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(54) **RESPIRATORY MUSCLE TRAINING DEVICE**

TRAINIERVORRICHTUNG DES ATEMMUSKELS

DISPOSITIF D'ENTRAÎNEMENT POUR MUSCLES RESPIRATOIRES

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(73) Proprietor: **Carlyle, James William**
Cambridgeshire PE13 1HY (GB)

(72) Inventor: **Carlyle, James William**
Cambridgeshire PE13 1HY (GB)

(74) Representative: **Shaw, Laurence**
5th Floor,
Metropolitan House,
1 Hagley Road,
Edgbaston
Birmingham B16 8TG (GB)

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Description

[0001] This invention relates to respiratory muscle training devices.

[0002] In US patent no. 4770413 is disclosed a respiratory muscle training device comprising a mouthpiece attached to a tubular body with a resistor sleeve coaxial with the body tube and having a number of resistance openings which align with a body tube opening and a selective one way flap exhaust valve which can be rotated 180 degrees to provide for inspiratory or expiratory training. This arrangement has a number of drawbacks:

- 1) The design makes it expensive to injection mould.
- 2) The nature of its construction and components makes it difficult to disassemble, clean and reassemble.
- 3) The size of the resistance opening is not infinitely and continuously variable, fine adjustments to its size not being possible, whilst the process of selecting a particular resistance setting might be problematic for an elderly population with impaired dexterity.
- 4) The immediacy with which the exhaust valve shuts on commencing inhalation places a disproportionately high load on the respiratory muscles at the commencement of inhalation requiring them to 'jerk' into action, which:
 - is potentially damaging to the respiratory muscles, particularly those of the elderly population for whom the device is largely prescribed, and
 - is unfavourable to some users, particularly sports people, who prefer the load to be experienced at a fractionally later stage during the inhalation process.

[0003] US-A-4739987 discloses a respiratory exercise device to promote inhalation and exhalation resistance. The device comprises a mouthpiece connected to a tubular body portion, having at each end a controlled opening, one being for inhalation and the other for exhalation. The openings comprise an inner plate having a single hole and an outer rotary plate having a range of holes of different diameters. One plate is rotated with respect to the other for stepwise adjustments.

[0004] GB-A-2278545 discloses an inspiratory muscle training device comprising a branched tube arrangement having a mouthpiece and a spring loaded inlet valve and a one-way exhaust valve on separate branches. Rotating of a sleeve on the inlet branch can be used to load the inlet valve.

[0005] It is an object of the present invention to provide an improved device which is made of plastics, is

simpler and safer to use, of greater benefit to healthier users and allows for the finest of adjustments to the size of the aperture even by those with impaired dexterity. It is also an object to make such a device which is easier to disassemble and clean, whilst the simplicity and robustness of its components suggest that it should last a lifetime.

[0006] Accordingly, the invention provides a respiratory muscle training device comprising a mouthpiece connected to a tubular body portion having a one way exhaust valve in communication with an adjustable resistance opening in the body portion, a one way exhaust valve being present in the body portion to open and close connection through an exhaust opening and a coaxial sleeve arranged to move in co-operation with a screw thread arrangement between the sleeve and the body whereby rotation of the sleeve at the body portion moves one linearly with respect to the other in the direction of the longitudinal axis of the body portion to provide a continuously variable obscuring of the resistance opening between the fully obscured and the non-obscured positions.

[0007] In one embodiment the exhaust valve is a ball valve contained in an adjustable housing whereby the distance the valve has to travel to seal off the exhaust opening during inhalation by a user of the mouthpiece is adjustable. Thus, in this embodiment the device comprises a one way exhaust valve, wherein the distance that the ball of the ball valve is required to travel in order to seal the exhaust aperture during inspiratory training is adjustable. It is also possible for said distance to be reduced to zero, such that the exhaust aperture is permanently though reversibly sealed, so allowing for expiratory training.

[0008] In a preferred embodiment a tubular sleeve is mounted to be movable on the body portion, the body portion having guide means to enable the position of the sleeve to move relative to the body portion whereby the resistance opening can be obscured to a greater or lesser extent by the sleeve, the degree of obscurement being continuously variable between the fully obscured and the not obscured positions of the sleeve.

[0009] The guide means may consist of a screw thread arrangement between the tubular body portion and the sleeve whereby rotation of the sleeve or tubular body portion moves them linearly with respect to each other in the direction of the longitudinal axis of the body portion. The screw thread preferably extends on the outer surface of the tubular body containing the resistance opening. Thus the body portion can be engaged to and co-operable with a corresponding thread on the inner surface of the sleeve such that when the sleeve is rotated it moves in a controlled and linear fashion backwards and forwards over the resistance opening.

[0010] In one embodiment the device may be of generally T' shape with the tubular body portion providing the cross-bar of the T' and the mouthpiece and its connection to the body portion providing the tail of the T'. In

this embodiment the resistance opening may be on one arm of the cross-bar of the T' and the exhaust valve on the other arm of the cross-bar of the T'. The means to obscure the resistance opening may be a threaded sleeve in the form of an end-cap on the arm of the cross-bar of the T'.

[0011] In another embodiment the device may be generally linear with the mouthpiece at one end, the exhaust valve at the other end and the resistance opening located between them.

[0012] Specific embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 shows a plan view of one device of the invention from above, in the fully closed position;

Figure 2 shows the device of Figure 1 opened and ready for use;

Figure 3 shows in cross-section the device as depicted in Figure 1;

Figure 4 is a similar view to Figure 2 of a second device of the invention; and

Figure 5 shows in cross-section the upper half of the device depicted in Figure 4 as viewed from below.

[0013] Referring to Figure 1 the device 10 comprises a T-shaped tube arrangement, portion 11 of which serves as the mouthpiece through which the user breathes and tubular body portion 12 of which remains external to the mouth serving to control the flow of air through the device during inhalation and exhalation.

[0014] Referring to Figure 2 the restriction placed on the flow of air through the device during inhalation is adjusted by means of the screwcap 13 on one end of body portion 12. Unscrewing the screwcap 13 reveals an aperture 14 through which air enters during inhalation; the more of the screwcap 13 is unscrewed the greater the effective size of the aperture 14. Increasing the effective size of the aperture 14 reduces the load on the inspiratory muscles during inhalation making inhalation easier whilst reducing the effective size of the aperture 14 increases the load making inhalation harder. The thread of the screwcap 13 is sufficiently fine so as to ensure that fine adjustments to the effective size of the aperture 14 are possible.

[0015] During exhalation the air leaves the device primarily through the apertures 15 which are of a fixed size and collectively much larger than the aperture 14 so ensuring that the user can exhale freely.

[0016] Referring to Figure 3 the cross-section reveals the ball valve system which controls the flow of air through the apertures 15 during inhalation and exhalation. During inhalation air is drawn through the mouth-

piece 11 in the direction of the arrow 16, so decreasing the pressure in the chamber 17 inside the tubular body. Whilst this momentarily causes some air to be drawn through the apertures 15, air which is drawn in through a small hole 18, in an end-cap 22 threaded on to the opposite end of body portion 12 to cap 13, soon forces a lightweight plastic ball 19 placed inside end-cap 22 in the direction of the arrow 20. The exhaust aperture 21 defined by annular shoulder 21A in the body portion is thereby sealed. The exhaust aperture might also feature a rubber washer to improve the seal. This sealing effect ensures that the air entering the mouthpiece is subsequently limited to that passing through the aperture 14. The momentary delay in the action of the ball valve in sealing the exhaust aperture 21 allows the user, on commencing inhalation, to gain some momentum before the resistance is met, this providing for both a safer and more pleasant experience. The duration of this delay may be increased by unscrewing the screwcap 22: the more the screwcap 22 is unscrewed, the greater the distance the ball 19 has to travel in order to seal the exhaust aperture 21 and so the greater the delay experienced before the resistance is met.

[0017] On exhaling through the device the pressure in the chamber 17 increases causing the ball 19 to return to its starting position as depicted in Figure 3 thereby allowing the air to escape freely through both the aperture 14 and the larger apertures 15.

[0018] Referring to Figure 4 the device comprises a generally linear tubular body 30 having an end portion 31 being connected to a rubber mouthpiece (not shown) through which the user breathes and a portion 32 remaining external to the mouth and serving to control the flow of air through the device during inhalation and exhalation. The restriction placed on the flow of air through the device during inhalation is adjusted by means of a threaded sleeve 33 coaxial to the tubular body which, being engaged to and co-operable with a corresponding thread 34 on the surface of the tubular body, when rotated clockwise or anticlockwise, adjustably obstructs an aperture 35 cut into the tubular body through which air enters during inhalation. Increasing the effective size of the aperture 35 reduces the load on the inspiratory muscles during inhalation making inhalation easier whilst reducing the effective size of the aperture 35 increases the load making inhalation harder. The thread of the sleeve 33 is sufficiently fine to ensure that fine adjustments to the effective size of the aperture 35 are possible.

During exhalation the air leaves the device both through the aperture 35 and an aperture 36 which is of a sufficient size to ensure the user is able to exhale freely.

[0019] Referring to Figure 5, the cross-section reveals the ball valve system which controls the flow of air through the aperture 36 during inhalation and exhalation. During inhalation air is drawn through the mouthpiece 31 in the direction of the arrow 37, so decreasing the pressure in the chamber 38. Whilst this momentarily

causes some air to be drawn through the aperture 36, air which is drawn in through the holes 39 in a screw-threaded end-cap 43 soon forces lightweight plastic ball 40 in the body in the direction of the arrow 41 thereby sealing the exhaust aperture 42 defined by an annular shoulder 42A and ensuring that the air entering the mouthpiece is subsequently limited to that passing through the aperture 35.

[0020] The duration of the momentary delay in the action of the ball valve in sealing the exhaust aperture 42 which determines the degree of momentum achieved in the inhalation process before the resistance is met, may be increased by unscrewing the threaded screwcap 43 which is engaged to a corresponding thread 44 on the surface of portion 32: the more the screwcap 43 is unscrewed, the greater the distance the ball 40 has to travel in order to seal the exhaust aperture 42 and so the greater the delay experienced before the resistance is met. This ability to increase the delay is again important since it helps guard against the possibility of overstressing or jerking' the respiratory muscles at the commencement of inspiration.

[0021] On exhaling through the device the pressure in the chamber 38 increases causing the ball 40 to return to its starting position as depicted in Figure 5 abutting a pin 45 in end-cap 43 thereby allowing the air to escape freely through both the aperture 35 and the larger aperture 36.

[0022] It will be noted that the inclusion of the one way exhaust valve is not essential to the device. The device might just include the sleeve 33 and aperture 35 arrangement with the end of the tubular body being sealed in which case the user, during inspiratory training, would be required to exhale through their nose.

[0023] The device may also be used for expiratory muscle training. To do so the cap 43 is rotated so as to cause the plastic ball 40 to seal the exhaust aperture. The user then breathes in through the nose and out through the device, the expiratory resistance being varied by adjustably obstructing the aperture 35 by rotating the sleeve 33 as described above.

[0024] The device may be prescribed for persons with respiratory problems, or anybody wishing to develop the strength and endurance of their respiratory muscles e. g. singers, athletes, divers.

Claims

1. A respiratory muscle training device (10; 30) comprising a mouthpiece (11; 31) connected to a tubular body portion (12; 30) having a one way exhaust valve (19, 40) in communication with an adjustable resistance opening (14; 35) in the body portion, the one way exhaust valve (19; 40) being present in the body portion to open and close connection through an exhaust opening (21; 39) and a coaxial sleeve (13; 33) arranged to move in co-operation with a

screw thread arrangement between the sleeve and the body whereby rotation of the sleeve (13; 33) or the body portion (12; 30) moves one linearly with respect to the other in the direction of the longitudinal axis of the body portion to provide a continuously variable obscuring of the resistance opening (14; 35) between the fully obscured and the non-obscured positions.

2. A device according to Claim 1, wherein the screw thread (14; 34) extends on the outer surface of the tubular body portion (12; 30) in the region containing the resistance opening (14; 35).
3. A device according to any Claim 1 or 2, in the moveable sleeve (13; Figures 1 to 3) is an end-cap (13) fitted to one end of the body portion (12) which has a lateral mouthpiece (11) whereby the body portion is of generally T-shape.
4. A device according to any preceding Claim, including a ball valve (19; 40) contained in an adjustable housing (22; 43) and wherein the distance the ball has to travel to seal off the exhaust opening (15; 36) during inhalation by a user of the mouthpiece is adjustable.
5. A device according to Claim 4, wherein the ball valve (19; 40) is arranged to abut against an annular shoulder (21A; 42A) inside the body portion (12; 30).
6. A device according to Claim 4, wherein the distance is adjustable to cause a delay before the ball valve (19; 40) seals the exhaust aperture (15; 36) whereby the user on commencing inhalation can gain some momentum before resistance is met.
7. A device (Figure 4; 5) according to Claim 4, 5 or 6, wherein the distance the ball (19) has to travel can be adjusted to zero, whereby the device can be used for expiratory training.

Patentansprüche

1. Trainingsvorrichtung für den Atemmuskel (10; 30), die ein Mundstück (11; 31) angeschlossen an einen röhrenförmigen Körperteil (12; 30) mit einem Rückschlagablaßventil (19, 40) in Verbindung mit einer einstellbaren Widerstandsöffnung (14; 35) in dem Körperteil aufweist, wobei das Rückschlagablaßventil (19; 40) in dem Körperteil zum Öffnen und Schließen einer Verbindung durch eine Ablassöffnung (21; 39) und eine koaxiale Hülse (13; 33) vorliegt, die für Bewegung in Zusammenarbeit mit einer Schraubgewindeeinrichtung zwischen der Hülse und dem Körper angeordnet ist, wodurch

- Drehung der Hülse (13; 33) oder des Körperteils (12, 30) die eine linear hinsichtlich des anderen in die Richtung der Längsachse des Körperteils bewegt, um eine kontinuierlich veränderbare Abdeckung der Widerstandsöffnung (14; 35) zwischen der vollständig abgedeckten und der nicht abgedeckten Position bereitzustellen. 5
2. Vorrichtung nach Anspruch 1, bei der das Schraubgewinde (14; 34) sich an der Außenfläche des röhrenförmigen Körperteils (12; 30) in dem Bereich erstreckt, der die Widerstandsöffnung (14; 35) enthält. 10
3. Vorrichtung nach einem der Ansprüche 1 oder 2, bei der in der bewegbaren Hülse (13; Figuren 1 bis 3) eine Endkappe (13) an einem Ende des Körperteils (12) befestigt ist, der ein seitliches Mundstück (11) aufweist, wodurch der Körperteil allgemein T-förmig ist. 15 20
4. Vorrichtung nach einem vorhergehenden Anspruch, die ein Kugelventil (19; 40) enthalten in einem einstellbaren Gehäuse (22; 43) umfaßt, und bei der der Abstand eingestellt werden kann, den die Kugel zum Verschließen der Ablaßöffnung (15; 36) während Einatmen durch einen Benutzer des Mundstücks zurücklegen muß. 25
5. Vorrichtung nach Anspruch 4, bei der das Kugelventil (19; 40) angeordnet ist, um gegen eine ringförmige Schulter (21A, 42A) innerhalb des Körperteils (12; 30) anzuliegen. 30
6. Vorrichtung nach Anspruch 4, bei der der Abstand zum Verursachen einer Verzögerung einstellbar ist, bevor das Kugelventil (19; 40) die Ablaßöffnung (15; 36) verschließt, wodurch der Benutzer zu Beginn des Einatmens etwas Schwung holen kann, bevor er auf Widerstand trifft. 35 40
7. Vorrichtung (Figur 4; 5) nach Anspruch 4, 5 oder 6, bei der der Abstand, den die Kugel (19) zurücklegen muß, bei null eingestellt werden kann, wodurch die Vorrichtung für Ausatmungstraining verwendet werden kann. 45
- au travers d'une ouverture servant à l'évacuer (21 ; 39) et d'une douille coaxiale (13 ; 33) conçue pour se déplacer grâce à un filetage disposé entre la douille et le corps, la rotation de ladite douille (13 ; 33) ou du corps (12 ; 30) s'effectuant de façon linéaire d'un élément par rapport à l'autre dans le sens de l'axe longitudinal du corps afin de provoquer un effacement progressif et continu de l'ouverture à résistance (14 ; 35) entre les deux positions totalement fermée et totalement ouverte.
2. Appareil selon la revendication 1, dans lequel le filet (14 ; 34) s'étend sur la surface externe du corps tubulaire (12 ; 30) dans la région contenant l'ouverture à résistance (14 ; 35).
3. Appareil selon l'une des revendications 1 ou 2 qui contient, à l'intérieur de la douille amovible un bouchon (13) disposé à l'une des extrémités du corps (12) comportant une embouchure latérale (11) lui procurant une forme générale de T.
4. Appareil selon l'une quelconque des revendications précédentes, comprenant une valve en forme de boule (19 ; 40) contenue dans une enveloppe réglable (22 ; 43) permettant de régler la distance que la boule doit parcourir pour fermer l'ouverture d'évacuation de l'air pendant l'inhalation d'un utilisateur par l'embouchure.
5. Appareil selon la revendication 4, dans lequel la valve en forme de boule (19 ; 40) est conçue pour venir en butée contre un épaulement annulaire (21A ; 42A) à l'intérieur du corps (12 ; 30).
6. Appareil selon la revendication 4, dans lequel on peut régler la distance afin de retarder le moment où la valve en forme de boule (19 ; 40) fermera l'ouverture servant à évacuer l'air (15 ; 36) par laquelle l'utilisateur peut gagner, au début de l'inhalation, quelques instants avant d'atteindre le niveau de résistance.
7. Appareil selon l'une des revendications 4, 5 ou 6, dans lequel le déplacement de la boule (19) doit parcourir peut être réglé à zéro, correspondant à une utilisation de l'appareil pour un travail d'expiration.

Revendications

1. Appareil d'entraînement des muscles respiratoires (10 ; 30) comprenant une embouchure (11 ; 31) liée à un corps tubulaire (12 ; 30) constitué d'une valve d'évacuation d'air unidirectionnelle (19 ; 40) qui communique avec une ouverture à résistance réglable (14 ; 35) à l'intérieur du corps, la valve d'évacuation d'air unidirectionnelle étant prévue dans le corps afin d'ouvrir et de fermer le passage de l'air 50 55

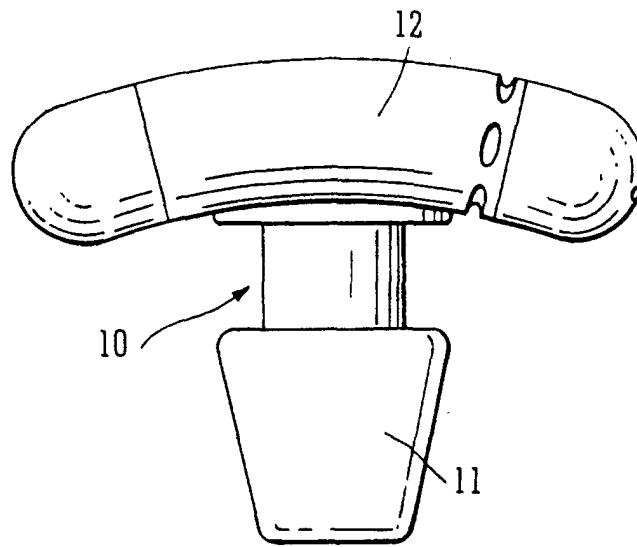


FIG. 1

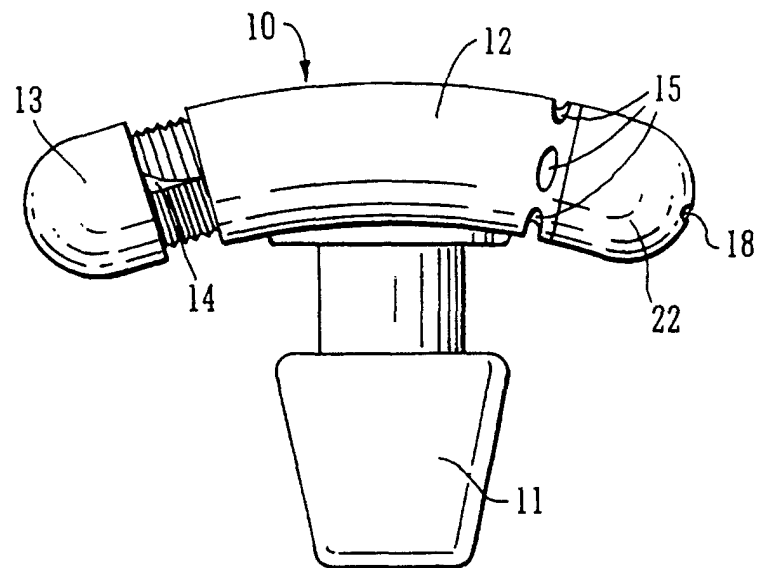


FIG. 2

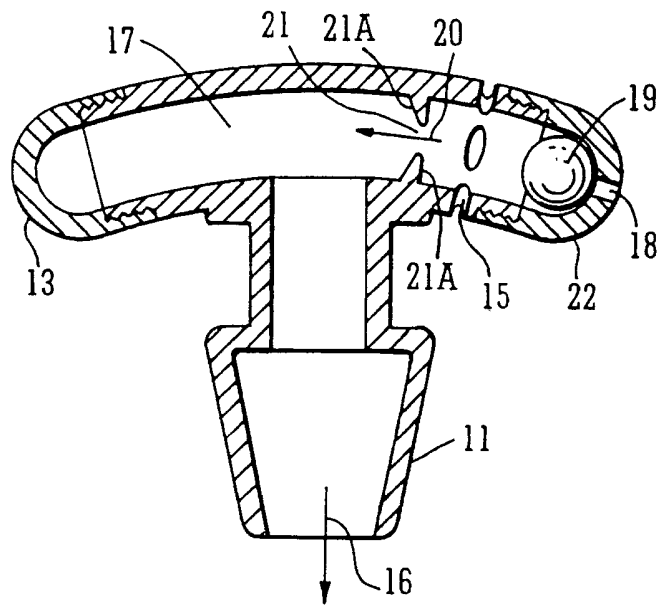


FIG. 3

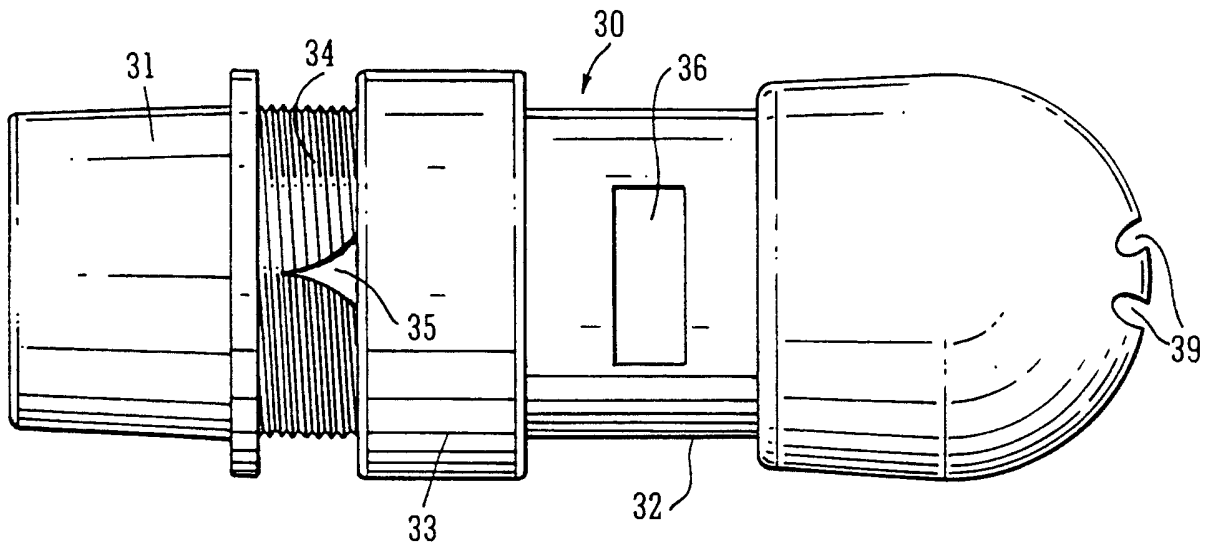


FIG. 4

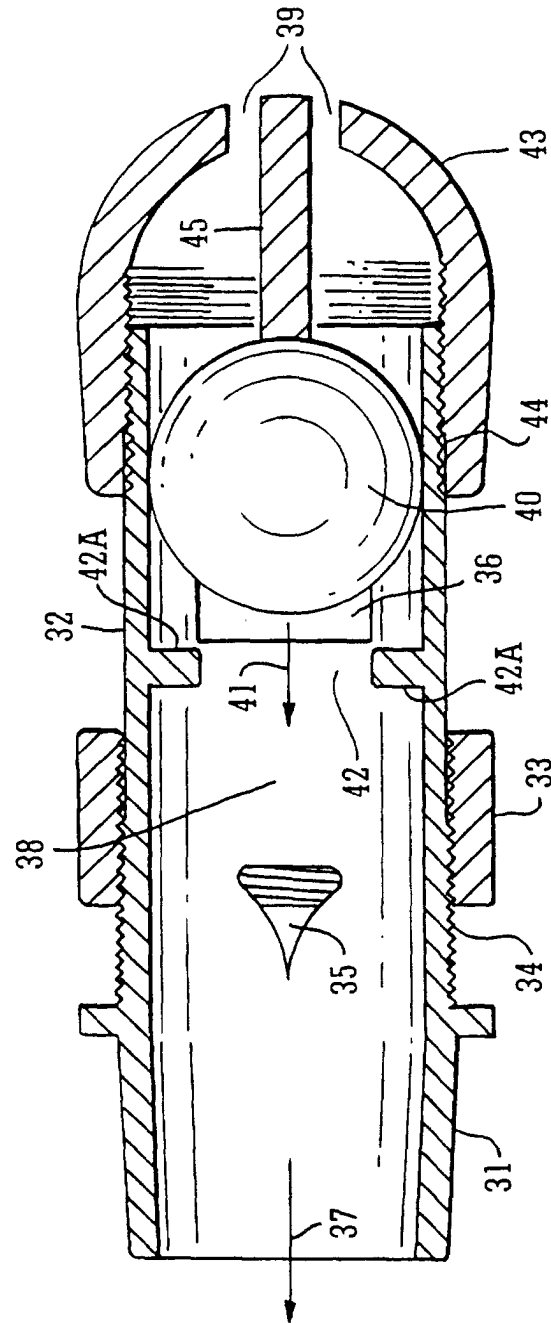


FIG. 5