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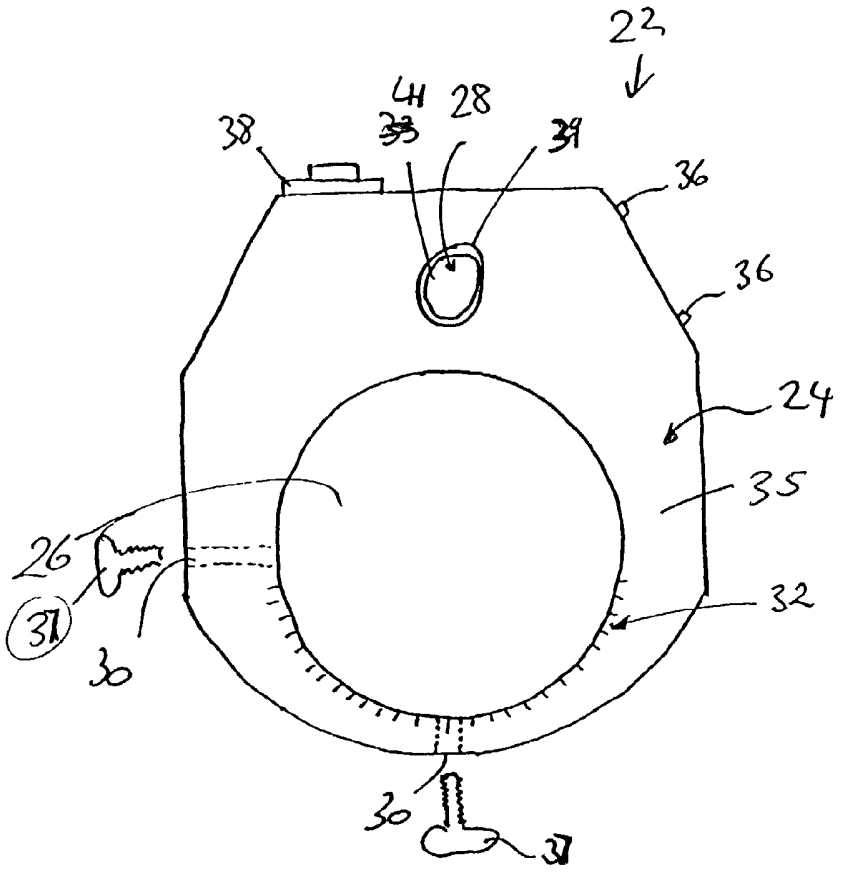

(57) Abstract: An adaptor (22) is described for use with a line of sight measurement instrument (10) having a lens (14) and lens hood (16). The instrument (10) typically emits a laser beam through the centre of lens (14). The adaptor (22) includes a body (24) provided with an opening (26) dimensioned to fit over the lens hood (16), and a laser module (28) supported by the body (24) for emitting a line laser beam. The body (24) is supported and can be rotated about the lens hood (16) to vary the rotational position from which the laser beam from laser module (28) is emitted relative to the lens (14). In one embodiment, the opening (26) extends through the whole length of the body (24) so as to open onto opposite faces (31 and 35). The module (28) is disposed so that the line beam emitted therefrom is intersected by the laser beam emitted from the instrument (10).

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

ADAPTOR FOR A LINE OF SIGHT MEASUREMENT INSTRUMENT

Field of the Invention

[0001] The present invention relates to an adaptor for a line of sight measurement instrument including surveying equipment and more particularly to an adaptor for a total station (also known as a theodolite).

Background of the Invention

[0002] Many different companies such as LEICA and PENTAX manufacture total stations and similar surveying equipment which project a point laser beam. Such total stations typically include a housing which contains a laser and other electronic equipment and a lens on a front face of the housing through which the laser beam is emitted. The lens is typically surrounded by a protective annular hood.

[0003] This type of total station is often used in mining to mark the back (ie the roof) or other walls of a tunnel or other excavation. When it is required to mark a line typically a surveyor would use the point laser beam to project a point at a desired location on the wall, mark that point with paint and then repeat the exercise two or more times in order to produce sufficient points from which a line can be drawn. While this does achieve the desired result of marking a line it is particularly inefficient.

[0004] The present invention was initially developed to provide means which attempt to overcome the above noted deficiencies in the prior art. However, embodiments of the present invention are not limited to application to laser projecting total station but may be used on non-laser projecting total station, or other surveying, optical or targeting equipment and devices and line of sight measurement instruments, whether they be laser or non-laser projecting. Such equipment and devices are hereinafter referred to generally, in the singular, as "a line of sight measurement instrument".

Summary of the Invention

[0005] According to the present invention there is provided an adaptor for a line of sight measurement instrument having a housing, a lens provided on the housing and a lens hood projecting from said housing over said lens, said adaptor including:

a body provided with an opening dimensioned to fit over said hood; and,

at least one laser module emitting a laser beam supported in said body;

whereby, in use, said body can be supported on and rotated about said lens hood to vary the position from which the laser beam is emitted relative to the lens.

[0006] Preferably the laser beam is emitted as a line beam.

[0007] In one embodiment, said body has a first end with a first face and a second opposite end with a second face, and said opening extends axially through said body and opens onto both said first face and said second face.

[0008] Preferably, when said line of sight measurement instrument projects a point laser beam from said lens, said laser module is disposed in said body at a location so that the line beam intersects the point beam.

[0009] In an alternate embodiment, said body has a first end with a first face and a second opposite end with a second face, and said opening opens onto said first face and extends axially toward and terminates prior to reaching, said second face.

[0010] In this embodiment, said laser module is supported in said body at a location whereby the laser beam emitted by said laser module would be intersected by a line along which a point beam emitted by said line of sight measurement instrument extends.

[0011] Preferably said body includes a first cavity for receiving one or more

batteries for providing electrical power to said laser module.

[0012] Preferably said body includes a second cavity for receiving a switch for selectively connecting said laser module to, and disconnecting said laser module from, said one or more batteries held in said cavity.

[0013] In a further embodiment, said adaptor includes a detachable battery pack and a docking station on said body for demountably receiving said battery pack and providing electrical coupling between said battery pack and said laser module.

[0014] Preferably said docking station includes a recess formed on said body and a clip attached to said body in said recess to which said battery pack is demountably received.

[0015] Preferably said clip includes at least one resiliently biased member protruding from a free face of said clip over which said battery pack is disposed when received in said dock, said at least one resiliently biased member biasing said battery pack away from said free face.

[0016] Preferably said adaptor further includes means for releasably clamping said adaptor to said lens hood.

[0017] Preferably said means for releasably clamping includes one or more holes formed transversely through said body and respective mechanical fasteners which extend through said holes and can be selectively brought into engagement with, and disengagement, from said lens hood.

[0018] Preferably said body includes a scale for providing an indication of the degree of rotation of said body about said lens from a reference point.

Brief Description of the Drawings

[0019] Embodiments of the present invention will now be described by way of example only with reference to the accompanying figures in which:

Figure 1 is a plan view of a first embodiment of the adaptor according to the present invention;

Figure 2 is a side view of the adaptor depicted in Figure 1;

Figure 3 is a representation of a total station in respect of which embodiments of the present adaptor can be used;

Figure 4 is a perspective view of the second embodiment of the present invention;

Figure 5 is an exploded view of the embodiment depicted in Figure 4;

Figure 6 is a wiring diagram of the embodiment depicted in Figures 4 and 5;

Figure 7 is a perspective view of a third embodiment of the present invention;

Figure 8 is an exploded view of the embodiment depicted in Figure 7;

Figure 9A is a plan view of a clip incorporated in the embodiment depicted in Figures 7 and 8;

Figure 9B is a view of the clip shown in Figure 9A along section AA;

Figure 9C is a view of the clip depicted in Figure 9A along section BB;

Figure 9D is an exploded partial view of the clip showing connection of an electrical contact; and,

Figure 10 is a wiring diagram of the embodiment depicted in Figures 7-9C.

Detailed Description of Preferred Embodiment

[0020] Prior to describing an embodiment of the present invention, reference is made to Figure 3 which depicts a typical form of a line of sight measurement instrument in the form of a known total station 10. The total station 10 includes a housing 12 which houses various electronic and optical devices and is provided with a lens 14. When the total station is a laser beam projecting total station, typically a point laser beam will be emitted from a central point of the lens 14. The lens 14 is protected by a lens hood 16 which projects forward of a front face 18 of the housing 12. Depending on the model and brand of the total station 10 a control panel 20 may be provided which includes a display and has keys to allow the entry of data. The total station 10 however by itself does not form part of the present invention. Rather, the total station is merely the vehicle in respect of which the present invention can be used.

[0021] In Figures 1 and 2, depict an embodiment of an adaptor 22 in accordance with the present invention for use with the total station 10. The adaptor 22 includes a body 24 provided with an opening 26 dimensioned to fit over the lens hood 16 and, a laser module 28 supported in the body 24 for emitting a laser beam. In use, the body 24 is supported and can be rotated about the lens hood 16 to vary the rotational position from which the laser beam from laser module 28 is emitted relative to the lens 14. The opening 26 extends from one axial end 29 of the body 24, opening onto a corresponding face 31, through the body 12 to opposite axial end 33 opening onto corresponding face 35. That is, the opening 26 extends axially through the body 24.

[0022] Preferably, the opening 26 is dimensioned so as to provide an interference fit over the lens hood 16 to the extent that the body 24 can be rotated about the lens hood 16 and self maintain the position to which it is rotated. However in an alternate embodiment, the opening 26 may be dimensioned to provide a clearance with the outer surface of the hood 16 in which case, the adaptor 22 is further provided with a clamping

means for releasably clamping the adaptor 22 to the lens hood 16. The clamping means includes one or more holes (in this case two) 30 formed transversely through the body 24 and respective mechanical fasteners such as screws or wing head bolts 37 which pass through the holes 30 and can be subsequently brought into engagement with and disengagement from the lens hood 16. To this end, the holes 30 are tapped to effect screw coupling with the bolts 37. As is apparent from Figure 1, and indeed implied from the above description, the holes 30 open onto the surface of the opening 26.

[0023] Most advantageously, the laser module 28 emits a laser beam in the form of a line ie a laser beam which, when striking a surface, projects a line rather than a point. With the adaptor in the orientation shown in Figure 1 the line beam would be vertical. The adaptor 22 is arranged so that when the laser module 28 emits a line beam, and the total station 10 emits a point laser beam, the line passes through or substantially adjacent to the point beam emitted by the total station 10 irrespective of the relative angular position of the body 24 relative to the lens 14. The laser module 28 is housed in a recess 39 formed in the body 24 and is covered by a lens 41.

[0024] A scale 32 is marked on face 35 of the body 24 for providing an indication of the degree of rotation of the body 24 about the lens 14 from a reference point. The reference point may correspond with a vertical marking (not shown) on the lens hood 16.

[0025] The housing 24 is provided with a cavity (not shown) in Figures 1-3 for housing a battery providing power to the laser module 28. The cavity is covered by plate 34 which is fixed to the body 24 by four screws 36. When the battery runs flat, the screws 36 are undone, the plate 34 removed, the battery replaced and plate 34 then reattached.

[0026] A switch 38 is mounted on a radially outer surface of the body 24 for turning the laser module ON and OFF.

[0027] In use, the adaptor 22 is fitted onto the lens hood 16 of the total station 10. If

it is desired to mark a line using the total station 10, a point in that line is first projected using the total station 10 in the normal manner on a wall. Once the point has been located and projected the laser 28 is turned ON to produce the line that passes through the point. By rotating the body 24 about the hood 16, the line can be inclined to a required angle.

[0028] A second embodiment of the adaptor denoted as item 22' is depicted in Figures 4-6 in which similar numbers are used to denote the same or similar features as those described in relation to the first embodiment. One substantive difference between the adaptor 22' and the adaptor 22 is that the opening 26 in the adaptor 22' extends only partially in the axial direction from the end 29 opening onto the face 31. That is, the opening 26 does not reach the second axial end 33 of the body 12 and does not open onto the corresponding face 35. Thus in this embodiment, the opening 26 is in the form of a blind hole. A further substantive difference is that the laser module 28 is now mounted at a location on the body 22 where a line laser beam emitted by the module 28 intersects an axis 42 of the opening 26. The axis 42 in turn is intended to be in alignment with a point laser beam emitted from the station 10. Also, the recess 39 into which the module 28 is disposed is provided with an increased diameter portion 44 adjacent the axial end 35 and formed with a screw thread for threadingly engaging a housing 46. The housing 46 is provided with an internal bore 48 for partially receiving the module 28 and a reduced diameter tail section 50 provided with a screw thread for engaging the thread on the portion 44. A seat 52 is formed at a forward end of the housing 46 for receiving the lens 41.

[0029] Figure 5 further depicts a cavity 54 into which a battery 56 is disposed for providing electrical power to the laser module 28. The cavity 54 is closed by the plate 34 and screws 36. The wiring of the adaptor 22 is particularly simple with one electrical conductor 58 extending from a positive terminal of the battery 56 to one terminal of the switch 38, an electrical conductor 60 extending from an opposite terminal of the switch 38 to one terminal of the laser module 28, and a further electrical conductor 62 extending between a second terminal of the module 28 and the negative terminal of the battery 56.

[0030] In this embodiment, the module 28 emits a line beam which contains a point coincident with a spot that would be produced by a point laser beam emitted from the total station 10 with the adaptor 22' removed from the hood 16. Thus, in effect, the adaptor 22' converts a point beam total station 10 into a line beam total station.

[0031] Figures 7-10 depict a further embodiment 22" of the adaptor. The embodiment 22' is similar to the embodiment 22' depicted in Figures 4-6, the main differences being the relocation of the switch 38, and the replacement of the battery 56 and battery cavity 54 with a detachable battery pack 56 and a docking station 64 for demountably receiving the battery pack 56. Ideally, the battery pack 56 includes rechargeable batteries and has external contacts 57.

[0032] The docking station 64 includes a recess 66 formed in an outer circumferential surface 68 of the body 24 and a clip 70 which is attached to the body 64 in the recess 66. The clip 70 is in the form of a tray having a substantially planar surface 72 which is disposed substantially parallel to a bottom surface of the recess 66, and side walls 74 extending along the opposite longitudinal edges of the web surface 72. The web surface 72 is provided with four spaced apart holes 76 which are disposed at the corners of an imaginary rectangle for receiving screws 78 to fasten the clip 70 into the recess 66. A further hole 80 is formed in the planar web 72 along its longitudinal axis and approximately one quarter of the way in from one end 81 of the clip 70. As depicted most clearly in Figure 9B, the hole 80 is formed with a reducing diameter in a direction from an undersurface 82 toward a free surface 84 of the planar web 72. The hole 80 accommodates a resiliently biased member in the form of a ball 86 which is biased by a spring 88. The ball 86 and spring 88 are held within the hole 82 by a plate 90 which is attached by screws 92 to the undersurface 82 of the planar web 72. The diameter of the hole 80 where it opens onto the free surface 84 is less than the diameter of the ball 86 so that the ball 86 can protrude partially through the hole 80 beyond the free surface 84.

[0033] Each of the side walls 74 is provided with two spaced apart inwardly

projecting tongues 94 for receipt in respective longitudinal grooves 96 formed along opposite sides of the battery pack 56.

[0034] Two blind holes 98 are formed in the planar web 72 from the undersurface 82 approximately one quarter of the distance inward from an end 99 of the planar web 72. The holes 98 receive screws 100 for attaching electrical contacts 101 to the web 72 and providing electrical communication to the electrical conductors 58 and 62 (see Figure 10). The screws 100 provide this electrical communication by abut with electrodes (not shown) that extend into the recess 66 and are electrically connected to conducts 58 and 62.

[0035] Two longitudinally extending spaced apart slots 102 are formed in the planar web 72 from end 99 of the planar web 72 extending approximately half way to, and in alignment with, the holes 98. The slots receive upturned fingers 104 of the contact 101.

[0036] To couple the battery pack 56 to the clip 70, the grooves 96 are aligned with the tongues 94 and the battery pack 56 slid into the clip 70 from the end 81. The ball 86 is biased into a position where it will contact an undersurface of the battery pack 56 as the battery pack 56 is being pushed home in the clip 70. As this occurs, the ball 86 is forced in a downward direction compressing the spring 88. The ball 86 and spring 88 continue to apply upward force to the battery pack 56 effectively holding it in the clip 70. When the battery pack 56 is in the home position, electrical contacts 57 on the battery pack 56 are placed into electrical contact with the contacts 101.

[0037] As shown in Figure 10, electrical conductor 58 connects one of the contacts 100 with one contact of the switch 38; a further conductor 60 connects a second contact of the switch 38 with a contact of the laser module 28; and, electrical conductor 62 connects a second contact of the module 28 with the other electrical contact 101.

[0038] As previously mentioned, the adaptor 22" also differs from the adaptor 22' by virtue of the switch 38 being housed in a recess 39 which opens onto face 35 of axial end 33 of the body 24.

[0039] Now that an embodiment of the present invention has been described in detail it will be apparent to those skilled in the relevant arts that numerous modifications and variations may be made without departing from the basic inventive concepts. For example, if desired, a plurality of lasers 28 can be provided about the body 24. In such an embodiment, the shape of the body 24 may be modified in order to provide sufficient space in which to mount the additional modules. For example, referring to Figure 1, a second module may be provided diagonally opposite the laser 28 spaced by the opening 26. The two modules can each project point beams which are arranged to lie in a line which also includes point beam emitted by the total station . In yet a further modification a second laser module may be placed adjacent laser module 28 for projecting a line beam perpendicular to a line beam projected by laser module 28 so that together the two laser modules project a cross beam with a centre point offset from the centre of lens 14 and a point beam projected by the total station 10. In a further modification a second laser module may be placed at location 90° from laser module 28 on the body 24 to project a line beam which perpendicularly intersects the line beam from laser module 28, and the point beam from total station 10. Thus the two modules again project a cross beam but this time the intersection point of the cross beam coincides with the point beam of the total system 10.

[0040] All such modifications and variations are deemed to be within the scope of the present invention the nature of which is to be determined from the above description and the appended claims.

The Claims Defining The Invention Are As Follows:

1. An adaptor for a line of sight measurement instrument having a housing, a lens provided on the housing and a lens hood projecting from said housing over said lens, said adaptor including:

a body provided with an opening dimensioned to fit over said hood; and,

at least one laser module emitting a laser beam supported in said body;

whereby, in use, said body can be supported on and rotated about said lens hood to vary the position from which the laser beam is emitted relative to the lens.

2. The adaptor according to claim 1 wherein, the laser beam is emitted as a line beam.

3. The adaptor according to claim 2 wherein, said body has a first end with a first race and a second opposite end with a second face, and said opening extends axially through said body and opens onto both said first face and said second face.

4. The adaptor according to claims 2 or 3 wherein, when said line of sight measurement instrument projects a point laser beam from said lens said module is disposed in said body at a location so that the line beam intersects the point beam.

5. The adaptor according to claim 1 wherein, said body has a first end with a first face and a second opposite end with a second face and said opening opens onto said first face and extends axially toward and terminates prior to reaching, said second face.

6. The adaptor according to claim 5 wherein, the laser beam is emitted as a line beam.

7. The adaptor according to claim 6 wherein, said laser module is supported in said

body at a location whereby the laser beam emitted by said laser module would be intersected by a line along which a point beam emitted by said line of sight measurement instrument extends.

8. The adaptor according to any one of claims 1-7 wherein, said body includes a first cavity for receiving one or more batteries for providing electrical power to said laser module.

9. The adaptor according to any one of claims 1-7 wherein, a detachable battery pack and a docking station on said body for demountably receiving said battery pack and providing electrical coupling between said battery pack and said laser module.

10. The adaptor according to claim 9 wherein, said docking station includes a recess formed on said body and a clip attached to said body in said recess to which said battery pack is demountably received.

11. The adaptor according to claim 10 wherein, said clip includes at least one resiliently biased member protruding from a free face of said clip over which said battery pack is disposed when received in said dock, said at least one resiliently biased member biasing said battery pack away from said free face.

12. The adaptor according to any one of claims 1-11 wherein, said body includes a cavity for receiving a switch for selectively connecting said laser module to, and disconnecting said laser module from, said one or more batteries.

13. The adaptor according to any one of claims 1-12 wherein, said adaptor further includes means for releasably clamping said adaptor to said lens hood.

14. The adaptor according to claim 13 wherein, said means for releasably clamping includes one or more holes formed transversely through said body and respective mechanical fasteners which extend through said holes and can be selectively brought into engagement with, and disengagement from, said lens hood.

15. The adaptor according to any one of claims 1-14 wherein, said body includes a scale for providing an indication of the degree of rotation of said body about said lens from a reference point.

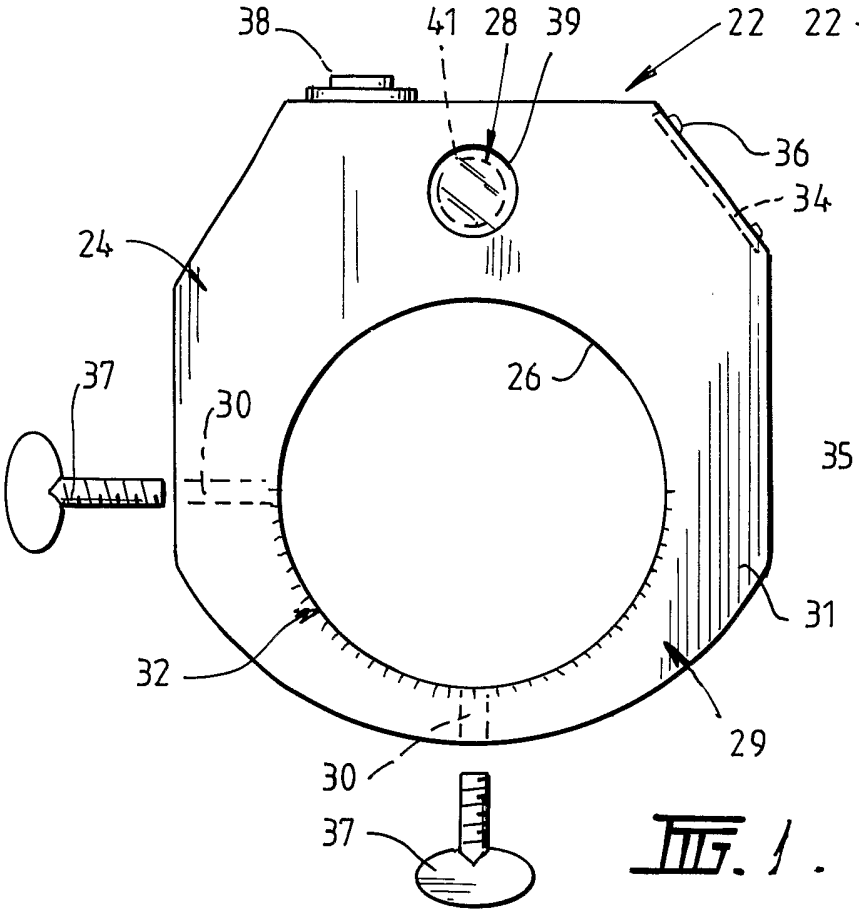


FIG. 1.

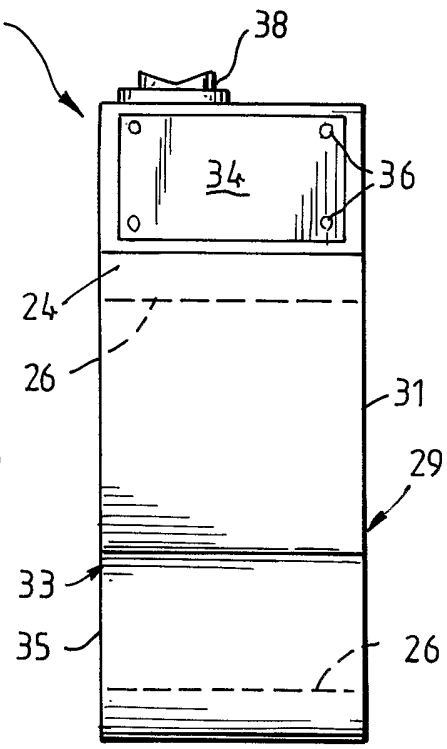


FIG. 2.

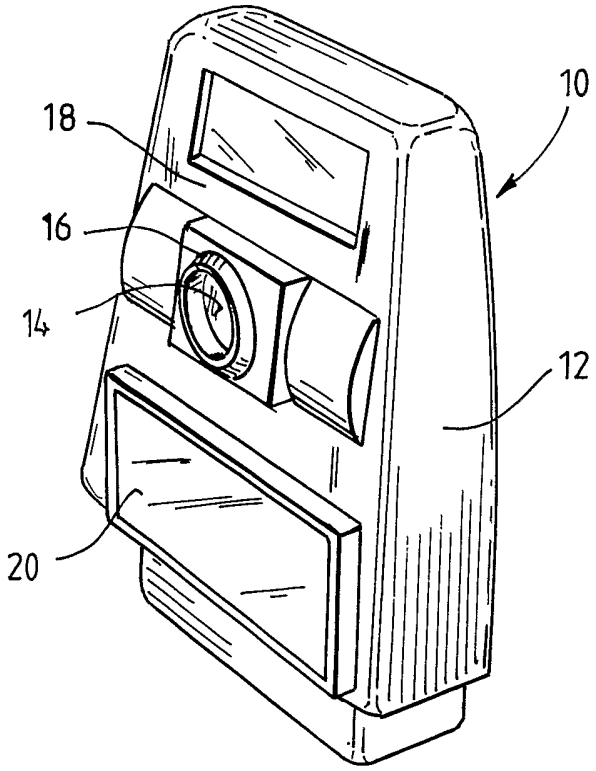


FIG. 3.

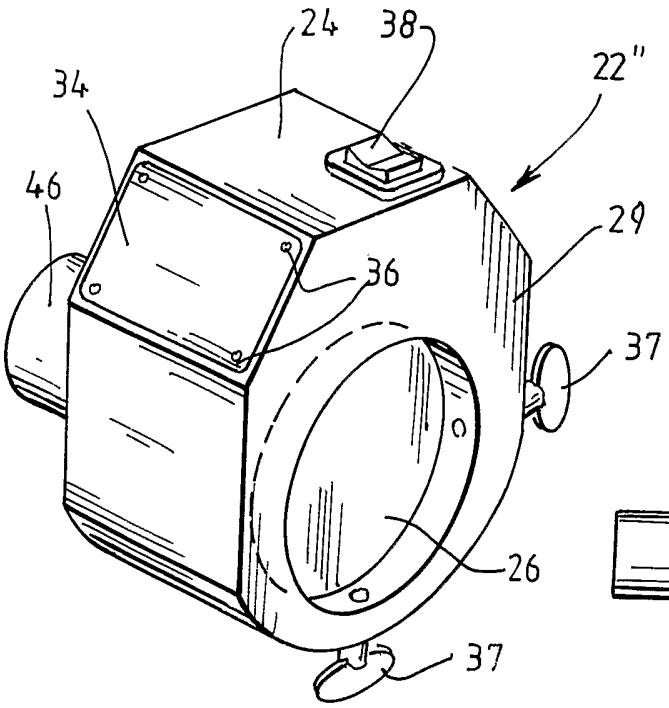


FIG. 4.

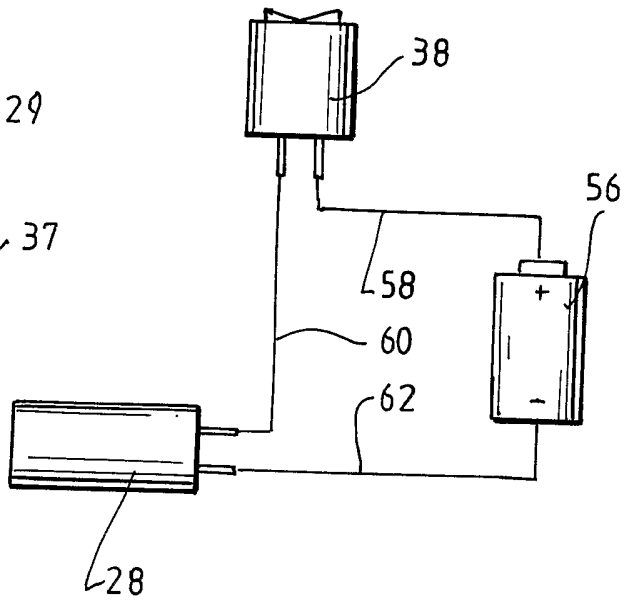


FIG. 6.

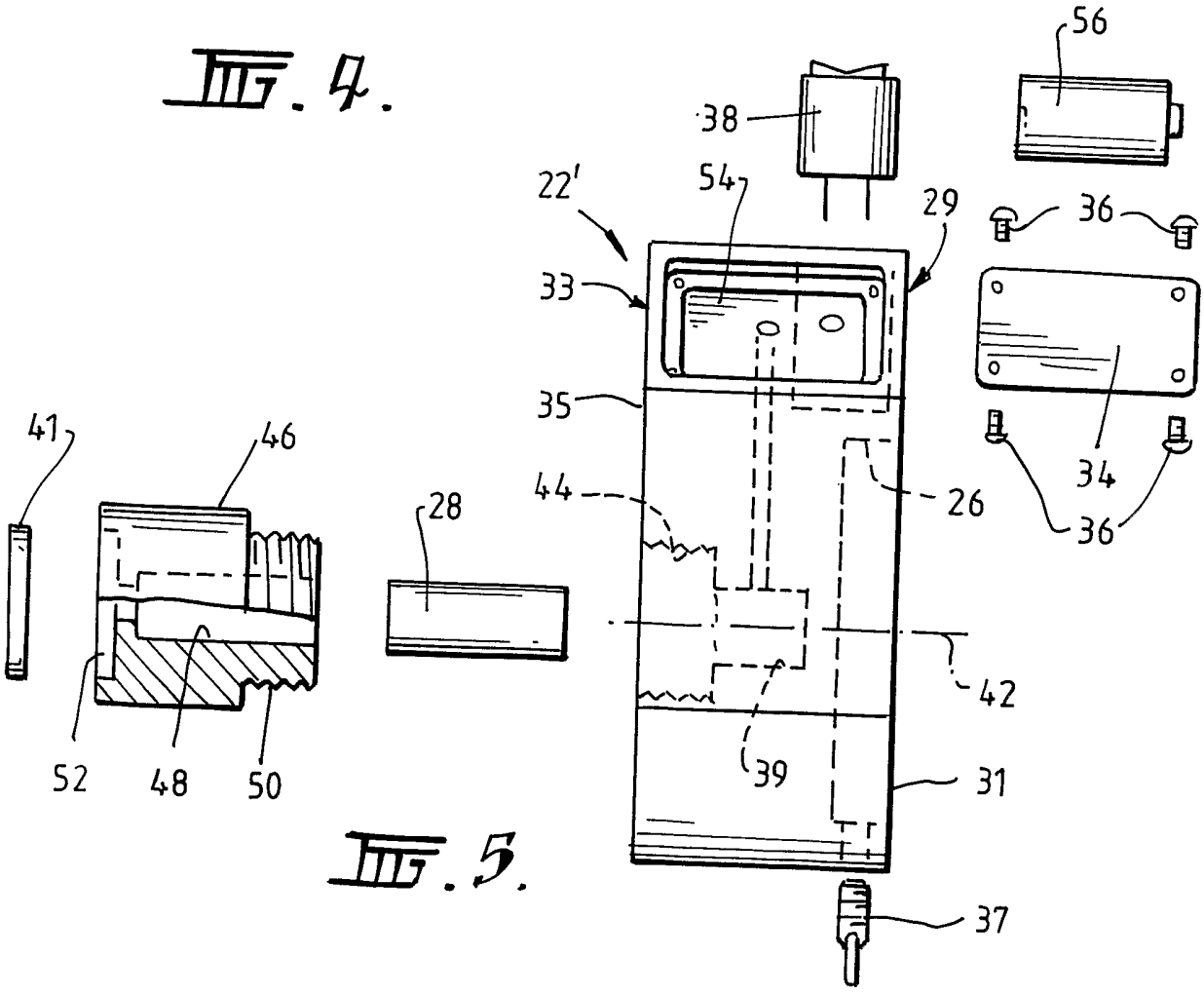
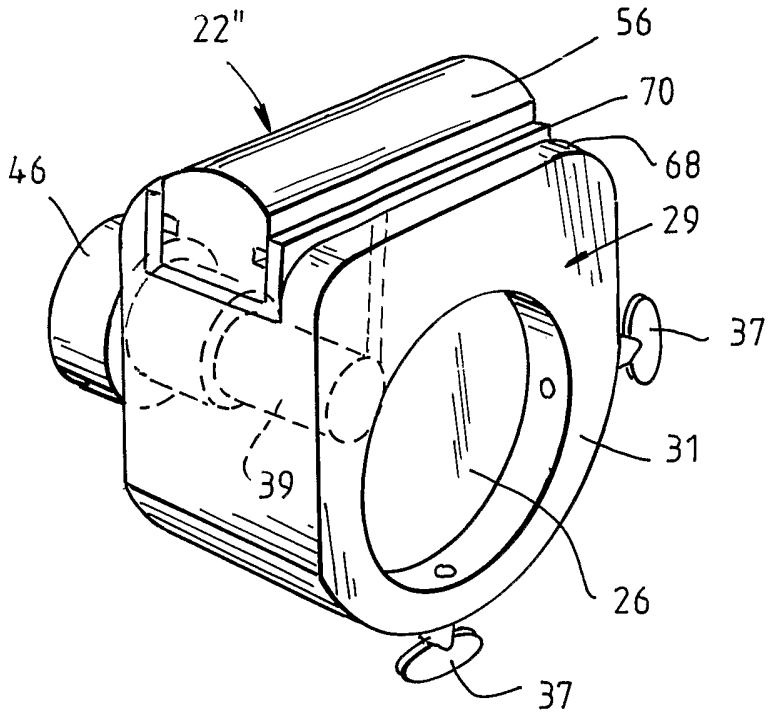


FIG. 5.


22"
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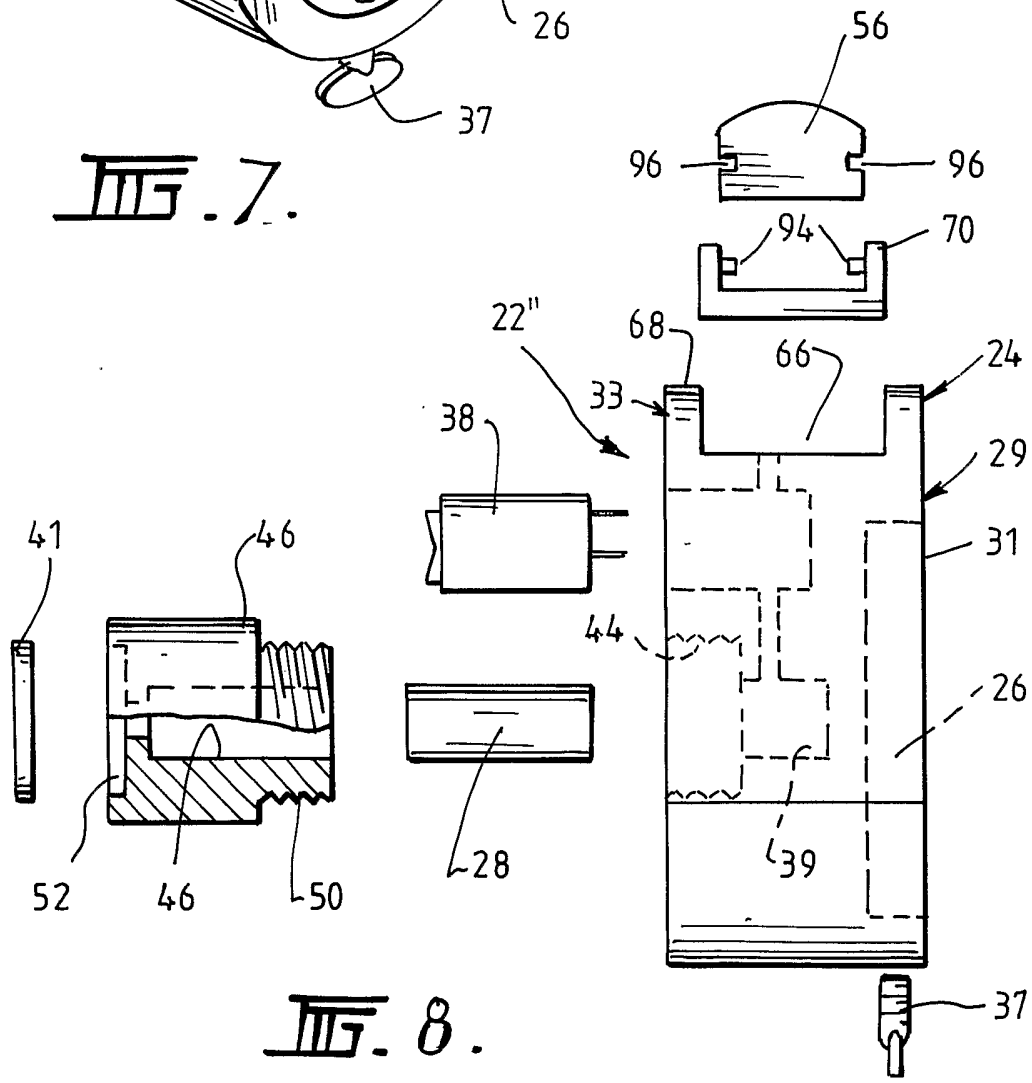
37

FIG. 7.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22"
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FIG. 8.

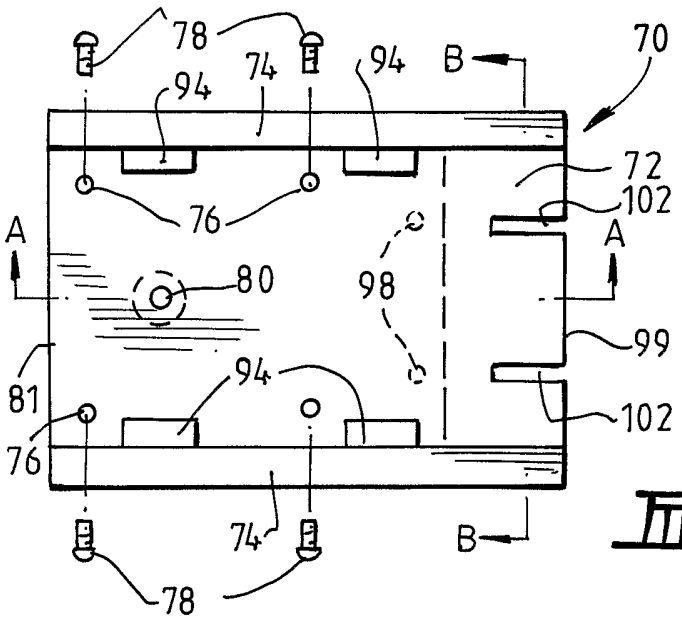


FIG. 9A

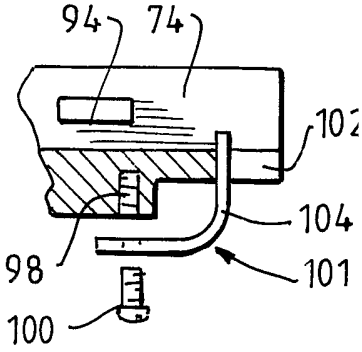


FIG. 9D

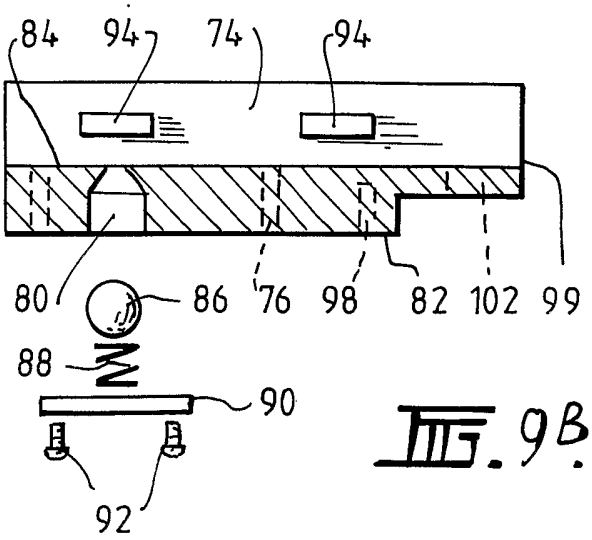


FIG. 9B

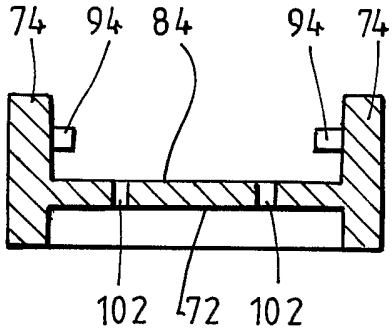
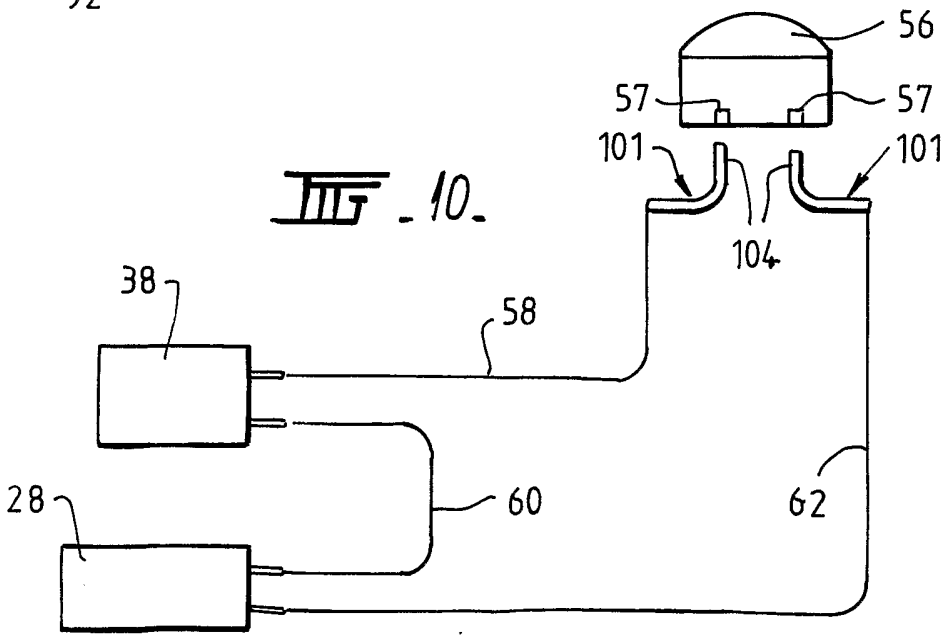


FIG. 9C

FIG. 10



INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU02/01622

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: G01C 15/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DWPI, keywords: theodolite, line of sight, (survey+, mark+, level+) (2D) (equipmet, apparatus, instrument, device); laser; line; rotat+, pivot+, turn+, revolv+, twist+; G01C/- and (laser, light); lens+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5838431 A (HARA et al.) 17 November 1998 Whole document	1-15
A	Derwent Abstract Accession No. 96-191579/20, Class S02, JP 08-061954 A (MIZUNO K) 8 March 1996 Abstract	1-15
A	Derwent Abstract Accession No. 98-207509/18, Class S02, WO 98/11407 A1 (WILLIAMS N E) 19 March 1998 Abstract	1-15

☐ Further documents are listed in the continuation of Box C ☒ See patent family annex

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Date of the actual completion of the international search	Date of mailing of the international search report
7 February 2003	17 FEB 2003
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **MARK COX** Telephone No : (02) 6283 2178

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU02/01622

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	5838431	JP	9196675	JP	9196674		
JP	8061954	NONE					
WO	9811407	AU	41316/97	EP	1012539	US	6351890

END OF ANNEX