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Norris

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(54) **MULTI-DIMENSIONAL LEVEL TOOL WITH LEVEL INDICATING DEVICES**

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(51) **Int. Cl.**
G01C 9/06 (2006.01)
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G01C 9/18 (2006.01)
G01C 9/12 (2006.01)
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CPC **G01C 9/06** (2013.01); **G01C 9/12** (2013.01); **G01C 9/16** (2013.01); **G01C 9/18** (2013.01); **G01C 15/10** (2013.01)

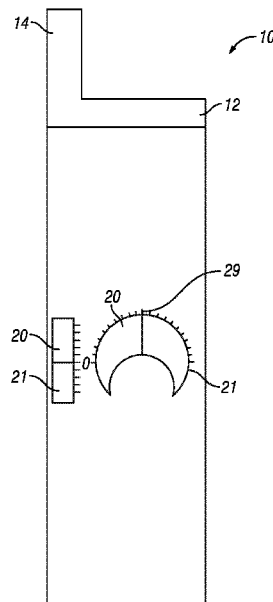
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CPC . G01C 15/10; G01C 9/06; G01C 9/12; G01C 9/16; G01C 9/18
USPC 33/371, 366.11
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(57) **ABSTRACT**
Level tools and level indicating devices for determining the angle of a vertically oriented object relative to both level and plumb capable of being read without requiring the tool's user to change his or her position or the position of the level tool.

17 Claims, 17 Drawing Sheets



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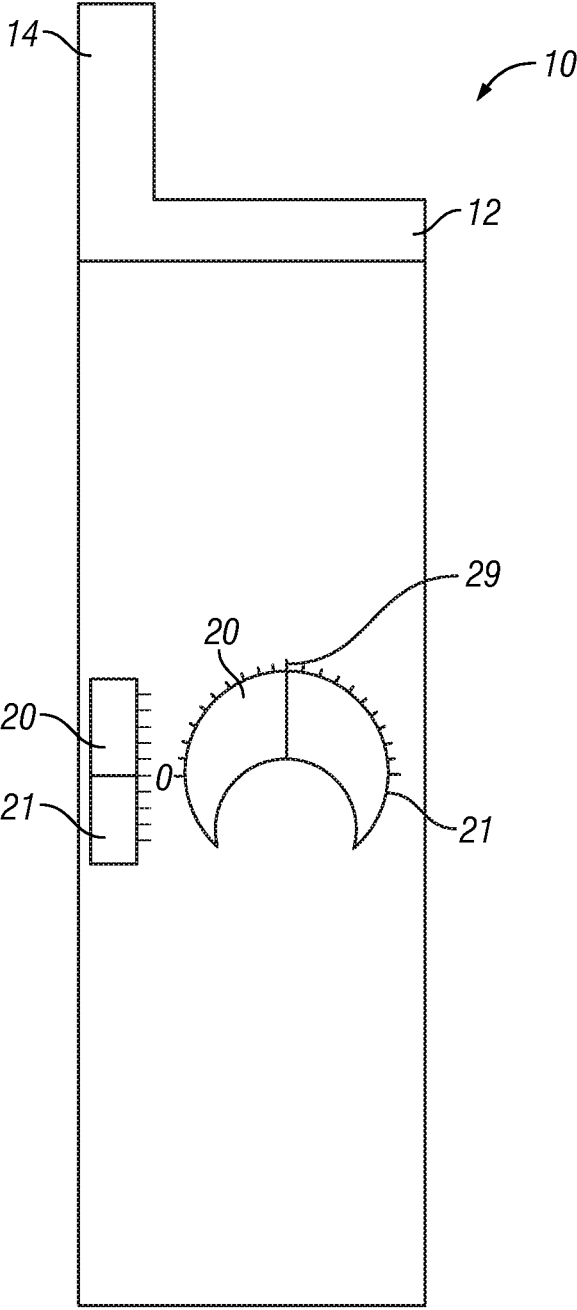


FIG. 1

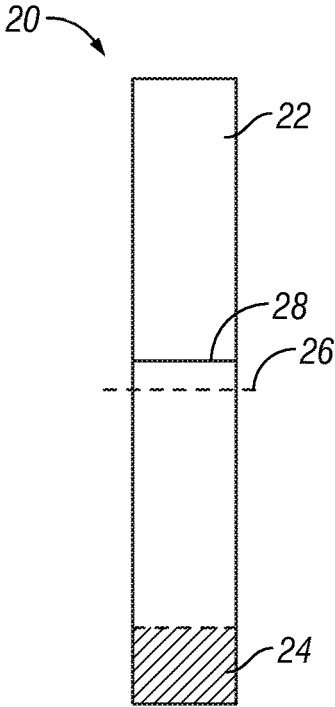


FIG. 2A

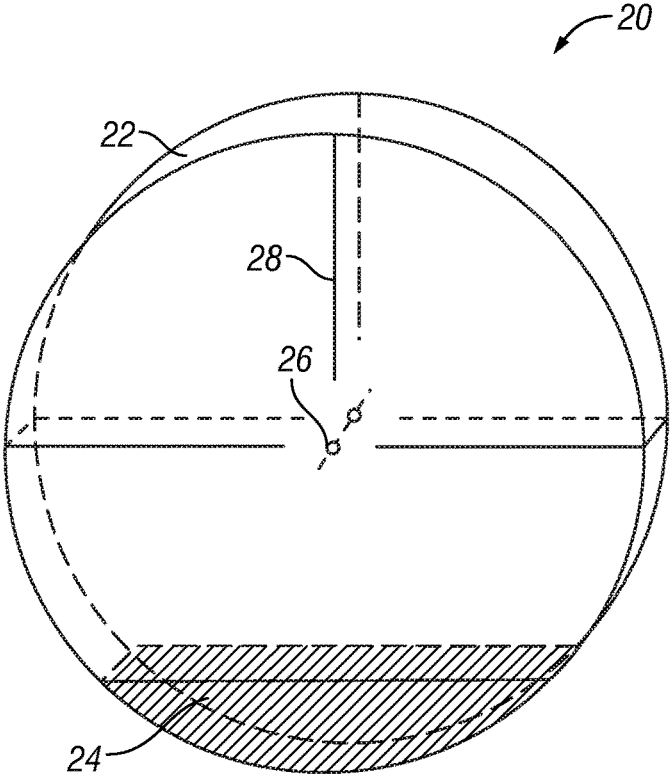


FIG. 2B

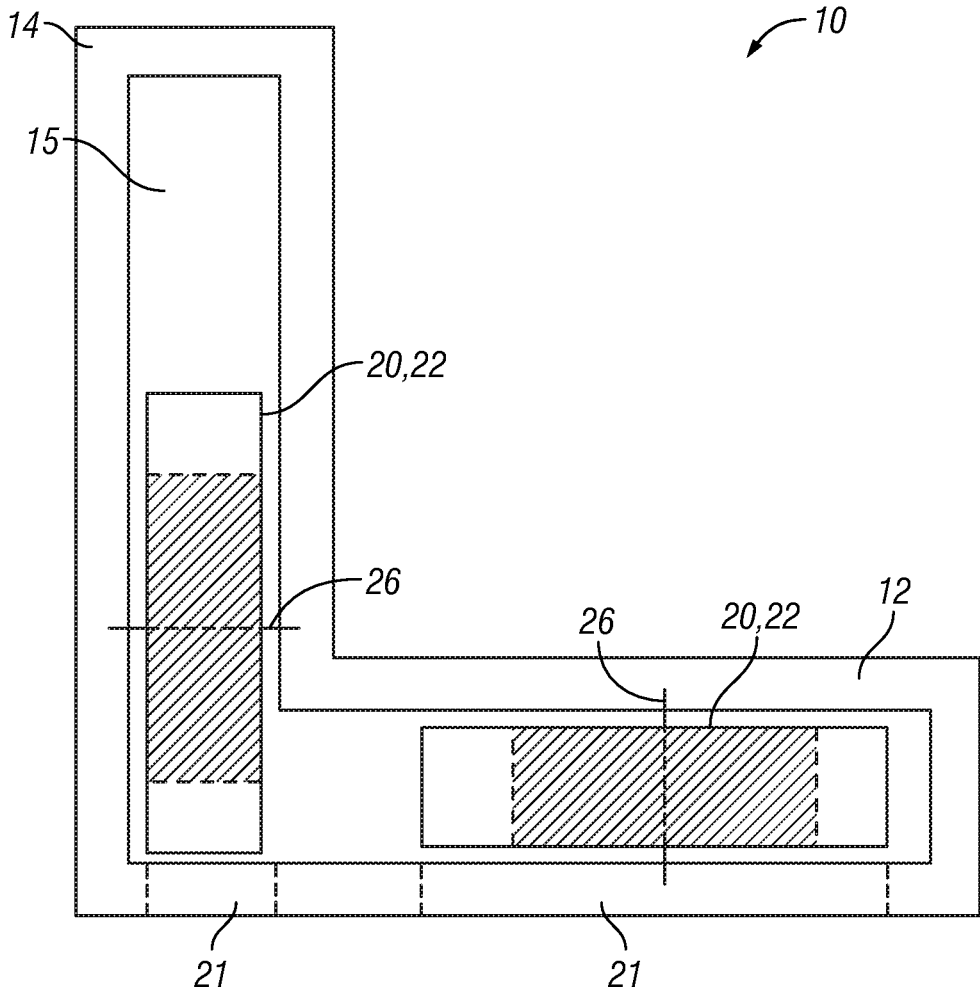


FIG. 3

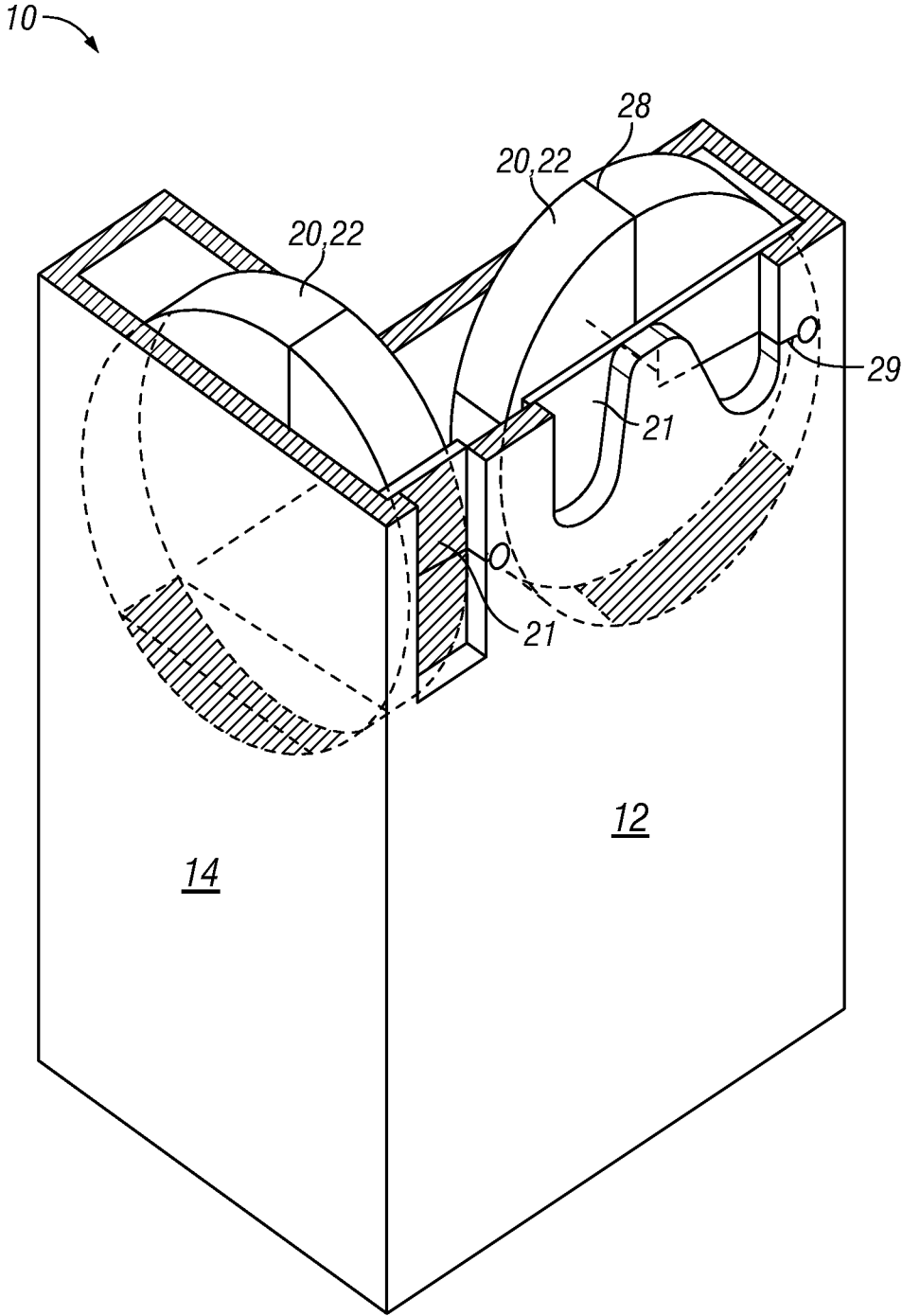


FIG. 4

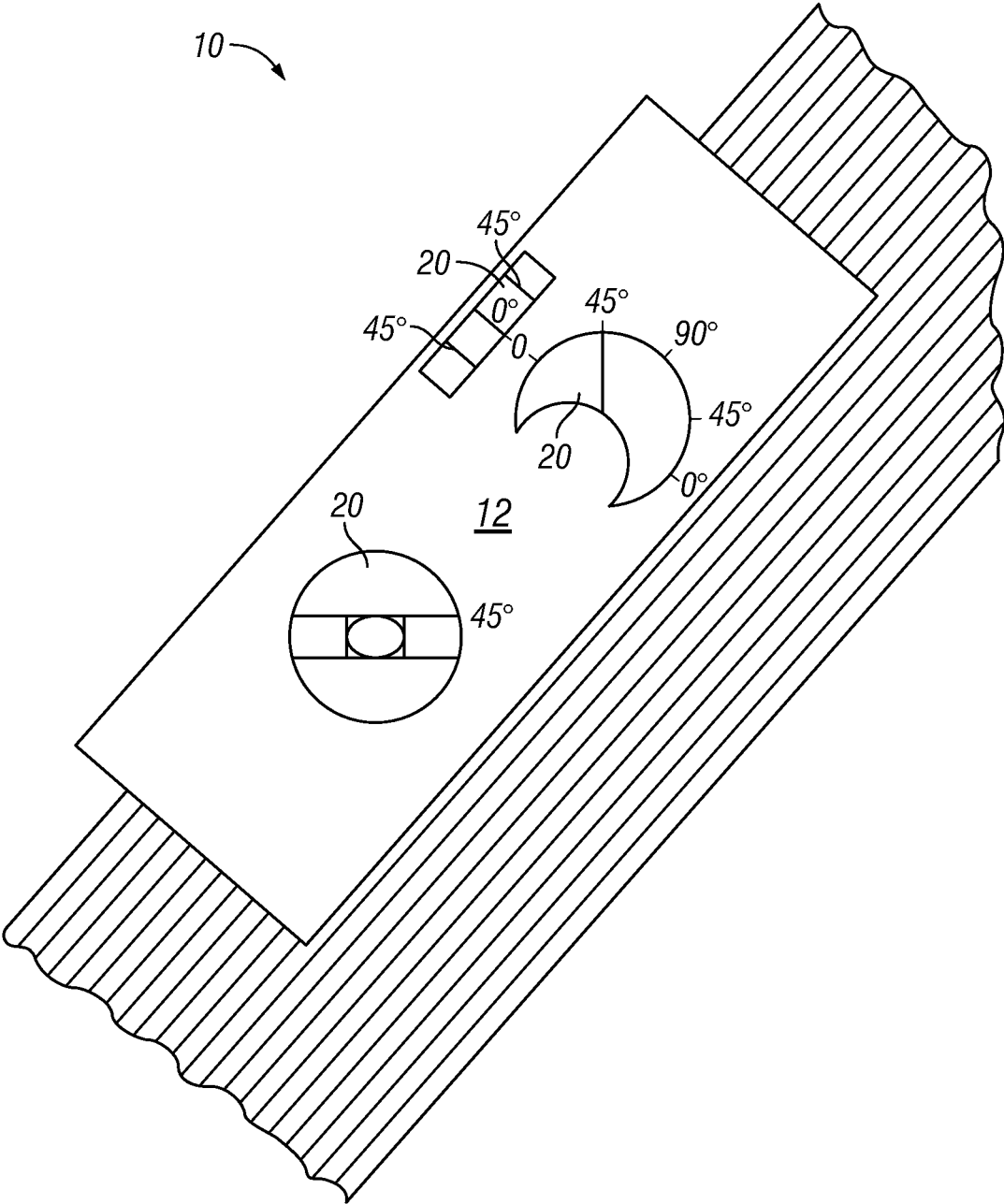


FIG. 5

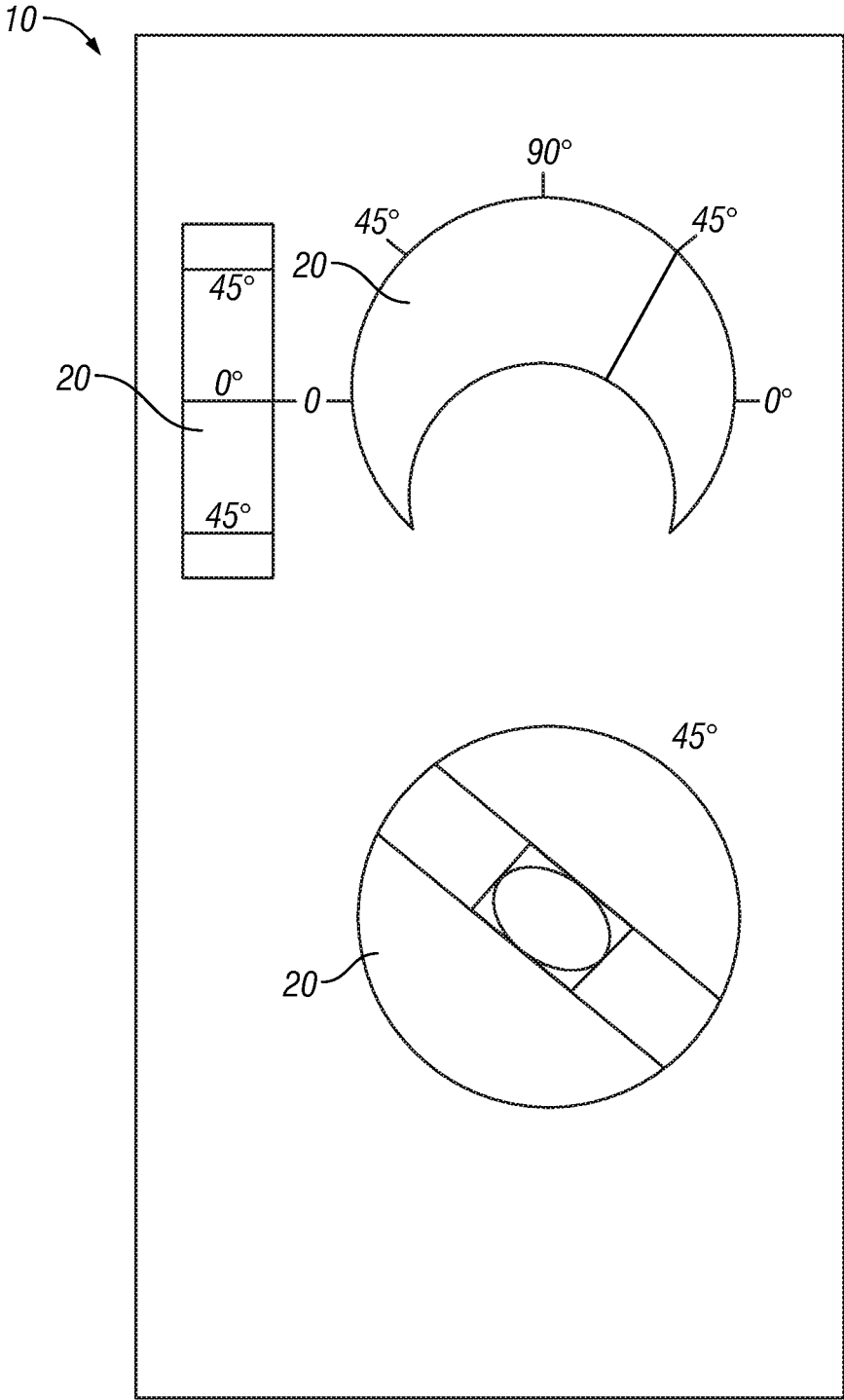
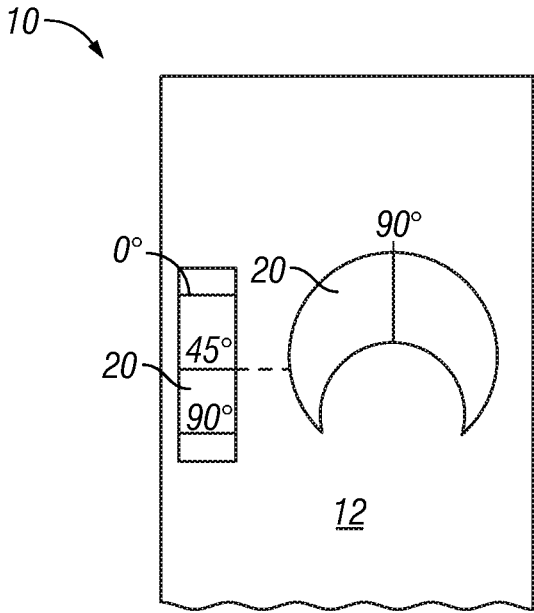
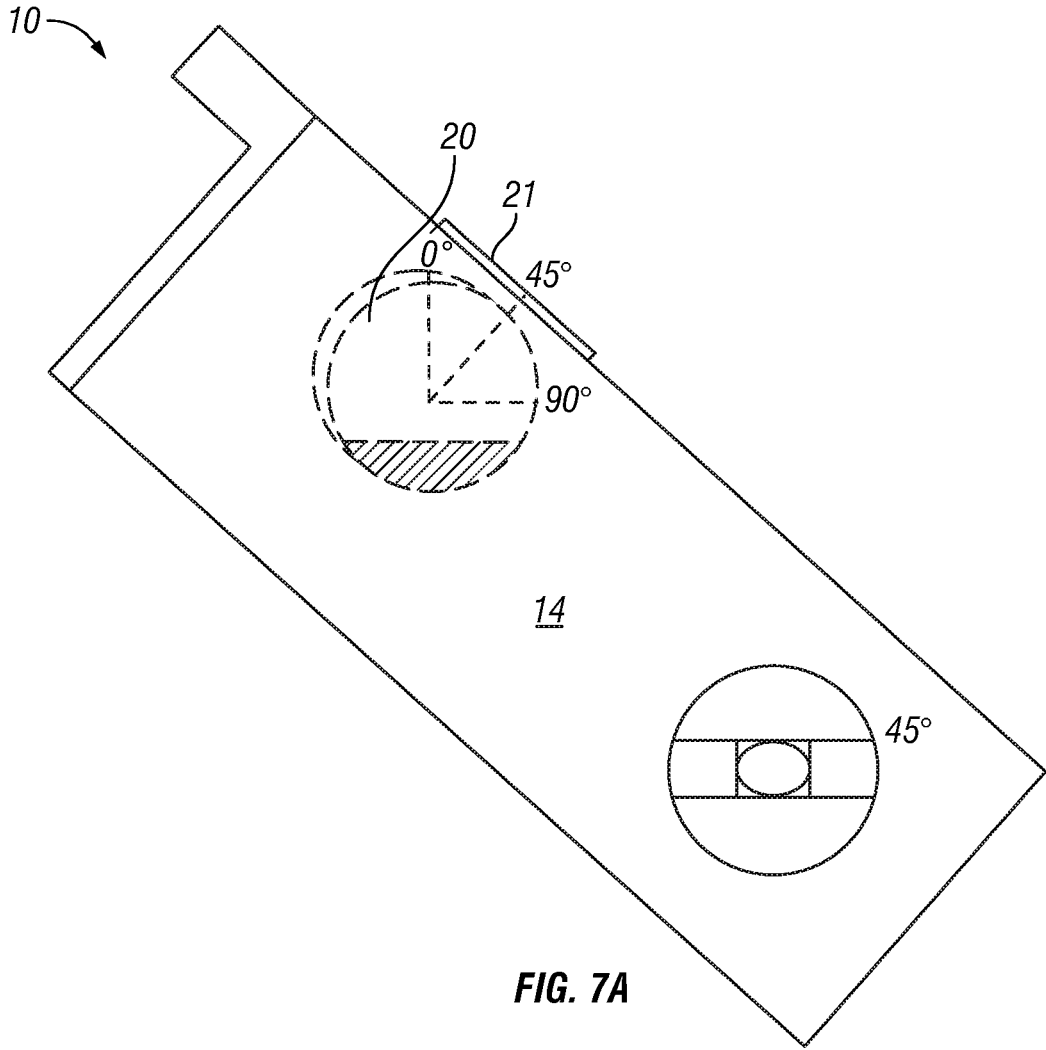


FIG. 6



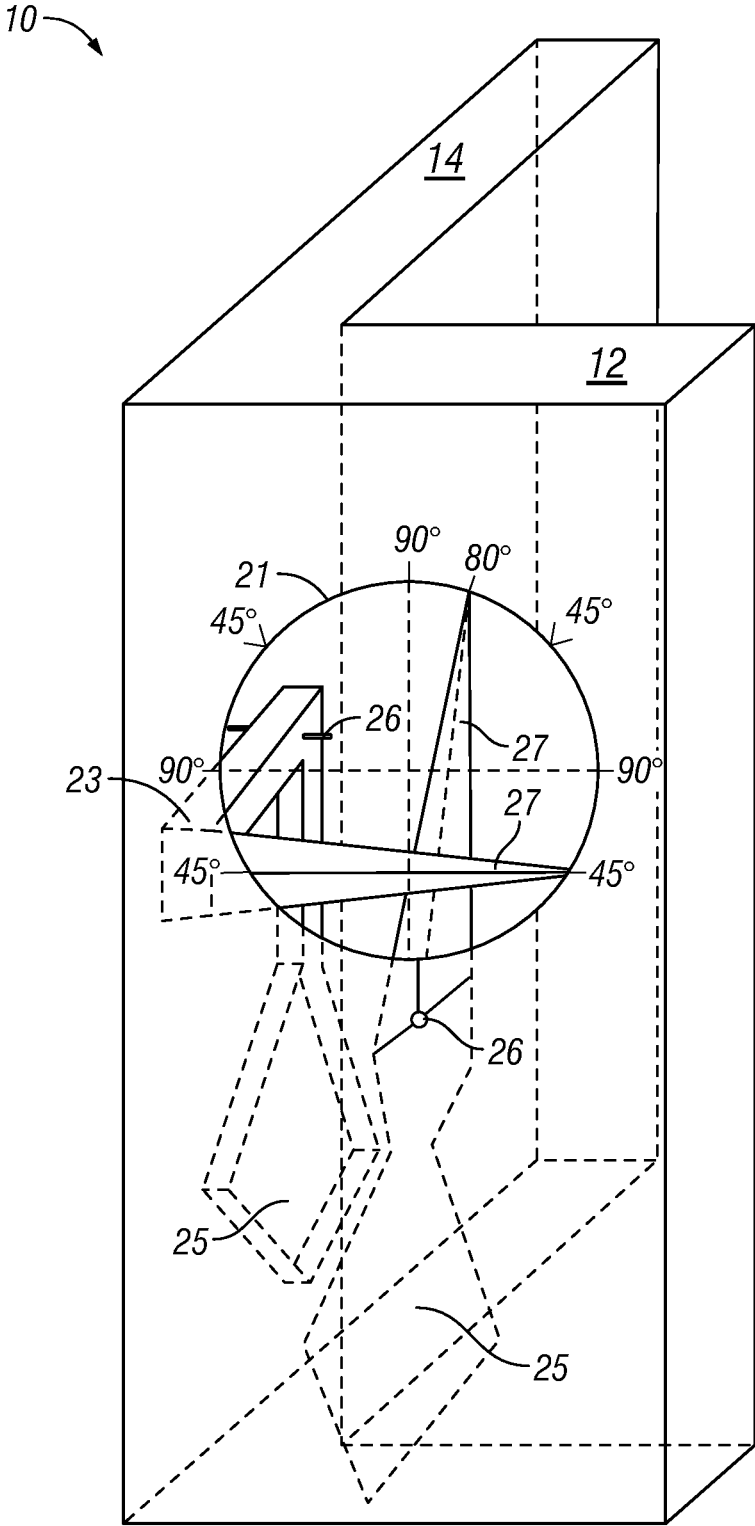


FIG. 8

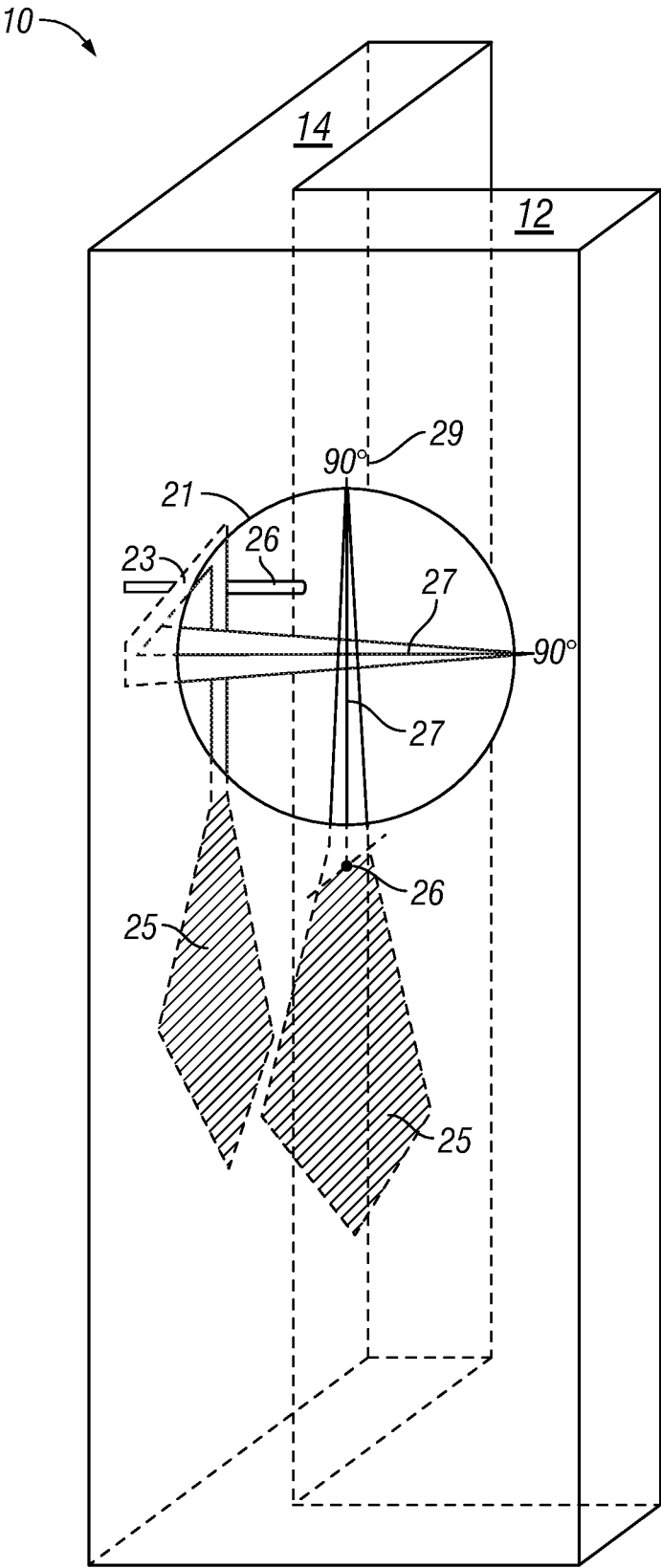


FIG. 9

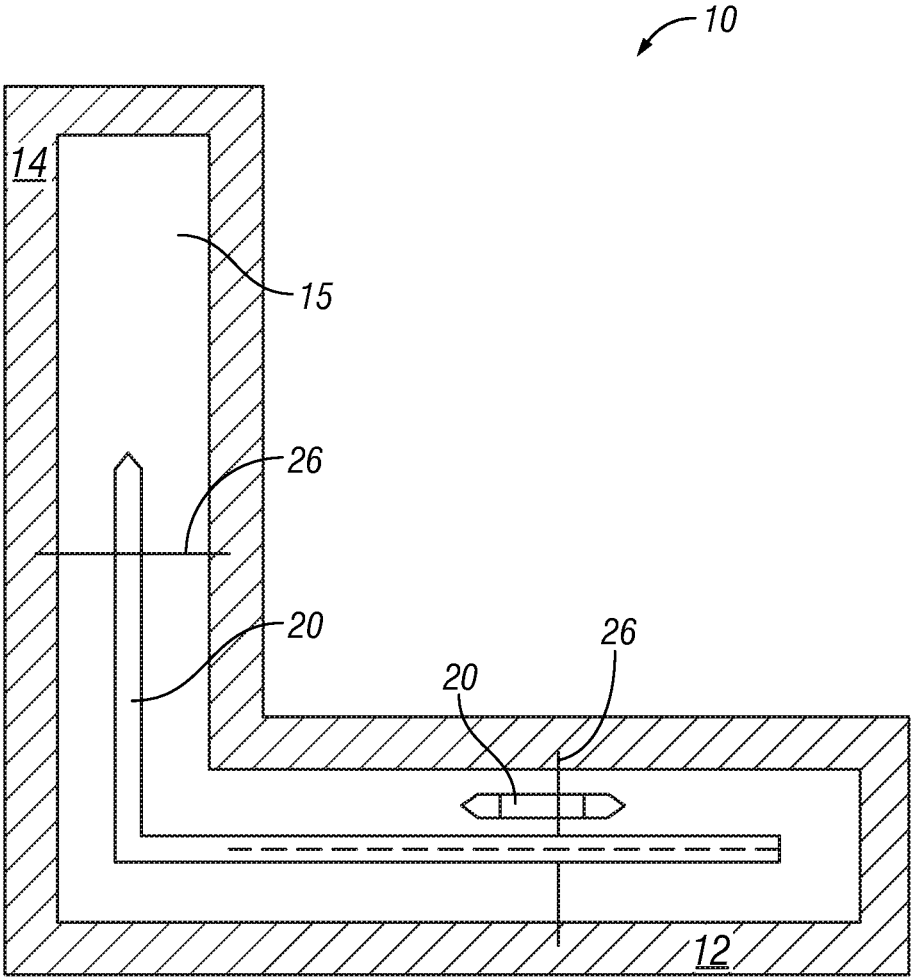


FIG. 10

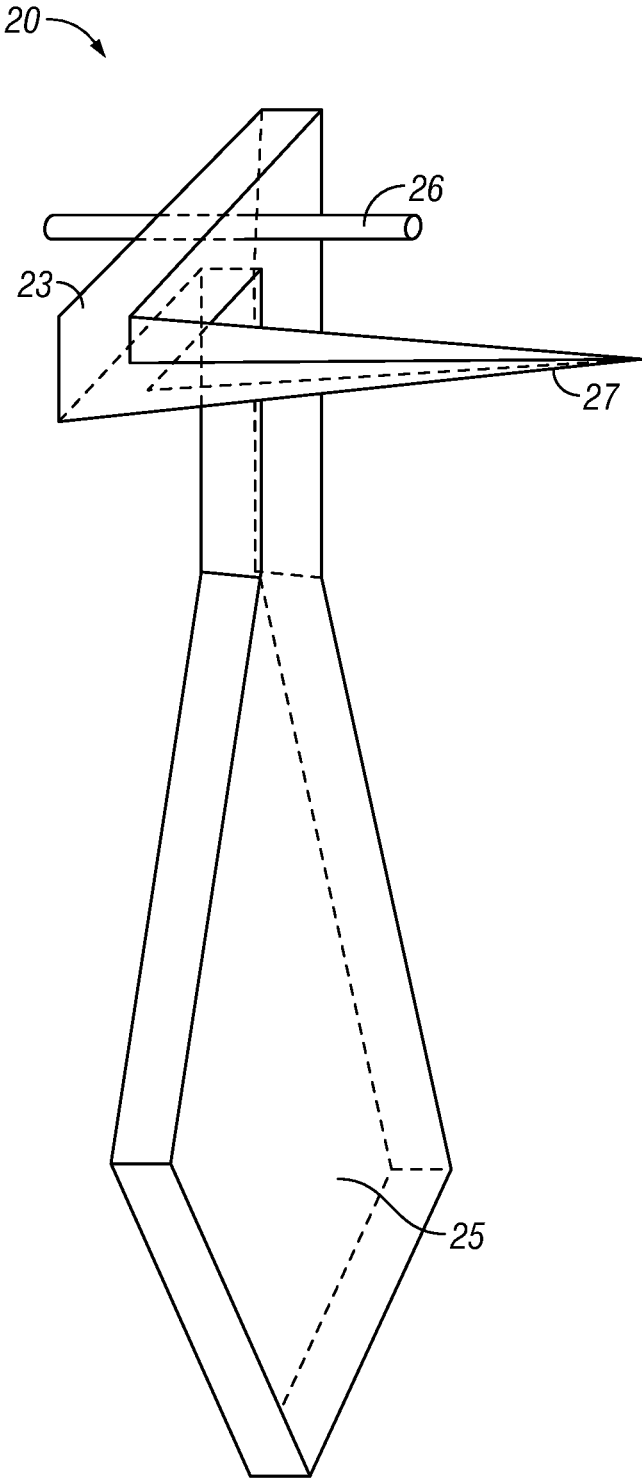


FIG. 11A

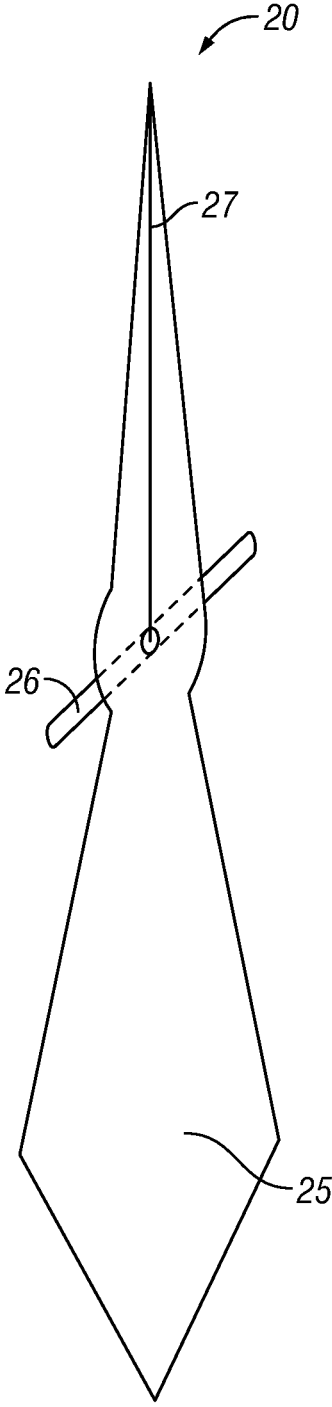


FIG. 11B

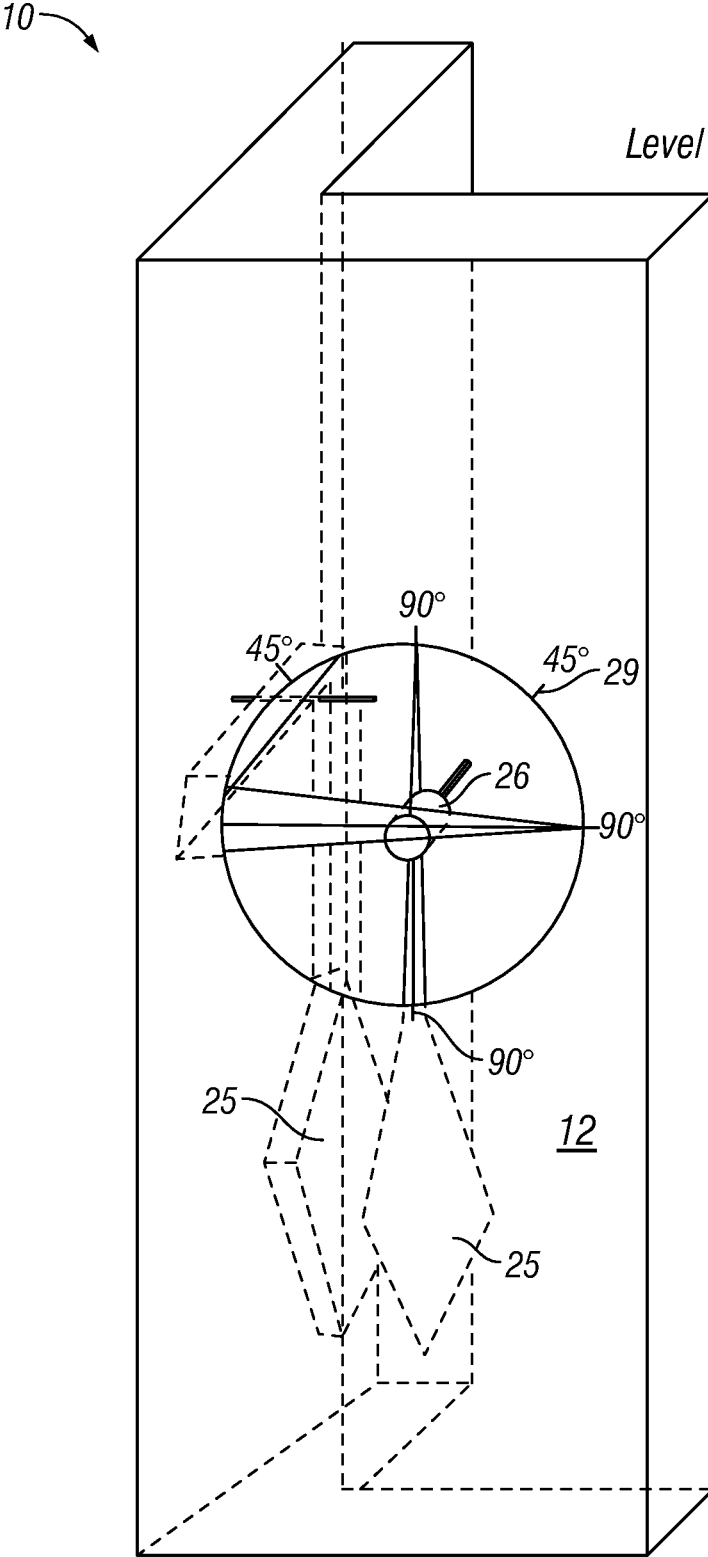


FIG. 12

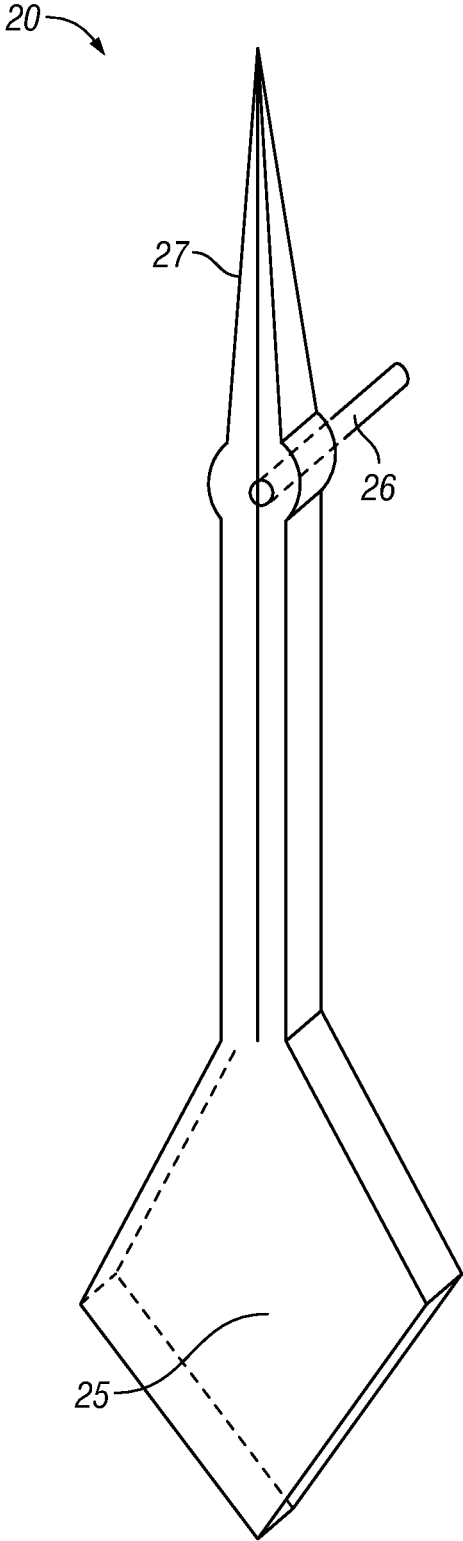


FIG. 13

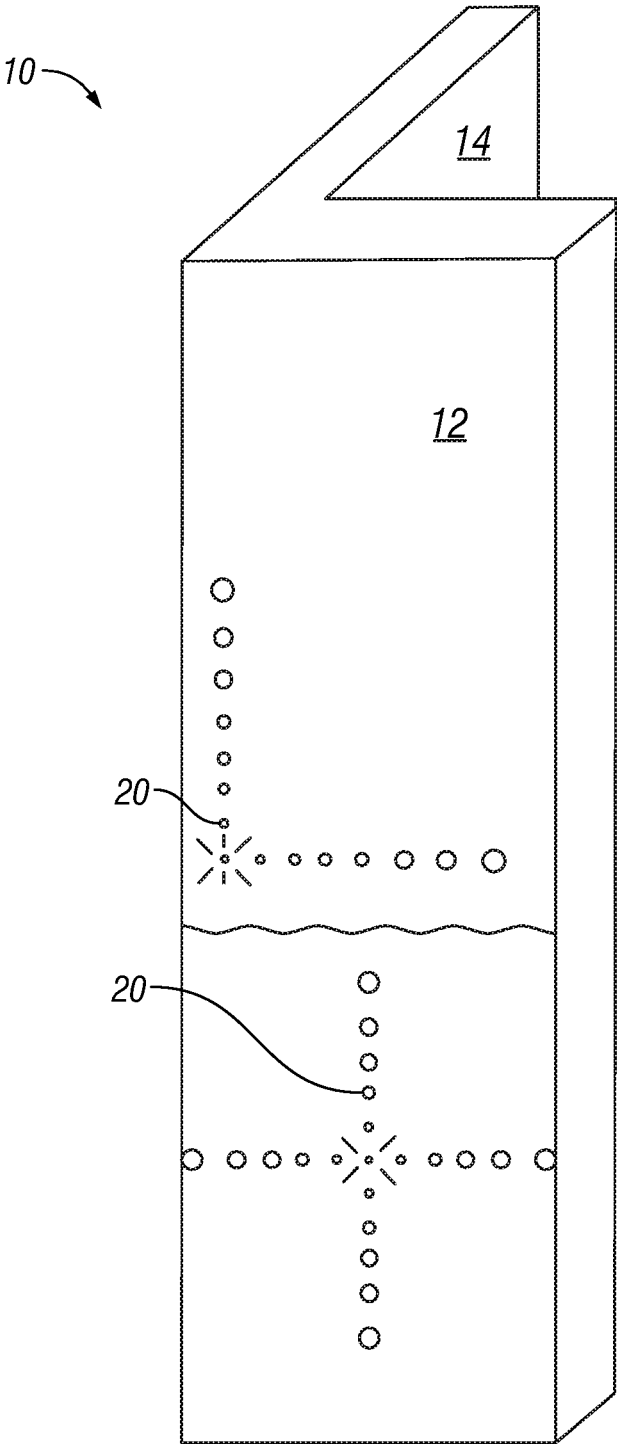


FIG. 14

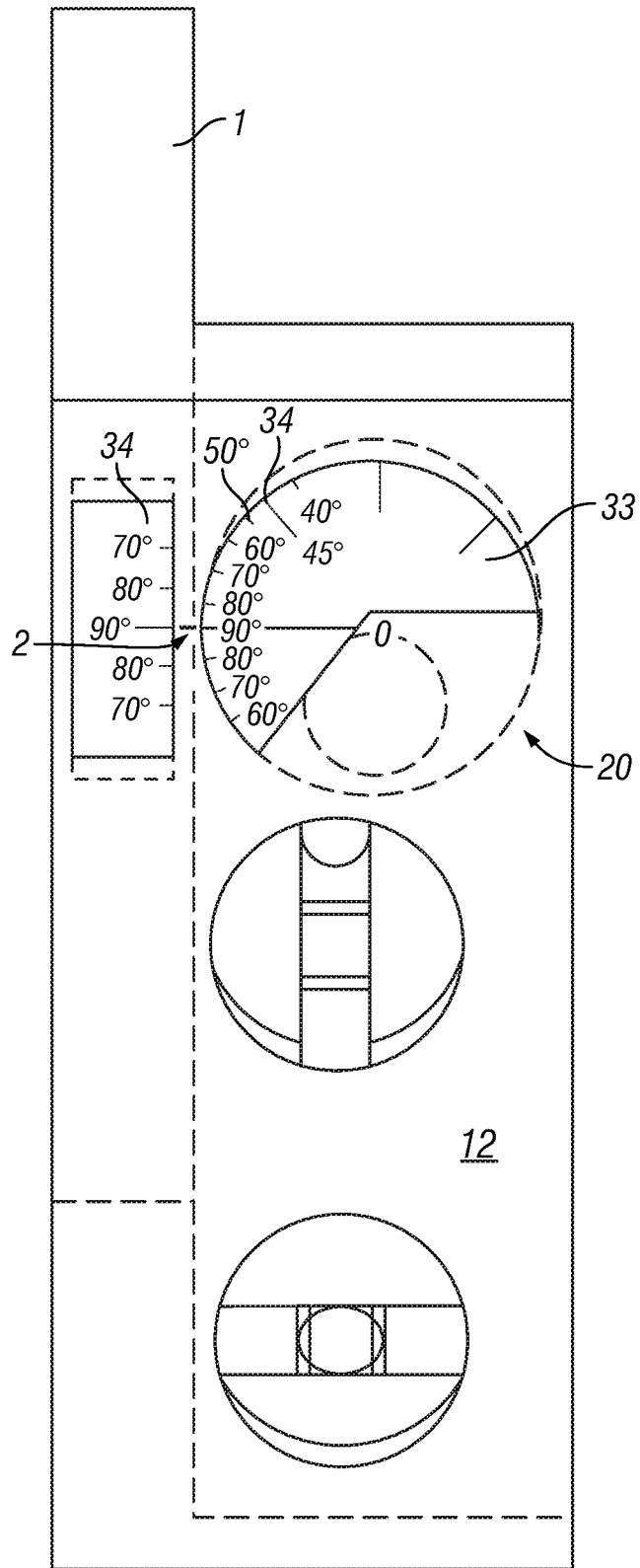


FIG. 15

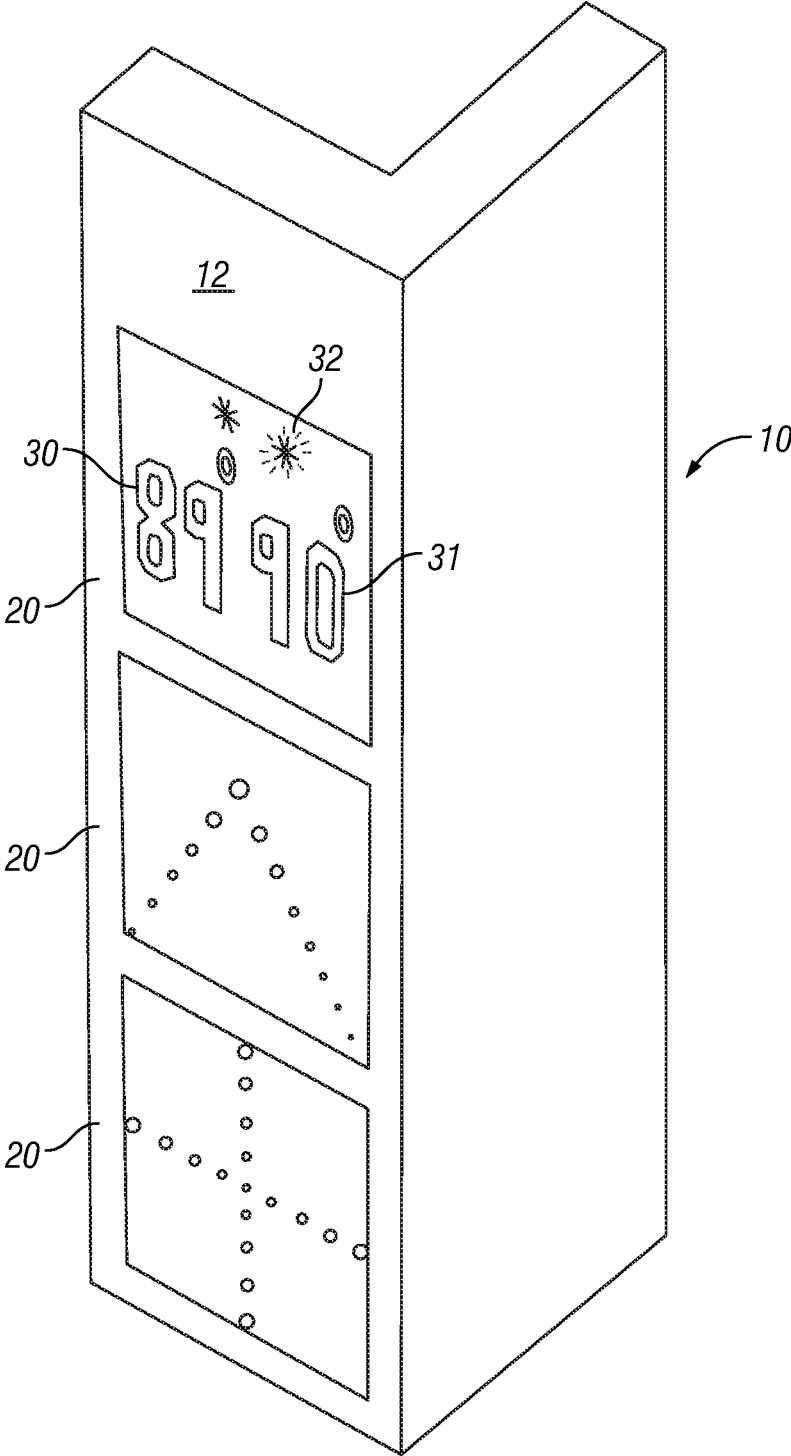


FIG. 16

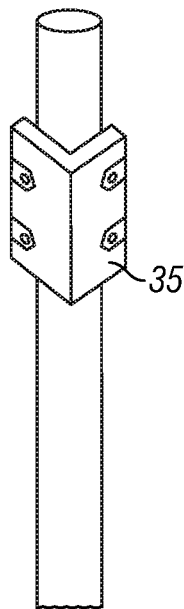


FIG. 17A

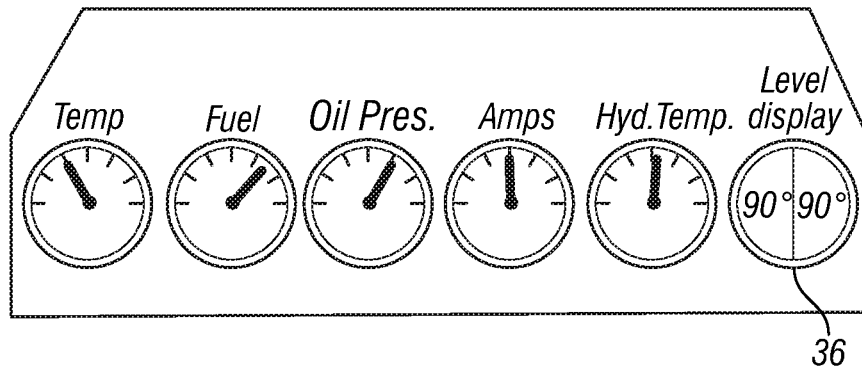


FIG. 17B

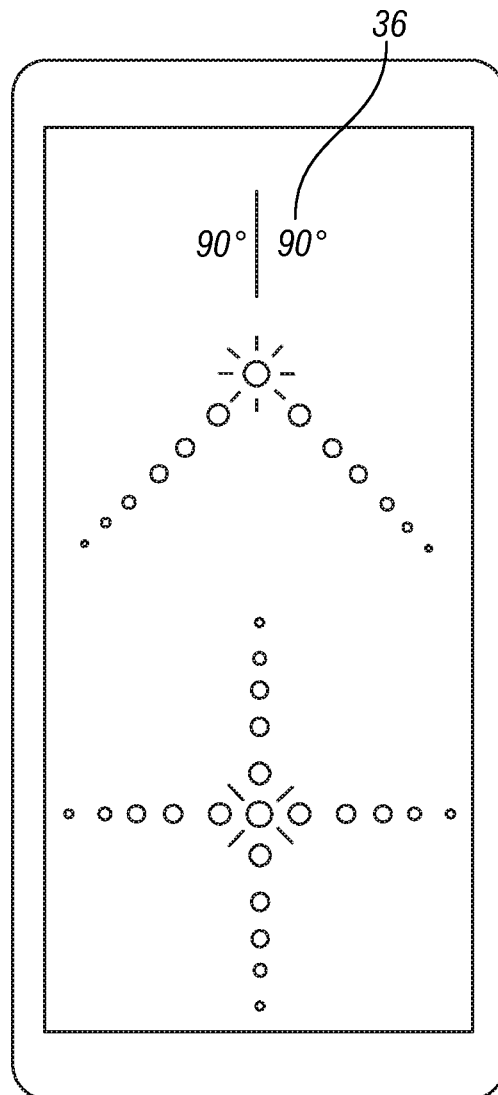


FIG. 17C

**MULTI-DIMENSIONAL LEVEL TOOL WITH
LEVEL INDICATING DEVICES**

**CROSS-REFERENCE TO RELATED
APPLICATIONS**

This application claims priority to and the benefit of the filing of U.S. Provisional Patent Application No. 62/458,137, filed on Feb. 13, 2017, and the specification and figures thereof are incorporated herein by reference.

**STATEMENT REGARDING FEDERALLY
SPONSORED RESEARCH OR DEVELOPMENT**

Not Applicable.

**NAMES OF PARTIES TO A JOINT RESEARCH
AGREEMENT**

Not Applicable.

**INCORPORATION BY REFERENCE OF
MATERIAL SUBMITTED ON A COMPACT
DISC**

Not Applicable.

**STATEMENT REGARDING PRIOR
DISCLOSURES BY INVENTOR**

Not Applicable.

COPYRIGHTED MATERIAL

Not Applicable.

BACKGROUND OF THE INVENTION

Field of the Invention (Technical Field)

The present invention relates to apparatuses and methods of measuring whether a given surface is level, plumb, and/or square.

Description of Related Art

A level device has level indicators, ordinarily one type of level indicator being vertical and one type being horizontal relative to a given surface being leveled. The horizontal type indicators measure the angle of the given surface relative to calibrated level. The vertical type indicators, once the level device is rotated 90 degrees, will indicate whether the given surface is plumb. Determining whether a given vertical object is both level and plumb requires that the level device be rotated 90 degrees, and/or placed on a different surface of the object, and/or that the person modify their position to view an obscured indicator. Sometimes, due to the positioning and environment of the surface being measured, it is impossible or highly inconvenient for the user to reposition or rotate the level device or reposition themselves. What is needed is a device and method of measuring whether a given object, for example a vertically oriented object, is level and plumb without having to rotate or modify the position of the level device or the position of the user of the level device.

BRIEF SUMMARY OF THE INVENTION

Embodiments of the present invention provide a level tool comprising level indicator devices for determining the angle

of a vertically oriented object relative to both level and plumb capable of being read without requiring the tool's user to change his or her position or the position of the level tool. Embodiments of the level tool comprise level indicating devices comprising disks, wheels, pendulums, liquid-filled containers, and/or electronic displays, and any combination thereof.

Objects, advantages and novel features, and further scope of applicability of the present invention will be set forth in part in the detailed description to follow, and in part will become apparent to those skilled in the art upon examination of the following, or may be learned by practice of the invention.

**BRIEF DESCRIPTION OF THE SEVERAL
VIEWS OF THE DRAWINGS**

The accompanying drawings, which are incorporated into and form a part of the specification, illustrate one or more embodiments of the present invention and, together with the description, serve to explain the principles of the invention. The drawings are only for the purpose of illustrating one or more preferred embodiments of the invention and are not to be construed as limiting the invention. In the drawings:

FIG. 1 is an illustration of an embodiment of the level of the present invention with two level indicating devices on its front from a front perspective view;

FIGS. 2A and 2B are illustrations of an embodiment of a level indicating device of the level of the present invention from a side view and front view, respectively;

FIG. 3 is a cross-sectional illustration of an embodiment of the level of the present invention from above looking down;

FIG. 4 is a cut-away illustration of an embodiment of the level of the present invention with two level indicating devices from a perspective view;

FIG. 5 is an illustration of an embodiment of the level of the present invention with several level indicating devices in use with a given surface at 45 degrees in one axis and zero degrees in the other axis as indicated on the level's front;

FIG. 6 is an illustration of an embodiment of the level of the present invention with several level indicating devices indicating 45 degrees in one axis and zero degrees in the other axis as indicated on the level's front;

FIGS. 7A and 7B are illustrations of an embodiment of the level of the present invention with two level indicating devices indicating 90 degrees in one axis and 45 degrees in the other axis from a side perspective view and front view, respectively;

FIG. 8 is an illustration of an embodiment of the level of the present invention with two level indicating devices indicating 45 degrees in one axis and 80 degrees in the other axis from a front perspective view;

FIG. 9 is an illustration of an embodiment of the level of the present invention with two level indicating devices indicating a perfectly plumb surface at 90 degrees in one axis and 90 degrees in the other axis from a front perspective view;

FIG. 10 is a cross-sectional illustration of an embodiment of the level of the present invention from above looking down;

FIGS. 11A and 11B are illustrations of embodiments of level indicating devices of the level of the present invention from a front view, FIG. 11A illustrating a level indicating device having an extension arm;

FIG. 12 is an illustration of an embodiment of the level of the present invention with two level indicating devices

indicating a perfectly plumb surface at 90 degrees in one axis and 90 degrees in the other axis from a front perspective view;

FIG. 13 is an illustration of an embodiment of a level indicating device of the level of the present invention from a front view;

FIG. 14 is an illustration of an embodiment of the level of the present invention with electronic level indicating devices on its front from a front perspective view;

FIG. 15 is an illustration of an embodiment of the level of the present invention with a weighted disc or plate level from a front perspective view;

FIG. 16 is an illustration of an embodiment of the level of the present invention with different embodiments of electronic level indicating devices from a perspective view; and

FIGS. 17A, 17B, and 17C are illustrations of embodiments of remote wire or wireless level indicating devices of the level of the present invention from a front perspective view, FIG. 17A illustrating a level indicating device attached to a pipe, FIG. 17B illustrating a level indicating device receiving data from remote level of the present invention, and FIG. 17C illustrating a smart phone level indicating device.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the figures, a level 10 of the present invention comprises a frame having at least one leg. Preferably, the frame comprises two legs 12 and 14 that join together at a substantially ninety-degree angle, giving the level 10 an L-shaped structure, so that a level indicator device 20 may be embedded in each of the legs 12 and 14 to indicate the angle of more than one dimension (both level and plumb) while permitting level 10 to act also as a square and/or to permit level 10 to be supported on surfaces that are flat and/or have edges. However, legs 12 and 14 may join together at other angles, or be formed as part of a continuous shape, to accommodate certain surfaces and be of any dimensions appropriate for the particular application.

In a preferred embodiment, the frame of level 10 is formed of any rigid material or combination of materials with non-magnetic properties, for example plastic. In this way, the frame's orientation is unaffected by magnetic fields nor can it affect any material in a level indicating device 20. However, some embodiments may be formed of any rigid material, including but not limited to metal, wood, etc., and may comprise magnets placed on or in any surface or part of level 10 for removably attaching level 10 to other objects with magnetic properties.

Embodiments of level 10 of the present invention comprise at least one level indicating device 20 for maintaining an orientation calibrated to level by which the angle of level 10 can be measured. Level 10 may comprise any number of level indicating devices 20 and any combination of types of level indicating devices 20, for example, as illustrated in FIG. 5, a level 10 may comprise a bubble-type level indicating device 20 along with other types of level indicating devices 20.

In a preferred embodiment, level 10 indicates the angle of the level 10 in relation to level and plumb such that the level indicators 20 are visible on level 10 on at least a single surface of level 10. In this way, the user of the level can read the level indicators for more than one dimension from a single perspective without having to re-position the level itself or to substantially alter his or her body position. Preferably, level 10 comprises at least one level indicating

device 20 attached to or embedded within leg 14 to indicate the angle of a first axis relative to level and at least one other attached to or embedded within leg 12 to indicate the angle of a second axis relative to level, both of which are readable from a single side, face, or surface of level 10. Embodiments of the present invention may employ any number of level indicating devices 20, embedded in any part or surface of level 10, with any orientation.

Preferably, a level indicating device 20 having moving parts is enclosed in a transparent liquid filled container 15 embedded within the frame of level 10, the liquid of which (sometimes called "spirit") is of a viscosity and surface tension that will allow a quick and accurate indication of the level, for example, alcohols such as ethanol. In one example illustrated in FIG. 3, two level indicator devices 20 are suspended in liquid-filled container 15 by pins 26 that attach each indicator device 20 to the frame of level 10 while allowing disks 22 to rotate independent of the frame. In another example illustrated in FIGS. 8-10, two level indicator devices 20 having pendulums 25 are suspended in liquid-filled container 15 by pins 26 that attach each indicator device 20 to the frame of level 10 while allowing pendulums 25 to rotate independent of the frame. In some embodiments of level 10, container 15 contains more than one level indicating device, or level 10 comprises more than one container 15. Container 15 may be of any shape capable of containing a level indicating device 20 within the frame of level 10 and may be embedded within any side, surface, leg, or part of level 10. Some embodiments of level 10 do not comprise a liquid-filled container 15.

Embodiments of level 10 of the present invention comprise level indicating device 20 comprising a disk 22, weight 24, pin 26, and level markings 28, for example as illustrated in FIGS. 1-7. As level 10 rotates in any given axis, level indicating device 20 maintains the same orientation relative to gravity because weight 24 keeps its bottom oriented towards the direction of gravity, and a user viewing level indicating devices 20 through the windows 21 can see markings 28 on level indicating devices 20 and read level markings 28 relative to frame markings 29 to determine the orientation of level 10 relative to level.

In order to permit level indicating device 20 to orient itself independent of the frame of level 10, embodiments of the present invention comprise pin bearings or bushings 26 ("pin"). Preferably, a pin 26 is attached to level indicating device 20 such that pin 26 is immovably attached to the level indicating device 20, for example, glued, mated, welded, sealed, or fastened to level indicating device 20 at its center of rotation, and pin 26 is attached at both of its ends to bearings or bushings embedded within the frame of level 10 on both sides of level indicating device 20. In this way, level indicator device 20 and pin 26 rotate together within the bearings or bushings of the frame of level 10. In some embodiments, pin 26 is immovably attached not to the level indicating device 20, but to the frame of level 10, for example, where level indicating device 20 orients itself independent of the pin 26 by use of a bearing or bushing on pin 26 or by virtue of the shape of level indicating device 20. Preferably, pin 26 passes entirely through level indicating device 20 such that pin 26 can attach to the frame of level 10 on both sides of level indicating device 20. However, in some embodiments, pin 26 does not pass all the way through level indicating device 20, for example, where level indicating device 20 is attached to or supported by pin 26 on one end of pin 26. In some embodiments, pin 26 may also pass through other objects, for example container 15.

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Preferably, weight **24** comprises a solid material that is permanently held in the bottom of level indicating device **20** with sufficient mass to substantially maintain level indicating device **20**'s orientation relative to level, for example, lead, brass, etc., of a material which does not evaporate, change form, or expand, and of any shape or size that does not interfere with the function of level indicating device **20**. As illustrated in FIGS. **2B** and **4**, weight **24** is lead bonded to the bottom-most part of level indicating device **20**. As illustrated in FIGS. **8-13**, weight **24** may take the form of a pendulum **25**. In some embodiments, weight **24** may be material attached to or embedded within a part of level indicating device **20**, for example lead balls attached to or embedded within pendulum **25**. Weight **24** comprises any material that flows by gravity to the bottom of disk **22** with sufficient mass to substantially maintain disk **22**'s orientation relative to gravity, for example, lead balls.

Preferably, level markings **28** are marked on the outer surface of level indicating device **20**, for example on disk **22**, calibrated in relation to level. In this way, level can be read relative to the frame of level **10**. Preferably, the zero, 45, and 90 degrees of angle relative to level are marked by numbers printed on the level indicating device **20** itself. Embodiments of the present invention may comprise level markings **28** having any manner or type of markings to mark any degree of angle, for example by points, solid lines, dotted lines, dots, circles, numbers, symbols, words, etc., and placed on the level indicating device **20** by any manner, including printing, gluing, melding, embedding, etching, writing, etc.

Preferably, the frame of level **10** itself is marked with frame markings **29**, at or near windows **21** calibrated to the orientation of the frame of level **10**. Preferably, zero degrees and ninety degrees are indicated by a solid line along window **21**. Embodiments of the present invention may comprise frame markings **29** having any manner or type of markings to mark any degree of angle, for example by points, solid lines, dotted lines, dots, circles, numbers, symbols, words, etc., and placed on the frame of level **10** by any manner, including printing, gluing, melding, embedding, etching, writing, etc.

Preferably, the frame of level **10** comprises windows **21** that allow a user of the level **10** to view a level indicating device **20**. As best seen in FIGS. **1** and **4**, there are two windows **21**, one for each of the two level indicating devices **20**. Because the level indicating device **20** for measuring a first axis is embedded within leg **14**, the window needed to see it is of a rectangular shape the length of which extends along a substantial length of the disk **22**'s diameter. In contrast, the window **21** for viewing the level indicating device **20** embedded within leg **12** is of a circular shape allowing the user to see a substantial amount of its circular face. The shapes of windows **21** may be of any shape allowing the viewer to see a substantial amount of markings **28** on a level indicating device **20**. In some embodiments, for example the embodiments illustrated in FIGS. **8-13**, more than one level indicating device **20** may be viewed from a single window. Preferably, each window **21** comprises a transparent material to protect the level indicating device **20**, for example, a window formed of clear plastic. However, in some embodiments, window **21** may be an empty opening, particularly in embodiments of level **10** comprising a container **15** that already protects level indicating devices **20**. Embodiments of the level **10** of the present invention may comprise any number of windows on any surface or face of

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the level. In some embodiments, windows **21** may permit a user to view a level indicating device **20** from both sides of a leg **12** or **14**.

Referring to embodiments illustrated in FIGS. **8-13**, a level indicating device **20** comprises a pendulum **25**, pin **26**, and pointer **27**. As level **10** rotates in any given axis, level indicating device **20** maintains the same orientation relative to level because pendulum **25** keeps pointer **27** oriented such that it points along the direction of the force of gravity, and a user viewing pointer **27** through the windows **21** can see whether pointer **27** is aligned with frame markings **29** to determine the orientation of level **10** relative to level.

Preferably pointer **27** is calibrated either to point at zero degrees or 90 degrees relative to level, and of a narrow shape that narrows even more as you approach its tip. In this way, the pointer can be read to an accurate degree. However, pointer **27** may take any shape that is capable of indicating any angle.

Preferably, pendulum **25** is weighted with or formed of a material with sufficient mass to substantially maintain pointer **27**'s orientation relative to level, and which is non-magnetic so its orientation is not altered by magnetic fields, for example, lead. Preferably, pendulum **25** and pointer **27** are formed of the same continuous material and the shape of the pendulum is such that it has a larger volume of the material at its end closest to the ground so that most of the level indicating device's weight is at its bottom, for example, as best seen in FIGS. **11A** and **11B**, a kite or diamond shape at its bottom. However, embodiments of the pendulum **25** may be of any shape as long as it substantially orients pointer **27** relative to gravity, and pendulum **25** and pointer **27** may be formed of any materials and different materials than each other.

In the embodiments illustrated in FIGS. **8-13**, two level indicating devices **20** each having a pendulum **25** are visible through a window **21** on a single face of level **10**, for example, the front face of leg **12**. In such embodiments, the pin **26** of one of the level indicating devices **20** is embedded in the leg that does not have the window, for example in leg **14**. In order for the pointer **27** of the level indicator device **20** embedded within the leg not having the window to be viewable in a window **21** of the other leg, an extension arm **23** preferably extends the pointer **27** in a perpendicular direction to the axis of the pendulum **25**, as illustrated in FIGS. **8-10**. The extension arm **23** in the embodiments illustrated preferably has an elbow-shaped bend, that is, the shape comprises an arm at a perpendicular angle to the axis of the pendulum **25** and then the pointer extending at a perpendicular angle to that to extend into leg **12**. To prevent the two pointers **27** of the two level indicating devices **20** from interfering with each other, preferably the pins **26** of the two level indicating devices **20** are at different heights on the level **10**, as best illustrated in FIG. **10**. In this way, the two pointers **27** of the two level indicating devices **20** each having its own pendulum **25** can be read to determine the level **10**'s orientation relative to level in two different axes.

Embodiments of the level **10** of the present invention comprise electronic level indicating devices. As illustrated in FIG. **14**, at least two level indicating devices **20** indicate the orientation of a first and second axis relative to level, both of which are readable from a single side, face, or surface of level **10**. Preferably, each level indicator device comprises an array of lights, for example LEDs, the lights being arranged in distinct patterns for the particular level indicating device **20**. For example, it is preferable to have a cross hair pattern for a level indicating device **20** because a cross hair has four rows of lights intersecting at a single light

in the middle, the middle light indicating that the leg **12** is perfectly level at all angles. Other arrangements of lights may be used, for example, an L-shaped array because an L-shaped array has two rows of lights, the light at the junction of its two rows marking that leg **14** is level. As illustrated in FIG. **16**, embodiments of the level **10** of the present invention may also comprise an electronic level indicating device **20** displaying digital numbers, one number **30** indicating plumb and the other number **31** indicating level, both of which are readable from a single side, face, or surface of level **10**. Preferably, each level indicating device **20** comprises the digital display number **31** and a light **32** in the corner, the light indicating that the leg **12** is perfectly level at all angles.

Referring to the embodiment illustrated in FIG. **15**, a level indicating device **20** comprises a weighted wheel, disc, or plate **33**. Degrees of angle **34** are aligned on wheels, disc, or plate **33**, such that when level **10** is perfectly plumb and level, the wheels **33** align with the frame, allowing the user to focus on only one location on level **10**. This embodiment may have spirit levels that allow the level **10** to be used on any horizontal or vertical object. This embodiment may also have magnets to hold level on pipes, beams, or any metal item. Level may also have straps to hold it on to any wood or plastic item.

Referring to the embodiment illustrated in FIG. **17**, a level indicating device **20** comprises a remote device **35** that may be secured to an object that needs to have both planes of level read. Preferably, each level indicating device **20** will have a wire or wireless remote display **36** that communicates with the particular level indicating device. For example, a smart phone app may be used to communicate via Bluetooth to the level **10** in order to remotely display the electronic level indicating device.

Although the invention has been described in detail with particular reference to these embodiments, other embodiments can achieve the same results. Variations and modifications of the present invention will be obvious to those skilled in the art and it is intended to cover all such modifications and equivalents.

What is claimed is:

1. An apparatus for indicating an angle of an object relative to both level and plumb comprising:

an L-shaped frame comprising a first side and a second side substantially perpendicular to said first side;

a first indicating apparatus disposed on said L-shaped frame and configured to indicate an angle of a first axis relative to level;

a second indicating apparatus disposed on said L-shaped frame and configured to indicate an angle of a second axis relative to level; and

wherein said second indicating apparatus is at least partially disposed on said first side of said L-shaped frame and wherein said first indicating apparatus and said second indicating apparatus are both at least partially displayed on said first side of said L-shaped frame;

wherein said first indicating apparatus and said second indicating apparatus are at least partially embedded within said L-shaped frame; and

wherein said first indicating apparatus comprises a first indicator disk and wherein said second indicating apparatus comprises a second indicator disk and wherein said first indicating apparatus and said second indicating apparatus comprise a weighted portion and further wherein said first indicator disk and said second indicator disk each comprise a diameter and an edge having a thickness.

2. The apparatus of claim **1** wherein said first and second indicating apparatuses are positioned such that both are observable from a single location without repositioning said L-shaped frame.

3. The apparatus of claim **2** wherein said first and said second indicating apparatuses are observable at the same time.

4. The apparatus of claim **1** further comprising at least one window disposed on a single side of said L-shaped frame through which said first and said second indicating apparatuses are both at least partially displayed.

5. The apparatus of claim **1** further comprising a first window disposed on said first side of said L-shaped frame and through which said first indicating apparatus is at least partially displayed, and a second window disposed on said first side of said frame and through which said second indicating apparatus is at least partially displayed.

6. The apparatus of claim **1** wherein at least one of said first and second indicating apparatuses comprises a pin disposed at the center of orientation of said first and second indicating apparatuses.

7. The apparatus of claim **6** wherein said pin is attached to said L-shaped frame such that said pin is immovable.

8. The apparatus of claim **7** wherein said pin passes entirely through at least one of said first indicating apparatus or said second indicating apparatus.

9. The apparatus of claim **8** wherein said weighted portion of said first indicating apparatus is at least partially contained within said first indicator disk, and said weighted portion of said second indicating apparatus is at least partially contained within said second indicator disk.

10. The apparatus of claim **1** further comprising a first pin about which said first indicator disk rotates and further comprising a second pin about which said second indicator disk rotates and wherein said first pin comprises a primary axis which is at least substantially perpendicular with respect to a primary axis of said first side of said L-shaped frame and said second pin comprises a primary axis which is at least substantially perpendicular with respect to a primary axis of said second side of said L-shaped frame and further wherein said primary axis of said first pin is at least substantially perpendicular with said primary axis of said second pin.

11. The apparatus of claim **10** further comprising a first window disposed on said first side of said L-shaped frame through which at least a portion of said diameter of said first indicator disk or said second indicator disk is visible and further comprising a second window disposed on said first side of said L-shaped frame through which at least a portion of said edge of said second disk is visible.

12. The apparatus of claim **1** wherein at least one of said first indicating apparatus or said second indicating apparatus comprises a pointer.

13. The apparatus of claim **12** wherein said at least one of said first indicating apparatus or said second indicating apparatus comprises an extension arm configured to extend said pointer in a perpendicular direction to the direction of gravity.

14. The apparatus of claim **1** further comprising an electronic display and an array of lights arranged in distinct patterns.

15. The apparatus of claim **14** wherein said electronic display displays at least two digital numbers, one of said at least two digital numbers indicating the angle of the object relative to level and another of said at least two digital numbers indicating the angle of the object relative to plumb.

16. The apparatus of claim **1** further comprising magnets.

17. The apparatus of claim 1 further comprising markings on said L-shaped frame indicating various angles.

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