(12) UK Patent Application (19) GB (11) 2 339 922 (13) A

(43) Date of A Publication 09.02.2000

(21) Application No 9909413.8

(22) Date of Filing 26.04.1999

(30) Priority Data
(31) 9809730 (32) 08.05.1998 (33) GB

(71) Applicant(s)
Smiths Industries Public Limited Company
(Incorporated in the United Kingdom)
765 Finchley Road, LONDON, NW11 8DS,
United Kingdom

(72) Inventor(s)
David Philip Poore
Eric Pagan

(74) Agent and/or Address for Service
Smiths Industries Public Limited Company
765 Finchley Road, LONDON, NW11 8DS,
United Kingdom

(51) INT CL[7]
G02B 23/26

(52) UK CL (Edition R)
G2J JB7R4

(56) Documents Cited
EP 0520743 A WO 95/00066 A US 5840014 A

(58) Field of Search
UK CL (Edition Q) G2J JB7R4
INT CL[6] G02B
ONLINE: WPI, EPODOC, JAPIO

(54) Abstract Title
Endoscope with removable sheath

(57) A fibre-optic endoscope assembly has a light or image guide 1 inserted within a removable sheath 2. The sheath 2 is closed at its viewing end 21 by a window or lens 22. A small quantity of a liquid 3 fills the space between the inside 23 of the lens 22 and the forward end 10 of the light guide 1, where the liquid may have a refractive index matched to that of the lens and the light guide. The sheath 2 can be disposed of after a single use and the light guide 1 reused with another sheath. The sheath 2 could be inserted to the location to be viewed first and the light guide 1 inserted subsequently. The lens 22 may be a plano-convex lens and the light guide 1 may be in the form of an optical bundle 13. The guide 1 and the sheath 2 may also be bendable or flexible. A method of using the endoscope assembly is also disclosed. A rear end 11 and a television camera 12 for viewing is also shown.

Fig.1.

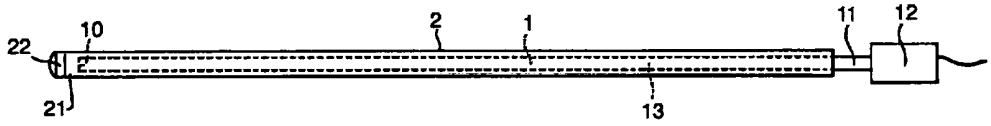
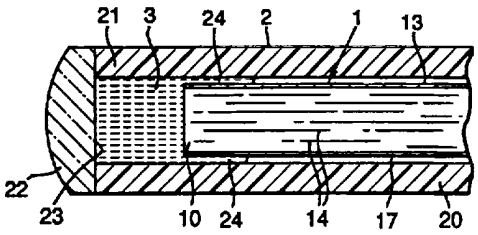


Fig.2.



GB 2 339 922 A

Fig.1.

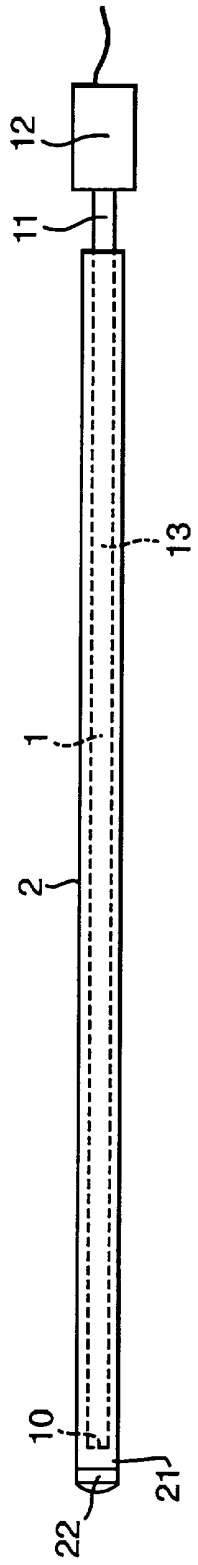
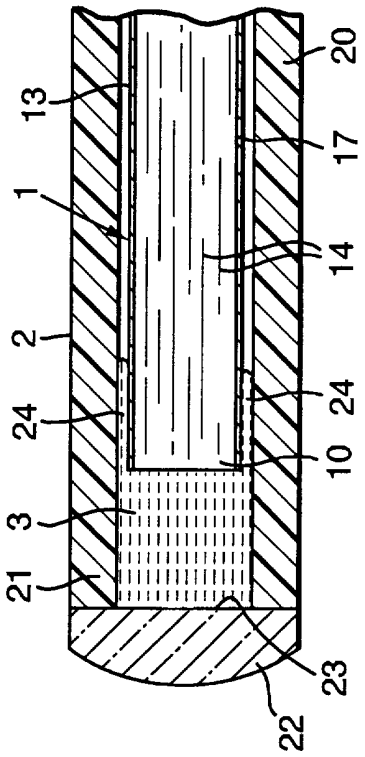


Fig.2.



ENDOSCOPE ASSEMBLY

This invention relates to endoscope assemblies.

Endoscopes have a fibre-optic of similar coherent light guide by which an inaccessible location can be viewed, either directly by the eye, or by a television camera. Endoscopes are used in many applications and, in particular, are used in surgical applications for viewing an inaccessible surgical site. Surgical endoscopes are preferably bendable and steerable, and have a small diameter.

One problem with endoscopes used during surgery is that it is necessary to sterilize the endoscope after each use, such as by chemical sterilization. The need to sterilize the endoscope means that it must be taken out of use for a time. Also, repeated sterilization can damage the endoscope. The use of chemical sterilization agents also leads to disposal and environmental problems.

It is an object of the present invention to provide an alternative endoscope assembly and method of using an endoscope assembly.

According to one aspect of the present invention there is provided an endoscope assembly comprising an elongate image guide, an outer removable sheath enclosing at least the forward end of the guide, the sheath having a transparent window sealed with the forward end of the sheath, and a transparent liquid within the forward end of the sheath making optical contact between the inner surface of the window and the forward end of the guide.

The window may be a lens, such as a plano-convex lens, the liquid contacting the plane surface of the lens. The refractive index of the liquid is preferably substantially the same as the refractive index of the material of the window and of the material of the guide. The guide and the sheath may be bendable and the guide may be an optical fibre bundle.

According to another aspect of the present invention there is provided a sheath for an endoscope according to the above one aspect of the invention.

According to a further aspect of the present invention there is provided a liquid for an endoscope according to the above one aspect of the invention.

According to a fourth aspect of the present invention there is provided a method of using an endoscope assembly including the steps of providing a sheath with a transparent window closing one end of the sheath, inserting an endoscope in the sheath such that the sheath extends along a substantial length of the endoscope and forms an assembly with the forward end of the endoscope optically coupled with the window by a transparent liquid in the sheath, viewing through the endoscope assembly, removing the sheath from the endoscope, inserting the endoscope in another sheath, and viewing again through the endoscope.

According to a fifth aspect of the present invention there is provided a method of using an endoscope assembly including the steps of inserting a sheath to a location to be viewed, the sheath having a transparent window at one end, and subsequently inserting an

endoscope into the sheath until the forward end of the endoscope makes optical contact with the window of the sheath via a transparent liquid in the sheath.

The liquid may be placed in the sheath prior to insertion of the endoscope in the sheath.

A fibre-optic endoscope assembly and its method of use, in accordance with the present invention, will now be described, by way of example, with reference to the accompanying drawing, in which:

Figure 1 is a side elevation view of the endoscope assembly; and

Figure 2 is an enlarged cross-sectional side elevation view of the viewing end of the assembly.

The assembly includes a conventional fibre-optic endoscope 1, or other image guide, with a forward, viewing end 10 and a rear end 11 with a video, television camera 12. Alternatively, the endoscope could have an eye cup with suitable optics so that the user can view an image of the scene at the forward end of the endoscope by placing his eye against the cup. The main part of the endoscope 1 consists of a bendable bundle 13 of optical fibres 14 extending longitudinally along the endoscope, the fibres being fused, or otherwise retained together at opposite ends 10 and 11 with the fibres disposed identically so that a coherent image can be transmitted along the bundle. Opposite ends 10 and 11 of the bundle 13 are ground to an optical finish. A thin, flexible, opaque sheath 17 is permanently secured to the

outside of the fibre bundle 13 along its length. As so far described, the endoscope assembly is entirely conventional.

The assembly additionally includes an outer sheath 2 having an extruded tubular wall 20 of a flexible material such as polyurethane or some other plastics material. The inside diameter of the sheath is just large enough to receive the endoscope 1 as a sliding fit with a small clearance. At its forward, viewing end 21, the sheath 2 has a window in the form of a plano-convex converging lens 22 hermetically sealed with the wall 20, such as by means of an adhesive. In some assemblies, the window need not have any optical power if the fibre bundle has a lens at its forward end. The refractive index μ of the glass or other material forming the lens 22 is preferably the same as that of the fibres 14. The lens 22, thereby seals closed the forward end 21 of the sheath 2. The sheath 2 extends along the major part of the length of the endoscope 1 from its forward end 10, covering at least that part of the endoscope that will come into contact with the patient.

The assembly is completed by a small volume of colourless, transparent liquid 3 in the forward end of the sheath 2, filling the space between the plane, rear face 23 of the lens 22 and the forward end 10 of the fibre bundle 13. The liquid 3 makes optical contact between the lens 22 and the fibre bundle 13. The liquid 3 may also enter the small clearance 24 between the cylindrical outside of endoscope 1 and the inside of the sheath 2 along a short distance. The liquid 3 preferably has the same refractive index μ as the fibres 14 and the lens 22. The liquid could be an oil, a gel or any other liquid-like substance.

There are various ways in which the assembly could be used. The sheath 2 could be supplied containing a small quantity of the liquid 3 so that the user simply has to slide the endoscope 1 into the sheath. Alternatively, the liquid 3 could be supplied in a separate container, which is transferred into the sheath 2 either by pouring into the sheath or coated on the endoscope after dipping the endoscope into the liquid. Air trapped in the sheath 2 can escape through the small clearance between the outside of the endoscope 1 and the inside of the sheath, passage of the endoscope being lubricated by the liquid 3. The endoscope 1 is pushed in to its full extent but the viscosity of the liquid prevents it flowing freely from the space at the forward end of the sheath so that a small volume remains separating the forward end 10 of the endoscope 1 from the lens 22. Variations in the separation between the lens 22 and the fibre bundle 13 do not affect the image because the refractive index of the lens, liquid 3 and fibres 14 is the same. The common refractive index also ensures that there is no chromatic dispersion at the interfaces.

The assembly is inserted into a body cavity, such as the trachea, oesophagus or urinary tract, with the sheath 2 in place and lubricated on its outside as necessary. The lens 22 and liquid 3 in the sheath 2 provides an efficient optical coupling to the endoscope 1 so that the quality of the image seen at the rear end 11 is not substantially impaired by the sheath. After use, the assembly is removed and the sheath 2 is slid off the endoscope 1 and discarded. The endoscope 1 can be immediately reused with a new sheath without the need for sterilization.

In an alternative method of use, the sheath could be inserted to the desired location first, without the endoscope, and used as a guide so that the endoscope could subsequently be

slid along the sheath. This method can be preferable in some circumstances because the sheath by itself is more flexible and may be easier to locate.

The invention is not confined to surgical endoscopes but could be used in other applications where it was necessary to protect the endoscope or the environment in which it was being used.

CLAIMS

1. An endoscope assembly comprising an elongate image guide, an outer removable sheath enclosing at least the forward end of the guide, the sheath having a transparent window sealed with the forward end of the sheath, and a transparent liquid within the forward end of the sheath making optical contact between the inner surface of the window and the forward end of the guide.

2. An assembly according to Claim 1, wherein the window is a lens.

3. An assembly according to Claim 2, wherein the lens is a plano-convex lens and the liquid contacts the plane surface of the lens.

4. An assembly according to any one of the preceding claims, wherein the refractive index of the liquid is substantially the same as the refractive index of the material of the window and of the material of the guide.

5. An assembly according to any one of the preceding claims, wherein the guide and the sheath are bendable.

6. An assembly according to any one of the preceding claims, wherein the guide is an optical fibre bundle.

7. An endoscope assembly substantially as hereinbefore described with reference to the accompanying drawing.

8. A sheath for an endoscope assembly according to any one of the preceding claims.

9. A liquid for an endoscope assembly according to any one of Claims 1 to 7.

10. A method of using an endoscope assembly including the steps of providing a sheath with a transparent window closing one end of the sheath, inserting an endoscope in the sheath such that the sheath extends along a substantial length of the endoscope and forms an assembly with the forward end of the endoscope optically coupled with the window by a transparent liquid in the sheath, viewing through the endoscope assembly, removing the sheath from the endoscope, inserting the endoscope in another sheath, and viewing again through the endoscope.

11. A method of using an endoscope assembly including the steps of inserting a sheath to a location to be viewed, the sheath having a transparent window at one end, and subsequently inserting an endoscope into the sheath until the forward end of the endoscope makes optical contact with the window of the sheath via a transparent liquid in the sheath.

12. A method according to Claim 10 or 11, wherein the liquid is placed in the sheath prior to insertion of the endoscope into the sheath.

13. A method of using an endoscope substantially as hereinbefore described with reference to the accompanying drawing.

14. Any novel and inventive feature or combination of features as hereinbefore described.

Application No: GB 9909413.8 **Examiner:** Andrew P Jenner
Claims searched: 1 - 13 **Date of search:** 15 November 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

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

UK Cl (Ed.Q): G2J: JB7R4

Int Cl (Ed.6): G02B

Other: Online: World Patents Index, Epodoc, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	EP 0520743 A1	BRISTOL-MYERS SQUIBB CO. - see figures	
A	WO 95/00066 A1	ADAIR	
X	US 5840014 A	FUJI PHOTO OPTICAL CO. LTD. - whole document relevant	1 - 2, 4, 8 - 12

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.