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(71) Applicant(s)
Samsung Electronics Co Limited

(Incorporated in the Republic of Korea)

416 Maetan-dong, Paldal-gu, Suwon-City, Kyungki-do, Republic of Korea

(72) Inventor(s)
Yeong-Ju Kim

(74) Agent and/or Address for Service
Dibb Lupton Alsop
Fountain Precinct, Balm Green, SHEFFIELD, S1 1RZ, United Kingdom

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UK CL (Edition O) **G2J JB7Q JGEB J9D , H1C CEX**
INT CL[6] **G02B , H01S 3/06**
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(54) **Backward light blocking apparatus for an optical amplifier**

(57) A backward light blocking apparatus has transmitted light detecting optical fibres 18,38 arranged at the input and output stages, between which is a backward light blocking device 24-32. The first detecting fibre 18 detects the input signal 12 by receiving the input signal reflected back 22 from within the apparatus. The second detecting fibre 38 detects the output signal 44 by receiving output light reflected 34 from the output fibre 42 and again from within the apparatus. The backward light blocking device 24-32 may comprise two collimating lenses 24,32, two polarisers 26,30 and a polarized-light rotator 28.

Also provided is an optical amplifier (figure 3) having two backward light blocking devices 10. The first detection signal 46 from the first device 10 and a second detection signal 54 indicative of the level of signal between the two devices 10 are transmitted to a control circuit 58 which controls an excited light source 50. An amplifying optical fibre 52 amplifies the output signal from a wavelength-dividing coupler 48.

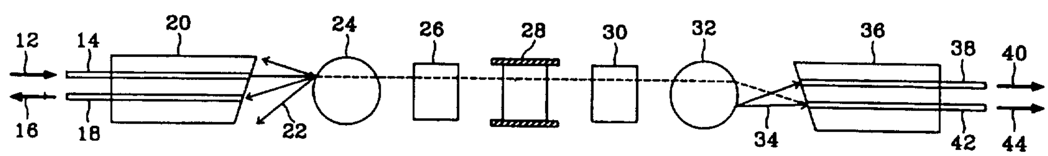

FIG. 2

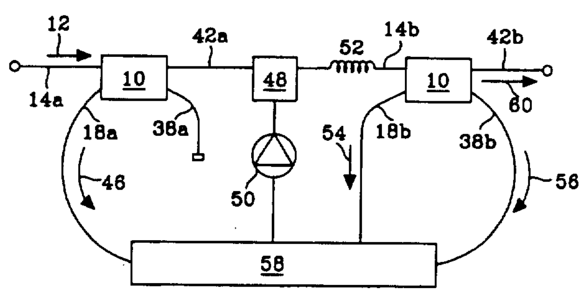

FIG. 3

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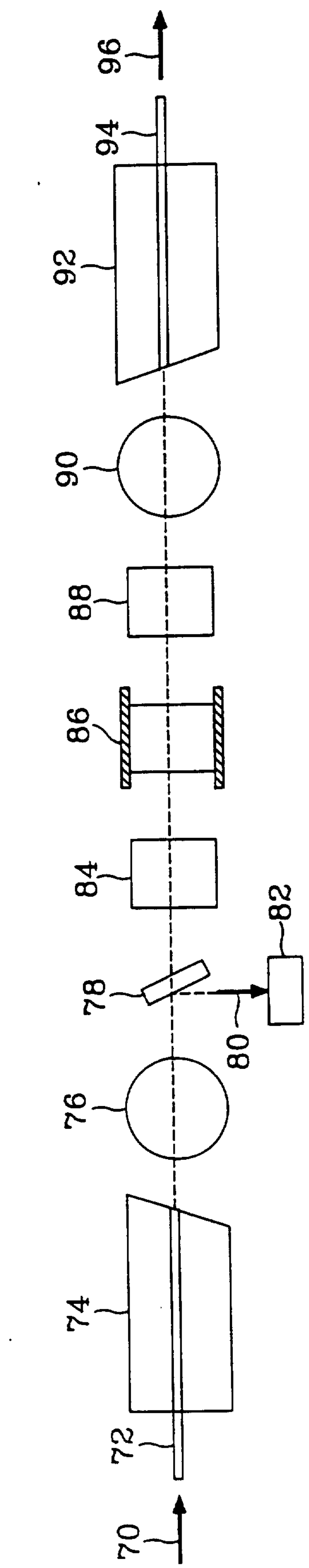
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72
74
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94
96

FIG. 1

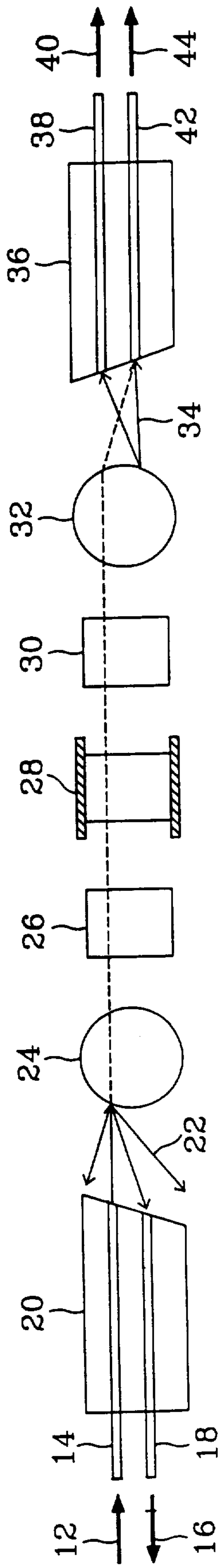
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44

FIG. 2

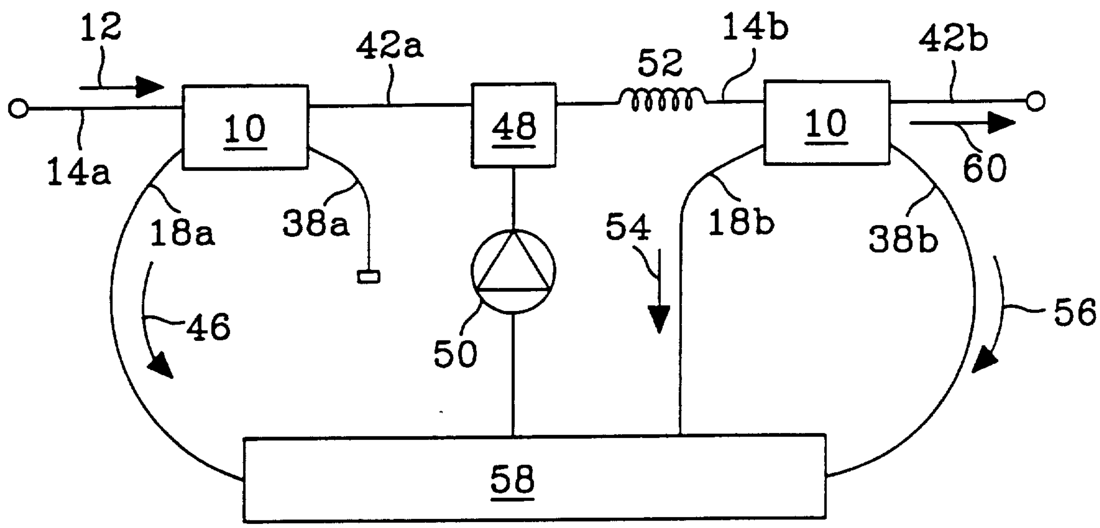
12
42a
52
14b
42b
10
48
10
60
14a
18a
38a
54
18b
38b
46
50
56
58

FIG. 3

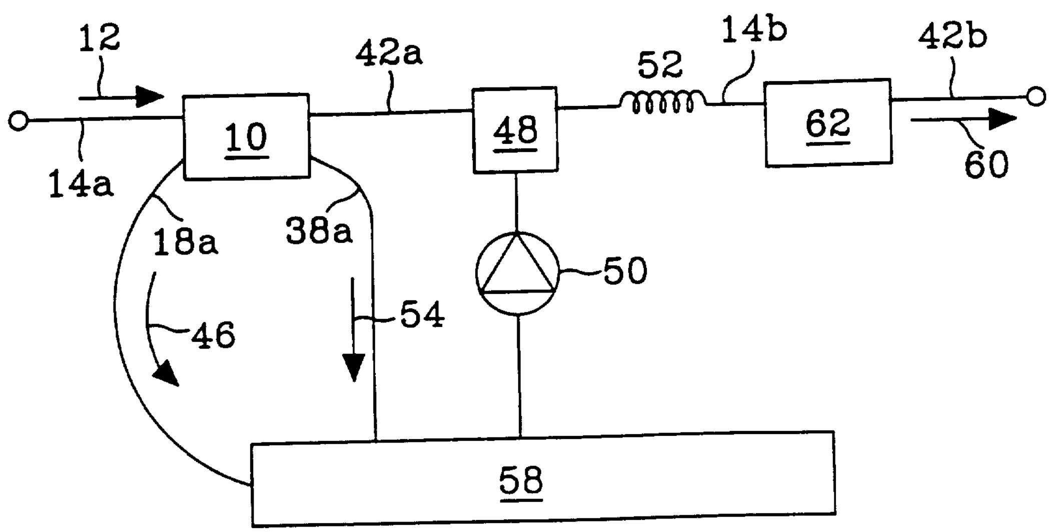
12
42a
52
14b
42b
10
48
62
60
14a
18a
38a
50
54
46
58

FIG. 4

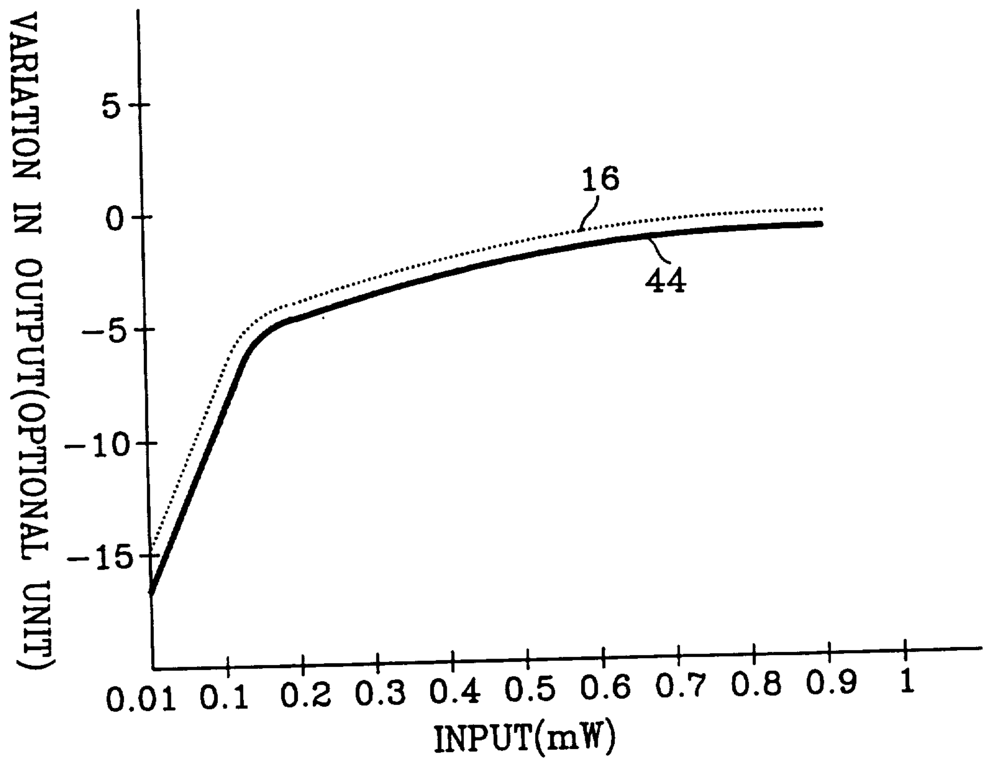
VARIATION IN OUTPUT(OPTIONAL UNIT)
5
0
−5
−10
−15
16
44
0.01
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
INPUT(mW)

FIG. 5

BACKWARD LIGHT BLOCKING APPARATUS AND METHOD OF DETECTING TRANSMITTED LIGHT

Background to the Invention

The present invention relates to an apparatus for blocking backward light, and more particularly to a backward light blocking apparatus having transmitted light detecting stages. The present invention also relates to a method of detecting transmitted light using such an apparatus.

Referring to FIG. 1, a conventional backward light blocking apparatus is illustrated which includes a monitoring photo-diode. As shown in FIG. 1, the backward light blocking apparatus includes an input optical fibre 72 for transmitting an input optical signal 70 to the device and a first ferrule 74 for supporting the input optical fibre 72. A first lens 76 is arranged downstream from the first ferrule 74 to collimate the input optical signal 70. Downstream from the first lens 76, an optical divider 78 is arranged which serves to reflect 1% of the input optical signal 70 to allow the level of the input optical signal 70 to be detected. A detecting member 82 is disposed beneath the optical divider 78 to detect detection light 80 reflected from the optical divider 78.

The optical divider 78 is a 99:1 optical divider which is provided with a particular coating to transmit a large portion (about 99%) of the input optical signal 70 while reflecting a small portion (about 1%) of the input optical signal 70.

Downstream from the optical divider 78, a first polarizer (birefringent lens) 84 is arranged which splits the input optical signal 70 transmitting the optical divider 78 into vertically and horizontally-polarized light beams. A polarized-light rotator (Faraday rotator) 86 is disposed downstream from the first polarizer 84 to rotate the planes of polarization of the input optical signal 70 split by the first polarizer 84. A second polarizer (birefringent lens) 88 is arranged downstream from the polarized-beam rotator 86 to concentrate the split beams of the input optical signal 70 rotated by the polarized-beam rotator 86.

A second lens 90 is also arranged downstream from the second polarizer 88 to collimate the input optical signal 70 emerging from the second polarizer 88 into an output optical fibre 94. The output optical fibre 94 is disposed downstream from the second lens 90 to receive the input optical signal 70 from the second lens 90, thereby outputting output optical signal 96. A second ferrule 92 is disposed around the output optical fibre 94 to firmly support the output optical fibre 94.

The operation of the conventional backward light blocking apparatus having the above-mentioned arrangement will now be described. An input optical signal 70, which is emitted from a light emitting element in an excited state, is first transmitted to the first lens 76 via the input optical fibre 72. During this transmission, the input optical signal 70 is partially converted into multiply-reflected light between the first ferrule 74 and the first lens 76.

Thereafter, the input optical signal 70 is collimated by the first lens 76 so that it is transmitted to the optical divider 78. The optical divider 78 transmits 99% of the input optical signal 70 which is, in turn, sent to the first polarizer 84. 1% of the input signal ling 70 is reflected as detection light 80 toward the detecting member 82 by the optical divider 78 so that it is used to detect the level of the input optical signal 70.

The detecting member 82 detects the detection light 80, thereby detecting variations in the level of the input optical signal 70. At the same time, the input optical signal 70 incident on the first polarizer 84 passes through the upper portion of the first polarizer 84. As a result, the input optical signal 70 is split into vertically and horizontally-polarized light beams.

The split light beams of the input optical signal 70 emerging from the first polarizer 84 then pass through the polarized-beam rotator 86 which, in turn, rotates the planes of polarization of the light beams.

The rotated light beams of the input optical signal 70 then pass through the second polarizer 88 which, in turn, concentrates the split beams. The second polarizer 88 then sends the resultant light to the output optical fibre 94 via the second lens 90. The output optical fibre 94 modulates the input optical signal 70 into an output optical signal 96 which is then output.

Since the above-mentioned backward light blocking apparatus uses the optical divider 87 and the detecting member 82 to detect transmitted light in accordance with the above-mentioned method, it requires an increase in the number of manufacturing steps necessary for the manufacture of the apparatus. Moreover, costs further increase because the optical divider 78 uses a particularly coated element.

For the detection of transmitted light, the optical divider 78 transmits a large portion (99%) of the input optical signal 70 while reflecting a portion (1%) of the input optical signal 70 toward the detecting member 82. As a result, a portion of the input optical signal 70 is unnecessarily consumed. Furthermore, the manufacturing process of the optical divider 78 is carried out separately from the process of manufacturing the backward light blocking apparatus. This results in an increase in manufacturing time and difficulties in manufacture. In addition, the backward light blocking apparatus becomes bulky, thereby degrading the appearance.

An objective of the invention is to address these problems and in particular to provide a more easily manufactured alternative.

Summary of the Invention

Accordingly, the present invention provides a backward light blocking apparatus comprising:

an input optical fibre adapted to transmit an input optical signal into the apparatus;

a first detecting optical fibre adapted to detect the input optical signal by receiving input signal light reflected from within the apparatus;

an output optical fibre adapted to transmit an output optical signal from the apparatus;

a backward light blocking device adapted to pass light from the input optical fibre to the output optical fibre, but not vice versa; and

a second detecting optical fibre adapted to detect the output optical signal by receiving output light reflected from the output optical fibre and reflected again from within the apparatus.

Preferably, the first detecting optical fibre is adapted to receive multiply-reflected light from within the apparatus.

The backward light blocking device may comprise:

a first lens adapted to collimate the input light emerging from the input optical fibre;

a first polarizer adapted to split the collimated input light into orthogonal plane polarized components;

a polarized-light rotator for rotating through a predetermined angle the planes of polarization of the orthogonal components;

a second polarizer adapted to recombine the rotated orthogonal components; and

a second lens adapted to collimate the recombined light emerging from the second polarizer into the output optical fibre.

Preferably, the apparatus further comprising:

a first ferrule adapted to support both the input optical fibre and the first detecting optical fibre; and

a second ferrule adapted to support both the output optical fibre and the second detecting optical fibre.

The first and second detecting optical fibres are preferably respectively arranged at input and output stages of the apparatus.

The present invention also extends to a method of detecting transmitted light using a backward light blocking apparatus according to any preceding claim, comprising:

detecting the input optical signal by detecting the quantity of input light reflected from within the apparatus into the first detecting optical fibre; and

detecting the output optical signal by detecting the quantity of output light reflected from the output optical fibre and reflected again from within the apparatus into the second detecting optical fibre.

The present invention also extends to an optical amplifier comprising:

an input optical fibre adapted to transmit an input optical signal into the optical amplifier;

a first detecting optical fibre adapted to transmit a first detection signal indicative of the level of the input optical signal;

a first backward light blocking device adapted to pass light from the input optical fibre to a first output optical fibre, but not vice versa;

an excited light source adapted to amplify the input optical signal;

a wavelength-dividing coupler adapted to divide the wavelength of the optical signal emitted from the excited light source along with the wavelength of the signal from the first optical fibre and to modulate the wavelength-divided signal;

an amplifying optical fibre adapted to amplify the output signal from the wavelength-dividing coupler;

a second backward light blocking device adapted to pass light from the amplifying optical fibre to a second output optical fibre, but not vice versa;

a second detecting optical fibre adapted to transmit a second detection signal indicative of the level of the optical signal between the backward light blocking device and the second backward light blocking device; and

a control circuit adapted to detect the first and second detection signals and to control the excited light source accordingly.

The second detecting optical fibre may be adapted to transmit a second detection signal indicative of the level of the optical signal input to the first output optical fibre and the second backward light blocking device may be comprised in an optical system.

Preferably, the optical amplifier further comprises a third detecting optical fibre adapted to transmit a third detection signal indicative of the level of the optical signal input to the second output optical fibre;

the second detecting optical fibre is adapted to transmit a signal indicative of the level of the amplified optical signal input to the second backward light blocking device; and

the control circuit is adapted to detect the first, second and third detection signals and to control the excited light source accordingly.

The first detection signal may be coupled between the first backward light blocking device and the control circuit and the second and third detection signals may be coupled between the second backward light blocking unit and the control circuit.

The control circuit may drive the excited light source by electrical control.

Brief Description of the Drawings

The present invention will now be described by way of example with reference to the accompanying drawings in which:

FIG. 1 is a schematic view of a conventional backward light blocking apparatus which includes a monitoring photo-diode;

FIG. 2 is a schematic view illustrating a backward light blocking apparatus according to one embodiment of the present invention;

FIGS. 3 and 4 are circuit diagrams respectively illustrating optical amplifiers in which the backward light blocking apparatus of the present invention is incorporated; and

FIG. 5 is a graph depicting the variation in the detection signal, which is reflected by a lens and then output at a detection stage, depending on the magnitude of input light in the backward light blocking apparatus of the present invention.

Detailed Description of the Preferred Embodiments

Referring to FIG. 2, a backward light blocking apparatus according to one embodiment of the present invention is illustrated. As shown in FIG. 2, the backward light blocking apparatus of the present invention includes an input optical fibre 14 adapted to transmit an input optical signal 12 to an output stage and a first detecting optical fibre 18 arranged beneath the input optical fibre 14 and adapted to receive multiply-reflected light 22 from the interior of the backward light blocking apparatus, to allow detection of input-stage detection light 16. The first detecting optical fibre 18 detects the multiply-reflected light 22 which is reflected between the input optical fibre 14 and a first lens 24, thereby detecting the level of the input optical signal 12 at the input stage.

A first ferrule 20 is arranged around the input optical fibre 14 and first detecting optical fibre 18 to firmly support the input optical fibre 14 and first detecting optical fibre 18. A first lens 24 is arranged downstream from the first ferrule 20 while being spaced from the input optical fibre 14 by its focal distance to collimate the input optical signal 12. Downstream from the first lens

24, a first polarizer (birefringent lens) 28 is arranged which splits the collimated input optical signal 12 into vertically and horizontally-polarized light beams. A polarized-light rotator (Faraday rotator) 28 is disposed downstream from the first polarizer 26 to rotate the plane of polarization of the beams of the input optical signal 12 split by the first polarizer 26. A second polarizer (birefringent lens) 30 is arranged downstream from the polarized-beam rotator 28 to concentrate the split beams of the input optical signal 12 phase-shifted by the polarized-beam rotator 28. A second lens 32 is arranged downstream from the second polarizer 30 to collimate the input optical signal 12 emerging from the second polarizer 30 into an output optical fibre 42.

The output optical fibre 42 is disposed downstream from the second lens 32 to modulate the input optical signal 12 emerging from the second lens 32 into an output optical signal 44. A second detecting optical fibre 38 is disposed above the output optical fibre 42 to detect backward light produced by the output optical signal 44 reflected back from the output optical fibre 42 and re-introduced into the apparatus, thereby detecting detection light 40 at the output stage. In this case, the second detecting optical fibre 38 detects a portion of the backward light reflected back from the output stage and introduced again in the second detecting optical fibre 38, namely, light 34 reflected between the output optical fibre 42 and the second lens 32, thus detecting the level of light reflected to the output stage and then fed to the backward light blocking apparatus.

A second ferrule 36 is disposed around both the output optical fibre 42 and second detecting optical fibre 38 to firmly support them. Thus, the first and second detecting optical fibres 18 and 38 are arranged at the input and output stages, respectively.

The operation of the backward light blocking apparatus having the above-mentioned arrangement according to the present invention will now be described. An input optical signal 12, which is emitted from a light emitting element in an excited state, is first transmitted to the first lens 24 via the input optical fibre 14. During this transmission, the input optical signal 12 is partially converted into multiply-reflected light 22 between the first ferrule 20 and the first lens 24.

Thereafter, the multiply-reflected light 22 is introduced into the first detecting optical fibre 18 which, in turn, detects the multiply-reflected light as detection light 16 at the input stage, thereby detecting the level of the input optical signal 12 at the input stage. At the same time, the input optical signal 12 is collimated by the first lens 24 so that it is transmitted to the first polarizer 26.

The input optical signal 12 incident on the first polarizer 26 then passes through the upper portion of the first polarizer 26. As a result, the input optical signal 12 is split into vertically and horizontally-polarized light beams. The split light beams of the input optical signal 12 emerging from the first polarizer 26 then pass through the polarized-beam rotator 28 which, in turn, rotates their planes of polarization.

The rotated light beams of the input optical signal 12 then pass through the second polarizer 30 which, in turn, concentrate the split beams. The second polarizer 30 then sends the resultant light to the output optical fibre 42 via the second lens 32. The output optical fibre 42 modulates the input optical signal 12 into an output optical signal 44 which is then output.

Subsequently, the output optical signal 44 may be reflected back by a medium and then re-introduced into the backward light blocking apparatus 10 via the output optical fibre 42. The re-introduced backward light is then partially converted into reflected light 34 between the second lens 32 and output optical fibre 42. Thereafter, the reflected light 34 enters the second detecting optical fibre 38, so that it is detected as detection light 40 at the output stage. Thus, the level of light fed to the backward light blocking apparatus is detected.

FIG. 5 is a graph which depicts the variation in the detection light, which is reflected by a lens and then output at the detection stage, depending on the magnitude of input light in the backward light blocking apparatus of the present invention.

FIG. 3 is a schematic view illustrating an optical amplifier in which the backward light blocking apparatus of the present invention is incorporated. As shown in FIG. 3, the optical amplifier includes an input-stage backward light blocking unit 10a coupled to an input stage of the optical amplifier and an output-stage backward light blocking unit 10b coupled to an output stage of the optical amplifier. The optical amplifier also includes a first input optical fibre 14a adapted to receive input optical signal 12 from the input stage and to transmit the input optical signal 12 toward the output stage via the input-stage backward light blocking unit 10a, and a first detecting optical fibre 18a adapted to transmit a signal indicative of the level of the input optical signal 12 output from the input-stage backward light blocking unit 10a as a first detection-stage output 46 to a control circuit 58.

The optical amplifier further includes a first output optical fibre 42a adapted to transmit the input optical signal 12 output from the input-stage backward light blocking unit 10a to a wavelength-dividing coupler 48, and a third detecting optical fibre 38a adapted to transmit optical signal reflected again from the first output optical fibre 42a toward the input-stage backward light blocking apparatus 10a in an amplified state toward the control circuit 58. The first detecting optical fibre 18a is connected to the control circuit 58 whereas the third detecting optical fibre 38 is not connected to the control circuit 58.

The optical amplifier includes an excited light source 50 for amplifying the input optical signal 12 when the input optical signal 12 is weak. The optical amplifier also includes the wavelength-dividing coupler 48 which divides the wavelength of an optical signal emitted from the excited light source 50 along with the wavelength of the input optical signal 12 and modulates the wavelength-divided signal. An amplifying optical fibre 52 is coupled to the wavelength-dividing coupler 48 to amplify an output signal from the wavelength-dividing coupler 48.

The optical amplifier further includes a second input optical fibre 14b adapted to transmit the amplified optical signal from the amplifying optical fibre 52 to the output-stage backward light blocking apparatus 10b, a second detecting optical fibre 18b adapted to transmit a signal indicative of the gain level of the amplified optical fibre as the second detection-stage output 54 to the control unit 58. The optical amplifier also includes a second output optical fibre 42b adapted to transmit the amplified output light 60 to the output stage of the optical amplifier, and a fourth detecting optical fibre 38b adapted to transmit a signal indicative of the level of optical signal reflected again from the second output optical fibre 42b toward the output-stage backward light blocking apparatus 10b as a third detection-stage output 56 to the control circuit 58. Both the second detecting optical fibre 18b and fourth detecting optical fibre 38b are connected to the control circuit 58.

The control circuit 58 serves to detect the first, second and third detection-stage outputs 46, 54 and 56, thereby detecting a variation in gains of those outputs and a variation in the level of the optical signal. When such a variation occurs, the control circuit 58 electrically controls the excited light source 50.

The operation of the optical amplifier as above will now be described. An input optical signal 12 is first transmitted to the input-stage backward light blocking unit 10a via the first input optical fibre 14a. The input-stage backward light blocking unit 10a sends a signal indicative of the level of the input optical signal 12 as a first detection-stage output 46 to the control circuit 58 via the first detecting optical fibre 18a. When the input optical signal 12 is weak, the control circuit 58 drives the excited light source 50 which, in turn, generates an optical signal. The optical signal from the excited light source 50 is transmitted to the wavelength-dividing modulator 48.

The input optical signal 12, which passes through the input-stage backward light blocking unit 10a, is modulated in the wavelength-dividing modulator 48 along with the optical signal output from the excited light source 50. The resultant light is fed to the amplifying optical fibre 52.

The optical signal is amplified while passing through the amplifying optical fibre 52. Thereafter, the amplified optical signal passes through the output-stage backward light blocking unit 10b connected to the output stage. The output-stage backward light blocking unit 10b then outputs the optical signal as amplified output light 60 via the second output optical fibre 42b.

At this time, the level of the amplified optical signal is transmitted as a second detection-stage output 54 to the control circuit 58 via the second detecting optical fibre 18b. The control circuit 58 also receives, as a third detection-stage output 56, a signal indicative of the level of reflected light introduced again in the output-stage backward light blocking unit 10b via the second output optical fibre 42b. When the control circuit 58 receives the third detection-stage output 56, it drives the excited light source 50 which, in turn, sends an optical signal to the wavelength-dividing modulator 48.

FIG. 4 is a schematic view illustrating another optical amplifier in which the backward light blocking apparatus of the present invention is incorporated. In FIG. 4, elements respectively corresponding to those in FIG. 3 are denoted by the same reference numerals. As shown in FIG. 4, the optical amplifier includes a backward light blocking unit 10 coupled to an input stage of the optical amplifier. The optical amplifier also includes a first input optical fibre 14a adapted to receive input optical signal 12 from the input stage of the optical amplifier and to transmit the input optical signal 12 toward the output stage of the optical amplifier via the backward light blocking unit 10, and a first detecting optical fibre 18a adapted to transmit a signal indicative of the level of the input optical signal 12 as a first detection-stage output 46 to a control circuit 58.

The optical amplifier also includes a first output optical fibre 42a adapted to transmit the input optical signal 12 to a wavelength-dividing coupler 48, and a second detecting optical fibre 38a adapted to transmit optical signal reflected again from the first output optical fibre 42a toward the backward light blocking unit 10 in an amplified state as a second detection-stage output 54 to the control circuit 58. Both the first and second detecting optical fibres 18a and 38a are connected to the control circuit 58.

The optical amplifier further includes an excited light source 50 for amplifying the input optical signal 12 when the input optical signal 12 is weak. The wavelength-dividing coupler 48 is also included in the optical amplifier. The wavelength-dividing coupler 48 divides the wavelength of an optical signal emitted from the excited light source 50 along with the wavelength of the input optical signal 12 and modulates the wavelength-divided signal. An amplifying optical fibre 52 is coupled to the wavelength-dividing coupler 48 to amplify an output signal from the wavelength-dividing coupler 48.

The optical amplifier further includes an optical system 62, a second input optical fibre 14b adapted to transmit the amplified optical signal from the amplifying optical fibre 52 to the optical system 62, and a second output optical fibre 42b adapted to transmit the amplified output light denoted by the reference numeral "60" to the output stage of the optical amplifier.

The control circuit 58 serves to detect the first and second detection-stage outputs 46 and 54, thereby detecting variations in the gains of the outputs and variations in the levels of the optical signals. When a variation occurs, the control circuit 58 electrically controls the excited light source 50.

The operation of the optical amplifier having the above-mentioned arrangement will now be described. An input optical signal 12 is introduced in the input optical fibre 14a which, in turn, sends the input optical signal 12 to the backward light blocking unit 10. The backward light blocking unit 10 sends a signal indicative of the level of the input optical signal 12 as a first detection-stage output 46 to the control circuit 58 via the first detecting optical fibre 18a. When the input optical signal 12 is weak, the control circuit 58 drives the excited light source 50 which, in turn, generates an optical signal. The optical signal from the excited light source 50 is transmitted to the wavelength-dividing modulator 48.

The input optical signal 12, which passes through the input-stage backward light blocking unit 10, is modulated in the wavelength-dividing modulator 48 along with the optical signal output from the excited light source 50. The resultant light is fed to the amplifying optical fibre 52.

The optical signal is amplified while passing through the amplifying optical fibre 52. Thereafter, the amplified optical signal passes through the optical system 62 connected to the output stage. The optical system 62 then outputs the optical signal as amplified output light 60 via the second output optical fibre 42b.

At this time, the level of the amplified optical signal is transmitted as a second detection-stage output 54 to the control circuit 58 via the second detecting optical fibre 38a. When the control circuit 58 receives the second detection-stage output 54, it drives the excited light source 50 which, in turn, sends an optical signal to the wavelength-dividing modulator 48.

As apparent from the above description, the backward light blocking apparatus of the present invention can have twice as many detection stages as compared with the conventional backward light blocking apparatus at the same manufacturing costs. In this regard, the backward light blocking apparatus of the present invention is highly competitive. In particular, the backward light blocking apparatus of the present invention has no light distributer, thus reducing the number of manufacturing or assembling processes. Accordingly, it is possible to achieve an improvement in productivity. Furthermore, the backward light blocking apparatus of the present invention is compact. Where the backward light blocking apparatus is incorporated in a light amplifier, it can be incorporated in either input or output stages of the light amplifier.

CLAIMS:

1. A backward light blocking apparatus comprising:

an input optical fibre adapted to transmit an input optical signal into the apparatus;

a first detecting optical fibre adapted to detect the input optical signal by receiving input signal light reflected from within the apparatus;

an output optical fibre adapted to transmit an output optical signal from the apparatus;

a backward light blocking device adapted to pass light from the input optical fibre to the output optical fibre, but not vice versa; and

a second detecting optical fibre adapted to detect the output optical signal by receiving output light reflected from the output optical fibre and reflected again from within the apparatus.

2. Apparatus according to claim 1 in which the first detecting optical fibre is adapted to receive multiply-reflected light from within the apparatus.

3. Apparatus according to claim 1 or claim 2 in which the backward light blocking device comprises:

a first lens adapted to collimate the input light emerging from the input optical fibre;

a first polarizer adapted to split the collimated input light into orthogonal plane polarized components;

a polarized-light rotator for rotating through a predetermined angle the planes of polarization of the orthogonal components;

a second polarizer adapted to recombine the rotated orthogonal components; and

a second lens adapted to collimate the recombined light emerging from the second polarizer into the output optical fibre.

4. Apparatus according to any preceding claim further comprising:

a first ferrule adapted to support both the input optical fibre and the first detecting optical fibre; and

a second ferrule adapted to support both the output optical fibre and the second detecting optical fibre.

5. Apparatus according to any preceding claim in which the first and second detecting optical fibres are respectively arranged at input and output stages of the apparatus.

6. A method of detecting transmitted light using a backward light blocking apparatus according to any preceding claim, comprising:

detecting the input optical signal by detecting the quantity of input light reflected from within the apparatus into the first detecting optical fibre; and

detecting the output optical signal by detecting the quantity of output light reflected from the output optical fibre and reflected again from within the apparatus into the second detecting optical fibre.

7. An optical amplifier comprising:

an input optical fibre adapted to transmit an input optical signal into the optical amplifier;

a first detecting optical fibre adapted to transmit a first detection signal indicative of the level of the input optical signal;

a first backward light blocking device adapted to pass light from the input optical fibre to a first output optical fibre, but not vice versa;

an excited light source adapted to amplify the input optical signal;

a wavelength-dividing coupler adapted to divide the wavelength of the optical signal emitted from the excited light source along with the wavelength of the signal from the first optical fibre and to modulate the wavelength-divided signal;

an amplifying optical fibre adapted to amplify the output signal from the wavelength-dividing coupler;

a second backward light blocking device adapted to pass light from the amplifying optical fibre to a second output optical fibre, but not vice versa;

a second detecting optical fibre adapted to transmit a second detection signal indicative of the level of the optical signal between the backward light blocking device and the second backward light blocking device; and

a control circuit adapted to detect the first and second detection signals and to control the excited light source accordingly.

8. An amplifier according to claim 7 in which the second detecting optical fibre is adapted to transmit a second detection signal indicative of the level of the optical signal input to the first output optical fibre.

9. An amplifier according to claim 8 in which the second backward light blocking device is comprised in an optical system.

10. An optical amplifier according to claim 7 further comprising:

a third detecting optical fibre adapted to transmit a third detection signal indicative of the level of the optical signal input to the second output optical fibre; and in which:

the second detecting optical fibre is adapted to transmit a signal indicative of the level of the amplified optical signal input to the second backward light blocking device; and

the control circuit is adapted to detect the first, second and third detection signals and to control the excited light source accordingly.

11. An optical amplifier according to claim 10 wherein the first detection signal is coupled between the first backward light blocking device and the control circuit and the second and third detection signals are coupled between the second backward light blocking unit and the control

circuit.

12. An optical amplifier according to claim 10 or claim 11 in which the control circuit drives the excited light source by electrical control.

13. A backward light blocking apparatus substantially as described with reference to and/or as illustrated in FIG. 2 of the accompanying drawings.

14. A method of detecting transmitted light substantially as described with reference to and/or as illustrated in any one of FIGs. 2-4 of the accompanying drawings.

15. An optical amplifier substantially as described with reference to and/or as illustrated in FIG. 3 or FIG. 4 of the accompanying drawings.

The Patent Office

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Application No:	GB 9704417.6	**Examiner:**	Richard Nicholls
Claims searched:	1-15	**Date of search:**	8 May 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): G2J (J9D, JB7Q, JGEB) ; H1C (CEX)

Int Cl (Ed.6): G02B ; H01S 3/06

Other: Online : WPI, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	US 4449782 A (I.B.M.) see especially figure 4	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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