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ABSTRACT

A laser level disposable on a reference surface includes a housing, a laser diode disposed within the housing for emitting a laser beam along a path, a lens disposed in the path for converting the laser beam into a planar beam. The planar beam thus forms a line
5 on the reference surface. The laser level also includes an electronic distance measurement circuit disposed within the housing for measuring distance. The distance measurement circuit including a display for showing the measured distance.

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COMPLETE SPECIFICATION

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INVENTION TITLE:

Laser level

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

Cross-Reference to Related Applications

[0001] This application is a continuation-in-part of US Application Serial No. 10/277,474, filed October 22, 2002, now pending, which in turn derives priority under 35 USC § 119(e) from US Application Serial No. 60/384,673, filed on May 31, 2002.

Field of the Invention

[0002] This invention relates generally to laser instruments and specifically to laser levels with additional non-leveling capabilities.

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Background of the Invention

[0003] Laser levels have been used in construction for many years. They typically seek to produce a plane of light for a reference for construction projects. Laser levels have been used for large scale construction projects like commercial excavating, laying foundations, and installing drop ceilings. Laser levels save considerable time during initial layout of a construction job compared to other tools such as beam levels, chalk lines, or torpedo levels. Some examples of jobs where laser levels would be useful include laying tile, mounting cabinets, installing counter tops, and building outdoor decks.

20 [0004] It is an object of the present invention to provide a laser level that is inexpensive and usable by the general public.

Summary of the Invention

[0005] In accordance with the present invention, an improved laser level is employed.

The laser level disposable on a reference surface includes a housing, a first laser diode disposed within the housing for emitting a first laser beam along a first path, a lens
5 disposed in the first path for converting the first laser beam into a first planar beam, the first planar beam forming a line on the reference surface, and an electronic distance measurement circuit disposed within the housing for measuring distance, said distance measurement circuit including a display for showing the measured distance.

[0006] Additional features and benefits of the present invention are described, and
10 will be apparent from, the accompanying drawings and the detailed description below.

Brief Description of the Drawings

[0007] The accompanying drawings illustrate preferred embodiments of the invention according to the practical application of the principles thereof, and in which:

15 [0008] FIG. 1 is a perspective view of a first embodiment of a laser level according to the invention;

[0009] FIG. 2 is a cross-sectional view of the laser level of FIG. 1; and

[0010] FIG. 3 illustrates a second embodiment of the laser level, where FIGS. 3A-3B are perspective and cross-sectional views of the laser level, respectively.

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Detailed Description

[0011] The invention is now described with reference to the accompanying figures, wherein like numerals designate like parts. Referring to FIGS. 1-2, a laser level 10 may

have a housing 11. The housing 11 may have a top portion 11T and a bottom portion 11B. The housing may also have a hole 12 extending through the housing 11. The hole 12 preferably extends through the top portion 11T. The perimeter of the hole 12 may be defined by an inner wall 11I.

- 5 [0012] The top portion 11T may carry a pendulum assembly 30. Preferably, the pendulum assembly 30 has a main body 31, which may be made of metal or plastic. Main body 31 may be disposed on a knife edge 11IK. Knife edge 11IK may be connected to and/or supported by inner wall 11I. Alternatively, knife edge 11IK may be connected to and/or supported by housing 11. Persons skilled in the art will recognize that
- 10 pendulum assembly 30 may be supported by means other than knife edge 11IK, such as a pin, bearing, point or other pendulous means.

- [0013] The main body 31 may carry at least one laser assembly 40 and preferably two laser assemblies 40 disposed left and right of the knife edge 11IK. Persons skilled in the art will recognize that a laser assembly 40 may disposed above knife edge 11IK. Persons
- 15 skilled in the art will also recognize that the laser assemblies 40 will emit laser beams. Accordingly, it is preferable to provide housing 11 with windows 13 to allow the laser beams to exit from housing 11.

- [0014] Persons skilled in the art will recognize that such arrangement will provide a self-leveling pendulum assembly that will emit substantially horizontal laser beams (and a
- 20 substantially vertical laser beam if a laser assembly 40 is disposed above knife edge 11IK and is directed upwardly) when laser level 10 is disposed against a wall. Persons skilled in the art will also recognize that it is preferable to allow laser assembly 40 to be angularly adjusted along a vertical plane relative to main body 31, to ensure that the

projected laser beam is substantially horizontal when the main body 31 is at its stationary position.

[0015] Persons skilled in the art should refer to US Application Serial Nos. 10/277,474 and 60/384,673, which are wholly incorporated herein by reference, for

5 further information on such laser level, adjustment methods, etc.

[0016] Referring to FIGS. 1-2, main body 31 may also have weights 33 to provide a lower center of gravity, and enhance the performance of the pendulum assembly 30. In addition, main body 31 may have at least one adjustment screw 33A to adjust the center of gravity of pendulum assembly 30, as necessary.

10 [0017] Main body 31 may also have a plaque 33M, made of magnetic material, ferrous material or non-ferrous conductive material, such as zinc or copper. Plaque 33M preferably is aligned with at least one magnet (and preferably two magnets) disposed in housing 11, e.g., on the inside of the front and rear walls of housing 11, for providing a damping action on pendulum assembly 30. Basically, eddie currents are generated within
15 plaque 33M, as the plaque moves and interacts with the magnetic field supplied by the magnet(s).

[0018] Persons skilled in the art shall recognize that pendulum assembly 30 is preferably wholly contained within housing 11. However, the pendulum assembly 30 may be at least partly, if not completely, disposed outside of housing 11.

20 [0019] Persons skilled in the art shall recognize that a damping mechanism for damping the motion of pendulum assembly 30 may be provided. Persons skilled in the art are directed to the damping mechanism disclosed in US Patent No. 5,144,487, which is wholly incorporated by reference herein, as well as to its equivalents.

[0020] The bottom portion 11B of housing 11 may carry a battery 50 for powering the laser assemblies 40. In addition, the bottom portion 11B may carry a stud sensor circuit 20. The circuitry of the stud sensor circuit 20 is not illustrated herein. Persons skilled in the art are referred to U.S. Pat. Nos. 4,099,118 and 4,464,622, which are wholly
5 incorporated herein by reference.

[0021] As is well known in the art, the stud sensor circuit 20 may include an on/off actuator or switch 21, which can be a push-button type actuator. Stud sensor circuit 20 may also include light emitting diodes 22 to display the location of a stud.

[0022] It is preferable to align the sensors within stud sensor circuit 20 with the center
10 of hole 12, so that the center of hole 12 indicates the location of the stud.

[0023] Persons skilled in the art should recognize that detector circuits other than stud sensor circuit 20 may be provided in laser level 10. Preferably, these detector circuits can detect features underneath a surface, such as a wall or floor. These features may include pipes or wires. Circuits for pipe and wire detectors, as well as other detector circuits, are
15 well known in the art.

[0024] The housing 11 may be formed from a hard impact resistant, preferably moldable material such as a hard thermoplastic material such as ABS or polystyrene. It is preferable to provide a grip 14 on bottom portion 11B. Grip 14 may be made of a soft or low durometer thermoplastic elastomer. In addition, grip 14 can be formed from any of
20 the so-called "soft-touch" elastomer materials, such as those sold under the tradenames "Santoprene", "Kraton" and "Monprene," and are preferably adhered or overmolded to the housing 11.

[0025] The bottom portion 11B may also carry an electronic distance measuring circuit 60. The circuitry of the distance measuring circuit 60 is not illustrated herein.

Persons skilled in the art will know that there are two main types of electronic distance measuring systems: those which are laser-based and those which are sound-based.

- 5 Persons skilled in the art are referred to U.S. Pat. Nos. 4,097,148, 5,262,837, 5,455,669, 5,638,163, 5,949,530, and 6,057,910, which are wholly incorporated herein by reference, which disclose laser-based electronic distance measuring systems. Similarly, persons skilled in the art are referred to U.S. Pat. Nos. 4,451,909, 4,464,738, and 4,910,717, which are wholly incorporated herein by reference, which disclose sound-based electronic
- 10 distance measuring systems.

- [0026] As is typical in electronic distance measuring systems, a sound or laser transmitter 61 is placed in housing 11. The transmitter 61 sends a signal, which contacts the target and bounces back towards the laser level 10. This signal is received by a sound or laser receiver 62 placed in housing 11. The distance measuring circuit 60 processes
- 15 the data and calculates the distance, as is well known in the art. The calculated distance can then be displayed on a display 63 disposed on housing 11.

- [0027] Referring to FIG. 2, laser assemblies 40 are disposed on main body 31. Laser assembly 40 may include a substantially cylindrical barrel 41, which may be adjustably connected to main body 31, laser diode 42 disposed in barrel 41, and a line lens 43
- 20 disposed in barrel 41. Persons skilled in the art will recognize that in the preferred embodiment, adjusting barrel 41 will result in moving laser diode 42 and line lens 43. In addition, persons skilled in the art will recognize that a collimating lens may be disposed

between laser diode 42 and line lens 43. Preferably, line lens 43 converts the laser beam exiting laser diode 42 into a planar beam.

[0028] Accordingly, when laser level 10 is disposed against a wall, laser assembly 40 will preferably emit a laser plane that contacts the wall, forming a laser line on the wall.

5 Persons skilled in the art will recognize that it is preferable to orient the laser assemblies 40 in such manner so that at least a portion of the laser plane will contact the wall. In addition, persons skilled in the art will recognize that providing laser assemblies 40 on the pendulum assembly 30 discussed above will preferably result in laser level 10 projecting substantially horizontal laser lines against the wall (and a substantially vertical

10 laser beam if a laser assembly 40 is disposed above knife edge 11IK and is directed upwardly).

[0029] A second embodiment of laser level 10 is shown in FIG. 3, where like numerals refer to like parts. The teachings of the first embodiment above are wholly incorporated by reference in the present embodiment. Like before, laser level 10 has laser

15 assemblies 40 for projecting laser beams, preferably in the form of planes. Furthermore, laser level 10 has a stud sensor circuit 20.

[0030] Laser level 10 may also have an electronic distance measuring circuit 60 as in the previous embodiment.

[0031] In this embodiment, the main difference is that the laser assemblies 40 are not

20 disposed on a pendulum. Instead, they are fixedly connected to housing 11. Accordingly, the user can disposed housing 11 at any position against a wall or floor, and two laser lines will be emitted unto the wall or floor.

[0032] A horizontal bubble vial 11HV may be provided on housing 11 to indicate to the user when the laser beams are level, i.e., substantially horizontal. Similarly, a vertical bubble vial 11VV may be provided on housing 11 to indicate to the user when the laser beams are plumb, i.e., substantially vertical. Persons skilled in the art will recognize that other means for detecting and indicating whether the laser beams are plumb or level can be used. In addition, persons skilled in the art will recognize that it may be preferable to dispose at least one laser assembly 40 at 90° from another laser assembly 40, to emit a perpendicular laser beam or line.

[0033] Persons skilled in the art may recognize other additions or alternatives to the means disclosed herein. However, all these additions and/or alterations are considered to be equivalents of the present invention.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

The reference to any prior art in this specification is not, and should not be taken as, an acknowledgement or any form of suggestion that that prior art forms part of the common general knowledge in Australia.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A laser level disposable on a reference surface comprising:
 - a housing;
 - a first laser diode disposed in the housing for emitting a first laser beam along a first
 - 5 path; and
 - an electronic distance measuring circuit disposed in the housing for measuring distance.
2. The laser level of Claim 1, further comprising a pendulum pivotably connected to the housing.
- 10 3. The laser level of Claim 2, wherein the first laser diode is disposed on the pendulum.
4. The laser level of Claim 2, further comprising a first lens disposed on the pendulum in the first path for converting the first laser beam into a first planar beam, the first planar beam forming a first line on the reference surface.
5. The laser level of Claim 2, further comprising a second laser diode disposed on the
- 15 pendulum for emitting a second laser beam along a second path, and a lens disposed on the pendulum in the second path for converting the second laser beam into a planar beam, the planar beam forming a second line on the reference surface.
6. The laser level of Claim 1, wherein the distance measuring circuit comprises a laser transmitter.
- 20 7. The laser level of Claim 1, wherein the distance measuring circuit comprises a laser receiver.
8. The laser level of Claim 1, wherein the distance measuring circuit comprises a sound transmitter.

9. The laser level of Claim 1, wherein the distance measuring circuit comprises a sound receiver.
10. The laser level of Claim 1, wherein the distance measuring circuit comprises a display disposed on the housing.
- 5 11. The laser level of Claim 1, further comprising a first lens disposed in the housing in the first path for converting the first laser beam into a first planar beam, the first planar beam forming a first line on the reference surface.
12. The laser level of Claim 11, further comprising a second laser diode disposed in the housing for emitting a second laser beam along a second path, and a second lens disposed
10 on the pendulum in the second path for converting the second laser beam into a second planar beam, the second planar beam forming a second line on the reference surface.
13. The laser level of Claim 12, wherein the first and second lines are substantially perpendicular.
14. The laser level of Claim 1, further comprising a detector circuit disposed in the
15 housing for detecting a feature behind or underneath the reference surface.
15. The laser level of Claim 14, wherein the detector circuit detects at least one of the group consisting of studs, wire and pipes.
16. The laser level of Claim 1, wherein the housing at least partially encloses the pendulum.
- 20 17. The laser level of Claim 1, wherein the housing has at least one window for allowing the first planar beam to exit therethrough.
18. The laser level of Claim 1, further comprising at least one bubble vial on the housing.

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19. A laser level substantially as hereinbefore described with reference to the drawings and/or Examples.
20. The steps, features, compositions and compounds disclosed herein or referred to or indicated in the specification and/or claims of this application, individually or collectively, and any and all combinations of any two or more of said steps or features.

DATED this TWENTY SECOND day of OCTOBER 2004

Black & Decker, Inc.

by DAVIES COLLISON CAVE
Patent Attorneys for the applicant(s)

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