IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

U.S. Patent No. 10,330,582 B2	Confirmation No.: Not Yet Assigned
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For: Flow Cytometer	
Requester: Cytek Biosciences, Inc.	

Mail Stop *Ex Parte* Reexamination
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

REQUEST FOR *EX PARTE* REEXAMINATION OF U.S. PATENT NO. 10,330,582 B2 UNDER 35 U.S.C. §§ 302-307 AND 37 C.F.R. § 1.510 *ET SEQ.*

Dear Sir or Madam:

Pursuant to 35 U.S.C. §§ 302-307 and 37 C.F.R. § 1.510 *et seq.*, the undersigned, on behalf of Cytek Biosciences, Inc. ("Requester"), respectfully request *ex parte* reexamination of claims 1-3, 6, 14, 15, 17, 18, 20, 21, 23, 25 and 26 of U.S. Patent No. 10,330,582 B2 ("the '582 patent") issued to Yong Qin Chen and currently assigned to Beckman Coulter, Inc. ("Patent Owner"), in light of the

substantial new questions of patentability ("SNQs") provided herein. A copy of the '582 patent is attached as **Exhibit A**.

TABLE OF CONTENTS

Page

I. INTRODUCTION 1

II. REQUIREMENTS FOR *EX PARTE* REEXAMINATION UNDER 37 C.F.R. § 1.510 3

A. Payment of Fees – 37 C.F.R. § 1.510(a) 4

B. Prior Art Patents and Printed Publications – 37 C.F.R. § 1.510(a) 4

C. Identification of Substantial New Questions of Patentability – 37 C.F.R. § 1.510(b)(1) 6

D. Identification of Claims for *Ex Parte* Reexamination – 37 C.F.R. § 1.510(b)(2) 10

E. Copy of Prior Art and Translations – 37 C.F.R. § 1.510(b)(3) 11

F. Copy of U.S. Patent No. 10,330,582 B2 – 37 C.F.R. § 1.510(b)(4) 11

G. Certification of Service on Patent Owner – 37 C.F.R. § 1.510(b)(5) 11

H. Certification That Estoppel Does Not Prohibit *Ex Parte* Reexam – 37 C.F.R. § 1.510(b)(6) 11

III. IDENTIFICATION AND STATUS OF LITIGATION INVOLVING THE CHALLENGED PATENT 12

IV. CONSTRUCTION OF THE CHALLENGED CLAIMS 12

V. DETAILED EXPLANATION OF THE PERTINENCE AND MANNER OF APPLYING THE PRIOR ART 17

A. TECHNOLOGY BACKGROUND 17

1. Flow Cytometers 17

2. Wavelength Division Demultiplexers 19

3. Avalanche Photodiodes (APDs) in Flow Cytometry 21

B. '582 PATENT 23

C. LEVEL OF ORDINARY SKILL 25

D. PRIORITY DATE OF THE CHALLENGED CLAIMS 26

E. BRIEF OVERVIEW OF THE PRIOR ART 33

1. Chen Pub '174 [Exhibit QQQ] 33
2. Chandler [Exhibit TT] 34
3. Goodman [Exhibit P] 35
4. Hamamatsu [Exhibit XX, Exhibit YY] 37
5. Oostman [Exhibit E] 37
6. Frazier [Exhibit I] 40

F. SNQ No. 1: Claims 1, 2, 3, 6, 14, 15, 17, 18, 20, 21, 22, 23, 25, 26 are Unpatentable as Anticipated and/or Obvious Over Over U.S. Pat. App. Pub. No. 2015/0115174 (Chen Pub '174) 41

1. Independent Claim 1 41

a. Claim 1[pre]: "An optical subsystem for a flow cytometer, the optical subsystem comprising:" 41

b. Claim 1[a]: "a collimating optical element arranged to receive light from a light source, the collimating optical element configured to project a collimated beam;" 43

c. Claim 1[b]: "an optical relay element arranged to receive at least a portion of the collimated beam from the collimating optical element," 45

d. Claim 1[c]: "the optical relay element comprising a curved mirror configured to reflect the portion of the collimated beam received from the collimating optical element to produce a first image;" 48

e. Claim 1[d]: "a first focusing optical element arranged to receive at least a portion of the collimated beam reflected by the optical relay element; and" 51

f. Claim 1[e]: "a first semiconductor detector," 54

g. Claim 1[f]: "wherein the first focusing optical element is configured to focus the portion of the collimated beam received from the optical relay element onto the first semiconductor detector." 56

2. Claim 2: "further comprising the light source, wherein the light source comprises light passing through a pinhole or light emitted from a facet of a multimode optical fiber." 58

3. Claim 3: "wherein the first focusing optical element is configured to focus the portion of the collimated beam received from the optical relay element to a size smaller than 1 millimeter in diameter." 59

4. Claim 6: "further comprising a first optical filter disposed along an optical path between the collimating optical element and the optical relay element, the first optical filter configured to separate the collimated beam into a first branch and a second branch." 59

5. Independent Claim 14 61

   a. Claim 14[pre]: "An optical subsystem for a flow cytometer, the optical subsystem comprising:" 61

   b. Claim 14[a]: "a collimating optical element arranged to receive light from a light source," 61

   c. Claim 14[a][i]: "the collimating optical element configured to project a collimated beam including a first image," 61

   d. Claim 14[a][ii]: "wherein the collimated beam has a collimated distance; and" 62

   e. Claim 14[b]: "an optical relay element arranged to receive the collimated beam," 63

   f. Claim 14[b][i]: "the optical relay element configured to extend the collimated distance of the collimated beam," 64

   g. Claim 14[b][ii]: "wherein the optical relay element comprises a curved mirror or a concave-shaped dichroic filter configured to produce a second image." 65

6. Claim 15: "wherein the second image and the first image are substantially the same size." 65

7. Claim 17: "further comprising a first focusing optical element arranged to receive the collimated beam from the optical relay element at the extended collimated distance, the first focusing optical element configured to focus the collimated beam onto a first semiconductor detector." 66

8. Claim 18: "an optical filter arranged along an optical path between the collimating optical element and the optical relay element, the optical filter configured to separate the collimated beam into a first branch and a second branch, wherein the first branch and the second branch comprise light of different colors, wherein the optical relay element is arranged to receive the first branch; and a second focusing optical element arranged to receive the second branch, the second focusing optical element configured to focus the second branch to a second semiconductor detector." 66

9. Independent Claim 20 69

   a. Claim 20[pre]: "An optical subsystem for a flow cytometer, the optical subsystem comprising:" 69

   b. Claim 20[a]: "a collimating optical element arranged to receive light from a light source, the collimating optical element configured to project a first image; and" 69

   c. Claim 20[b]: "an optical relay element arranged near the first image, the optical relay element configured to receive light from the collimating optical element and to project a second image;" 69

   d. Claim 20[b][i]: "wherein the size of the first image is substantially the same as the size of the second image, and" 71

   e. Claim 20[b][ii]: "wherein the optical relay element comprises a curved mirror or a concave-shaped dichroic filter." 71

10. Claim 21: "wherein the optical distance from the collimating optical element to the first image is

substantially the same as the optical distance from the optical relay element to the second image." 71

11. Claim 22: "further comprising the light source, wherein the light source comprises an extended light source that forms an object, wherein the first image is a magnified image of the object." 72

12. Claim 23: "wherein the light source comprises light passing through a pinhole or light emitted from a facet of a multimode optical fiber." 73

13. Claim 25: "wherein the first image is less than approximately 10 times the size of the object." 73

14. Claim 26: "further comprising a first focusing optical element arranged near the second image, the first focusing optical element configured to focus the light from the optical relay element to a size smaller than the object of the light source to a first semiconductor detector." 74

G. SNQ No. 2: Claims 1, 2, 3, 6, 14, 15, 17, 18, 20, 21, 22, 23, 25, 26 are Unpatentable as Obvious Over Chandler in View of Goodman. 75

1. Motivation to Combine Chandler with Goodman and Reasonable Expectation of Success 75

2. Independent Claim 1 78

a. Claim 1[pre]: "An optical subsystem for a flow cytometer, the optical subsystem comprising:" 78

b. Claim 1[a]: "a collimating optical element arranged to receive light from a light source, the collimating optical element configured to project a collimated beam;" 80

c. Claim 1[b]: "an optical relay element arranged to receive at least a portion of the collimated beam from the collimating optical element," 82

d. Claim 1[c]: "the optical relay element comprising a curved mirror configured to reflect the portion of

the collimated beam received from the collimating optical element to produce a first image;".....84

e. Claim 1[d]: "a first focusing optical element arranged to receive at least a portion of the collimated beam reflected by the optical relay element; and".....86

f. Claim 1[e]: "a first semiconductor detector,".....89

g. Claim 1[f]: "wherein the first focusing optical element is configured to focus the portion of the collimated beam received from the optical relay element onto the first semiconductor detector.".....90

3. Claim 2: "further comprising the light source, wherein the light source comprises light passing through a pinhole or light emitted from a facet of a multimode optical fiber." 90

4. Claim 3: "wherein the first focusing optical element is configured to focus the portion of the collimated beam received from the optical relay element to a size smaller than 1 millimeter in diameter.".....92

5. Claim 6: "further comprising a first optical filter disposed along an optical path between the collimating optical element and the optical relay element, the first optical filter configured to separate the collimated beam into a first branch and a second branch.".....95

6. Independent Claim 14 97

a. Claim 14[pre]: "An optical subsystem for a flow cytometer, the optical subsystem comprising:".....97

b. Claim 14[a]: "a collimating optical element arranged to receive light from a light source,".....97

c. Claim 14[a][i]: "the collimating optical element configured to project a collimated beam including a first image,".....97

d. Claim 14[a][ii]: "wherein the collimated beam has a collimated distance; and".....99

e. Claim 14[b]: "an optical relay element arranged to receive the collimated beam," 101

f. Claim 14[b][i]: "the optical relay element configured to extend the collimated distance of the collimated beam," 101

g. Claim 14[b][ii]: "wherein the optical relay element comprises a curved mirror or a concave-shaped dichroic filter configured to produce a second image." 103

7. Claim 15: "wherein the second image and the first image are substantially the same size." 104

8. Claim 17: "further comprising a first focusing optical element arranged to receive the collimated beam from the optical relay element at the extended collimated distance, the first focusing optical element configured to focus the collimated beam onto a first semiconductor detector." 106

9. Claim 18: "an optical filter arranged along an optical path between the collimating optical element and the optical relay element, the optical filter configured to separate the collimated beam into a first branch and a second branch, wherein the first branch and the second branch comprise light of different colors, wherein the optical relay element is arranged to receive the first branch; and a second focusing optical element arranged to receive the second branch, the second focusing optical element configured to focus the second branch to a second semiconductor detector." 106

10. Independent Claim 20 108

a. Claim 20[pre]: "An optical subsystem for a flow cytometer, the optical subsystem comprising:" 108

b. Claim 20[a]: "a collimating optical element arranged to receive light from a light source, the collimating optical element configured to project a first image; and" 108

c. Claim 20[b]: "an optical relay element arranged near the first image, the optical relay element

configured to receive light from the collimating optical element and to project a second image;".....109

d. Claim 20[b][i]: "wherein the size of the first image is substantially the same as the size of the second image, and".....110

e. Claim 20[b][ii]: "wherein the optical relay element comprises a curved mirror or a concave-shaped dichroic filter.".....111

11. Claim 21: "wherein the optical distance from the collimating optical element to the first image is substantially the same as the optical distance from the optical relay element to the second image.".....111

12. Claim 22: "further comprising the light source, wherein the light source comprises an extended light source that forms an object, wherein the first image is a magnified image of the object.".....112

13. Claim 23: "wherein the light source comprises light passing through a pinhole or light emitted from a facet of a multimode optical fiber.".....114

14. Claim 25: "wherein the first image is less than approximately 10 times the size of the object.".....114

15. Claim 26: "further comprising a first focusing optical element arranged near the second image, the first focusing optical element configured to focus the light from the optical relay element to a size smaller than the object of the light source to a first semiconductor detector.".....116

H. SNQ No. 3: Claims 3, 26 are Unpatentable as Obvious Over Chandler in View of Goodman and Hamamatsu.....117

1. Motivation to Combine Chandler and Goodman with Hamamatsu and Reasonable Expectation of Success.....117

2. Claim 3: "wherein the first focusing optical element is configured to focus the portion of the collimated beam received from the optical relay element to a size smaller than 1 millimeter in diameter.".....118

3. Claim 26: "further comprising a first focusing optical element arranged near the second image, the first focusing optical element configured to focus the light from the optical relay element to a size smaller than the object of the light source to a first semiconductor detector." 118

I. SNQ No. 4: Claims 1, 2, 3, 6, 14, 15, 17, 18, 20, 21, 22, 23, 25, 26 are Unpatentable as Obvious Over Oostman in View of Goodman and Frazier. 119

1. Motivation to Combine Oostman and Goodman and Reasonable Expectation of Success 119

2. Motivation to Combine Oostman and Goodman with Frazier and Reasonable Expectation of Success 121

3. Independent Claim 1 123

a. Claim 1[pre]: "An optical subsystem for a flow cytometer, the optical subsystem comprising:" 123

b. Claim 1[a]: "a collimating optical element arranged to receive light from a light source, the collimating optical element configured to project a collimated beam;" 124

a. Claim 1[b]: "an optical relay element arranged to receive at least a portion of the collimated beam from the collimating optical element," 125

b. Claim 1[c]: "the optical relay element comprising a curved mirror configured to reflect the portion of the collimated beam received from the collimating optical element to produce a first image;" 126

c. Claim 1[d]: "a first focusing optical element arranged to receive at least a portion of the collimated beam reflected by the optical relay element; and" 128

d. Claim 1[e]: "a first semiconductor detector," 129

e. Claim 1[f]: "wherein the first focusing optical element is configured to focus the portion of the

collimated beam received from the optical relay element onto the first semiconductor detector."....130

4. Claim 2: "further comprising the light source, wherein the light source comprises light passing through a pinhole or light emitted from a facet of a multimode optical fiber." 130

5. Claim 3: "wherein the first focusing optical element is configured to focus the portion of the collimated beam received from the optical relay element to a size smaller than 1 millimeter in diameter." 132

6. Claim 6: "further comprising a first optical filter disposed along an optical path between the collimating optical element and the optical relay element, the first optical filter configured to separate the collimated beam into a first branch and a second branch." 132

7. Independent Claim 14 134

   a. Claim 14[pre]: "An optical subsystem for a flow cytometer, the optical subsystem comprising:"....134

   b. Claim 14[a]: "a collimating optical element arranged to receive light from a light source," 134

   c. Claim 14[a][i]: "the collimating optical element configured to project a collimated beam including a first image,"....134

   d. Claim 14[a][ii]: "wherein the collimated beam has a collimated distance; and"....135

   e. Claim 14[b]: "an optical relay element arranged to receive the collimated beam," 136

   f. Claim 14[b][i]: "the optical relay element configured to extend the collimated distance of the collimated beam,"....136

   g. Claim 14[b][ii]: "wherein the optical relay element comprises a curved mirror or a concave-shaped dichroic filter configured to produce a second image."....137

8. Claim 15: "wherein the second image and the first image are substantially the same size." 139

9. Claim 17: "further comprising a first focusing optical element arranged to receive the collimated beam from the optical relay element at the extended collimated distance, the first focusing optical element configured to focus the collimated beam onto a first semiconductor detector." 140

10. Claim 18: "an optical filter arranged along an optical path between the collimating optical element and the optical relay element, the optical filter configured to separate the collimated beam into a first branch and a second branch, wherein the first branch and the second branch comprise light of different colors, wherein the optical relay element is arranged to receive the first branch; and a second focusing optical element arranged to receive the second branch, the second focusing optical element configured to focus the second branch to a second semiconductor detector." 141

11. Independent Claim 20 142

    a. Claim 20[pre]: "An optical subsystem for a flow cytometer, the optical subsystem comprising:" 142

    b. Claim 20[a]: "a collimating optical element arranged to receive light from a light source, the collimating optical element configured to project a first image; and" 143

    c. Claim 20[b]: "an optical relay element arranged near the first image, the optical relay element configured to receive light from the collimating optical element and to project a second image;" 143

    d. Claim 20[b][i]: "wherein the size of the first image is substantially the same as the size of the second image, and" 144

    e. Claim 20[b][ii]: "wherein the optical relay element comprises a curved mirror or a concave-shaped dichroic filter." 145

12. Claim 21: "wherein the optical distance from the collimating optical element to the first image is substantially the same as the optical distance from the optical relay element to the second image." 145

13. Claim 22: "further comprising the light source, wherein the light source comprises an extended light source that forms an object, wherein the first image is a magnified image of the object." 146

14. Claim 23 "wherein the light source comprises light passing through a pinhole or light emitted from a facet of a multimode optical fiber." 147

15. Claim 25 "wherein the first image is less than approximately 10 times the size of the object." 147

16. Claim 26: "further comprising a first focusing optical element arranged near the second image, the first focusing optical element configured to focus the light from the optical relay element to a size smaller than the object of the light source to a first semiconductor detector." 149

J. SNQ No. 5: Claims 3, 26 are Unpatentable as Obvious Over Oostman in View of Goodman, Frazier, and Hamamatsu. 149

1. Motivation to Combine Oostman, Goodman, and Frazier with Hamamatsu and Reasonable Expectation of Success 149

2. Claim 3: "wherein the first focusing optical element is configured to focus the portion of the collimated beam received from the optical relay element to a size smaller than 1 millimeter in diameter." 149

3. Claim 26: "further comprising a first focusing optical element arranged near the second image, the first focusing optical element configured to focus the light from the optical relay element to a size smaller than the object of the light source to a first semiconductor detector." 150

VI. LIST OF EXHIBITS 150

VII. CONCLUSION 157

I. INTRODUCTION

Requester respectfully requests *ex parte* reexamination of claims 1, 2, 3, 6, 14, 15, 17, 18, 20, 21, 22, 23, 25, 26 of U.S. Patent No. 10,330,582 B2 ("'582" or "'582 patent") (collectively, the "Challenged Claims"). The Challenged Claims attempt to capture decades-old demultiplexing technology from the analogous field of optical communications to the detection optics in a flow cytometer. This WDM—wavelength division [de]multiplexer—separates fluorescent and scattered light, collected from a flow cell and transported through an optical fiber, into distinct color bands (i.e., wavelength ranges) for photodetection through use of a series of filters and mirrors.

But the Challenged Claims are overbroad and go beyond what the applicant disclosed in its priority applications. The '528 patent is a continuation application of U.S. Patent No. 9,746,412 (the "'412 patent") **[Exhibit MMM]**, which is a continuation-in-part of PCT/US2013/043453 (the "PCT App.") **[Exhibit NNN]**. Each independent claim in the '528 patent recites a "curved mirror" that lacks written description support and had not been previously claimed. Examiners at the European Patent Office ("EPO") recognized this issue during prosecution of EP2415670 that shares the same priority applications as the '582 patent. In issuing a rejection on the claims, examiners at the EPO indicated that "a curved mirror is introduced, but the parent application does not disclose a generic curved mirror, but

a concave mirror." (Ex. SSS, p.039.) Rather than provide the examiners with citations to the written description to support "curved mirror," Patent Owner instead narrowed its claims to narrow curved mirror to the only mirror supported by the written description—a concave mirror. (Ex. SSS, p.016.)

The lack of written description support for "curved mirror" strips the '582 claims of claiming priority back to the '412 patent or PCT App, such that (1) the claims are accorded priority as the filing date for the non-provisional utility application to the '582 patent, June 30, 2017; and (2), as a result, the AIA governs. *See, e.g.*, *Tesla, Inc. v. iQar, Inc.*, IPR2024-00630, Paper 7 at 14-17 (P.T.A.B. Sept. 26, 2024) (lack of written description support for claim limitations defeats priority claim to prior application(s))); *Lam Rsch. Corp. v. Inpria Corp.*, IPR2024-00033, Paper 13 at 13-15 (P.T.A.B. Apr. 24, 2024) (same); *LTI Flexible Prods., Inc. v. Regents of Univ. of Cal.*, IPR2021-01189, Paper 13 at 17-18 (P.T.A.B. Jan. 11, 2022) (same). Requester cites to U.S. 2015/0115174 (**Exhibit QQQ** ("**Chen Pub '174**")) in SNQ No. 1, the published application of the '412 patent, as anticipating prior art to the '582 claims. *Tesla*, IPR2024-00630, Paper 7 at 27-32 (finding parent publication anticipating prior art); *Lam Rsch.*, IPR2024-00033, Paper 13 at 7-8 (same); *LTI Flexible Prods.*, IPR2021-01189, Paper 13 at 20 (same).

Setting aside the inventor's prior publication, the claimed WDM configuration had been publicly disclosed in flow cytometry before the time of the

alleged invention, including the current Patent Owner's publications. (**Exhibit I** ("**Frazier**").) The only remaining point of purported novelty, use of a "semiconductor detector," had been used in flow cytometers for over twenty years and is also disclosed in **Exhibit I**, among other references. Requester logically combines and applies these well-known features from the prior art to demonstrate the obviousness of the Challenged Claims in SNQ Nos. 2-5.

II. REQUIREMENTS FOR *EX PARTE* REEXAMINATION UNDER 37 C.F.R. § 1.510

Pursuant to 37 C.F.R. § 1.510, each requirement for *ex parte* reexamination is satisfied. The application for the '582 patent was filed on June 30, 2017 as a continuation-in-part to an application filed on May 30, 2013. First, the '582 patent currently sits within the six-year window of enforceability for seeking *ex parte* reexamination. Second, the '582 patent is currently the subject of patent infringement litigation filed by Patent Owner against Requester, *Beckman Coulter, Inc. v. Cytek Biosciences, Inc.*, No. 1:24-cv-00945-CFC-EGT (D. Del. filed June 5, 2025), which is currently pending in the U.S. District Court for the District of Delaware. (Exhibit U (Complaint).) For both reasons, the '582 patent is eligible for *ex parte* reexamination. *See* MPEP 2211 ("Under 37 CFR 1.510(a), any person may, at any time during the period of enforceability of a patent, file a request for *ex parte* reexamination.... The period of enforceability is generally determined by adding 6

years to the date on which the patent expires but the period may be extended if there is pending litigation." (underlining added)).

A. Payment of Fees – 37 C.F.R. § 1.510(a)

Requester authorizes the Patent and Trademark Office to charge Deposit Account No. 50-1283 for the fees set forth in **37 C.F.R. § 1.20(c)(1)**.

B. Prior Art Patents and Printed Publications – 37 C.F.R. § 1.510(a)

Pursuant to 35 U.S.C. §§ 301-302 and 37 C.F.R. § 1.510, Requester identifies the following patents and printed publications on which this Request is based.

Prior Art Reference	Exhibit
U.S. Patent Application Publication No. 2015/0115174 A1 to Yong Qin Chen (filed Nov. 26, 2014; published Apr. 30, 2015) ("**Chen Pub '174**")	QQQ
U.S. Patent No. 6,139,800 to Van S. Chandler (filed June 22, 1998; published Oct. 31, 2000) ("**Chandler**")	TT
U.S. Patent No. 6,542,306 B2 to Timothy D. Goodman (filed March 16, 2001; published April 1, 2003) ("**Goodman**")	P
Archived website page for Hamamatsu NIR High Sensitivity Type products, (June 20, 2010), https://web.archive.org/web/20100620045039/http://jp.hamamatsu.com/products/sensor-ssd/pd078/pd079/pd083/index_en.html	XX
Archived website page for Hamamatsu Short Wavelength Type products, (June 20, 2010), https://web.archive.org/web/20100620044720/http://jp.hamamatsu.com/products/sensor-ssd/pd078/pd079/pd082/index_en.html	YY
U.S. Patent No. 6,683,314 B2 to Clifford A. Oostman, Jr. et al. (filed August 28, 2001; published January 27, 2004) ("**Oostman**")	E

Prior Art Reference	Exhibit
U.S. Patent No. 8,284,402 B2 to Erich Frazier et al. (filed February 26, 2010; published October 9, 2012) ("**Frazier**")	I

Each of these references qualifies as a prior art patent or printed publication with respect to the '582 patent. With respect to Hamamatsu, these qualify as printed publications under at least pre-AIA 35 U.S.C. § 102(a)-(b) or AIA 35 U.S.C. § 102(a) because each of these references was published before the earliest patent application to which the '582 patent claims priority, as explained in the accompanying Affidavit of Mina Ching (**Exhibit KKK**). Chandler, Goodman, and Oostman likewise qualify as prior art under at least pre-AIA 35 U.S.C. § 102(a)-(b) or AIA 35 U.S.C. § 102(a)(1) because each of these were published before the earliest patent application to which the '582 patent claims priority. Frazier qualifies as prior art under at least pre-AIA 35 U.S.C. § 102(e) or AIA 35 U.S.C. § 102(a)(1) because it was filed before the earliest patent application to which the '582 patent claims priority. Chen Pub '174 qualifies as prior art under AIA 35 U.S.C. § 102(a)(1) because it was published on April 30, 2015 over two years before the June 30, 2017 filing date for the '582 patent, and no exception under AIA 35 U.S.C. § 102(b) applies.

C. Identification of Substantial New Questions of Patentability – 37 C.F.R. § 1.510(b)(1)

This Request is based upon prior art documents identified on the accompanying Patent and Trademark Office Form SB/08a.

The detailed explanation of each new SNQ is provided in **Part V**, below. The SNQs presented by this Request for claims 1, 2, 3, 6, 14, 15, 17, 18, 20, 21, 23, 25, and 26 are listed below:

SNQ No.	SNQ (Written as Proposed Rejections for the '582 Patent)
1	Whether claims 1, 2, 3, 6, 14, 15, 17, 18, 20, 21, 22, 23, 25, 26 are unpatentable as anticipated over Chen Pub '174
2	Whether claims 1, 2, 3, 6, 14, 15, 17, 18, 20, 21, 22, 23, 25, 26 are unpatentable as obvious over Chandler in view of Goodman
3	Whether claims 3, 26 are unpatentable as obvious over Chandler in view of Goodman and Hamamatsu
4	Whether claims 1, 2, 3, 6, 14, 15, 17, 18, 20, 21, 22, 23, 25, 26 are unpatentable as obvious over Oostman in view of Goodman and Frazier
5	Whether claims 3, 26 are unpatentable as obvious over Oostman in view of Goodman, Frazier, and Hamamatsu

Each of the prior art references cited above raises a substantial new question (SNQ) of patentability of the challenged claims. As explained in **Part V** below, which provides a detailed explanation of the pertinence and manner of applying the prior art, these references disclose and render obvious all limitations of the challenged claims. Requester has also provides a Declaration of Fedor A. Ilkov

(**Exhibit B**), a qualified technical expert, who describes the state of the art at the time of the alleged invention and further explains why the Challenged Claims are unpatentable based on anticipation and/or obviousness based on the prior art cited here.

This Request does not present a situation in which "the same or substantially the same prior art or arguments previously were presented to the Office." 35 U.S.C. § 325(d). In the parent application to the '582 patent, the applicant submitted an IDS spanning hundreds of references cited (Ex. X, pp.002-011), prompting the Examiner to request applicant's input on information of "particular relevance." (*Id.*, p.046.) In response, the applicant did not identify the prior art cited in the Request for "higher degree consideration" during prosecution, instead submitting another IDS citing hundreds of references. (Ex. C, pp.147-160.)

The prior art is not the same or substantially the same as what was previously presented to the Patent Office. Chandler and Hamamatsu were never cited during prosecution. Although Goodman, Frazier, and Oostman were included in the applicant's expansive IDS, Goodman and Frazier were never discussed during prosecution.

During prosecution, the applicant received rejections based on U.S. Patent Pub. Appl. No. 2003/0045967 to Heffelfinger ("Heffelfinger"), U.S. Patent No. 4,385,234 to Johnson ("Johnson"), U.S. Patent Pub. Appl. No. 2005/0002425 to

Govorkov ("Govorkov"), and U.S. Patent No. 6,683,314 to Oostman. (Ex. C, pp.530-542.) The Examiner relied on Oostman in a § 102 rejection based on disclosures related to FIG. 5 (*id.*, pp.537-540.), but SNQ Nos. 4 and 5 rely on Oostman for the limited purpose of disclosing (1) an optical subsystem used in a flow cytometer (with reference to FIG. 4); (2) the redundant disclosure of a multimode optical fiber, consistent with Goodman; and (3) a collimating optical element. At base, SNQ Nos. 4 and 5 rely primarily on Goodman for the majority of the limitations in the challenged claims.

Chen Pub '174 was never considered because the Examiner did not issue a rejection that would require a priority determination. Longstanding black letter law recognizes that "[i]n the absence of an interference or rejection which would require the PTO to make a determination of priority, the PTO does not make such findings as a matter of course in prosecution." *PowerOasis, Inc. v. T-Mobile USA, Inc.*, 522 F.3d 1299, 1305 (Fed. Cir. 2008). To the extent Patent Owner contends the Examiner considered the applicant's priority claim, the Examiner respectfully committed a material error that affects the patentability of the Challenged Claims for the reasons discussed in Section V.D below and in SNQ No. 1 in **Part V**.

Chen Pub '174, Chandler, Goodman, Frazier, and Hamamatsu are not cumulative with prior art that the Examiner substantively examined during prosecution. Chandler is distinguishable in its flow cytometer configuration and use

of APD detectors. Frazier and Hamamatsu are both distinguishable in their disclosures related to APDs. Chen Pub '174 and Goodman differ from Heffelfinger and Oostman at least because they disclose an "**optical relay element that includes a curved mirror**"—a key limitation that permitted the applicant to overcome these references during prosecution. (*See* Ex. C, pp.575-577 (Heffelfinger), 579-581 (Oostman).) Chen Pub '174 and Goodman are further differentiated from Heffelfinger because they disclose an "**optical relay element ... configured to reflect a portion of a collimated beam received from a collimating optical element**" for the reasons discussed in **Part V** below. The applicant argued during prosecution that "Heffelfinger describes that the focused beam passes through relay lens 42. Heffelfinger does not describe that the relay lens reflects a portion of a collimated beam[.]" (Ex. C, p.578.) Goodman describes how its collimating reflectors receive a collimated beam in each of SNQ Nos. 2-5 as shown in **Part V**. Chen Pub '174 includes concave mirrors that receive a collimated beam from a collimating optical element, as discussed in SNQ No. 1.

The arguments in **Part V** related to SNQ Nos. 1-5 are not the same or substantially the same as those made during prosecution. The Examiner during prosecution raised a § 102(b) claim rejection and a § 103(a) claim rejection based on Oostman, a § 102(b) claim rejection and a § 103(a) claim rejection based on Heffelfinger, a § 103(a) claim rejection based on Heffelfinger in combination with

Johnson, and a § 103(a) claim rejection based on Oostman in combination with Gorokov. (Ex. C, pp.530-542.) The Examiner relied on Gorokov to provide the concave mirror absent from Oostman, and Johnson to provide the "achromatic doublet lens" for a dependent claim (not challenged here) absent from Heffelfinger. (*Id.*, pp.540-542.) Requester's arguments in SNQ Nos. 1-5 are fundamentally different. Only Chen Pub '174 in SNQ No. 1 relies on anticipation, and its concave mirror disclosures cover what is expressly absent from Heffelfinger and Oostman. Chandler and Oostman are separately combined with Goodman in SNQ Nos. 2 and 4, respectively, to implement Goodman's wavelength division [de]multiplexer (WDM) architecture in Chandler and Oostman's flow cytometers. Frazier is combined with Oostman and Goodman in SNQ No. 4 for its disclosures on use of avalanche photodiodes (APDs) in a WDM. And SNQ Nos. 3 and 5 add express disclosures from Hamamatsu on small area APDs that a skilled artisan would have implemented in Goodman's WDM.

D. Identification of Claims for *Ex Parte* Reexamination – 37 C.F.R. § 1.510(b)(2)

Requester respectfully requests *ex parte* reexamination of claims 1, 2, 3, 6, 14, 15, 17, 18, 20, 21, 23, 25, and 26 of the '582 patent. Claims 1, 14, and 20 are independent claims. Detailed explanations of the pertinence and manner of applying the prior art to each claim for which reexamination is requested may be found in **Part V** below.

E. Copy of Prior Art and Translations – 37 C.F.R. § 1.510(b)(3)

A copy of the prior art relied upon in this Request is included as **Exhibits E, I, P, TT, XX, YY, QQQ**. Because all of these references are in the English language, no translation is provided.

F. Copy of U.S. Patent No. 10,330,582 B2 – 37 C.F.R. § 1.510(b)(4)

Attached as **Exhibit A** is a copy of the '582 patent as required by 37 C.F.R. § 1.510(b)(4).

G. Certification of Service on Patent Owner – 37 C.F.R. § 1.510(b)(5)

The undersigned certifies that a complete and entire copy of this Request for *Ex Parte* Reexamination and all supporting documents have been provided to Patent Owner by serving the attorney/agent of record with the U.S. Patent and Trademark Office ("Patent Office") for the '582 patent, at the following address:

129381 – NORTON ROSE FULBRIGHT US LLP – BCI,
98 San Jacinto Blvd., Suite 1100,
Austin, TX 78701

A complete and entire copy of this Request for *Ex Parte* Reexamination and all supporting documents will also be provided to Patent Owner's counsel of record in the ongoing litigation identified in **Part III** below.

H. Certification That Estoppel Does Not Prohibit *Ex Parte* Reexam – 37 C.F.R. § 1.510(b)(6)

Requester hereby certifies that it is not prohibited under the provisions of 35 U.S.C. §§ 315(e)(1) or 325(e)(1) from filing this Request for *Ex Parte*

Reexamination. Neither Requester nor those in privity with Requester have requested an *Inter Partes* Review or Post-Grant Review of the '582 patent that has resulted in a final written decision. *See* 35 U.S.C. §§ 315(e)(1), 325(e)(1); 37 C.F.R. § 1.510(b)(6).

III. IDENTIFICATION AND STATUS OF LITIGATION INVOLVING THE CHALLENGED PATENT

The '582 patent is the subject of pending litigation against Requester in *Beckman Coulter, Inc. v. Cytek Biosciences, Inc.*, No. 1:24-cv-00945-CFC-EGT (D. Del. filed June 5, 2025), in which Patent Owner asserts that Requester infringes certain claims of the '582 patent. This case remains pending. Requester also recently challenged the related U.S. Patent No. 11,703,443 in *Cytek Biosciences, Inc. v. Beckman Coulter, Inc.*, IPR2025-01319.

IV. CONSTRUCTION OF THE CHALLENGED CLAIMS

As explained in more detail below, Requester does not believe the challenged claims require express construction by the Examiner in order to apply the claims to the prior art identified in this Request. Requester nevertheless, in the interests of completeness, identifies below (1) competing constructions proposed by Patent Owner and Requester in the pending action involving the '582 patent, and (2) constructions upon which the parties to that action have agreed. Requester respectfully submits that the challenged claims are invalid based on at least Patent Owner's constructions proposed in the pending litigation and certainly under any

other reasonable construction. For the convenience of the Examiner, the analysis provided in **Part V** explains how the prior art discloses the claim limitations under each of the proposed or agreed-upon constructions from the pending litigation unless otherwise specified.

The table below identifies proposed constructions of certain claim terms proposed by Patent Owner and Requester in the pending litigation involving the '582 patent:

Claim Term	**Patent Owner Proposed Construction**	**Requester's Proposed Construction**
"first" / "second"	No construction necessary; plain and ordinary meaning. *That is*: An element or limitation as distinguished from another instance of the element or limitation; "first" and "second" are used to distinguish between repeated instances of an element or limitation	**First**: "initial [curved mirror / focusing optical element / filter/ optical filter / dichroic filter / semiconductor detector / image] in the optical path through the WDM," otherwise indefinite. **Second**: "second sequential [filter / focusing optical element / semiconductor detector] after an initial [filter / focusing optical element / semiconductor detector / image] in the optical path through the WDM," otherwise indefinite.
"collimating" / "collimate"	No construction necessary; plain and ordinary meaning.	"making/make rays of light that originate from a point on the source parallel to each other and not converging

Claim Term	Patent Owner Proposed Construction	Requester's Proposed Construction
	That is: rendering /render rays of light more nearly parallel	(i.e., focused) or diverging," otherwise indefinite.
"collimated beam"	No construction necessary; plain and ordinary meaning. *That is*: a beam with nearly parallel rays	"a beam wherein all rays of light originating from a point on the source are projected parallel with each other and those rays within the beam are neither converging (i.e., a focused beam) or diverging," otherwise indefinite.
"image"	No construction necessary; plain and ordinary meaning. *That is*: representation of an object	"a pictorial representation of an object (e.g., light source) where rays of light from points on the object are focused to a corresponding point by an optical component," otherwise indefinite.
"collimating optical element"	No construction necessary; plain and ordinary meaning. *That is*: an optical element, such as a lens, mirror, or grating, to render rays of light more nearly parallel; a collimator *Alternatively, if means-plus-function*: '582 Patent, cl. 1:	35 U.S.C. § 112, ¶ 6 / 35 U.S.C. § 112(f). '582 Patent, cl. 1: **Function**: (1) receive light from a light source; and (2) project a "collimated beam" onto an optical relay element. **Structure**: Indefinite. '582 Patent, cl. 14:

Claim Term	Patent Owner Proposed Construction	Requester's Proposed Construction
	Function: (1) receive light from a light source; (2) project a collimated beam **Structure**: a lens, such as an achromatic doublet lens, and structural equivalents thereof '582 Patent, cl. 14: **Function**: (1) receive light from a light source; (2) project a collimated beam including a first image **Structure**: a lens, such as an achromatic doublet lens, and structural equivalents thereof '582 Patent, cl. 20: **Function**: (1) receive light from a light source; (2) project a first image **Structure**: a lens, such as an achromatic doublet lens, and structural equivalents thereof	**Function**: (1) receive light from a light source; and (2) project a "collimated beam" including a first image onto an optical relay element. **Structure**: Indefinite. '582 Patent, cl. 20: **Function**: (1) receive light from a light source; and (2) project a first image onto an optical relay element. **Structure**: Indefinite.
"focusing optical element"	No construction necessary; plain and ordinary meaning. *That is*: an optical element, such as a lens, mirror, or grating, to converge light *Alternatively, if means-plus-function*:	'582 Patent, cl. 1: **Function**: (1) receive at least "a portion of a collimated beam" reflected by the optical relay element; (2) focus the portion of the collimated beam received from the optical relay

Claim Term	Patent Owner Proposed Construction	Requester's Proposed Construction
	'582 Patent, cl. 1: **Function**: (1) receive at least a portion of a collimated beam reflected by the optical relay element; (2) focus the portion of the collimated beam received from the optical relay element onto a semiconductor detector **Structure**: a lens and structural equivalents thereof '582 Patent, cl. 17: **Function**: (1) receive the collimated beam from the optical relay element at the extended collimated distance and (2) focus the collimated beam onto a first semiconductor detector **Structure**: a lens and structural equivalents thereof '582 Patent, cl. 26: **Function**: focus the light from the optical relay element to a size smaller than the object of the light source onto a semiconductor detector **Structure**: a lens and structural equivalents thereof	element onto a semiconductor detector. **Structure**: "focusing lens that is of a size that captures all light rays of the at least a portion of a 'collimated beam.'" '582 Patent, cl. 17: **Function**: (1) receive the "collimated beam" from the optical relay element at the extended collimated distance and (2) focus the collimated beam onto a first semiconductor detector. **Structure**: Indefinite. '582 Patent, cl. 26: **Function**: focus the light from the optical relay element to a size smaller than the object of the light source onto a semiconductor detector. **Structure**: "focusing lens that is of a size that captures all light rays of the at least a portion of a 'collimated beam.'"

Claim Term	Patent Owner Proposed Construction	Requester's Proposed Construction
"portion of the…"	No construction necessary; plain and ordinary meaning. *That is*: a part of any whole, either separated from or integrated with it	"a subset of the spectrum of wavelengths of light within a defined beam" otherwise indefinite.

(*See* Ex. LLL, pp. 029, 040, 060, 093-094, 121-122, 140.) The parties in the co-pending district court case have agreed that the preamble of the '582 patent claims are limiting. (*See* Ex. R, p.003.) As of the filing of this Request, the district court has not issued a claim construction order addressing the disputes between Patent Owner and Requester.

V. DETAILED EXPLANATION OF THE PERTINENCE AND MANNER OF APPLYING THE PRIOR ART

A detailed explanation of the pertinence and manner of applying the prior art references to all of the claims for which reexamination is requested is provided below.

A. TECHNOLOGY BACKGROUND

1. Flow Cytometers

Flow cytometers are optical instruments capable of detecting and measuring particles, cells, or beads flowing through a flow channel. In a flow cytometer, light sources, such as one or more lasers, illuminate the sample flowing through a flow channel at different points within the flow channel. (Ex. B, ¶37.) Particles, cells, or

beads are often tagged with fluorescent markers, such as fluorescent dyes, that emit light of certain wavelengths when illuminated by one or more lasers. (*Id.*) Light incident on the particles, cells, or beads can be either scattered or absorbed by the fluorescent markers; the absorbed light can result in a fluorescence emission from the fluorescent markers. (*Id.*) The scattered light and the fluorescent light can be collected, detected, and with detected signals digitized for further quantitative analysis of the analyzed particles, cells, or beads. (*Id.*; Ex. D, pp.010, 016-017.)

Fluorescence detection-based flow cytometers, like the one described in the '582 patent, typically comprise four subsystems: (1) illumination subsystem with optics and electro-optics (e.g., a laser or arc lamp); (2) a fluidic subsystem, including the flow channel permitting samples to flow in suspension to an illumination site; (3) collection subsystem with optics, such as an objective lens, to collect and focus the scattered and/or fluorescent light; and (4) detection subsystem with optics and electro-optics that separate the collected light into multiple color bands and direct those bands into photodetectors for further analysis. (Ex. B, ¶38; Ex. D, pp.016-024.) A general schematic for a flow cytometer is shown below.

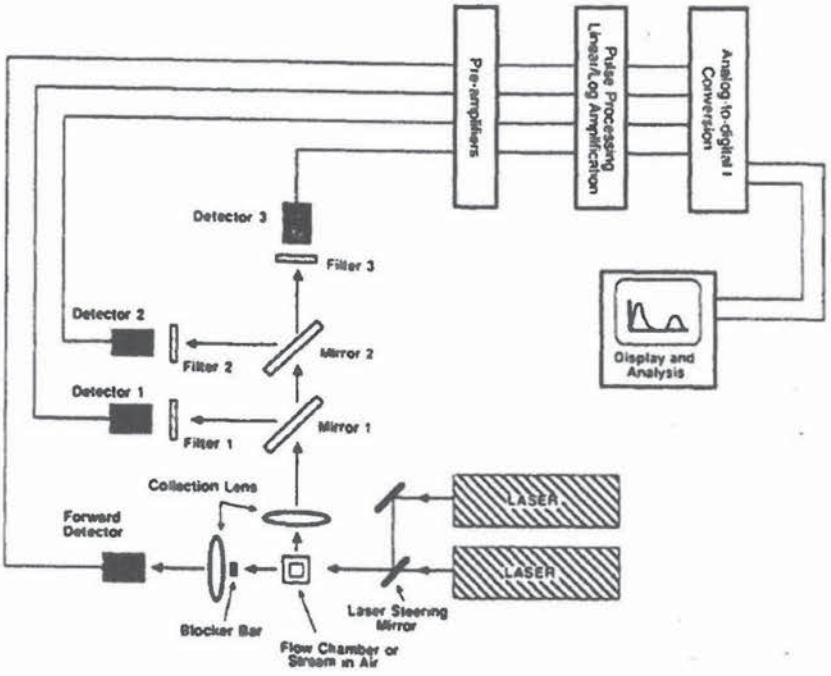


Figure 4 A generalized flow cytometer system.

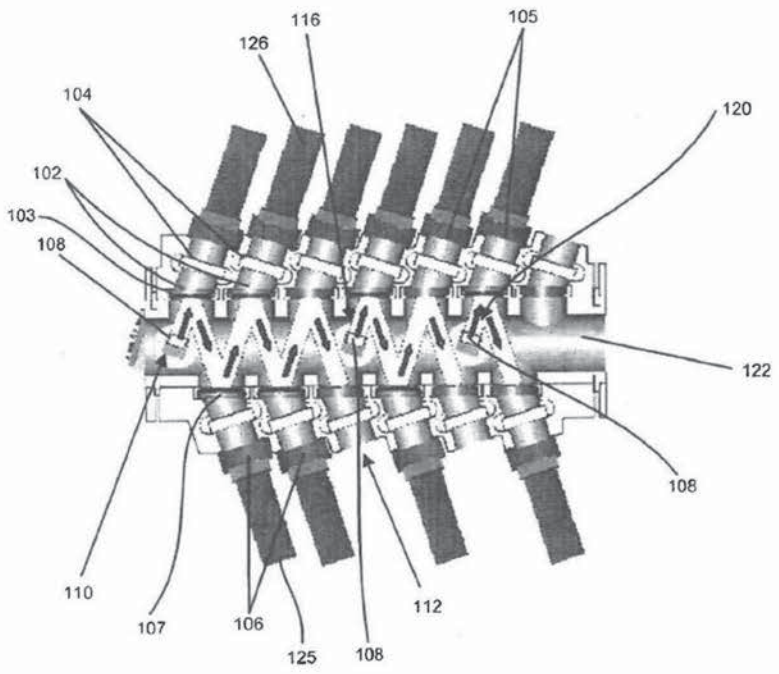
(Ex. D, p.017.)

2. Wavelength Division Demultiplexers

Detection in fluorescence detection-based flow cytometers typically involves spectrally separating collected light into multiple color bands (i.e., wavelength ranges) and then directing those color bands into separate photodetectors. A POSA would have known that a "wavelength division [de]multiplexer" or "WDM" refers to the optical components that demultiplex light into those color bands. (Ex. B, ¶39.) WDMs accomplish spectral separation through the use of filters, mirrors, and lenses to separate light into color bands and focus those color bands into photodetectors. (*Id.*, ¶40.)

Multiple WDM configurations existed in the art by 2011. (Ex. B, ¶¶40-41.) Multiple prior art references disclosed a well-known linear branch configuration of WDMs. (Ex. F, FIG. 1; Ex. G, p.082 (Fig. 1-21); Ex. H, FIG. 1, [0017].) The '582 patent also describes a WDM "star configuration" disclosed by Oostman **[Exhibit E]** (*see* '582, 5:11-18).

The '582's zig-zag WDM was also a well-known demultiplexing configuration in flow cytometry. For example, Patent Owner's own disclosures in Frazier **[Exhibit I]** show optical fibers that transport light collected from a flow cell, where the light is collimated by a lens and then spectrally separated for detection by zig-zagging between arrays of filters and mirrors.



(Frazier, FIG. 1; *see also id.*, 4:14-5:17, 7:3-17, 7:34-61; Ex. B, ¶42.)

This zig-zag configuration was commonly used for both single mode and multimode optical fiber waveguides in the optical communication industry, which a POSA would have considered an analogous field to flow cytometry. (Ex. B, ¶43.) The '582 patent admits that "WDM techniques well-established in the optical communication industry can be readily adapted for fluorescence light detection," indicating that the optical communication industry is an analogous field of art. ('582, 4:50-60; Ex. B, ¶44.) A POSA would have expected such, particularly because the WDMs in both fields are "almost identical in function and architecture," addressing the same set of problems in light demultiplexing and detection. (*Id.*, 44:7-14.)

Numerous examples from the optical communication industry disclose a zig-zag WDM configuration. (Ex. B, ¶¶44-46 (citing Ex. K-Ex. O).) Goodman [Ex. P], described below, is an example of this zig-zag WDM configuration that was already well-established in the art by 2011. (Ex. B, ¶46.)

3. Avalanche Photodiodes (APDs) in Flow Cytometry

The '582 patent acknowledges that flow cytometers can use avalanche photodiodes (APDs), known semiconductor detectors. ('582, 43:31-42; Ex. B, ¶47.) APDs had been used in fluorescence light detection for flow cytometers for almost twenty years before the date of the alleged invention; their benefits were well-

known; and technical hurdles to their implementation had long been overcome. (Ex. B, ¶¶48-50 (citing Exs. Z, AA, BB, G).)

As early as 1994, numerous sources disclosed use of APDs for fluorescence detection in flow cytometers. (Ex. B, ¶¶51-55 (citing Ex. DD-Ex. KK).) These references recognized the multiple advantages and benefits of using APDs over photomultiplier tubes (PMTs) or other types of detectors. (Ex. B, ¶¶50-55.) Specifically, by 2011, the APD was well-known as an "excellent photo-counting device, whose features include the following: excellent photon detection efficiency; high gain 10^5-10^6; room temperature operation; insensitive to magnetic fields; excellent time resolution, that are important for the laboratory-built optical system." (Ex. HH, p.002; *see also* Ex. AA, p.001; Ex. DD, 6:10-13 (superior in weak fluorescent light environment); Ex. EE, pp.003, 006; Ex. FF, p.009 (high quantum efficiency in IR region); Ex. GG, p.010 (better signal-to-noise ratio as PMTs in red and near IR spectral regions); Ex. B, ¶¶52-54.)

With advances in APD technology and their known benefits, use of APD photodetectors in flow cytometers arose with more frequency in commercial systems and the patent literature, including for Patent Owner. (Ex. B, ¶¶55-56.) Frazier **[Exhibit I]**, discussed with respect to SNQ Nos. 4 and 5, recognizes that its zig-zag WDM could be adapted to use APDs. (Frazier, 4:19-21.) Other pre-2011 flow cytometry patents similarly discuss use of APDs for fluorescence detection in flow

cytometers. (*See, e.g.*, Ex. II, 13:5-19; Ex. JJ, [0020]; Ex. KK, Abstract.) Researchers began swapping out PMTs for APDs in commercial flow cytometers without difficulty. (Ex. EE (Becton Dickinson); Ex. FF, p.001; Ex. B, ¶¶52-53.)

Commercial flow cytometers with APDs were also available by 2011. (Ex. B, ¶56.) Partec, Optoflow, and Becton Dickinson sold flow cytometers using APDs as early as 2003. (Ex. G, p.155; Ex. WW, p.002.) Luminex Corporation also sold several flow cytometer systems (e.g., Luminex 100, Luminex 200, and Luminex Flexmap 3D System) that implemented APD detector arrays, obtaining patent rights to the technology as early as the late 1990s. (*See* Ex. B, ¶56 (citing Ex. LL-Ex. SS).) Chandler **[Ex. TT]**, discussed with respect to SNQ Nos. 2 and 3, is a Luminex patent that implements APDs within a flow cytometer.

B. '582 PATENT

The Challenged Claims of the '582 patent recite a WDM that comprises a collimating optical element that projects a collimated beam into an array of filters and mirrors, while maintaining the size of the beam throughout. (*See, e.g.*, '582, 2:26-35, 4:34-55, 4:63-5:22, 6:39-50, 8:51-55, 9:51-65, 20:18-33, 20:62-21:10, 21:40-48.) FIG. 25 represents an optical ray trace of the collimated beam for an exemplary six-port WDM using a zig-zag configuration.

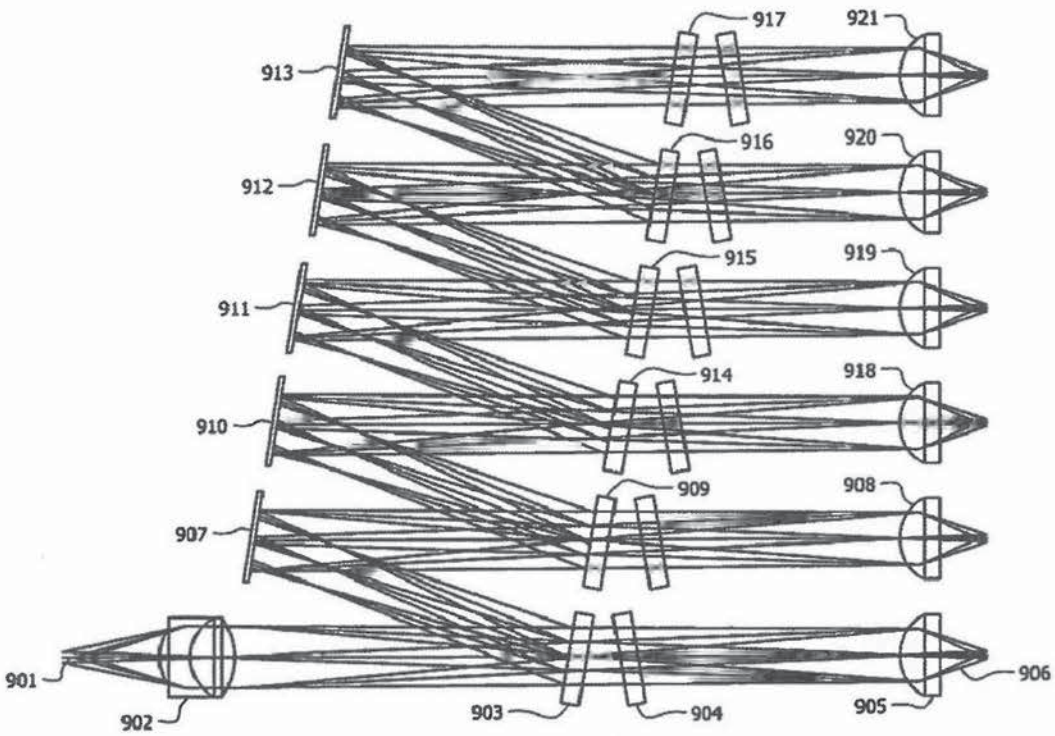


FIG. 25

(*Id.*, FIG. 25.) Dichroic filters **903**, **909**, **914**, **915**, **916**, **917** separate the collimated beam into multiple color bands (i.e., wavelength ranges). The size of the collimated beam remains constant as the light zig-zags between mirrors **907**, **910**, **911**, **912**, **913** and filters **903**, **909**, **914**, **915**, **917**.

A collimating optical element **902** captures light from source **901** and projects a collimated beam toward a dichroic filter **903**. ('582, 44:58-66, 45:8-10.) Dichroic filter **903** spectrally separates the incident beam, "pass[ing] the color band of interest" to a focusing lens **905** to focus light into a photodetector while "reflect[ing] the remaining colors in the beam of light for further processing." (*Id.*, 45:4-7, 45:8-

13.) The portion of light that passes through the filter **903** may also pass through an (optional) band pass filter **904** to improve color isolation. (*Id.*, 45:13-15.)

The remaining color bands in the collimated light incident on dichroic filter **903** are reflected toward and impinge on a next relay element, e.g., a concave mirror **907**. ('582, 45:16-17.) The collimated light reflects off concave mirror **907** toward a second dichroic filter **909** and passes another color band in the collimated beam to a second focusing lens **908** while reflecting the remainder to another concave mirror **910**. (*Id.*, 45:18-29, 45:35-38.) The process continues to separate and process additional color bands in the collimated beam as the beam zig-zags between mirrors **907**, **910**, **911**, **912**, **913** and the dichroic filters **903**, **909**, **914**, **915**, **916**, **917**. (*Id.*, 45:44-49.)

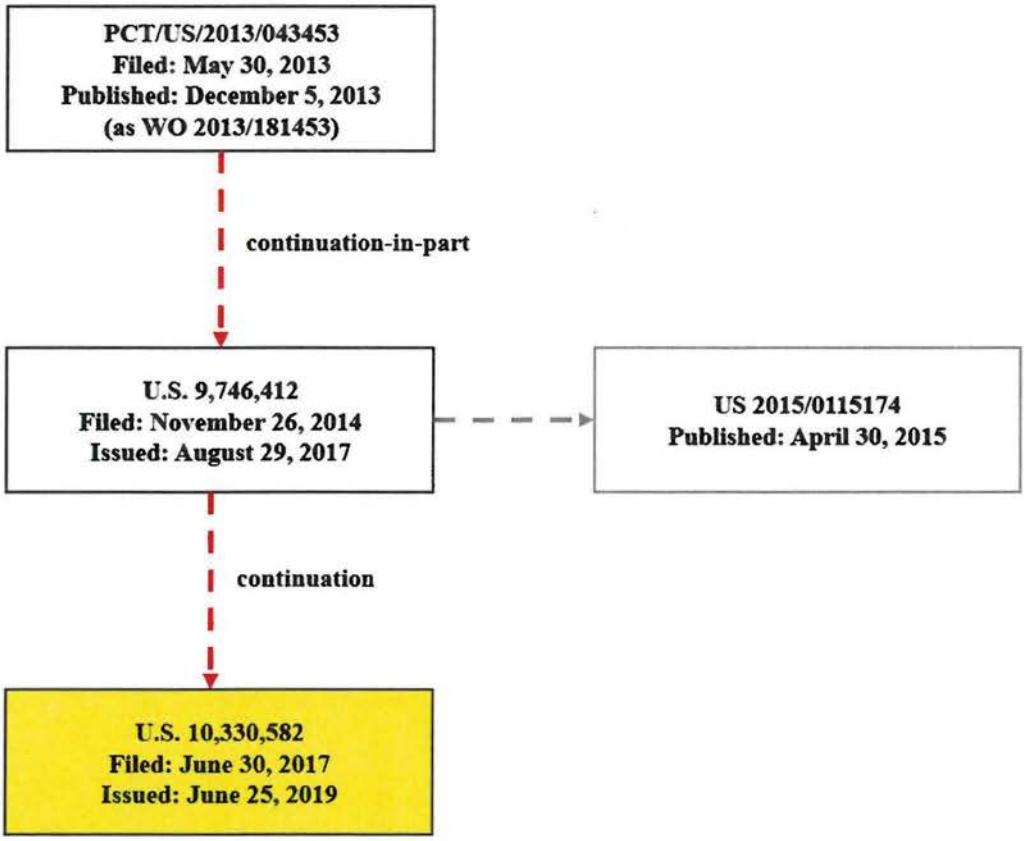
C. LEVEL OF ORDINARY SKILL

A person of ordinary skill in the art ("POSA") as of June 2017 would have had at least a B.S. in physics, mechanical engineering, electrical engineering, or optical engineering (or equivalent degree) and at least two years of experience in designing optical and electro-optical systems, including for flow cytometer applications. A person could also have qualified as a POSA with a combination of (1) more formal education (such as a doctoral degree) and less technical experience, or (2) less formal educational and more technical or professional experience. (Ex. B, ¶14.) This definition nevertheless applies if Examiner determines the '582 patent

is entitled to claim priority to one or more of its provisional applications, or a date earlier (e.g., December 2011).

D. PRIORITY DATE OF THE CHALLENGED CLAIMS

The Challenged Claims are entitled only to claim priority to the filing date of the '582 patent on June 30, 2017. The '582 patent is a continuation of U.S. Patent No. 9,746,412 ("'412 patent") [**Exhibit MMM**], which is a continuation-in-part of international patent application No. PCT/US2013/043453 ("PCT App.") [**Exhibit NNN**]. The application for the '412 patent published on April 30, 2015 as U.S. Patent Application Publication No. US 2015/0115174 A1 ("Chen Pub '174").



The independent claims of the '582 patent each recite an "**optical relay element comprising a curved mirror,**" but the written description in the parent '412 patent (and grandparent PCT App.) does not support the recited limitation of a "curved mirror." The term "curved mirror" appears in the priority chain for the first time in the '582 patent claims. (Ex. B, ¶ 75.) Prior disclosures teach a "concave mirror" that fail to indicate the inventor was in possession of a "curved mirror" as of the filing dates of either the '412 patent or the PCT App. (*Id.*)

Under 35 U.S.C. § 120, a proper priority claim to an earlier-filed application requires compliance with 35 U.S.C. § 112's written description requirement. *Lockwood v. Am. Airlines, Inc.*, 107 F.3d 1565, 1571-72 (Fed. Cir. 1997). That is, the written description must sufficiently convey "to a person of skill in the art that the patentee had possession of the claimed invention at the time of the application, i.e., that the patentee invented what is claimed." *Lizardtech, Inc. v. Earth Res. Mapping Inc.*, 424 F.3d 1336, 1345 (Fed. Cir. 2005); *Purdue Pharma L.P. v. Faulding Inc.*, 230 F.3d 1320, 1323 (Fed. Cir. 2000). "Entitlement to a filing date extends only to subject matter that is disclosed; not to that which is obvious." *Rsch. Corp. Techs., Inc. v. Microsoft Corp.*, 627 F.3d 859, 870 (Fed. Cir. 2010). "'[P]ossession' or reduction to practice outside of the specification is not enough." *Mondis Tech. Ltd. v. LG Elecs. Inc.*, No. 2023-2117, slip op. at 14 (Fed. Cir. Aug. 8,

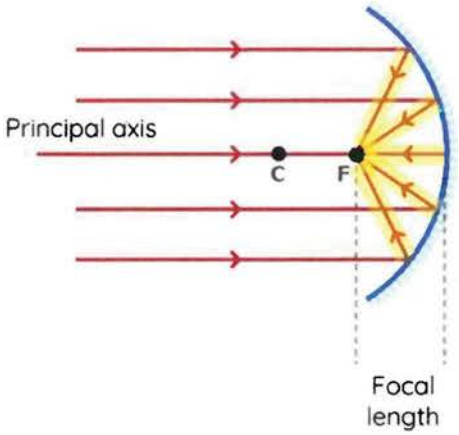
2025) (citing *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1352 (Fed Cir. 2010) (en banc)).

The written description for the '412 parent patent and its PCT App. predecessor only describe concave mirrors in the WDM (or "optical subsystem of a flow cytometer" as claimed in the '582 patent). (Ex. B, ¶81.) The written description provides:

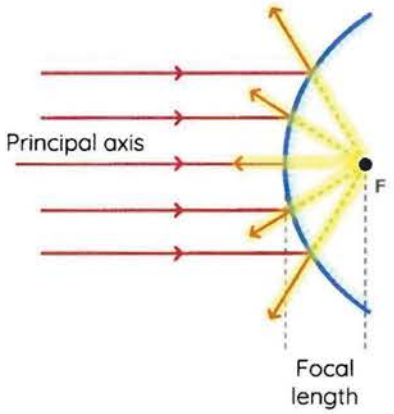
> Light reflected from the dichroic filter **903** may impinge upon a second optical element **907**, **such as a concave mirror.** The **concave mirror** **907** may a [sic] radius of curvature approximately equal to the distance between the collimating optical element **902** and the image near focusing lens **905**. The **concave mirror** **907** therefore creates a second image of the collimating lens **902** near a second focusing lens **908**. The light beam between the **concave mirror** **907** and the second image at the lens **908** may have substantially the same diameter as the beam of light between the collimating lens **902** and the first image near the focusing lens **905**. The relay imaging **concave mirror** **907** therefore effectively doubles the collimated beam path without expanding the beam's diameter.

(*See* '412, 45:6-19 (emphasis added); PCT App., p.170 (43:14-26).)

But the term "curved mirror" is broader than "concave mirror." The existence of multiple mirror types with different curvatures was well-known as of the filing dates for the '412 patent and PCT App. (Ex. B, ¶¶78-80.) Broadly speaking, curved mirrors can be concave or convex depending on the mirror's radius of curvature. A ***positive*** radius of curvature indicates an inward curve for the mirror—a concave mirror—that causes incident light rays to ***converge*** (or become less divergent) from the surface of the mirror.



(*Id.*, ¶78.) A mirror with a ***negative*** radius of curvature indicates an outward curve for the mirror—a convex mirror—that cause incident light rays to ***diverge*** from the surface of the mirror.



(*Id.*) Even within these broad categories, concave mirrors and convex mirrors may include more specific geometries (*e.g.*, spherical, aspherical, parabolic, ellipsoidal, hyperboloidal) that uniquely affect how incident light is shaped and will travel when reflected by the mirror. (*Id.*, ¶79.) And a POSA would have understood that convex mirrors and concave mirrors are not functionally interchangeable. (*Id.*, ¶¶83-84.)

Nowhere in the '412 patent or the PCT App. do the written descriptions recite a "curved mirror" or convex mirrors. (Ex. B, ¶¶81, 83.) This is no accident. Because concave mirrors lessen the divergence of light rays within an incident beam of light, the written descriptions teach that they are useful to "extend the collimated distance" of a collimated beam within the WDM. (*See* '412, 45:8-19; PCT App., p.050 (43:15-26); Ex. B, ¶¶82-83.) This teaching aligns with broader, consistent teachings in the written description about how the claimed invention propagates a collimated beam of light through its WDM cascaded 1:1 relay architecture for "efficient photodetection." (*See* '412, 44:61-64, 45:39-44; PCT App., p.050, (43:2-5), p.051 (44:2-6); Ex. B, ¶¶82-83.)

In contrast, the written description lacks any "blaze marks" to indicate to a POSA that the inventors had possession of the broader "curved mirror" limitation that would necessarily include convex mirrors. (Ex. B, ¶¶84-85.) Nowhere does the written description teach or suggest use of convex mirrors in a WDM as § 112(1) requires. *See, e.g., Purdue Pharma L.P. v. Faulding Inc.*, 230 F.3d 1320, 1326-27 (Fed. Cir. 2000) (no "blaze marks" directing POSA to specific species); *Mondis Tech.*, slip op. at 10-11 (lack of written description for broader "type of said display unit" limitation when specification only supported specific display unit).

The term "curved mirror" in the '582 claims is not a stand-in for "concave mirror" but contemplates a broader set of (undisclosed) mirror types. (Ex. B, ¶77 &

n.2, ¶80.) In U.S. Patent No. 11,703,443 (the '443 patent") [**Exhibit RRR**], a sibling patent to the '582 patent that shares the same written description as the '412 patent, the applicant recited "curved mirror" in independent claim 1 and then specified that the "curved mirror" could be a "concave mirror" in dependent claim 6. (*See* Ex. RRR, cls. 1 (reciting "at least one curved mirror"), 6 (reciting "the at least one curved mirror is a concave mirror.").) Claim differentiation instructs that, by reciting that the "curved mirror" may comprise "concave mirror" in a narrower dependent claim, the applicant intended for "curved mirror" to be broader. *See, e.g.*, *Phillips v. AWH Corp.*, 415 F.3d 1303, 1324-25 (Fed. Cir. 2005). (*See also* Ex. B, ¶77 & n.2, ¶80.)

Examiners at the European Patent Office reached the same conclusion that the written description cannot support the full scope of "curved mirror." During (still ongoing) prosecution of a foreign counterpart to the '443 patent that shares the same specification as the '582 patent, EP24151670, Patent Owner originally asserted nearly identical claims to those recited in the '443 patent, including a "curved mirror." (Ex. SSS, p.056.) But the examiners rejected those claims on multiple grounds, including:

> Furthermore in claim 1 a curved mirror is introduced, but the parent application does not disclose a generic curved mirror, but a concave mirror

(*Id.*, p.039.) Rather than provide the examiners with citations to the written description to support "curved mirror," Patent Owner instead narrowed its claims to

narrow curved mirror to the only mirror supported by the written description—a concave mirror:

New Claims

1. A flow cytometer (40) that comprises

a multimode optical fiber (852), and

a **wavelength division multiplexer (WDM)** (90) configured to receive light from the multimode optical fiber (852), the WDM (90) **comprising**:

a first optical element (902),

a set of dichroic **filters** (903, 909, 914, 915, 916, 917), wherein

the first optical element (902) is positioned in an optical path of the light received from the multimode optical fiber (852) upstream of the set of dichroic filters, and

each dichroic **filter of the set of** dichroic **filters** is **configured to pass a corresponding portion of multiple portions of the light** received from the multimode optical fiber (852),

at least one mirror (907, 910, 911, 912, 913) **including at least one** curved concave **mirror, the at least one mirror configured to**:

receive one or more portions of the light from the set of dichroic **filters; and**

reflect the one or more portions of the light to the set of dichroic **filters, and**

a set of avalanche ~~detectors~~photodiodes (APDs), **each** ~~detector~~ APD **of the set of** ~~detectors~~ APDs **corresponding to a** dichroic **filter of the set of** dichroic **filters and configured to receive a portion of the light at the** ~~detector~~ APD **that passed through the** dichroic **filter corresponding to the** ~~detector~~APD.

(Ex. SSS, p.016 (annotated).) Patent Owner then pointed to passages from the specification that only support a "concave mirror" in its remarks on the amendments:

- that the curved mirror is a "concave mirror" (see Specification at paragraphs [0034], [0069]); and

(*Id.*, p.026.)

Patent Owner also made a passing comment that the written description's generalized disclosure that "other types of refractive and/or reflective optical components may also be used to achieve the same design goal," (Ex. SSS, p.027; *see also* '412, 4:59-60; PCT App., p.022 (15:20-22)), but such an argument, at best, suggests that it would be *obvious* to a POSA reading the specification to (unduly) experiment with curved mirrors that were not concave. (Ex. B, ¶¶83-85.) The written description requirement is more exacting, and some unarticulated explanation of the general knowledge of a person of ordinary skill cannot bridge the gap. *Rsch. Corp. Techs.*, 627 F.3d at 870. As such, the '582 claims are not entitled to claim priority to any prior date except for its own filing date of the patent application that issued into the '582 patent, June 30, 2017.

E. BRIEF OVERVIEW OF THE PRIOR ART

1. Chen Pub '174 [Exhibit QQQ]

Chen Pub '174 **[Ex. QQQ]** is a published patent application, filed on November 26, 2014, published on April 30, 2015, and entitled, "Flow Cytometer."

But for the patent claims and priority claims, Chen Pub '174 and the '582 patent share the same specification and drawings. Chen Pub '174 qualifies as prior art under AIA 35 U.S.C. § 102(a)(1).

2. Chandler [Exhibit TT]

Chandler **[Ex. TT]** is a patent issued on October 31, 2000, entitled "Interlaced Lasers for Multiple Fluorescence Measurement." Chandler qualifies as prior art under pre-AIA §102(b) and AIA § 102(a)(1).

Chandler discloses an improved fluorescence-detection based flow cytometer that uses multiple lasers to irradiate fluorescence-tagged materials in a flow cell ("viewing chamber"). The light is gathered by multiple collecting optical units ("optical detectors") routed through multimode optical fibers into filtering, amplification, and digital conversion units ("FADC units") for demultiplexing, detection, digital conversion, and signal processing. (Chandler, 4:62-5:4, 5:23-33, 7:24-45; *see also id.*, FIG. 4.) Each FADC unit consists of a set of standard bandpass filters, a set of standard photodetectors, and a set of standard analog to digital converters. (Chandler, 3:66-4:15, 7:46-49.) The photodetectors may be avalanche photo-diode detectors ("APDs"). (*Id.*, 4:6-8, 5:30-32, 8:32-34.)

3. Goodman [Exhibit P]

Goodman [**Ex. P**] is a patent issued on April 1, 2003, entitled "Compact Multiple Channel Multiplexer/Demultiplexer Devices." Goodman qualifies as prior art under pre-AIA §102(b) and AIA § 102(a)(1).

Goodman explains that in a typical wavelength division (de)multiplexing ("WDM") system, optical signals, generated by some light sources, are transmitted over a waveguide, such as an optical fiber and then demultiplexed into individual color bands to be routed to an optical detector, corresponding to each channel wavelength range. (Goodman, 1:46-52.) Goodman also identifies, and provides a solution for, conventional, bulky WDMs with optical attenuation issues. (*Id.*, 3:37-44.)

Goodman depicts an exemplary WDM device **10** in FIG. 1 below.

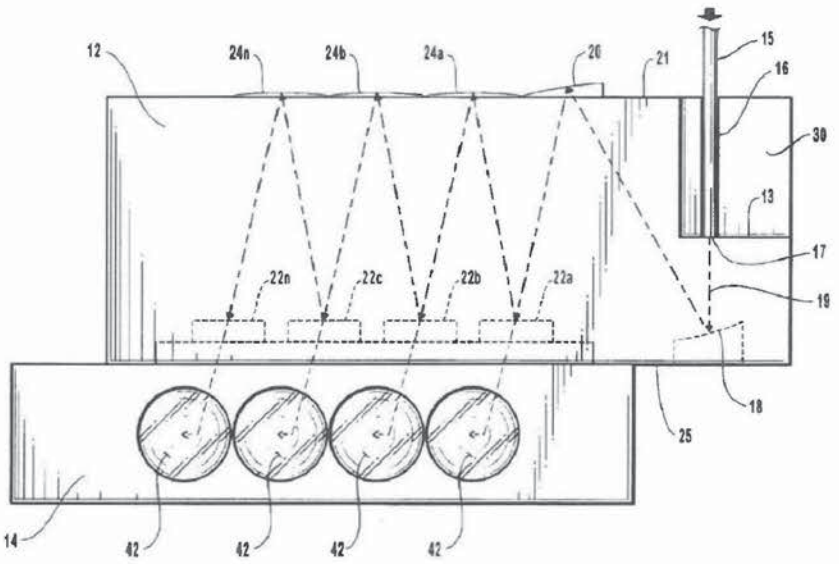


FIG. 1

(Goodman, FIG. 1.)

WDM device **10** includes an optical block **12**, configured to receive an optical beam **19** through an optical fiber **15**. (Goodman, 7:1-3, 7:17-21.) The optical beam **19** first impinges on imaging optical element **18** that reflects the beam onto imaging optical element **20**. (*Id.*, 7:17-30.) Imaging optical element **20** then reflects optical beam **19** onto a first of a set of wavelength selective elements **22*a*-22*n***. (*Id.*, 8:21-23.)

Wavelength selective elements **22*a*-22*n*** are "each capable of transmitting a selected range of wavelengths within beam **19** and reflecting other wavelengths." (Goodman, 8:23-26.) These wavelength selective elements can be dichroic filters, among other types, and separate each wavelength channel to demultiplex the entire multiwavelength beam. (*Id.*, 9:16-49.) A set of reflectors **24*a*-24*n*** are positioned on the top surface of the optical block **12**, opposite from the wavelength selective elements **22*a*-22*n***, such that "each of the reflectors directs beam **19** from one wavelength selective element to an adjacent wavelength selective element." (*Id.*, 9:58-67.) For each reflector, Goodman explains "[t]he reflective surface can comprise at least one collimating reflector or at least one non-collimating reflector," for example, "converging lenses or mirrors, collimating lenses or mirrors, or simple reflecting surfaces." (*Id.*, 10:17-21.)

Selected ranges of wavelengths transmitted through wavelength selective elements **22*a*-22*n*** travel into a beam-directing member **14** that is configured to "redirect and focus the optical energy transmitted through wavelength selective elements **22*a*-22*n***." (Goodman, 10:45-51.) Beam-directing member **14** includes a set of focusing lenses **42** within each optical channel that focuses a selected wavelength beam into a corresponding optical receiver, such as a detector. (*Id.*, 11:30-41.)

4. Hamamatsu [Exhibit XX, Exhibit YY]

Hamamatsu refers to two archived website pages, depicting commercial sale of small area APDs used in low light measurement applications, including with flow cytometers. Ex. XX discloses Hamamatsu's offer for sale of certain small area APDs with active areas of 1 mm or less in diameter and spectral response ranges from 440 – 1100 nm (visible to near IR). Ex. YY discloses Hamamatsu's offer for sale of certain small area APDs with active areas of 1mm or less in diameter and spectral response ranges from 200/320 nm to 1000 nm. Hamamatsu qualifies as prior art under pre-AIA §102(b) and AIA § 102(a)(1). (*See* Ex. KKK, pp.001-002.)

5. Oostman [Exhibit E]

Oostman [**Ex. E**] is a patent issued on January 27, 2004, entitled "Fluorescence Detection Instrument with Reflective Transfer Legs for Color Decimation," that discloses "an improved system for detecting fluorescent light

having multiple colors emitted from a target[.]" (Oostman, 2:60-63.) The preferred embodiment of the invention features a flow cytometer that uses multiple WDMs for fluorescent and scattered light color band separation and detection. (*Id.*, 5:33-37.) Oostman qualifies as prior art under pre-AIA §102(b) and AIA § 102(a)(1).

Oostman discloses an optical instrument (flow cytometer) that includes multiple laser light sources, a flow cell, collection lens, optical fibers, and a plurality of detector array clusters as depicted in FIG. 4 below.

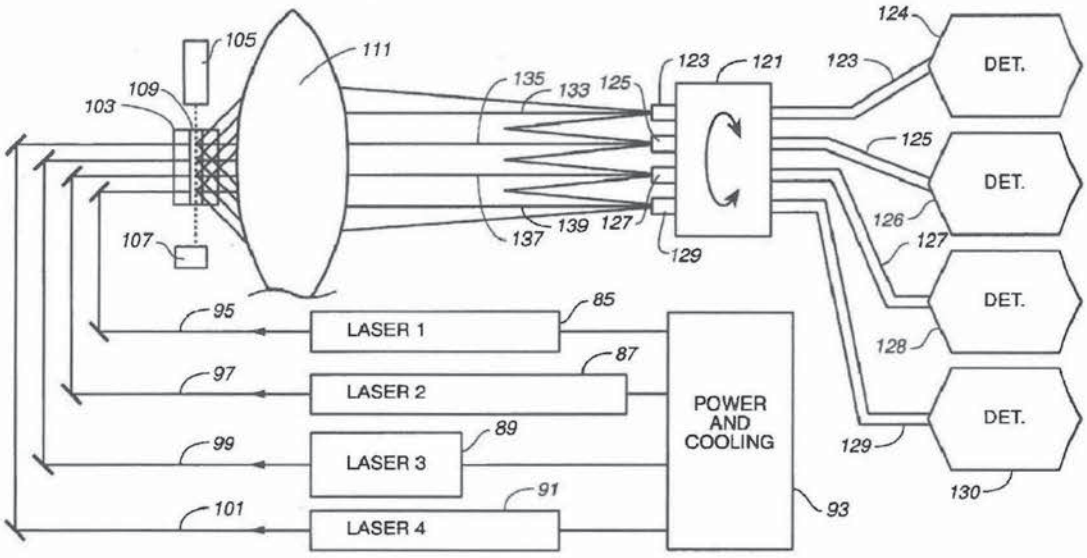


FIG._4

(Oostman, FIG. 4.)

Each of lasers **85**, **87**, **89**, and **91** produces a beam of light with a unique wavelength that is directed toward a flow stream **103** in fluid system **105** that contains fluorescent dye marked particles within a liquid sample. (Oostman, 5:27-

33, 5:41-44.) Laser beams interact with the fluorescent dye marked particles, "causing scattering and fluorescence that is spatially separated along a line parallel to the flow channel **109**." (*Id.*, 5:58-62.) This impinging of the laser beams upon the fluorescent dye marked particles of the liquid sample of flow stream **103** in flow channel **109** creates an "illuminated zone." (*Id.*, 5:44-46.)

Scattered and fluorescent light is then "imaged by a lens light collector **111** to four respective optical fibers **123**, **125**, **127**, and **129**," each of which is a multi-mode optical fiber. (Oostman, 5:63-6:7.) Light collected and focused into each optical fiber is then transmitted to a respective detector cluster **124**, **126**, **128**, and **130**, which comprises an array of detectors. (*Id.*, 6:26-28.) "Each array of detectors differentially separates bands of light by filtering, using coatings on beam splitters and lenses, in a known manner." (*Id.*, 6:34-36.)

Oostman's FIG. 5 and FIG. 6 each shows a detector cluster with two polygonal WDM arrangements to demultiplex the fluorescent light into separate bands for each detector.

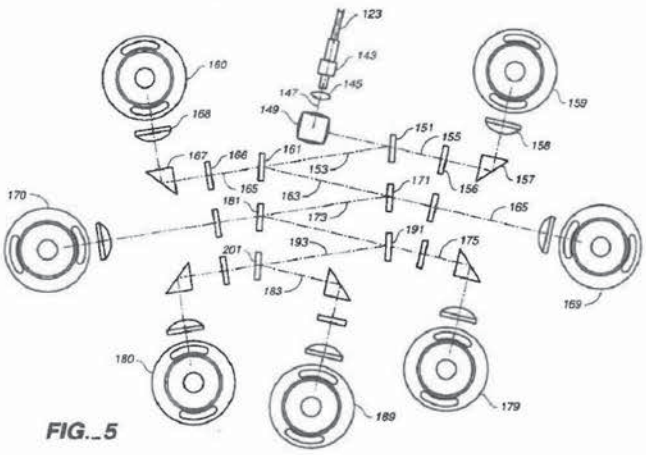


FIG._5

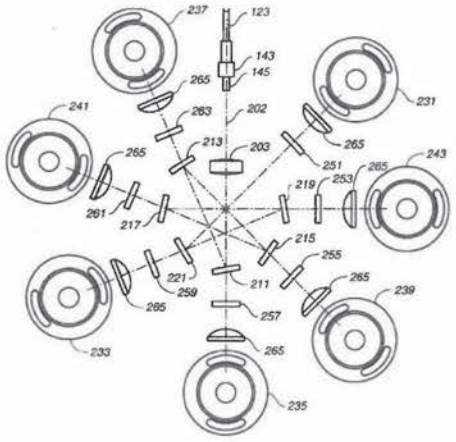


FIG._6

(Oostman, FIGs. 5, 6.) An optical fiber **123** guides light into each of Oostman's polygonal WDMs within each detector cluster and is optically coupled to a collimating lens (**145** for FIG. 5, **203** for FIG. 6).

6. Frazier [Exhibit I]

Frazier [**Ex. I**] is a patent filed on February 26, 2010, entitled "Fluorescence Detection Instrument with Orthogonal Laser Entry." Frazier qualifies as prior art under pre-AIA §102(b) and AIA § 102(a)(1).

Frazier discloses a "detector assembly for analysis of light emitted form [sic] a fluorescent material, an optical alignment assembly for introducing an output beam into a detector array or demultiplexer, and methods of demultiplexing a beam of light into wavelength bands." (Frazier, Abstract.) Frazier also indicates that its detectors can be "various … types of photodetectors, for example, photo avalanche detectors[.]" (*Id.*, 4:19-20.)

F. SNQ No. 1: Claims 1, 2, 3, 6, 14, 15, 17, 18, 20, 21, 22, 23, 25, 26 are Unpatentable as Anticipated and/or Obvious Over Over U.S. Pat. App. Pub. No. 2015/0115174 (Chen Pub '174).

1. Independent Claim 1

a. Claim 1[pre]: "An optical subsystem for a flow cytometer, the optical subsystem comprising:"

Chen Pub '174 discloses the preamble. The Challenged Claims appear to recite an "optical subsystem" as interchangeable with a wavelength division (de)multiplexer (WDM). (*See, e.g.*, '582, 44:37-42, 44:58-66, 45:8-15, 45:16-29, 46:27-29; Ex. B, ¶¶105-106.) Requester treats "optical subsystem" as a WDM for purposes of this Request, and Chen Pub '174 describes a WDM. (*See* Chen Pub '174, [0404]-[0427].) As an example, Chen Pub '174 explains that FIG. 25 "illustrates a 6-port wavelength division multiplexer for a beam of light from the extended light source," (*id.*, [0416]), depicted below.

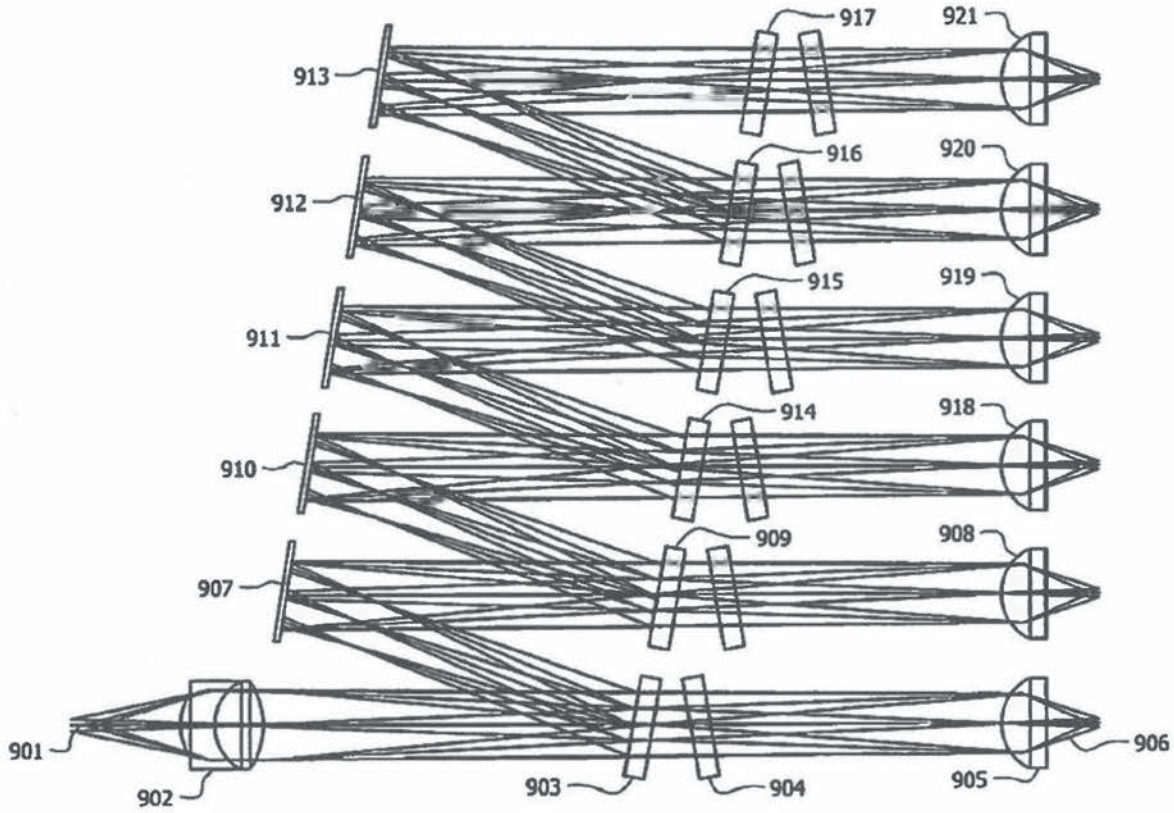


FIG. 25

(*Id.*, FIG. 25.)

To the extent Patent Owner argues that the claimed "optical subsystem" differs from a WDM, Requester notes that Chen Pub '174 shares its specification and drawings with the '582 patent and would thus disclose an "optical subsystem" under any alternate interpretation offered by Patent Owner (provided that it is supported by the written description in the '582 patent).

b. Claim 1[a]: "a collimating optical element arranged to receive light from a light source, the collimating optical element configured to project a collimated beam;"

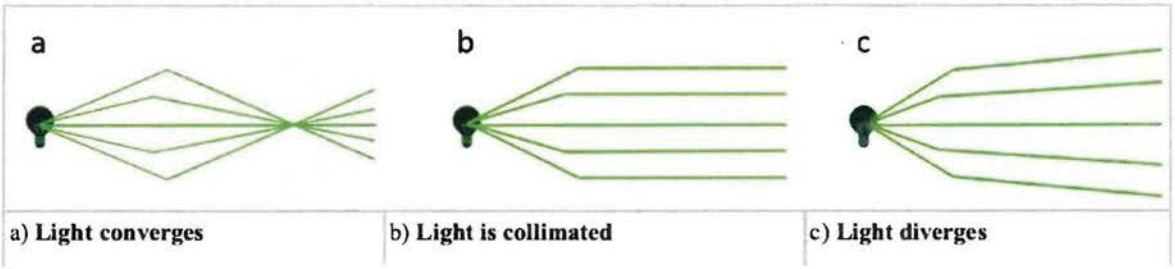
Chen Pub '174 discloses Claim 1[a]. Patent Owner contends in the underlying district court litigation that a "**collimating optical element**" (Ex. LLL, p.093) is a "lens, mirror, or grating, to render rays of light more nearly parallel." (Ex. B, ¶110.) Chen Pub '174's collimating optical element **902** satisfies this construction, as it may be a "achromatic doublet lens" and Chen Pub '174 discloses that it projects a collimated beam where rays of light are parallel. (Chen Pub '174, [0412]; *see also id.*, FIG. 25, Ex. B, ¶111.)

Chen Pub '174's collimating optical element **902** "**receive**[s] **light from a light source**." (Ex. B, ¶112.) Chen Pub '174 explains how, "[a]s depicted in FIG. **25**, a collimating optical element, in this case an achromatic doublet lens **902**, may capture the light from source **901**." (Chen Pub '174, [0412] (underlining added).)

Chen Pub '174's collimating optical element **902** also "**projects a collimated beam**." POSA would have understood that a beam of light can be characterized as converging, collimated, or diverging. (Ex. B, ¶113.) Shapiro, a textbook cited in the '582 specification (*see* '582, 28:19-23, 43:31-42) and in Chen Pub '174 (*see* Chen Pub '174, [0323], [0404]), explains that in a converging beam, the rays get closer together as they travel along; in a collimated beam, the rays are parallel to

each other; and in a diverging beam, the rays get farther apart as they travel along. (Ex. G, p.110; Ex. B, ¶113 & n.7.)

Whether the light converges, is collimated, or diverges can be illustrated by the nature of resulting light rays emitted from a point source (within the lightbulb) affected by a spherical surface like a lens (gray shading) in different ways.



(*See* Ex. T, p.005; Ex. B, ¶114.)

In the underlying district court litigation, the parties proposed competing constructions for the term "**collimated beam**." (Ex. LLL, p.040.) The dispute lies at whether a "**collimated beam**" must result in parallel or "nearly parallel" light rays within a beam. Requester's indefiniteness concern, related to the degree of beam divergence/convergence before a beam is no longer collimated, is immaterial to the analysis in this Request.

Chen Pub '174's teachings of a collimated beam comprising parallel light rays satisfy both parties' constructions. (Ex. B, ¶116.) Chen Pub '174 teaches how its collimating optical element **902** will "project a magnified image of the object near a final focusing lens **905**.... Consequently, [the] beam of light propagating between

the collimating optical element **902** and the focusing lens **905** may be effectively collimated." (Chen Pub '174, [0412] (underlining added).)

FIG. **25** depicts collimating optical element **902** "**receiv**[ing] **light from a light source**" **901** and "**project**[ing] **a collimated beam**."

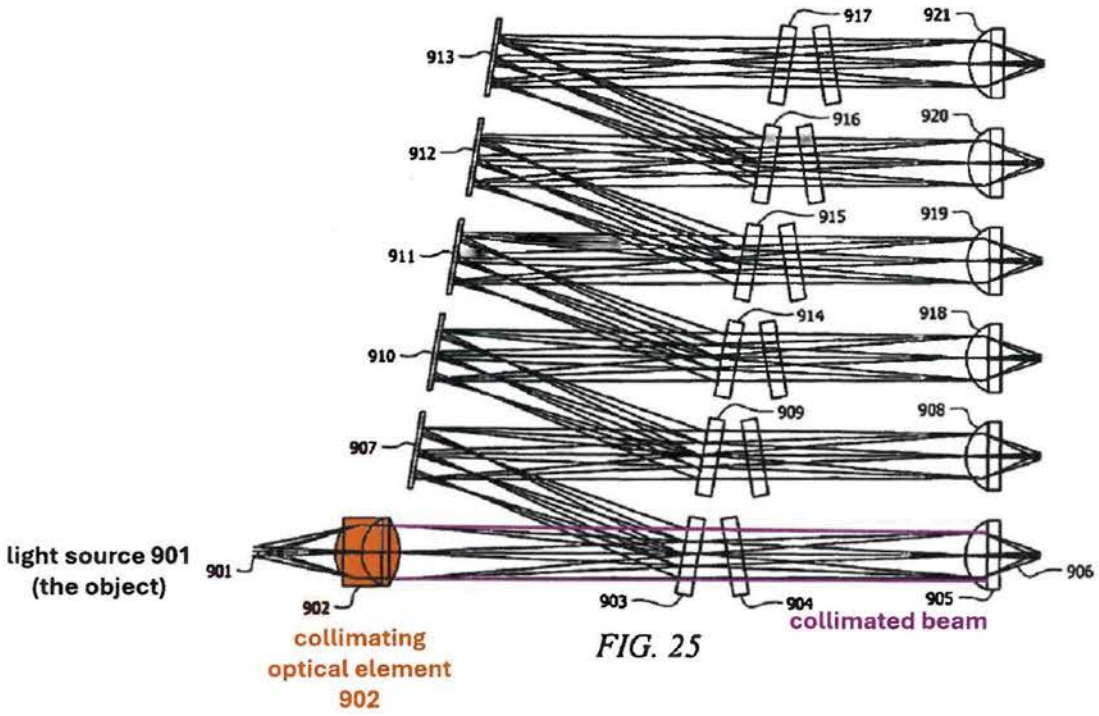


FIG. 25

(*Id.*, FIG. 25 (annotated).)

c. Claim 1[b]: "an optical relay element arranged to receive at least a portion of the collimated beam from the collimating optical element,"

Chen Pub '174 discloses Claim 1[b]. Chen Pub '174's concave mirror **907** is an "**optical relay element**" that receives "**at least a portion of the collimated beam**" projected by collimating optical element **902**. (Ex. B, ¶118.)

Chen Pub '174 teaches that "[a] dichroic filter **903**… may be inserted into the optical path between the collimating optical element **902** and the focusing lens **905**." (Chen Pub '174, [0413].) Dichroic filter **903** passes a color band of interest and "reflects the remaining colors in the beam of light for further processing within the WDM **90[**,]" these "remaining colors in the beam of light" being "**at least a portion of the collimated beam from the collimating optical element**." (*Id.*) "Light reflected from the dichroic filter **903** may impinge upon a second optical element **907**, such as a concave mirror." (*Id.*, [0414].) This concave mirror **907** is an "**optical relay element**," is expressly referred to as a "relay imaging concave mirror **907**," and performs the function of relaying light to a dichroic filter **909**. (*Id.*; *see also* Ex. B, ¶119.)

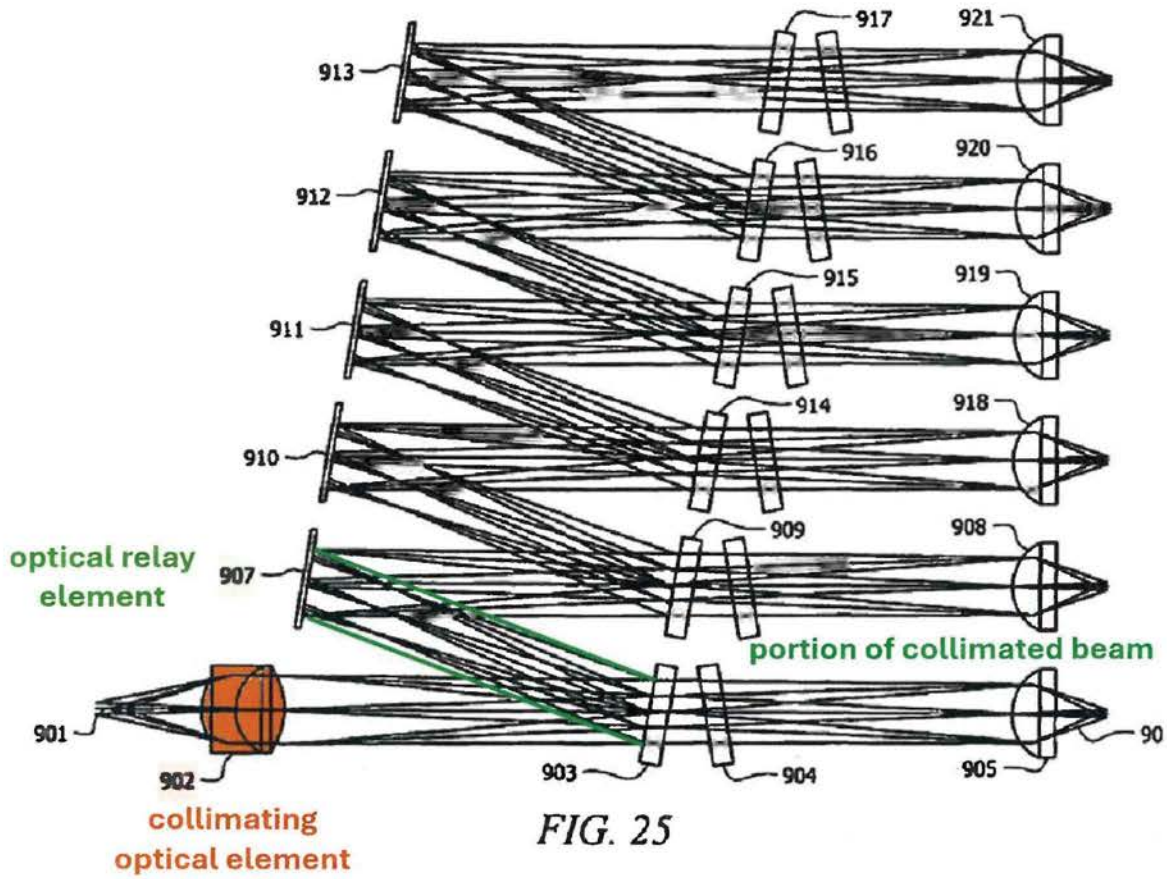


FIG. 25

(Chen Pub '174, FIG. 25 (annotated).)

In the underlying district court litigation, the parties offer competing constructions for "**portion**," (Ex. LLL, p.140), but Chen Pub '174 discloses Claim 1[b] regardless of the construction applied, as concave mirror **907** is configured to "receive at least a portion of the collimated beam" in the remaining colors of the beam of light reflected from dichroic filter **903**. (Chen Pub '174, [0413], Ex. B, ¶120.)

d. Claim 1[c]: "the optical relay element comprising a curved mirror configured to reflect the portion of the collimated beam received from the collimating optical element to produce a first image;"

Chen Pub '174 discloses Claim 1[c]. The "**optical relay element**" is a "**curved mirror**" because Chen Pub '174 discloses that its second optical element **907** can be a "concave mirror." (Chen Pub '174, [0413], [0414].) A concave mirror is a species of curved mirror, as described in Section V.D above. (Ex. B, ¶121.) Concave mirror **907** will "**reflect the portion of the collimated beam received from the collimating optical element**," as Chen Pub '174 explains that light reflecting off concave mirror **907** is directed to a dichroic filter **909**, where dichroic filter **909** "may pass another band of color in the beam of light received by the WDM **90** at location **901**[.]" (Chen Pub '174, [0414]; Ex. B, ¶121.) FIG. 25 also shows how concave mirror **907** reflects a portion of the collimated beam received from the collimating optical element.

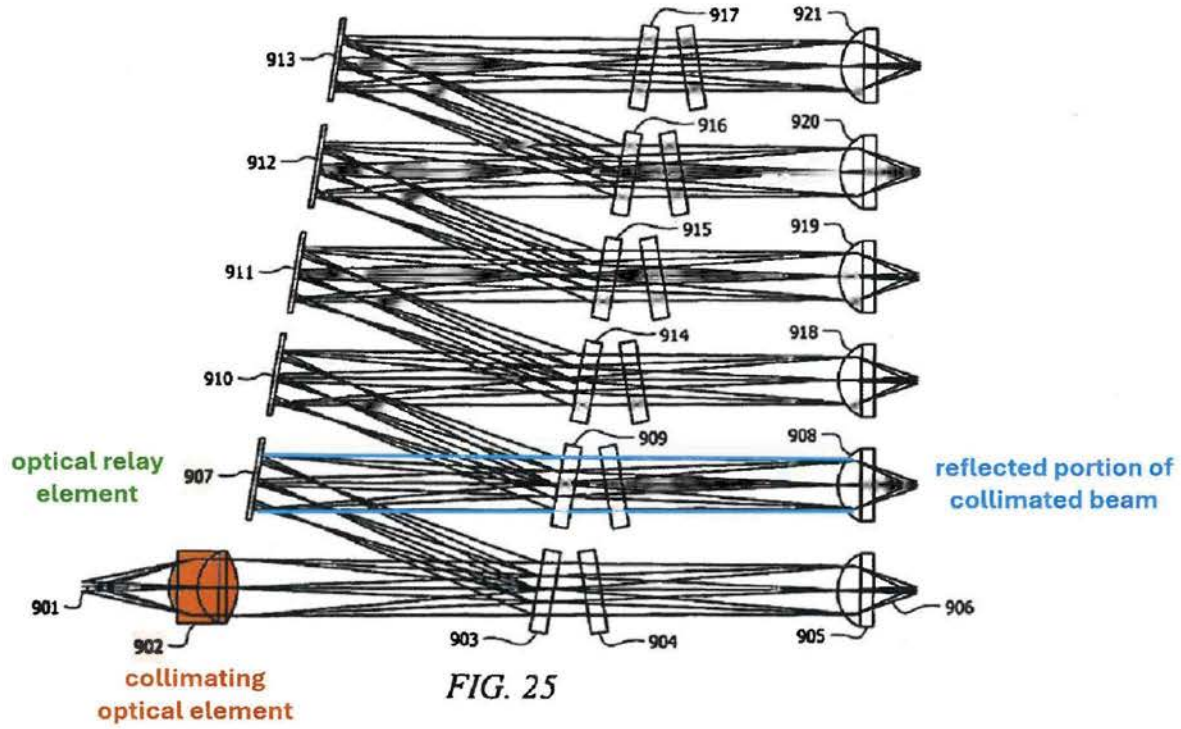


FIG. 25

(Chen Pub '174, FIG. 25 (annotated).)

A dispute in the pending litigation exists regarding construction of "**image**," with Patent Owner taking the position that this term should be given its plain and ordinary meaning and that it is "a representation of an object." The district court has not addressed this issue, but to streamline the Examiner's consideration of the prior art, Requester for purposes of this Request only adopts Patent Owner's construction of "**image**." *E.g.*, *Glux Visual Effects Tech (Shenzhen) v. Ultravision Techs., LLC*, IPR2020-01052, Paper 28, p.33 (P.T.A.B. Nov. 17, 2021) ("*Western Digital* states, and we agree, that '37 C.F.R.§ [42.]104(b)(3) does not require [a p]etitioner to express its subjective agreement regarding correctness of its proffered claim constructions or to take ownership of those constructions,' such as in a district court

proceeding."). Patent Owner contends that its construction is supported by intrinsic evidence. (*See* '582, 6:39-46, 10:24, 27:43-58, cl. 13.) Patent Owner has also pointed to extrinsic evidence including multiple definitions from lay and technical dictionaries. (Ex. LLL, p.060.)

Under Patent Owner's construction, Chen Pub '174 discloses an "**image**," and teaches that light reflecting off concave mirror **907** "creates a second image of the collimating lens **902** near a second focusing lens **908**." (Chen Pub '174, [0414]; Ex. B, ¶130.)

A dispute in the pending litigation also exists regarding construction of "**first**" and "**second**" with Patent Owner taking the position that these terms distinguish one like element from another. (Ex. LLL, p.029.) For purposes of this Request, Requester applies Patent Owner's proposed construction. Patent Owner contends that this construction is supported by intrinsic evidence and points to claim 12's recitation that a "first image is a reimage of the second image" in support. ('582, cl. 12.) Patent Owner has also pointed to statements in the written description that purport to use "first" and "second" without positional significance. (*Id.*, 9:26-33.)

Under Patent Owner's construction, Chen Pub '174 discloses that the image discussed above is a "**first**" image because it is distinguishable from others. (Ex. B, ¶132.) Chen Pub '174 expressly distinguishes this image from the image projected by a collimating optical element, stating:

> The concave mirror **907** therefore creates a second image of the collimating lens **902** near a second focusing lens **908**. The light beam between the concave mirror **907** and the second image at the lens **908** may have substantially the same diameter as the beam of light between the collimating lens **902** and the first image near the focusing lens **905**.

(Chen Pub '174, [0414] (underlining added).)

e. Claim 1[d]: "a first focusing optical element arranged to receive at least a portion of the collimated beam reflected by the optical relay element; and"

Chen Pub '174 discloses Claim 1[d]. Chen Pub '174 teaches a focusing lens **908** that is a "**focusing optical element**." This focusing lens **908** is "**arranged to receive at least a portion of the collimated beam reflected by the optical relay element**." Chen Pub '174 explains that "[l]ight reflected from the dichroic filter **903** may impinge upon a second optical element **907**, such as a concave mirror" and that light reflecting off concave mirror **907** "creates a second image of the collimating lens 902 near a second focusing lens **908**." (Chen Pub '174, [0414].) Chen Pub '174 further explains that a "second dichroic filter **909** may then be inserted in between the relay imaging concave mirror **907** and the second image near focusing lens **908**" such that dichroic filter **909** "may pass another band of color in the beam of light received by the WDM **90** at location **901**[,]" i.e., "**a portion of the collimated beam reflected by the optical relay element**." (Ex. B, ¶¶133-134.)

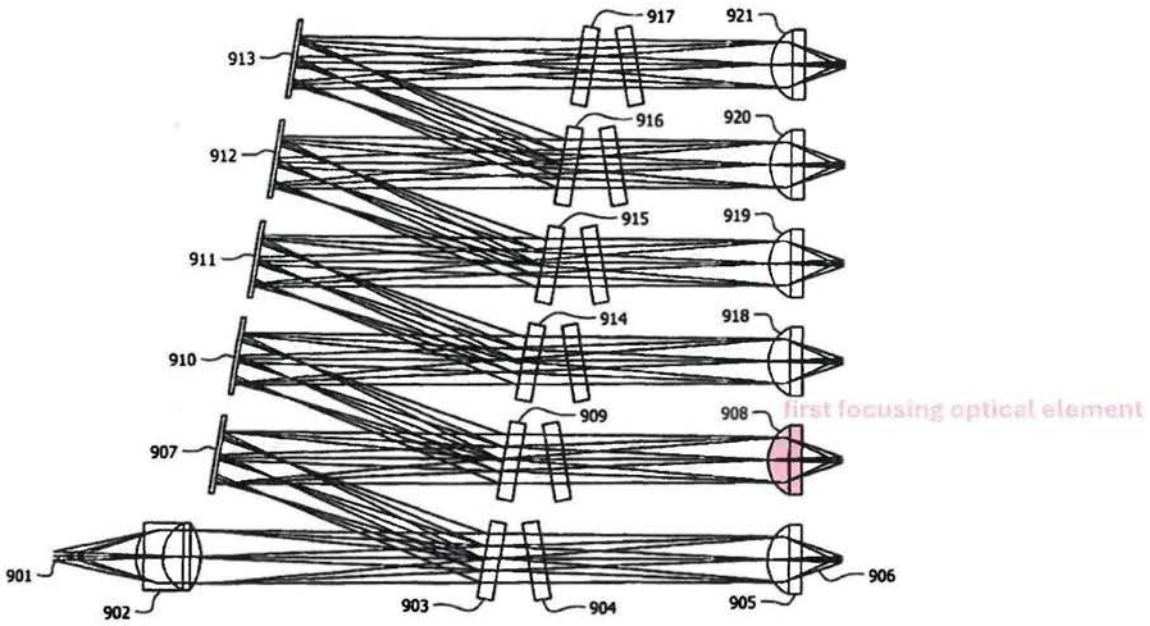


FIG. 25

(Chen Pub '174, FIG. 25 (focusing lens **908** in pink).)

The parties offered competing constructions for "**focusing optical element**." (Ex. LLL, pp.121-123.) Chen Pub '174's focusing lens **908** discloses a "**focusing optical element**" under either party's construction. (Ex. B, ¶¶134-136.) It is a lens, which is all that is required under Patent Owner's construction. With respect to Requestor's construction, FIG. 25 demonstrates that focusing lens **905** is of the same or larger size than collimating optical element **902**, sufficient to gather all light from a collimated beam that passes through dichroic filter **904** and focus it into the optical detectors while also minimizing photon loss. (Ex. B, ¶136.) Focusing lens **908** is approximately the same size as focusing lens **905** and is thus of the same or larger size than collimating optical element **902**.

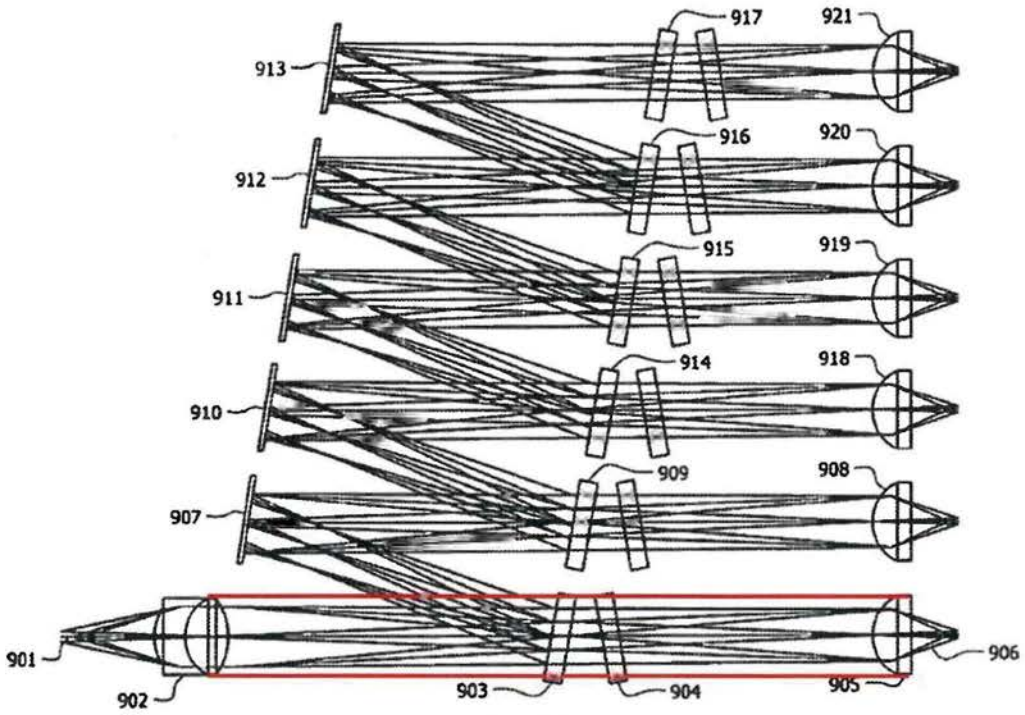


FIG. 25

(Chen Pub '174, FIG. 25 (annotated).) Chen Pub '174 further explains that the collimated optical element "project[s] a magnified image of the object near a final focusing lens **905**," that "[t]he size of the image near **905** may be kept approximately the same as the effective size of the collimating optical element **902**," and that "[t]he light beam between the concave mirror **907** and the second image at the lens **908** may have substantially the same diameter as the beam of light between the collimating lens **902** and the first image near the focusing lens **905**." (*Id.*, [0412], [0414].) These disclosures confirm that focusing lenses **905** and **908** are structurally the same. (Ex. B, ¶137.)

Focusing lens **908** is "**first**" under Patent Owner's construction because it is distinguishable from other focusing lenses (*e.g.*, focusing lenses **905**, **918**, **919**, **920**, **921**) in Chen Pub '174's WDM. (Ex. B, ¶138.)

f. Claim 1[e]: "a first semiconductor detector,"

Chen Pub '174 discloses Claim 1[e]. Chen Pub '174 explains that FIG. 25A is a "top view of a light detection assembly **937** with the WDM **90** illustrated in FIG. 25[.]" (Chen Pub '174, [0417].) Light assembly **937** includes WDM **90** and a photodetector system **938**. "After being processed by the WDM **90**, the beam of light ... may split into multiple colored bands with different wavelengths to be detected by photodetectors **940**, **941**, **942**, **943**, **944**, and **945**, respectively." (*Id.*) Each photodetector can be, according to Chen Pub '174, "a semiconductor detector, an avalanche photodetector (APD), and a carbon nanotube detector." (*Id.*)

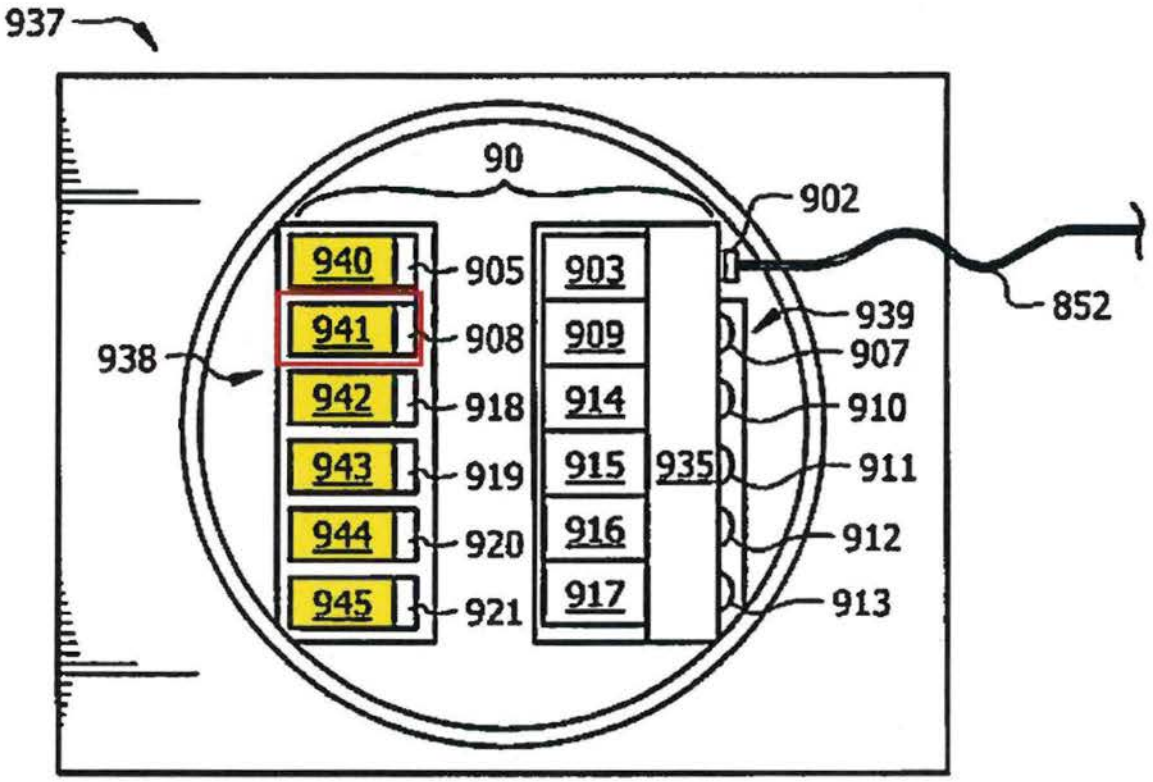


FIG. 25A

(Chen Pub '174, FIG. 25A (semiconductor detectors in yellow).) The "**first semiconductor detector**" in Chen Pub '174's system is associated with photodetector **941** (red box above). (Ex. B, ¶ 139.)

Photodetector **941** is "**first**" under Patent Owner's construction because it is distinguishable from other semiconductor detectors (*e.g.*, photodetectors **940**, **942**, **943**, **944**, **945**) in Chen Pub '174's WDM. (Ex. B, ¶139.)

g. Claim 1[f]: "wherein the first focusing optical element is configured to focus the portion of the collimated beam received from the optical relay element onto the first semiconductor detector."

Chen Pub '174 discloses Claim 1[f]. Focusing lens **908** is "**configured to focus the portion of the collimated beam**" received from concave mirror **907** ("**optical relay element**") onto photodetector **941** ("**first semiconductor detector**"). Chen Pub '174 describes how "due to the present disclosure's 1:1 imaging relay architecture, the spots of light produced by focusing lenses **905**, **908**, **918**, **919**, **920**, and **921** are all smaller than the source of the beam of light, and therefore can be easily captured by small area APD's." (*Id.*, [0415].) This explanation is confirmed in FIGs. 25, 25A. (Ex. B, ¶ 141.) FIG. 25 shows how focusing lens **908** focuses down a "**portion of the collimated beam received from the optical relay element**" to a focal point.

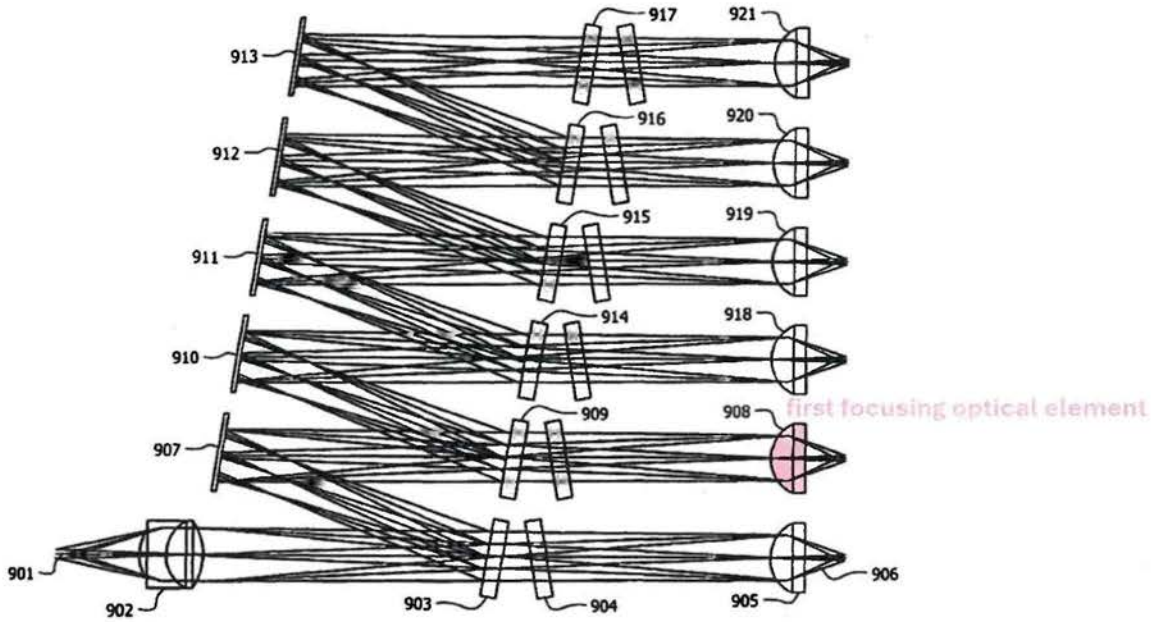


FIG. 25

(*Id.*, FIG. 25 (focusing lens **908** in pink).) FIG 25A shows that focusing lens **908** (in pink) is optically coupled to photodetector **941** (in yellow).

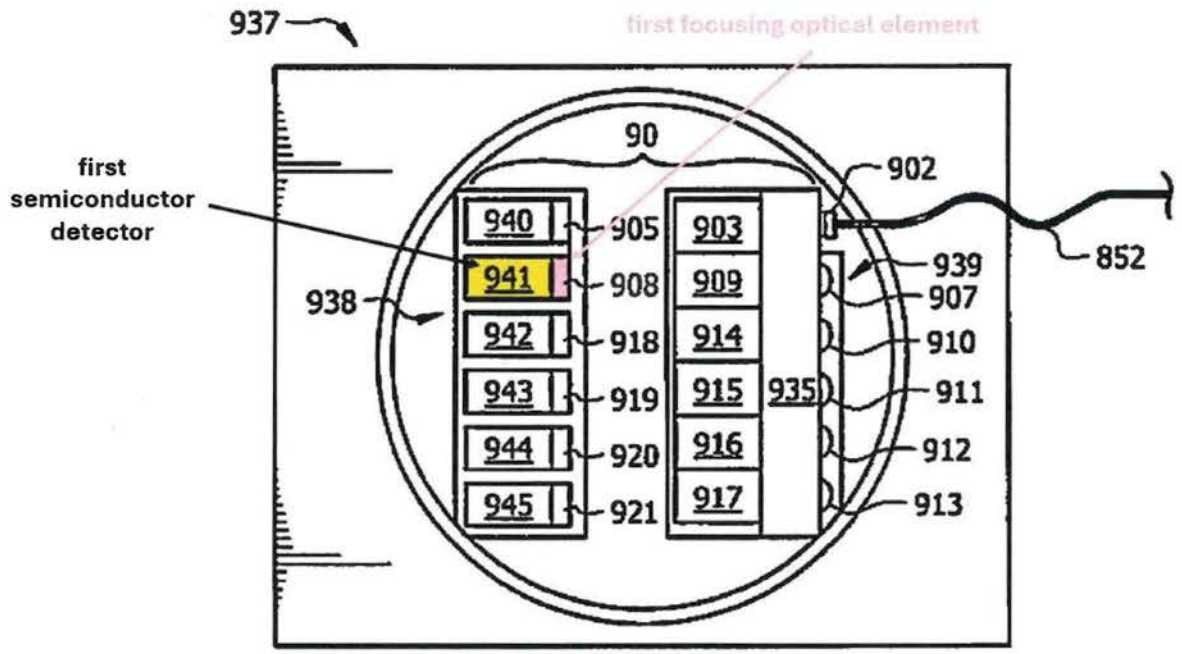


FIG. 25A

(*Id.*, FIG. 25A (annotated).)

2. Claim 2: "further comprising the light source, wherein the light source comprises light passing through a pinhole or light emitted from a facet of a multimode optical fiber."

Chen Pub '174 discloses Claim 2. Chen Pub '174 explains that "[a]s shown in FIG. 25, fluorescence light going through a pinhole or emitted from the facet of a multimode optical fiber, such as the optical fiber **852** depicted in FIG. 1, forms an extended object or light source at location **901**, i.e. the optical input of the WDM **90**." (Chen Pub '174, [0411] (underlining added); Ex. B, ¶142.)

3. Claim 3: "wherein the first focusing optical element is configured to focus the portion of the collimated beam received from the optical relay element to a size smaller than 1 millimeter in diameter."

Chen Pub '174 discloses Claim 3. Chen Pub '174 explains how "the practical size of the pinhole or the core diameter of the multimode optical fiber is measured in millimeters," (Chen Pub '174, [0411]), and then later explains that "so long as the magnification factor is kept small, for example, less than around 10, using a simple singlet lens as the focusing lens **905**, the collimated beam of light can [be] readily focused down to a spot smaller than that of the beam of light received by the WDM **90** at location **901**" (*id.*, [0412]). Chen Pub '174 later indicates with respect to lens **908** that "the extended yet collimated beam can be easily focused down to a spot smaller than that of the light source at **901**. The diameter of the spot may be smaller than 1 mm, for example, around 600 μm." (*Id.*, [0414] (underlining added); Ex. B, ¶143.)

4. Claim 6: "further comprising a first optical filter disposed along an optical path between the collimating optical element and the optical relay element, the first optical filter configured to separate the collimated beam into a first branch and a second branch."

Chen Pub '174 discloses Claim 6. Dichroic filter **103** is a "first optical filter disposed along an optical path between the collimating optical element and the optical relay element." Chen Pub '174 explains that "[a] dichroic filter **903**, …, may be inserted into the optical path in between the collimating optical element **902** and

the focusing lens **905**." (Chen Pub '174, [0413].) Dichroic filter **903** is also disposed along the optical path between collimating optical element **902** and concave mirror **907** ("**optical relay element**") (*see id.*, [0414]), as further depicted in FIG. 25.

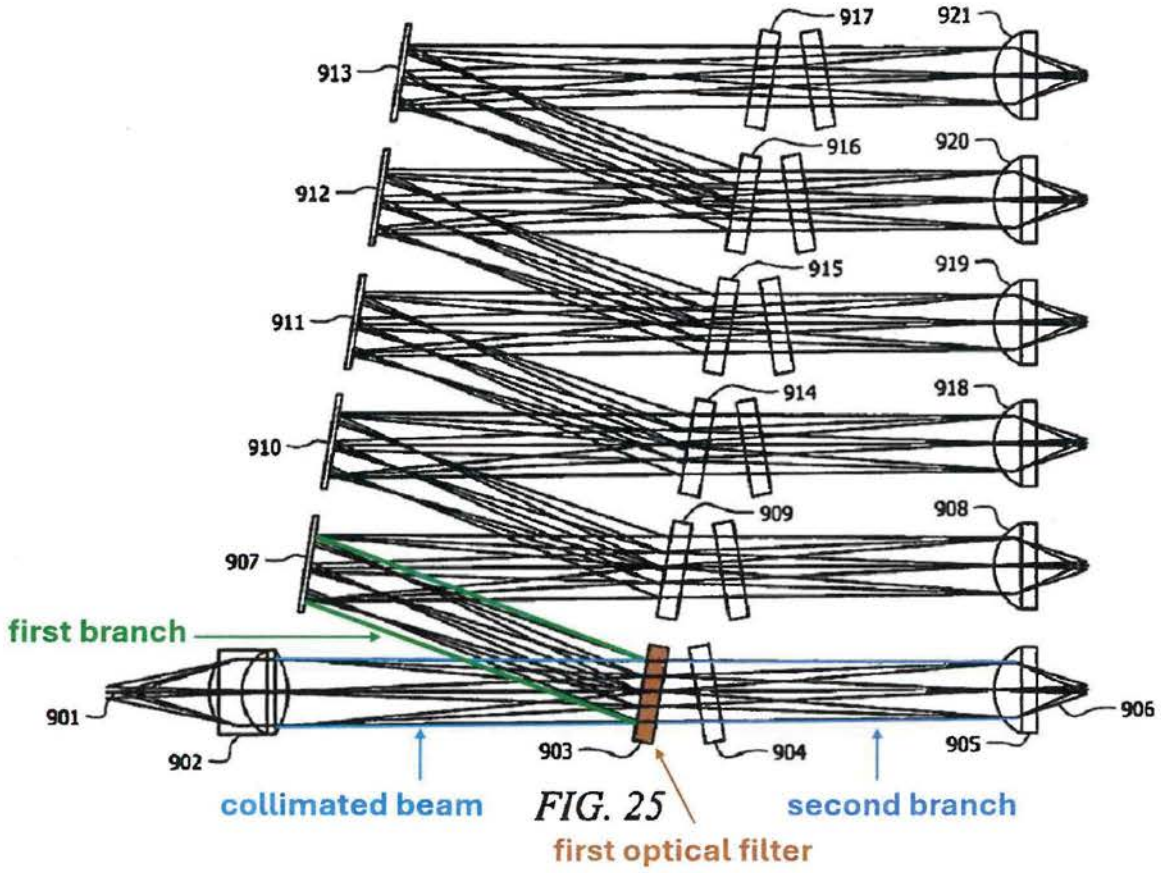


FIG. 25

(*Id.*, FIG. 25 (annotated).) As shown above, dichroic filter **903** "pass[es] the color band of interest and reflects the remaining colors in the beam of light for further processing within the WDM 90 (*id.*, [0413]), i.e., it "**separate[s] the collimated beam into a first branch and a second branch**." (Ex. B, ¶144.)

5. Independent Claim 14

a. Claim 14[pre]: "An optical subsystem for a flow cytometer, the optical subsystem comprising:"

Chen Pub '174 discloses Claim 14[pre] for the same reasons provided for Claim 1[pre]. (Ex. B, ¶145.)

b. Claim 14[a]: "a collimating optical element arranged to receive light from a light source,"

Chen Pub '174 discloses Claim 14[a] for the same reasons provided for Claim 1[a]. (Ex. B, ¶146.)

c. Claim 14[a][i]: "the collimating optical element configured to project a collimated beam including a first image,"

Chen Pub '174 discloses a "**collimating optical element configured to project a collimated beam**" for the same reasons provided for Claim 1[a]. Chen Pub '174 additionally discloses that collimating optical element **902** projects a collimated beam that "**includ**[es] **a first image**." A POSA would have understood that the image is ultimately disposed at two locations: (1) near the optical relay element, concave mirror **907**, and (2) near focusing lens **905**. (Chen Pub '174, [0412], [0414], FIG. 25, Ex. B, ¶147.)

FIG. 25 in Chen Pub '174 shows a collimating optical element **902** that captures light from light source **901** (the "object") and "project[s] a magnified image of the object" in the form a collimated beam of light. (Chen Pub '174, [0412].)

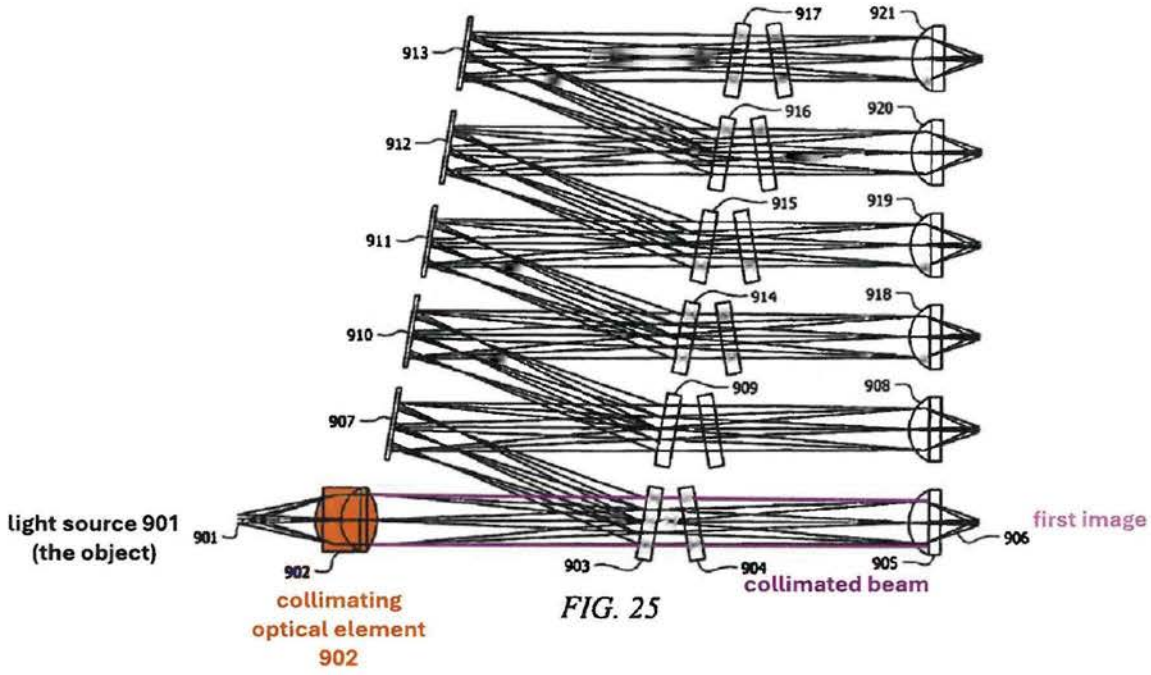


FIG. 25

(*Id.*, FIG. 25 (annotated).) As shown, a "**first image**" of the light source **901** is projected with the collimated beam, e.g., a portion of the collimated beam that is filtered through the dichroic filter **903** and directed toward focusing lens **905**. (*Id.* [0412], [0413]; Ex. B, ¶148.)

Under Patent Owner's construction, this image is "**first**" because it is distinguishable from the "second image" produced by concave mirror **907** ("**optical relay element**") and arranged near a second focusing lens **908**. (*See* Chen Pub '174, [0414]; Ex. B, ¶149.)

d. Claim 14[a][ii]: "wherein the collimated beam has a collimated distance; and"

Chen Pub '174 discloses Claim 14[a][ii]. (Ex. B, ¶150.) While the '582 specification fails to quantify when a beam is collimated (versus not) or at what

optical distance a beam is collimated (versus not), ('582, 44:51-57), a POSA would have understood that a collimated beam must have *some* finite distance that it is effectively collimated. (Ex. B, ¶¶151-155.) Overall beam divergence will increase with optical distance in any given optical system, and at some point, the beam diverges to where it is no longer considered collimated. (Ex. B, ¶¶153-156; *see also* Ex. HHH, pp.001, 003; Ex. III, pp.001-002.)

Chen Pub '174 describes the existence of a "beam of light propagating between the collimating optical element **902** and the focusing lens **905**" that is "effectively collimating," suggesting to a POSA that this beam has a "**collimated distance**" for a finite distance along the optical path. (Chen Pub '174, [0412]; *see also id.*, FIG. 25. Ex. B, ¶156.) Chen Pub '174 also describes how concave mirror **907** can "effectively double[] the collimated beam path without expanding the beam's diameter," indicating that the portion of the collimated beam incident on concave mirror **907** had a collimated distance. (Chen Pub '174, [0414].)

e. Claim 14[b]: "an optical relay element arranged to receive the collimated beam,"

Chen Pub '174 discloses Claim 14[b] for the same reasons provided for Claim 1[b]. (Ex. B, ¶157.)

f. Claim 14[b][i]: "the optical relay element configured to extend the collimated distance of the collimated beam,"

Chen Pub '174 discloses Claim 14[b][i]. Chen Pub '174 explains that its concave mirror **907** "may [have] a radius of curvature approximately equal to the distance between the collimating optical element **902** and the image near focusing lens **905**." (Chen Pub '174, [0414].) When a collimated beam is incident on concave mirror **907**, it will "create[] a second image of the collimating lens **902** near a second focusing lens **908**" where "[t]he light beam between the concave mirror **907** and the second image at the lens **908** may have substantially the same diameter as the beam of light between the collimating lens **902** and the first image near the focusing lens **905**." (*Id.*) Because of its radius of curvature, the "relay imaging concave mirror **907** therefore effectively doubles the collimated beam path without expanding the beam's diameter[,]" i.e., being "**configured to extend the collimated distance of the collimated beam**." (*Id.*) The functionality of concave mirror **907** ("**optical relay element**") within Chen Pub '174's zig-zag WDM configuration is consistent with the "present disclosure's 1:1 imaging relay architecture[.]" (*Id.*, [0415]; *see also id.*, FIG. 25 (showing concave mirror **907** receiving collimated beam and projecting collimated beam); Ex. B, ¶158.)

g. Claim 14[b][ii]: "wherein the optical relay element comprises a curved mirror or a concave-shaped dichroic filter configured to produce a second image."

Chen Pub '174 discloses an "**optical relay element**" that "**comprises a curved mirror**" in Claim 14[b][ii] for the same reasons provided for Claim 1[c]. Concave mirror **907** also is "**configured to produce a second image**," as Chen Pub '174 explains that "concave mirror **907** therefore creates a second image of the collimating lens **902** near a second focusing lens **908**." (Chen Pub '174, [0414].) Under Patent Owner's construction, this image is "**second**" because it is distinguishable from the "first image" projected by a collimating optical element and arranged near focusing lens **905**. (*See id.*, [0412], [0414]; Ex. B, ¶159.)

6. Claim 15: "wherein the second image and the first image are substantially the same size."

Chen Pub '174 discloses Claim 15. Chen Pub '174 teaches that "[t]he light beam between the concave mirror **907** and the second image at the lens **908** may have substantially the same diameter as the beam of light between the collimating lens **902** and the first image near the focusing lens **905**." (Chen Pub '174, [0414]; Ex. B, ¶ 160.)

7. **Claim 17: "further comprising a first focusing optical element arranged to receive the collimated beam from the optical relay element at the extended collimated distance, the first focusing optical element configured to focus the collimated beam onto a first semiconductor detector."**

Chen Pub '174 discloses Claim 17 for the same reasons provided for Claims 1[d], 1[f], and 14[b][i]. (Ex. B, ¶161.)

8. **Claim 18: "an optical filter arranged along an optical path between the collimating optical element and the optical relay element, the optical filter configured to separate the collimated beam into a first branch and a second branch, wherein the first branch and the second branch comprise light of different colors, wherein the optical relay element is arranged to receive the first branch; and a second focusing optical element arranged to receive the second branch, the second focusing optical element configured to focus the second branch to a second semiconductor detector."**

Chen Pub '174 discloses Claim 18. For ease of reference, annotations to FIG. 25 show how Chen Pub '174 discloses these additional limitations.

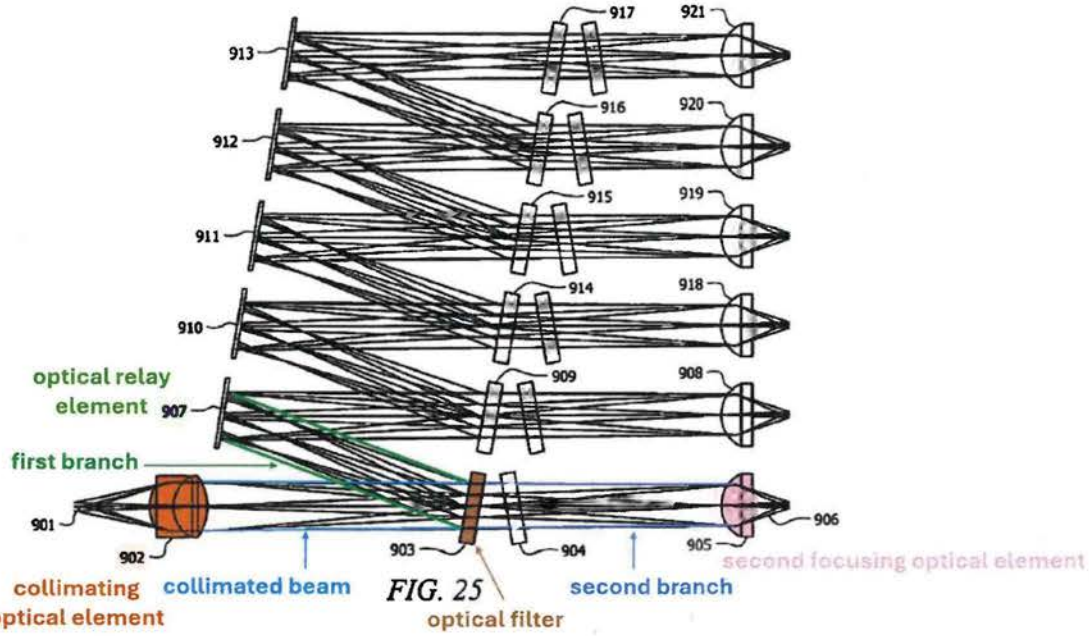


FIG. 25

(Chen Pub '174, FIG. 25 (annotated); Ex. B, ¶ 162.)

Chen Pub '174 discloses "**an optical filter arranged along an optical path between the collimating optical element and the optical relay element, the optical filter configured to separate the collimated beam into a first branch and a second branch**" for the reasons discussed for Claim 6. Chen Pub '174 also explains how "dichroic filter **903** may pass the color band of interest and reflects the remaining colors in the beam of light for further processing within the WDM **90**[,]" indicating that the "**first branch and the second branch comprise light of different colors**." (Chen Pub '174, [0413]; Ex. B, ¶ 163.)

Chen Pub '174's "**optical relay element is arranged to receive the first branch**," as Chen Pub '174 describes how "[l]ight reflected from the dichroic filter

903 may impinge upon a second optical element **907**, such as a concave mirror [**907**]." (Chen Pub '174, [0414]; Ex. B, ¶164.)

Chen Pub '174's focusing lens **905** ("**second focusing optical element**") is also "**arranged to receive the second branch.**" (Chen Pub '174, [0412].) As shown in FIG. 25, focusing lens **905** differs from focusing lens **908** (the "**first focusing optical element**" identified for Claim 17), consistent with Patent Owner's construction. (Ex. B, ¶165.) Chen Pub '174's focusing lens **905** is "**configured to focus the second branch**" to a second semiconductor detector, photodetector **940**, as shown in FIG. 25A.

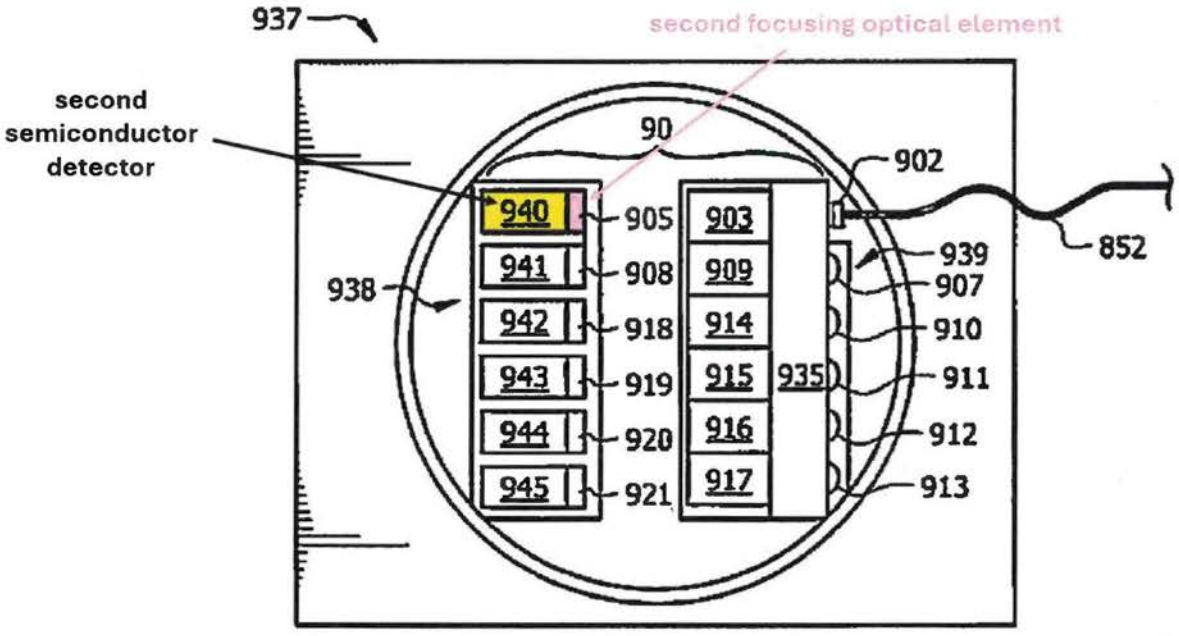


FIG. 25A

(Chen Pub '174, FIG. 25A (annotated).)

9. Independent Claim 20

a. Claim 20[pre]: "An optical subsystem for a flow cytometer, the optical subsystem comprising:"

Chen Pub '174 discloses Claim 20[pre] for the same reasons provided for Claim 1[pre]. (Ex. B, ¶166.)

b. Claim 20[a]: "a collimating optical element arranged to receive light from a light source, the collimating optical element configured to project a first image; and"

Chen Pub '174 discloses Claim 20[a] for the same reasons provided for Claims 1[a] and 14[a][i]. (Ex. B, ¶167.)

c. Claim 20[b]: "an optical relay element arranged near the first image, the optical relay element configured to receive light from the collimating optical element and to project a second image;"

Chen Pub '174 discloses Claim 20[b]. To start, Chen Pub '174 discloses an "**optical relay element**" for the same reasons provided for Claim 1[b]. Concave mirror **907** is "**arranged near the first image**." As explained for Claim 14[a][i], a "**first image**" is projected by collimating optical element and ultimately disposed at two locations: (1) near the "**optical relay element**," concave mirror **907**, and (2) near focusing lens **905**. (Chen Pub '174, [0412], [0414], FIG. 25, Ex. B, ¶168.)

Chen Pub '174 discloses that concave mirror **907** is "**configured to receive light from the collimating optical element**." Collimating element **902** projects a collimated beam toward dichroic filter **903**. (Chen Pub '174, [0412], [0413], FIG.

25.) Dichroic filter **903** "may pass the color band of interest and reflects the remaining colors in the beam of light for further processing within the WDM **90**." (*Id.*, [0413].) The "[l]ight reflected from the dichroic filter **903** may impinge upon a second optical element **907**, such as a concave mirror." (*Id.*, [0414].)

Concave mirror **907** also "**project**[s] **a second image**." Concave mirror **907** "may [have] a radius of curvature approximately equal to the distance between the collimating optical element **902** and the image near focusing lens **905**." (Chen, [0414].) As a result, "concave mirror **907** therefore creates a second image of the collimating lens **902** near a second focusing lens **908**." (*Id.*)

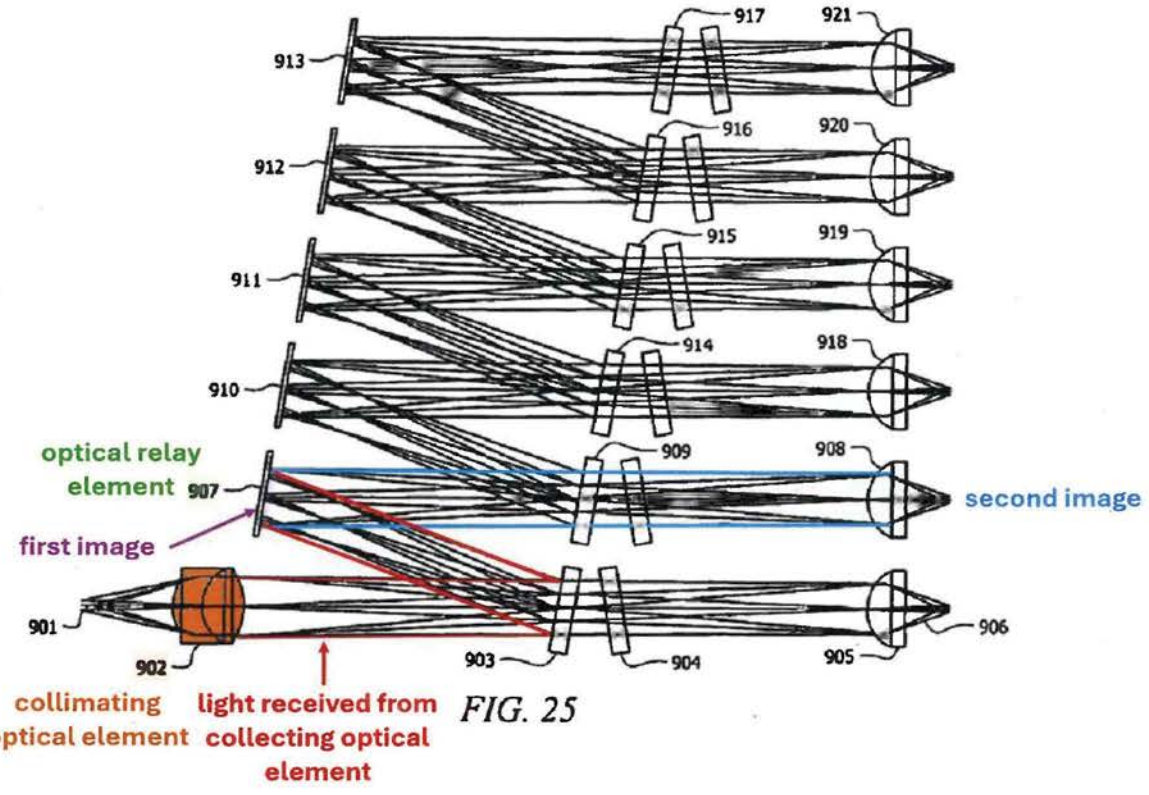


FIG. 25

(*Id.*, FIG. 25 (annotated); Ex. B, ¶170.)

d. Claim 20[b][i]: "wherein the size of the first image is substantially the same as the size of the second image, and"

Chen Pub '174 discloses Claim 20[b][i] for the same reasons provided for Claim 15. (Ex. B, ¶171.)

e. Claim 20[b][ii]: "wherein the optical relay element comprises a curved mirror or a concave-shaped dichroic filter."

Chen Pub '174 discloses Claim 20[b][ii] for the same reasons provided for Claim 1[c]. (Ex. B, ¶172.)

10. Claim 21: "wherein the optical distance from the collimating optical element to the first image is substantially the same as the optical distance from the optical relay element to the second image."

Chen Pub '174 discloses Claim 21. As discussed for Claims 20[a] and 20[b], respectively, a "**first image**" is arranged near focusing lens **905**, whereas a "**second image**" is arranged near focusing lens **908**. (*See* Chen Pub '174, [0412], [0414].) The optical distance from collimating optical element **902** to focusing lens **905** is "**substantially the same**" as the optical distance from concave mirror **907** to focusing lens **908**, as shown in FIG. 25 below.

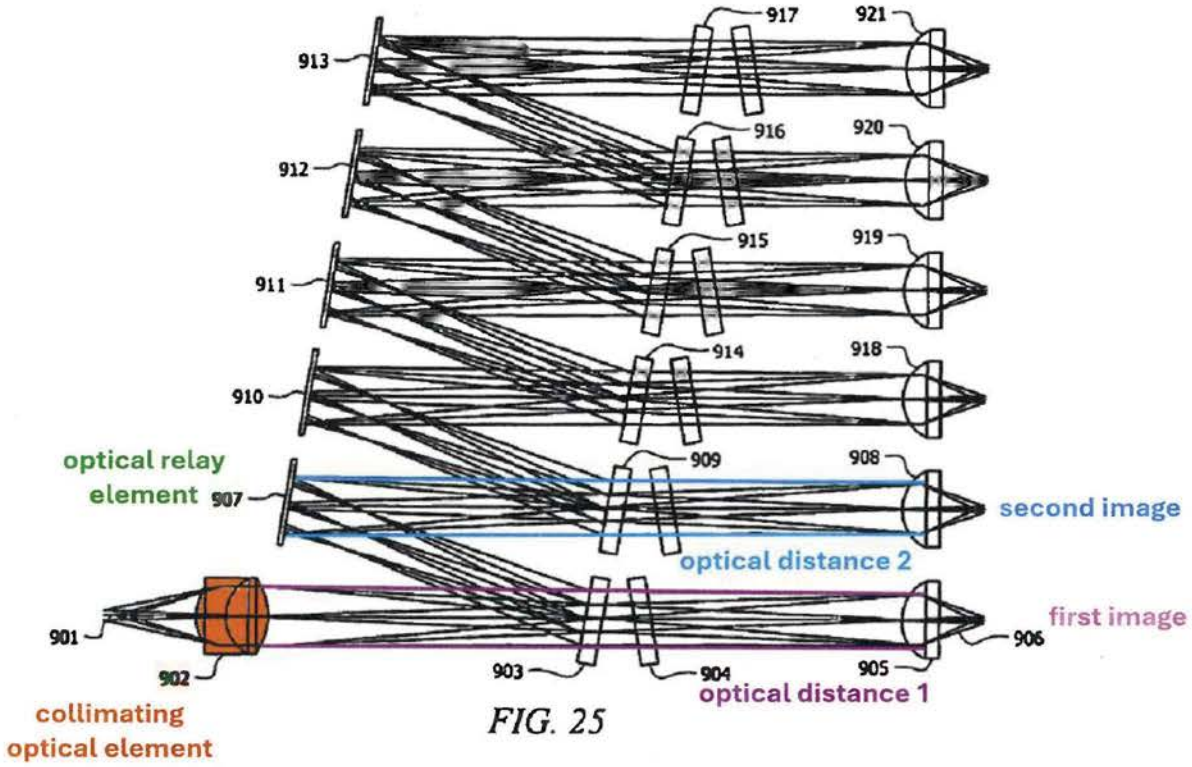


FIG. 25

(*Id.*, FIG. 25; Ex. B, ¶173.)

11. Claim 22: "further comprising the light source, wherein the light source comprises an extended light source that forms an object, wherein the first image is a magnified image of the object."

Chen Pub '174 discloses Claim 22. Chen Pub '174 first describes that its "**light source comprises an extended light source that forms an object**," explaining that "[a]s shown in FIG. 25, fluorescence light going through a pinhole or emitted from the facet of a multimode optical fiber, such as the optical fiber **852** depicted in FIG. 1, forms an extended object or light source at location **901**, i.e. the optical input of the WDM **90**." (Chen Pub '174, [0411] (underlining added).) Chen

Pub '174 then indicates that the "**first image is a magnified image of the object**" by stating that "a collimating optical element … may capture the light from source **901**, and project a magnified image of the object near a final focusing lens **905**." (*Id.*, [0412] (underlining added); Ex. B, ¶175.)

12. Claim 23: "wherein the light source comprises light passing through a pinhole or light emitted from a facet of a multimode optical fiber."

Chen Pub '174 discloses Claim 23 for the same reasons provided for Claim 2. (Ex. B, ¶176.)

13. Claim 25: "wherein the first image is less than approximately 10 times the size of the object."

Chen Pub '174 discloses Claim 25. Chen Pub '174 explains that "a collimating optical element… may capture the light from source **901**, and project a magnified image of the object near a final focusing lens **905**." (Chen Pub '174, [0412].) Chen Pub '174 goes on to state: "[a]s shown in FIG. 25, so long as the magnification factor is kept small, for example, less than around 10, using a simple singlet lens as the focusing lens **905**, the collimated beam of light can [be] readily focused down to a spot smaller than that of the beam of light received by the WDM **90** at location **901**." (*Id.* (underlining added); Ex. B, ¶177.)

14. Claim 26: "further comprising a first focusing optical element arranged near the second image, the first focusing optical element configured to focus the light from the optical relay element to a size smaller than the object of the light source to a first semiconductor detector."

Chen Pub '174 discloses Claim 26. To start, Chen Pub '174 disclose a "**first focusing optical element**" in focusing lens **908** for the same reasons provided for Claims 1[d], 1[f], and 14[b][i]. (*See also* Chen Pub '174, [0412], [0414], FIG. 25.) Focusing lens **908** is "**arranged near the second image**," as concave mirror **907** "creates a second image of the collimating lens **902** near a second focusing lens **908**." (*Id.*, [0414].) Chen Pub '174 also discloses a "**first semiconductor detector**" in photodetector **941** for the same reasons provided for Claim 1[e]. (*See also id.*, [0417], FIG. 25A.) Finally, focusing lens **908** is "**configured to focus the light from the optical relay element to a size smaller than the object of the light source to a first semiconductor detector**" for the reasons provided for Claim 3. (*See also id.*, [0411] (core diameter of multimode optical fiber in millimeters), [0412] (collimated beam of light can be focused down to a spot smaller than the beam of light received by the WDM at location **901**), [0414] (collimated beam "can be easily focused down to a spot smaller than that of the light source at **901**."); Ex. B, ¶179.)

G. SNQ No. 2: Claims 1, 2, 3, 6, 14, 15, 17, 18, 20, 21, 22, 23, 25, 26 are Unpatentable as Obvious Over Chandler in View of Goodman.

1. Motivation to Combine Chandler with Goodman and Reasonable Expectation of Success

A POSA would have found it obvious to combine Chandler's flow cytometers with Goodman's teachings regarding its wavelength division demultiplexer devices. Chandler, as modified by Goodman, would have predictably resulted in the substitution of the branched configuration of Chandler's bandpass filters within its FADC units with Goodman's more modular, efficient, cost-effective WDM. (Ex. B, ¶¶180-181.)

Chandler's FADC units have an associated footprint that would have to be managed and/or miniaturized if additional light sources are used to irradiate fluorescence-tagged material. (Ex. B, ¶182.) At the same time, Chandler intended to make conventional flow cytometers "small and inexpensive." (Chandler, 3:51-55.) But a POSA would have recognized that Chandler's branched configuration in the FADC units was suboptimal for achieving Chandler's stated goals, particularly where more color separation per light source was desired. (Ex. B, ¶182.)

A POSA seeking to reduce the footprint of Chandler's FADC units without sacrificing detection capabilities would naturally have consulted alternate WDM arrangements, including Goodman. (Ex. B, ¶183.) Goodman and Chandler are analogous references in the same field of the alleged invention related to fiber optics,

aimed at compact modular optical instruments for color separation and detection. (Chandler, 1:11-15, 3:32-35; Goodman, 1:8-12, 3:48-67, 6:19-35.) Chandler and Goodman are directed to the same problems faced by the inventor of efficiently demultiplexing and detecting light, and the '582 patent specifically identifies WDMs in the optical communication industry as analogous to WDMs in flow cytometry. ('582, 4:50-60, 44:7-14.)

A POSA would have been motivated to combine Chandler with Goodman because Goodman teaches improvements aligned to Chandler's design goals. (Ex. B, ¶184.) Goodman explains that its invention is intended to provide a demultiplexer device:

- "in which each optical surface therein can be produced within current standard molding tolerances;"
- "in which all surfaces are simple geometric forms and are easily accessible for measurement;"
- "that is easy to mold and fabricate accurately;"
- "that is easy to handle and assemble due to simple component geometries;"
- "that is easy to incorporate into other optical systems;" and
- "is easily scalable or modified."

(Goodman, 3:48-67.) These motivations are confirmed by multiple prior art references. (*See, e.g.*, Oostman, 2:60-64, 3:36-42, 4:14-24, 4:39-45; Frazier, 2:39-46; Wang, 1:65-2:2; Lemoff, 2:19-24; He, 2:36-38; Grann, 2:51-56; Nosu, 3:31-52.)

It would have been obvious to try Goodman's demultiplexer device in Chandler's flow cytometer system. Goodman provides a zig-zag pattern in an optical block that was widely accepted in optical communications and had long found adoption within flow cytometry applications. (*See* Section V.A.2.) Goodman's WDM configuration was a known alternative to Chandler's branched configuration, and one of several options available to a POSA at the time of the invention. (Ex. B, ¶¶185-186; *see* Section V.A.2.)

A POSA would have had a reasonable expectation that the combination would have been successful. (Ex. B, ¶187.) Goodman designed its invention to specifically provide a "demultiplexer device that is easy to incorporate into other optical systems." (Goodman, 3:65-67.) Its demultiplexing devices satisfy this objective by advantageously being "formed with geometrically simple shapes and without complex off-axis surfaces" that "allows for ease of fabrication, ease of metrology, and relatively simple incorporation into more complex optical systems." (*Id.*, 6:19-24.) Chandler also describes that its FADC unit configuration is flexible. (Chandler, 8:25-30, 11:39-67, 12:42-51.) The '582 specification confirms that a WDM from the optical communication industry can be "readily adapted for fluorescence light detection," as such a WDM is "almost identical in function and architecture" to WDMs used in flow cytometry. ('582, 4:50-60, 44:7-14.)

2. Independent Claim 1

a. Claim 1[pre]: "An optical subsystem for a flow cytometer, the optical subsystem comprising:"

The combination of Chandler and Goodman discloses Claim 1[pre]. Chandler's "flow cytometric systems and/or methods of fluorescence measurement, including, multiple fluorescence measurement" is depicted in FIG. 4. (Chandler, 1:11-15, FIG. 4.) Chandler's "improved flow cytometer" includes "four standard laser diodes, or light emitting sources, **10**, **12**, **14**, **16** and four standard optical detectors **20**, **22**, **24**, **26**" surrounding a viewing chamber **1**. (*Id.*, 7:1-4.) Multimode fiber optic cables connect each of the optical detectors to a "filtering, amplification, and digital conversion (FADC) unit." The FADC unit includes sets of bandpass filters and photodetectors. (*Id.*, 7:35-49, 9:35-41, 9:52-61, 11:39-67.)

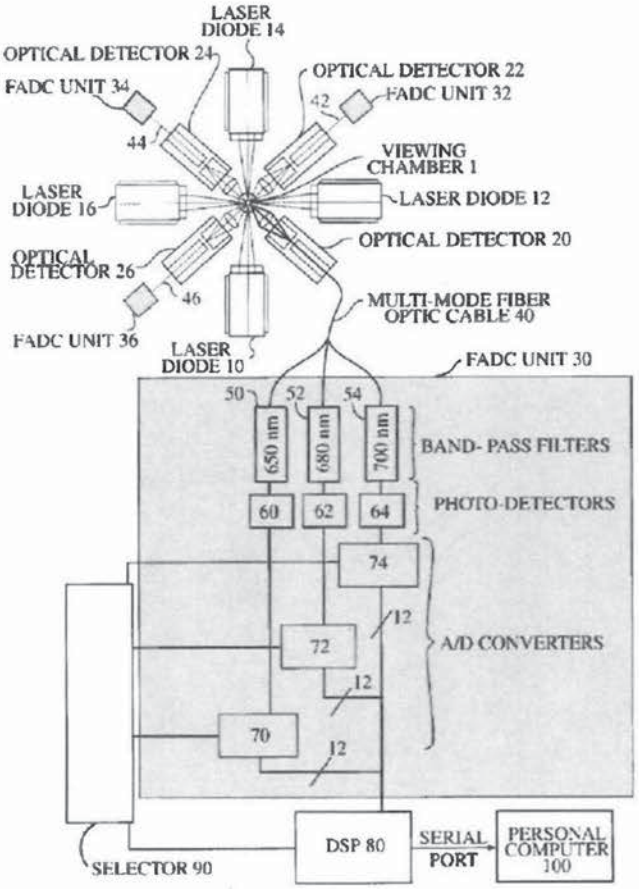


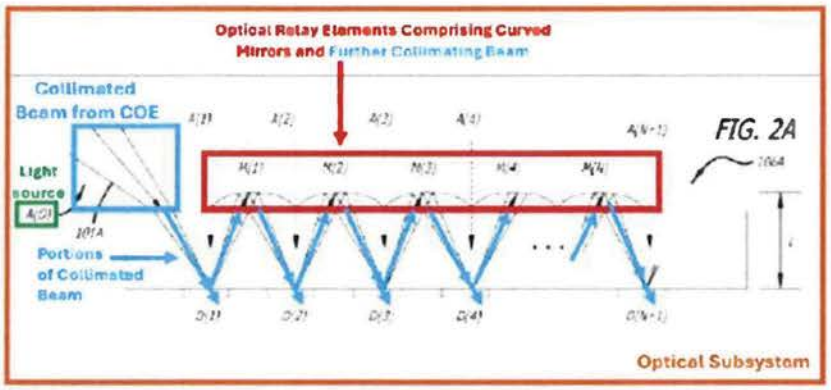
FIG. 4

(Chandler, FIG. 4 (annotated).) A POSA would have understood that the FADC units demultiplex scattered and fluorescent light using the filters and are thus an "**optical subsystem for a flow cytometer**." (Ex. B, ¶189.) A POSA would have been motivated to replace Chandler's branched FADC unit(s) with Goodman's alternate, known, zig-zag demultiplexing configuration, as discussed above. (Ex. B, ¶190.)

b. Claim 1[a]: "a collimating optical element arranged to receive light from a light source, the collimating optical element configured to project a collimated beam;"

Goodman discloses Claim 1[a]. (Ex. B, ¶191.) Goodman's collimating reflector **24***a* satisfies Patent Owner's construction for "**collimating optical element**" of a "lens, mirror, or grating, to render rays of light more nearly parallel." (Goodman, 10:17-21; *see also id.*, FIG. 1; Ex. B, ¶192.)

Goodman's collimating reflector **24***a* "**receive**[s] **light from a light source**." (Ex. B, ¶193.) "[M]ulti-wavelength optical beam **19** is emitted from output end **17** of optical fiber **15**, enters optical block **12**" and impinges upon an imaging optical element **18**. (Goodman, 11:53-55.) The imaging optical element **18** then reflects optical beam **19** onto an imaging optical element **20**, that further reflects the beam to a wavelength selective element **22***a*. (*Id.*, 11:56-62.) The wavelength selective element **22***a* pass select wavelengths of the beam and reflect or absorb the remainder. (*Id.*, 12:1-4.) The reflected wavelengths of the beam—"**light from a light source**"—are directed to collimating reflector **24***a*. (*Id.*, 12:4-5.) This interpretation is consistent with Patent Owner's infringement allegations against Requester that identify "curved mirrors" being collimating optical elements that are optically disposed after a first dichroic filter.



(*See* Ex. JJJ, p.003; *see also id.*, p.004.)

Goodman's collimating reflector **24***a* also "**projects a collimated beam**" under either party's construction for "**collimated beam**." Reflector **24***a* (orange) receives non-collimated light (pointed to by black arrow) exiting from optical fiber **15** because the imaging optical elements that precede collimating reflector **24***a* merely "control the tendency of non-collimated light to diverge." (Goodman, 11:63-66.) Reflector **24***a* can be a collimating lens or mirror. (*Id.*, 10:17-21.) A POSA would thus have understood that collimating reflector **24***a* collimates incident light, thereby "**project**[ing] **a collimated beam**" (blue) toward wavelength selective element **22***b*. (Ex. B, ¶¶194-195.) This is illustrated in FIG. 1 below.

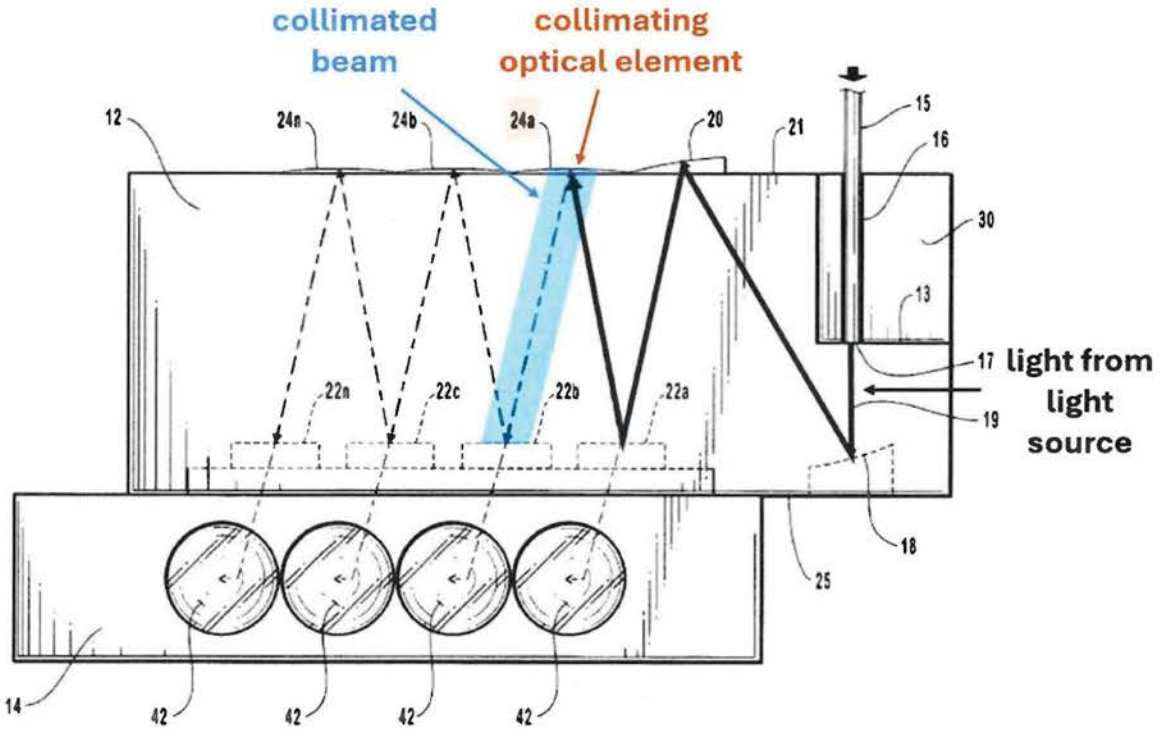


FIG. 1

(Goodman, FIG. 1 (annotated).)

c. Claim 1[b]: "an optical relay element arranged to receive at least a portion of the collimated beam from the collimating optical element,"

Goodman discloses Claim 1[b]. (Ex. B, ¶196.) Collimating reflector **24***b* is an "**optical relay element**" that receives "**a portion of the collimated beam**" projected by collimating reflector **24***a* ("**collimating optical element**").

Goodman teaches "a plurality of discrete reflectors **24***a*-**24***n* that are positioned on top surface **21** of optical block **12** in a linear arrangement." (Goodman, 9:58-61.) These reflectors can be "collimating lenses or mirrors" and may be "designed to relay the image of the fiber facet down the optical train." (*Id.*,

10:19-23.) FIG. 1 (annotated below) shows a collimated beam (blue) from collimating reflector **24***a* being directed "towards wavelength selective element **22***b*, which in turn passes a selected band of wavelengths [(gray blue)] and reflects the remainder to a subsequent [collimating] reflector **24***b* [(green)]." (*Id.*, 12:4-8.)

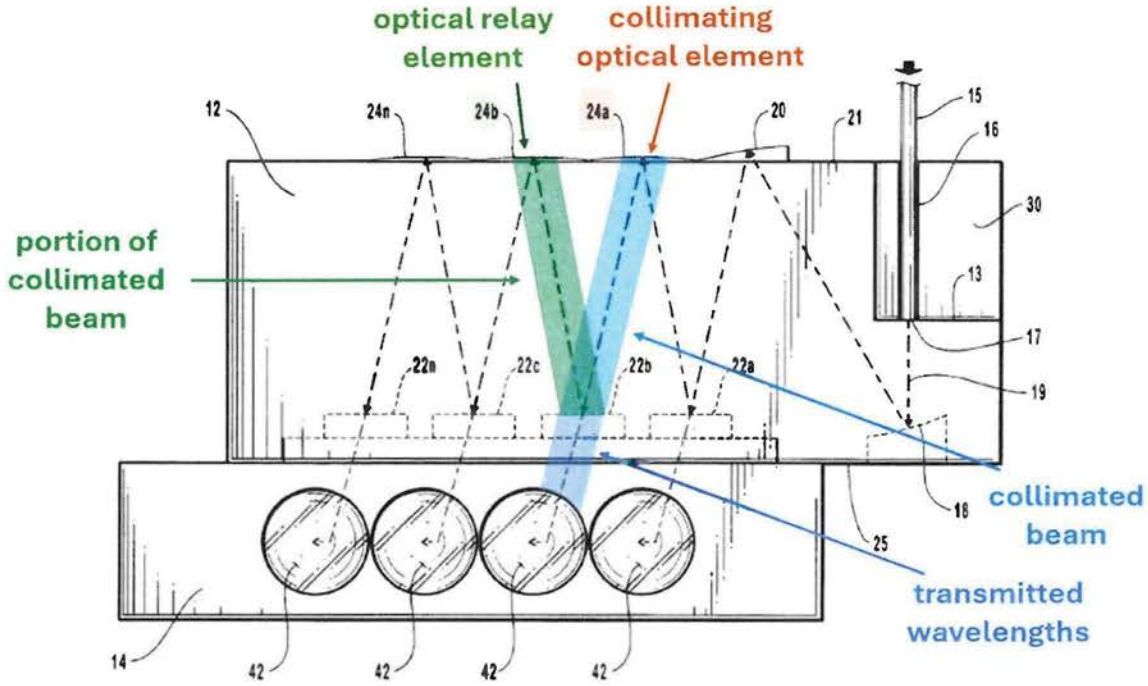


FIG. 1

(*Id.*, FIG. 1 (annotated); *see also* Ex. B, ¶197.)

In the underlying district court litigation, the parties offer competing constructions for "**portion**," (Ex. LLL, p.140), but Goodman discloses Claim 1[b] regardless of the construction applied, as collimating reflector **24***b* is configured to "receive at least a portion of the collimated beam" in the remainder of wavelengths reflected from wavelength selective element **22***b*. (Ex. B, ¶197.)

d. Claim 1[c]: "the optical relay element comprising a curved mirror configured to reflect the portion of the collimated beam received from the collimating optical element to produce a first image;"

Goodman discloses Claim 1[c]. (Ex. B, ¶198.) Goodman's reflectors, including collimating reflector **24***b*, can be "mirrors." (Goodman, 10:19-23.) FIG. 1 further depicts collimating reflector **24***b* with a curved, reflective surface.

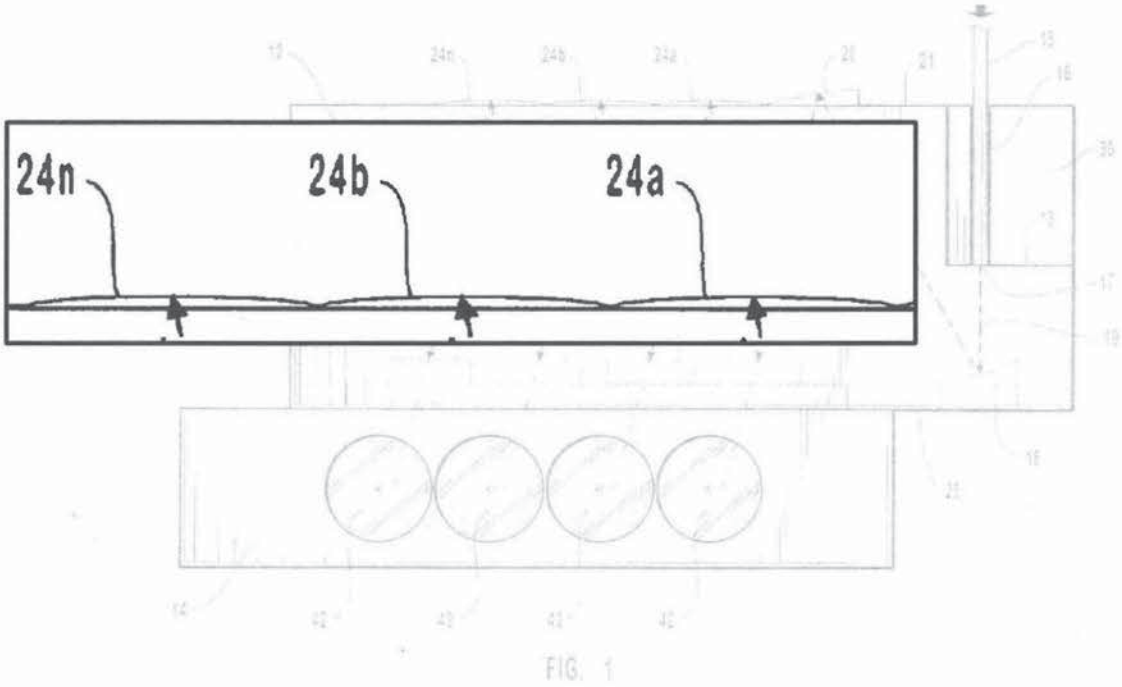


FIG. 1

(Goodman, FIG. 1 (magnified view of collimating reflector **24***b*).) A POSA would thus have understood that collimating mirrors are "**a curved mirror**." (Ex. B, ¶198.)

Goodman's collimating reflector **24***b* is "**configured to reflect the portion of the collimated beam received from the collimating optical element**." "Incident light on [collimating] reflector **24***b* is relayed to wavelength selective element

22*c*[.]" (Goodman, 12:8-9.) A POSA would have understood "relay" to mean reflecting the portion of the collimated beam received by collimating reflector **24***b*. (Ex. B, ¶199.) FIG. 1 also shows that collimating reflector **24***b* reflects the portion of the collimated beam to wavelength selective element **22***c*.

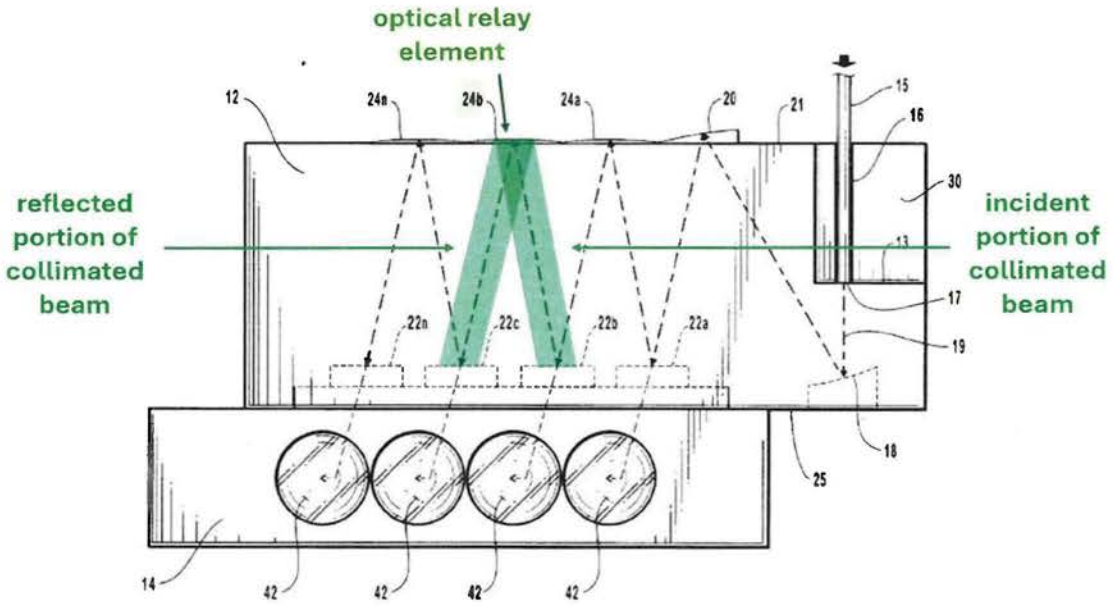


FIG. 1

(*Id.*, FIG 1 (annotated).)

Collimating reflector **24***b* reflects the portion of a collimated beam to "**produce a first image**" under Patent Owner's construction. (Ex. B, ¶200; *see also id.*, ¶¶198-200.) Goodman's collimating reflector **24***b* controls the incident collimated beam divergence by re-collimating the beam to maintain and extend collimation, thereby "**produc**[ing] **a first image**." (Goodman, 10:17-23 (reflectors

"designed to relay the image of the fiber facet down the optical train"), 10:26-29; *see* Ex. B, ¶200.)

Under Patent Owner's construction, Goodman discloses that the image discussed above is a "**first**" image. (Ex. B, ¶201.) Collimating reflector **24***n* may later reimage this "first image" to produce a second image, which is distinguishable from the first image along the optical path of the WDM. (Ex. B, ¶201.)

e. Claim 1[d]: "a first focusing optical element arranged to receive at least a portion of the collimated beam reflected by the optical relay element; and"

Goodman discloses Claim 1[d]. Each of Goodman's set of focusing lenses **42** discloses a "**focusing optical element**." (Ex. B, ¶202.) "[E]mitted wavelength beams" propagating from wavelength selective elements **22***a*-**22***n* may be "transmitted to the focusing lenses" and then "[e]ach of lenses **42** [(pink)] can <u>focus</u> a selected wavelength beam onto a corresponding optical receiver such as an optical detector[.]" (Goodman, 11:24-30, 11:40-42 (underlining added).)

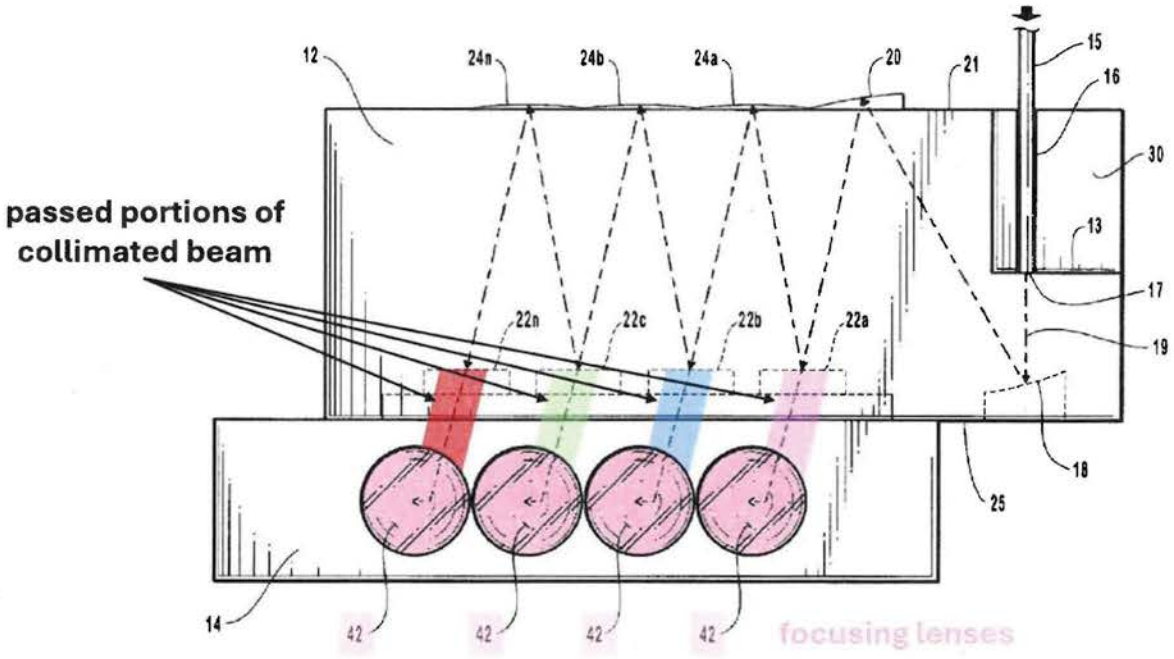


FIG. 1

(*Id.*, FIG. 1 (annotated); *id.*, 4:59-63.)

The light received by a focusing lens is "**at least a portion of the collimated beam reflected by the** [prior] **optical relay element**." Collimating reflector **24***b* ("**optical relay element**") "**reflects**" a portion of a collimated beam to wavelength selective element **22***c*. (Goodman, 11:8-12; s*ee also id.*, 11:24-30; Ex. B, ¶203.) A "**portion of the collimated beam**" (i.e., selected wavelengths) passes through wavelength selective element **22***c* toward a corresponding focusing lens **42** ("**first focusing optical element**") in the beam-directing member that is "**arranged to receive at least a portion of the collimated beam**":

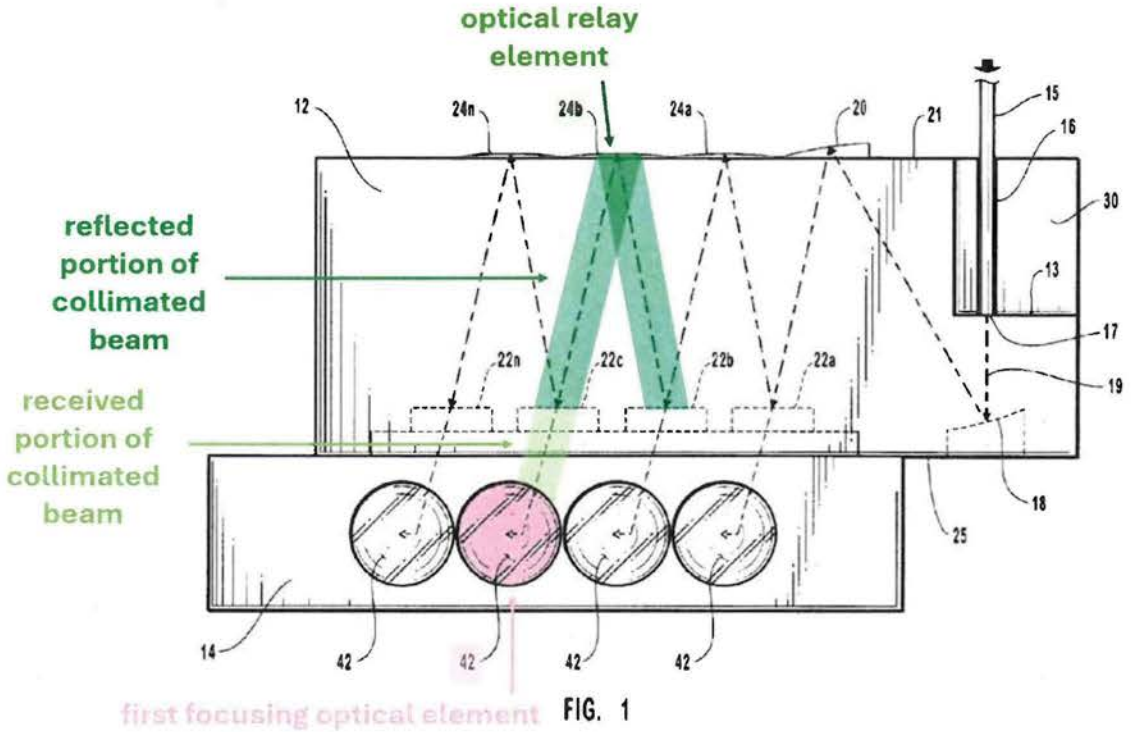


FIG. 1

(Goodman, FIG. 1 (annotated).)

The parties offered competing constructions for "**focusing optical element**." (Ex. LLL, pp.121-123.) Goodman's "focusing lenses" discloses a "**focusing optical element**" under either party's construction. (Ex. B, ¶¶204-205.) A POSA would have understood that these focusing lenses are of the same or larger size than the collimating reflectors **24***a*-**24***b* to gather all light and focus it into the optical detectors while also minimizing photon loss. (Ex. B, ¶205.) FIG. 1 depicts that a focusing lens has an approximately equal diameter to a corresponding reflector.

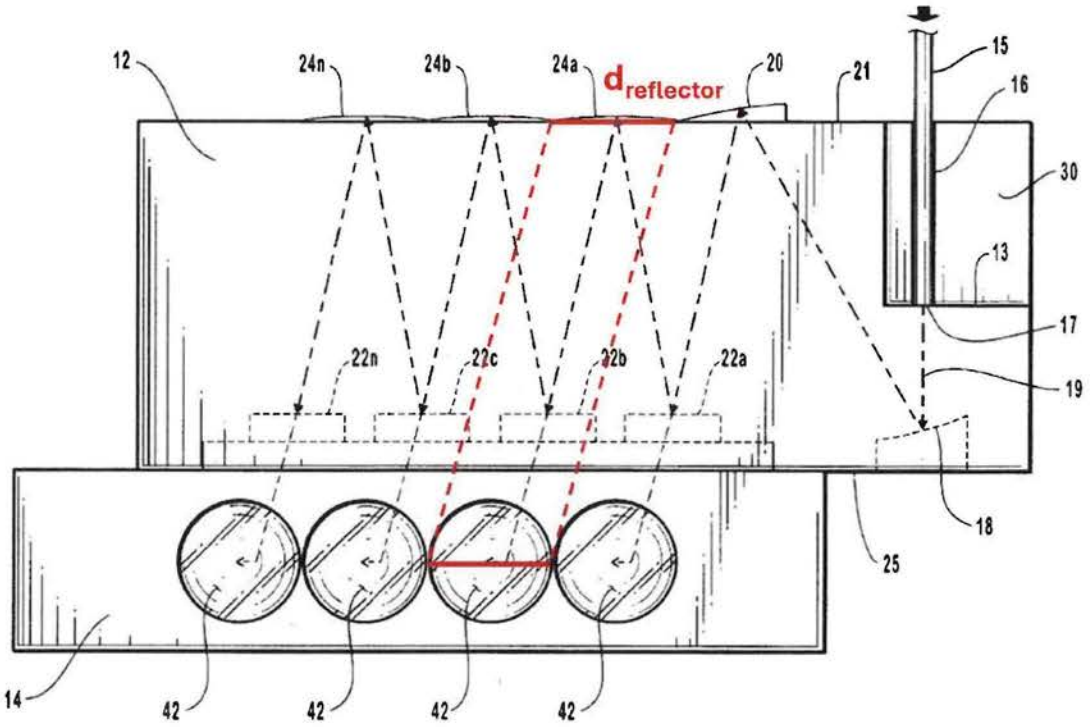


FIG. 1

$d_{reflector} \cong d_{focusing\ lens}$

(Goodman, FIG. 1 (annotated).) This focusing lens is "**first**" under Patent Owner's construction because it is distinguishable from others. (Ex. B, ¶206.)

f. Claim 1[e]: "a first semiconductor detector,"

The combination of Chandler and Goodman discloses Claim 1[e]. Chandler's optical detector includes an "amplifying photo-detector" that may be "an avalanche photo-diode." (Chandler, 3:66-4:8, 5:24-32, 8:31-34.) A POSA would have understood an avalanche photo-diode ("APD") detector to be a semiconductor detector. (Ex. B, ¶207; *see also* '582, 46:27-30.) The "**first semiconductor detector**" in the Chandler-Goodman combination is the "optical detector" associated

with the "**first focusing optical element**" identified in Claim 1[d]. This semiconductor detector is "**first**" under Patent Owner's construction because it is distinguishable from others. (Ex. B, ¶207.)

g. Claim 1[f]: "wherein the first focusing optical element is configured to focus the portion of the collimated beam received from the optical relay element onto the first semiconductor detector."

The combination of Goodman and Chandler discloses Claim 1[f]. Goodman discloses a "**first focusing optical element**" as identified in Claim 1[d]. (Ex. B, ¶208; *see also* Goodman, 11:8-30, 12:24-32.) As further explained in Claim 1[d], focusing lens **42** receives the portion of the collimated beam that passed through wavelength selective element **22***c*. Lastly, Goodman's focusing lens **42** can "**focus**" this portion of the collimated beam "onto a corresponding optical receiver such as an optical detector[,]" i.e., Chandler's avalanche photo-diode ("**first semiconductor detector**"). (Goodman, 11:40-42.)

3. Claim 2: "further comprising the light source, wherein the light source comprises light passing through a pinhole or light emitted from a facet of a multimode optical fiber."

The combination of Goodman and Chandler discloses a "**light source**" that "**comprises … light emitted from a facet of a multimode optical fiber**." (Ex. B, ¶209.) Goodman's "optical block **12** . . . is configured to receive an optical signal through a waveguide such as an optical fiber **15**." (Goodman, 7:1-3 (underlining added); *see also id.*, 10:22-24.) Optical fiber **15** (light green) is a multimode optical

fiber, configured "as an input port for receiving a plurality of optical signal channels from an outside optical energy source." (*Id.*, 7:10-12, 14:15-17.)

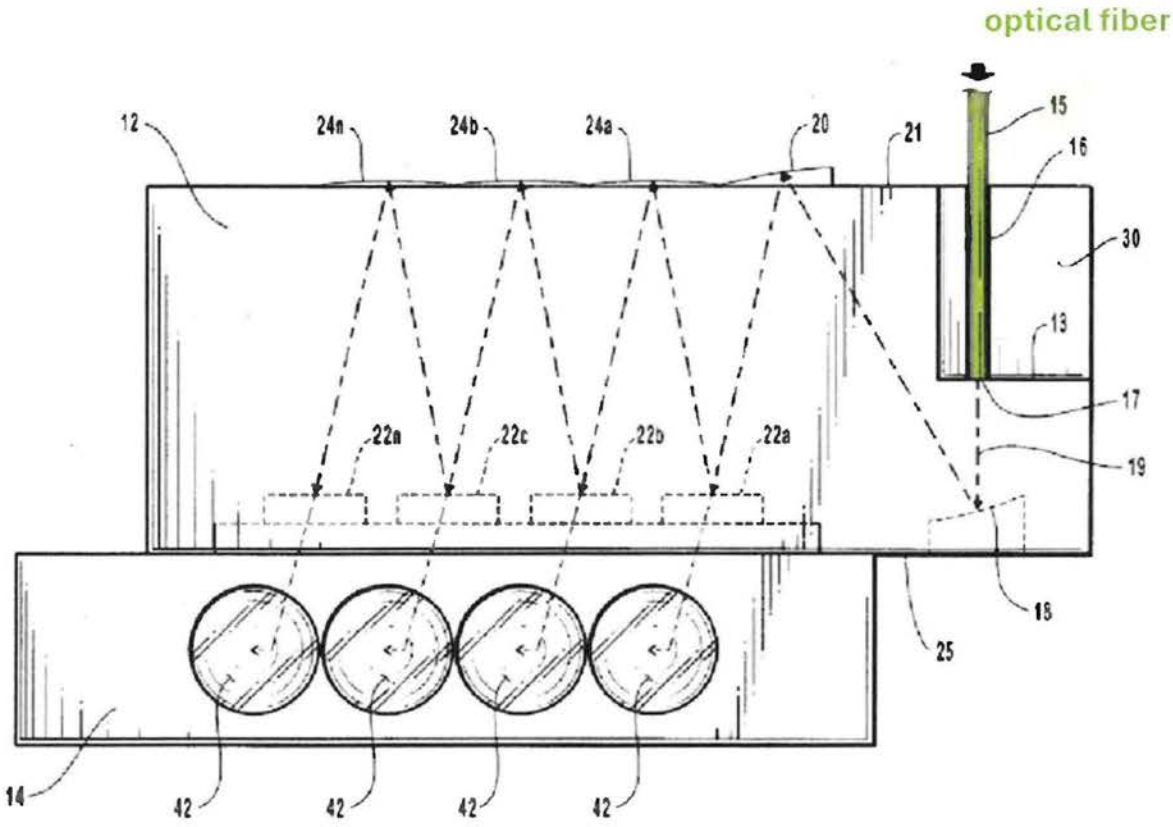


FIG. 1

(*Id.*, FIG. 1 (annotated).)

Chandler also discloses a "**multimode optical fiber**," connecting optical detectors **20**, **22**, **24**, and **26** to corresponding FADC units **30**, **32**, **34**, and **36** (the "**optical subsystem**[s]").

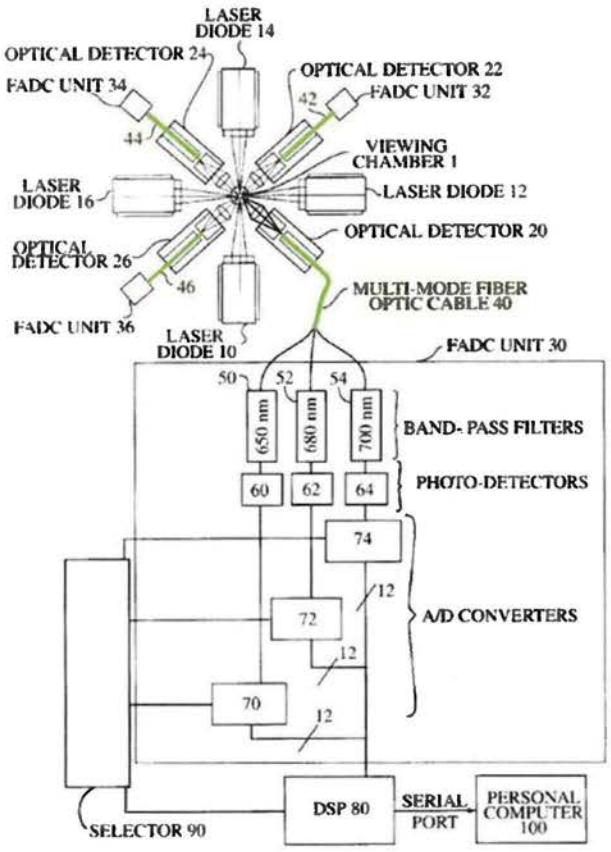


FIG. 4

(Chandler, FIG. 4 (annotated); *see also id.*, 7:35-38, 7:66-8:3.) Light is emitted from a facet of these multi-mode fiber optic cables. (*Id.*, 9:52-56; Ex. B, ¶211.)

4. Claim 3: "wherein the first focusing optical element is configured to focus the portion of the collimated beam received from the optical relay element to a size smaller than 1 millimeter in diameter."

Claim 3 requires a beam to be focused to an approximate circular area size of 0.785 mm2 or less, or, for a rectangular configuration, less than 1 mm by 1 mm. A POSA would have understood that Goodman's focusing lenses should be able to focus the beam to a size smaller than or equal to the effective detection area of the

APD. (Ex. B, ¶212; *see* Goodman, 11:48-50.) Commercially available small area APDs from multiple vendors had active areas less than 1 millimeter in diameter, and a POSA would have understood that use of these APDs in the Goodman-Chandler optical subsystems would have required that Goodman's focusing lenses "**focus the portion of the collimated beam received from the optical relay element to a size smaller than 1 millimeter in diameter**." (Ex. B, ¶212.)

The '582 specification does not describe a unique semiconductor detector and a POSA would have understood that the '582's optical subsystem would have used off-the-shelf semiconductor detectors. Chandler generally discloses use of APDs without specifying the size or model, but a POSA would have understood that major semiconductor manufacturers, like Hamamatsu and SensL cited in the '582 (*see* '582, 43:63-66), sold small area APDs with effective active area sizes less than 1 mm in diameter. (Ex. B, ¶¶213-214.) Hamamatsu's APDs, available publicly before December 2011, had effective active areas from 0.03 – 0.78 mm^2.

■ General ratings / Absolute maximum ratings

Type No.	Dimensional outline/ Window material *1	Package	Effective active *2 area size (mm)	Effective active area (mm^2)	Absolute maximum ratings	
					Operating temperature Topr (°C)	Storage temperature Tstg (°C)
S9073	①/U	TO-18	φ0.2	0.03	-20 to +60	-55 to +100
S9074			φ0.5	0.19		
S5343			φ1.0	0.78		
S9075	②/U	TO-5	φ1.5	1.77		
S5344			φ3.0	7.0		
S5345	③/U	TO-8	φ5.0	19.6		

(Ex. CCC, p.001; *see also* Ex. DDD, p.001; Ex. EEE, p.001; Ex. XX-Ex. YY; Ex. CC.) By 2007, SensL also offered several APD modules with active areas of 1 x 1

mm and specifically identified that these APDs can be used in flow cytometers. (Ex. AA, p.002; *id.*, p.001.) Other manufacturers, such as Menlo Systems and First Sensor, had similar small area APD offerings by 2011 with active area sizes optimized to capture a beam with less than 1 mm diameter while maximizing signal-to-noise ratio. (Ex. BB, pp.001-002; Ex. FFF; Ex. GGG, p.001; Ex. B, ¶215.)

A POSA would have generally known of these small area APDs' use in flow cytometry applications, would have used them in the Chandler-Goodman optical subsystem, and would have selected and/or designed focusing lenses to focus the incident portion of the collimated beam down to the effective active area size for these APDs. A POSA would have found implementation of small area size APDs to be highly desirable because (1) smaller size APDs improves the WDM's compactness, enabling additional channels to be built into the device within a form factor; and (2) these types of APDs further address the known issue in APDs of having high dark current by improving the signal-to-noise ratio with a smaller active detection area. (Ex. B, ¶216; *see also* Section V.A.3.) Based on the commercially available small area APDs and the implementation of 1 mm APDs in SensL, a POSA would have also known that the focusing lenses would have to focus the portion of the collimated beam down the effective active area size of these APDs, which was "**to a size smaller than 1 millimeter in diameter**." (Ex. B, ¶216.)

5. Claim 6: "further comprising a first optical filter disposed along an optical path between the collimating optical element and the optical relay element, the first optical filter configured to separate the collimated beam into a first branch and a second branch."

Goodman discloses Claim 6. (Ex. B, ¶217.) Goodman's wavelength selective element **22*b*** is a "**first optical filter**." (Ex. B, ¶218.) Goodman describes that its "demultiplexer device … generally includes an optically transparent optical block" that "includes a plurality of wavelength selective elements such as optical interference filters[.]" (Goodman, 5:63-67 (underlining added).) "Each wavelength selective element is preselected to pass a designated wavelength range and reflect both higher and lower wavelengths." (*Id.*, 6:12-16 (underlining added); *see also id.*, 8:21-26.) A POSA would have understood that an optical filter transmits a selected range of wavelengths as described in Goodman. Goodman also discloses a "**first**" optical filter under Patent Owner's construction, as it is distinguishable from others.

Wavelength selective element **22*b*** is "**disposed along an optical path between**" collimating reflector **24*a*** ("**collimating optical element**") and collimating reflector **24*b*** ("**optical relay element**"). (Goodman, FIG. 1, 12:4-8; *see also* Ex. B, ¶219.)

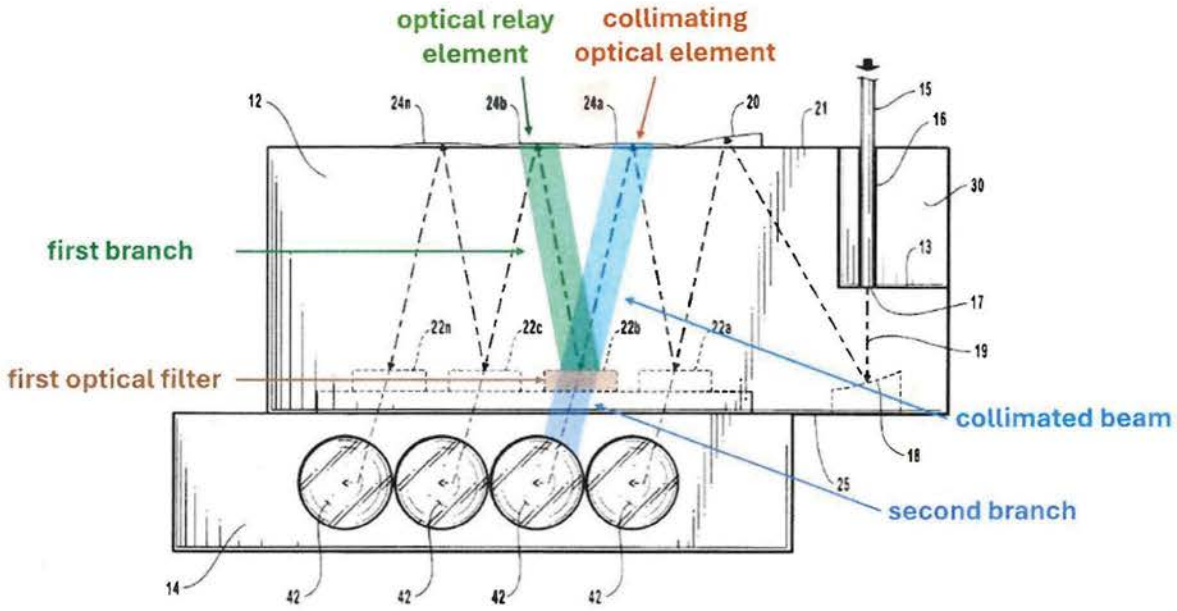


FIG. 1

(Goodman, FIG. 1 (annotated).)

Wavelength selective element **22***b* is also "**configured to separate the collimated beam into a first branch and a second branch**." A POSA would have understood that each "branch" is a "distinctive color," in other words, distinctive wavelength ranges. (*See* '582, 57:4-7; Ex. B, ¶220.) Goodman's wavelength selective element **22***b* is "capable of transmitting a selected range of wavelengths within beam **19** and reflecting other wavelengths." (Goodman, 8:21-26 (underlining added); *see also id.*, 6:12-19.) A POSA would have understood that wavelength selective element **22***b* separates an incident collimated beam from collimating reflector **24***a* into a "**first branch**" that is reflected to collimating reflector **24***b* (i.e., "**optical relay element**") and a "**second branch**" that passes through the filter. (Ex.

B, ¶220.) This is also consistent with Patent Owner's construction for "first" and "second" because each branch is distinguishable from the other. (Ex. B, ¶221.)

6. Independent Claim 14

a. Claim 14[pre]: "An optical subsystem for a flow cytometer, the optical subsystem comprising:"

The combination of Chandler and Goodman discloses Claim 14[pre] for the same reasons provided for Claim 1[pre]. (Ex. B, ¶222.)

b. Claim 14[a]: "a collimating optical element arranged to receive light from a light source,"

The combination of Chandler and Goodman discloses Claim 14[a] for the same reasons provided for Claim 1[a]. (Ex. B, ¶223.)

c. Claim 14[a][i]: "the collimating optical element configured to project a collimated beam including a first image,"

Goodman discloses a "**collimating optical element configured to project a collimated beam**" for the same reasons provided for Claim 1[a]. Goodman additionally discloses that its collimating reflector **24***a* projects a collimated beam that "**includ**[es] **a first image**." (Ex. B, ¶224.)

FIG. 25 in the '582 patent shows a collimating optical element **902** that captures light from light source **901** (the "object") and "project[s] a magnified image of the object" in the form a collimated beam of light. ('582, 21:40-45, 44:58-61, 45:8-13.)

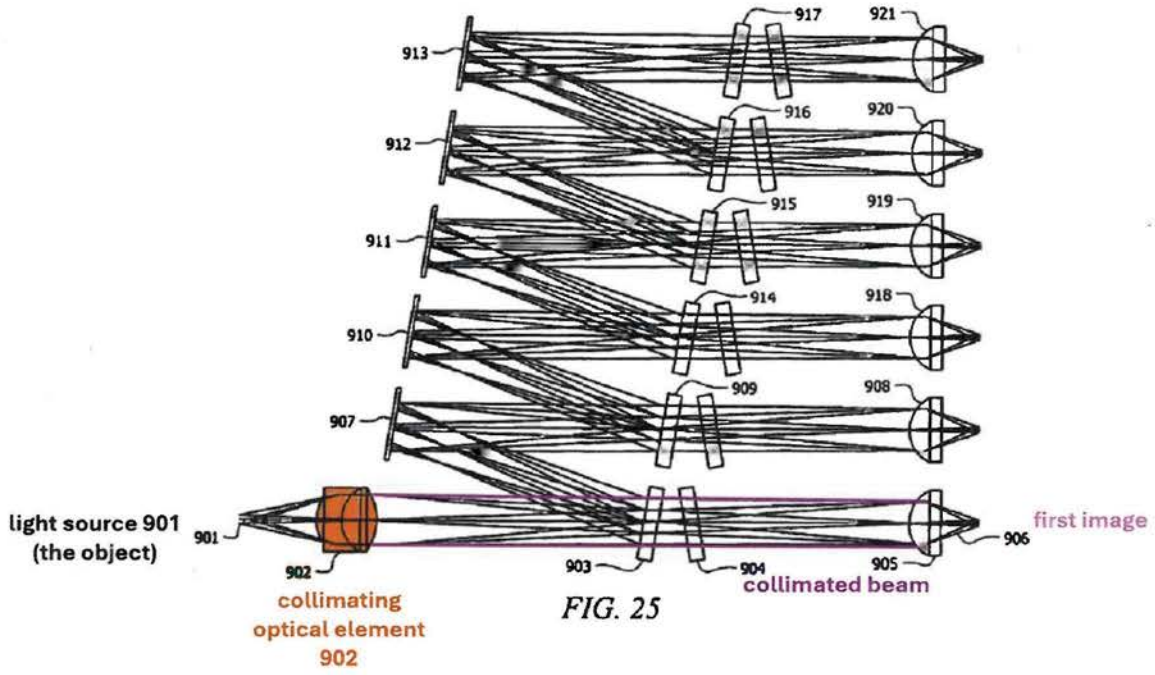


FIG. 25

('582, FIG. 25 (annotated).) As shown, a "first image" of the light source **901** is projected with the collimated beam, i.e., a portion of the collimated beam that is filtered through the dichroic filter **903** and directed toward focusing lens **905**. (*Id.* 44:58-61, 45:8-13; Ex. B, ¶225.)

Goodman's collimating reflector **24***a* similarly projects a collimated beam from light received from optical fiber **15**. (Ex. B, ¶226.) That collimated beam includes a "**first image**" that propagates with the collimated beam and is ultimately disposed at two locations: (1) near the optical relay element, collimating reflector **24***b*, and (2) near the focusing lens **42** optically coupled to wavelength selective element **22***b*. (Goodman, FIG. 1, 10:21-23.) As shown in the annotations to FIG. 1, collimating reflector **24***a* projects a collimated beam (blue); transmitted wavelengths

of the collimated beam (grey blue) pass through wavelength selective element **22*b***; and a "**first image**" is arranged near a corresponding focusing lens **42**.

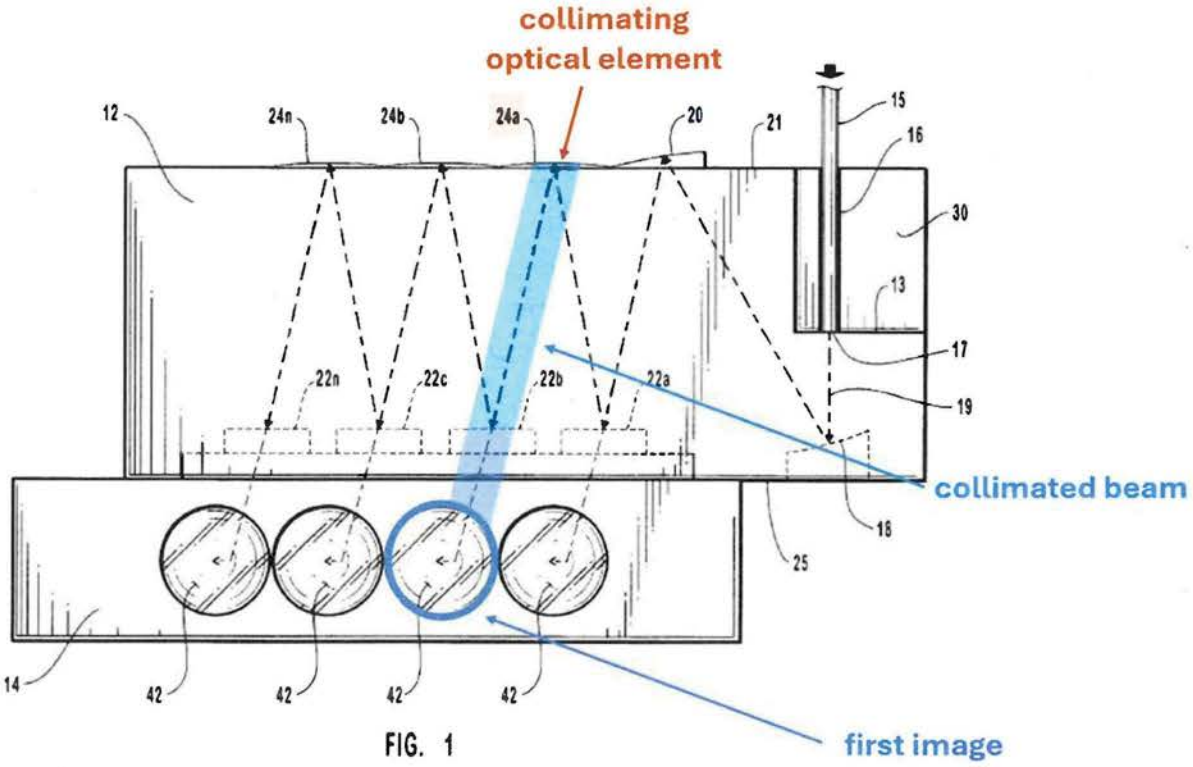


FIG. 1

(Goodman, FIG. 1 (annotated); Ex. B, ¶227.) This image is "**first**" under Patent Owner's construction, as it is distinguishable from the "**second image**" below.

d. Claim 14[a][ii]: "wherein the collimated beam has a collimated distance; and"

Goodman discloses Claim 14[a][ii]. Goodman's ray traces show that a collimating reflector projects a beam that is collimated for a finite distance, i.e., a "**collimated distance**." (Ex. B, ¶228.) For example, collimating reflector **108** in

FIG. 6 projects a collimated beam with a collimated distance to reflector **112** by way of filter **110**.

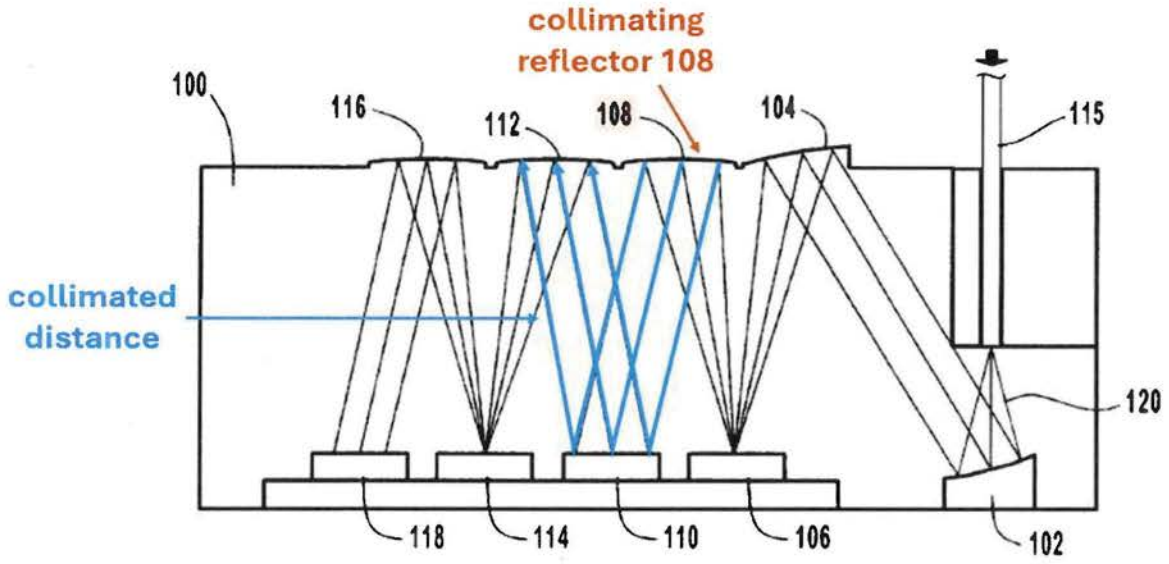


FIG. 6

(Goodman, FIG. 6 (annotated); *see also id.*, 13:3-5, 13:11-16.) A POSA would have thus understood that the collimated beam projected by a collimating reflector **24***a* in Goodman's FIG. 1 would have also included a collimated distance to collimating reflector **24***b* by way of wavelength selective element **22***b*.

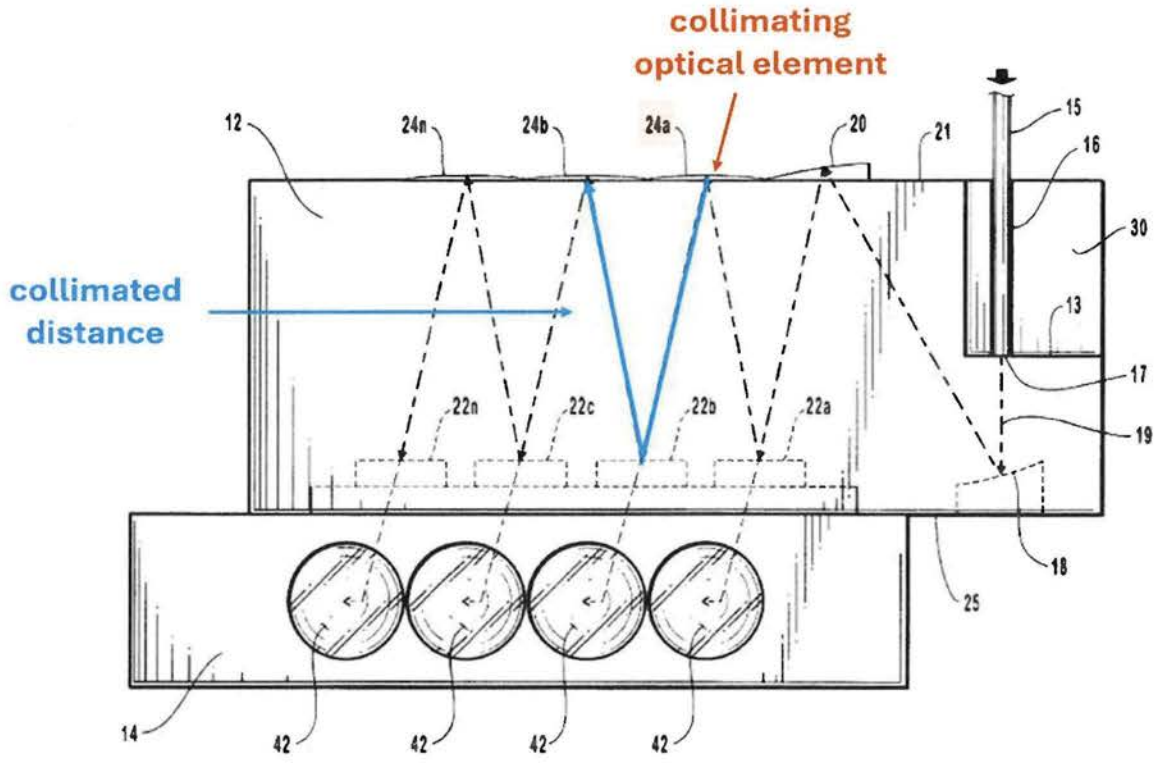


FIG. 1

(Goodman, FIG. 1 (annotated); *see also* Ex. B, ¶229.)

e. Claim 14[b]: "an optical relay element arranged to receive the collimated beam,"

The combination of Chandler and Goodman discloses Claim 14[b] for the same reasons provided for Claim 1[b].

f. Claim 14[b][i]: "the optical relay element configured to extend the collimated distance of the collimated beam,"

Goodman discloses Claim 14[b][i]. Goodman's collimating reflector **24***b* is "**configured to extend the collimated distance of the collimated beam**," Goodman's collimating reflector **24***b* can also be a collimating mirror that will re-collimate the incident beam, extending the collimated distance for the beam. (*See*

Goodman, 10:18-28; Ex. B, ¶231.) A POSA would have understood that the extended collimated distance where collimating reflector **24***b* re-collimates the beam, would be (1) the optical distance to collimating reflector **24***n* for wavelengths of the beam reflecting off wavelength selective element **22***c*; and (2) the optical distance to focusing lens **42** optically coupled to wavelength selective element **22***c* for wavelengths of the beam passing through wavelength selective element **22***c*. (Goodman, FIG. 1, 10:21-23; Ex. B, ¶¶231-232.)

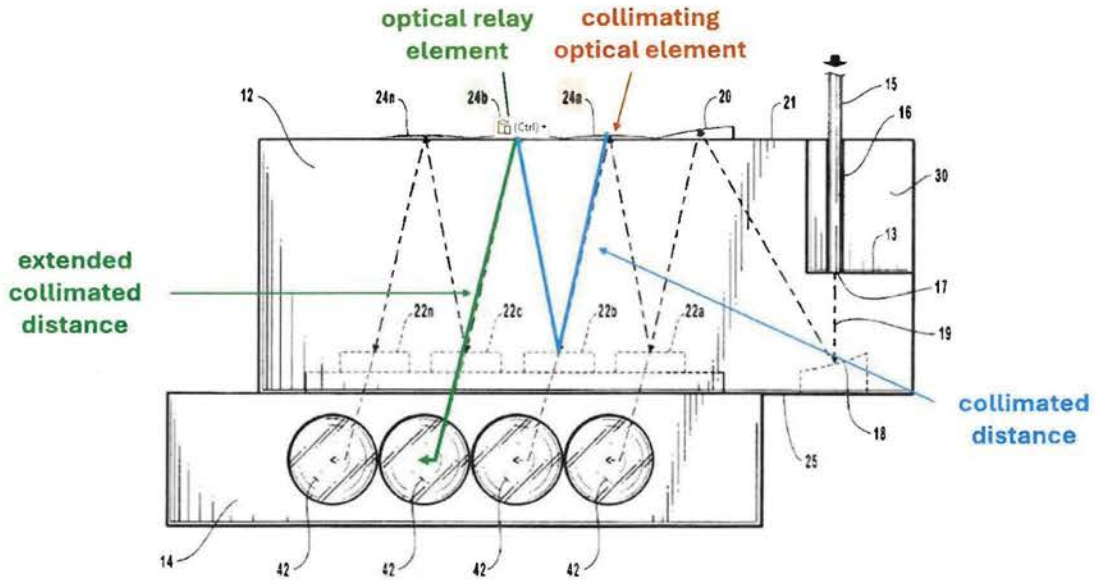


FIG. 1

(Goodman, FIG. 1 (annotated).)

g. Claim 14[b][ii]: "wherein the optical relay element comprises a curved mirror or a concave-shaped dichroic filter configured to produce a second image."

Goodman discloses Claim 14[b][ii]. As discussed in Claim 1[c], Goodman's collimating reflector **24***b* is a "**curved mirror**." This curved mirror is "**configured to produce a second image**" by controlling divergence of the beam and re-collimating it to its original beam size when projected from collimating reflector **24***a*. (*See* Goodman, FIG. 1, 10:19-24; Ex. B, ¶233.)

A POSA would understand that the "**second image**" is a reimage of the "**first image**," and is thus an image of the collimating optical element as described in the '582 specification. ('582, 45:18-22, FIG. 25; Ex. B, ¶234.)

Goodman's collimating reflector **24***b* performs this reimaging function and thus "**produces a second image**." Collimating reflector **24***a* receives non-collimated light originally from optical fiber **15** and projects a collimated beam. (Goodman, 10:18-24, 11:51-12:5; *see also id.*, FIG. 6; Ex. B, ¶235.) This collimated beam includes a "first image." (*See supra*, Claim 14[a][i].) Collimating reflector **24***b* can be a collimating mirror, which a POSA would have understood to re-collimate the light. (Goodman, 10:25-28; Ex. B, ¶236; *see also supra*, Claim 14[b][i].) A POSA would have understood that re-collimation of the light beam by collimating reflector **24***b* would reimage the "**first image**," producing a "**second**

image" of a diameter consistent with the size of the collimating optical element, collimating reflector **24***a*.

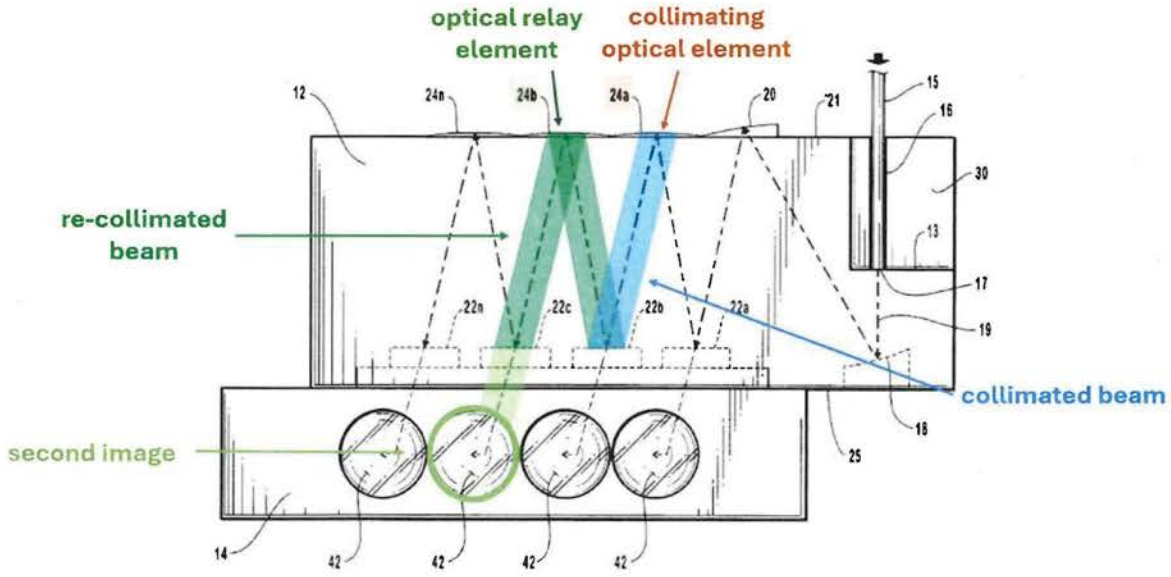


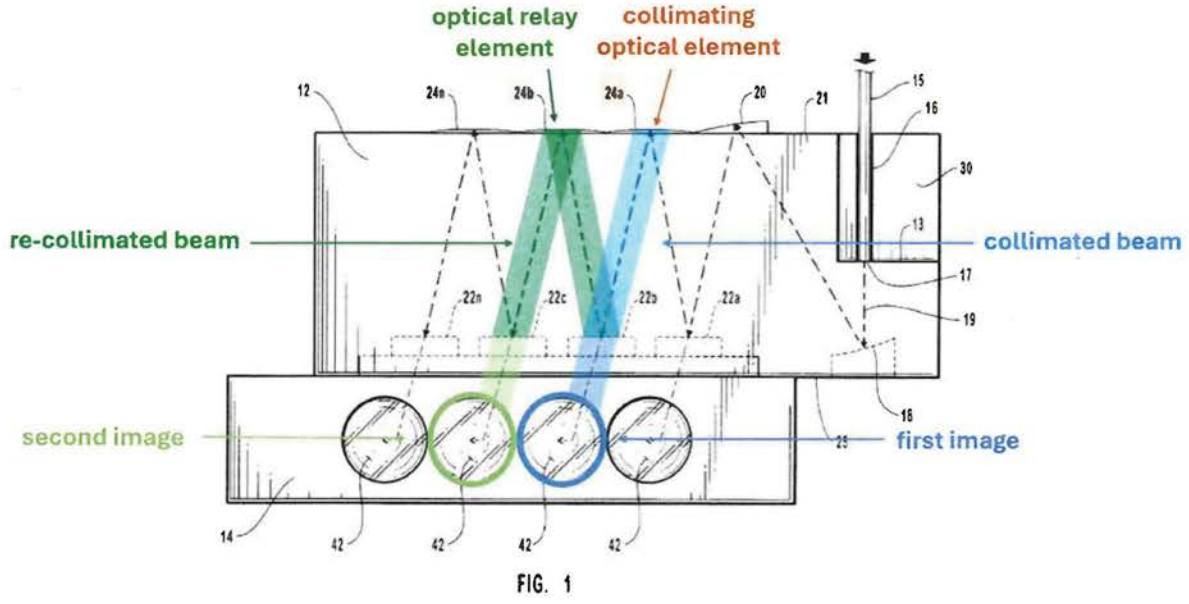
FIG. 1

(Goodman, FIG. 1 (annotated).) "**Second image**" is distinguishable from the "**first image**," consistent with Patent Owner's construction.

7. Claim 15: "wherein the second image and the first image are substantially the same size."

Goodman discloses Claim 15. A POSA would have understood that the beam size of a collimated beam projected and/or produced by a collimating reflector remains substantially the same size as the beam travels along the optical path to either (1) the next collimating reflector (for reflected wavelengths); or (2) a focusing lens coupled to the next wavelength selective element (for transmitted wavelengths). (Goodman, FIG. 6; *see also* Claim 14[a][ii]; Ex. B, ¶237.) As a "first image" is

included in a collimated beam projected from collimating reflector **24***a*, and "second image" is produced by collimating reflector **24***b* that extends the collimated distance of an incident collimated beam, a POSA would have understood that "**the second image and the first image are substantially the same size**." This is confirmed by annotations to FIG. 1 below that demonstrate a position of the "**first image**" and "**second image**" at their respective focusing lenses **42**, at the same optical distance away from the collimating reflector that projected a collimated beam and the optical relay element that projected the re-collimated beam. (Ex. B, ¶238.)



(Goodman, FIG. 1 (annotated).)

8. **Claim 17: "further comprising a first focusing optical element arranged to receive the collimated beam from the optical relay element at the extended collimated distance, the first focusing optical element configured to focus the collimated beam onto a first semiconductor detector."**

The combination of Chandler and Goodman discloses Claim 17 for the same reasons provided for Claims 1[d], 1[f], and 14[b][i]. (Ex. B, ¶239.)

9. **Claim 18: "an optical filter arranged along an optical path between the collimating optical element and the optical relay element, the optical filter configured to separate the collimated beam into a first branch and a second branch, wherein the first branch and the second branch comprise light of different colors, wherein the optical relay element is arranged to receive the first branch; and a second focusing optical element arranged to receive the second branch, the second focusing optical element configured to focus the second branch to a second semiconductor detector."**

Goodman discloses "**an optical filter arranged along an optical path between the collimating optical element and the optical relay element, the optical filter configured to separate the collimated beam into a first branch and a second branch**" for the same reasons provided for Claim 6. (Ex. B, ¶¶240-241.)

Goodman further discloses "**first branch and the second branch comprise light of different colors**." (Ex. B, ¶242.) Collimating reflector **24***a* projects a collimated beam "towards wavelength selective element **22***b*, which in turn passes a selected band of wavelengths and reflects the remainder to a subsequent reflector **24***b*." (Goodman, 12:4-8, 10:19-21.) A POSA would have understood that the wavelengths ("**second branch**") that passed through wavelength selective element

22*b* "**comprise light of different colors**" than the reflected remainder ("**first branch**") because the wavelength selective element separates an incident light beam by allowing some wavelength ranges to pass while reflecting the rest. (*See id.*, 6:12-14, 8:23-26; Ex. B, ¶242.)

Goodman's "**optical relay element is arranged to receive the first branch,**" as wavelength selective element **22*b*** "passes a selected band of wavelengths and reflects the remainder to a subsequent reflector **24*b***." (Goodman, 12:6-8 (underlining added).) Goodman's focusing lens **42** ("**second focusing optical element**") is also "**arranged to receive the second branch**." (*Id.*, 11:26-30, 11:37-40, 12:24-28; Ex. B, ¶243.) This focusing lens is different from the "first focusing optical element" identified for Claim 17, consistent with Patent Owner's construction. Goodman's focusing lens **42** is "**configured to focus the second branch**" to a second APD in the Chandler-Goodman optical subsystem, because it "can focus a selected wavelength beam onto a corresponding optical receiver such as an optical detector." (Goodman, 11:40-42; Ex. B, ¶243.)

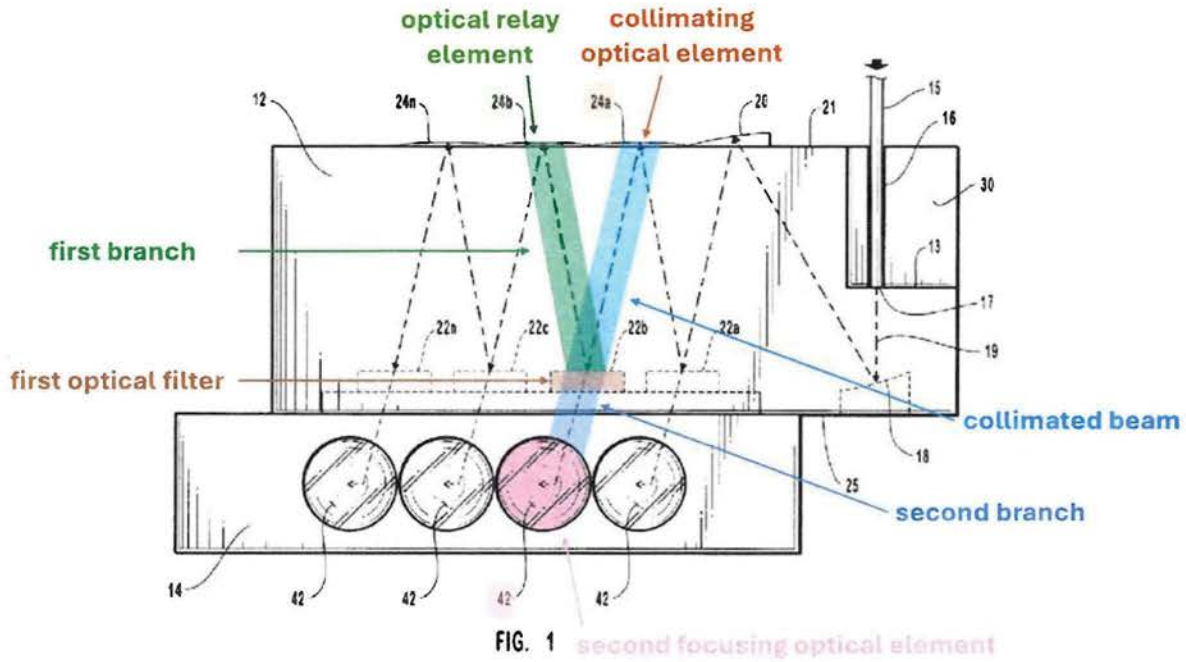


FIG. 1

(Goodman, FIG. 1 (annotated).)

10. Independent Claim 20

a. Claim 20[pre]: "An optical subsystem for a flow cytometer, the optical subsystem comprising:"

The combination of Chandler and Goodman discloses Claim 20[pre] for the same reasons provided for Claim 1[pre].

b. Claim 20[a]: "a collimating optical element arranged to receive light from a light source, the collimating optical element configured to project a first image; and"

The combination of Chandler and Goodman discloses Claim 20[a] for the same reasons provided for Claims 1[a] and 14[a][i], which applies here because a "**first image**" travels with the collimated beam projected by collimating reflector

24*a* and can be represented as a cross-sectional view of the collimated beam at a plane perpendicular to the optical axis of the beam. (Ex. B, ¶245.)

c. Claim 20[b]: "an optical relay element arranged near the first image, the optical relay element configured to receive light from the collimating optical element and to project a second image;"

The combination of Chandler and Goodman discloses Claim 20[b]. Goodman discloses an "**optical relay element**" for the same reasons provided in Claim 1[b]. Collimating reflector **24*b*** is "**arranged near the first image**." (Ex. B, ¶246.) As explained in Claim 14[a][i], a "**first image**" is projected within a collimated beam by collimating reflector **24*a*** and arranged at two locations within Goodman's WDM. Goodman's collimating reflector **24*b*** controls divergence in the collimated beam and "relay[s] the image of the fiber facet down the optical train." (Goodman, 10:18-29.) Thus, a POSA would have understood that collimating reflector **24*b*** re-collimates light received by collimating reflector **24*b***, thereby re-imaging the "**first image**" to "**project a second image**" at two locations within Goodman's WDM: (1) at the interface with the next collimating reflector **24*n*** (another optical relay element) and (2) near the focusing lens **42** that is optically coupled to wavelength selective element **22*c***. (Ex. B, ¶247.)

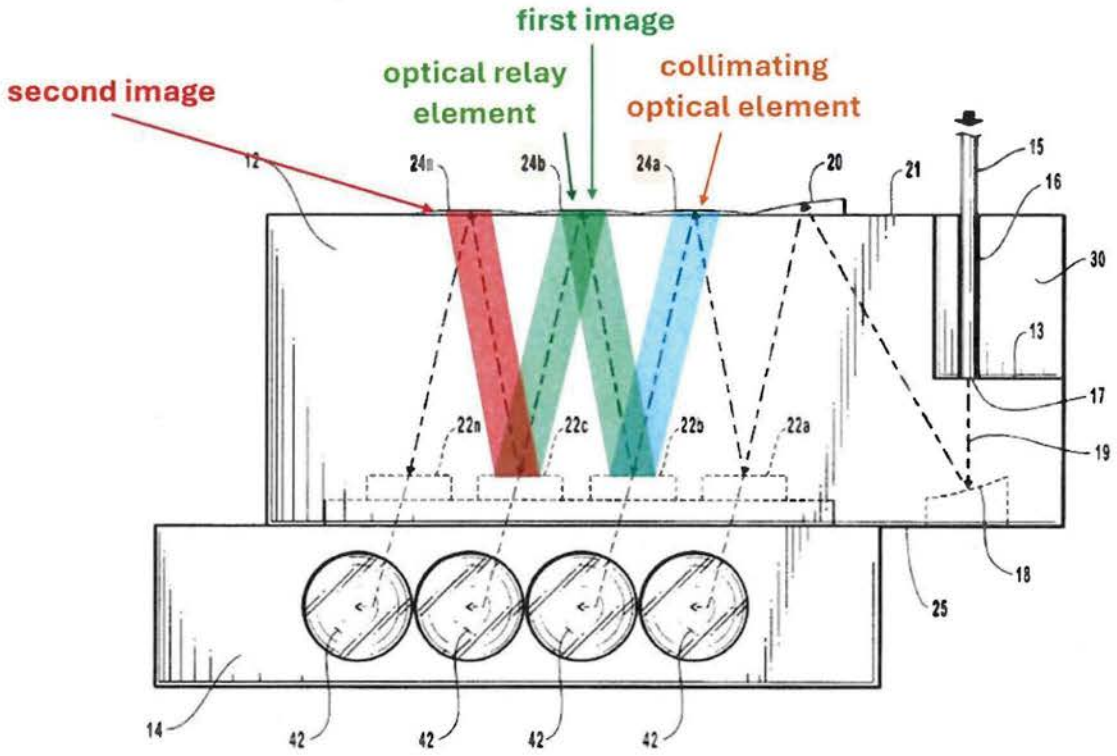


FIG. 1

(Goodman, FIG. 1 (annotated).) The "**first**" and "**second**" images are distinguishable from each other, consistent with Patent Owner's construction.

d. Claim 20[b][i]: "wherein the size of the first image is substantially the same as the size of the second image, and"

The combination of Chandler and Goodman discloses Claim 20[b][i] for the same reasons provided for Claim 15.

e. Claim 20[b][ii]: "wherein the optical relay element comprises a curved mirror or a concave-shaped dichroic filter."

The combination of Chandler and Goodman discloses Claim 20[b][ii] for the same reasons provided for Claim 1[c].

11. Claim 21: "wherein the optical distance from the collimating optical element to the first image is substantially the same as the optical distance from the optical relay element to the second image."

Goodman discloses Claim 21. As discussed for Claims 20[a] and 20[b], respectively, a "**first image**" is arranged near collimating reflector **24***b*, whereas a "**second image**" is arranged near collimating reflector **24***n*. A POSA would have understood the optical distance between collimating reflector **24***a* ("**collimating optical element**") and collimating reflector **24***b* is "**substantially the same**" as the optical distance from collimating reflector **24***b* ("**optical relay element**") to collimating reflector **24***n*. (Ex. B, ¶250.) Goodman's wavelength selective elements have even center-to-center spacing and, the reflectors are directly opposite the wavelength selective elements in a linear array. (Goodman, 8:18-20, 9:58-67.) This results in substantially the same optical distance between collimating reflector **24***a* and collimating reflector **24***b* (location of first image) on the one hand, and collimating reflector **24***b* and collimating reflector **24***n* (location of second image) on the other hand. (Ex. B, ¶250.)

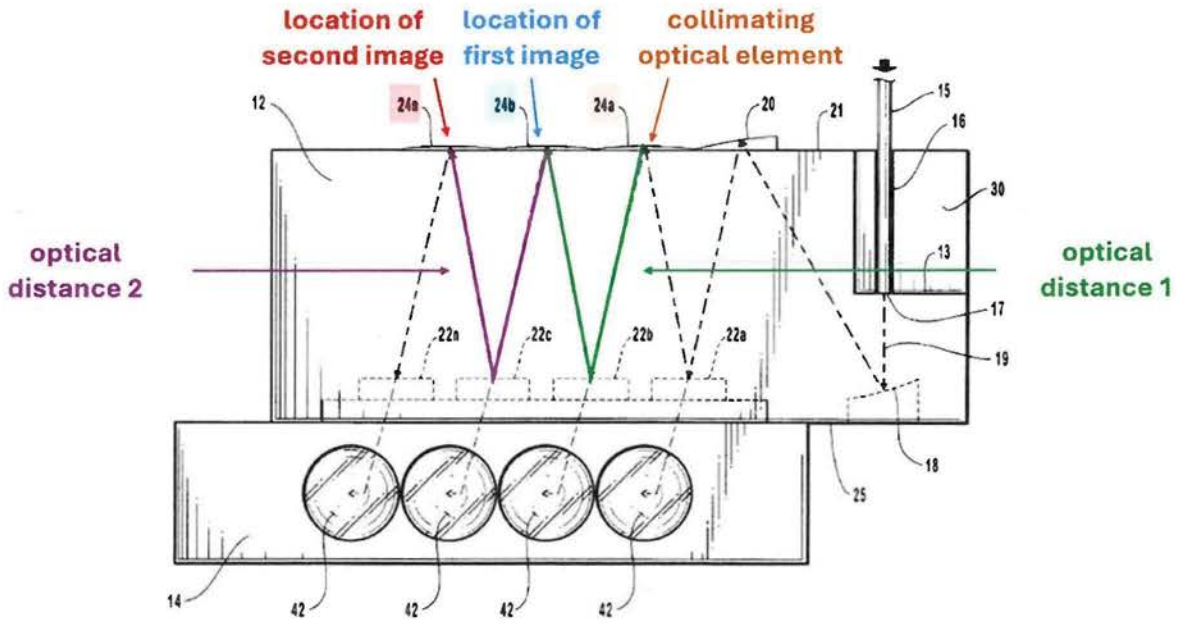


FIG. 1

(Goodman, FIG. 1 (annotated).)

12. Claim 22: "further comprising the light source, wherein the light source comprises an extended light source that forms an object, wherein the first image is a magnified image of the object."

Goodman discloses Claim 22. (Ex. B, ¶251.) The light output from Goodman's optical fiber **15** is a "**light source**." (Goodman, 7:1-3, 7:10-12.) A facet of multimode optical fiber **15** is also an "**extended light source that forms an object**," as confirmed by the '582 specification. (Goodman, 11:64-65; '582, 4:37-38, 44:17-18; *see also id.*, cl. 23; *see also* Ex. B, ¶252; Ex. BBB, p.004 (defining "object" that would include a facet of a multimode optical fiber).)

Goodman's "**first image**" is a "**magnified image of the object**." Collimating reflector **24***a* projects a "**first image**," which is a magnified image of the facet of the

multimode optical fiber that is then relayed down the optical train by subsequent collimating reflectors. (Goodman, 10:21-23; Ex. B, ¶¶253-254.) This must be true, as light propagating from an output end of the optical fiber will diverge before reaching even the first imaging element. (Ex. B, ¶¶253-254.)

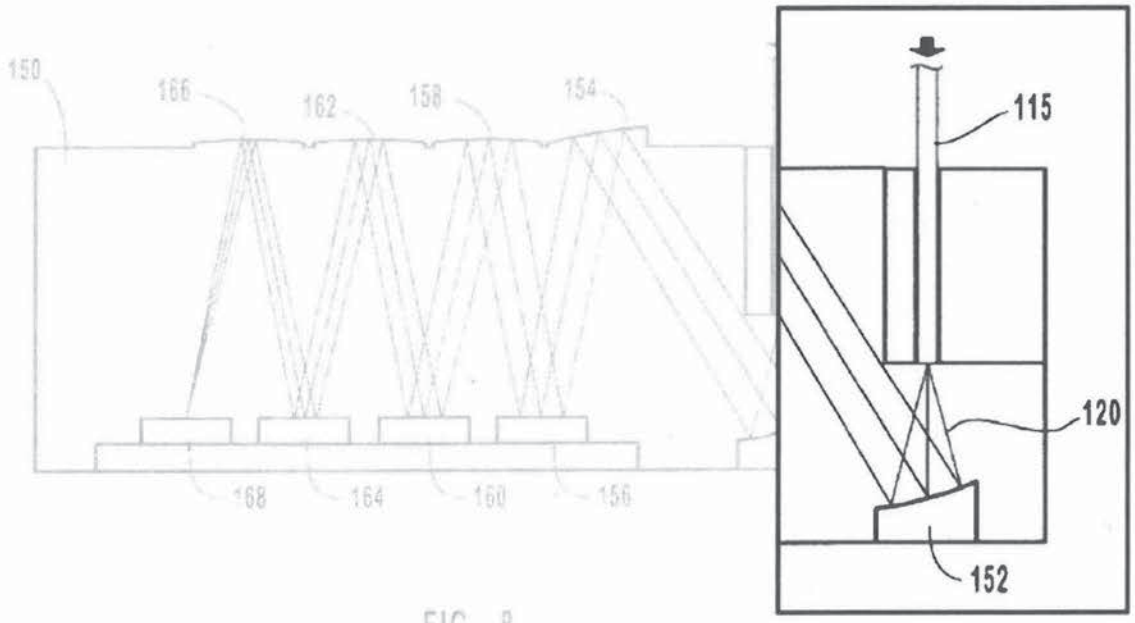


FIG. 8

(E.g., Goodman, FIG. 8 (magnified view of diverging light from optical fiber).)

When the collimated beam is near collimating reflector **24***b*, the spot size of the beam, or image, is magnified as compared to the dimensions of the facet of the multimode optical fiber **15**.

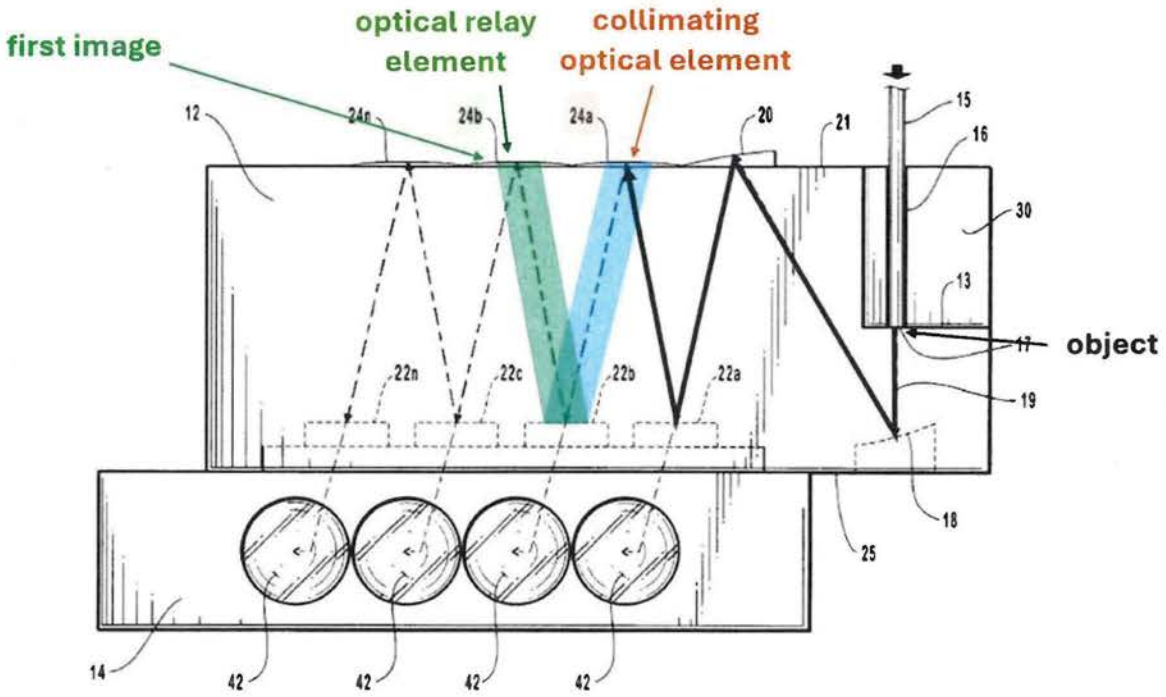


FIG. 1

(Id., FIG. 1 (annotated); *see also* Ex. B, ¶254.)

13. Claim 23: "wherein the light source comprises light passing through a pinhole or light emitted from a facet of a multimode optical fiber."

The combination of Chandler and Goodman discloses Claim 23 for the same reasons provided for Claim 2.

14. Claim 25: "wherein the first image is less than approximately 10 times the size of the object."

Goodman discloses Claim 25. A POSA would have understood that Goodman's collimating reflector **24***a* is designed to capture the incident optical beam from optical fiber **15** and project a collimated beam with a beam size less than

ten times the size of a facet of the optical fiber to minimize photon loss. (Ex. B, ¶256.)

A POSA would have known that multimode optical fibers have core diameters on the order of millimeters. ('582, 44:42-46; Ex. B, ¶257.) A collimating optical element produces an "image" only as large as the diameter of itself, as the collimating optical element projects a collimating beam with minimal divergence. (Ex. B, ¶257.) A "**first image is less than approximately 10 times the size of the object**" indicates the collimating optical element's diameter is on the order of centimeters, or about ten times the size of a 1 mm core diameter of a multimode optical fiber. But a POSA would have understood Goodman's teachings to suggest that its optical components (including collimating reflectors) are configured to shape a beam with image magnification less than 10 times the size of the facet of a multimode optical fiber. (*See* Goodman, 10:25-31; Ex. B, ¶257.) FIG. 1 shows the diameter of collimating reflector **24***a* is about six (6) times the diameter of output **17** of optical fiber **15**.

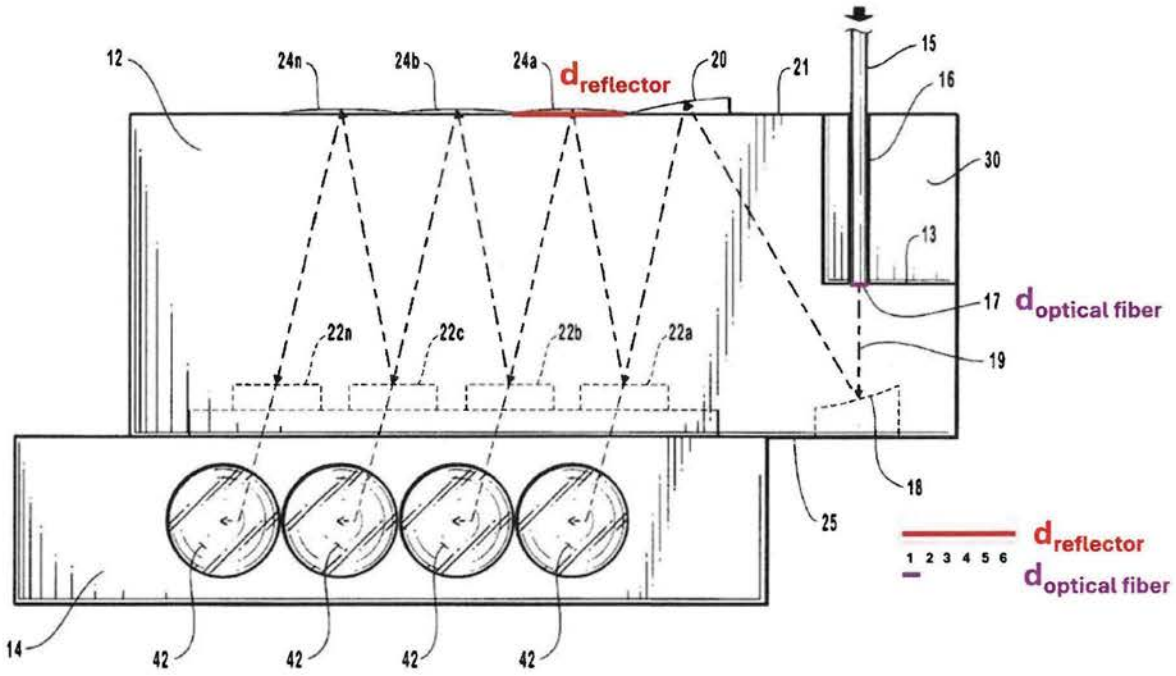


FIG. 1

(Goodman, FIG. 1 (annotated); *see also* Ex. B, ¶258.)

15. **Claim 26: "further comprising a first focusing optical element arranged near the second image, the first focusing optical element configured to focus the light from the optical relay element to a size smaller than the object of the light source to a first semiconductor detector."**

The combination of Goodman and Chandler discloses Claim 26. (Ex. B, ¶¶259-260.) To start, Goodman disclose a "**first focusing optical element**" in focusing lens **42** associated with wavelength selective element **22***c* for the same reasons provided for Claims 1[d], 1[f], and 14[b][i]. That focusing lens **42** is "**arranged near the second image**" as discussed for Claim 20[b]. The combination of Goodman and Chandler also discloses a "**first semiconductor detector**" in the

APD optically coupled to the focusing lens **42** for the same reasons provided for Claim 1[e].

This focusing lens 42 is also "configured to focus the light from the optical relay element to a size smaller than the object of the light source to a first semiconductor detector." The "object of the light source" is the core diameter of a multimode optical fiber measured in millimeters. ('582, 44:42-46.) As discussed with Claim 3, a POSA would have known that small area APDs commercially available by 2011 had diameters less than 1 mm, and a POSA implementing the small area APDs in the Goodman-Chandler device would naturally have focused the collimated beam down to a spot size less than the core diameter (1 mm or greater as suggested by the '582 patent) of a multimode optical fiber. (Ex. B, ¶261.)

H. SNQ No. 3: Claims 3, 26 are Unpatentable as Obvious Over Chandler in View of Goodman and Hamamatsu.

1. Motivation to Combine Chandler and Goodman with Hamamatsu and Reasonable Expectation of Success

A POSA would have been motivated to use APDs and combine the Chandler-Goodman optical subsystem with Hamamatsu to further reduce footprint and improve signal-to-noise ratio by using an APD with a small active area size. (Ex. B, ¶262.) Given the well-known benefits of APDs in flow cytometers and the existing commercially available flow cytometers using APDs by 2011, a POSA would have

had reasonable expectation of success that APDs could be used in the Chandler-Goodman optical subsystem. (Ex. B, ¶¶263-264; *see also* Chandler, 5:29-31.)

2. Claim 3: "wherein the first focusing optical element is configured to focus the portion of the collimated beam received from the optical relay element to a size smaller than 1 millimeter in diameter."

The combination of Chandler and Goodman discloses Claim 3 for the same reasons provided for Claim 3 in SNQ No. 2. Hamamatsu expressly discloses what a POSA would have generally known at the time of invention—commercially available APDs that detect over the full visible light spectrum with active area diameters at or smaller than 1 mm. (*See* Ex. XX, p.001; Ex. YY, p.001; Ex. CCC; Ex. B, ¶¶266-268.)

3. Claim 26: "further comprising a first focusing optical element arranged near the second image, the first focusing optical element configured to focus the light from the optical relay element to a size smaller than the object of the light source to a first semiconductor detector."

The combination of Chandler, Goodman, and Hamamatsu discloses Claim 26 for the same reasons provided for Claim 26 in SNQ No. 2, in combination with the reasons provided for Claim 3 in SNQ No. 3 supported by Hamamatsu's express disclosures. (Ex. B, ¶¶269-270.)

I. SNQ No. 4: Claims 1, 2, 3, 6, 14, 15, 17, 18, 20, 21, 22, 23, 25, 26 are Unpatentable as Obvious Over Oostman in View of Goodman and Frazier.

1. Motivation to Combine Oostman and Goodman and Reasonable Expectation of Success

A POSA would have found it obvious to combine Oostman's flow cytometers with Goodman's teachings regarding its wavelength division (de)multiplexer devices. (Ex. B, ¶271.) Oostman, as modified by Goodman, would have predictably resulted in the substitution of Oostman's detector array cluster arrangements with Goodman's more modular, compact, and efficient optical block demultiplexers that included Oostman's collimating lens.

A POSA would have been motivated to combine Oostman's flow cytometers with Goodman's teachings regarding its modular, efficient, cost-effective optical block demultiplexers. (Ex. B, ¶272.) Oostman and Goodman both identified and proposed a solution for the same problem, which is to develop a WDM device that is compact and cost-effective, and at the same time, capable of separating colors and detecting light over a wide range of wavelengths. (Oostman, 2:60-64, 3:39-41, 3:53-55, 4:14-16; Goodman, 1:8-12; Ex. B, ¶¶272-274.) Further, a POSA would have been motivated to combine Oostman's teachings with the teachings of Goodman regarding an optical block. Optical alignment is critical to WDM operation, particularly in Oostman's non-integrated designs where light propagates through air and optical components are oriented/fixated through holders. (Oostman, 8:48-59,

FIGs. 9-11.) Optical alignment and calibration were known technical challenges that practitioners actively attempted to solve in flow cytometer applications. (*See, e.g.*, Ex. Y, pp.013-014; Ex. G, p.089; Ex. B, ¶273.)

Oostman and Goodman are analogous references in the same fields of the alleged invention related to optical fibers and, more particularly, modular optical instruments for color separation and detection. (Oostman, 1:8-12, 5:34-40; Goodman, 1:8-12, 3:48-67, 6:19-35; *see also, e.g.*, '582, 2:35; *see* Ex. B, ¶274.) Other prior art references discussed in the motivation to combine analysis for SNQ No. 2 confirm this motivation to develop such a device. (Ex. B, ¶275.) The combined Oostman-Goodman device would have resulted in a flow cytometer with the zig-zag WDM configuration by substituting Oostman's polygonal WDMs with Goodman's more modular, efficient, cost-effective zig-zag WDM. (Ex. B, ¶¶274-278.)

Lastly, a POSA would have had a reasonable expectation that the combination would have been successful given that both Goodman and Oostman disclosed that their configurations are adaptable. (Oostman, 3:39-41, 4:44-45; Goodman, 3:65-67, 6:19-24; *see also, e.g.*, '582, 4:50-60, 44:7-14; Ex. B, ¶¶272, 279.) The '582 specification confirms that a WDM from the optical communication industry can be "readily adapted for fluorescence light detection," as such a WDM is "almost

identical in function and architecture" to WDMs used in flow cytometry. ('582, 4:50-60, 44:7-14.)

2. Motivation to Combine Oostman and Goodman with Frazier and Reasonable Expectation of Success

A POSA would have been motivated to combine the Oostman-Goodman optical subsystem with Frazier's teachings on the use of APDs within its WDM to further reduce footprint of a flow cytometer while expanding color separation and increasing detection sensitivity capabilities. (Ex. B, ¶280.)

Oostman, Goodman, and Frazier are analogous references in the same field as the alleged invention related to wavelength division demultiplexing, fluorescence detection, and/or flow cytometry. (*See, e.g.*, Oostman, 1:8-12, 5:34-40; Goodman, 1:8-12, 3:48-67, 6:19-35; Frazier, Abstract, 1:15-20, 4:5-13.) Frazier discloses a zig-zag WDM configuration similar to Goodman's albeit with a central boulevard design. (*Compare, e.g.*, Frazier, FIG. 1, *with* Goodman, FIG. 1.) (Ex. B, ¶281.)

A POSA would have understood the benefits of using APDs (*see* Section V.A.3) in developing a more compact flow cytometer with expanded color separation and more sensitive detection capabilities. (Ex. B, ¶282.) A POSA would have further found these technical features of APDs to be highly desirable over PMTs, including because APDs are significantly smaller than larger PMTs with bulkier housings. (Ex. DD, 6:10-13; Ex. FF, p.009; Ex. EE, pp.003, 006; Ex. GG,

p.010; Ex. HH, p.002; Ex. AA, p.001; *see also* Ex. CCC, Ex. DDD, Ex. EEE; Ex. B, ¶282.)

Given the well-known benefits of APDs in flow cytometers and the existing commercially available flow cytometers using APDs by 2011, a POSA would have had a reasonable expectation of success that APDs could be used in the Oostman-Goodman optical subsystem. (Ex. B, ¶283; *see also* Chandler, 5:29-31.) With relative ease, researchers in the field had already demonstrated that PMTs can be successfully substituted with APDs in a commercial system (LSR-II) that embodied Oostman's polygonal arrangement. (Ex. EE, p.006.) (Ex. B, ¶283.)

A POSA would not have anticipated any additional technical hurdles from implementing APDs, as opposed to using bulkier PMTs with Goodman's zig-zag WDM configuration in the Oostman flow cytometer system. Frazier's zig-zag WDM configuration is substantively similar to Goodman's zig-zag WDM configuration and discloses use of APDs. And, as discussed in Section V.A.3, skilled artisans had already long since resolved the technical issues that early APD adopters had encountered when using APDs in flow cytometry applications (e.g., temperature dependence, preamplification, high dark current). (Ex. B, ¶¶283-284.)

3. Independent Claim 1

a. Claim 1[pre]: "An optical subsystem for a flow cytometer, the optical subsystem comprising:"

The combination of Oostman and Goodman discloses Claim 1[pre]. (Ex. B, ¶285.) Oostman's "preferred embodiment features a flow cytometer." (Oostman, 5:34-37; *see also* '582, 5:11-18.) Oostman's FIG. 4 depicts a flow cytometer setup comprising lasers **95**, **97**, **99**, **101** irradiating a target sample within fluidic system **105**, where fluorescent and scattered light is collected by a light collector **111** and focused into optical fibers **123**, **125**, **127**, **129** to route to respective detector arrays **124**, **126**, **128**, **130** (grey) for color separation and detection.

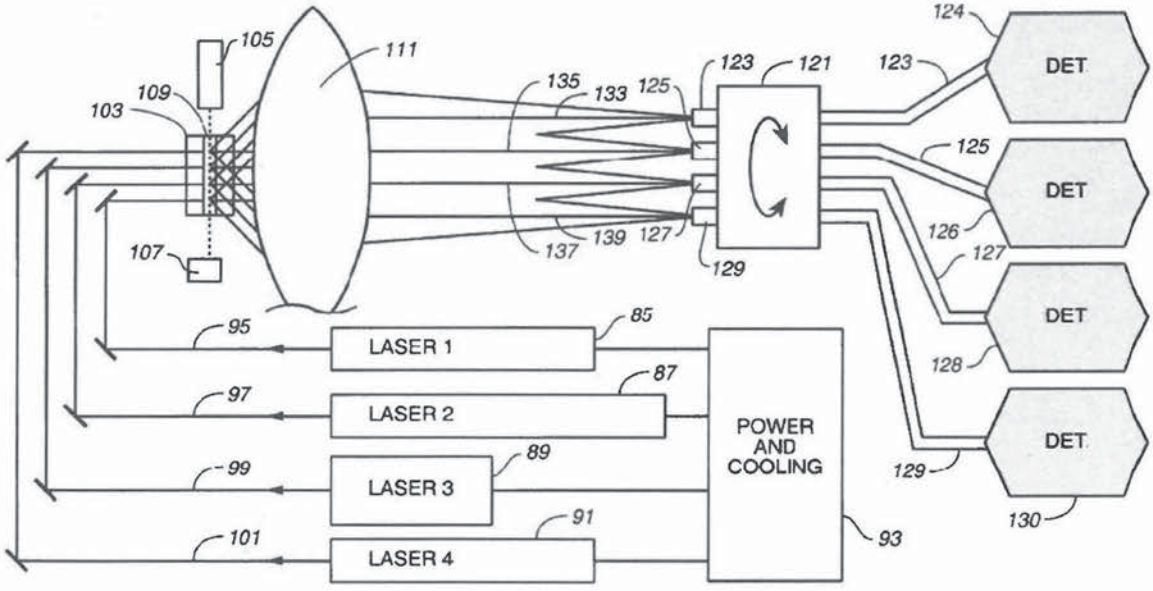


FIG._4

(*Id.*, FIG. 4 (annotated); *see also id.*, 2:66-3:35, 4:25-45.) Each detector array **124**,

126, **128**, **130** demultiplexes and detects light with each detector receiving a passband of wavelengths of light. (*Id.*, 6:34-36; Ex. B, ¶286.)

b. Claim 1[a]: "a collimating optical element arranged to receive light from a light source, the collimating optical element configured to project a collimated beam;"

The combination of Oostman and Goodman discloses Claim 1[a]. (Ex. B, ¶288.) Oostman's WDM, modified with Goodman's zig-zag configuration, would have predictably resulted in the placement of Oostman's collimating lens at a focal length of the collimating lens from the output end of optical fiber **15** but before imaging element **18**, as shown below. Oostman's collimating lens, implemented in Goodman's WDM, is a "**collimating optical element**" under Patent Owner's proposed constructions. (Ex. B, ¶¶288-289.)

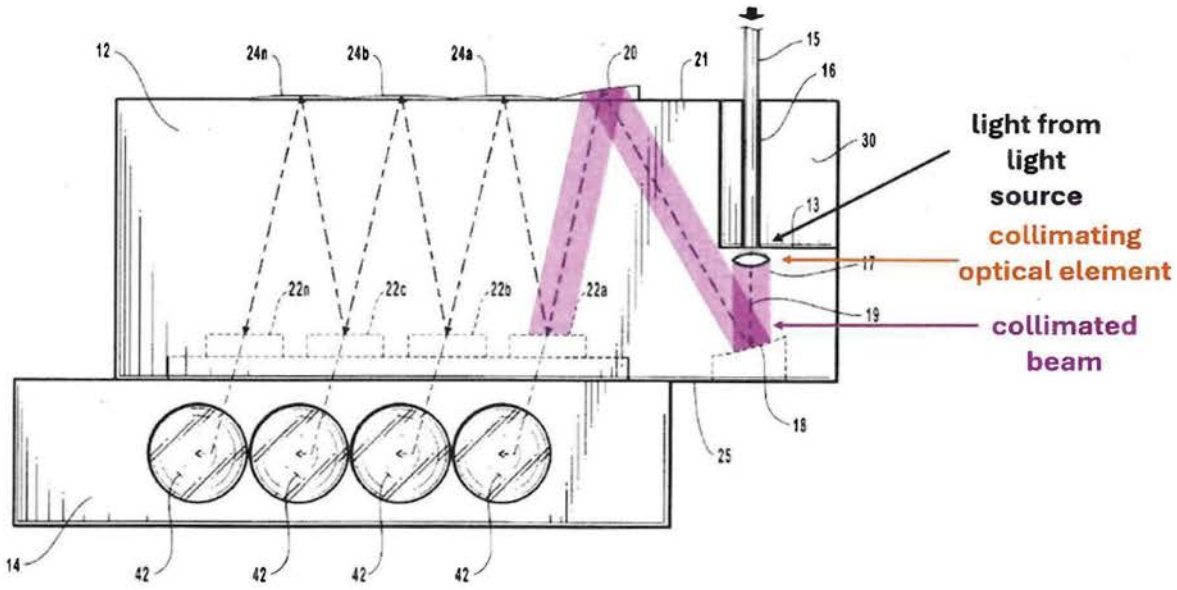


FIG. 1

(Goodman, FIG. 1 (annotated with Oostman's collimating lens).)

Oostman's collimating lens "**receive**[s] **light from a light source**" from Goodman's optical fiber **15**. (Goodman, 11:53-55; Ex. B, ¶290.) Oostman's collimating lens also "**project**[s] **a collimated beam**" under either parties' construction, as a POSA would have expected Oostman's collimating lens to project parallel light rays when positioned a focal length away from the output end **17** of Goodman's optical fiber **15**. (Ex. B, ¶291.)

a. Claim 1[b]: "an optical relay element arranged to receive at least a portion of the collimated beam from the collimating optical element,"

Goodman discloses Claim 1[b]. (Ex. B, ¶292.) Collimating reflector **24***a* is an "**optical relay element**" that is arranged to receive "**a portion of the collimated beam**" from Oostman's collimating lens.

Goodman's FIG. 1 embodiment includes "a plurality of discrete reflectors **24***a*-**24***n* that are positioned on top surface **21** of optical block **12** in a linear arrangement." (Goodman, 9:58-61.) A collimated beam (violet) from Oostman's collimating lens is directed "onto the surface of wavelength selective element **22***a*" where "selected wavelengths incident upon wavelength selective element **22***a* pass therethrough (violet) while the remainder [("**portion of the collimated beam**")] (blue) are reflected or absorbed. The reflected wavelengths of the beam (blue) are directed to reflector **24***a*[.]" (Goodman, 11:59-62, 12:1-5.) Reflector **24***a* is

"designed to relay the image of the fiber facet down the optical train." (*Id.*, 10:19-23 (underlining added); *see also* Ex. B, ¶¶293-294.)

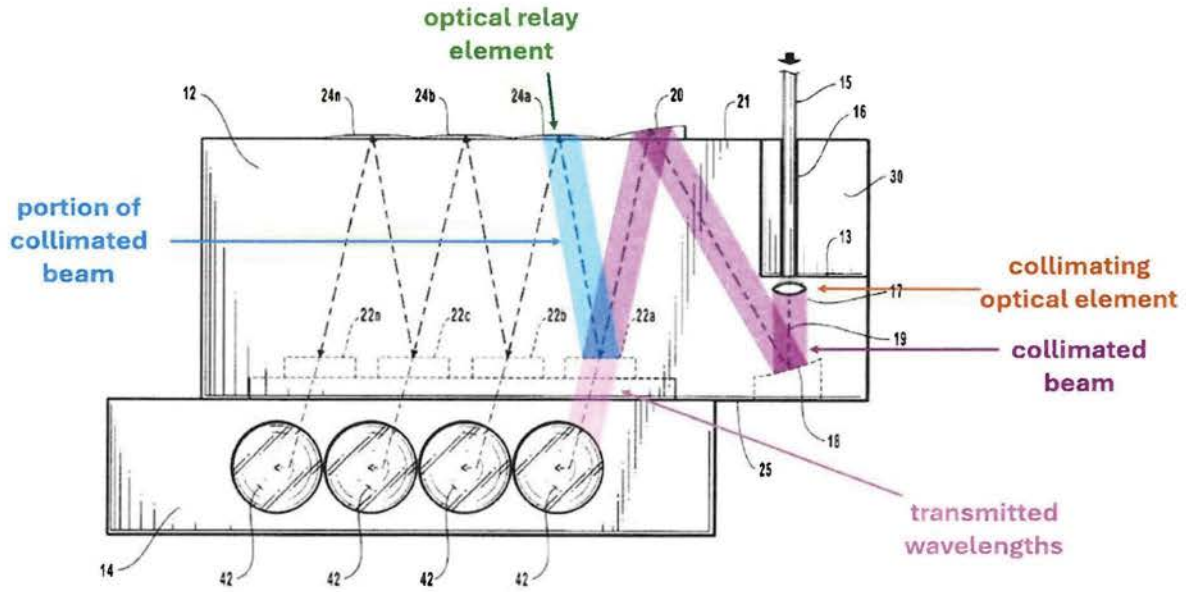


FIG. 1

(Goodman, FIG. 1 (annotated with Oostman's collimating lens).) A "**portion**" is disclosed by Goodman under either party's construction of the term. (Ex. B, ¶295.)

b. Claim 1[c]: "the optical relay element comprising a curved mirror configured to reflect the portion of the collimated beam received from the collimating optical element to produce a first image;"

Goodman discloses Claim 1[c]. Goodman discloses "**a curved mirror**" for the same reasons as described in Claim 1[c] in SNQ No. 2 with respect to collimating reflector **24***b* in SNQ No. 2). (Ex. B, ¶296.)

Goodman's collimating reflector **24***a* is "**configured to reflect the portion of the collimated beam received from the collimating optical element**."

Collimating reflector **24***a* "reflects the light incident thereupon towards wavelength selective element **22***b*[.]" (Goodman, 12:5-6; *see also id.*, FIG. 1; Ex. B, ¶297.)

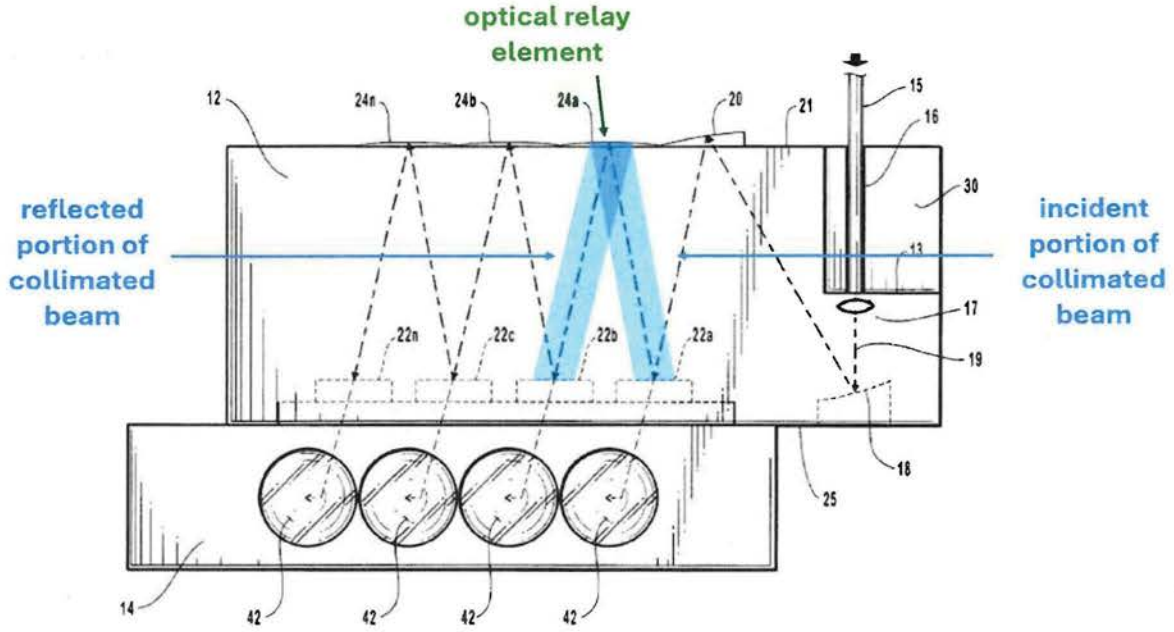


FIG. 1

(*Id.*, FIG 1 (annotated with Oostman's collimating lens).)

Goodman's collimating reflector **24***a* "**produces a first image**" because it re-collimates an incident collimated beam to control beam divergence, a desired function to maintain and/or extend collimation in an incident collimated beam. (Goodman, 10:26-29; *see also id.*, 10:17-23; Ex. B, ¶298.) The "**first image**" produced by collimating reflector **24***a* is distinguishable from images produced by subsequent collimating reflectors, consistent with Patent Owner's construction for "**first**" and "**second**." (Ex. B, ¶2987.)

c. Claim 1[d]: "a first focusing optical element arranged to receive at least a portion of the collimated beam reflected by the optical relay element; and"

Goodman discloses Claim 1[d]. (Ex. B, ¶299.) Goodman discloses a "**focusing optical element**" for the same reasons for Claim 1[d] in SNQ No. 2.

The light received by the focusing lens is "**at least a portion of the collimated beam reflected by the optical relay element**." (Goodman, 11:8-12; *see also id.*, 11:24-30.) A POSA would also have understood that collimating reflector **24***a* ("**optical relay element**") "**reflects**" a collimated beam to wavelength selective element **22***b*. A "**portion of the collimated beam**" passes through wavelength selective element **22***b* toward a corresponding focusing lens **42** ("**first focusing optical element**") in the beam-directing member that is "**arranged to receive at least a portion of the collimated beam**" as shown below. (Ex. B, ¶299.)

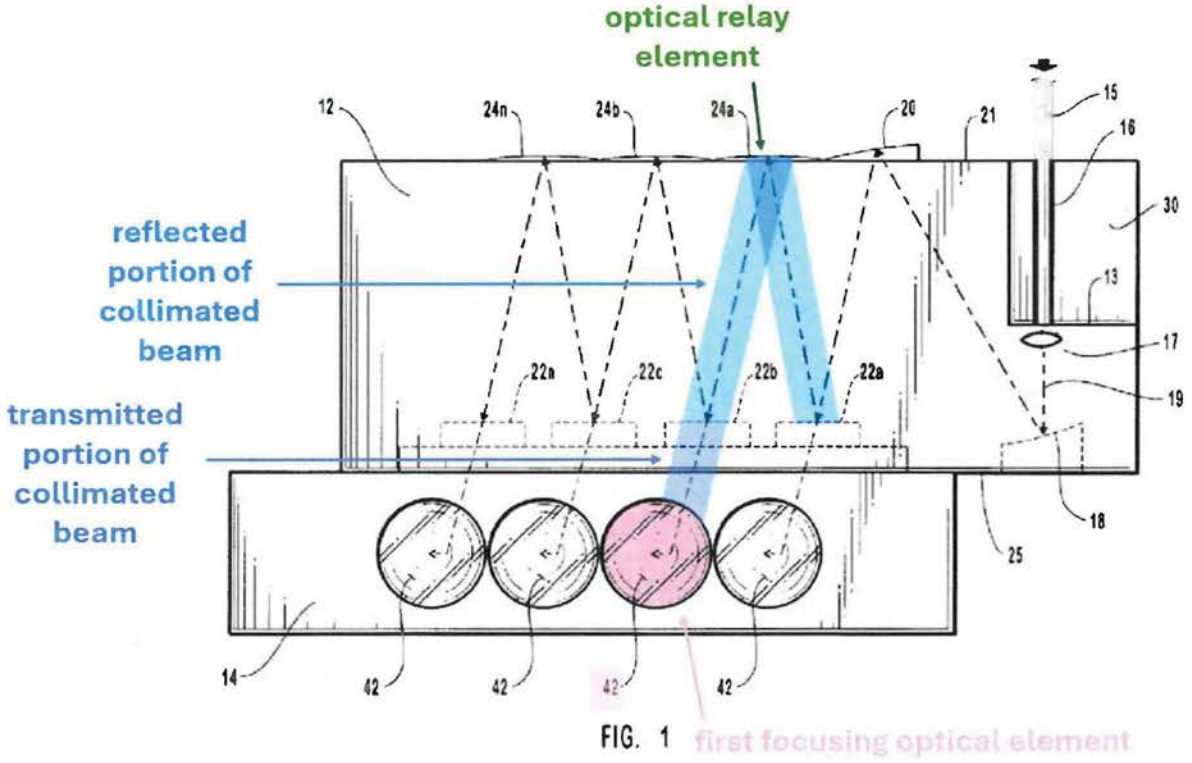


FIG. 1

(Goodman, FIG. 1 (annotated with Oostman's collimating lens).)

Goodman discloses a "**first**" focusing optical element under Patent Owner's construction because it is distinguishable from others. (Ex. B, ¶300.)

d. Claim 1[e]: "a first semiconductor detector,"

The combination of Goodman, Oostman, and Frazier discloses Claim 1[e]. Frazier provides that its photodetectors can include photo avalanche detectors (APDs), a "**semiconductor detector**." (Frazier, 4:19-21.) The "**first semiconductor detector**" in the Goodman-Oostman-Frazier optical subsystem is the APD associated with the focusing lens **42** identified in Claim 1[d] as the "**first focusing optical element**." Goodman discloses a "**first**" semiconductor detector

under Patent Owner's construction because it is distinguishable from others. (Ex. B, ¶301.)

e. Claim 1[f]: "wherein the first focusing optical element is configured to focus the portion of the collimated beam received from the optical relay element onto the first semiconductor detector."

The combination of Goodman, Oostman, and Frazier discloses Claim 1[f]. Goodman discloses a "**first focusing optical element**" as identified in Claim 1[d]. (Ex. B, ¶302; *see also* Goodman, 12:24-26, 11:8-30, 12:24-32.) As explained in Claim 1[d], focusing lens **42** receives the portion of the collimated beam that passed through wavelength selective element **22***b*. Lastly, Goodman's focusing lens **42** can "**focus**" this portion of the collimated beam "onto a corresponding optical receiver such as an optical detector," i.e., Frazier's APD ("**first semiconductor detector**"). (Goodman, 11:40-42.)

4. Claim 2: "further comprising the light source, wherein the light source comprises light passing through a pinhole or light emitted from a facet of a multimode optical fiber."

The combination of Goodman, Oostman, and Frazier discloses Claim 2. (Ex. B, ¶303.) Goodman discloses Claim 2 for the same reasons discussed in Claim 2 in SNQ No. 2. (Ex. B, ¶304.) Oostman also discloses a "**multimode optical fiber**" that directs collected light into an optical subsystem of the flow cytometer. (Ex. B, ¶305.) First, a POSA would have understood Oostman's "array of detectors" (grey) to be optical subsystems of the flow cytometer. (Ex. B, ¶305.)

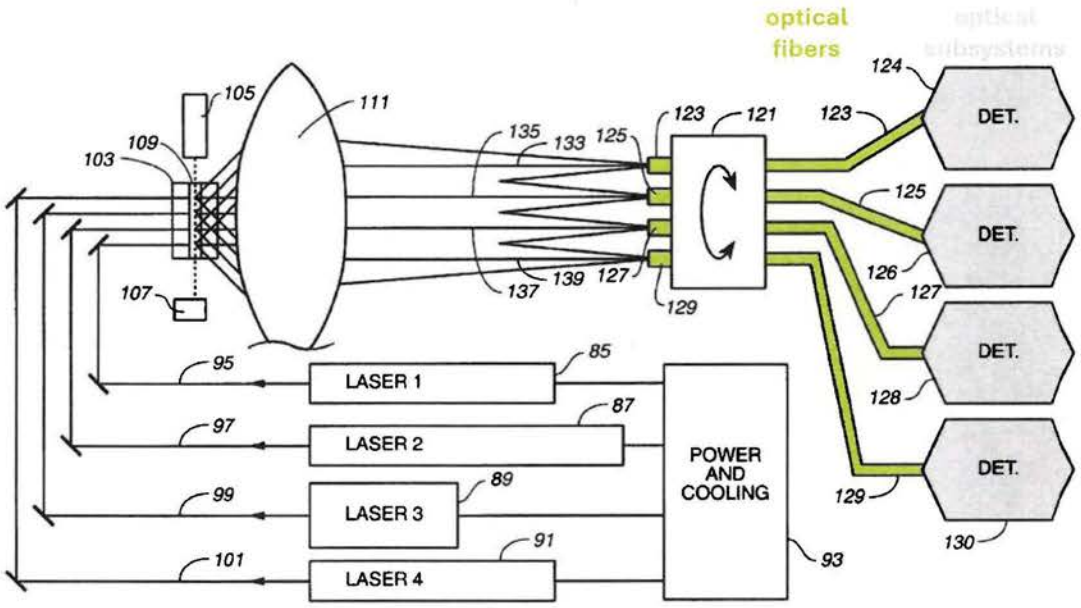


FIG._4

(Oostman, FIG. 4 (annotated).) The incident light into the light collector **111** is gathered and focused onto optical fibers, to be routed into the optical subsystems for demultiplexing and detection. (*Id.*, 6:4-7, 6:26-28, 6:34-39.) It would have thus been clear to a POSA that Oostman's flow cytometer and detection array setup, as modified to include Goodman's WDMs, would necessarily result in a "**light emitted from a facet of a multimode optical fiber**" within Goodman's WDM. (Ex. B, ¶305.)

5. Claim 3: "wherein the first focusing optical element is configured to focus the portion of the collimated beam received from the optical relay element to a size smaller than 1 millimeter in diameter."

The combination of Oostman, Goodman, and Frazier, in view of a POSA's general knowledge regarding the state of the art in small area APDs by December 2011, renders obvious Claim 3 for the same reasons provided for Claim 3 in SNQ No. 2. (Ex. B, ¶306.)

6. Claim 6: "further comprising a first optical filter disposed along an optical path between the collimating optical element and the optical relay element, the first optical filter configured to separate the collimated beam into a first branch and a second branch."

Goodman discloses Claim 6. Wavelength selective element **22***a* is an "**optical filter**" for the same reasons provided for Claim 6 in SNQ No. 2 (with respect to wavelength selective element **22***b* in SNQ No. 2). (Ex. B, ¶¶307-308.) Goodman's wavelength selective element **22***a* is "**disposed along an optical path between**" Oostman's collimating lens ("**collimating optical element**")and reflector **24***a* ("**optical relay element**"). (Goodman, FIG. 1, 11:59-62, 12:1-5; *see also* Ex. B, ¶309.)

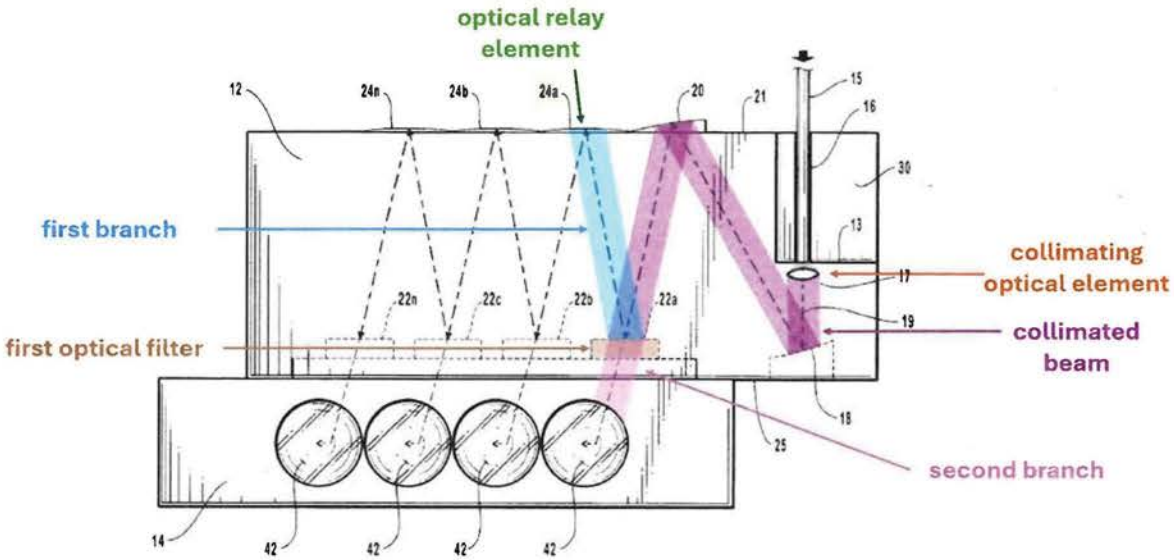


FIG. 1

(Goodman, FIG. 1 (annotated with Oostman's collimating lens).)

Goodman's wavelength selective element **22***a* is also "**configured to separate the collimated beam between a first branch and a second branch.**" "[S]elected wavelengths incident upon wavelength selective element **22***a* pass therethrough while the remainder are reflected or absorbed." (Goodman, 12:1-5.) A POSA would have understood the reflected wavelengths to be a "**first branch**" of the incident collimated beam, whereas the remainder are a "**second branch**," distinguishable from the "**first branch**," consistent with Patent Owner's construction. (Ex. B, ¶¶310-311.)

7. Independent Claim 14

a. Claim 14[pre]: "An optical subsystem for a flow cytometer, the optical subsystem comprising:"

The combination of Oostman, Goodman, and Frazier discloses Claim 14[pre] for the same reasons provided for Claim 1[pre].

b. Claim 14[a]: "a collimating optical element arranged to receive light from a light source,"

The combination of Oostman, Goodman, and Frazier discloses Claim 14[a] for the same reasons provided for Claim 1[a].

c. Claim 14[a][i]: "the collimating optical element configured to project a collimated beam including a first image,"

Goodman as modified by Oostman discloses a "**collimating optical element configured to project a collimated beam**" for the same reasons provided for Claim 1[a]. Oostman's collimating lens, projects a collimated beam from light received from optical fiber **15**. (Ex. B, ¶314.) That collimated beam includes a "**first image**" that propagates with the collimated beam and is ultimately disposed at two locations: (1) near the optical relay element, collimating reflector **24***a*, and (2) near the focusing lens **42** optically coupled to wavelength selective element **22***a*. (*Id.*) Goodman confirms that the collimated beam includes a "first image," noting that the reflectors are "designed to relay the image of the fiber facet down the optical train," and

therefore must receive an image included in the collimated beam projected by Oostman's collimating lens. (Goodman, 10:22-24 (underlining added).)

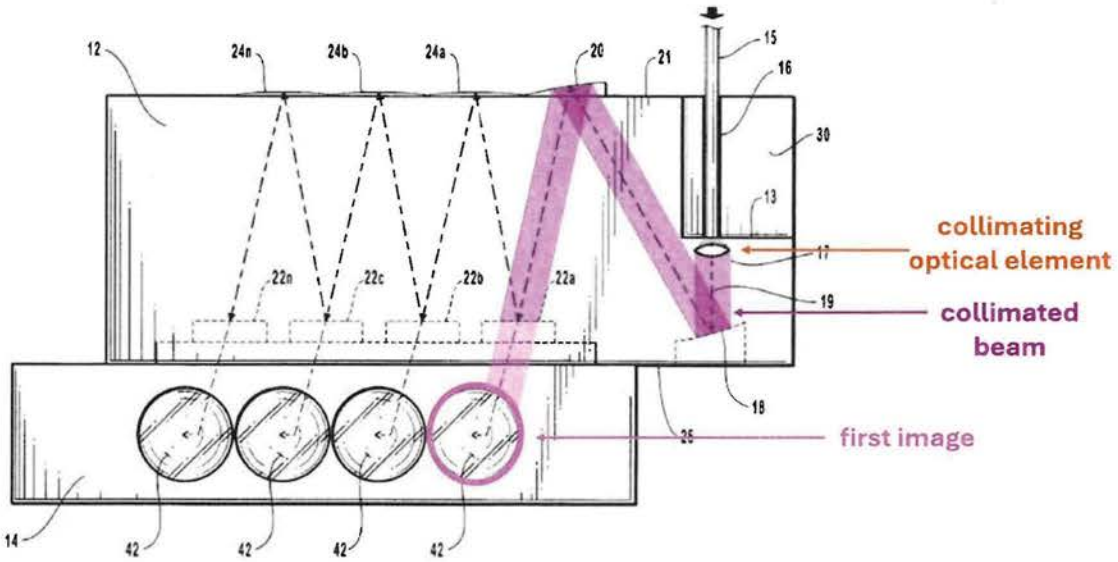


FIG. 1

(Goodman, FIG. 1 (annotated with Oostman's collimating lens).) This image is "**first**" and distinguishable from the "**second image**" discussed for Claim 14[b][ii]. (Ex. B, ¶315.)

d. Claim 14[a][ii]: "wherein the collimated beam has a collimated distance; and"

Goodman discloses Claim 14[a][ii]. Oostman's collimating lens projects a collimated beam over a certain distance for the reasons discussed regarding properties of a collimated beam for Claim 14[a][ii] in SNQ No. 2. A POSA would have understood that the collimated beam projected by Oostman's collimating lens would have also included a collimated distance to collimating reflector **24***a* by way

of wavelength selective element **22***a* and imaging elements **18** and **20**. (Ex. B, ¶¶316-317.)

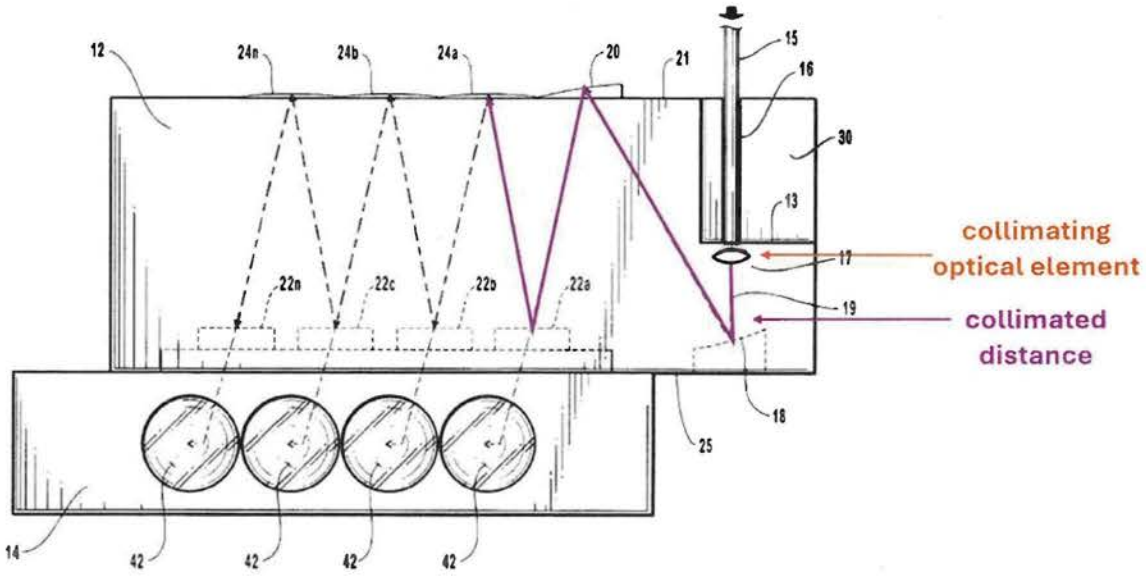


FIG. 1

(Goodman, FIG. 1 (annotated with Oostman's collimating lens).)

e. Claim 14[b]: "an optical relay element arranged to receive the collimated beam,"

The combination of Oostman, Goodman, and Frazier discloses Claim 14[b] for the same reasons provided for Claim 1[b]. (Ex. B, ¶318.)

f. Claim 14[b][i]: "the optical relay element configured to extend the collimated distance of the collimated beam,"

Goodman teaches that its collimating reflector **24***a* is "**configured to extend the collimated distance of the collimated beam**." Goodman's collimating reflector **24***a* can also be a collimating mirror that will re-collimate the incident beam, extending the collimated distance for the beam. (Goodman, 10:18-21, 10:25-28.) A

POSA would have understood that the extended collimated distance would be (1) the optical distance to collimating reflector **24***b* for wavelengths of light reflecting off wavelength selective element **22***b*; and (2) the optical distance to focusing lens **42** optically coupled to wavelength selective element **22***b* for wavelengths of light passing through wavelength selective element **22***b*. (Goodman, FIG. 1, *see also id.*, 10:21-23; Ex. B, ¶¶319-320.)

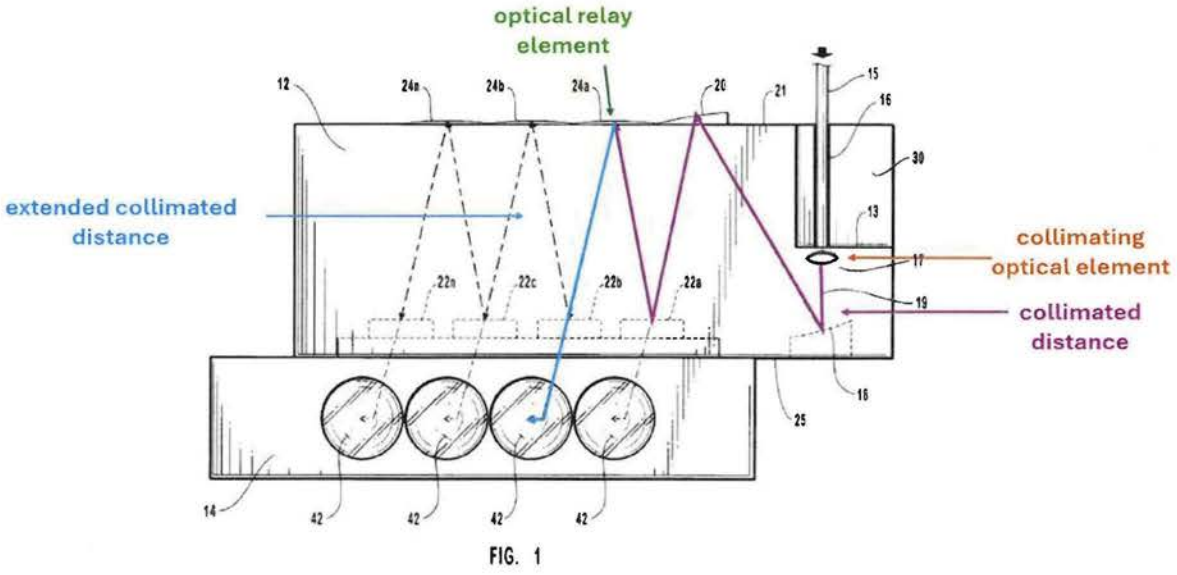


FIG. 1

(Goodman, FIG. 1 (annotated with Oostman's collimating lens).)

g. Claim 14[b][ii]: "wherein the optical relay element comprises a curved mirror or a concave-shaped dichroic filter configured to produce a second image."

Goodman discloses a "**curved mirror**" for the same reasons provided for Claim 1[c]. This curved mirror is also "**configured to produce a second image**" for same reasons provided for Claim 14[b][ii] in SNQ No. 2. (Ex. B, ¶321.)

Goodman's collimating reflector **24***a* performs this reimaging function and thus "**produces a second image**." A POSA would have understood that collimating reflector **24***a* receives a collimated beam projected from Oostman's collimating lens. (Ex. B, ¶322; *see also* SNQ No. 2, Claim 14[a].) This collimated beam includes a "first image" that is the relayed, magnified image of the facet of optical fiber **15**. Collimating reflector **24***a* can also be a collimating mirror, which a POSA would have understood to have a positive curvature designed to re-collimate the light. (Goodman, 10:18-28; Ex. B, ¶322.) A POSA would have understood that re-collimation of the light beam by collimating reflector **24***a* would reimage the "**first image**," producing a "**second image**" of a diameter consistent with the size of the collimating optical element.

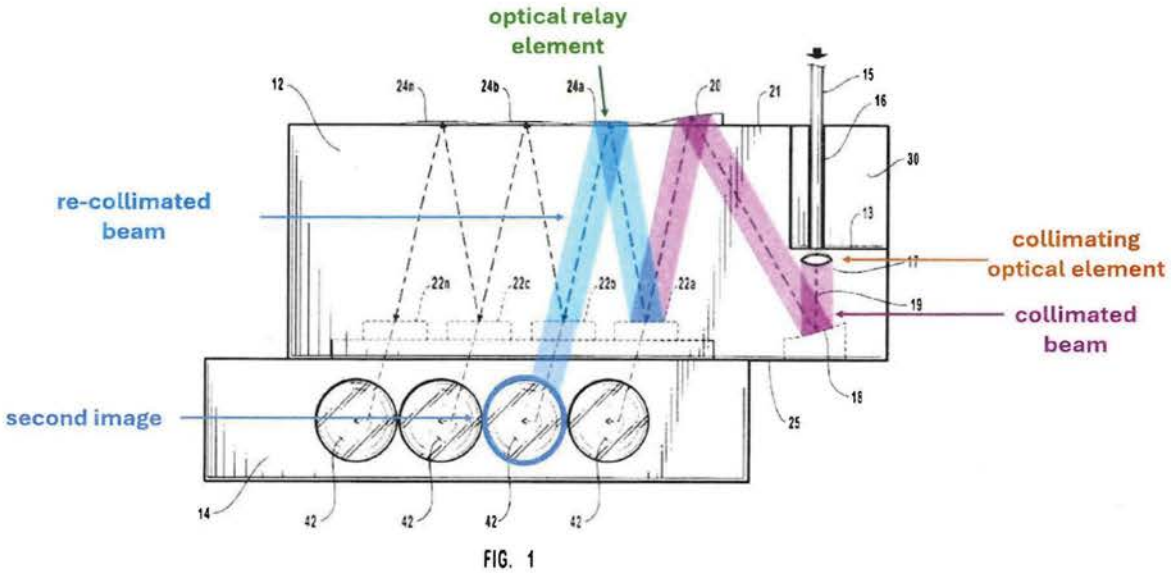


FIG. 1

(Goodman, FIG. 1 (annotated with Oostman's collimating lens); *see also id.*, 10:19-

24; Ex. B, ¶323.) This "**second image**" is distinguishable from the earlier-discussed "**first image**" and consistent with Patent Owner's construction. (Ex. B, ¶323.)

8. Claim 15: "wherein the second image and the first image are substantially the same size."

Goodman discloses Claim 15. The "**first image**" at the collimated distance of the collimated beam projected by Oostman's collimating lens will be substantially the same size as the "**second image**" produced by collimating reflector **24***a* at the extended collimated distance. (Goodman, FIG. 6; *see also* SNQ No. 2, Claim 14[a][ii].) Given Goodman's compact WDM design, the difference in the optical distance from Oostman's collimating lens to collimating reflector **24***a* (or alternatively, to the focusing lens **42** optically coupled to wavelength selective element **22***a*) as compared to the optical distance from collimating reflector **24***a* to collimating reflector **24***b* (or alternatively, to the focusing lens **42** optically coupled to wavelength selective element **22***b*) would have minimal impact on the size of the image. Thus, a POSA would have understood that that "**the second image and the first image are substantially the same size**." (Ex. B, ¶¶324-325.)

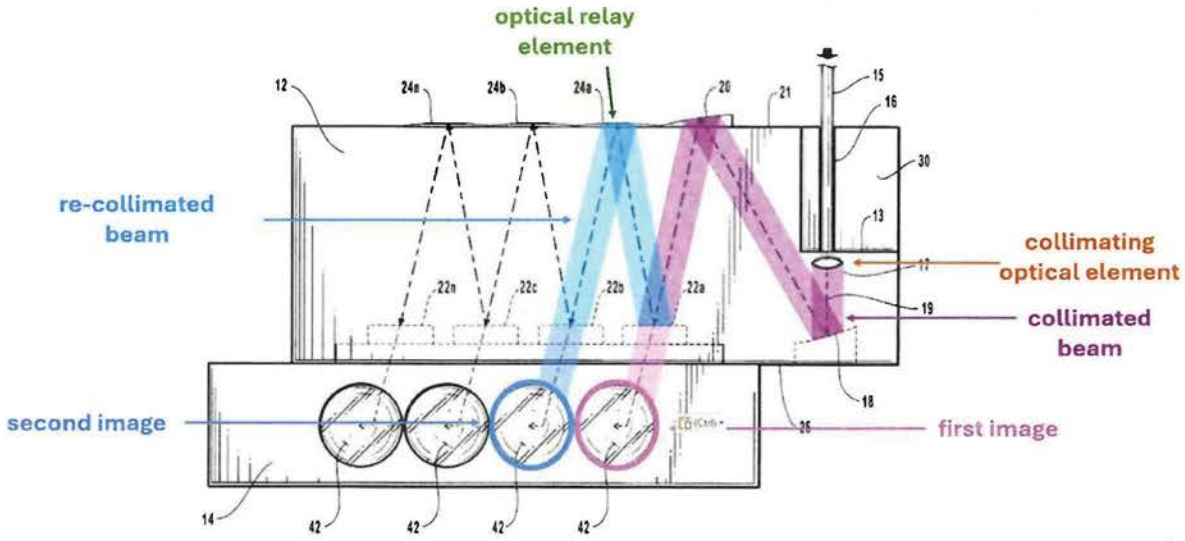


FIG. 1

(Goodman, FIG. 1 (annotated with Oostman's collimating lens).)

9. **Claim 17: "further comprising a first focusing optical element arranged to receive the collimated beam from the optical relay element at the extended collimated distance, the first focusing optical element configured to focus the collimated beam onto a first semiconductor detector."**

The combination of Oostman, Goodman, and Frazier discloses Claim 17 for the same reasons provided for Claims 1[d] and 1[f].

10. **Claim 18: "an optical filter arranged along an optical path between the collimating optical element and the optical relay element, the optical filter configured to separate the collimated beam into a first branch and a second branch, wherein the first branch and the second branch comprise light of different colors, wherein the optical relay element is arranged to receive the first branch; and a second focusing optical element arranged to receive the second branch, the second focusing optical element configured to focus the second branch to a second semiconductor detector."**

The combination of Goodman, Oostman, and Frazier disclose Claim 18. Goodman discloses "**an optical filter arranged along an optical path between the collimating optical element and the optical relay element, the optical filter configured to separate the collimated beam into a first branch and a second branch**" for the reasons discussed for Claim 6. (Ex. B, ¶¶327-329.)

The "**first branch and the second branch comprise light of different colors**" in Goodman. (Ex. B, ¶330.) Goodman's "selected wavelengths incident upon wavelength selective element **22***a* pass therethrough while the remainder are reflected or absorbed. The reflected wavelengths are directed to collimating reflector **24***a*, the "**optical relay element**." (Goodman, 12:1-5.) A POSA would have understood that the selected wavelengths ("**second branch**") that passed through wavelength selective element **22***a* "**comprise light of different colors**" than the reflected remainder ("**first branch**") because the wavelength selective elements separate an incident light beam. As discussed for SNQ No. 2, ranges of wavelengths

passing through the filter are mutually exclusive with the ranges of wavelengths that reflect off the filter. (*See id.*, 6:12-14, 8:23-26.)

Goodman teaches that the "**optical relay element is arranged to receive the first branch**" from wavelength selective element **22***a*, as "reflected wavelengths are directed to reflector **24***a*[.]" (Goodman, 12:4-5 (underlining added); Ex. B, ¶331.) Goodman also discloses "**a second focusing optical element arranged to receive the second branch**," noting that the passed selected wavelengths from wavelength selective element **22***a* are received by a corresponding focusing lens **42** ("**second focusing optical element**"). (*Id.*, 11:26-30, 11:37-40, 12:24-28.) Goodman teaches that this focusing lens **42** "can focus a selected wavelength beam onto a corresponding optical receiver such as an optical detector," and would thus be "**configured to focus the second branch**" to a second APD in the Oostman-Goodman-Frazier optical subsystem. (Ex. B, ¶331.)

11. Independent Claim 20

a. Claim 20[pre]: "An optical subsystem for a flow cytometer, the optical subsystem comprising:"

The combination of Oostman, Goodman, and Frazier discloses Claim 20[pre] for the same reasons provided for Claim 1[pre].

b. Claim 20[a]: "a collimating optical element arranged to receive light from a light source, the collimating optical element configured to project a first image; and"

The combination of Chandler and Goodman discloses a "**collimating optical element arranged to receive light from a light source**" for the same reasons provided for Claim 1[a]. Oostman's collimating lens is "**configured to project a first image**" for the same reasons provided for Claim 14[a][i]. (Ex. B, ¶333.)

c. Claim 20[b]: "an optical relay element arranged near the first image, the optical relay element configured to receive light from the collimating optical element and to project a second image;"

The combination of Oostman, Goodman, and Frazier discloses Claim 20[b]. Goodman discloses an "**optical relay element**" in collimating reflector **24***a* for the same reasons provided for Claim 1[b]. Collimating reflector **24***a* is "**arranged near the first image**." As explained for Claim 14[a][i], a POSA would have understood that each collimating reflector in the set of collimating reflectors **24***a*-**24***n* "re-images" a collimated beam and projects an image of the image it receives with that incident collimated beam, thereby re-imaging the "**first image**" to "**project a second image**." (Ex. B, ¶¶334-335.)

Similar to the "**first image**," the projected "**second image**" is arranged at two locations within Goodman's WDM: (1) at the interface with the next collimating

reflector (another optical relay element) and (2) at the interface of the focusing lens **42** that is optically coupled to wavelength selective element **22*b***. (Ex. B, ¶335.)

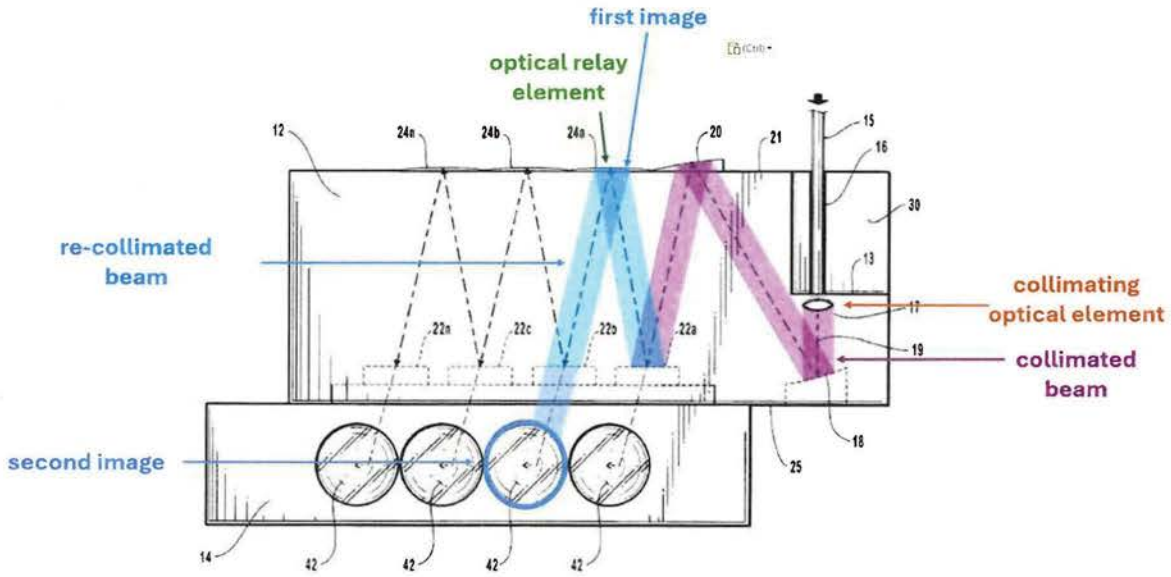


FIG. 1

(Goodman, FIG. 1 (annotated with Oostman's collimating lens).) These "**images**" are distinguishable from each other, consistent with the Patent Owner's construction. (Ex. B, ¶335.)

d. Claim 20[b][i]: "wherein the size of the first image is substantially the same as the size of the second image, and"

The combination of Oostman, Goodman, and Frazier discloses Claim 20[b][i] for the same reasons provided for Claim 15.

e. Claim 20[b][ii]: "wherein the optical relay element comprises a curved mirror or a concave-shaped dichroic filter."

The combination of Oostman, Goodman, and Frazier discloses Claim 20[b][ii] for the same reasons provided for Claim 1[c].

12. Claim 21: "wherein the optical distance from the collimating optical element to the first image is substantially the same as the optical distance from the optical relay element to the second image."

The combination of Oostman, Goodman, and Frazier discloses Claim 21. (Ex. B, ¶338.) Goodman teaches that its reflectors **24*a*-24*n*** can be "converging lenses or mirrors, collimating lenses or mirrors, or simple reflecting surfaces." (Goodman, 10:19-22.) A POSA would have understood that a reflective surface that does not shape the light, e.g., reflective planar surface, may relay but does not re-image. (Ex. B, ¶339.) Thus, a POSA would have understood that Goodman teaches a reflector **24*a*** that is a collimating mirror, a reflector **24*b*** that is a reflective surface that does not reimage the received beam, and a reflector **24*n*** that is a collimating reflector. Under that configuration, a second image is arranged near reflector **24*n*** and "**the optical distance from the collimating optical element to the first image is substantially the same as the optical distance from the optical relay element to the second image**," as shown below. (Ex. B, ¶340.)

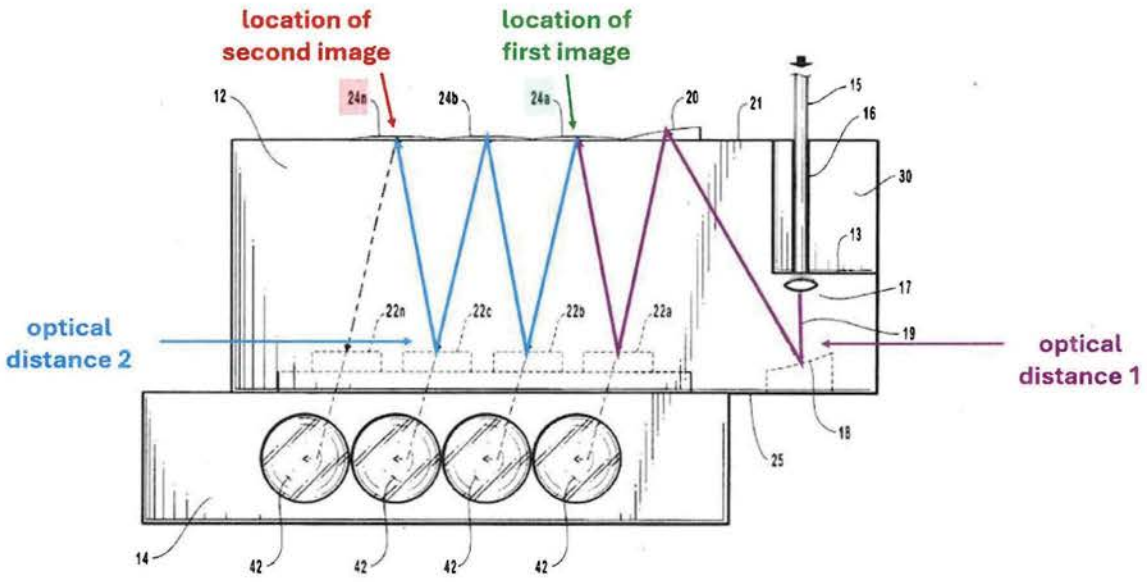


FIG. 1

(Goodman, FIG. 1 (annotated with Oostman's collimating lens).)

13. Claim 22: "further comprising the light source, wherein the light source comprises an extended light source that forms an object, wherein the first image is a magnified image of the object."

Goodman discloses Claim 22 for the same reasons explained for Claim 22 in SNQ No. 2. In the Goodman, Oostman, and Frazier combination, the "**first image is a magnified image of the object**" because when light reaches Oostman's collimating lens that projects a "**first image**," that "**first image**" is a magnified image of the facet of the multimode optical fiber that is then relayed down the optical train by collimating reflectors **24***a*-**24***n*. (Goodman, 10:21-23; Ex. B, ¶¶341-342.) When the collimated beam is near collimating reflector **24***a*, the spot size of the beam, or image, is magnified as compared to the dimensions of the facet of the multimode optical fiber **15**. (Ex. B, ¶342.)

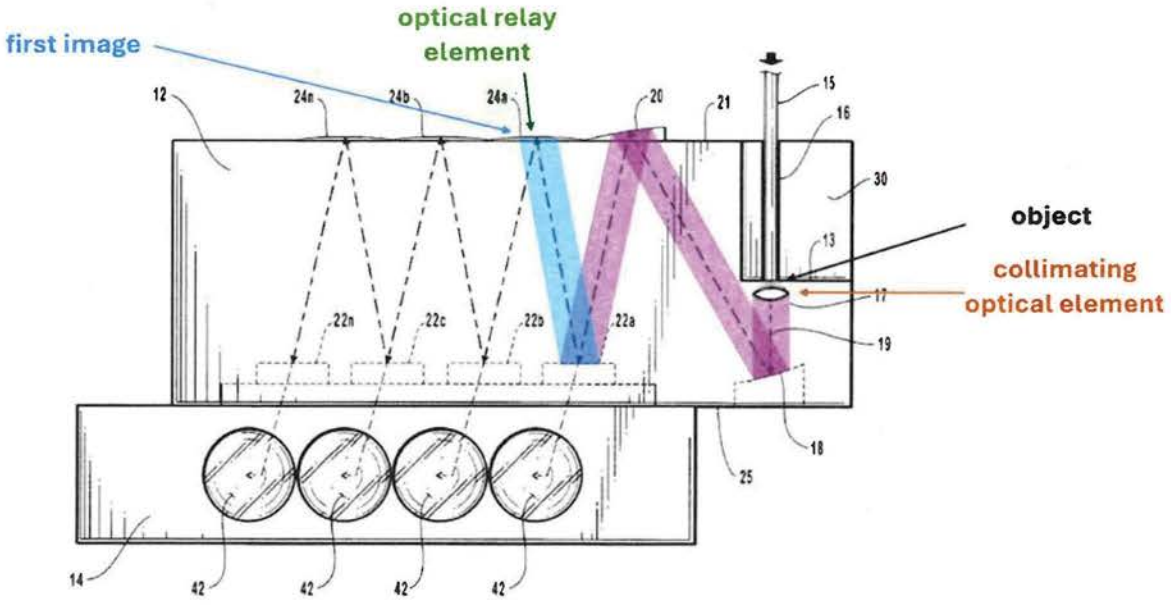


FIG. 1

(*Id.*, FIG. 1 (annotated with Oostman's collimating lens).)

14. Claim 23 "wherein the light source comprises light passing through a pinhole or light emitted from a facet of a multimode optical fiber."

The combination of Oostman, Goodman, and Frazier discloses Claim 23 for the same reasons provided for Claim 2.

15. Claim 25 "wherein the first image is less than approximately 10 times the size of the object."

The combination of Oostman, Goodman, and Frazier discloses Claim 25. In incorporating Oostman's collimating lens into Goodman's WDM design, a POSA would have selected or designed a collimating lens that would project a collimated beam through imaging elements **18** and **20**, wavelength selective element **22***a*, and onto collimating reflector **24***a* of a beam diameter that was consistent with, or

smaller than, the diameter of collimating reflector **24***a* to ensure minimal photon loss when relaying the image through Goodman's WDM. (Ex. B, ¶¶344-345.) As shown in FIG. 1, the diameter of collimating reflector **24***a* is about six (6) times the diameter of output **17** of optical fiber **15**.

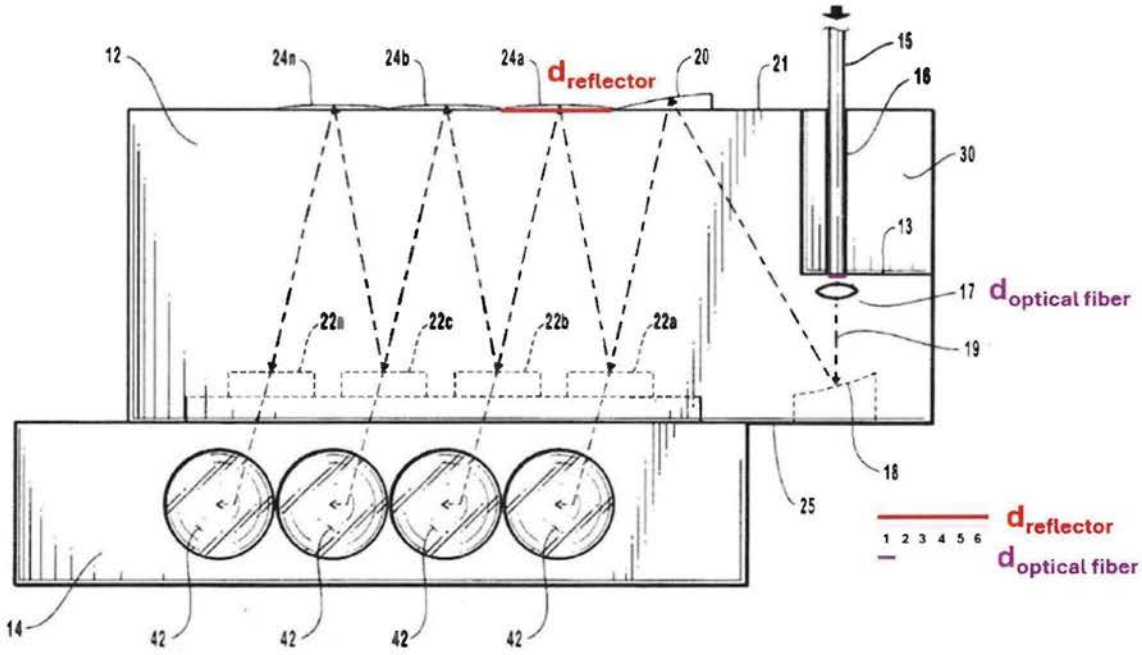


FIG. 1

(Goodman, FIG. 1 (annotated); *see also id.*, 10:25-31.)

16. **Claim 26: "further comprising a first focusing optical element arranged near the second image, the first focusing optical element configured to focus the light from the optical relay element to a size smaller than the object of the light source to a first semiconductor detector."**

The combination of Oostman, Goodman, and Frazier discloses Claim 26 for the same reason as provided for Claim 26 in SNQ No. 2, except Frazier teaches use of APDs in a flow cytometer instead of Chandler. (Ex. B, ¶¶346-347.)

J. SNQ No. 5: Claims 3, 26 are Unpatentable as Obvious Over Oostman in View of Goodman, Frazier, and Hamamatsu.

1. Motivation to Combine Oostman, Goodman, and Frazier with Hamamatsu and Reasonable Expectation of Success

A POSA would have been motivated to combine Oostman, Goodman, and Frazier with Hamamatsu for the same reasons provided with respect to SNQ No. 3. (Ex. B, ¶¶346-348.)

2. Claim 3: "wherein the first focusing optical element is configured to focus the portion of the collimated beam received from the optical relay element to a size smaller than 1 millimeter in diameter."

The combination of Oostman, Goodman, Frazier, and Hamamatsu discloses Claim 3 for the same reasons provided for Claim 3 in SNQ No. 3. (Ex. B, ¶¶349-350.)

3. **Claim 26: "further comprising a first focusing optical element arranged near the second image, the first focusing optical element configured to focus the light from the optical relay element to a size smaller than the object of the light source to a first semiconductor detector."**

The combination of Oostman, Goodman, Frazier, and Hamamatsu discloses Claim 26 for the same reasons provided for Claim 26 in SNQ No. 3, in combination with the reasons provided for Claim 3 in SNQ No. 4. (Ex. B, ¶¶351-352.)

VI. LIST OF EXHIBITS

The following is a list of all exhibits filed with this Request:

Description of Exhibit	**New Exhibit**
U.S. Patent No. 10,330,582 B2 ("**'582 patent**")	A
Declaration of Fedor A. Ilkov, Ph.D.	B
Prosecution History of U.S. Patent No. 10,330,582 B2	C
Nigel P. Carter and Michael G. Ormerod, *Chapter 1, Introduction to the Principles of flow cytometry*, Flow Cytometry, pp. 1-22 (3rd ed. 2000)	D
U.S. Patent No. 6,683,314 B2 to Clifford A. Oostman, Jr. et al. (filed August 28, 2001; published January 27, 2004) ("**Oostman**")	E
U.S. Patent No. 5,317,162 to Bertram G. Pinsky et al. (filed September 9, 1992; published May 31, 1994) ("**Pinsky**")	F
Excerpts of Howard M. Shapiro, Practical Flow Cytometry (4th ed. 2003) ("**Shapiro**")	G
World Patent No. WO 2010/101623 A1 to Michael Thomas (filed March 2, 2010; published September 10, 2010) ("**Thomas**")	H

Description of Exhibit	**New Exhibit**
U.S. Patent No. 8,284,402 B2 to Erich Frazier et al. (filed February 26, 2010; published October 9, 2012) ("**Frazier**")	I
U.S. Patent No. 4,244,045 to Kiyoshi Nosu et al. (filed January 31, 1979; published January 6, 1981) ("**Nosu**")	J
U.S. Patent No. 8,537,468 B1 to Xuan Wang et al. (filed June 10, 2011; published September 17, 2013) ("**Wang**")	K
U.S. Patent No. 6,198,864 B1 to Brian E. Lemoff et al. (filed November 24, 1998; published March 6, 2001) ("**Lemoff**")	L
U.S. Patent No. 7,212,343 B1 to Chun He et al. (filed July 11, 2003; published May 1, 2007) ("**He**")	M
U.S. Patent No. 5,835,517 to Vijaysekhar Jayaraman et al. (filed October 4, 1996; published November 10, 1998) ("**Jayaraman**")	N
U.S. Patent No. 6,201,908 B1 to Eric B. Grann (filed July 2, 1999; published March 13, 2001) ("**Grann**")	O
U.S. Patent No. 6,542,306 B2 to Timothy D. Goodman (filed March 16, 2001; published April 1, 2003) ("**Goodman**")	P
Listing of Challenged Claims	Q
Joint Claim Construction Chart including Exhibit A Parties Agreed and Proposed Constructions filed in *Beckman Coulter, Inc. v. Cytek Biosciences, Inc.*, C.A. No. 24-945 (D. Del. May 28, 2025), D.I. 89 & 89-1	R
Plaintiff's Disclosure of Asserted Claims and Infringement Contentions [Redacted Version], served in *Beckman Coulter, Inc. v. Cytek Biosciences, Inc.*, C.A. No. 24-945 (D. Del. Feb. 14, 2025)	S
Steve Wasserman, *Geometrical optics and ray tracing*, Course Wiki (August 27, 2019)	T

Description of Exhibit	**New Exhibit**
Complaint filed in *Beckman Coulter, Inc. v. Cytek Biosciences, Inc.*, C.A. No. 1:24-cv-00945 (D. Del. Aug. 14, 2024), D.I. 1	U
Summons in a Civil Action to Cytek Biosciences, Inc. c/o Cogency Global, Inc. served on August 15, 2024, filed in *Beckman Coulter, Inc. v. Cytek Biosciences, Inc.*, C.A. No. 1:24-cv-00945 (D. Del. Aug. 16, 2024), D.I. 5	V
Stipulation and Order Amending Scheduling Order filed in *Beckman Coulter, Inc. v. Cytek Biosciences, Inc.*, C.A. No. 1:24-cv-00945 (D. Del. March 4, 2025), D.I. 55	W
Excerpts of the Prosecution history of U.S. Patent No. 9,746,412	X
Rochelle A. Diamond, *Chapter 8: Quality Control Guidelines for Research Flow Cytometry*, In Living Color, pp. 98-105 (2000)	Y
R.M.P. Doornbos et al., *White Blood Cell Differentiation Using a Solid State Flow Cytometer*, Cytometry 14:589-594 (1993) ("**Doornbos**")	Z
SensL SPMMini High Gain APD (Oct. 2007)	AA
Menlo Systems APD210/310 High Sensitivity Detector Unit (Apr. 2021)	BB
Thorlabs.com – High-Sensitivity Avalanche Photodetectors website Overview, Specs and Documents & Drawings, (Aug. 31, 2011), https://web.archive.org/web/20110831115024/http://www.thorlabs.com/NewGroupPage9.cfm?ObjectGroup_ID=947	CC
World Patent No. WO 94/29695 to Oddbjørn Gjelsnes (filed June 8, 1993; published December 22, 1994) ("**Gjelsnes**")	DD
Carleton C. Stewart et al., *Flow Cytometer in the Infrared: Inexpensive Modifications to a Commercial Instrument*, Cytometry Part A, 67A:104-111 (2005) ("**Stewart**")	EE

Description of Exhibit	**New Exhibit**
William G. Lawrence et al., *A 16-channel avalanche photodiode detector array for visible and near-infrared flow cytometry*, Imaging, Manipulation, and Analysis of Biomolecules, Cells, and Tissues IV, Proc. of SPIE, Vol. 6088, 60880T, (2006) ("**Lawrence**")	FF
Wiliam G. Lawrence et al., *A Comparison of Avalanche Photodiode and Photomultiplier Tube Detectors for Flow Cytometry*, Imaging, Manipulation, and Analysis of Biomolecules, Cells, and Tissues VI, Proc. of SPIE Vol. 6859, 68590M, (2008) ("**Lawrence 2008**")	GG
Shutao Zhao et al., *High gain avalanche photodiode (APD) arrays in flow cytometer opitical [sic] system*, IEEE (2011) ("**Zhao**")	HH
U.S. Patent No. 8,188,438 B2 to Dongqing Li (filed Mar. 8, 2010; published May 29, 2012) ("**Li-438**")	II
Canadian Patent No. 2 771 324 to Paul Patt (filed Aug. 20, 2010; published June 21, 2016) ("**Patt-324**")	JJ
U.S. Patent No. 7,580,120 B2 to Yuichi Hamada et al. (filed Apr. 6, 2006; published Aug. 25, 2009) ("**Hamada**")	KK
World Patent No. 98/59233 to Van S. Chandler (filed June 22, 1998; published Dec. 30, 1998) ("**Chandler-233**")	LL
U.S. Patent No. 7,523,637 B2 to Wayne D. Roth et al. (filed Nov. 29, 2007; published Apr. 28, 2009) ("**Roth-637**")	MM
U.S. Patent No. 7,505,131 B2 to Wayne D. Roth (filed Mar. 6, 2008; published Mar. 17, 2009) ("**Roth-131**")	NN
U.S. Patent Application Publication No. 2008/0305481 A1 to Douglas F. Whitman et al. (filed Dec. 13, 2007; published Dec. 11, 2008) ("**Whitman**")	OO

Description of Exhibit	**New Exhibit**
U.S. Patent Application Publication No. 2007/0269345 A1 to Adam Richard Schilffarth et al. (filed May 17, 2007; published Nov. 22, 2007) ("**Schilffarth-345**")	PP
U.S. Patent Application Publication No. 2007/0207513 A1 to Keld Sorensen et al. (filed Mar. 5, 2007; published Sept. 6, 2007) ("**Sorensen**")	QQ
U.S. Patent Application Publication No. 2009/0071225 A1 to Adam Richard Schilffarth (filed Sept. 17, 2008; published Mar. 19, 2009) ("**Schilffarth-225**")	RR
U.S. Patent Application Publication No. 2009/0237658 A1 to Edward Calvin et al. (filed Apr. 9, 2009; published Sept. 24, 2009) ("**Calvin**")	SS
U.S. Patent No. 6,139,800 to Van S. Chandler (filed June 22, 1998; published Oct. 31, 2000) ("**Chandler**")	TT
Luminex 100™ IS User Manual Version 2.3 (Oct. 2005)	UU
Luminex FlexMap 3D® User Manual (Jan. 2019)	VV
BD Biosciences Immunocytometry Systems Technical Specifications BD FACSArray (Oct. 2003)	WW
Archived website page for Hamamatsu NIR High Sensitivity Type products, (June 20, 2010), https://web.archive.org/web/20100620045039/http://jp.hamamatsu.com/products/sensor-ssd/pd078/pd079/pd083/index_en.html	XX
Archived website page for Hamamatsu Short Wavelength Type products, (June 20, 2010), https://web.archive.org/web/20100620044720/http://jp.hamamatsu.com/products/sensor-ssd/pd078/pd079/pd082/index_en.html	YY
Excerpt from Julio Chaves, Introduction to Nonimaging Optics (2008)	ZZ

Description of Exhibit	**New Exhibit**
Definition of Image from Warren J. Smith, Modern Optical Engineering (4th ed. 2008)	AAA
Definitions of Image and Object from Martin H. Weik, Fiber Optics Standard Dictionary (3rd ed. 1997)	BBB
Hamamatsu Si APD S5343 to S5345, S9073 to S9075, Short wavelength type APD (Apr. 2004)	CCC
Hamamatsu Si APD S8890 series, Long wavelength type APD (June 2010)	DDD
Hamamatsu Si APD S2381 to S2385, S5139, S8611, S3884, S4315 series, Low bias operation, for 800 nm band (May 2010)	EEE
Hamamatsu Products by Division, (Aug. 7, 2011), https://web.archive.org/web/20110807025645/http://sales.hamamatsu.com:80/en/products.php	FFF
First Sensor APD Data Sheet Part Description AD800-11 to Order # 500970, Version 20-06-11 (June 2011)	GGG
Thorlabs, Collimated Light's Non-Zero Beam Divergence, *Does collimated light maintain a constant beam diameter out to infinity?* (Apr. 20, 2021), https://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=14489	HHH
Edmund Optics, Considerations in Collimation, https://www.edmundoptics.com/knowledge-center/application-notes/optics/considerations-in-collimation/	III
Excerpts of Exhibit 1 Initial Infringement Contentions for U.S. Patent No. 10,330,582 to Plaintiff's Disclosure of Asserted Claims and Infringement Contentions, served in *Beckman Coulter, Inc. v. Cytek Biosciences, Inc.*, C.A. No. 24-945 (D. Del. Feb. 14, 2025)	JJJ
Affidavit of Mina Ching	KKK

Description of Exhibit	**New Exhibit**
Joint Claim Construction Brief filed in *Beckman Coulter, Inc. v. Cytek Biosciences, Inc.*, C.A. No. 1:24-cv-00945 (D. Del. July 27, 2025), D.I. 114	LLL
U.S. Patent No. 9,746,412 B2 to Yong Qin Chen (filed Nov. 26, 2014; published Aug. 29, 2017) ("'**412**")	MMM
Prosecution History of PCT/US2013/043453 (the "PCT App.")	NNN
2.3: Spherical Mirrors, Bowdoin College, Phys1140: Introductory Physics II: Part 2, https://phys.libretexts.org/Courses/Bowdoin_College/Phys1140:_Introductory_Physics_II:_Part_2/02:_Geometric_Optics_and_Image_Formation/2.03:_Spherical_Mirrors	OOO
Michael W. Davidson, Molecular Expressions, Optical Microscopy Primer, Physics of Light and Color, Florida State University (Nov. 13, 2015), https://micro.magnet.fsu.edu/primer/lightandcolor/mirrorsintro.html	PPP
U.S. Patent Application Publication No. 2015/0115174 A1 to Yong Qin Chen (filed Nov. 26, 2014; published Apr. 30, 2015) ("**Chen Pub '174**")	QQQ
U.S. Patent No. 11,703,443 B2 to Yong Qin Chen (filed Nov. 4, 2022; published July 18, 2023) ("'**443**")	RRR
Prosecution history of EP24151670	SSS
Optics: Concave and Convex Mirrors and Lenses, ScienceReady (2025), https://scienceready.com.au/pages/mirrors-and-lenses	TTT

VII. CONCLUSION

Requester respectfully requests that the PTO grant this Request and return a first Office Action rejecting all Challenged Claims in accordance with the proposed rejections listed in Part II.C, above, with special dispatch.

Dated: August 8, 2025

Respectfully submitted,

/ Dustin M. Knight /

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CERTIFICATE OF SERVICE

I hereby certify, pursuant to 37 C.F.R. § 1.510(b)(5), that on August 8, 2025, I caused a true and correct copy of the foregoing **REQUEST FOR *EX PARTE* REEXAMINATION OF U.S. PATENT NO. 10,330,582 B2** to be served via First Class U.S. Mail on:

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