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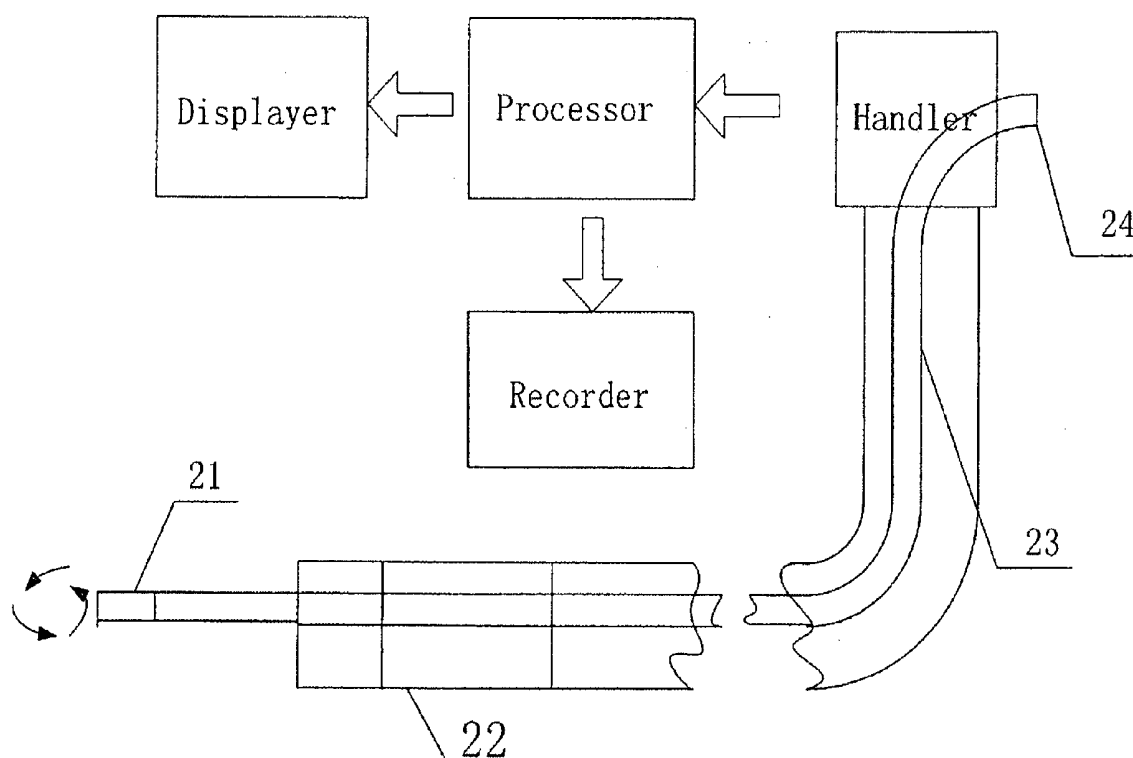
(19) **United States**(12) **Patent Application Publication** (10) **Pub. No.: US 2005/0288582 A1****Yu et al.**(43) **Pub. Date: Dec. 29, 2005**(54) **MICRO MEDICAL-ULTRASONIC
ENDOSCOPIC OCT PROBE****Publication Classification**(51) **Int. Cl.⁷** **A61B 8/00**(52) **U.S. Cl.** **600/437**(76) **Inventors: Daoyin Yu, Tianjin (CN); Tieying
Zhou, Beijing (CN); Ping Xue, Beijing
(CN); Xiaodong Chen, Tianjin (CN);
Kaili Jiang, Beijing (CN)**(57) **ABSTRACT**

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A micro medical-ultrasonic endoscopic OCT probe comprising: a micro ultrasonic motor stator for connecting a friction layer and a magnetic rotor; an ultrasonic transducer and a prism being adhered to a rotor respectively; an acoustic couplant for immersing the ultrasonic transducer; an OCT imaging system consisting of prism, grism lens and fiber. The present invention can not only observe the pathologic changes on the surface of mucosa through endoscope, but can also obtain the histological tomogram of an organ through OCT scan and ultrasonic scan, thus broadening the diagnosis range and increasing the diagnosis ability of endoscopes. The probe of this invention is driven by a micro motor directly mounted on the front end of the probe, and does not need soft wires. Compared with the existing technology, its lifespan is greatly expanded.

(21) **Appl. No.: 11/149,671**(22) **Filed: Jun. 10, 2005**(30) **Foreign Application Priority Data**

Jun. 28, 2004 (CN) 2004100197463



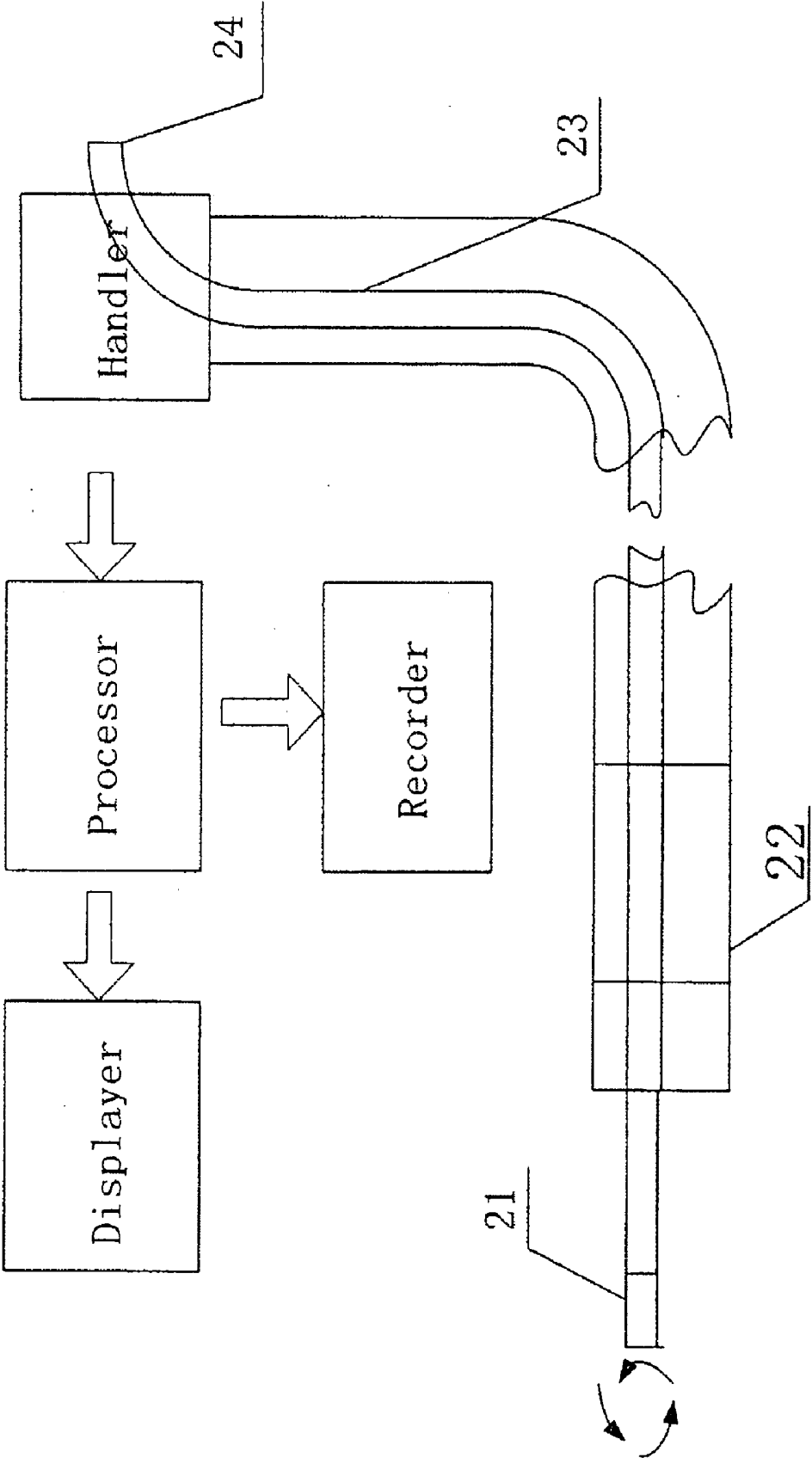


Fig. 1

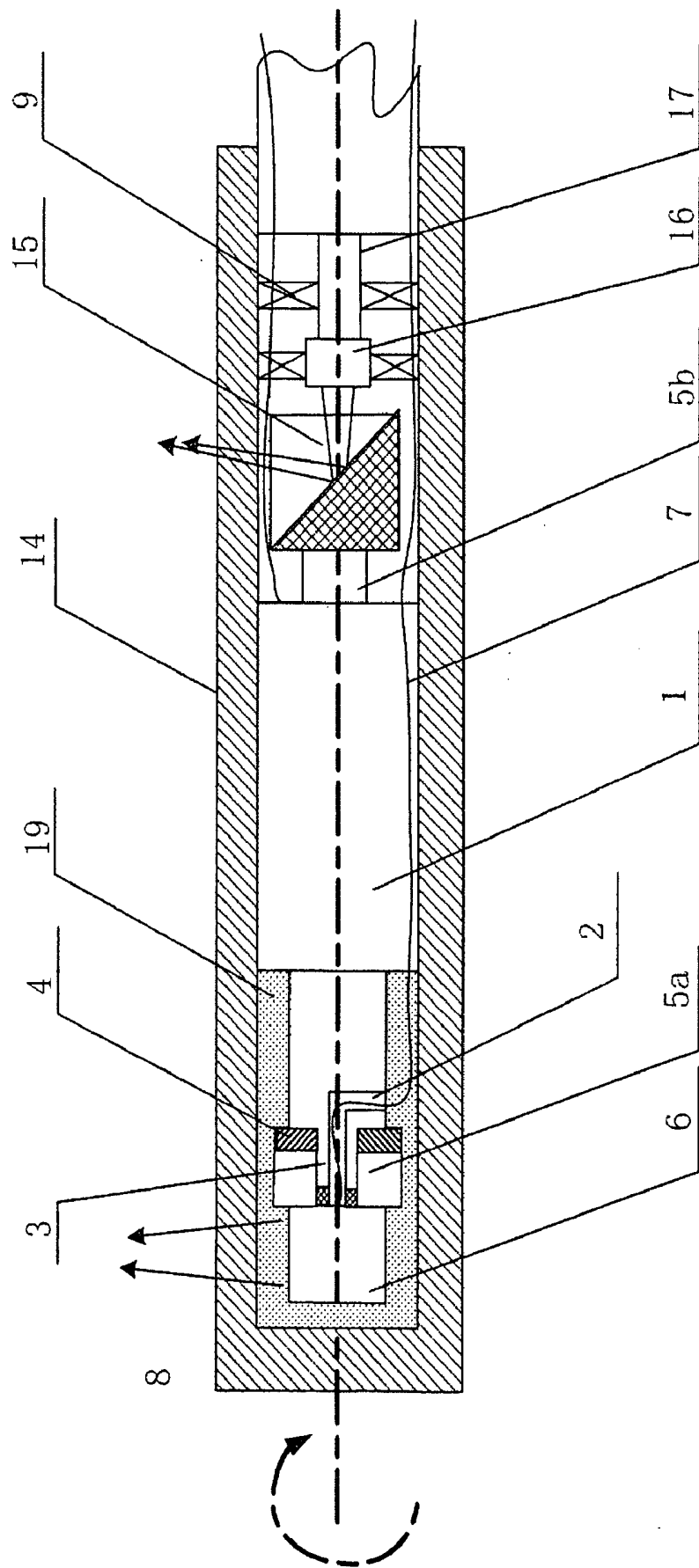


Fig. 2

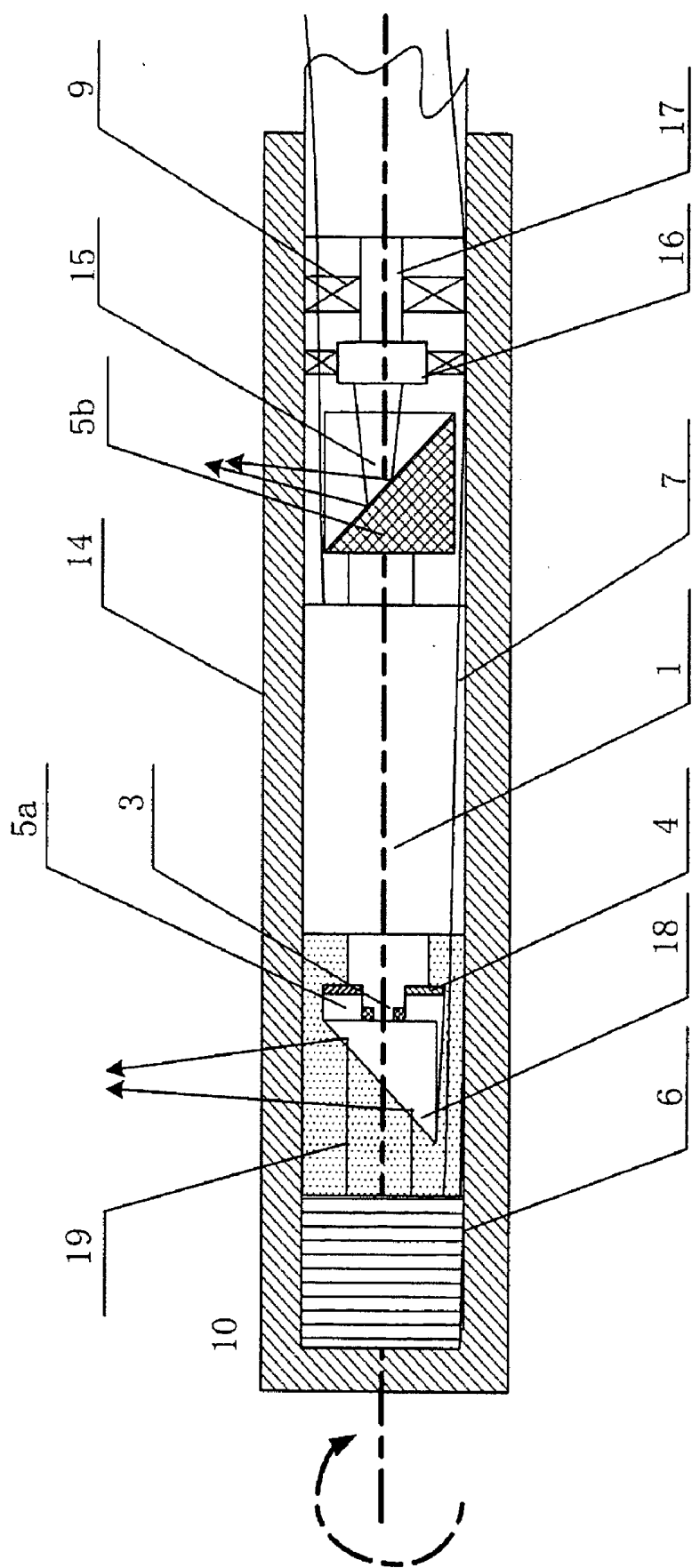


Fig. 3

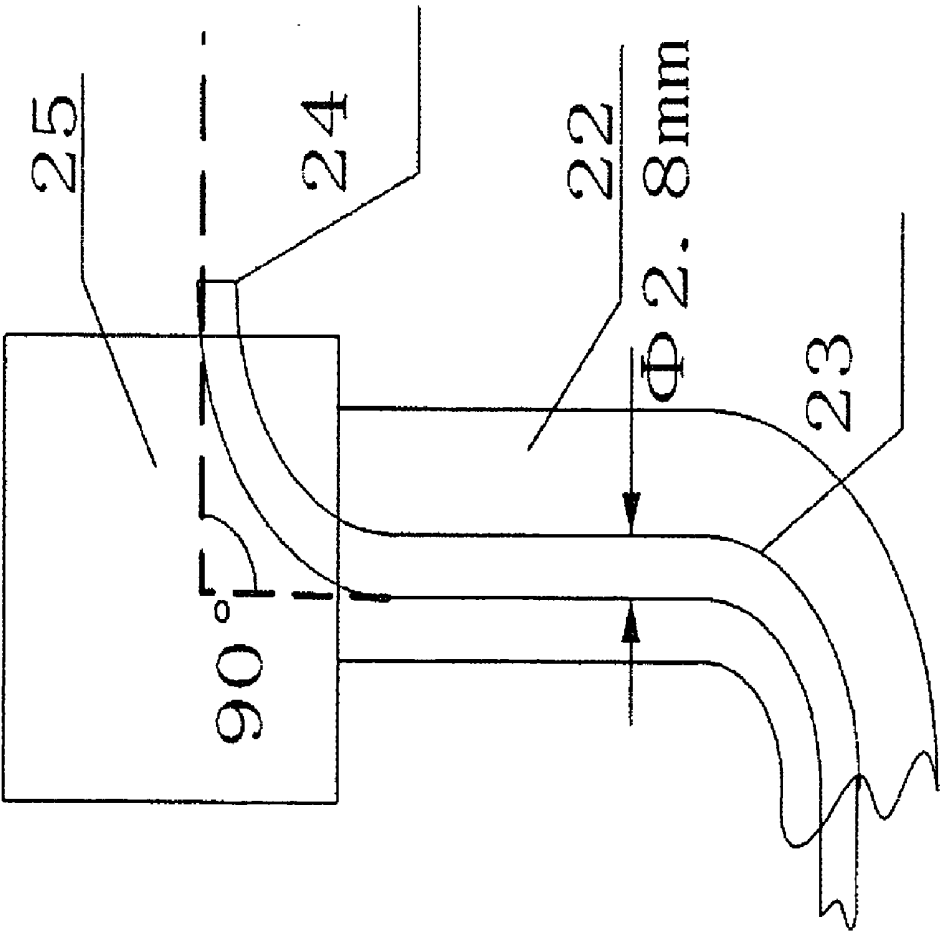


Fig. 4

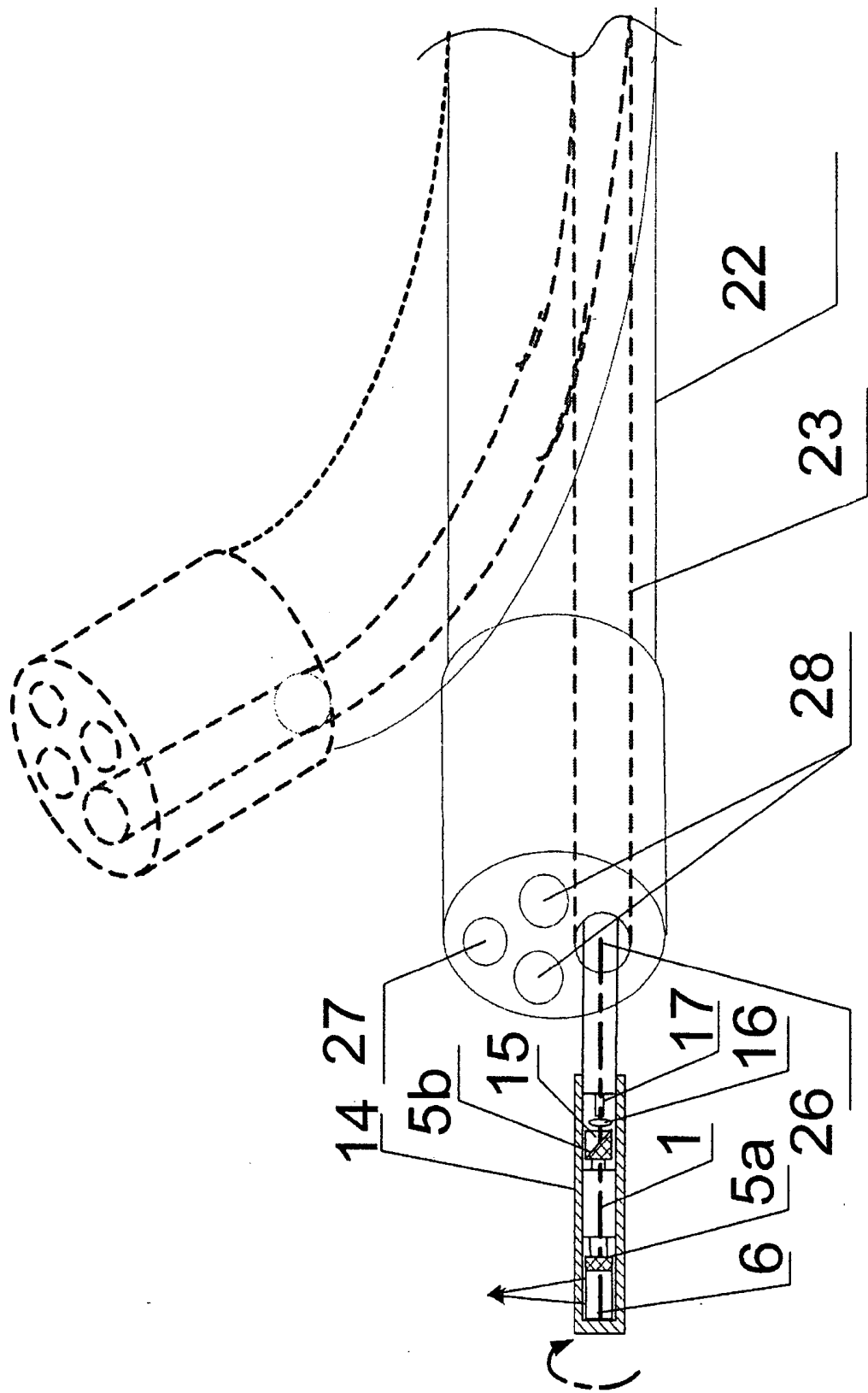


Fig. 5

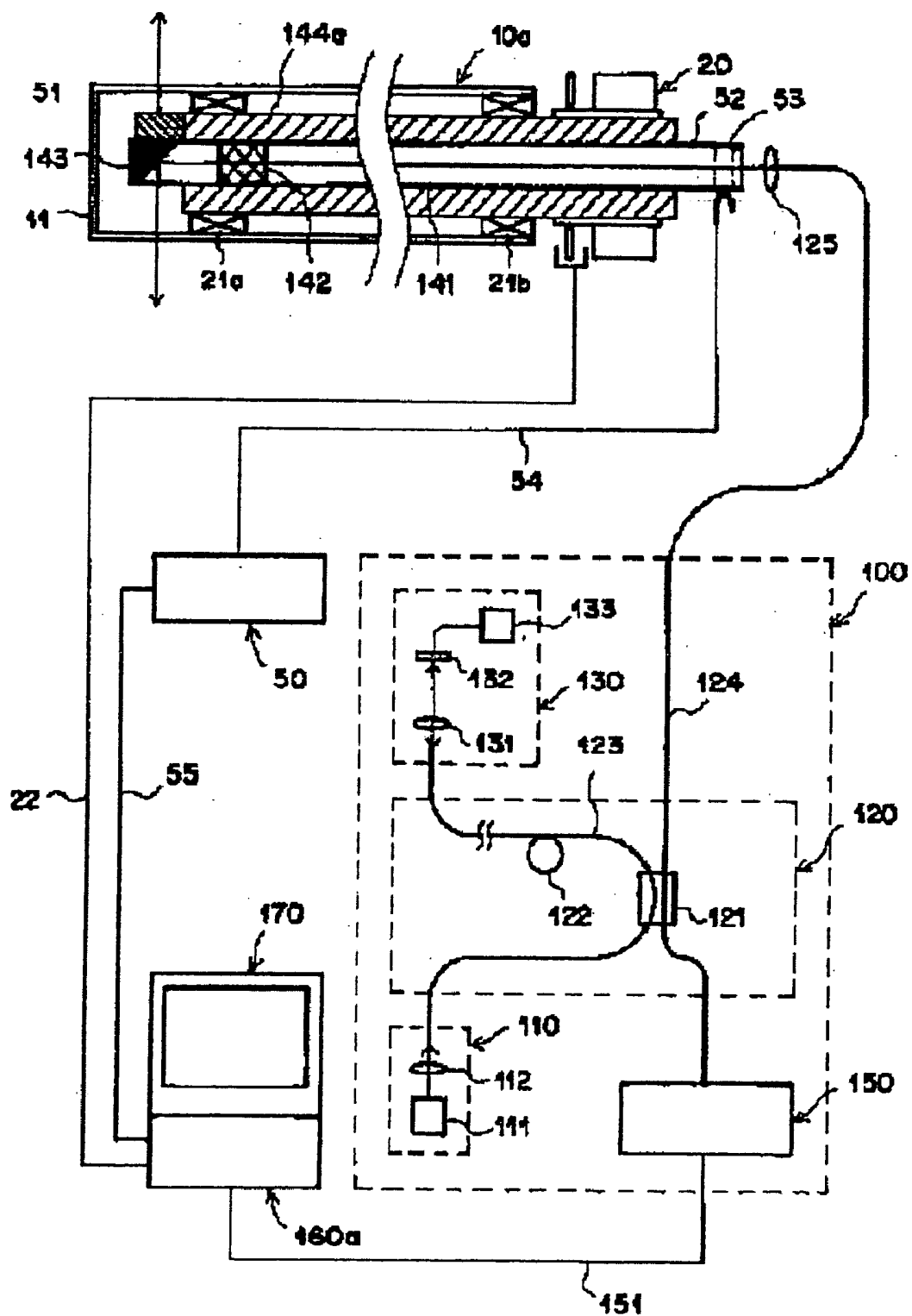


Fig. 6

MICRO MEDICAL-ULTRASONIC ENDOSCOPIC OCT PROBE

CROSS REFERENCES TO RELATED APPLICATIONS

[0001] This application claims priority from a Chinese patent application, serial number 2004100197463, filed on Jun. 28, 2004 with the same title, by the same inventors, which is incorporated herein by reference.

FIELD OF INVENTION

[0002] This invention relates to a medical instrument, more particularly, to a micro medical-ultrasonic OCT (Optical Coherence Tomography) probe which is used through endoscopes.

BACKGROUND OF INVENTION

[0003] In the diagnosis of pathologic changes, diagnosing diseases by just relying on morphologic changes on the surface of tissue is subjective and has its limitations. An endoscopic ultrasonic OCT imaging system is capable of getting a clear and precise tomogram of organ tissue through both ultrasonic scan and OCT scan, and therefore can provide a physicians with more objective evidence for diagnosis.

[0004] Meanwhile, by putting the micro probe into the body cavity through the biopsy orifice of a medical endoscope, not only can the physicians observe the pathologic changes on the surface of mucosa through endoscope, but can also get the histological tomogram of an organ through OCT scan and ultrasonic scan, thus expanding the diagnosis range and increasing the diagnosis ability of the endoscope. As a result, its advantage in diagnosis is well recognized by physicians.

[0005] Limited by the dimension of biopsy channel of medical endoscope, the design of a probe is difficult. For example, JP2002153472-A/Fuji Photo Film Co. Ltd. (Hayashi Katsume). -2002.05.28, discloses an imaging diagnosis device which can get OCT and ultrasonic images simultaneously. Its ultrasonic transducer, prism and endoscope are all of hard-tube, and it uses a rear-mounted coreless motor to drive the scan. Its principle is described below.

[0006] As shown in FIG. 6, a probe 10a provided with an ultrasonic wave transducer 51 and an OCT scanning part 140 in the inside is inserted to the forceps port of an endoscope and the inside of the colon of a patient is observed. Ultrasonic wave signals are oscillated by an ultrasonic wave signal processor 50, an object is irradiated with ultrasonic waves from the ultrasonic wave transducer 51 on the basis of the signals and measurement is performed. Simultaneously, the light source of an OCT device is driven, the object is irradiated with signal light Ls and the measurement is performed. Further, the probe 10a is rotated by driving a center-less motor 20 and radial scanning is performed. On the basis of information obtained by the scanning, the ultrasonic images and the OCT images are acquired.

[0007] Although the device can be inserted into a body through the biopsy channel of a medical endoscope, it cannot be used in soft-tube systems because the endoscope itself is of hard-tube.

SUMMARY OF THE INVENTION

[0008] The objection of present invention is to resolve the problem mentioned above, and to provide a micro medical-ultrasonic OCT probe which can go through an endoscope so that it can be used in soft-tube systems.

[0009] The invention provides a micro medical-ultrasonic endoscopic OCT probe comprising:

[0010] a micro ultrasonic motor stator for connecting a friction layer and a magnetic rotor;

[0011] an ultrasonic transducer and a prism being adhered to a rotor respectively;

[0012] an acoustic couplant for immersing the ultrasonic transducer;

[0013] an OCT imaging system consisting of prism, grism lens and fiber.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] A full understanding of the invention can be gained from the following description of the preferred embodiments when read in conjunction with the accompanying drawings in which:

[0015] FIG. 1 shows a micro medical-ultrasonic OCT probe operated through endoscope scanning. According to the invention;

[0016] FIG. 2 is a structure diagram of the micro probe in embodiment 1;

[0017] FIG. 3 is a structure diagram of the micro probe in embodiment 2;

[0018] FIG. 4 is a diagram of digestive tract endoscopic handle and biopsy orifice;

[0019] FIG. 5 is a structure diagram of a digestive tract endoscope with a micro ultrasonic OCT probe;

[0020] FIG. 6 is a structure diagram of prior art.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] As shown in FIG. 2, a micro ultrasonic motor stator 1, whose shaft 3 connects to a friction layer 4 and magnetic rotors 5a/5b, has a wire channel 2 in it. The friction layer 4 is fixed on the micro ultrasonic motor stator 1 which is riveted with packaging case 14. The rotor 5a/5b is in connection with the shaft 3 by axle tree. An ultrasonic transducer 6 and a prism 15 are adhered to the rotor 5a and 5b respectively. A cable 7 connects to the ultrasonic transducer 6 through the wire channel 2 in a probe 8. The ultrasonic transducer 6 is immersed in an acoustic couplant 19. A prism 15, a grism lens 16 and a fiber 17 together make the OCT imaging system, in which the grism lens 16 and fiber 17 are pegged with the packaging case 14 by several carriers 9.

[0022] An ultrasonic signal is coupled to the ultrasonic transducer 6 through the cable 7 and is changed into a supersonic wave. By continuously rotating shaft 3 by the micro ultrasonic motor stator 1, a friction generated by the friction layer 4 rotates the rotor 5a and changes the direction of radiation of supersonic wave, so that the radial scan centering on the longitudinal direction of the probe 8 is

performed. At the same time, the rotor **5b** moves the direction of radiating light and signal light received by radial scan centering on the longitudinal direction of probe **8** and is collected by the prism **15** into the fibre through the grim lens **16**.

[0023] As shown in FIG. 3, a friction layer **4** is fixed on the micro ultrasonic motor stator **1** whose shaft **3** connects to the friction layer **4** and magnetic rotors **5a/5b**. The rotor **5a/5b** is in connection with the shaft **3** by axletree. Acoustic reflector **18** and prism **15** are adhered to rotors **5a** and **5b** respectively. The micro ultrasonic motor stator **1** and ultrasonic transducer **6** are fixed with packaging case **14**. A cable **7** is coupled to the ultrasonic transducer **6** through a probe **8**. The ultrasonic transducer **6** and acoustic reflector **18** are immersed in acoustic couplant **19**. Prism **15**, grim lens **16** and fiber **17** together make the OCT imaging system, in which the grim lens **16** and the fiber **17** are pegged with packaging case **14** by several carriers **9**.

[0024] An ultrasonic signal is coupled to the ultrasonic transducer **6** through the cable **7** and is changed into a supersonic wave. By continuously rotating shaft **3** by the micro ultrasonic motor stator **1**, friction generated by the friction layer **4** rotates the rotor **5a** and changes the direction of acoustic reflector **18**, thus changing the direction of emissive and return supersonic waves and achieving the performance of radial scan centering on the longitudinal direction of the probe **10**. At the same time, the rotor **5b** moves the direction of radiating light and signal light received by radial scan centering on the longitudinal direction of probe **10** and is collected by the prism **15** into fibre through the grim lens **16**.

Application

EXAMPLE 1

[0025] FIG. 1 is the structure of an endoscopic ultrasonic OCT imaging system. Micro ultrasonic OCT probe **21** includes micro ultrasonic transducer, OCT implementation and ultrasonic motor. The micro ultrasonic OCT probe is inserted into a body from biopsy orifice **24** of endoscope **22** through biopsy channel **23**, and its rotating part is driven by ultrasonic motor rotor to scan.

EXAMPLE 2

[0026] A digestive tract endoscope for checking the digestive tract. An endoscopic ultrasonic OCT probe is inserted into a body through biopsy channel of a digestive tract endoscope. FIG. 4 shows biopsy channel **23** of endoscope **3**. It is a Teflon soft pipe with an inner radius of 2.8 mm. As biopsy channel having an orthogonal hard-tube bending below entrance **24**, the diameter of ultrasonic OCT probe must be equal to or smaller than 2 mm, and the length of the inflexible part must be less than 12 mm, in order to make sure that the probe can pass.

[0027] FIG. 5 shows the front part of the digestive tract endoscope. The front part of the endoscope has four holes. Biopsy orifice **26** is for biopsy devices and micro ultrasonic probe scan; CCD (charge-coupled device) imaging implementation **27** is for recording color video image of tissue surface; illuminating channel **28** is for background illuminating. The digestive tract endoscope is of soft-tube lens.

[0028] The present invention has following advantage:

[0029] (1) Triple diagnosis. Not only can it observe the pathologic changes on the surface of mucosa through endoscope, but can also get the histological tomogram of an organ through OCT scan and ultrasonic scan, thus broadening the diagnosis range and increasing the diagnosis ability of endoscopes.

[0030] (2) Long life-time. The biggest drawback of the existing technology is its short life-time. In the existing systems, the motor is placed at the rear end of the endoscope far away from the probe and drives probe only through soft wires. Since the soft wires are easy to damage, the probe itself must be discarded before its life expectancy. On the other hand, the probe of this invention is driven by a micro motor directly mounted on the front end of the probe, and does not need soft wires. Compared with the existing technology, its lifespan is greatly expanded.

[0031] (3) Versatility. The ultrasonic OCT endoscope imaging system uses the regular endoscope as a carrier and therefore no special endoscope carrier is required. The system can be used with any endoscope system having a standard biopsy channel for ultrasonic diagnosis and OCT diagnosis, and therefore has wide applications.

[0032] (4) Easy operation. When using the endoscope for diagnosis or treatment, the operators, assistants and other medical professionals can operate the system with a monitor, which makes the cooperation between them harmonious and safe. Therefore the system is flexible, convenient and easy to operate.

[0033] (5) The driving part has no electromagnetic interference.

What is claimed is:

1. A micro medical-ultrasonic endoscopic OCT probe comprising:

a micro ultrasonic motor stator for connecting a friction layer and a magnetic rotor;

an ultrasonic transducer and a prism being adhered to a rotor respectively;

an acoustic couplant for immersing the ultrasonic transducer; and

an OCT imaging system comprises a prism, grim lens and a fiber.

2. The micro medical-ultrasonic endoscopic OCT probe of claim 1, further comprising a wire channel, for connecting cable to the ultrasonic transducer.

3. The micro medical-ultrasonic endoscopic OCT probe of claim 1, wherein said friction layer is being fixed on the micro ultrasonic motor stator.

4. The micro medical-ultrasonic endoscopic OCT probe of claim 1, wherein said rotor is connected to a shaft by an axletree.

5. The micro medical-ultrasonic endoscopic OCT probe of claim 1, wherein said grim lens and fiber is being pegged with a packaging case by several carriers.

6. A micro medical-ultrasonic endoscopic OCT probe comprising:

a micro ultrasonic motor stator for connecting a friction layer and a magnetic rotor;

an ultrasonic reflector and a prism being adhered to a rotor respectively;

an acoustic couplant for immersing the ultrasonic transducer; and

an OCT imaging system comprises a prism, grim lens and a fiber.

7. The micro medical-ultrasonic endoscopic OCT probe of claim 6, further comprising a cable coupling to the ultrasonic transducer through the probe.

8. The micro medical-ultrasonic endoscopic OCT probe of claim 6, wherein said friction layer is being fixed onto the micro ultrasonic motor stator.

9. The micro medical-ultrasonic endoscopic OCT probe of claim 6, wherein said rotor is connected to a shaft by an axletree.

10. The micro medical-ultrasonic endoscopic OCT probe of claim 6, wherein said grim lens and fiber is being pegged with a packaging case by several carriers.

* * * * *

专利名称(译)	微型医用超声内镜OCT探头		
公开(公告)号	US20050288582A1	公开(公告)日	2005-12-29
申请号	US11/149671	申请日	2005-06-10
[标]申请(专利权)人(译)	俞导引 周铁英 薛平 陈晓东 江凯丽		
申请(专利权)人(译)	俞导引 周铁鹰 薛平 陈晓东 姜开利		
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IPC分类号	A61B1/00 A61B5/00 A61B8/00 A61B8/12		
CPC分类号	A61B5/0066 A61B5/6852 A61B8/445 A61B8/4461 A61B8/12		
优先权	200410019746.3 2004-06-28 CN		
外部链接	Espacenet USPTO		

摘要(译)

一种微型医用超声波内窥镜OCT探头，包括：微型超声波电动机定子，用于连接摩擦层和磁性转子；超声波换能器和棱镜分别粘附在转子上；用于浸没超声换能器的声耦合剂；OCT成像系统由棱镜，冷镜和光纤组成。本发明不仅可以通过内窥镜观察粘膜表面的病理变化，还可以通过OCT扫描和超声扫描获得器官的组织断层图像，从而拓宽了诊断范围，提高了内窥镜的诊断能力。本发明的探头由直接安装在探头前端的微电机驱动，不需要软线。与现有技术相比，其寿命大大扩展。

