

1 The opinion in support of the decision being entered today
2 was *not* written for publication and
3 is *not* binding precedent of the Board.
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7 UNITED STATES PATENT AND TRADEMARK OFFICE
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10 BEFORE THE BOARD OF PATENT APPEALS
11 AND INTERFERENCES
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14 *Ex parte* ALAIN P. KING and MAHAN MOVASSAGHI
15
16

17 Appeal No. 2007-0490
18 Application No. 10/095,716
19 Technology Center 3600
20
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22 Decided: March 21, 2007
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25 Before JENNIFER D. BAHR, STUART S. LEVY, and ROBERT E. NAPPI,
26 *Administrative Patent Judges.*

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28 NAPPI, *Administrative Patent Judge.*
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31 DECISION ON APPEAL
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33 This is a decision on appeal under 35 U.S.C. § 134 of the final
34 rejection of claims 1 through 16. For the reasons stated *infra* we affirm the
35 Examiner's rejection of these claims.
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INVENTION

The invention is directed to a design for an optical amplifier. The amplifier of the present invention utilizes Raman and Erbium amplification in a single module using a common optical pumping device. See pages 1 and 2 of Appellants' Specification. Claims 1 and 5 are representative of the invention and reproduced below:

1. An optical amplifier arranged to amplify an optical signal, comprising
a first optical fiber segment arranged to provide Raman amplification having a first gain slope,
a second optical fiber segment connected to said first segment and arranged to provide erbium amplification having a second gain slope, said second gain slope being substantially opposite of said first gain slope,
means for applying said optical signal to said first and second segments, and
a single pump means arranged to supplying optical pump energy to both of said segments, such that said first gain slope and said second gain slope combine to produce a desired gain profile for said optical amplifier.

5. An optical amplifier, comprising
an optical fiber that supports Raman amplification, and
a pump laser for supplying pump energy to said optical fiber,
CHARACTERIZED IN THAT said optical fiber is doped with erbium such that erbium amplification is provided in response to said pump laser, and such that a gain slope of said Raman amplification and a gain slope of said erbium amplification combine to produce a desired gain profile for said optical amplifier.

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ISSUES DIRECTED TO § 102 REJECTION OVER MASUDA

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Appellants contend that the Examiner's rejection based upon Masuda under 35 U.S.C. § 102(b) is in error. Specifically, Appellants argue that Masuda a) discloses using multiple optical pumps and as such does not teach using one pump as claimed and b) is silent as to arranging the gain amplifier section to provide a desired output. Appellants' statements on pages 10 through 12 of the Brief apply the same arguments to claims 1, through 4, 8, 9, and 13.

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The Examiner contends that the rejection is proper. The Examiner states the claim "does not exclude the use of additional pumps." (Answer 7-8). The Examiner finds that in Masuda, figure 1, type 4, discloses a single pump to pump both fiber segments. Further, the Examiner finds that Masuda discloses that the gains of the Raman amplification and erbium amplification are purposefully combined to provide a desired flat gain profile.

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Appellants rebut the Examiner's statement on page 2 of the Brief, asserting that the claim limitation of a "single pump" means "one pump" whereas Masuda teaches using three pumps in the type 4-configuration. Further, the Appellants argue that the claim recites that the desired gain curve is for a one pump configuration, not the combined gain curve from multi-pump, multi-amplifier device such as Masuda's device.

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Thus, the contentions present us with the issue of whether the scope of the claims is limited to an amplifier which makes use of only one pump and

1 whether the “desired gain profile” is similarly limited to an amplifier with
2 only one pump.

3 FINDINGS OF FACT RELATING TO MASUDA

4 Masuda is an article discussing many types of Hybrid amplifiers
5 which make use of both Raman and Erbium amplification. In figure 1,
6 Masuda describes several amplifier arrangements. The type 3 and type 4
7 amplifier configurations contain both amplification in one discrete amplifier.
8 In figure 1 the pump light source is denoted as a box with the letter “P.” The
9 text notes that components such as Erbium Doped Fiber (EDF) pumping
10 devices are not depicted. In the configuration for the type 3 amplifier there
11 is one pump depicted and two EDFs; for the type 4 amplifier there are two
12 pumps depicted and one EDF. The depicted pumps inject light energy
13 opposite signal propagation, i.e., in figure 1 the signal propagates left to
14 right and the pumping energy is injected right to left. As the pumping
15 energy flows from right to left it is necessarily transmitted to each fiber
16 segment to the left of the depicted pump. Thus, we find in the type 3
17 amplifier the single depicted pump injects light to the Raman Fiber segment
18 and one of the EDFs, i.e., one pump supplies energy to two segments. In the
19 type 4 amplifier, we find that the right most of the two depicted pumps
20 injects light to two Raman Fiber segments and the EDF; the other depicted
21 pump injects light into one of the Raman Fiber segments and the EDF. As
22 such we find that both the type 3 and type 4 amplifiers contain light sources
23 which pump both a Raman Fiber segment and an EDF.

24 Masuda also discusses, in paragraph 3, that the gain characteristics of
25 the hybrid amplifier are desirable to provide a wide bandwidth. In figures 2

1 and 3, plot (b) depicts the gain characteristics of the type 4 amplifier. These
2 figures show the EDF filter has a negative tilt gain profile and when
3 combined with a Raman amplifier, the combined amplifier provides a flat
4 gain profile over a wide 80.0 nm bandwidth.

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6 ANALYSIS RELATING TO § 102 REJECTION OVER MASUDA

7 Initially we note that Appellants' arguments group claims 1 through 4,
8 8, 9, and 13 together. In accordance with 37 C.F.R. § 41.37(c)(1)(vii) we
9 select claim 4 as representative of the group. Appellants' claim 4 recites a
10 step "applying at least a portion of the output of at least one pump laser to
11 both the erbium doped fiber and the Raman amplifier, such that a gain slope
12 of said Raman amplifier and gain slope of said erbium doped fiber combine
13 to produce a desired gain profile." Thus, claim 4 clearly recites that one
14 pump laser provides light to two fibers (the Raman amplifier is a fiber
15 segment). However, we do not find that the limitation "a portion of the
16 output of at least one pump laser" limits the scope of the claim to a
17 configuration where only one pump laser is used to provide pumping power
18 to the fiber segments. Similarly, we do not find that the scope of the claim is
19 limited to the desired gain being produced by the output of just one pumping
20 laser. Accordingly, we find that claim 4 is limited to a device where one
21 pumping laser is used to provide power to two amplifier segments, but do
22 not find that it precludes use of additional pumping power sources.

23 Thus, we find for the Examiner as we find that claim 4 is not limited
24 to an amplifier which uses only one pump. Further, we find ample evidence
25 to support the Examiner's determination that Masuda teaches one pump

1 supplies light to both a Raman amplifier and Erbium fiber. Accordingly, we
2 sustain the Examiner's rejection of claims 1 through 4, 8, 9, and 13

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4 ISSUES RELATED TO REJECTION OF CLAIMS 10, 11, 14, and 15
5 UNDER 35 U.S.C. § 103

6 Appellants contend that the Examiner's rejection of claims 10, 11, 14,
7 and 15 as being unpatentable over Masuda is in error. Appellants assert that
8 the rejection is erroneous for the same reasons asserted with respect to the
9 Examiner's rejection of claims 1 through 4, 8, 9, and 13 under 35 U.S.C. §
10 102.

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12 ANALYSIS RELATED TO REJECTION OF CLAIMS 10, 11, 14,
13 AND 15 UNDER 35 U.S.C. § 103

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15 Claims 10, 11, 14, and 15 are argued as a group. Accordingly we
16 group the claims and select claim 14 as a representative claim. Claim 14 is
17 dependent upon claim 4. As discussed *supra* we are not persuaded by
18 Appellants' arguments directed to the rejection of claim 4. We find that the
19 scope of claim 4 is not limited to an amplifier which uses only one pump.
20 Claim 14 does not further limit claim 4 to a configuration where only one
21 pump laser is used to provide pumping power to the fiber segments. As
22 discussed *supra*, we find ample evidence to support the Examiner's finding
23 that Masuda teaches one pump supplies light to both a Raman amplifier and
24 Erbium fiber. Thus, for the same reasons discussed *supra* with respect to the
25 Examiner's rejection of claims 1 through 4, 8, 9, and 13 under 35 U.S.C. §

1 102, we are not persuaded of error in the Examiner's rejection of claims 10,
2 11, 14, and 15 under 35 U.S.C. § 103.

3 ISSUES RELATED TO REJECTION OF CLAIMS 12 AND 16
4 UNDER 35 U.S.C. § 103

5 Appellants contend that the Examiner's rejection of claims 12 and 16
6 over Masuda and Becker is in error. Appellants argues that the combined
7 teachings of the Masuda and Becker "do not indicate changing or selecting
8 pump power in order to adjust gain slope of the EDFA in order to
9 compensate for signal slope accumulated in the transmission fiber."
10 (Br. 18).

11 The Examiner contends that the rejection of claims 12 and 16 is
12 proper. The Examiner states "it is well known in the art, the power
13 conversion efficiency is the pump to signal energy conversion via population
14 inversion, that is the population density of the inverted level as is clearly
15 disclosed by fig. 8.32." (Answer 13).

16 Thus, the issue before us is whether the combination of the references
17 teaches adjusting the pump power to adjust the gain of the fiber amplifier.

18 FINDINGS OF FACT RELATED TO BECKER

19 We find that Becker teaches on page 281, that the efficiency of
20 pumping power in erbium fiber is a function of length of the fiber and
21 pumping power. Figure 8.25 shows two plots of power conversion
22 efficiency (power conversion is proportional to gain) versus length of fiber.
23 Becker teaches that if the fiber is too short, there are insufficient erbium ions
24 to absorb the pumping power. Becker shows that pumping power also

1 affects power conversion efficiency, as Becker teaches that different
2 pumping powers produce different efficiencies for the same length of fiber.

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4 ANALYSIS RELATED TO REJECTION OF CLAIMS 12 AND 16
5 UNDER 35 U.S.C. § 103

6 Appellants' arguments group claims 12 and 16 together. Accordingly
7 we group the claims together and select claim 16 as a representative claim.
8 Claim 16 is dependent upon claim 14 and as such also dependent upon claim
9 4. In combination, claim 16 recites that the desired gain profile is adjusted
10 by varying the power of the pump means. As discussed *supra*, we find that
11 Masuda teaches that the EDF amplification has a negative tilt. Further, we
12 find that Becker teaches that the efficiency and gain of an EDF amplifier is
13 dependent upon pumping power. We consider that one skilled in the art
14 building Masuda's device, would recognize the relationship between
15 pumping power and gain and that the gain is adjusted by varying the
16 pumping power. Accordingly, we find ample evidence to support the
17 Examiner's rejection of claims 12 and 16 under 35 U.S.C. § 103.

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19 ISSUES DIRECTED TO § 102 REJECTION OVER WEN

20 Appellants contend that the Examiner's rejection of claims 5 through
21 8 under 35 U.S.C. § 102(b) as anticipated by Wen, is in error. Appellants
22 assert that Wen teaches "the characteristics of gain and signal to noise ratio
23 of an erbium doped fiber (EDFA) and the effects of stimulated Raman
24 scattering (SRS) on the characteristics of the EDFA." (Br. 13). However,
25 Appellants argue (Br. 15):

1 show the pump power being depleted more across the length of the fiber
2 when Raman amplification is used as the pump power is being used to
3 produce Raman amplification. In the second (right) column of text, Wen
4 discloses that combining Raman amplification with erbium amplification
5 produces greater gain than if Erbium amplification were used alone.

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7 ANALYSIS DIRECTED TO § 102 REJECTION OVER WEN

8 Appellants argue claims 5 through 8 as a group. Accordingly we
9 group the claims together and select claim 8 as a representative claim.¹

10 Claim 8 recites:

11 A method for amplifying an optical signal, comprising the step of
12 simultaneous providing Raman and erbium amplification to an optical
13 signal using a common source of pump energy, such that a gain slope
14 of said Raman amplification and a gain slope of said erbium
15 amplification combine to produce a desired gain profile for said
16 optical amplifier.

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18 Claim 8 recites no limitation concerning the erbium doping within a fiber or
19 the control of the different amplification methods. Further, the only
20 limitation within claim 8 which limits the desired gain profile recites that it
21 is produced by the combination of Raman amplification and erbium
22 amplification. As discussed *supra* we find that Wen teaches that a signal can
23 be amplified by an amplifier which uses both Erbium amplification and
24 Raman amplification. Wen teaches that a single pump source can be used to
25 produce both amplification methods and that the gains from the two

¹ Appellants' statements on page 15 of the Brief directed to claims 6-8 does not constitute a separate argument see 37 C.F.R. § 41.37(c)(1)(vii) (2006).

1 amplification methods combine to produce a greater gain. Thus, we find
2 ample evidence of record to support the Examiner's rejection of claim 8 and
3 the claims grouped with claim 8, claims 5 through 7.

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CONCLUSION

6 Appellants have not demonstrated error in the Examiner's rejections
7 of claims 1 through 9 and 13 under 35 U.S.C. § 102(b) and the Examiner's
8 rejections of claims 10 through 12, and 14 through 16 under 35 U.S.C. §
9 103(a). Accordingly, we sustain these rejections. The decision of the
10 Examiner is affirmed.

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AFFIRMED

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16 PATTERSON & SHERIDAN, LLP/
17 LUCENT TECHNOLOGIES, INC
18 595 SHREWSBURY AVENUE
19 SHREWSBURY, NJ 07702

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