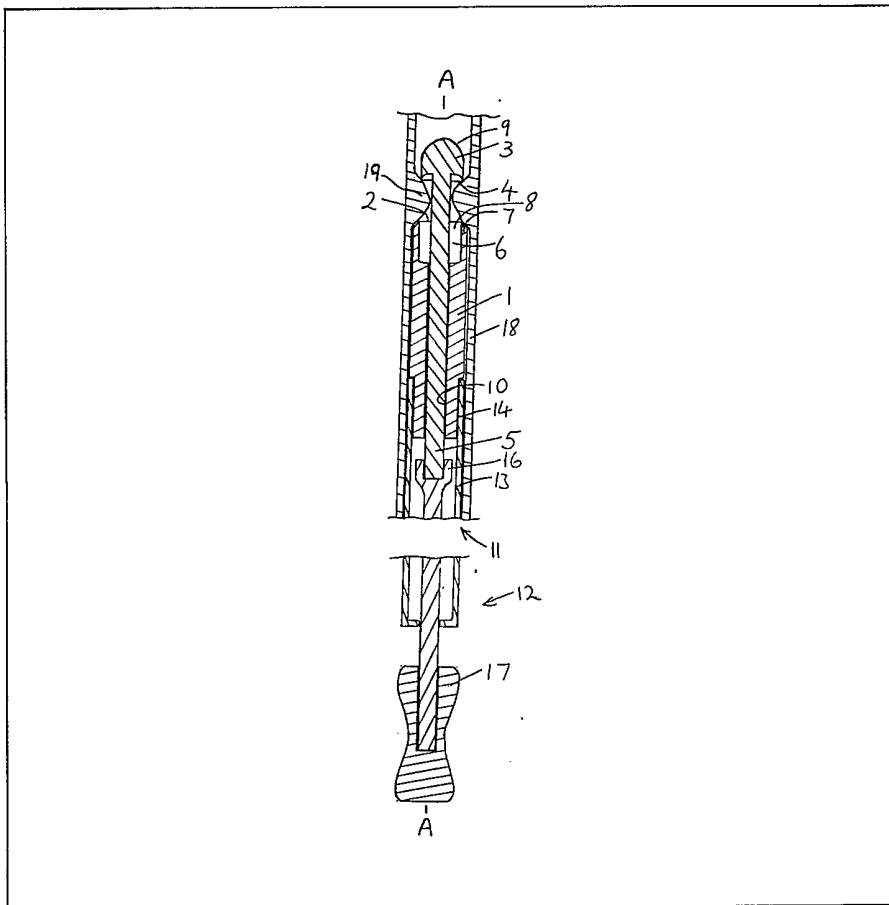
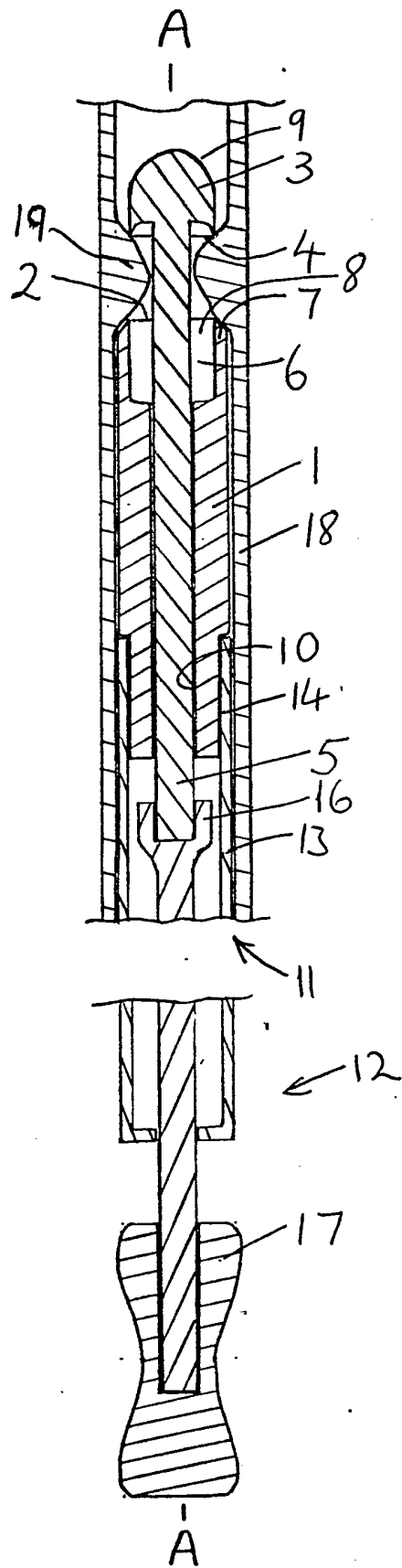


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(54) Device for removing material from stenoses

(57) A cutting device, and an instrument incorporating it, for removing material from stenoses within blood vessels, the device comprising: a generally cylindrical body (1) having at one end a cutting edge (2); a head (3) mounted in tandem with the body (1) and having a cutting edge (4); and operating means (5) for causing relative movement of the head (3) towards the body (1). When connected to a suitable catheter (11, 12) the device can be inserted into a blood vessel (18) having a stenosis (19) therein with the head (3) and body (1) positioned on opposite sides of the stenosis (19), and the operating means (5) can then be used to draw the head (3) and the body (1) together so that material is cut from the stenosis (19) by the co-operation of the cutting edges (2 and 4).





## SPECIFICATION

**Cutting device for use in an instrument for removing material from stenoses within blood vessels**

5 Stenoses in the vascular system give rise to increased blood pressure upstream of the stenoses as well as a reduction in the flow of blood in the affected blood vessels. When the stenosis becomes  
10 sufficiently serious to occlude the blood vessel completely, the blood flow downstream of the stenosis ceases altogether. As is well known, stenoses in coronary arteries are common and are particularly serious in their effects, since the consequent interference with the supply of blood to the heart can cause a great deal of pain to the patient and ultimate failure of the heart.

Surgical removal of material from stenoses within blood vessels can mitigate or even entirely remove  
20 the adverse effects of the treated stenoses. In such surgical procedures, it is important that the instrument used should enable the material taken from the stenosis to be removed from within the blood vessel, so that it will not subsequently give rise to an  
25 embolism. Hitherto, the instruments employed for somewhat similar procedures in other organs (gastro-intestinal system) have been based on biopsy needles and forceps. As these devices are not designed specifically for removal of material from  
30 vascular stenoses, they are not entirely satisfactory for such use.

According to the present invention, there is provided a cutting device for use in an instrument for removing material from stenoses within blood vessels,  
35 the device comprising; a generally cylindrical body having at one end a first cutting edge; a head mounted in tandem with said body and having a second cutting edge, positioned in opposed relation to said first cutting edge for co-operation therewith;  
40 and operating means for causing relative movement of said head towards said body, the cutting device being dimensioned and arranged to operate so that when connected to a suitable catheter it can be inserted into a blood vessel having a stenosis therein  
45 with the head and body positioned on opposite sides of the stenosis, and the operating means can then be used to cause relative movement of said head towards said body so that material is cut from the stenosis by the co-operation of said first and second  
50 cutting edges.

With devices in accordance with the invention, it is relatively easy to arrange for the cut material to be held by the device, by arranging for the material to be held between the head and the body of the  
55 device. For this purpose, the device may have a chamber arranged to receive and hold material which has been cut by the device, and the chamber may be in the form of an open-ended cavity recessed into the said one end of the body of the device. In  
60 accordance with a preferred embodiment, the latter chamber and the head of the device are dimensioned and arranged to co-operate so that when material has been cut by the device, the head can, on continued relative movement in the cutting direction, enter the chamber so as to tamp the cut

material and to close the open end of the chamber.

I prefer that the first and second cutting edges of my device should be such that they co-operate for cutting over substantially the whole of their lengths  
70 simultaneously. With this type of cutting arrangement, the material being cut is not pushed away from the advancing cutting edges as can happen with a scissors type of cutting action.

For the avoidance of doubt, it is pointed out that  
75 the term "cutting edge" as used herein means an edge which is capable of co-operating with another cutting edge to produce cutting, and that such a cutting edge is not necessarily such that it can produce cutting in the absence of such co-operation, as can the cutting edge of a sharp knife, for example.

In order to enable the cutting device to be used to cut around the whole periphery of a circumferential segmental stenosis with a single cut, I prefer that the two cutting edges should be endless; and in most  
85 circumstances it is best that they should be circular.

Preferably the head is shaped to taper away from the body in the direction of the cylindrical axis of the body, this shape of head assists in the insertion of the device into the blood vessel, especially when  
90 pushing the head past the stenosis.

The operating means may comprise a member which is connected to the head and passes through a bore through the length of the body of the device. This enables the device to be operated from its tail end, i.e. from the end opposite to the head.  
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The body of the device conveniently may be recessed at its tail end for reception of a catheter housing.

The present invention also comprehends an instrument for removing material from stenoses within blood vessels, the instrument comprising a catheter, and a cutting device in accordance with the invention connected to the leading end of the catheter, the operating means of the cutting device  
100 being attached to an actuating member passing through the interior of the catheter so that the cutting device can be operated from the tail end of the catheter.

In order that the invention may be more fully understood, an embodiment in accordance therewith will now be described with reference to the accompanying drawing, which shows, diagrammatically and in section, a cutting device in accordance with the invention as incorporated in an instrument  
115 in accordance with the invention for removing material from stenoses within blood vessels.

The cutting device comprises: a generally cylindrical body 1 having a first cutting edge, shown at 2; a head 3 mounted in tandem with the body 1 and having a second cutting edge, shown at 4 and positioned in opposed relation to the first cutting edge 2 for co-operation therewith; and operating means 4, for causing relative movement of the head 3 towards the body 1.  
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The cutting edges 2 and 4 are both circular and lie in parallel planes which are perpendicular to the longitudinal axis of the cylindrical body 1.

A chamber 6 is provided to receive and hold material which has been cut by the device, the chamber being a cavity which is recessed into the  
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forward end 7 of the body 1, and which is open at its end 8. The cutting edge 4 is formed around the outside of the base of the head 3 and its radius is slightly less than that of the cutting edge 2, which in turn is formed around the mouth of the chamber 6.

As shown at 9, the head 3 is shaped to taper away from the body 1 in the direction of the cylindrical axis A-A of the body 1.

The operating means 5 is in the form of a rod which is connected to the head 3 and integral with it and which passes through a bore 10 through the length of the body 1.

The cutting device may be machined out of stainless steel, for example.

As can be seen from the drawing, the cutting device can be incorporated in a complete instrument in accordance with the invention for removing material from stenoses within blood vessels. The instrument comprises a catheter the front and rear portions of which are shown at 11 and 12 respectively, and the above-described cutting device. The catheter comprises a housing 13 of flexible biocompatible material which is fitted at its leading end over a recess 14 formed around the rear end of the body 1 of the device. An actuating member 15 of a suitable flexible material which is capable of transmitting along its length both compression and tension forces, passes through the interior of the catheter, and is attached at its leading end to the rear of the operating rod 5 of the cutting device as shown schematically at 16 and has an operating handle 17 affixed to its rear end so that the rod can be pushed or pulled, as required, from the tail end of the catheter (i.e. the end of the catheter which is in use outside the blood vessel). If desired, one can replace the handle 17 by any suitable manually operable linkage between the rear ends of the actuating member 15 and the housing 13 to provide a mechanical advantage greater than unity.

The outside diameter of the instrument must be such as to enable it to be passed inside the blood vessels which are to be treated. This means, for example, that where the instrument is to be used in the treatment of coronary arteries, the outside diameter of the cutting device and catheter must, in general, be less than 4 mm, and in some cases it must be as little as 1 mm.

In use, the cutting device connected as described above at the leading end of the catheter is passed along the blood vessel (a section of which is shown at 18) containing the stenosis to be treated, until the stenosis (shown diagrammatically at 19) is encountered by the head 3 of the cutting device. The handle 17 is then urged towards the housing 13 to cause the head 3 to pass through the stenosis 19 to its far side so that the body 1 of the cutting device can then be moved up to the near side of the stenosis 19. At this stage the device is in the position shown in the drawing. Further relative movement of the handle 17 away from the housing 13 causes the head 3 and the body 1 to come together to cut through the stenosis 19. Since the cutting edges 2 and 4 come together about their entire circumference simultaneously, the cutting of the stenosis 19, if it is circumferentially uniform, takes place simultaneously at all points on

its circumference. As the withdrawal of the handle 17 is continued, the cut material is drawn back and tamped into the base of the chamber 6, the head 3 entering into and closing the end 8 of the chamber.

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## CLAIMS

1. A cutting device for use in an instrument for removing material from stenoses within blood vessels, the device comprising: a generally cylindrical body having at one end a first cutting edge; a head mounted in tandem with said body and having a second cutting edge, positioned in opposed relation to said first cutting edge for co-operating therewith; and operating means for causing relative movement of said head towards said body, the cutting device being dimensioned and arranged to operate so that when connected to a suitable catheter it can be inserted into a blood vessel having a stenosis therein with the head and body positioned on opposite sides of the stenosis, and the operating means can then be used to cause relative movement of said head towards said body so that material is cut from the stenosis by the co-operation of said first and second cutting edges.

2. A device according to claim 1, wherein said first and second cutting edges are such that they co-operate for cutting over substantially the whole of their lengths simultaneously.

3. A device according to claim 1 or claim 2, wherein said first and second cutting edges are endless.

4. A device according to claim 3, wherein said first and second cutting edges are circular.

5. A device according to any one of claims 1 to 4, and having a chamber arranged to receive and hold material which has been cut by the device.

6. A device according to claim 5, wherein said chamber is an open-ended cavity recessed into said one end of said body.

7. A device according to claim 6, wherein said chamber and said head are dimensioned and arranged to co-operate so that when material has been cut by the device said head can, on continued relative movement in the cutting direction, enter said chamber so as to tamp the cut material into the chamber and to close the open end of the chamber.

8. A device according to any one of claims 1 to 7, wherein said head is shaped to taper away from said body in the direction of the cylindrical axis of said body.

9. A device according to any one of claims 1 to 8, wherein said operating means comprises a member which is connected to said head and passes through a bore through the length of said body.

10. A device according to any one of claims 1 to 9, wherein said body is recessed at its end opposite one end, for reception of a catheter housing.

11. A cutting device for use in an instrument for removing stenoses within blood vessels, substantially as described with reference to, and as schematically illustrated in, the accompanying drawing.

12. An instrument for removing material from stenoses within blood vessels, the instrument comprising a catheter, and a cutting device in accordance

with any one of claims 1 to 11 connected to the leading end of the catheter, the operating means of the cutting device being attached to an actuating member passing through the interior of the catheter  
5 so that the cutting device can be operated from the tail end of the catheter.

13. An instrument for removing material from stenoses within blood vessels, the instrument being substantially as described with reference to , and as  
10 schematically illustrated in, the accompanying drawings.

14. Each and every novel invention hereinbefore disclosed.

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