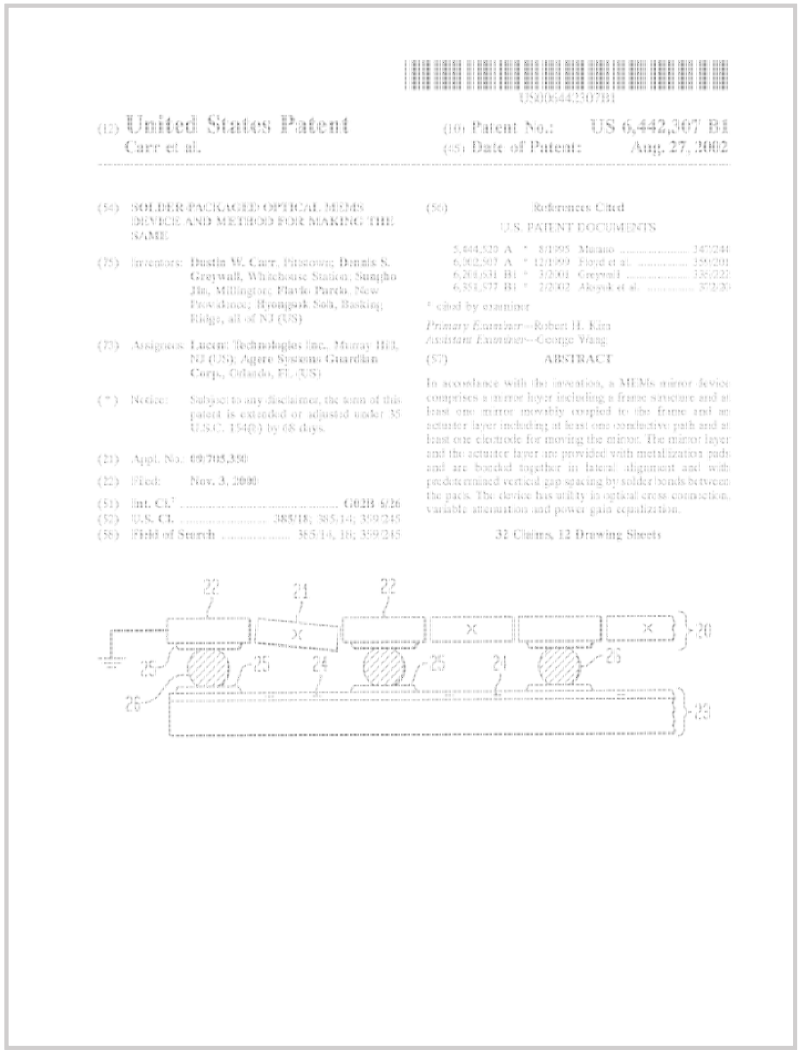



***Fig 2b***

Sparks, FIG. 2b;
'726 POR, p. 27; '727 POR, p. 27

# Carr Uses Misalignment to Control Power



US006442307B1

(12) **United States Patent**
Carr et al.

(10) Patent No.: US 6,442,307 B1
(45) Date of Patent: Aug. 27, 2002

(54) SOLDER PACKAGED OPTICAL MEMS DEVICE AND METHOD FOR MAKING THE SAME

(75) Inventors: Dustin W. Carr, Piscataway; Dennis S. Greywall, Whitehouse Station; Sangho Ha, Millington; Hariklis Pardo, New Providence; Hyongsok Soh, Basking Ridge, all of NJ (US)

(73) Assignees: Lucent Technologies Inc., Murray Hill, NJ (US); Agere Systems Guardian Corp., Orlando, FL (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 68 days.

(21) Appl. No.: 09/705,350

(22) Filed: Nov. 3, 2000

(51) Int. Cl.[7] ..... G02B 5/26

(52) U.S. Cl. ..... 385/18; 385/14; 359/245

(58) Field of Search ..... 385/14, 18; 359/245

(56) References Cited

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* cited by examiner

*Primary Examiner*—Robert H. Kim
*Assistant Examiner*—George Yang

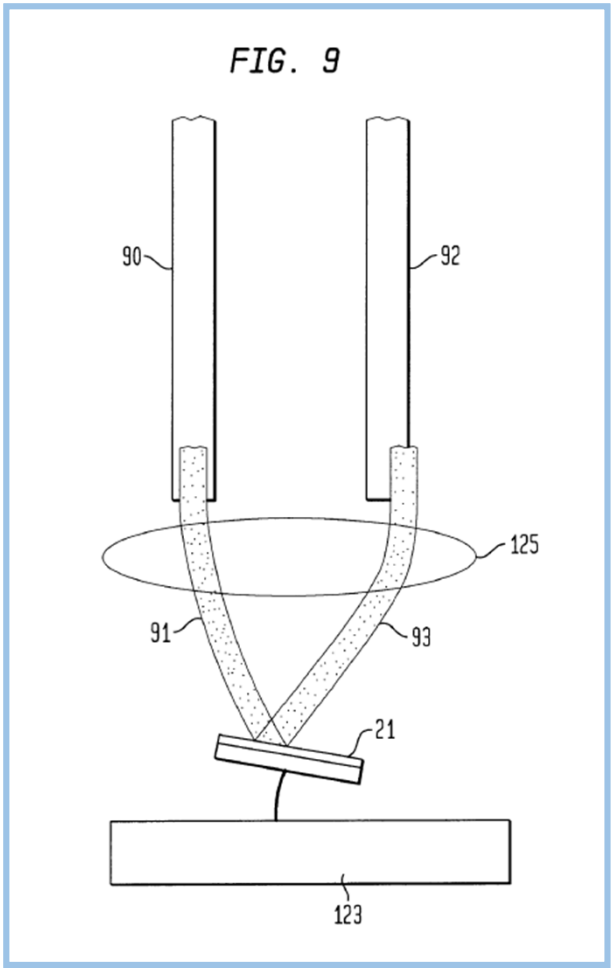
(57) ABSTRACT

In accordance with the invention, a MEMs mirror device comprises a mirror layer including a frame structure and at least one mirror movably coupled to the frame and an actuator layer including at least one conductive path and at least one electrode for moving the mirror. The mirror layer and the actuator layer are provided with metallization pads and are bonded together in lateral alignment and with predetermined vertical gap spacing by solder bonds between the pads. The device has utility in optical cross connection, variable attenuation and power gain equalization.

32 Claims, 12 Drawing Sheets

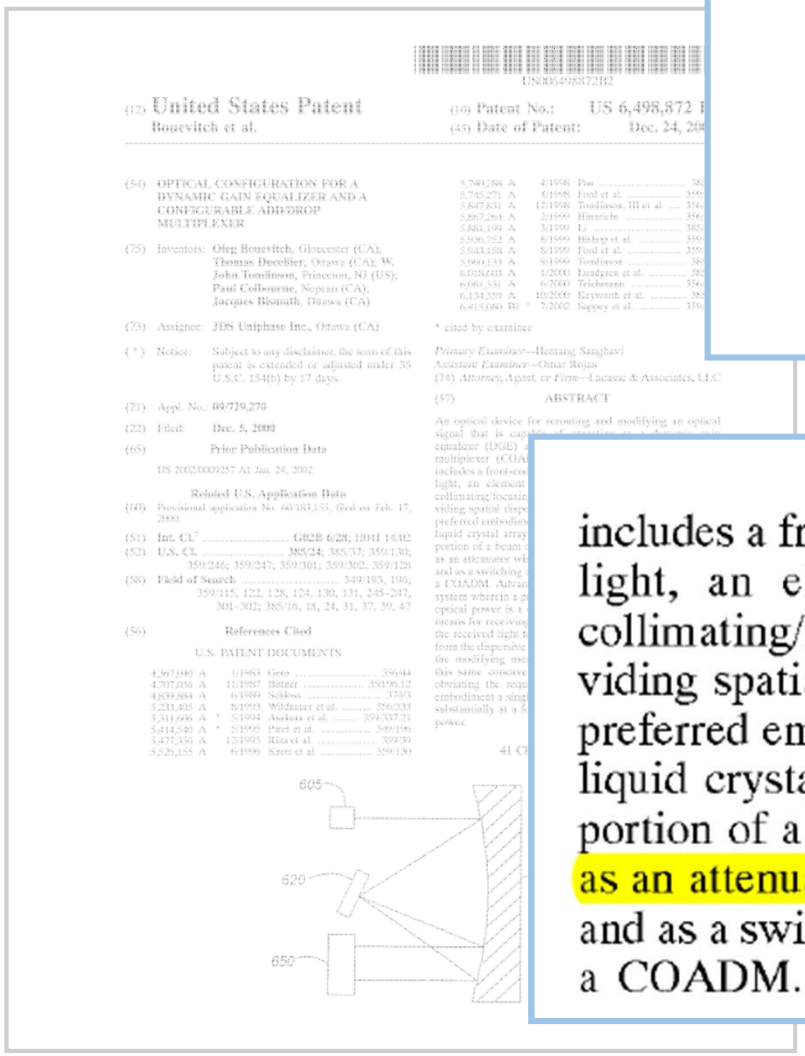


**Carr**




Carr, FIG. 9; '726 POR, p. 27; '727 POR, p. 27;

# Bouevitch Attenuates Power at a Modifying Means



(12) **United States Patent**
**Bouevitch et al.**

(54) **OPTICAL CONFIGURATION FOR A DYNAMIC GAIN EQUALIZER AND A CONFIGURABLE ADD/DROP MULTIPLEXER**

Bouevitch, Title

The optical design includes a front-end unit for providing a collimated beam of light, an element having optical power for providing collimating/focusing effects, a diffraction element for providing spatial dispersion, and modifying means which in a preferred embodiment includes one of a MEMS array and a liquid crystal array for reflecting and modifying at least a portion of a beam of light. The modifying means functions as an attenuator when the optical device operates as a DGE and as a switching array when the optical device operates as a COADM.

Bouevitch, Abstract

# Bouevitch Attenuates Power at a Modifying Means

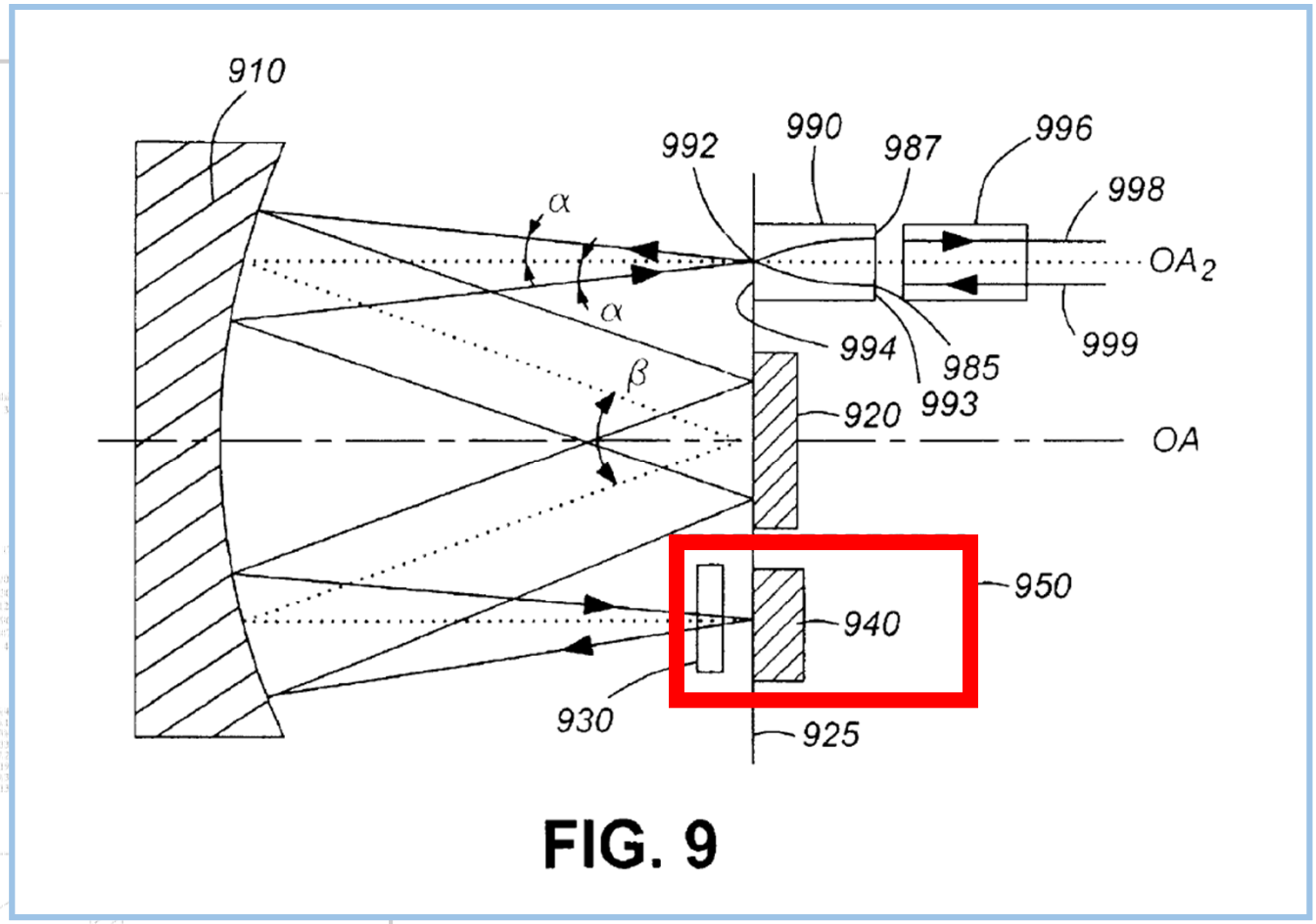
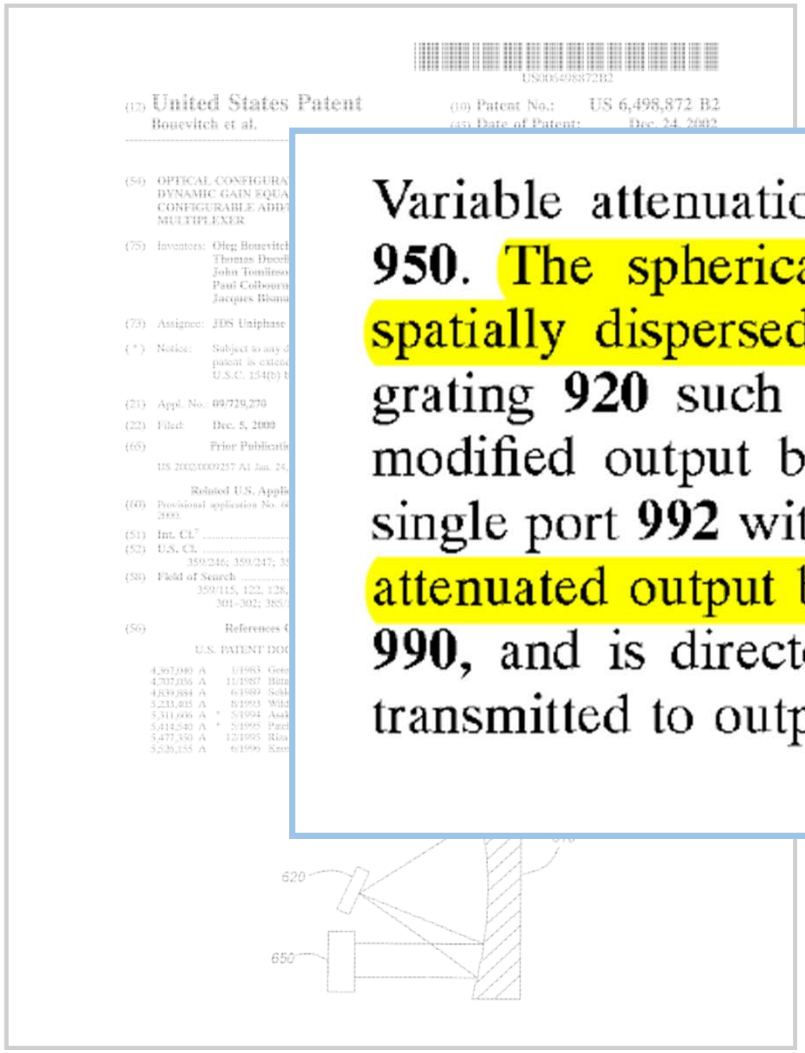



FIG. 9

Bouevitch, FIG. 9; '726 POR, pp. 28-29; '727 POR, pp. 28-29

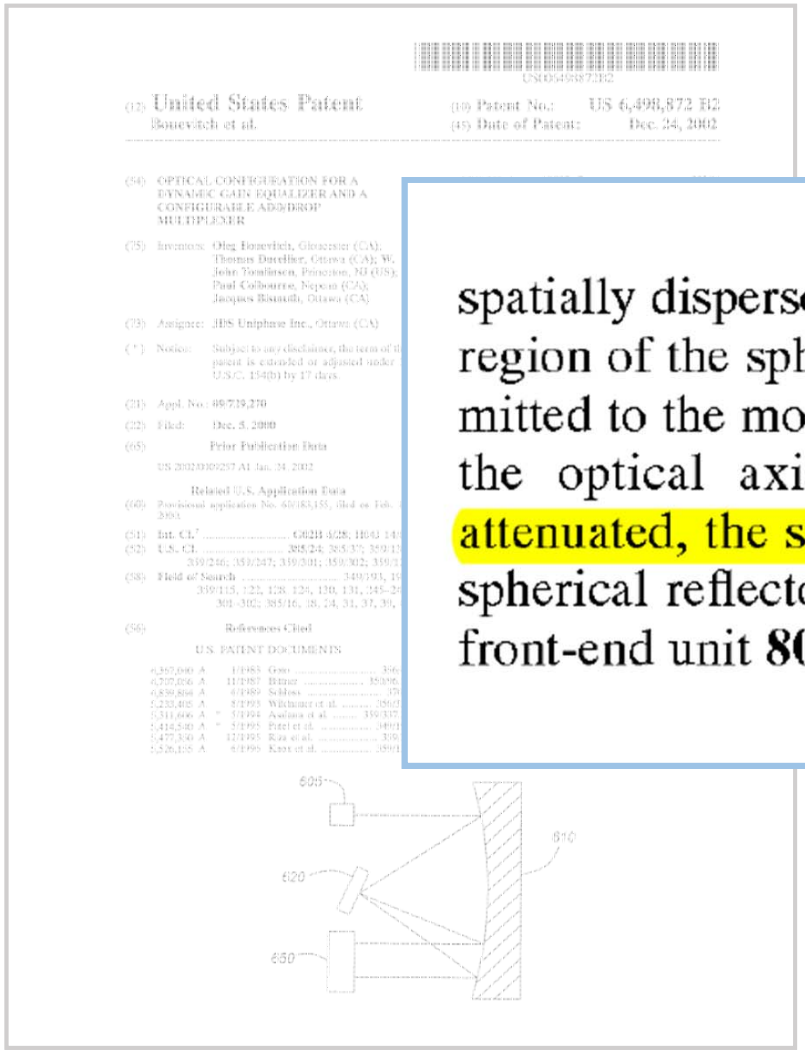
# Bouevitch Attenuates Power at a Modifying Means




Variable attenuation is provided by the modifying means **950**. The spherical reflector **910** redirects the modified spatially dispersed beam of light back to the diffraction grating **920** such that it is recombined to form a single modified output beam of light, which is incident on the single port **992** with an angle of incidence close to $-\alpha$. The attenuated output beam of light is passed through the lens **990**, and is directed towards output port **987** where it is transmitted to output optical fibre **998**.

Bouevitch, 12:59-67; '726 POR, p. 28; '727 POR, p. 28

# Bouevitch Attenuates Power at a Modifying Means



(12) **United States Patent**
Bouevitch et al.

(10) Patent No.: US 6,498,872 B2
(45) Date of Patent: Dec. 24, 2002

(54) OPTICAL CONFIGURATION FOR A DYNAMIC GAIN EQUALIZER AND A CONFIGURABLE ADD/DROP MULTIPLEXER

(75) Inventors: Oleg Bouevitch, Gloucester (CA); Thomas Duerdler, Ottawa (CA); W. Jolie Tomlinson, Princeton, NJ (US); Paul Colbourne, Nepean (CA); Jacques Bismuth, Ottawa (CA)

(73) Assignee: JDS Uniphase Inc., Ottawa (CA)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 17 days.

(21) Appl. No.: 09/739,270

(22) Filed: Dec. 5, 2000

(65) Prior Publication Data

US 2002/0093257 A1 Jan. 24, 2002

Related U.S. Application Data

(60) Provisional application No. 60/183,155, filed on Feb. 17, 2000.

(51) Int. Cl.[7] ..... G02B 26/08; H04J 14/02

(52) U.S. Cl. ..... 398/24; 398/37; 359/124; 359/246; 359/247; 359/301; 359/302; 359/337

(58) Field of Search ..... 359/193, 199; 359/115, 122, 128, 129, 130, 131, 245–248, 301–302; 385/16, 18, 24, 31, 37, 39, 47

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5,311,606 A * 5/1994 Asahina et al. ..... 359/337
5,414,540 A * 5/1995 Patel et al. ..... 349/
5,477,350 A 12/1995 Kuo et al. ..... 359/
5,526,155 A 6/1996 Knox et al. ..... 359/

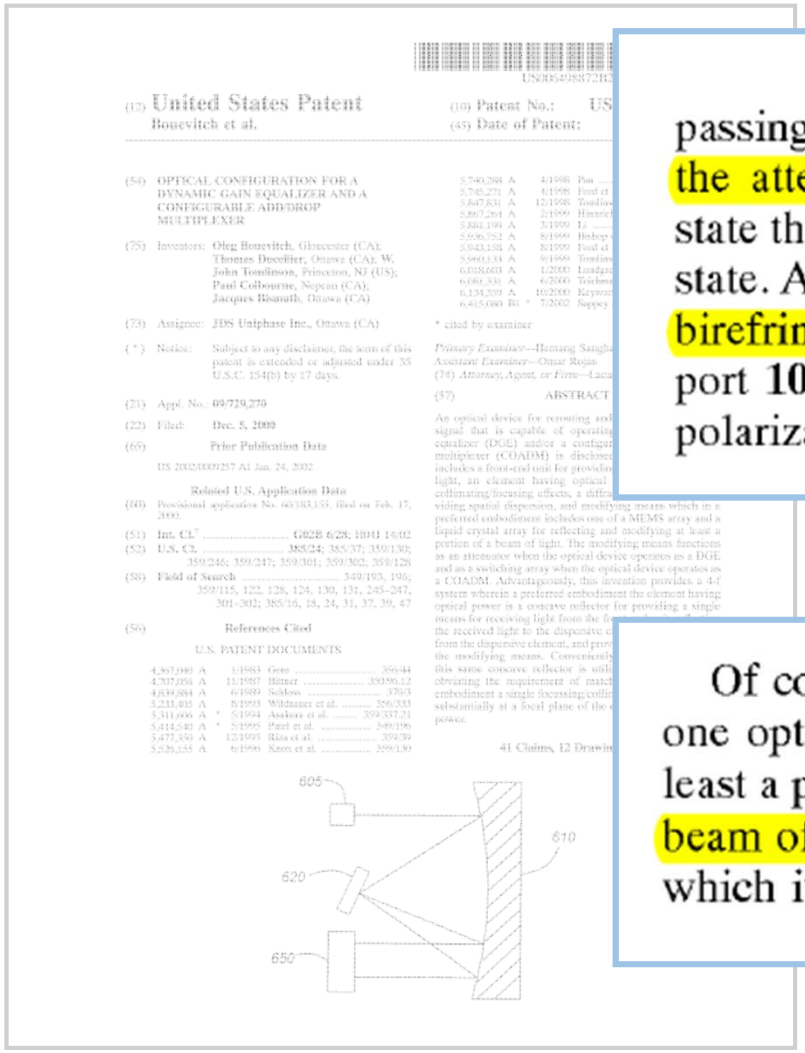




The spatially dispersed sub-beams of light incident on the lower region of the spherical reflector **810** are reflected and transmitted to the modifying means **850** in a direction parallel to the optical axis of the spherical reflector **810**. Once attenuated, the sub-beams of light are reflected back to the spherical reflector **810**, the diffraction grating **820**, and the front-end unit **805** along the same optical path.

Bouevitch, 11:28-35; '726 POR, p. 28; '727 POR, p. 28

# Bouevitch Attenuates Power at a Modifying Means



(12) **United States Patent**
Bouevitch et al.

(10) Patent No.: US
(45) Date of Patent:

(54) OPTICAL CONFIGURATION FOR A DYNAMIC GAIN EQUALIZER AND A CONFIGURABLE ADD/DROP MULTIPLEXER

(75) Inventors: Oleg Bouevitch, Gloucester (CA); Thomas Doscolier, Ottawa (CA); W. John Tomlinson, Princeton, NJ (US); Paul Colbourne, Nepean (CA); Jacques Bisaillh, Ottawa (CA)

(73) Assignee: JDS Uniphase Inc., Ottawa (CA)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 17 days.

(21) Appl. No.: 09/729,270

(22) Filed: Dec. 5, 2000

(65) Prior Publication Data

US 2002/0009257 A1 Jan. 24, 2002

Related U.S. Application Data

(60) Provisional application No. 60/183,155, filed on Feb. 17, 2000.

(51) Int. Cl.[7] ..... G02B 6/28; H04J 14/02

(52) U.S. Cl. ..... 385/24; 385/37; 359/130; 359/246; 359/247; 359/301; 359/302; 359/128

(58) Field of Search ..... 349/193, 196; 359/115, 122, 128, 124, 130, 131, 245–247, 301–302; 385/16, 18, 24, 31, 37, 39, 47

(56) References Cited

U.S. PATENT DOCUMENTS

* cited by examiner

*Primary Examiner*—Hemang Sanghavi
*Assistant Examiner*—Omar Rojas
(74) *Attorney, Agent, or Firm*—Lacasse

(57) ABSTRACT

41 Claims, 12 Drawing Sheets



After passing through the quarter waveplate **157** for a second time, the attenuated sub-beam of light will have a polarization state that has been rotated 90° from the original polarization state. As a result the attenuated sub-beam is refracted in the birefringent element **156** and is directed out of the device to port **102***b*. A half wave plate **158** is provided to rotate the polarization of the refracted sub-beams of light by 90°.

Bouevitch, 7:37-44; '726 POR, p. 28; '727 POR, p. 28

Of course, other modifying means **150** including at least one optical element capable of modifying a property of at least a portion of a beam of light and reflecting the modified beam of light back in substantially the same direction from which it originated are possible.

Bouevitch, 7:45-49; '726 POR, p. 28; '727 POR, p. 28

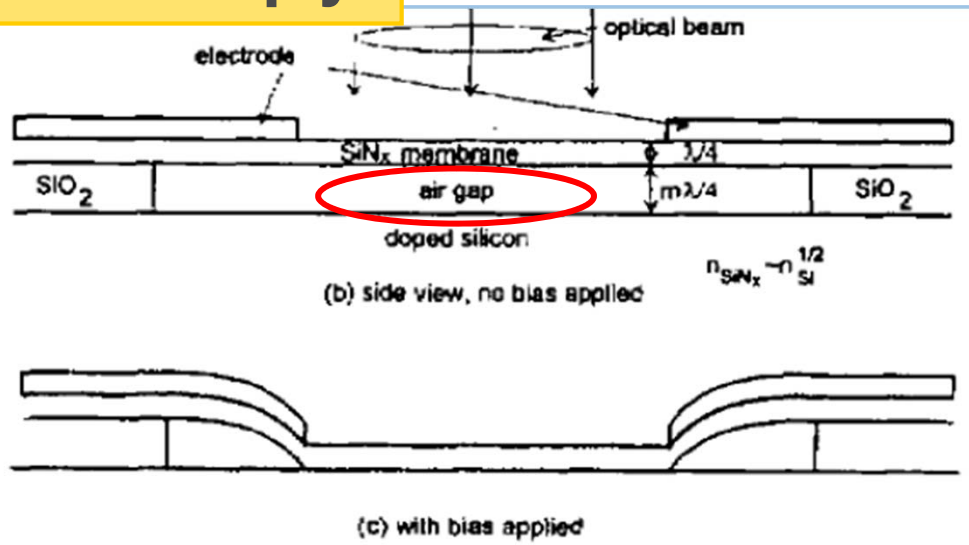
# Bouevitch Attenuates Power at a Modifying Means

## Bouevitch

The degree of attenuation is based on the degree of deflection provided by the reflector (i.e., the angle of reflection).

Bouevitch, 7:35-37; '726 POR, p. 30; '727; POR, p. 30

## Petitioner Reply




*See '726* Reply, p. 9; '727 Reply, p. 9

# The Figure 11 Embodiment Does Not Control Power

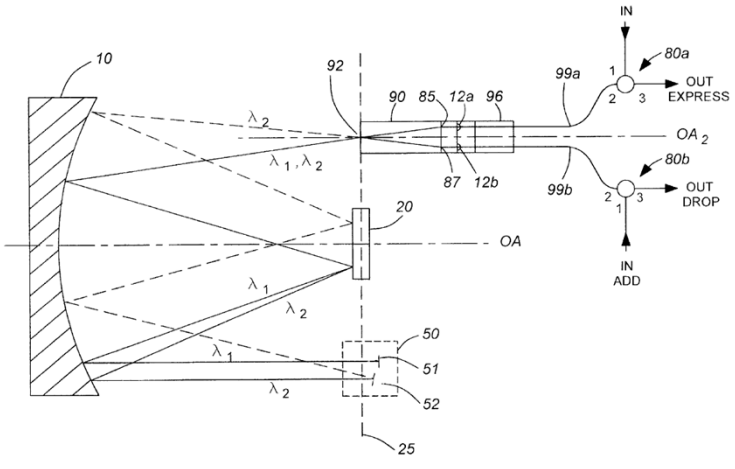



FIG. 11

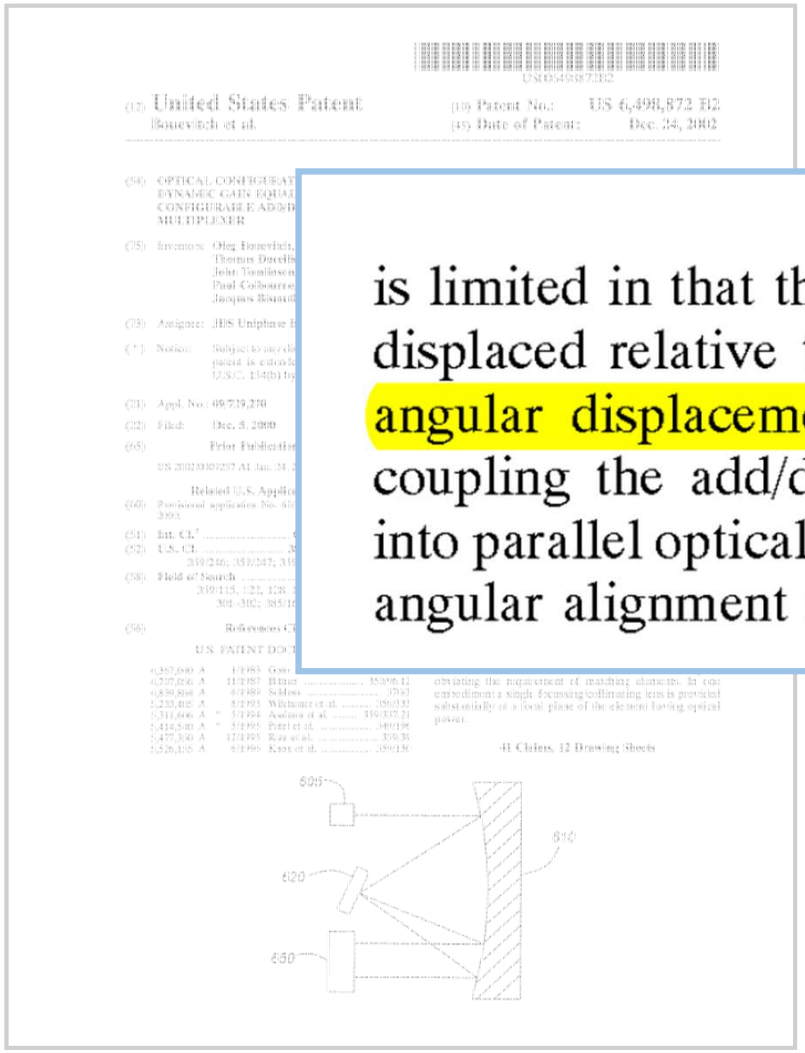
Bouevitch, FIG. 11; '726 POR, p. 12; '727 POR, p. 12

FIG. **11** is a schematic diagram of the preferred embodiment of a COADM in accordance with the instant invention;

A preferred embodiment is illustrated in FIG. **11**, wherein an arrangement similar to that shown in FIG. **9** designed to operate as a COADM, is shown.

Bouevitch, 5:6-7, 14:14-16; '726 POR, p. 40; '727 POR, p. 40

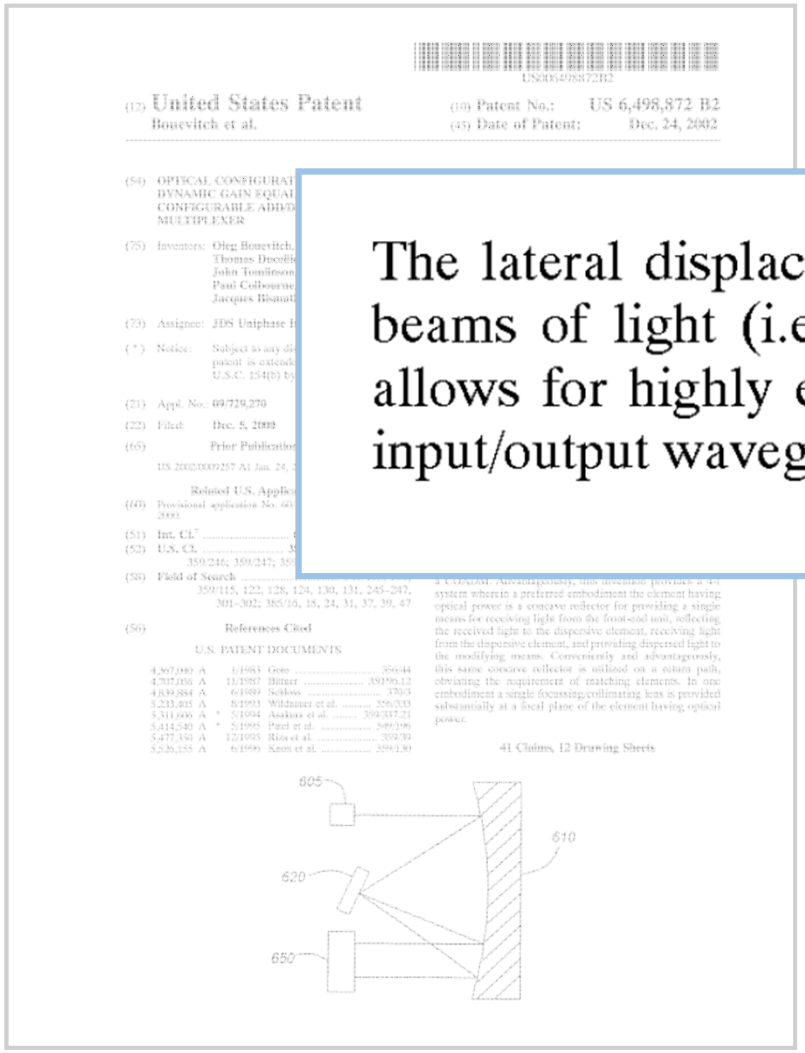
# Bouevitch Discourages Misalignment




However, the disclosed device is limited in that the add/drop beams of light are angularly displaced relative to the input/output beams of light. This angular displacement is disadvantageous with respect to coupling the add/drop and/or input/output beams of light into parallel optical waveguides, in addition to the additional angular alignment required for the input beam of light.

Bouevitch, 2:1-7; '726 POR, pp. 28-29; '727 POR, pp. 28-29

# Bouevitch Discourages Misalignment



(12) **United States Patent**
Bouevitch et al.

(10) Patent No.: US 6,498,872 B2
(45) Date of Patent: Dec. 24, 2002

(54) OPTICAL CONFIGURAT
DYNAMIC GAIN EQUAL
CONFIGURABLE ADDD
MULTIPLEXER

(75) Inventors: Oleg Bouevitch,
Thomas Drocelli
John Tomlinson
Paul Colbourne
Jacques Bisnaut

(73) Assignee: JDS Uniphase I

( * ) Notice: Subject to any di
patent is extend
U.S.C. 154(b) by

(21) Appl. No.: 09/729,270

(22) Filed: Dec. 5, 2000

(65) Prior Publicatio

US 2002/0009257 A1 Jan. 24,

Related U.S. Applic

(60) Provisional application No. 60
2000.

(51) Int. Cl.[7] .....

(52) U.S. Cl. .....
359/246; 359/247; 35

(58) Field of Search .....
359/115, 122, 128, 124, 130, 131, 245-247,
301-302; 385/16, 18, 24, 31, 37, 39, 47

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5,414,540 A * 5/1995 Patel et al. ..... 349/196
5,477,350 A 12/1995 Rita et al. ..... 359/39
5,629,155 A 6/1996 Kaen et al. ..... 359/130

...a system wherein a preferred embodiment the element having optical power is a concave reflector for providing a single means for receiving light from the front-end unit, reflecting the received light to the dispersive element, receiving light from the dispersive element, and providing dispersed light to the modifying means. Conveniently and advantageously, this same concave reflector is utilized on a return path, obviating the requirement of matching elements. In one embodiment a single focussing/collimating lens is provided substantially at a focal plane of the element having optical power.

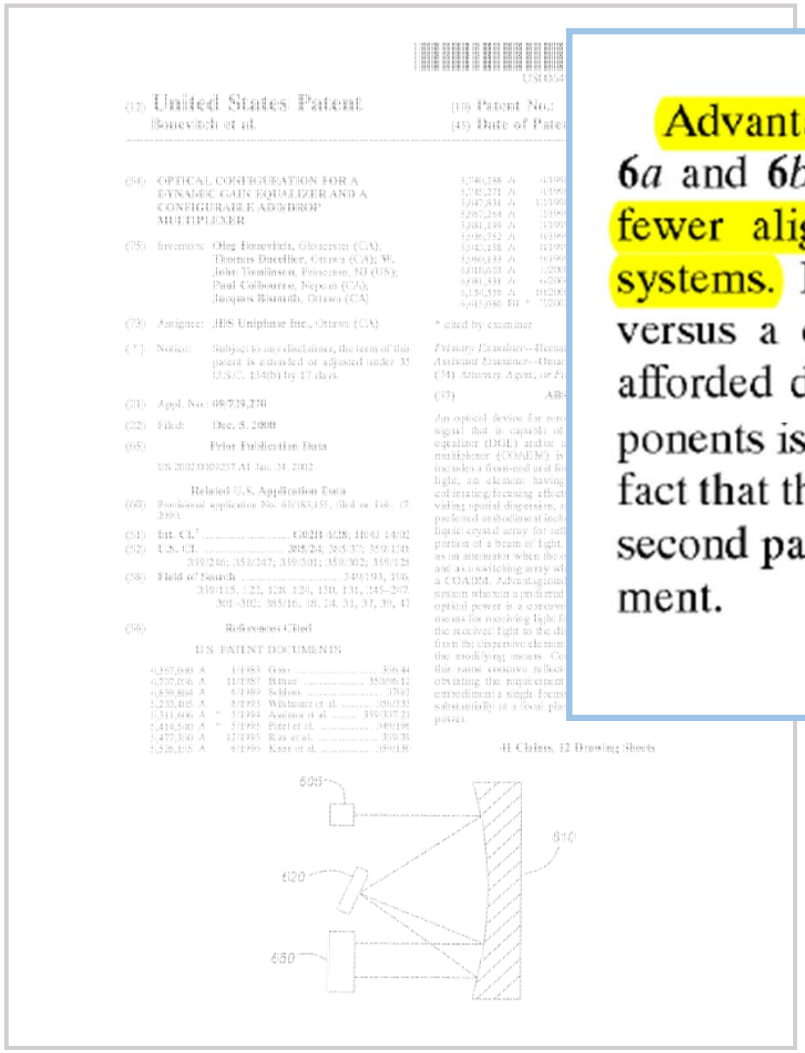
41 Claims, 12 Drawing Sheets



The lateral displacement of the input and modified output beams of light (i.e., as opposed to angular displacement) allows for highly efficient coupling between a plurality of input/output waveguides.

Bouevitch, 7:60-63; '726 POR, pp. 28-29; '727 POR, pp. 28-29

# Bouevitch is Designed to Correct Misalignment



(12) United States Patent
Bouevitch et al.

(54) OPTICAL CONFIGURATION FOR A DYNAMIC GAIN EQUALIZER AND A CONFIGURABLE ADD/DROP MULTIPLEXER

(75) Inventors: Oleg Bouevitch, Gloucester (CA); Thomas Ducellier, Ottawa (CA); W. John Tomlinson, Princeton, NJ (US); Paul Colbourne, Nepean (CA); Jacques Bismuth, Ottawa (CA)

(73) Assignee: JDS Uniphase Inc., Ottawa (CA)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 17 days.

(21) Appl. No.: 09/729,270

(22) Filed: Dec. 5, 2000

(65) Prior Publication Data

US 2002/0093257 A1 Jan. 24, 2002

Related U.S. Application Data

(60) Provisional application No. 60/183,155, filed on Feb. 17, 2000.

(51) Int. Cl.[7] ..... G02B 26/08; H04J 14/02

(52) U.S. Cl. ..... 398/24; 398/37; 359/199; 359/246; 359/247; 359/301; 359/302; 359/128

(58) Field of Search ..... 359/193, 199; 359/115, 122, 128, 129, 130, 131, 245–247, 301–302; 385/16, 18, 24, 31, 37, 39, 47

(56) References Cited

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5,477,350 A 12/1995 Kuo et al. ..... 359/30
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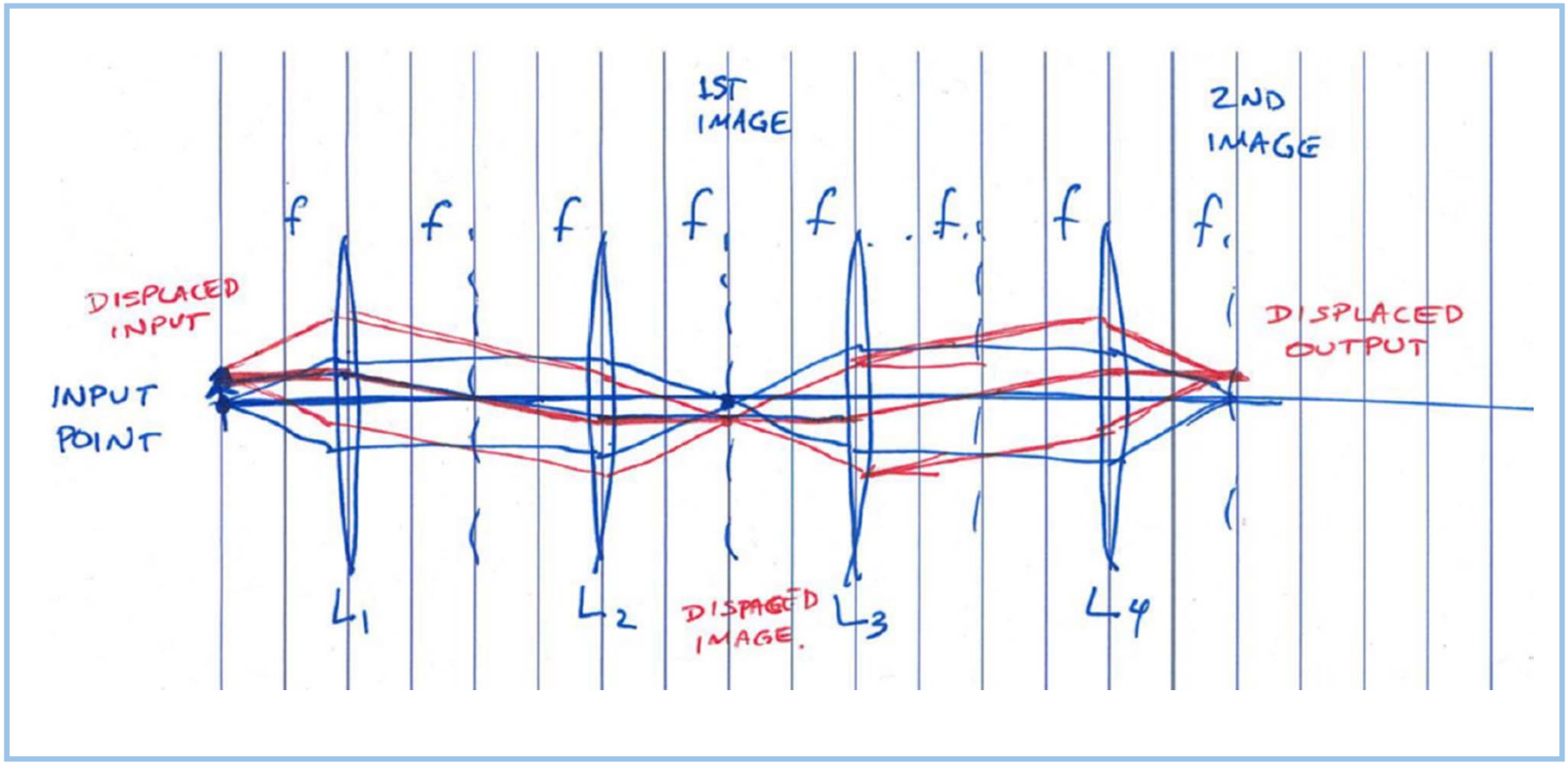
11 Claims, 12 Drawing Sheets



Advantageously, the optical arrangement shown in FIGS. **6***a* and **6***b* provides a symmetrical 4-f optical system with fewer alignment problems and less loss than prior art systems. In fact, many of the advantages of this design versus a conventional 4f system using separate lenses is afforded due to the fact that the critical matching of components is obviated. One significant advantage relates to the fact that the angle of incidence on the grating, in the first and second pass, is inherently matched with the optical arrangement.

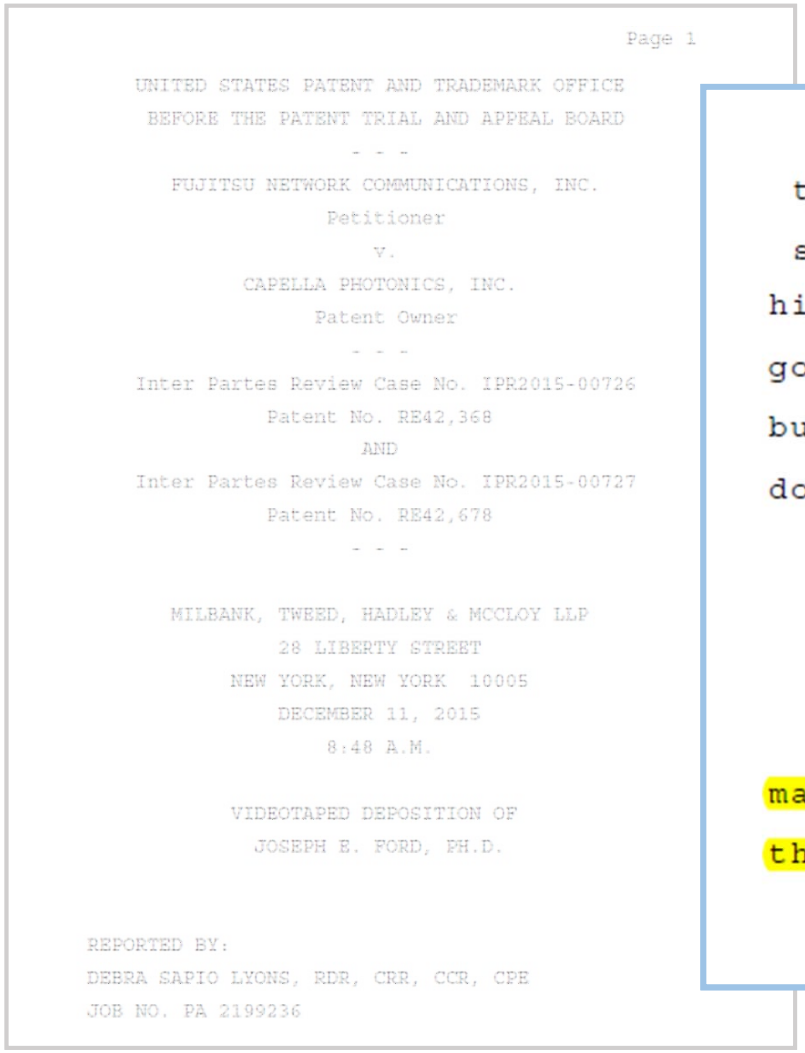
Bouevitch, 10:62-11:4; '726 POR, p. 24; '727 POR, p. 24

# Bouevitch is Designed to Correct Misalignment




Ex. 2034; '726 POR, p. 25; '727 POR, p. 25

# Bouevitch is Designed to Correct Misalignment



Page 1

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FUJITSU NETWORK COMMUNICATIONS, INC.
Petitioner
v.
CAPELLA PHOTONICS, INC.
Patent Owner
- - -
Inter Partes Review Case No. IPR2015-00726
Patent No. RE42,368
AND
Inter Partes Review Case No. IPR2015-00727
Patent No. RE42,678
- - -

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VIDEOTAPED DEPOSITION OF
JOSEPH E. FORD, PH.D.

REPORTED BY:
DEBRA SAPIO LYONS, RDR, CRR, CCR, CPE
JOB NO. PA 2199236

**Dr. Ford**

Q. So just so I understand, so if the fiber were shifted down accidentally for some reason and then it went through the lens, hit the grating, went back to the MEMS, would go through the lens again, hit the grating, but then it would come back to the shifted down part of --

A. Yes.

Q. -- the fiber automatically?

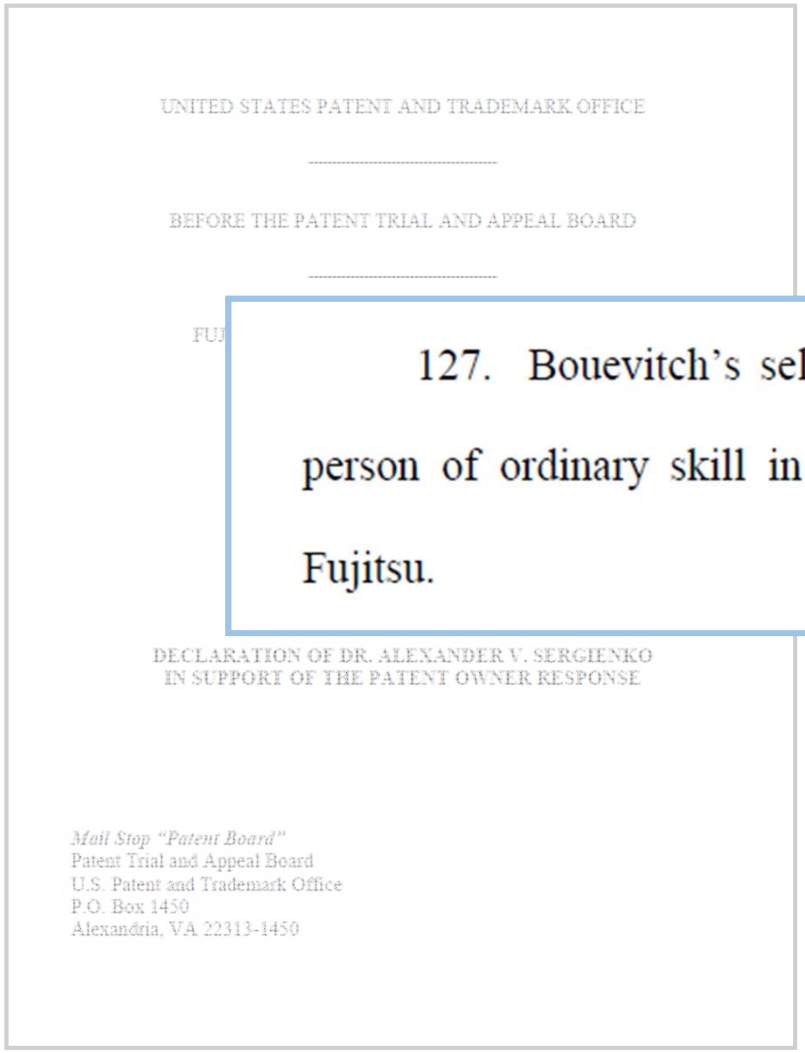
A. Automatically.

Q. So it's a way to automatically make sure that the -- the light gets back into the fiber?

A. That's right.

Ford Depo. Tr., 140:23-141:12; '726 POR, p. 25; '727 POR, p. 25

# Changes the Principle of Operation



UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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DECLARATION OF DR. ALEXANDER V. SERGIENKO
IN SUPPORT OF THE PATENT OWNER RESPONSE

*Mail Stop "Patent Board"*
Patent Trial and Appeal Board
U.S. Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

**Dr. Sergienko:**

127. Bouevitch's self-alignment principle of operation would preclude a person of ordinary skill in the art from making the combination proposed by Fujitsu.

Sergienko Dec., ¶ 127; '726 POR, p. 26; '726 POR, p. 26

# Outline

I. Capella Invented a New Class of Optical Switches

II. No Motivation to Combine

- Hindsight
- Changes the Principle of Operation

III. **Ports**

- Collimator Ports vs. circulators
- Disavowal / Disclaimer
- The ’217 Provisional

# Collimator Ports vs. circulators

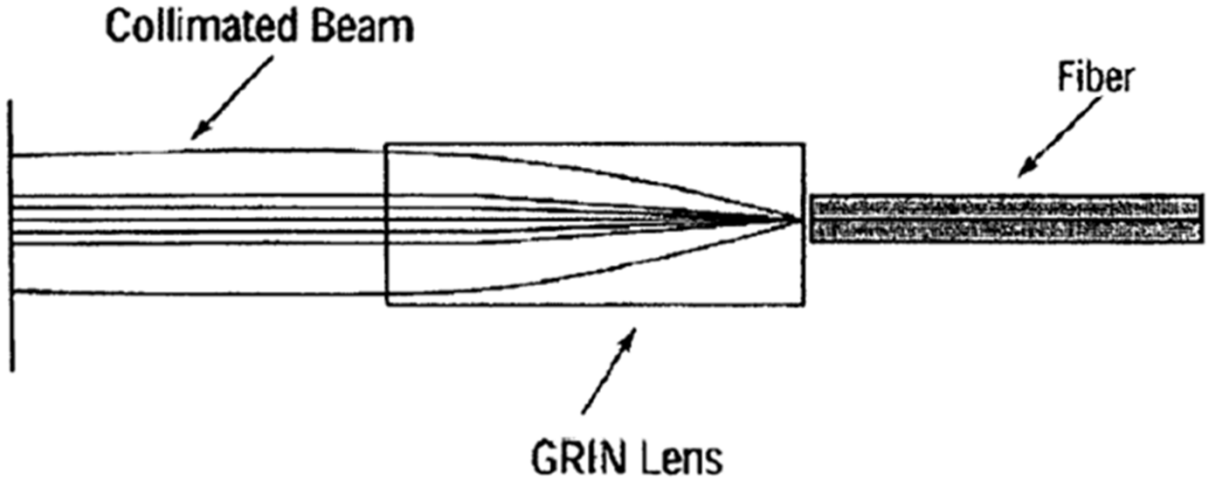
## '368 Patent

an input port for an input multi-wavelength optical signal having first spectral channels;
one or more other ports for second spectral channels; an output port for an output multi-wavelength optical signal;

## '678 Patent

a) multiple fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports;

# Collimator Ports vs. circulators




Ex. 1001, FIG. 1D; '726 POR, p. 15; '727 POR, p. 15

Each output port is provided by a quarter-pitch GRIN lens (2 mm in diameter) coupled to an optical fiber (see FIG. 1D).

Ex. 1001, 8:41-43; '726 POR, p. 15; '727 POR, p. 15

# Collimator Ports vs. circulators

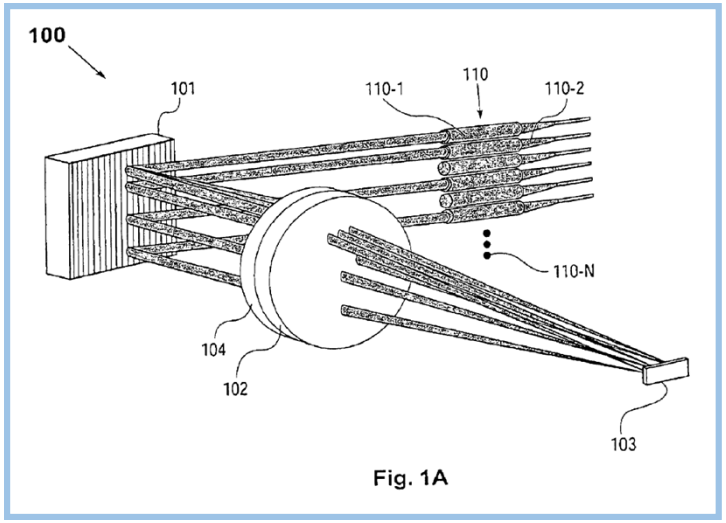


Fig. 1A

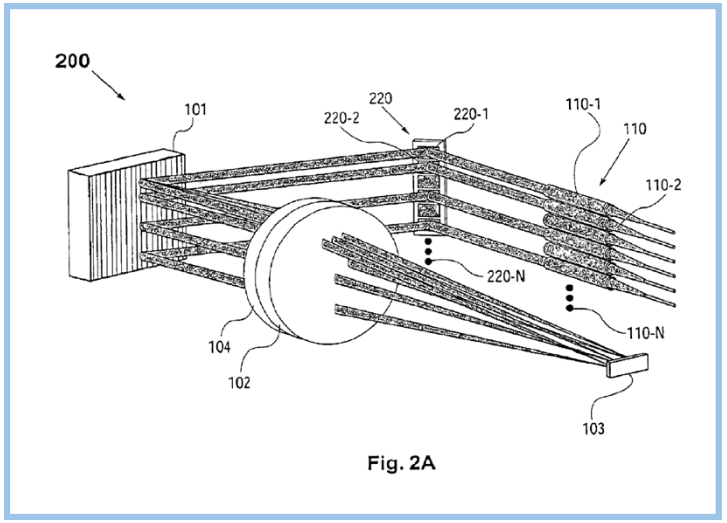


Fig. 2A

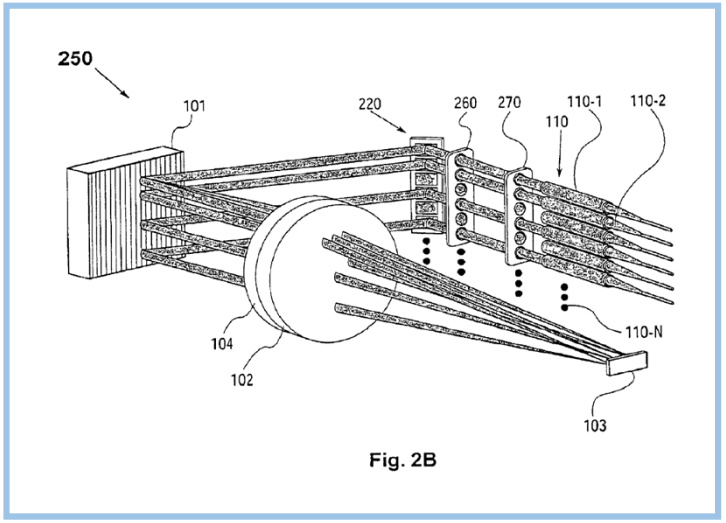


Fig. 2B

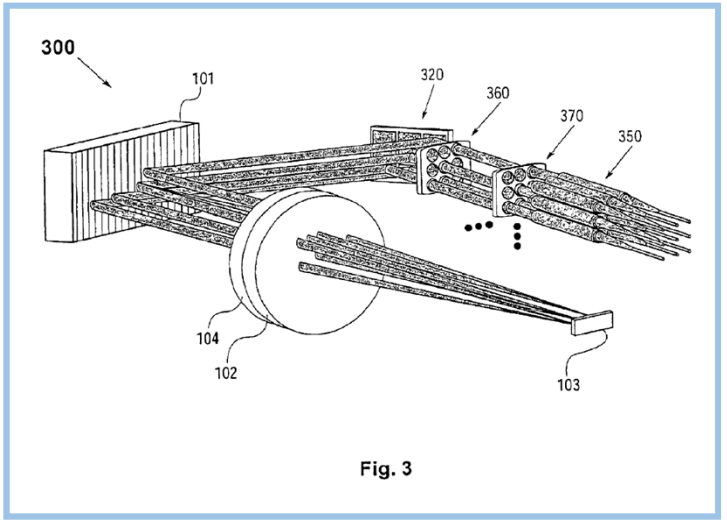
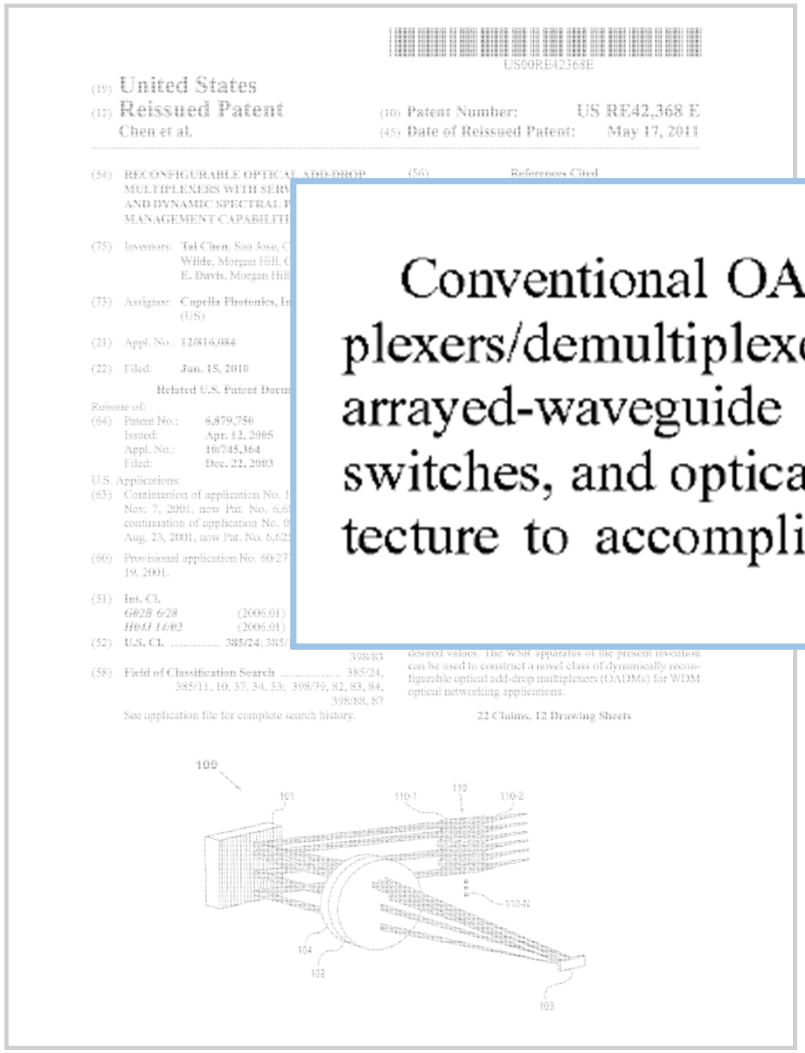


Fig. 3

# Collimator Ports vs. circulators

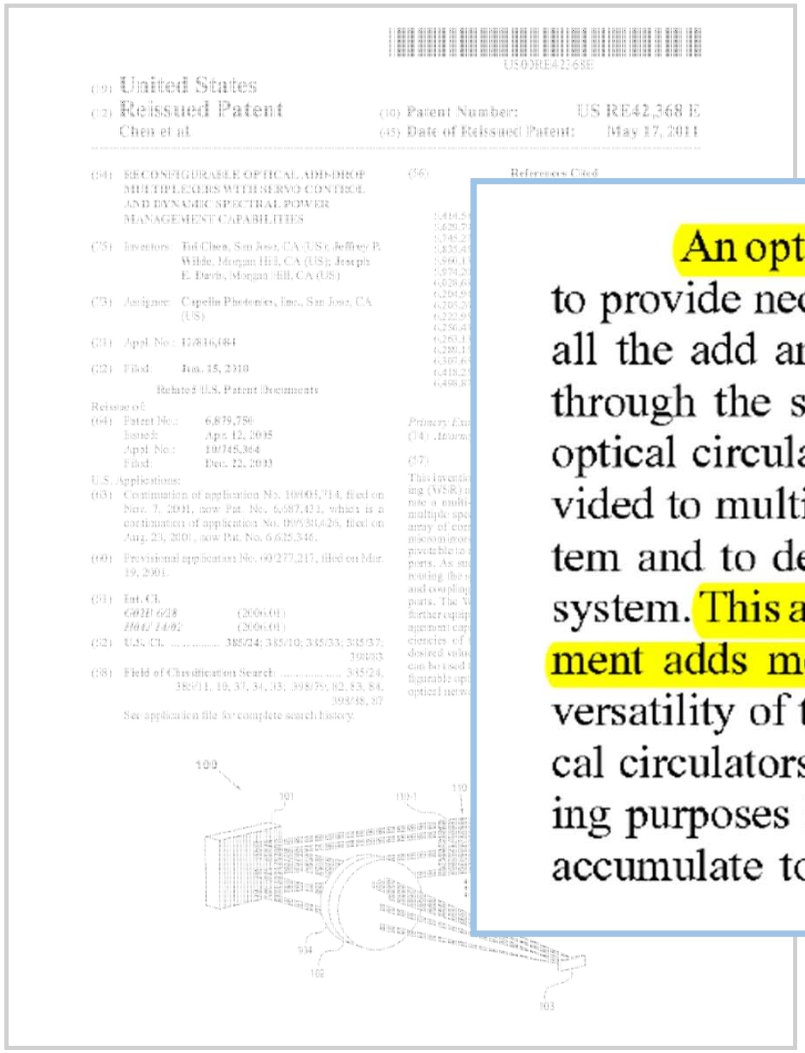



**Background**

Conventional OADMs in the art typically employ multiplexers/demultiplexers (e.g, waveguide grating routers or arrayed-waveguide gratings), tunable filters, optical switches, and optical circulators in a parallel or serial architecture to accomplish the add and drop functions.

Ex. 1001, 1:59-63; '726 POR, p. 39; '727 POR, p. 39

# Collimator Ports vs. circulators



(12) United States
Reissued Patent
Chen et al.

(10) Patent Number: US RE42,368 E
(45) Date of Reissued Patent: May 17, 2011

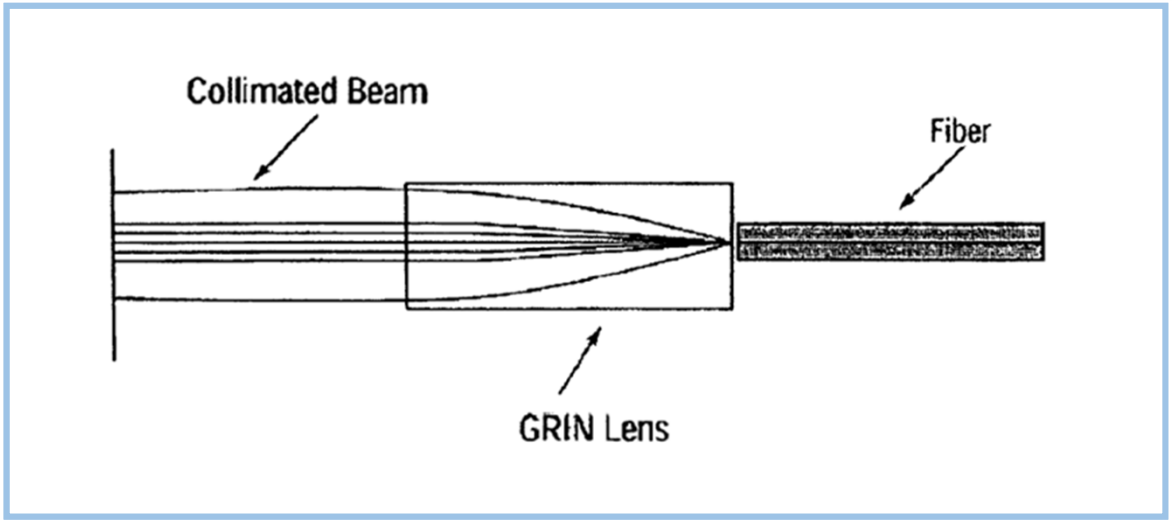
(54) RECONFIGURABLE OPTICAL ADD-DROP MULTIPLEXERS WITH SERVO CONTROL AND DYNAMIC SPECTRAL POWER MANAGEMENT CAPABILITIES

## Background

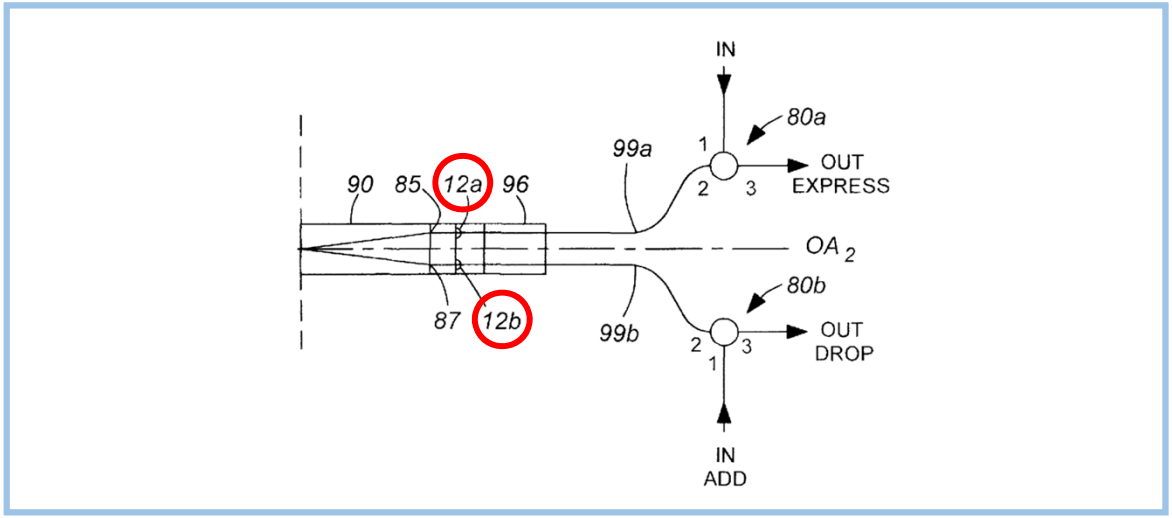
An optical circulator therefore has to be implemented, to provide necessary routing of these two signals. Likewise, all the add and drop channels enter and leave the OADM through the same output port, hence the need for another optical circulator. Moreover, additional means must be provided to multiplex the add channels before entering the system and to demultiplex the drop channels after exiting the system. This additional multiplexing/demultiplexing requirement adds more cost and complexity that can restrict the versatility of the OADM thus-constructed. Second, the optical circulators implemented in this OADM for various routing purposes introduce additional optical losses, which can accumulate to a substantial amount.

Ex. 1001, 2:45-57; '726 POR, p. 39; '727 POR, p. 39

# Collimator Ports vs. circulators




Ex. 1001, FIG. 1D; '726 POR, p. 15; '727 POR, p. 15




*See* Bouevitch, FIG. 11; '726 POR, p. 41; '727 POR, p. 41

# Outline

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# Disavowal / Disclaimer

## Legal Requirement

"[The Federal Circuit has] found disavowal or disclaimer based on . . . '***the present invention includes*** . . .' or '***the present invention is*** . . . .'"

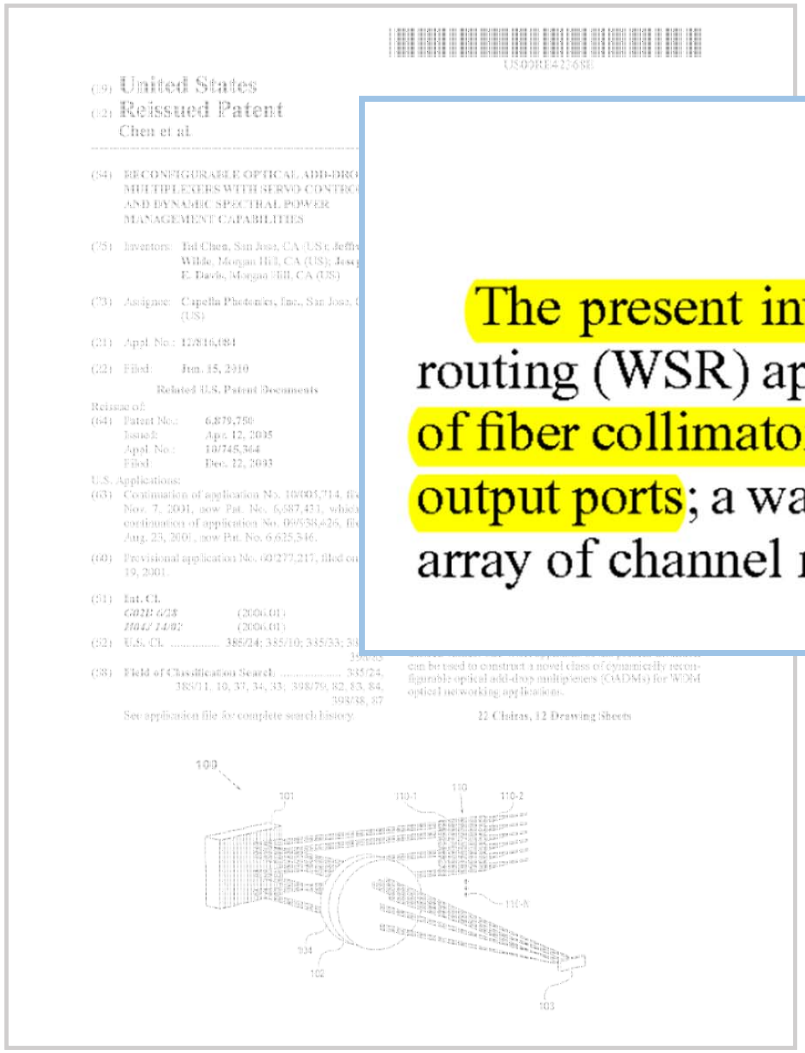
*Pacing Techs., LLC v. Garmin Int'l, Inc.*, 778 F.3d 1021, 1024 (Fed. Cir. 2015) (internal citations omitted)

## Evidence Shows

"***The present invention provides*** a wavelength-separating-routing (WSR) apparatus and method which employ an array of fiber collimators serving as an input port and a plurality of output ports . . . ."

Ex. 1001, 3:54-58 (emphasis added); '726 POR, p. 39; '727 POR, p. 39

# Disavowal / Disclaimer



(12) Reissued Patent
Chen et al.

(54) RECONFIGURABLE OPTICAL ADD-DROP MULTIPLEXERS WITH SERVO CONTROL AND DYNAMIC SPECTRAL POWER MANAGEMENT CAPABILITIES

(75) Inventors: Ed Chen, San Jose, CA (US); Jeffrey Wilde, Morgan Hill, CA (US); Joseph E. Davis, Morgan Hill, CA (US)

(73) Assignee: Capella Photonics, Inc., San Jose, CA (US)

(21) Appl. No.: 12/816,081

(22) Filed: Jun. 15, 2010

Related U.S. Patent Documents

Reissue of:
(64) Patent No.: 6,879,750
Issued: Apr. 12, 2005
Appl. No.: 10/745,364
Filed: Dec. 22, 2003

U.S. Applications:
(63) Continuation of application No. 10/003,714, filed Nov. 7, 2001, now Pat. No. 6,587,471, which is a continuation of application No. 09/558,626, filed Aug. 25, 2000, now Pat. No. 6,625,346.

(60) Provisional application No. 60/277,217, filed on Mar. 19, 2001.

(51) Int. Cl.
*G02B 6/28* (2006.01)
*H04J 14/02* (2006.01)

(52) U.S. Cl. ..... 385/24; 385/10; 385/33; 398/79; 398/82; 398/83; 398/84; 398/87

(58) Field of Classification Search ..... 385/24, 385/11, 10, 37, 34, 33; 398/79, 82, 83, 84, 398/87

See application file for complete search history.

22 Claims, 12 Drawing Sheets



## SUMMARY

The present invention provides a wavelength-separating-routing (WSR) apparatus and method which employ an array of fiber collimators serving as an input port and a plurality of output ports; a wavelength-separator; a beam-focuser; and an array of channel micromirrors.

Ex. 1001, 3:54-58; '726 POR, p. 39; '727 POR, p. 39

# Outline

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# The ’217 Provisional

## Dr. Sergienko

176. I understand that Petitioner may allege that the ’368 patent’s provisional application, included as Exhibit 2012, is inconsistent with the claim construction that the claimed ports are not circulator ports. I would strongly disagree with Petitioner on this point.

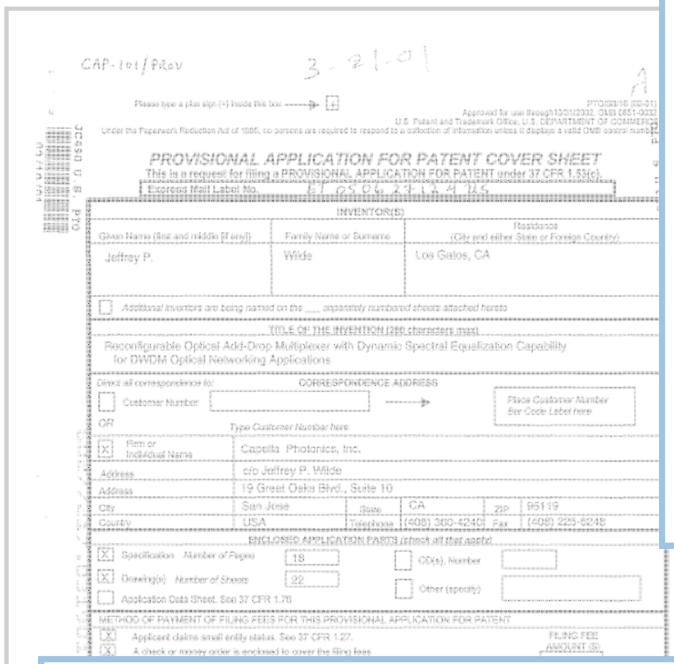
’726 Sergienko Dec., ¶ 176; ’727 Sergienko Dec., ¶ 176

## Dr. Ford

**Did Not Consider the ’217 Provisional For Claim Construction**

’726 Ford Dec., pp. 4-6; ’727 Ford Dec., pp. 4-6

# The ’217 Provisional



PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

| INVENTOR(S) | | |
|---|---|---|
| Given Name (first and middle [if any]) | Family Name or Surname | Residence (City and either State or Foreign Country) |
| Jeffrey P. | Wilde | Los Gatos, CA |

Reconfigurable Optical Add-Drop Multiplexer with Dynamic Spectral Equalization Capability for DWDM Optical Networking Applications

CORRESPONDENCE ADDRESS

Customer Number

OR

Type Customer Number here

Place Customer Number Bar Code Label here

| | |
|---|---|
| Firm or Individual Name | Capella Photonics, Inc. |
| Address | c/o Jeffrey P. Wilde |
| Address | 19 Great Oaks Blvd., Suite 10 |
| City | San Jose |
| State | CA |
| ZIP | 95119 |
| Country | USA |
| Telephone | (408) 360-4240 |
| Fax | (408) 225-6248 |

ENCLOSED APPLICATION PARTS (check all that apply)

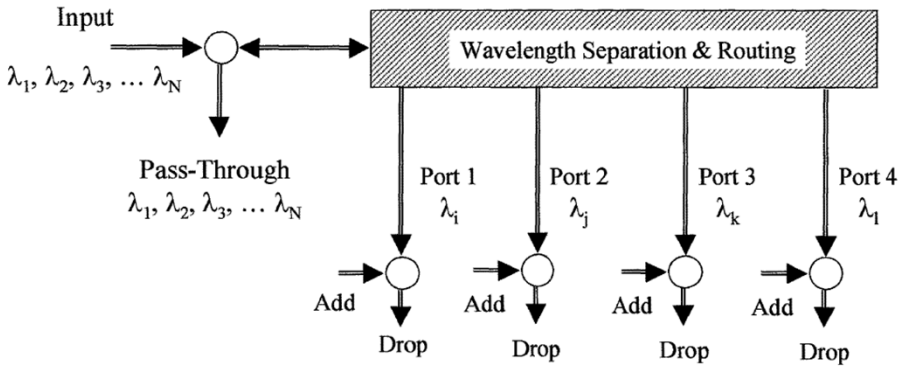
- Specification — Number of Pages: 18
- Drawing(s) — Number of Sheets: 22
- Application Data Sheet. See 37 CFR 1.76
- CD(s), Number:
- Other (specify):

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT

- Applicant claims small entity status. See 37 CFR 1.27.
- A check or money order is enclosed to cover the filing fees

FILING FEE AMOUNT ($)

**Bi-Directional OADM Approach (Circulator Scheme)**

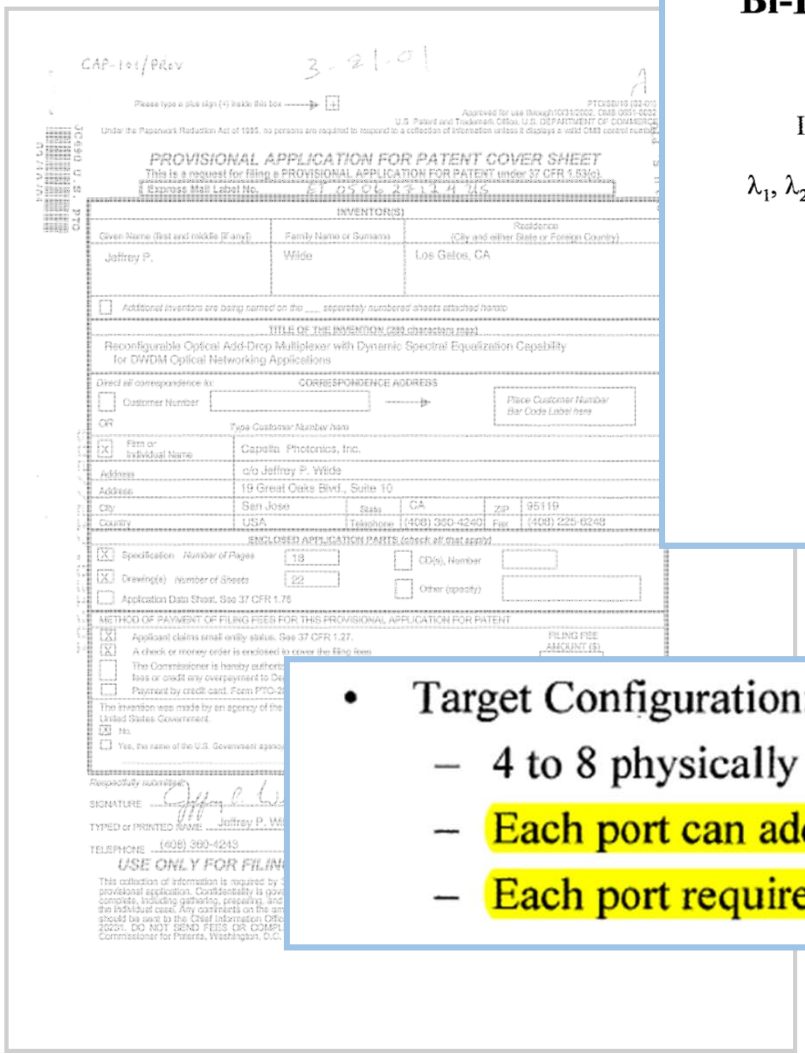



Ex. 2012, FIG. 9; ’726 POR, p. 39; ’727 POR, p. 39

The third architecture (Fig. 9) is also bi-directional, but uses only one WSR unit. Circulators are situated on all of the physical input/output ports, allowing for two-way optical propagation. This design has the restriction that at each of the add/drop ports, the add and drop wavelengths must be the same.

Ex. 2012, *4; ’726 POR, p. 39; ’727 POR, p. 39

# The ’217 Provisional



PROVISIONAL APPLICATION FOR PATENT COVER SHEET

Reconfigurable Optical Add-Drop Multiplexer with Dynamic Spectral Equalization Capability for DWDM Optical Networking Applications

| Given Name (first and middle (if any)) | Family Name or Surname | Residence (City and either State or Foreign Country) |
|---|---|---|
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19 Great Oaks Blvd., Suite 10
San Jose, CA 95119
USA
Telephone (408) 360-4240 Fax (408) 225-6248

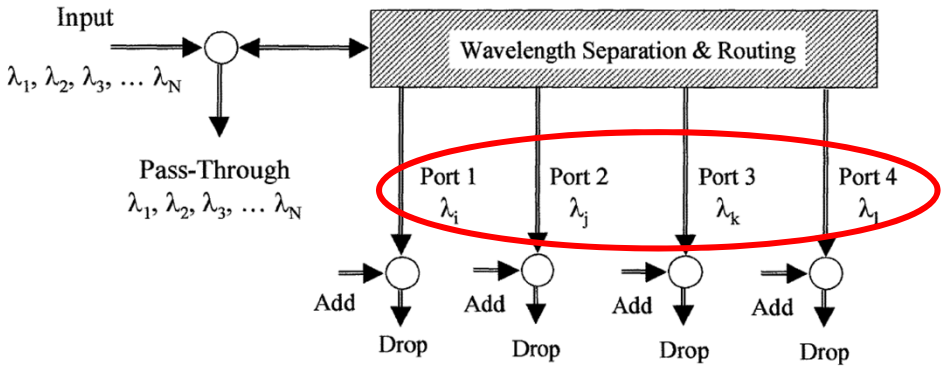
Specification Number of Pages 18
Drawing(s) Number of Sheets 22
CD(s), Number
Other (specify)

Applicant claims small entity status. See 37 CFR 1.27.
A check or money order is enclosed to cover the filing fees.

SIGNATURE
TYPED or PRINTED NAME Jeffrey P. Wilde
TELEPHONE (408) 360-4243

USE ONLY FOR FILING

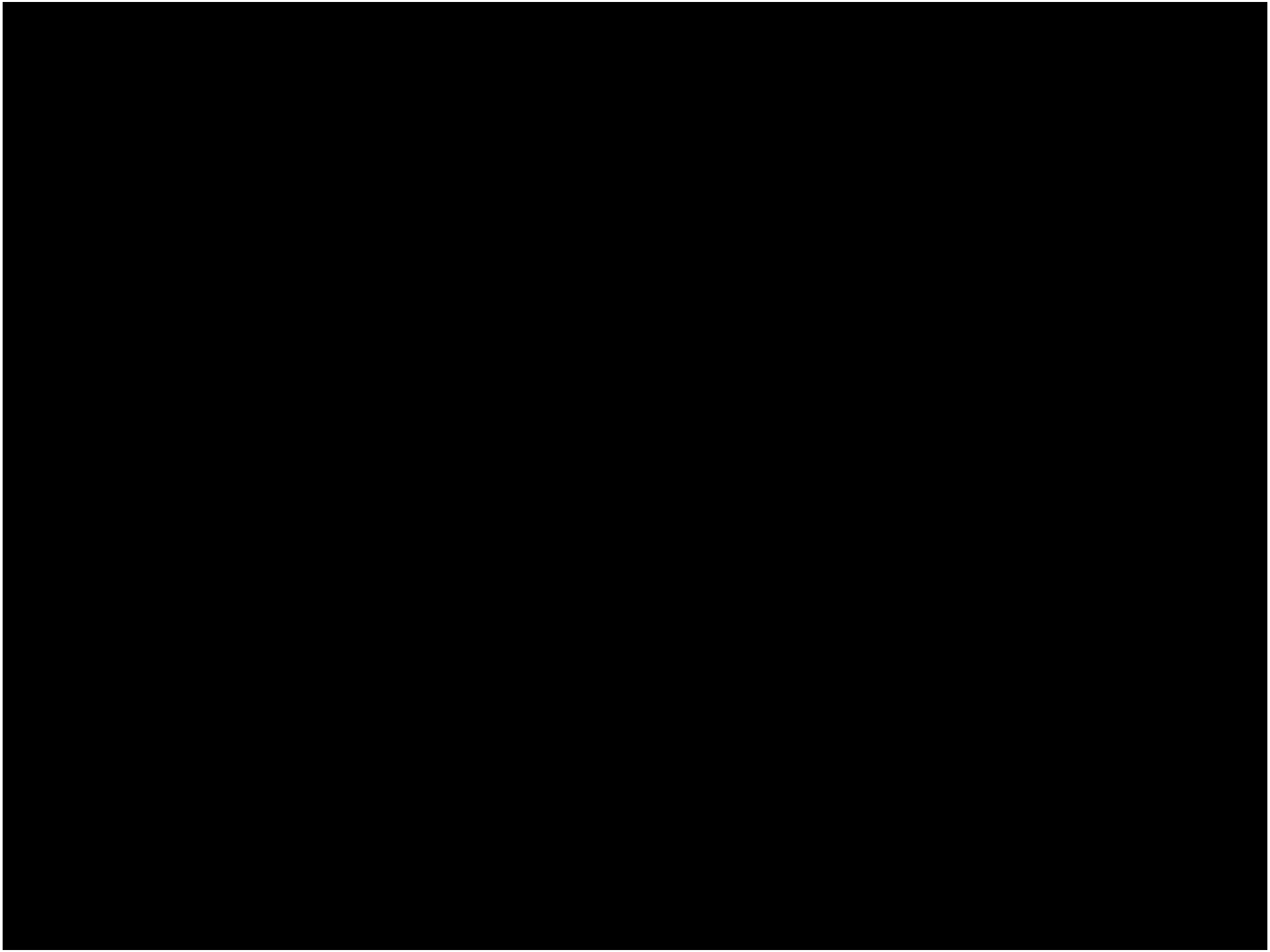
## Bi-Directional OADM Approach (Circulator Scheme)




Ex. 2012, FIG. 9; ’726 POR, p. 39; ’727 POR, p. 39

- Target Configuration:
  - 4 to 8 physically separate add/drop ports
  - Each port can add & drop multiple wavelengths
  - Each port requires a circulator to separate the add & drop channels

Ex. 2012, *35; ’726 POR, p. 39; ’727 POR, p. 39



# '368 Patent: Claim 1

**1**. An optical add-drop apparatus comprising

an input port for an input multi-wavelength optical signal having first spectral channels;

one or more other ports for second spectral channels; an output port for an output multi-wavelength optical signal;

a wavelength-selective device for spatially separating said spectral channels; **[**and**]**

a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable *in two dimensions* to reflect its corresponding spectral channel to a selected one of said ports *and to control the power of the spectral channel reflected to said selected port*.

# ’368 Patent: Claim 15

**15**. An optical add-drop apparatus, comprising

an input port for an input multi-wavelength optical signal having multiple spectral channels;

an output port for an output multi-wavelength optical signal;

one or more drop ports for selected spectral channels dropped from said multi-wavelength optical signal;

a wavelength-selective device for spatially separating said multiple spectral channels; and

a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable *in two dimensions* to reflect its corresponding spectral channel to a selected one of said ports *and to control the power of the spectral channel reflected to said selected port*, whereby a subset of said spectral channels is directed to said drop ports.

# ’368 Patent: Claim 16

**16**. An optical add-drop apparatus, comprising

an input port for an input multi-wavelength optical signal having multiple spectral channels;

an output port for an output multi-wavelength optical signal;

one or more add ports for selected spectral channels to be added to said output multi-wavelength optical signal;

a wavelength-selective device for reflecting said multiple and said selected spectral channels; and

a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable *in two dimensions* to reflect its corresponding spectral channel to a selected one of said ports *and to control the power of the spectral channel reflected to said selected port*, whereby said spectral channels from said add ports are selectively provided to said output port.

# ’368 Patent: Claim 17

17. A method of performing dynamic add and drop in a WDM optical network, comprising

separating an input multi-wavelength optical signal into spectral channels;

imaging each of said spectral channels onto a corresponding beam-deflecting element; and

controlling dynamically and continuously said beam-deflecting elements *in two dimensions* so as to combine selected ones of said spectral channels into an output multi-wavelength optical signal *and to control the power of the spectral channels combined into said output multi-wavelength optical signal.*

# ’678 Patent: Claim 1

1. A wavelength-separating-routing apparatus, comprising:

a) multiple fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports;

b) a wavelength-separator, for separating said multi-wavelength optical signal from said input port into multiple spectral channels;

c) a beam-focuser, for focusing said spectral channels into corresponding spectral spots; and

d) a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being **pivotal about two axes and being** individually and continuously controllable to reflect **[[**said**]] corresponding received** spectral channels into **any** selected ones of said output ports **and to control the power of said received spectral channels coupled into said output ports**.

# ’678 Patent: Claim 21

21. A servo-based optical apparatus comprising:

a) multiple fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports;

b) a wavelength-separator, for separating said multi-wavelength optical signal from said input port into multiple spectral channels;

c) a beam-focuser, for focusing said spectral channels into corresponding spectral spots; and

d) a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually controllable to reflect said spectral channels into selected ones of said output ports; and

e) a servo-control assembly, in communication with said channel micromirrors and said output ports, for maintaining a predetermined coupling of each reflected spectral channel into one of said output ports.

# ’678 Patent: Claim 44

44. An optical system comprising a wavelength-separating-routing apparatus, wherein said wavelength-separating-routing apparatus includes:

a) an array of fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports including a pass-through port and one or more drop ports;

b) a wavelength-separator, for separating said multi-wavelength optical signal from said input port into multiple spectral channels;

c) a beam-focuser, for focusing said spectral channels into corresponding spectral spots; and

d) a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being **pivotal about two axes and being** individually and continuously **[[**pivotable**]] controllable** to reflect **[[**said**]] corresponding received** spectral channels into **any** selected ones of said output ports **and to control the power of said received spectral channels coupled into said output ports**, whereby said pass-through port receives a subset of said spectral channels.

# ’678 Patent: Claim 61

61. A method of performing dynamic wavelength separating and routing, comprising:

a) receiving a multi-wavelength optical signal from an input port;

b) separating said multi-wavelength optical signal into multiple spectral channels;

c) focusing said spectral channels onto a spatial array of corresponding beam-deflecting elements, whereby each beam-deflecting element receives one of said spectral channels; and

d) dynamically and continuously controlling said beam-deflecting elements**[ [**, thereby directing**] ] in two dimensions to direct** said spectral channels into **[ [**a plurality**] ] any selected ones** of **said** output ports **and to control the power of the spectral channels coupled into said selected output ports**.

# Bouevitch, Figure 11

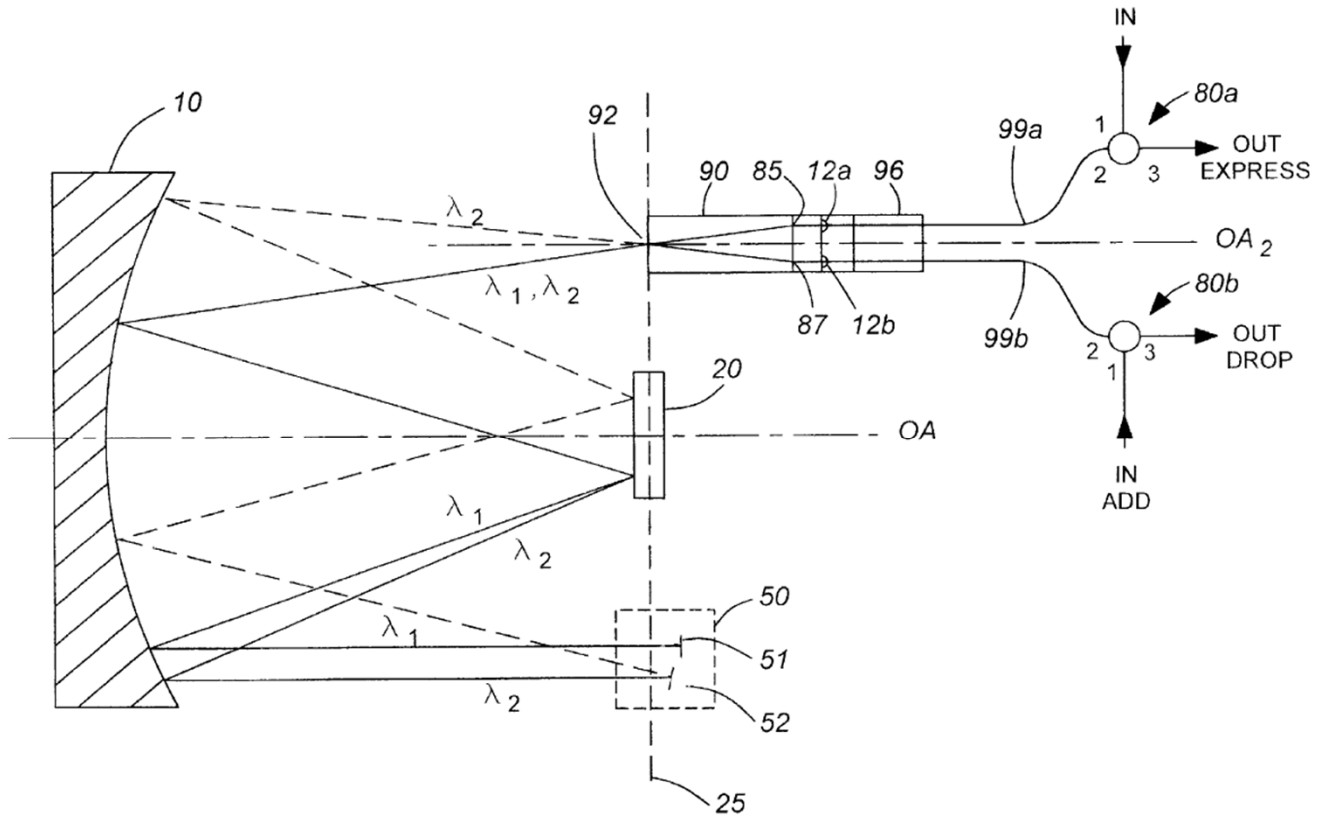



FIG. 11

Bouevitch, FIG. 11; '726 POR, p. 12; '727 POR, p. 12