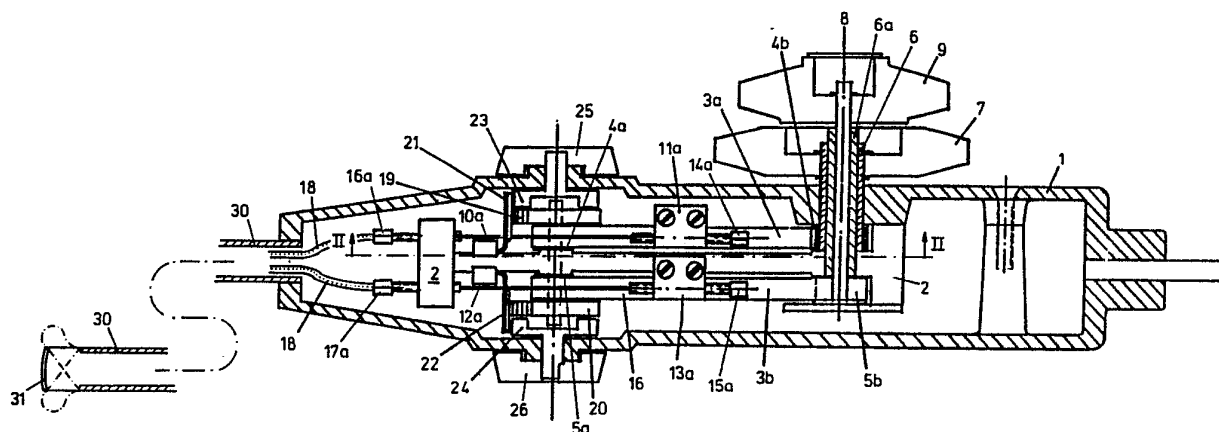




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<p>(21) International Application Number: PCT/NL91/00121 (22) International Filing Date: 8 July 1991 (08.07.91) (30) Priority data: 9001564 9 July 1990 (09.07.90) NL (71) Applicant (for all designated States except US): B.V. OPTISCHE INDUSTRIE 'DE OUDE DELFT' [NL/NL]; Van Miereveltlaan 9, NL-2612 XE Delft (NL). (72) Inventor; and (75) Inventor/Applicant (for US only): VAN DER HEIDE, Hendrik, Teake [NL/NL]; Torenmolenerf 24, NL-2807 DK Gouda (NL). (74) Agent: VAN DER BURG, Louis; B.V. Optische Industrie 'De Oude Delft', Van Miereveltlaan 9, NL-2612 XE Delft (NL).</p>		<p>(81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US.</p> <p>Published With international search report. In English translation (filed in Dutch).</p>

(54) Title: TUBE FOR INTRODUCING INTO A BODY, WITH A BENDING MECHANISM



(57) Abstract

An endoscope is provided with one or more pairs of control cables. The control cables are operated by a manipulator comprising a housing. For each pair of control cables a knob is present outside the housing, which knob is connected to a toothed wheel inside the housing. A toothed belt is run round this toothed wheel and a second toothed wheel. The pair of control cables in question is connected by the ends to the toothed belt.

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Title: TUBE FOR INTRODUCING INTO A BODY, WITH A BENDING MECHANISM

The invention relates to a tube which can be
5 introduced into the body through a body orifice, said tube
being provided with a manipulator for moving at least one
pair of control cables through the tube, which manipulator
comprises a housing in which for each pair of control cables
provision is made for means provided with a tothing which
10 are coupled to said pair of control cables in such a way
that when said means are moved the control cables of the
relevant pair are moved in opposite directions relative to
the housing, the manipulator for each pair of control cables
being provided with a control element which is placed
15 outside the housing and is coupled to a toothed wheel placed
inside the housing, which toothed wheel is coupled to the
means provided with a tothing, in order to permit
displacement thereof, and is provided with means to provide
a stepwise movement of the means provided with a tothing,
20 which stepwise movement means can be switched off by
disconnection means.

Such a tube, which is also known under the name of
an endoscope, is known from US Patent 4,207,873 and is
designed to permit manoeuvring of the flexible end of the
25 endoscope into any desired position relative to the body of
the endoscope by means of two pairs of cables in the body of
a patient. For this, each cable of a pair is fixed to a rack
which is movable in the lengthwise direction of the
elongated housing, while a single toothed wheel is placed
30 between the pair of racks belonging to one pair of cables,
which toothed wheel is connected to a control knob placed
outside the housing. By turning this control knob and the
toothed wheel with it, the racks are moved in opposite
directions relative to the housing, as a result of which one
35 cable is pulled in and the other cable paid out, so that the

flexible end of the endoscope is moved in one plane. Due to the fact that provision is made for two pairs of cables each with its own pair of racks, a toothed wheel and a control knob, operation of the two control knobs permits a movement
5 of the flexible end in two planes at right angles to each other and to all positions lying there between. In order to be able to move and fix the flexible end very accurately, the known device is provided with a mechanism fitted in the interior of each of the control knobs and having spring
10 catches which can engage on a toothed wheel. This mechanism can be put out of action by pulling the relevant knob outwards relative to the housing.

The manipulator of the known endoscope is designed so that in virtually all cases it can be operated with one
15 hand by the person operating it, so that the person keeps the other hand free to guide the tube of the endoscope. In practice, however, disconnecting the click mechanism of one or both control knobs with only one hand is found to be extremely difficult. Another disadvantage of the known
20 manipulator is that it is fairly expensive, due to the fact that racks which are labour-intensive to manufacture and thus expensive are used. Besides, the toothed ring forming part of the stepwise movement mechanism is provided in the axial direction with an additional edge serving to prevent
25 accidental movement from the disconnected state to the coupled state, and the provision of such an edge requires an additional operation and is thus expensive.

The object of the invention is therefore to provide a tube which is provided with a manipulator 5 which can be
30 controlled without any problem with one hand also for disconnecting the stepwise movement mechanism, and which can also be manufactured considerably more cheaply than the known tube.

To this end, the invention provides a tube of the
35 above-mentioned type in which the means provided with a

toothings comprise a toothed belt which is guided over two toothed wheels, of which the first is the toothed wheel coupled to the control knob and the second is rotatable mounted inside the housing and is connected to the stepwise movement means in order to provide a stepwise movement facility of the toothed belt, said stepwise movement means being accommodated in the housing and being disconnectable by means of a separate control element placed on the outside of the housing.

10 The stepwise movement means preferably comprise a resilient element rigidly connected to the housing and a knurled disc coupled to the second toothed wheel, and the means for disconnecting preferably comprise a cam disc which is rotatable by means of a control element.

15 Through the fact that according to the invention use is made of cheap, generally available toothed belts, the tube according to the invention can be made considerably more cheaply than the known tube, and the tube according to the invention, in particular as regards the disconnection of the means for permitting stepwise movement of the toothed belt, can be operated much more easily with one hand, because it need be turned only through a small angle relative to the housing along the housing wall, and does not have to be pulled out relative to the housing, as in the case of the known tube.

Further advantages of the invention will become clear from the description which follows of an example of an embodiment with reference to the drawing. In the drawing:

30 Figure 1 shows a side view of a cross-section of the manipulator according to the invention;

Figure 2 shows a side view along the line II-II in Figure 1 of only the movement mechanism for a pair of cables.

The manipulator of the tube 30 according to the invention, as shown in Figures 1 and 2, comprises a housing

1 which is round or rectangular in cross-section and is composed of two parts fixed to each other by, for example, screws. A frame 2 is rigidly fixed to the housing 1, for example by means of screws. The housing has fitted in it two
5 toothed belts 3a and 3b. Toothed belt 3a is guided with the toothed side at one end over a toothed wheel 4a and at the other end over a toothed wheel 4b. In the same way the toothed belt 3b is guided over toothed wheels 5a and 5b. The
10 toothed wheels 4a, 4b and 5a, 5b are rotatable mounted relative to the frame 2, and the toothed wheel 4b is further coupled by means of a hollow shaft 6 to a control knob 7. The toothed wheel 5b is connected by means of a shaft 8
15 running through a fixed sleeve 6a to a control knob 9. The shaft 6 is guided rotatable in a manner which is known per se through the housing 1 and the fixed sleeve 6a, and the
shaft 8 is also rotatable in a manner which is known per se relative to shaft 6, so that the toothed wheels 4b and 5b, and thus the toothed belts 3a and 3b, can be rotated
20 independently of each other by means of control knobs 7 and 9 respectively.

A first pair of control cables 10a and 10b is connected to the toothed belt 3a by means of connecting blocks 11a and 11b respectively. In the same way a second pair of control cables 12a and 12b (not shown in the figure)
25 is connected to the toothed belt 3b by means of connecting blocks 13a and 13b respectively (not shown in the figure). The connecting blocks are made of, for example, two parts fixed to each other by means of screws, the part lying on the toothed side of the toothed belt at the side facing the
30 tothing preferably also being provided with a corresponding tothing in order to ensure a correct positioning of the connecting block, while even in operation the connecting block cannot be pulled askew as a result of tensile forces exerted by the cables.

35 It is possible by means of the control cables 10a,

b and 12a, b to move the flexible end 31 of the tube 30. The flexible end 31 of the tube 30 can be fixed in any desired position in the manner described below in connection with the knurled discs 19 and 20.

5 The control cables 10a, b and 12a, b are preferably fixed by their ends to elongated screwed sleeves 14a, b and 15a, b (15b not shown in the figure), which screwed sleeves are threaded on the outside and fitted rotatable in a corresponding screw thread formed in the connecting blocks.

10 This design, which is already known per se in other types of equipment, has the advantage that the cables can be tensioned in a simple manner in order to be able to set the flexible end accurately. The control cables are preferably also guided via screwed sleeves 16a,b and 17a,b (17b not

15 shown in the figure) through the frame 2, the screwed sleeves being rotatable relative to the frame. A sheath 18 of the control cables ends in the open ends of the screwed sleeves facing the front side of the housing, as a result of which a turning of the screwed sleeves 16a,b and 17a,b

20 provides a further adjustment facility for the cables.

 Knurled discs 19 and 20 are rigidly fixed to the toothed wheels 4a and 5a respectively. The free leg of respective L-shaped resilient elements 21 and 22 can be accommodated in the knurls of the knurled discs 19 and 20,

25 the other leg in each case being rigidly fixed to the frame 2. Provision is also made for cam discs 23 and 24, which are rotatable mounted in the housing 1 and can be turned by knobs 25 and 26 respectively from a first position to a second position. The peripheries of the cam discs 23 and 24

30 lie near the ends of the free legs of the resilient elements 21 and 22 respectively. The cam discs are dimensioned in such a way that in the first position of the knobs 25 or 26 the periphery of the cam disc corresponding to said knob is clear of the resilient element, which can consequently fall

35 into a notch of the corresponding knurled disc, so that when

the knobs 7 and/or 9 are turned the toothed belts 3a and 3b, and thus the control cables, are moved stepwise due to the fact that the resilient elements always engage in a next notch of the knurled disc.

5 In the second position of the cam disc 23 or 24 it lies against the resilient element 21 or 22 and presses it away until it is outside the periphery of the knurled disc in question, as a result of which the cables can be moved continuously and, if desired, rapidly by turning the knobs
10 7 and/or 9, for example in order to take the flexible end of the endoscope quickly to the vicinity of the position in the body to be examined, following which turning the knob 25 and/or 26, which can easily be carried out with one finger of the hand holding the housing, makes it possible to change
15 over to the stepwise movement of the toothed belts, to permit accurate seeking of the end position.

The continuous movement facility also serves to prevent the flexible end from remaining in a fixed curved position on withdrawal of the tube 30 from the body,
20 something which could seriously damage the inside of the body orifice in question.

In the above a description is given of a tube according to the invention, without details being given concerning the design of the actual endoscope and the
25 flexible end thereof, but these parts need no further explanation because they can have different designs which are well-known in professional circles. The endoscope can comprise, for example, an optical fibre which is guided through the housing 1, and of which the end comes out at the
30 rear side of the housing, seen on the right in the figure, and is coupled to suitable optical elements to permit looking into the body through the fibre. Another possibility is that the flexible end of the endoscope contains an ultrasonic transducer and that the signal cable of said
35 transducer is guided through the housing 1.

Finally, it is also pointed out that, although the example of an embodiment described has a manipulator with two pairs of control cables, the principle of the invention is also applicable without further ado if only movements in
5 one plane need be carried out, for which a tube which is provided with a manipulator then has only one pair of control cables.

CLAIMS

1. Tube which can be introduced into the body through a body orifice, said tube being provided with a manipulator
5 for moving at least one pair of control cables through the tube, which manipulator comprises a housing in which for each pair of control cables provision is made for means provided with a tothing which are coupled to said pair of control cables in such a way that when said means are moved
10 the control cables of the relevant pair are moved in opposite directions relative to the housing, the manipulator for each pair of control cables being provided with a control element which is placed outside the housing and is coupled to a toothed wheel placed inside the housing, which
15 toothed wheel is coupled to the means provided with a tothing, in order to permit displacement thereof, and is provided with means to provide a stepwise movement of the means provided with a tothing, which stepwise movement means can be switched off by disconnection means, charac-
20 terised in that the means provided with a tothing comprise a toothed belt which is guided over two toothed wheels, of which the first is the toothed wheel coupled to the control knob and the second is rotatable mounted inside the housing and is connected to the stepwise movement means in order to
25 provide a stepwise movement facility of the toothed belt, said stepwise movement means being accommodated in the housing and being disconnectable by means of a separate control element placed on the outside of the housing.

2. Tube according to Claim 1, in which two pairs of
30 control cables are provided, characterised in that for each of the two pairs of control cables a toothed belt and two toothed wheels are provided.

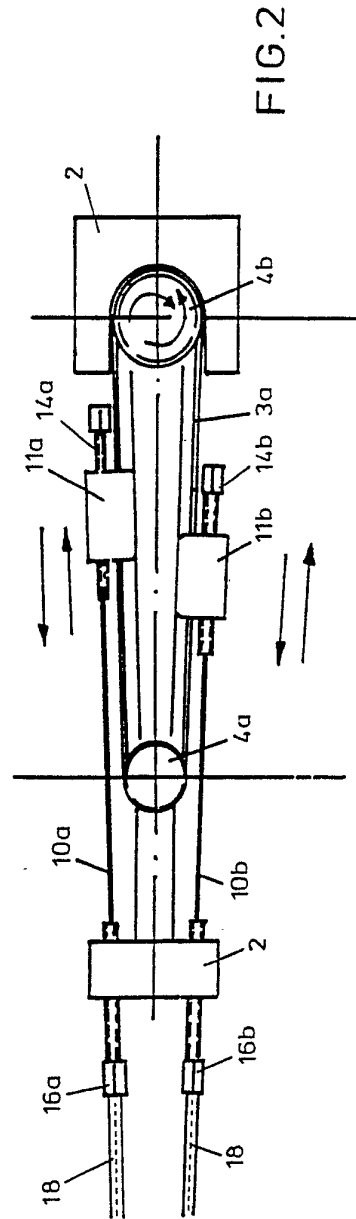
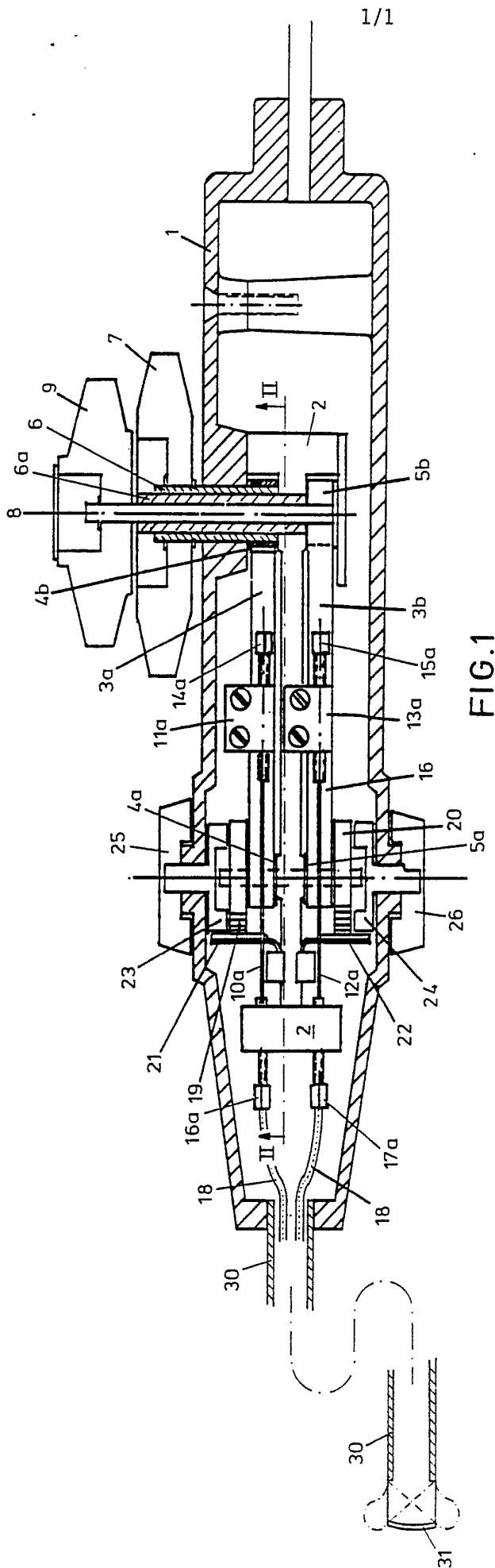
3. Tube according to Claim 1 or 2, characterised in that the stepwise movement means comprise a resilient
35 element rigidly connected to the housing and a knurled disc

coupled to the second toothed wheel, and that the means for disconnecting comprise a cam disc which is rotatable by means of a control element.

4. Tube according to Claims 1, 2 or 3 characterised
5 in that the control cables are connected by means of connecting blocks to the toothed belt, and in that a connecting block is provided with a tothing corresponding to the tothing of the toothed belt, by means of which the connecting block engages on the toothed belt.

10 5. Tube according to Claim 4, characterised in that the control cables are adjustably connected to the connecting blocks by means of screwed sleeves rotatably mounted in the connecting blocks.

6. Manipulator of the type described in any of Claims
15 1, 2, 3, 4, or 5.



INTERNATIONAL SEARCH REPORT

PCT/NL 91/00121

International Application No

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC Int.Cl. 5 A61B1/00		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.Cl. 5	A61B ; A61M	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
A	US,A,4633882 (K.MATSUO ET AL.) 06 January 1987 see abstract see column 8, line 26 - column 9, line 27; figures 8-15 ---	1
A	US,A,4688555 (J.L.WARDLE) 25 August 1987 see abstract; figures 1-12 ---	1-6
A	US,A,4207873 (T.A.KRUY) 17 June 1980 see abstract; figures 1-5 (cited in the application) ---	1, 6
A	US,A,4294233 (N.TAKAHASHI) 13 October 1981 see abstract; figures 1, 2 ---	1, 4-6
<p>¹⁰ Special categories of cited documents :</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
13 SEPTEMBER 1991	26. 09. 91	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE	HUNT B.W.	

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

NL 9100121
SA 49386

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		JP-A- 58157432	19-09-83
		DE-A- 3309097	15-09-83
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US-A-4207873	17-06-80	None	
US-A-4294233	13-10-81	DE-A, C 2914748	18-10-79