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U.S. DEPARTMENT OF COMMERCE
U.S. Patent and Trademark Office

To the Honorable Commissioner of Patents and Trademarks: Please record the attached original documents or copy thereof.

1. Name of conveying party(ies):
Inventors: Muehlemann, Michael M.
Noble, Donald J.
Assignee: Illumination Technologies, Inc.
Additional name(s) of conveying party(ies) attached? Yes No

re
8-26-03

2. Name and address of receiving party(ies)
Name: BSB Bank & Trust Company
Internal Address: Karen M. Zavada
Commercial Loans
Street Address: 58-68 Exchange Street
City: Binghamton State: N.Y. Zip: 13902
Additional name(s) & address(es) attached? Yes No

3. Nature of conveyance:
 Assignment Merger
 Security Agreement Change of Name
 Other
Execution Date: 02.21.03

4. Application number(s) or patent number(s):
Patent #5,550,946
If this document is being filed together with a new application, the execution date of the application is:
A. Patent Application No.(s)
B. Patent No.(s)
Additional numbers attached? Yes No

5. Name and address of party to whom correspondence concerning document should be mailed:
Name: BSB Bank & Trust Company
Internal Address: Karen M. Zavada
Commercial Loans
Street Address: 58-68 Exchange Street
City: Binghamton State: N.Y. Zip: 13902

6. Total number of applications and patents involved: 1
7. Total fee (37 CFR 3.41).....\$ 40.00
 Enclosed
 Authorized to be charged to deposit account
8. Deposit account number:
(Attach duplicate copy of this page if paying by deposit account)

DO NOT USE THIS SPACE

9. Statement and signature.
To the best of my knowledge and belief, the foregoing information is true and correct and any attached copy is a true copy of the original document.
Name of Person Signing: Karen M. Zavada
Signature: Karen M. Zavada
Date: 08-26-03

03/28/2003 BBYR/E 00000013 5550946

Total number of pages including cover sheet, attachments, and documents: 1

01 FC:8021

40.00 documents to be recorded with required cover sheet information to:
Commissioner of Patents & Trademarks, Box Assignments
Washington, D.C. 20231

PATENT
REEL: 014446 FRAME: 0546

COMMERCIAL SECURITY AGREEMENT

Principal	Loan Date	Maturity	Loan No	Call / Coll	Account	Officer	Initials
\$303,300.00	02-21-2003	02-15-2004	10833	04A8 / IC	6002	504	

References in the shaded area are for Lender's use only and do not limit the applicability of this document to any particular loan or item.
Any item above containing "****" has been omitted due to text length limitations.

Grantor: Illumination Technologies, Inc.
5 Adler Drive
East Syracuse, NY 13057

Lender: BSB BANK & TRUST COMPANY
Commercial Loans Department
P.O. Box 1056 (58-68 Exchange Street)
Binghamton, NY 13902

THIS COMMERCIAL SECURITY AGREEMENT dated February 21, 2003, is made and executed between Illumination Technologies, Inc. ("Grantor") and BSB BANK & TRUST COMPANY ("Lender").

GRANT OF SECURITY INTEREST. For valuable consideration, Grantor grants to Lender a security interest in the Collateral to secure the Indebtedness and agrees that Lender shall have the rights stated in this Agreement with respect to the Collateral, in addition to all other rights which Lender may have by law.

COLLATERAL DESCRIPTION. The word "Collateral" as used in this Agreement means the following described property, whether now owned or hereafter acquired, whether now existing or hereafter arising, and wherever located, in which Grantor is giving to Lender a security interest for the payment of the Indebtedness and performance of all other obligations under the Note and this Agreement:

All Inventory, Accounts, Equipment and General Intangibles

Assignment of United States Patent #5,550,946 dated August 27, 1996 for Modular Fiber Optic Light Line Unit, Inventors: Muehlemann, Michael M.; Noble, Donald J. Assignee: Illumination Technologies, Inc. Application #519394 filed August 25, 1995. See Attached Exhibit.

Assignment of United States Patent #5,591,972 dated January 7, 1997 for Apparatus for Reading Optical Information. Inventors: Noble, Donald J.; Muehlemann, Michael M. Assignee: Illumination Technologies, Inc. Application #509758 filed August 3, 1995. See Attached Exhibit.

Assignment of United States Patent #5,661,838 dated August 26, 1997 for Multiple Fiber Optic Light Line Unit. Inventors: Muehlemann, Michael Mark; Perry, Robert B. Assignee: Illumination Technologies, Inc. Application #694818 filed August 9, 1996. See Attached Exhibit.

Assignment of United States Patent #5,752,767 dated May 19, 1998 for Diffuse Ring Illuminator, Inventors: Muehmann, Michael Mark Assignee: Illumination Technologies, Inc. Application #548488 filed October 26, 1995. See Attached Exhibit.

In addition, the word "Collateral" also includes all the following, whether now owned or hereafter acquired, whether now existing or hereafter arising, and wherever located:

- (A) All accessions, attachments, accessories, tools, parts, supplies, replacements of and additions to any of the collateral described herein, whether added now or later.
- (B) All products and produce of any of the property described in this Collateral section.
- (C) All accounts, general intangibles, instruments, rents, monies, payments, and all other rights, arising out of a sale, lease, or other disposition of any of the property described in this Collateral section.
- (D) All proceeds (including insurance proceeds) from the sale, destruction, loss, or other disposition of any of the property described in this Collateral section, and sums due from a third party who has damaged or destroyed the Collateral or from that party's insurer, whether due to judgment, settlement or other process.
- (E) All records and data relating to any of the property described in this Collateral section, whether in the form of a writing, photograph, microfilm, microfiche, or electronic media, together with all of Grantor's right, title, and interest in and to all computer software required to utilize, create, maintain, and process any such records or data on electronic media.

Despite any other provision of this Agreement, Lender is not granted, and will not have, a nonpurchase money security interest in household goods, to the extent such a security interest would be prohibited by applicable law. In addition, if because of the type of any Property, Lender is required to give a notice of the right to cancel under Truth in Lending for the Indebtedness, then Lender will not have a security interest in such Collateral unless and until such a notice is given.

CROSS-COLLATERALIZATION. In addition to the Note, this Agreement secures all obligations, debts and liabilities, plus interest thereon, of Grantor to Lender, or any one or more of them, as well as all claims by Lender against Grantor or any one or more of them, whether now existing or hereafter arising, whether related or unrelated to the purpose of the Note, whether voluntary or otherwise, whether due or not due, direct or indirect, determined or undetermined, absolute or contingent, liquidated or unliquidated whether Grantor may be liable individually or jointly with others, whether obligated as guarantor, surety, accommodation party or otherwise, and whether recovery upon such amounts may be or hereafter may become barred by any statute of limitations, and whether the obligation to repay such amounts may be or hereafter may become otherwise unenforceable.

RIGHT OF SETOFF. To the extent permitted by applicable law, Lender reserves a right of setoff in all Grantor's accounts with Lender (whether checking, savings, or some other account and whether evidenced by a certificate of deposit). This includes all accounts Grantor holds jointly with someone else and all accounts Grantor may open in the future. However, this does not include any IRA or Keogh accounts, or any trust accounts for which setoff would be prohibited by law. Grantor authorizes Lender, to the extent permitted by applicable law, to charge or setoff all sums owing on the Indebtedness against any and all such accounts.

GRANTOR'S REPRESENTATIONS AND WARRANTIES WITH RESPECT TO THE COLLATERAL. With respect to the Collateral, Grantor represents and promises to Lender that:

Perfection of Security Interest. Grantor agrees to execute financing statements and to take whatever other actions are requested by Lender to perfect and continue Lender's security interest in the Collateral. Upon request of Lender, Grantor will deliver to Lender any and all of the documents evidencing or constituting the Collateral, and Grantor will note Lender's interest upon any and all chattel paper if not delivered to Lender for possession by Lender.

Notices to Lender. Grantor will promptly notify Lender in writing at Lender's address shown above (or such other addresses as Lender may designate from time to time) prior to any (1) change in Grantor's name; (2) change in Grantor's assumed business name(s); (3) change in the management of the Corporation Grantor; (4) change in the authorized signer(s); (5) change in Grantor's principal office address; (6) change in Grantor's state of organization; (7) conversion of Grantor to a new or different type of business entity; or (8) change in any other aspect of

**COMMERCIAL SECURITY AGREEMENT
(Continued)**

not be cancelled or diminished without at least thirty (30) days' prior written notice to Lender and not including any disclaimer of the insurer's liability for failure to give such a notice. Each insurance policy also shall include an endorsement providing that coverage in favor of Lender will not be impaired in any way by any act, omission or default of Grantor or any other person. In connection with all policies covering assets in which Lender holds or is offered a security interest, Grantor will provide Lender with such loss payable or other endorsements as Lender may require. If Grantor at any time fails to obtain or maintain any insurance as required under this Agreement, Lender may (but shall not be obligated to) obtain such insurance as Lender deems appropriate, including if Lender so chooses "single interest insurance," which will cover only Lender's interest in the Collateral.

Application of Insurance Proceeds. Grantor shall promptly notify Lender of any loss or damage to the Collateral. Lender may make proof of loss if Grantor fails to do so within fifteen (15) days of the casualty. All proceeds of any insurance on the Collateral, including accrued proceeds thereon, shall be held by Lender as part of the Collateral. If Lender consents to repair or replacement of the damaged or destroyed Collateral, Lender shall, upon satisfactory proof of expenditure, pay or reimburse Grantor from the proceeds for the reasonable cost of repair or restoration. If Lender does not consent to repair or replacement of the Collateral, Lender shall retain a sufficient amount of the proceeds to pay all of the indebtedness, and shall pay the balance to Grantor. Any proceeds which have not been disbursed within six (6) months after their receipt and which Grantor has not committed to the repair or restoration of the Collateral shall be used to prepay the indebtedness. Grantor hereby appoints Lender as its attorney-in-fact with full power and authority to endorse in Grantor's name any check or draft representing the proceeds of any insurance on the Collateral and to settle or compromise in Grantor's name any claims with respect to such insurance.

Insurance Reserves. Lender may require Grantor to maintain with Lender reserves for payment of insurance premiums, which reserves shall be created by monthly payments from Grantor of a sum estimated by Lender to be sufficient to produce, at least fifteen (15) days before the premium due date, amounts at least equal to the insurance premiums to be paid. If fifteen (15) days before payment is due, the reserve funds are insufficient, Grantor shall upon demand pay any deficiency to Lender. The reserve funds shall be held by Lender as a general deposit and shall constitute a non-interest-bearing account which Lender may satisfy by payment of the insurance premiums required to be paid by Grantor as they become due. Lender does not hold the reserve funds in trust for Grantor, and Lender is not the agent of Grantor for payment of the insurance premiums required to be paid by Grantor. The responsibility for the payment of premiums shall remain Grantor's sole responsibility.

Insurance Reports. Grantor, upon request of Lender, shall furnish to Lender reports on each existing policy of insurance showing such information as Lender may reasonably request including the following: (1) the name of the insurer; (2) the risks insured; (3) the amount of the policy; (4) the property insured; (5) the then current value on the basis of which insurance has been obtained and the manner of determining that value; and (6) the expiration date of the policy. In addition, Grantor shall upon request by Lender (however not more often than annually) have an independent appraiser satisfactory to Lender determine, as applicable, the cash value or replacement cost of the Collateral.

Financing Statements. Grantor authorizes Lender to file a UCC-1 financing statement, or alternatively, a copy of this Agreement to perfect Lender's security interest. At Lender's request, Grantor additionally agrees to sign all other documents that are necessary to perfect, protect, and continue Lender's security interest in the Property. Grantor will pay all filing fees, title transfer fees, and other fees and costs involved unless prohibited by law or unless Lender is required by law to pay such fees and costs. Grantor irrevocably appoints Lender to execute financing statements and documents of title in Grantor's name and to execute all documents necessary to transfer title if there is a default. Lender may file a copy of this Agreement as a financing statement. If Grantor changes Grantor's name or address, or the name or address of any person granting a security interest under this Agreement changes, Grantor will promptly notify the Lender of such change.

GRANTOR'S RIGHT TO POSSESSION AND TO COLLECT ACCOUNTS. Until default and except as otherwise provided below with respect to accounts, Grantor may have possession of the tangible personal property and beneficial use of all the Collateral and may use it in any lawful manner not inconsistent with this Agreement or the Related Documents, provided that Grantor's right to possession and beneficial use shall not apply to any Collateral where possession of the Collateral by Lender is required by law to perfect Lender's security interest in such Collateral. Until otherwise notified by Lender, Grantor may collect any of the Collateral consisting of accounts. At any time and even though no Event of Default exists, Lender may exercise its rights to collect the accounts and to notify account debtors to make payments directly to Lender for application to the indebtedness. If Lender at any time has possession of any Collateral, whether before or after an Event of Default, Lender shall be deemed to have exercised reasonable care in the custody and preservation of the Collateral if Lender takes such action for that purpose as Grantor shall request or as Lender, in Lender's sole discretion, shall deem appropriate under the circumstances, but failure to honor any request by Grantor shall not of itself be deemed to be a failure to exercise reasonable care. Lender shall not be required to take any steps necessary to preserve any rights in the Collateral against prior parties, nor to protect, preserve or maintain any security interest given to secure the indebtedness.

LENDER'S EXPENDITURES. If any action or proceeding is commenced that would materially affect Lender's interest in the Collateral or if Grantor fails to comply with any provision of this Agreement or any Related Documents, including but not limited to Grantor's failure to discharge or pay when due any amounts Grantor is required to discharge or pay under this Agreement or any Related Documents, Lender on Grantor's behalf may (but shall not be obligated to) take any action that Lender deems appropriate, including but not limited to discharging or paying all taxes, liens, security interests, encumbrances and other claims, at any time levied or placed on the Collateral and paying all costs for insuring, maintaining and preserving the Collateral. All such expenditures incurred or paid by Lender for such purposes, with the exception of insurance premiums paid by Lender with respect to motor vehicles, but including the payment of attorneys' fees and expenses, will then bear interest at the rate charged under the Note from the date incurred or paid by Lender to the date of repayment by Grantor. All such expenses will become a part of the indebtedness and, at Lender's option, will (A) be payable on demand; (B) be added to the balance of the Note and be apportioned among and be payable with any installment payments to become due during either (1) the term of any applicable insurance policy; or (2) the remaining term of the Note; or (C) be treated as a balloon payment which will be due and payable at the Note's maturity. The Agreement also will secure payment of these amounts. Such right shall be in addition to all other rights and remedies to which Lender may be entitled upon Default.

DEFAULT. Each of the following shall constitute an Event of Default under this Agreement:

Payment Default. Grantor fails to make any payment when due under the indebtedness.

Other Defaults. Grantor fails to comply with or to perform any other term, obligation, covenant or condition contained in this Agreement or in any of the Related Documents or to comply with or to perform any term, obligation, covenant or condition contained in any other agreement between Lender and Grantor.

False Statements. Any warranty, representation or statement made or furnished to Lender by Grantor or on Grantor's behalf under this Agreement or the Related Documents is false or misleading in any material respect, either now or at the time made or furnished or becomes false or misleading at any time thereafter.

Defective Collateralization. This Agreement or any of the Related Documents ceases to be in full force and effect (including failure of any collateral document to create a valid and perfected security interest or lien) at any time and for any reason.

Insolvency. The dissolution or termination of Grantor's existence as a going business, the insolvency of Grantor, the appointment of a receiver for any part of Grantor's property, any assignment for the benefit of creditors, any type of creditor workout, or the commencement of any proceeding under any bankruptcy or insolvency laws by or against Grantor.

Creditor or Forfeiture Proceedings. Commencement of foreclosure or forfeiture proceedings, whether by judicial proceeding, self-help,

**COMMERCIAL SECURITY AGREEMENT
(Continued)**

Caption Headings. Caption headings in this Agreement are for convenience purposes only and are not to be used to interpret or define the provisions of this Agreement.

Governing Law. This Agreement will be governed by, construed and enforced in accordance with federal law and the laws of the State of New York. This Agreement has been accepted by Lender in the State of New York.

No Waiver by Lender. Lender shall not be deemed to have waived any rights under this Agreement unless such waiver is given in writing and signed by Lender. No delay or omission on the part of Lender in exercising any right shall operate as a waiver of such right or any other right. A waiver by Lender of a provision of this Agreement shall not prejudice or constitute a waiver of Lender's right otherwise to demand strict compliance with that provision or any other provision of this Agreement. No prior waiver by Lender, nor any course of dealing between Lender and Grantor, shall constitute a waiver of any of Lender's rights or of any of Grantor's obligations as to any future transactions. Whenever the consent of Lender is required under this Agreement, the granting of such consent by Lender in any instance shall not constitute continuing consent to subsequent instances where such consent is required and in all cases such consent may be granted or withheld in the sole discretion of Lender.

Notices. Any notice required to be given under this Agreement shall be given in writing, and shall be effective when actually delivered, when actually received by telefacsimile (unless otherwise required by law), when deposited with a nationally recognized overnight courier, or, if mailed, when deposited in the United States mail, as first class, certified or registered mail postage prepaid, directed to the addresses shown near the beginning of this Agreement. Any party may change its address for notices under this Agreement by giving formal written notice to the other parties, specifying that the purpose of the notice is to change the party's address. For notice purposes, Grantor agrees to keep Lender informed at all times of Grantor's current address. Unless otherwise provided or required by law, if there is more than one Grantor, any notice given by Lender to any Grantor is deemed to be notice given to all Grantors.

Power of Attorney. Grantor hereby appoints Lender as Grantor's irrevocable attorney-in-fact for the purpose of executing any documents necessary to perfect, amend, or to continue the security interest granted in this Agreement or to demand termination of filings of other secured parties. Lender may at any time, and without further authorization from Grantor, file a carbon, photographic or other reproduction of any financing statement or of this Agreement for use as a financing statement. Grantor will reimburse Lender for all expenses for the perfection and the continuation of the perfection of Lender's security interest in the Collateral. Grantor authorizes Lender to file a financing statement covering the Collateral without Grantor's signature pursuant to Uniform Commercial Code Section 9-402(2)(e).

Severability. If a court of competent jurisdiction finds any provision of this Agreement to be illegal, invalid, or unenforceable as to any circumstance, that finding shall not make the offending provision illegal, invalid, or unenforceable as to any other circumstance. If feasible, the offending provision shall be considered modified so that it becomes legal, valid and enforceable. If the offending provision cannot be so modified, it shall be considered deleted from this Agreement. Unless otherwise required by law, the illegality, invalidity, or unenforceability of any provision of this Agreement shall not affect the legality, validity or enforceability of any other provision of this Agreement.

Successors and Assigns. Subject to any limitations stated in this Agreement on transfer of Grantor's interest, this Agreement shall be binding upon and inure to the benefit of the parties, their successors and assigns. If ownership of the Collateral becomes vested in a person other than Grantor, Lender, without notice to Grantor, may deal with Grantor's successors with reference to this Agreement and the Indebtedness by way of forbearance or extension without releasing Grantor from the obligations of this Agreement or liability under the Indebtedness.

Survival of Representations and Warranties. All representations, warranties, and agreements made by Grantor in this Agreement shall survive the execution and delivery of this Agreement, shall be continuing in nature, and shall remain in full force and effect until such time as Grantor's Indebtedness shall be paid in full.

Time is of the Essence. Time is of the essence in the performance of this Agreement.

Waive Jury. All parties to this Agreement hereby waive the right to any jury trial in any action, proceeding, or counterclaim brought by any party against any other party.

DEFINITIONS. The following capitalized words and terms shall have the following meanings when used in this Agreement. Unless specifically stated to the contrary, all references to dollar amounts shall mean amounts in lawful money of the United States of America. Words and terms used in the singular shall include the plural, and the plural shall include the singular, as the context may require. Words and terms not otherwise defined in this Agreement shall have the meanings attributed to such terms in the Uniform Commercial Code:

Account. The word "Account" means a trade account, account receivable, other receivable, or other right to payment for goods sold or services rendered owing to Grantor (or to a third party grantor acceptable to Lender).

Agreement. The word "Agreement" means this Commercial Security Agreement, as this Commercial Security Agreement may be amended or modified from time to time, together with all exhibits and schedules attached to this Commercial Security Agreement from time to time.

Borrower. The word "Borrower" means Illumination Technologies, Inc., and all other persons and entities signing the Note in whatever capacity.

Collateral. The word "Collateral" means all of Grantor's right, title and interest in and to all the Collateral as described in the Collateral Description section of this Agreement.

Default. The word "Default" means the Default set forth in this Agreement in the section titled "Default".

Environmental Laws. The words "Environmental Laws" mean any and all state, federal and local statutes, regulations and ordinances relating to the protection of human health or the environment, including without limitation the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. Section 9601, et seq. ("CERCLA"), the Superfund Amendments and Reauthorization Act of 1986, Pub. L. No. 99-499 ("SARA"), the Hazardous Materials Transportation Act, 49 U.S.C. Section 1801, et seq., the Resource Conservation and Recovery Act, 42 U.S.C. Section 6901, et seq., or other applicable state or federal laws, rules, or regulations adopted pursuant thereto.

Event of Default. The words "Event of Default" mean any of the events of default set forth in this Agreement in the default section of this Agreement.

Grantor. The word "Grantor" means Illumination Technologies, Inc..

Guarantor. The word "Guarantor" means any guarantor, surety, or accommodation party of any or all of the Indebtedness.

Guaranty. The word "Guaranty" means the guaranty from Guarantor to Lender, including without limitation a guaranty of all or part of the Note.

Hazardous Substances. The words "Hazardous Substances" mean materials that, because of their quantity, concentration or physical, chemical or infectious characteristics, may cause or pose a present or potential hazard to human health or the environment when improperly used, treated, stored, disposed of, generated, manufactured, transported or otherwise handled. The words "Hazardous Substances" are used in their very broadest sense and include without limitation any and all hazardous or toxic substances, materials or waste as defined by or listed under the Environmental Laws. The term "Hazardous Substances" also includes, without limitation, petroleum and petroleum by-products or any fraction thereof and asbestos.

USPTO PATENT FULL-TEXT AND IMAGE DATABASE

(1 of 1)

United States Patent
Muehleemann , et al.

5,550,946
August 27, 1996

Modular fiber optic light line unit

Abstract

A modular fiber optic light line unit provides a uniform linear beam of illumination. A number of these modular units can be butted together end to end to create a long, seamless line of uniform strip lighting. The unit has a housing in which a distal portion of the fiber optic bundle fans out so that the termini of the fibers are arrayed in a single continuous fiber row at a distal face plate of the housing. The ends of the row are flush with end edges of the distal face plate. In one embodiment the housing has first and second halves that sandwich the fiber termini, and there are respective sawtooth or similar recesses that each hold a respective fiber end or terminus. The housing can be anodized aluminum, and the optical fibers can be polymer fibers, for example with a diameter of 0.030 inches.

Inventors: Muehleemann; Michael M. (Liverpool, NY); Noble; J. Donald (La Fayette, NY)

Assignee: Illumination Technologies, Inc. (East Syracuse, NY)

Appl. No.: 519394

Filed: August 25, 1995

Current U.S. Class: 385/121; 362/556; 385/120; 385/901
Intern'l Class: G02B 006/06
Field of Search: 385/121,120,115,116,901 362/32,114

References Cited [Referenced By]

U.S. Patent Documents			
<u>3038959</u>	Jun., 1962	Beurle	178/7.
<u>3192843</u>	Jul., 1965	Kapany et al.	95/73.
<u>3398669</u>	Aug., 1968	Hicks, Jr.	95/73.
<u>3512961</u>	May., 1970	Schackert	350/96.
<u>3610726</u>	Oct., 1971	Aijala	350/96.
<u>3718515</u>	Feb., 1973	Goldstein	156/174.

<u>3909109</u>	Sep., 1975	Aurenz	350/96.
<u>3950074</u>	Apr., 1976	Tanaka	350/96.
<u>4153333</u>	May., 1979	Harada et al.	350/96.
<u>4154500</u>	May., 1979	Funato et al.	350/96.
<u>4462662</u>	Jul., 1984	Lama	350/413.
<u>4735479</u>	Apr., 1988	Nicholls	350/96.
<u>4911526</u>	Mar., 1990	Hsu et al.	350/96.
<u>4950048</u>	Aug., 1990	Kakii et al.	350/96.
<u>4952022</u>	Aug., 1990	Genovese	350/96.
<u>4991930</u>	Feb., 1991	Baek et al.	350/96.
<u>5032718</u>	Jul., 1991	Murakami	250/227.
<u>5367440</u>	Nov., 1994	Gruszczynski et al.	385/120.
<u>5367595</u>	Nov., 1994	Jennings et al.	385/71.

Primary Examiner: Lee; John D.

Assistant Examiner: Palmer; Phan T. H.

Attorney, Agent or Firm: Trapani & Molldrem

Claims

We claim:

1. Modular fiber optic light line unit for producing a thin, continuous line of illumination, comprising
 a housing having a distal face from which said line of illumination emanates, said distal face extending from a first end edge to a second end edge of said housing;

a fiber optic bundle formed of a plurality of optical fibers, said bundle including a proximal portion carried in a sheath, said proximal portion including means to receive light from a light source, and a distal portion disposed within said housing, with the optical fibers in said distal portion being fanned out to terminate in a fiat linear array; and

wherein said distal face of said housing includes means for holding distal termini of said optical fibers in a continuous row that extends the length of said distal face and such that ends of said row are flush with said first and second end edges, such that another similar modular fiber optic light line unit can be positioned abutting the first-mentioned module to form a single uninterrupted light line.

2. The modular fiber optic light line unit of claim 1, wherein said housing includes first and second housing portions that fit together at a line on said distal face that defines said continuous row.

3. The modular fiber optic light line unit of claim 1, wherein said housing is formed of anodized aluminum.

4. The modular fiber optic light line unit of claim 1, wherein said optical fibers are polymer fibers.

5. The modular fiber optic light line unit of claim 4, wherein said fibers are on the order of 0.030 inches

in diameter.

6. Modular fiber optic light line unit for producing a thin, continuous line of illumination, comprising a housing having a distal face from which said line of illumination emanates, said distal face extending from a first end edge to a second end edge of said housing; and

a fiber optic bundle formed of a plurality of optical fibers, said bundle including a proximal portion carried in a sheath, said proximal portion including means to receive light from a light source, and a distal portion disposed within said housing, with the optical fibers in said distal portion being fanned out to terminate in a flat linear array;

wherein said distal face of said housing includes means for holding distal termini of said optical fibers in a continuous row that extends the length of said distal face and such that ends of said row are flush with said first and second end housing includes first and second housing portions that fit together at a line on said distal face that defines said continuous row, and wherein said means in said distal face includes respective rows of serrations facing one another in said first and second housing parts along said line on said distal face.

7. The modular fiber optic light line unit of claim 6, wherein said housing distal face is an elongated flat wall and said housing has first and second end walls at right angles to said distal face and defining said first and second end edges, such that a plurality of said modular fiber optic light line units can be joined end to end to produce a single continuous line of illumination.

8. The modular fiber optic light line unit of claim 4, wherein said housing has a proximal wall with a shoulder formed at said first end wall from which the proximal portion of said fiber optic bundle extends, and a recess formed at said second wall to accommodate a fiber optic bundle extending from an adjacent modular fiber optic light line unit.

9. A linear illuminating arrangement formed of a plurality of modular fiber optic light line units for producing a thin, continuous line of illumination, each said modular light line unit comprising

a housing having a distal face from which said line of illumination emanates, said distal face extending from a first end edge to a second end edge of said housing; and

a fiber optic bundle formed of a plurality of optical fibers, said bundle including a proximal portion carried in a sheath, said proximal portion including means to receive light from a light source, and a distal portion disposed within said housing, with the optical fibers in said distal portion being fanned out to terminate in a flat linear array;

wherein said distal face of said housing includes means for holding distal termini of said optical fibers in a continuous row that extends the length of said distal face and such that ends of said row are flush with said first and second end edges;

said modular light line units abutting one another so that the first end edge of one modular light line unit is flush with the second end edge of an adjacent light line unit.

10. The linear illuminating arrangement of claim 9, in which the flat arrays of the optical fibers of successive said modular light line units abut one another to form a continuous row of fibers with no gaps at locations at which the modular light line units abut one another.

Description

BACKGROUND OF THE INVENTION

This invention relates to apparatus for illuminating an object and for providing a uniform, thin line of light onto an object for line scan applications. More specifically, the invention relates to light line units of modular design that can be butted end to end to provide very long, seamless lines of light. The invention is more particularly directed to an optical fiber based unit which can conduct light from a remote light source and convert the illumination from that source into a thin, long line of light.

Light line units are employed in a variety of applications where a long, narrow strip of light is needed. Light line units can be used in line-scan applications, e.g., with line-scan type CCD cameras in web-type applications. The current preference for a light line unit employs a fluorescent tube and an elongated aperture to produce a line of light. The fluorescent tube light line units have difficulty producing a line of light that is uniform from one end of the line to the other, or a light that remains uniform over time. The fluorescent units have temperature-sensitive output fluctuations, and outputs that vary with age and with other conditions. Also, if two units are to be joined to provide a light line of extra length, there is additional illumination drop-off between modules.

Optical fibers have been used as line illuminators, and one example is described in U.S. Pat. No. 4,952,022 to Genovese. In the Genovese patent, the illuminating device is comprised of a bundle of large-diameter fibers, in which the distal ends or termini are deformed into a rectangular cross section. There, the idea was to produce a linear beam that is uniform along the output of the array. However, the patent does not address how to join two or more units to produce a very long linear beam with no drop-off or discontinuity from one modular unit to another. Another system for transmitting a linear beam of light from a lamp to a workpiece using optical fibers is described in U.S. Pat. No. 3,192,843 to Kapany et al. In the system of that patent, there are alternating layers of illuminating fibers and imaging fibers, and no provision for joining a number of units end-to-end for any reason.

In a number of industrial applications, it is necessary to provide a line of illumination up to several meters in length, and with uniformities of better than 10% in a transmission or reflective mode. A typical application can be automated quality inspection of a web type product that travels past, for example a fabric or carpet. The quality of the inspection depends entirely on the uniformity of the light source, that is, on uniformity across the light line. Such high uniformity has been difficult to achieve using standard techniques, such as apertured fluorescent lamps. In addition, inspection of heat-sensitive materials requires removing the light source from the product, and this has been impossible with conventional linear light sources.

OBJECTS AND SUMMARY OF THE INVENTION

It is an object of the present invention to provide a modular light line unit, that is a modular linear light beam source, that produces a line of light that is uniform across its length and creates a seamless long light line when a number of such modular units are butted together.

It is another object to provide a simple, robust assembly in which a flexible fiber optic bundle carries illumination from a remote light source to the modular unit.

It is a further object to provide a light line with a significantly enhanced light output as compared with conventional linear light sources.

It is another object to provide a modular light line unit that can be routinely reconfigured to meet varying application needs, can accommodate specific working distance and environmental requirements, and can meet dimensional limitations.

According to an aspect of the invention, a modular fiber optic light line unit produces a thin, continuous line of illumination, and a number of these units can be joined together end to end to produce a long, seamless linear light beam. The units have a housing with a flat distal face member from which the line of light emanates, and a fiber optic bundle that is formed of a plurality of optical fibers. A sheath, e.g., a flexible vinyl tube contains the proximal end of the bundle that extends from the housing, and a coupling at the distal end connects to a light source. The proximal part of the fiber bundle is contained within the housing, and is fanned out so that the distal ends or termini of the fibers are arrayed in a single-thickness row of fibers that extends over the length of the distal face of the housing from a first end edge to a second end edge. The distal face member of the housing contains structure that holds the termini of the fibers in a continuous row to define the light line. In one preferred embodiment, the housing is formed of first and second halves that meet at this line with the optical fibers held in place therebetween. Each half has a facing row of serrations extending the entire length of the distal end, so that the row of fibers has its ends flush with the first and second end edges of the distal face member of the housing. In this fashion, when two or more modular units are butted together, there are no gaps in the combined rows of optical fibers, and the light line from the several units is presented as a continuous, seamless thin linear beam, without drop-out between units. The light line units can be used for white light, specific color light, infrared, or ultraviolet illumination.

The housing can be made of anodized aluminum, and the optical fibers can be polymer fibers, for example with a diameter of 0.030 inches.

The above and many other objects, features, and advantages of this invention will become apparent from the ensuing description of a preferred embodiment, which should be read in connection with the accompanying Drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of a modular light line unit according to one embodiment of this invention.

FIG. 2 is an elevational view showing an arrangement of a series of modular units of this for providing a long, seamless linear beam.

FIG. 3 is a plan view showing the distal face of the unit of this embodiment.

FIG. 4 is an enlargement of the area identified at 4 in FIG. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to the Drawing, a modular light line unit 10 has a housing or casing 12 formed of a first housing half 12 and a second housing half 13. Here, the halves are preferably made of a cast anodized aluminum, although many other suitable materials exist. The halves fit together at a join line 14. At a lower or distal side of the housing is an elongated flat distal face plate 15, where the join line 14 defines a light line 16, and from the latter emanates the light line or linear beam of illumination. The housing 11 has a first side 17 at a right angle to the face plate 15 and an opposed second side 18 also at a right angle to the face plate 15. These sides 17, 18 rise to a stepped top or proximal side 19, such that the housing 11 has a shoulder 20 at the first side 17 and a recess 21 at the second side 18. A laterally protruding

block 22 is formed at the shoulder 20 on the side 17 near the proximal wall 19, and a flexible fiber optic bundle 23 extends out of the housing from this block 22. A flexible vinyl tubular protective sheath 24 covers the proximal portion of the fiber optic bundle 23. Not shown here, a strain relief protects the fiber bundle as it enters the block 22. At the proximal end of the bundle 23 and sheath 24 is a coupler 25 that fits a mating receptacle in a standard light source (not shown). In a preferred embodiment, the bundle 23 is comprised of polymer optical fibers with a diameter of 0.030 inches. However, in other embodiments, glass fibers or other optical fibers could be used.

As shown in cutaway in FIG. 2, within the housing 11 a proximal portion 27 of the fiber optic bundle 23 fans out into a single layer, and ends or termini 28 of the optical fibers are arranged side-by-side into a single row to form the light line 16 on the face plate 15. Here, the ends of the row of optical fibers are flush with the end edges of the face plate 15 at the positions of the first and second sides 17 and 18. This permits a number of the modular units 10 to be joined end to end to form a single uninterrupted light line, as will be discussed shortly. Most favorably, each terminus 28 is configured and polished for optimal light distribution.

As illustrated in FIGS. 3 and 4, the distal face plate 15 is formed in two parts that join together at the join line 14 with the optical fiber termini 28 sandwiched between them. On the upper housing half 12 is an upper half 29 of the face plate 15, and on the lower housing half 13 is a lower half 30 of the face plate. The termini 28 are clamped between the upper and lower halves 29, 30 when the housing halves 12, 13 are fastened together, e.g., with screws 31, 31 (FIGS. 1,2). In this embodiment, the halves 29, 30 have a sawtooth configuration at facing edges, with a series of sawtooth recesses 32 or serrations on the upper half 29 and a similar series of sawtooth recesses 33 on the lower half 30. Respective pairs 32 and 33 of the upper and lower sawtooth recesses each hold one optical fiber end or terminus. As shown in FIG. 4, an end terminus 34, here the left-most fiber, lies flush with the end edge of the face plate 15 at the second side 18 of the housing. A similar end fiber is disposed flush with the opposite end edge at the first side 17.

While in this embodiment, the recesses or serrations 32, 33 are of sawtooth shape, the same could be undular or crenellate in shape.

Referring again to FIG. 2, a series of modular units 10a, 10b, 10c, and 10d are shown butt-joined, with side 17 of one unit joined to side 18 of the next. More or fewer units 10 could be employed, depending on the application. Clamping structure, not shown here, can be employed as needed for a given application, and this would be within the capability of the user. Each unit 10 has its respective fiber bundle 23 associated with a suitable light source, with the coupler 25 fitted to the light source as appropriate. For the sake of illustration, a lamp 35 and collimator lens group 36 are shown schematically with respect to one of the units 10b. It is possible with suitable Y couplers to join more than one unit 10 to a given light source. The intensity of illumination can be controlled in known fashion using diaphragms or filters contained in the light sources.

Here, the shoulders 20 and recesses 21 permit the units to be coupled adjacent to one another, with the fiber bundles 23 tiding over the stepped proximal wall 19 of the next modular unit 10. With the units 10a to 10d butted together end to end as shown, the units together produce a single seamless, continuous line of light, with no gaps at the junctions of the units 10a to 10d.

Also shown in FIG. 2 is an optional cylindrical lens 37 disposed with its cylindrical axis across the linear beam of light. In many possible configurations, the lens 37 could be omitted, and in others another type of lens could be employed.

While the invention has been described with reference to a single preferred embodiment, it should be

recognized that the invention is not limited to that precise embodiment. Rather, many modifications and variations will be apparent to persons skilled in the art without departing from the scope and spirit of this invention, as defined in the appended claims.

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