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(54) **SAMPLING DEVICE AND METHOD FOR OBTAINING SAMPLES OF INTERNAL BODY
SUBSTANCES AND METHOD FOR PRODUCING A SAMPLING DEVICE**

PROBENENTNAHMEVORRICHTUNG UND VERFAHREN ZUR ENTNAHME VON PROBEN VON
KÖRPERSUBSTANZEN SOWIE VERFAHREN ZUR HERSTELLUNG EINER
PROBENENTNAHMEVORRICHTUNG

DISPOSITIF D'ECHANTILLONNAGE ET PROCEDE PERMETTANT L'OBTENTION
D'ECHANTILLONS DE SUBSTANCES CORPORELLES INTERNES ET PROCEDE DE
REALISATION D'UN DISPOSITIF D'ECHANTILLONNAGE

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Description

Field of the invention

[0001] The present invention relates to a sampling device for obtaining samples of internal body substances in the digestive system of humans or animals. The sampling device has the shape of a swallowable capsule which allows a sample of the body substance to enter the capsule through an inlet opening which is opened in a predetermined position of the digestive tract following contact with the body substance to be collected. The invention also relates to a sampling method for obtaining samples of internal body substances and a method for producing the sampling device.

Background of the invention

[0002] Examination of internal body substances, gases or solid particles in the digestive system or the gastrointestinal tract in the human or animal body provides essential medical information for diagnosing and treatment. Examination of a sample of the gastric fluid of a patient provides important information of pH, acid contents, abdominal enzyme activity as well as information for diagnosing gastric ulcer and gastritis, cancer and tumour diseases, etc. A gastroscopic examination gives the physician who is treating a patient important information and plays a great role for a diagnosis. These intubation examinations are thus used extensively. A gastroscopic examination, in which a tube, having a diameter of a little finger, is inserted into the patient's mouth or nose, through the oesophagus and to the gastrointestinal system, is difficult to perform and demands the assistance of a physician. For the patient, the intubation of the digestive tract using these methods is a very unpleasant intervention, both physically and psychologically, especially during the insertion of the tube and also when it is pulled out. The intubation demands that the patient is given a local anaesthetic and in some instances even tranquilliser or a general anaesthetic to overcome the stress to which the patient is subjected. The intubation examination methods described above are disadvantageous since they are very time-consuming for a qualified physician and thus expensive and a very unpleasant intervention for the patient.

[0003] The application of a swallowable capsule for automatically obtaining samples of internal gastric fluids has been proposed as an alternative examination method and is described in US-A-4,481,952. The capsule is equipped with mechanisms, which control the opening and closing of the capsule. The mechanisms are blocked by blocking mechanisms, including a mass which is dissolved after a short time following contact with the gastric fluid. The opening of the capsule, the collection of the sample and the reclosing of the capsule takes place automatically in the patient's stomach. The described sampling device is advantageous in many ways. However, it

has proved to function unsatisfactorily and has therefore not been widely used. The described capsule is expensive, is mechanically complicated and comprises mutually movable parts, mostly metal parts. As a consequence, the parts tend to jam, fluids tend to leak between the parts, friction forces between the parts must be overcome, e.g. by spring forces, and metal parts, such as springs, may loosen in the gastrointestinal tract causing injuries to the patients.

Basic idea of the invention

[0004] The object of the present invention is to solve the above-mentioned problems of the prior art by providing a sampling device which operates automatically in the system of a patient and which is simple, inexpensive to produce, reliable and easy to use.

[0005] This object is achieved in accordance with the invention in a sampling device and a method for obtaining samples and a method for producing a sampling device as described above and with the characterising features as defined in the attached claims.

[0006] In accordance with the invention, a sampling device for automatically obtaining samples of internal body substances is shaped as a capsule such that it may be swallowed by the patient without any stress or pain. In a predetermined position in the digestive system, the capsule is opened and a sample of the body substance is aspirated through an inlet opening into the capsule by the force of a vacuum or substantial underpressure in the capsule. When a predetermined volume of the sampling substance has been collected in the capsule, i.e. the capsule is filled, the inlet opening is automatically closed, sealing it from the inside of the capsule, such that the sample remains in the capsule. The capsule with the collected sample is fed through the gastrointestinal tract of the digestive system and, still with no stress or pain for the patient, out of the human body together with the feces in a normal manner. The capsule with the collected sample subsequently is sent or handed over to a medical institution or laboratory, where the sample is evacuated from the capsule to be analysed.

[0007] The sampling device according to the invention is simple and is made of a few essential parts. Just one of these part, the elastic blocking member, is resiliently movable between a flow permitting configuration and a flow preventing configuration and is affected by forces ensuing from the pressure difference between the outside and the inside of the capsule. Through this constructional feature of the closing member, a reliable, simple and inexpensive sampling device is achieved with no metal or mutually movable parts that may jam, leak or come loose in the system and cause injuries to the patient. Through the production method according to the invention a vacuum or substantial underpressure is created in the capsule and this vacuum or substantial underpressure exerts sufficient forces for opening the closing member and for aspiration of a sample of a body

substance into the capsule. Through the sampling method according to the invention, the collection of internal body substances can be performed extremely simple and inexpensive and the examination may be carried out without any pain, stress or discomfort to the patient.

Short description of the drawings

[0008] The invention will be described more in detail below with reference to the attached drawings, in which:

Figure 1 is a sectional view of a sampling device according to a first embodiment of the invention, in a first closed and sealed state,

Figure 2 shows the sampling device of Figure 1 in a second, open state, and in a flow permitting configuration with the body substance flowing into the device,

Figure 3 shows the sampling device of Figure 1 in a third, reclosed state, and in a flow preventing configuration in which the body substance has filled up the sampling device,

Figure 4 shows the sampling device of Figure 1 in a fourth, evacuating state, in which the sample of body substance is evacuated from the capsule to be analysed,

Figure 5 is a sectional view of a sampling device according to a second embodiment of the invention, in a first closed and sealed state,

Figure 6 shows the sampling device of Figure 5 from above,

Figure 7 shows an enlarged scale perspective view of an embodiment of the blocking member, and

Figure 8 shows a schematic elevation view of the vacuum chamber.

Detailed description of embodiments of the invention

[0009] Figure 1 is a sectional view of a sampling device according to the invention, said device being designed to obtain samples of internal body substances, such as body fluids, in the digestive tract of a patient. In Figure 1, the sampling device is shown in a first closed and sealed state, in which it is handed over to be swallowed by a patient, from whom a sample of an internal body fluid, such as the gastric fluid in the stomach, for example, shall be collected.

[0010] The sampling device has the shape of a capsule 2, such as a conventional pharmaceutical capsule, and is thus suitable for ingestion. The capsule 2 is preferably elongated and has rounded end portions and preferably a circular or oval-shaped cross-section. The capsule 2 comprises an inner chamber 5 defined by a capsule wall 3.

[0011] The capsule 2, preferably made of a thermoplastic material or any other suitable material, is made of at least two capsule members, a cap member 4 and

a body member 6, said cap 4 and body 6 members being permanently joined to each other, as will be described more in detail below. The inner chamber 5 of the capsule 2 may comprise a filter 10, preferably clamped in the capsule 2 between the cap member 4 and the body member 6, to filtrate the body fluid sample, when required.

[0012] A blocking member 12 in the capsule is shown in an enlarged view in Figure 7. The inner blocking member 12, such as a membrane valve, made of a flexible, elastic and resilient rubbery material, has a circular fixation edge 19 which is clamped in the capsule 2 between the cap member 4 and the body member 6. In the embodiment as shown, the blocking member 12 has the form of a bulb and has at least one, preferably several, apertures 16 arranged in the slanted side of the bulb. In the closed and sealed state, as shown in Figure 1, the blocking member 12 bears on a preferably circular contact surface 22 on the inside of the capsule wall 3. The contact or sealing area 17 on the blocking member 12 is shown between the dashed lines in Figure 7. Through the shape of the blocking member and the resilience of the material, the blocking member 12 bears on the contact surface 22 with a bearing pressure.

[0013] The circular contact surface 22, formed as a bulge-formed lining, is arranged on the inside of the capsule wall 3 and extends around an inlet opening 18 in said wall. In the closed and sealed state of the capsule as shown in Figure 1, the inlet opening 18 is sealed by a plug 20. The plug 20 in the capsule 2 is made of a material which is chosen depending on the application of the capsule, i.e. the specific body fluid to be collected. The plug 20 is dissolved after a short period of time in the body fluid in question, in the embodiment as described, the digestive fluid. Thus, the material of the plug 20 is adapted to the specific fluid or substance in the external environment of the capsule in the position in the body system where the sample is collected. The material of the plug 20 is, for example, gelatine, molten sugar, salt, glue, organic edible materials or any other suitable material. Alternatively, the plug 20 can be made of two or more layers of different materials, which dissolve gradually upon contact with different substances in the external environment of the capsule 2 during its passage through the digestive system. The innermost layer dissolves upon contact with body fluid to be collected by the capsule 2.

[0014] A section of the capsule wall 3, preferably in the body member 6 of the capsule, is thinner and forms a notch 24. The notch 24 is used when the body fluid sample in the inner chamber 5 shall be evacuated from the capsule, as will be described more in detail with reference to Figure 4.

[0015] In the inner chamber 5 of the capsule, defined by the capsule wall 3 and the plug 20, a vacuum or substantial underpressure prevails as long as the capsule 2 is in the closed and sealed state as shown in Figure 1.

[0016] When an examination of a body fluid in the digestive system is required, the patient swallows the cap-

sule 2, e.g. the capsule as shown in Figure 1, without any stress or pain. The size of the capsule 2 may vary depending on the volume of body fluid required for the examination and analysis. A suitable size of a capsule which is easy to swallow has, for example, a length of

about 25 mm and a width of about 10 mm.
[0017] In Figure 2, the inlet opening 18 of the capsule 2 has been opened. When the capsule is in the state as shown in Figure 2, the capsule has previously been swallowed by the patient, has passed the oesophagus and has entered into the stomach. During the passage of the capsule 2 from the mouth to the position in the system of the patient in which the sample shall be collected, the patient feels no more discomfort than he feels when he swallows an ordinary pharmaceutical capsule, i.e. a discomfort which is principally non-existing.

[0018] When the plug 20 has been dissolved, as shown in Figure 2, the inlet opening 18 is open. A suction effect is generated by the pressure difference between the external environment of the capsule 2 and the inner chamber 5 in which a vacuum or substantial underpressure prevails: This suction effect forces the resilient blocking member 12 into a flow permitting configuration, as shown in Figure 2. The body fluid 26 in the external environment of the capsule flows into the inlet opening 18 and exerts a pressure on the resilient and elastic, self-sealing blocking member 12, such that a fluid passage into the chamber 5 is opened between the contact surface 22 and the blocking member 12. The body fluid 26 flows further through the apertures 16 in the blocking member 12, through the filter 10, if any, and into the inner chamber 5, as shown in Figure 2.

[0019] The blocking member 12 is opened and is kept open by the pressure difference between the external environment of the capsule and the inner chamber of the capsule 2. As soon as the external and internal pressure of the capsule have been equalised and the body fluid 26 has filled up the inner chamber 5 of the capsule, the blocking member 12 reverts to a flow preventing configuration, such that the inlet opening 18 is closed and thus the flow of body fluid from the inner chamber 5 of the capsule is prevented. This reclosed state of the capsule is shown in Figure 3. Since the body fluid sample fills up the inner chamber 5 of the capsule and the fluid is prevented by the blocking member 12 to leave the chamber, the exact volume of the collected body fluid in a sampling capsule can be predetermined. The capsule 2 with the enclosed sample of body fluid 26 is now fed through the gastrointestinal tract and is recovered from the feces of the patient.

[0020] Figure 4 shows the recovered capsule 2 in a state in which the body fluid sample is evacuated from the inner chamber 5 of the capsule. An evacuation needle 28, directly or indirectly connected to an instrument for examination and analysis of the body fluid sample, penetrates the notch 24 of the chamber wall 3 and empties the inner chamber 5.

[0021] Figures 5 and 6 show a second preferred em-

bodiment of the invention, which differs from the embodiment of Figures 1 - 4 only in that the inlet of the capsule 2 is designed differently. Several, e.g. four in the shown embodiment, protrusions 30 are disposed externally on the capsule 2 at the inlet opening 18. Between the protrusions 30 laterally directed inlet grooves 32 are formed. The protrusions 30 protect the inlet opening 18 in such a way that they prevent the capsule 2 from being adhered to the walls of the digestive system by the suction forces generated by the internal underpressure. A free flow of body fluid through the inlet grooves 32 into the capsule 2 is thus always secured.

[0022] As described above, the capsule 2 consists of two members 4, 6 which are permanently joined together. The members 4, 6 are preferably made of injection-moulded thermoplastic, such as Macrolon® D for example, which is a strong, acid resistant and transparent material and thus suitable for this purpose.

[0023] The blocking member 12 is preferably made of an elastic rubbery material and may be injection-moulded. The shape (see for example Figures 3-5) and the material properties of the blocking member 12 generate the self-closing function and force the blocking member to bear on and seal off the inlet opening 18 from the inside of the capsule 2.

[0024] The sampling device according to the invention is made of a few parts, i.e. the cap member 4 with the plug 20, the body member 6, the blocking member 12 and, when required, also the filter 10. As shown in Figure 8, these parts are fully or partly assembled in a vacuum chamber 40, in which a vacuum or substantial underpressure is maintained by means of a vacuum pump (not shown) connected to the vacuum chamber through the vacuum hose 42. In accordance with the invention, at least the assembly-step that finally seals off the inner chamber 5 of the capsule from the external environment shall be carried out in the vacuum chamber 40 in order to achieve a vacuum or substantial underpressure in the inner chamber 5, such that sufficient suction forces are generated to force the blocking member 12 to a flow permitting configuration and the body fluid sample to enter and fill the capsule.

[0025] To assemble the sampling device according to the invention, the blocking member 12 and possibly the filter 10 are initially mounted in the cap member 4 or the body member 6 and subsequently the two members of the capsule are permanently joined together, preferably by ultrasonic welding. The plug 20 may previously have been inserted in the inlet opening 18 of the capsule. In that case, the joining of the two members 4, 6 together, constitutes the assembly-step that seals off the inner chamber 5 of the capsule. Thus, at least this assembly-step must be carried out in the vacuum chamber 40.

[0026] Alternatively, when the blocking member 12 and the filter 10 have been mounted in either of the two members 4, 6 of the capsule 2, these two members 4, 6 are permanently joined together, and then the final sealing of the inner chamber 5 of the capsule is made by

introducing the plug 20 into the inlet opening 18. Thus, at least this final assembly-step shall be carried out in the vacuum chamber 40. The plug 20, for example made of an organic glue, is quickly set when it is cooled. In the embodiment as shown in Figure 7, the plug 20 is applied by means of a nozzle 44 and the glue is fed into the nozzle from the container 46. In the embodiment of Figure 7, the nozzle 44 initially is inserted into and through the inlet opening 18 of the capsule in the vacuum chamber, such that the elastic and self-closing blocking member 12 is forced by the nozzle 44 to open the communication to the inner chamber 5 of the capsule and the vacuum in the vacuum chamber is transmitted to the inner chamber 5. The nozzle 44 is then withdrawn to the position of the inlet opening 18, where the plug 20 is applied by the nozzle 44 and sets, such that the capsule with its internal vacuum or substantial underpressure is finally sealed. Thus, in this assembly-step, the nozzle 44 is first used to open the blocking member 12 and subsequently to apply the plug 20 of glue in the inlet opening 18.

[0027] The capsule 2 may further be provided with an additional outer, covering film of gelatine or any other suitable material, which is dissolved in the digestive system. The film may be applied in order to minimise the resistance when the capsule is swallowed by the patient.

[0028] It will be understood that the invention is not restricted to the aforescribed exemplifying embodiments thereof and that several conceivable modifications of the invention are possible within the scope of the following claims. For example, the plug may be formed to be fully dissolved after a predetermined time in the digestive system, such that a time delay of the opening of the inlet opening is obtained. The elastic blocking member may have other forms and shapes and be placed differently in the capsule. Instead of one single inlet opening, as described in the embodiments above, several adjoining inlet openings may be provided in the capsule. In the description above, only samples of body fluids have been discussed. It should, however, be noted that the sampling device according to the invention also may be used to collect samples comprising gases and/or solid particles in the digestive system.

Claims

1. A sampling device for obtaining samples of internal body substances in the digestive tract of a patient, said device having a shape of a swallowable capsule (2) comprising a capsule wall (3) and an inner chamber (5), defined by said capsule wall (3) and disposed to preserve a vacuum or substantial underpressure when the inlet opening (18) is sealed, which capsule (2) allows a sample of the body substance to enter the capsule through at least one inlet opening (18) which is opened in a predetermined position of the digestive tract following contact with the body substance to be collected,

characterised in that the

capsule wall (3) comprises said inlet opening (18), which initially is sealed and, when the patient has swallowed the capsule (2), is opened in said predetermined position following contact with the body substance to be collected, and the capsule comprises

a blocking member (12) disposed in the inner chamber (5) adjacent to the inlet opening (18) in the capsule wall (3), said blocking member (12) being elastic and having a configuration, such that, when the inlet opening (18) has been opened following contact with said body substance, the blocking member (12) has a flow permitting configuration which admits a flow of body substance into the inner chamber (5) as long as there is a pressure difference between the inner chamber (5) and the external environment of the capsule (2) and a flow preventing configuration which blocks the inlet opening (18) from the inside of the chamber (5) when said pressure difference has been equalised by the flow of body substance into the capsule (2).

2. A sampling device according to claim 1, **characterised in that** the inlet opening (18) is sealed by a plug member (20) of a material that is dissolved following contact with said body substance.

3. A sampling device according to claim 1, **characterised in that** the blocking member (12) consists of an elastic, self-sealing membrane, which in said flow preventing configuration sealingly bears on the inside of the capsule wall (3), such that an outflow of the body substance in the inner chamber (5) is prevented.

4. A sampling device according to claim 3, **characterised in that** the capsule (2) comprises two members, a cap member (4) and a body member (6), which are permanently joined to each other, and that said blocking member (12) is clamped in the capsule wall (3) between said cap member (4) and said body member (6).

5. A sampling device according to claim 4, **characterised in that** the blocking member (12) is substantially bulb-formed and has at least one laterally located aperture (16) for a through-flow of body substance into the inner chamber (5).

6. A sampling device according to claim 5, **characterised in that** a peripheral edge of the blocking member (12) is clamped between said cap member (4) and said body member (6).

7. A sampling device according to claim 2, **characterised in that** the plug member (20) consists of two or more layers of different materials and that each

layer is dissolved in different positions in the digestive tract following contact with a specific body substance.

8. A sampling device according to claim 4, **characterised in that** a filter (10) is clamped between said cap member (4) and said body member (6) for filtrating the body substance that flows into the inner chamber (5).
9. A sampling device according to any of the preceding claims, **characterised in that** protrusions (30) are disposed externally on the capsule (2) circumferentially of the inlet opening (18), thereby forming inlet grooves (32) between the protrusions (30) for securing a free flow of body substance to the inlet opening (18).
10. A sampling method for obtaining samples of internal body substances in the digestive tract of a patient, wherein a capsule (2) is swallowed by the patient and the capsule (2) is opened in a predetermined position of the digestive tract following contact with the body substance to be collected, wherein the body substance is aspirated into the capsule (2) by the force of a vacuum or substantial underpressure inside the capsule, and **characterised in that** the body substance is blocked in the capsule (2) by an elastic, self-sealing blocking member (12) disposed inside the capsule (2).
11. A sampling method according to claim 10, **characterised in that** the capsule (2) is opened to collect a sample in that a plug member (20) in an inlet opening (18) in the capsule wall (3) is dissolved following contact with the body substance to be collected.
12. A sampling method according to the claim 11, **characterised in that** said self-sealing blocking member (12) is opened to collect a sample of said body fluid by the force of the vacuum or substantial underpressure in the capsule (2) when the plug member (20) has been dissolved.
13. A sampling method according to claim 12, **characterised in that** said blocking member (12) is blocking the inlet opening (18) from the inside of the capsule (2) when the vacuum or substantial underpressure in the capsule has been equalised.
14. A method for producing a sampling device for obtaining samples of internal body substances in the digestive tract of a patient, said device having a shape of a swallowable capsule (2) which allows a sample of the body substance to enter the capsule through at least one inlet opening (18) in the capsule wall (3) which is opened in a predetermined position of the digestive tracts following contact with the body

substance to be collected,

characterised in that the inlet opening (18) in the capsule wall (3) is sealed and/or that the capsule (2), which is made of two permanently joined members (4, 6), is permanently joined in a vacuum chamber (40) preserving a constant vacuum or substantial underpressure, such that a vacuum or substantial underpressure is formed in an inner chamber (5) of the capsule when the inlet opening is sealed and/or when the two members (4, 6) of the capsule are permanently joined together.

15. A method according to claim 14, **characterised in that** said two members (4, 6) of the capsule are injection-moulded and are permanently joined together, preferably by ultrasonic welding.
16. A method according to claim 15, **characterised in that** an blocking member (12) of the inlet opening (18) is injection-moulded and is mounted between the two members (4, 6) of the capsule prior to permanently joining the two members together.
17. A method according to any of claims 14 - 16, **characterised in that** the inlet opening (18) of the capsule is sealed off by a plug member (20), preferably made of an organic glue, and that the two members (4, 6) are joined together in the vacuum chamber (40).
18. A method according to any of claims 14 - 16, **characterised in that** the two members (4, 6) of the capsule are permanently joined together and that the capsule (2) is sealed off in a vacuum chamber (40) in that a plug member (20) is applied in the inlet opening (18).
19. A method according to claim 18, **characterised in that** applications means (44) for applying the plug member (20), preferably a nozzle, is inserted into and through the inlet opening (18) in the capsule wall (3), that the application means (44) forces the blocking member (12) to open, and that the application means (44) is withdrawn into the inlet opening (18) and the plug member (20), preferably of an organic glue, is applied in the opening (18) by said application means (44).

50 Revendications

1. Dispositif d'échantillonnage pour obtenir des échantillons de substances corporelles internes dans le tube digestif d'un patient, ledit dispositif ayant la forme d'une capsule (2) pouvant être avalée, comportant une paroi de capsule (3) et une chambre intérieure (5) définie par ladite paroi de capsule (3) et disposée pour préserver un vide ou une sous-pres-

sion importante lorsque l'ouverture d'entrée (18) est rendue étanche, laquelle capsule (2) permet à un échantillon de la substance corporelle d'entrer dans la capsule à travers au moins une ouverture d'entrée (18) qui est ouverte dans une position prédéterminée du tube digestif à la suite d'un contact avec la substance corporelle à recueillir,

caractérisé en ce que

la paroi de capsule (3) comporte ladite ouverture d'entrée (18), qui est initialement rendue étanche et, lorsque le patient a avalé la capsule (2), qui est ouverte dans ladite position prédéterminée à la suite d'un contact avec la substance corporelle devant être recueillie,

et **en ce que** la capsule comporte

un élément de blocage (12) disposé dans la chambre intérieure (5) adjacent à l'ouverture d'entrée (18) dans la paroi de capsule (3), ledit élément de blocage (12) étant élastique et ayant une configuration telle que lorsque l'ouverture d'entrée (18) a été ouverte à la suite d'un contact avec ladite substance corporelle, l'élément de blocage (12) a une configuration d'autorisation d'écoulement qui autorise un écoulement de substance corporelle dans la chambre intérieure (5) aussi longtemps qu'il y a une différence de pression entre la chambre intérieure (5) et l'environnement externe de la capsule (2), et une configuration d'empêchement d'écoulement qui bloque l'ouverture d'entrée (18) à partir de l'intérieur de la chambre (5) lorsque ladite différence de pression a été égalisée par l'écoulement de substance corporelle dans la capsule (2).

2. Dispositif d'échantillonnage selon la revendication 1, **caractérisé en ce que** l'ouverture d'entrée (18) est rendue étanche par l'élément formant bouchon (20) d'un matériau qui est dissous à la suite d'un contact avec ladite substance corporelle.
3. Dispositif d'échantillonnage selon la revendication 1, **caractérisé en ce que** l'élément de blocage (12) est constitué d'une membrane à auto-étanchéité élastique qui, dans ladite configuration d'empêchement d'écoulement, appuie de manière étanche sur l'intérieur de la paroi de capsule (3), de telle sorte qu'un écoulement de la substance corporelle dans la chambre intérieure (5) est empêché.
4. Dispositif d'échantillonnage selon la revendication 3, **caractérisé en ce que** la capsule (2) comporte deux éléments, un élément de capuchon (4) et un élément de corps (6), qui sont reliés de manière permanente l'un à l'autre, et **en ce que** ledit élément de blocage (12) est serré dans la paroi de capsule (3) entre ledit élément de capuchon (4) et ledit élément de corps (6).
5. Dispositif d'échantillonnage selon la revendication

4, **caractérisé en ce que** l'élément de blocage (12) est sensiblement en forme de bulbe, et a au moins une ouverture (16) située latéralement pour un écoulement traversant de substance corporelle dans la chambre intérieure (5).

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6. Dispositif d'échantillonnage selon la revendication 5, **caractérisé en ce que** un bord périphérique de l'élément de blocage (12) est serré entre ledit élément de capuchon (4) et ledit élément de corps (6).
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7. Dispositif d'échantillonnage selon la revendication 2, **caractérisé en ce que** l'élément formant bouchon (20) est constitué de deux couches ou plus de matériaux différents, et **en ce que** chaque couche est dissoute dans différentes positions dans le tube digestif à la suite d'un contact avec une substance corporelle spécifique.
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8. Dispositif d'échantillonnage selon la revendication 4, **caractérisé en ce que** un filtre (10) est serré entre ledit élément de capuchon (4) et ledit élément de corps (6) pour filtrer la substance corporelle qui s'écoule dans la chambre intérieure (5).
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9. Dispositif d'échantillonnage selon l'une quelconque des revendications précédentes, **caractérisé en ce que** des saillies (30) sont disposées extérieurement sur la capsule (2) circonférentiellement par rapport à l'ouverture d'entrée (18), en formant ainsi des gorges d'entrée (32) entre les saillies (30) pour garantir un écoulement libre d'une substance corporelle vers l'ouverture d'entrée (18).
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10. Procédé d'échantillonnage pour obtenir des échantillons de substances corporelles internes dans le tube digestif d'un patient, dans lequel une capsule (2) est avalée par le patient, et la capsule (2) est ouverte dans une position prédéterminée du tube digestif suite à un contact avec la substance corporelle à recueillir, dans lequel la substance corporelle est aspirée dans la capsule (2) par la force d'un vide ou d'une sous-pression importante à l'intérieur de la capsule, et **caractérisé en ce que** la substance corporelle est bloquée dans la capsule (2) par un élément de blocage à auto-étanchéité élastique (12) disposé à l'intérieur de la capsule (2).
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11. Procédé d'échantillonnage selon la revendication 10, **caractérisé en ce que** la capsule (2) est ouverte pour recueillir un échantillon, et **en ce que** un élément formant bouchon (20) dans une ouverture d'entrée (18) dans la paroi de capsule (3) est dissous à la suite d'un contact avec la substance corporelle devant être recueillie.
- 55
12. Procédé d'échantillonnage selon la revendication 11, **caractérisé en ce que** ledit élément de blocage

à auto-étanchéité (12) est ouvert pour recueillir un échantillon dudit fluide corporel par la force du vide ou de la sous-pression importante dans la capsule (2) lorsque l'élément formant bouchon (20) a été dessous.

- 5
13. Procédé d'échantillonnage selon la revendication 12, **caractérisé en ce que** ledit élément de blocage (12) bloque l'ouverture d'entrée (18) à partir de l'intérieur de la capsule (2) lorsque le vide ou la sous-pression importante dans la capsule a été égalisée.
- 10
14. Procédé pour produire un dispositif d'échantillonnage pour obtenir des échantillons de substances corporelles internes dans le tube digestif d'un patient, ledit dispositif ayant la forme d'une capsule (2) pouvant être avalée qui permet à un échantillon de la substance corporelle d'entrer dans la capsule à travers au moins une ouverture d'entrée (18) dans la paroi de capsule (3) qui est ouverte dans une position prédéterminée du tube digestif à la suite d'un contact avec la substance corporelle devant être recueillie, **caractérisé en ce que** l'ouverture d'entrée (18) dans la paroi de capsule (3) est rendue étanche et/ou **en ce que** la capsule (2), qui est constituée de deux éléments reliés en permanence (4, 6), est reliée en permanence dans une chambre à vide (40) préservant un vide constant ou une sous-pression importante, de telle sorte qu'un vide ou une sous-pression importante est formée dans une chambre intérieure (5) de la capsule lorsque l'ouverture d'entrée est rendue étanche et/ou lorsque les deux éléments (4, 6) de la capsule sont reliés de manière permanente l'un à l'autre.
- 15
15. Procédé selon la revendication 14, **caractérisé en ce que** lesdits deux éléments (4, 6) de la capsule sont moulés par injection et sont reliés de manière permanente l'un à l'autre, de préférence par soudage par ultrasons.
- 20
16. Procédé selon la revendication 15, **caractérisé en ce qu'un** élément de blocage (12) de l'ouverture d'entrée (18) est moulé par injection et est monté entre les deux éléments (4, 6) de la capsule avant de relier les deux éléments ensemble de manière permanente.
- 25
17. Procédé selon l'une quelconque des revendications 14 à 16, **caractérisé en ce que** l'ouverture d'entrée (18) de la capsule est rendue étanche par un élément formant bouchon (20), de préférence réalisé en une colle organique, et **en ce que** les deux éléments (4, 6) sont reliés ensemble dans la chambre à vide (40).
- 30
18. Procédé selon l'une quelconque des revendications 14 à 16, **caractérisé en ce que** les deux éléments (4, 6) de la capsule sont reliés de manière perma-

nente ensemble, et **en ce que** la capsule (2) est rendue étanche dans une chambre à vide (40), **en ce qu'un** élément formant bouchon (20) est appliqué dans l'ouverture d'entrée (18).

- 5
19. Procédé selon la revendication 18, **caractérisé en ce que** des moyens d'application (44) pour appliquer l'élément formant bouchon (20), de préférence une buse, sont insérés dans l'ouverture d'entrée (18) dans la paroi de capsule (3), et à travers celle-ci, **en ce que** les moyens d'application (44) poussent l'élément de blocage (12) à s'ouvrir, et **en ce que** les moyens d'application (44) sont retirés dans l'ouverture d'entrée (18) et l'élément formant bouchon (20), constitué de préférence d'une colle organique, est appliqué dans l'ouverture (18) par lesdits moyens d'application (44).

20 Patentansprüche

1. Probenentnahmeeinrichtung zum Gewinnen von Proben von inneren Körpersubstanzen im Verdauungstrakt eines Patienten, wobei die Einrichtung die Form einer schluckbaren Kapsel (2) aufweist, die eine Kapselwand (3) und eine innere Kammer (5) aufweist, die durch die Kapselwand (3) definiert und so angeordnet ist, dass sie ein Vakuum oder einen erheblichen Unterdruck bewahrt, wenn die Einlassöffnung (18) versiegelt ist, die Kapsel (2) es ermöglicht, dass eine Probe der Körpersubstanz durch wenigstens eine Einlassöffnung (18), welche an einer vorbestimmten Stelle des Verdauungstrakts nach dem Kontakt mit der zu sammelnden Körpersubstanz geöffnet wird, in die Kapsel eintritt, **dadurch gekennzeichnet, dass** die Kapselwand (3) die Einlassöffnung (18) aufweist, welche anfänglich versiegelt ist und, wenn der Patient die Kapsel (2) geschluckt hat, an der vorbestimmten Stelle nach dem Kontakt mit der zu sammelnden Körpersubstanz geöffnet wird, und dass die Kapsel aufweist:

ein Blockierungselement (12), das in der inneren Kammer (5) benachbart zur Einlassöffnung (18) in der Kapselwand (3) angeordnet ist, wobei das Blockierungselement (12) elastisch ist und eine derartige Konfiguration aufweist, dass, wenn die Einlassöffnung (18) nach dem Kontakt mit der Körpersubstanz geöffnet wurde, das Blockierungselement (12) eine Durchfluss ermöglichende Konfiguration, welche einen Fluss von Körpersubstanz in die innere Kammer (5) zulässt, so lange ein Druckunterschied zwischen der inneren Kammer (5) und der äußeren Umgebung der Kapsel (2) vorliegt, und eine Durchfluss verhindernde Konfiguration, welche die Einlassöffnung (18) von der Innenseite der

- Kammer (5) blockiert, wenn der Druckunterschied durch den Fluss von Körpersubstanz in die Kapsel (2) ausgeglichen wurde, aufweist.
2. Probenentnahmeeinrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Einlassöffnung (18) durch ein Steckelement (20) aus einem Material versiegelt ist, das nach dem Kontakt mit der Körpersubstanz aufgelöst wird. 5
 3. Probenentnahmeeinrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** das Blockierungselement (12) aus einer elastischen selbstdichtenden Membran besteht, welche in der Durchfluss verhin- 10 dernden Konfiguration abdichtend an die Innenseite der Kapselwand (3) drückt, derart dass ein Ausfluss der Körpersubstanz in die innere Kammer (5) verhindert wird. 15
 4. Probenentnahmeeinrichtung nach Anspruch 3, **dadurch gekennzeichnet, dass** die Kapsel (2) zwei 20 Elemente, ein Kappenelement (4) und ein Körperelement (6), aufweist, welche dauerhaft miteinander verbunden sind, und dass das Blockierungselement (12) zwischen dem Kappenelement (4) und dem Körperelement (6) in der Kapselwand (3) eingeklemmt 25 ist. 30
 5. Probenentnahmeeinrichtung nach Anspruch 4, **dadurch gekennzeichnet, dass** das Blockierungselement (12) im Wesentlichen ballonförmig ist und wenigstens ein seitlich angeordnetes Loch (16) für einen Durchfluss von Körpersubstanz in die innere Kammer (5) aufweist. 35
 6. Probenentnahmeeinrichtung nach Anspruch 5, **dadurch gekennzeichnet, dass** eine Randkante des Blockierungselements (12) zwischen dem Kappenelement (4) und dem Körperelement (6) eingeklemmt ist. 40
 7. Probenentnahmeeinrichtung nach Anspruch 2, **dadurch gekennzeichnet, dass** das Steckelement (20) aus zwei oder mehr Schichten verschiedener Materialien besteht, und dass jede Schicht an verschiedenen Stellen im Verdauungstrakt nach dem Kontakt mit einer bestimmten Körpersubstanz aufgelöst wird. 45
 8. Probenentnahmeeinrichtung nach Anspruch 4, **dadurch gekennzeichnet, dass** ein Filter (10) zwischen dem Kappenelement (4) und dem Körperelement (6) zum Filtern der Körpersubstanz, die in die innere Kammer (5) fließt, eingeklemmt ist. 50
 9. Probenentnahmeeinrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** Vorsprünge (30) außen auf der Kapsel (2) 55 umlaufend um die Einlassöffnung (18) angeordnet sind, um **dadurch** Einlasskanäle (32) zwischen den Vorsprüngen (30) zum Sichern eines freien Flusses von Körpersubstanz zur Einlassöffnung (18) zu bilden.
 10. Probenentnahmeverfahren zum Gewinnen von Proben von inneren Körpersubstanzen im Verdauungstrakt eines Patienten, wobei eine Kapsel (2) durch einen Patienten geschluckt wird und die Kapsel (2) an einer vorbestimmten Stelle des Verdauungstrakts nach dem Kontakt mit der zu sammelnden Körpersubstanz geöffnet wird, wobei die Körpersubstanz durch die Kraft eines Vakuums oder eines erheblichen Unterdrucks innerhalb der Kapsel in die Kapsel (2) gesaugt wird, und **dadurch gekennzeichnet, dass** die Körpersubstanz in der Kapsel (2) durch ein elastisches selbstdichtendes Blockierungselement (12), das innerhalb der Kapsel (2) angeordnet ist, blockiert wird.
 11. Probenentnahmeverfahren nach Anspruch 10, **dadurch gekennzeichnet, dass** die Kapsel (2) geöffnet wird, um eine Probe zu sammeln, indem ein Steckelement (20) in einer Einlassöffnung (18) in der Kapselwand (3) nach dem Kontakt mit der zu sammelnden Körpersubstanz aufgelöst wird.
 12. Probenentnahmeverfahren nach Anspruch 11, **dadurch gekennzeichnet, dass** das selbstdichtende Blockierungselement (12) durch die Kraft des Vakuums oder des erheblichen Unterdrucks in der Kapsel (2), wenn das Steckelement (20) aufgelöst wurde, geöffnet wird, um eine Probe des Körperfluids zu sammeln.
 13. Probenentnahmeverfahren nach Anspruch 12, **dadurch gekennzeichnet, dass** das selbstdichtende Blockierungselement (12) die Einlassöffnung (18) von der Innenseite der Kapsel (2) blockiert, wenn das Vakuum oder der erhebliche Unterdruck in der Kapsel ausgeglichen wurde.
 14. Verfahren zur Herstellung einer Probenentnahmeeinrichtung zum Gewinnen von Proben von inneren Körpersubstanzen im Verdauungstrakt eines Patienten, wobei die Einrichtung die Form einer schluckbaren Kapsel (2) aufweist, welche es ermöglicht, dass eine Probe der Körpersubstanz durch wenigstens eine Einlassöffnung (18) in der Kapselwand (3), welche an einer vorbestimmten Stelle des Verdauungstrakts nach dem Kontakt mit der zu sammelnden Körpersubstanz geöffnet wird, in die Kapsel eintritt, **dadurch gekennzeichnet, dass** die Einlassöffnung (18) in der Kapselwand (3) versiegelt wird und/oder dass die Kapsel (2), welche aus zwei dauerhaft verbundenen Elementen (4, 6) hergestellt wird, in einer Vakuumkammer (40) dau-

erhaft zusammengefügt wird, wobei ein konstantes Vakuum oder ein erheblicher Unterdruck bewahrt wird, derart dass ein Vakuum oder ein erheblicher Unterdruck in einer inneren Kammer (5) der Kapsel gebildet wird, wenn die Einlassöffnung versiegelt wird und/oder wenn die beiden Elemente (4, 6) der Kapsel dauerhaft miteinander verbunden werden. 5

15. Verfahren nach Anspruch 14, **dadurch gekennzeichnet, dass** die beiden Elemente (4, 6) der Kapsel spritzgegossen werden und vorzugsweise durch Ultraschallschweißen dauerhaft miteinander verbunden werden. 10
16. Verfahren nach Anspruch 15, **dadurch gekennzeichnet, dass** ein Blockierungselement (12) der Einlassöffnung (18) spritzgegossen und vor dem dauerhaften Zusammenfügen der beiden Elemente zwischen den beiden Elementen (4, 6) der Kapsel befestigt wird. 15
20
17. Verfahren nach einem der Ansprüche 14 bis 16, **dadurch gekennzeichnet, dass** die Einlassöffnung (18) der Kapsel durch ein Steckelement (20), das vorzugsweise aus einem organischen Leim hergestellt ist, versiegelt wird, und dass die beiden Elemente (4, 6) in der Vakuumkammer (40) miteinander verbunden werden. 25
18. Verfahren nach einem der Ansprüche 14 bis 16, **dadurch gekennzeichnet, dass** die beiden Elemente (4, 6) der Kapsel dauerhaft miteinander verbunden werden, und dass die Kapsel (2) in einer Vakuumkammer (40) versiegelt wird, indem ein Steckelement (20) in die Einlassöffnung (18) eingesetzt wird. 30
35
19. Verfahren nach Anspruch 18, **dadurch gekennzeichnet, dass** ein Auftragsmittel (44) zum Auftragen des Steckelements (20), vorzugsweise eine Düse, in und durch die Einlassöffnung (18) in der Kapselwand (3) eingeführt wird, dass das Auftragsmittel (44) das Blockierungselement (12) zwingt, sich zu öffnen, und dass das Auftragsmittel (44) in die Einlassöffnung (18) zurückgezogen wird und das Steckelement (20), vorzugsweise ein organischer Leim, in die Öffnung (18) durch das Auftragsmittel eingesetzt wird. 40
45

50

55

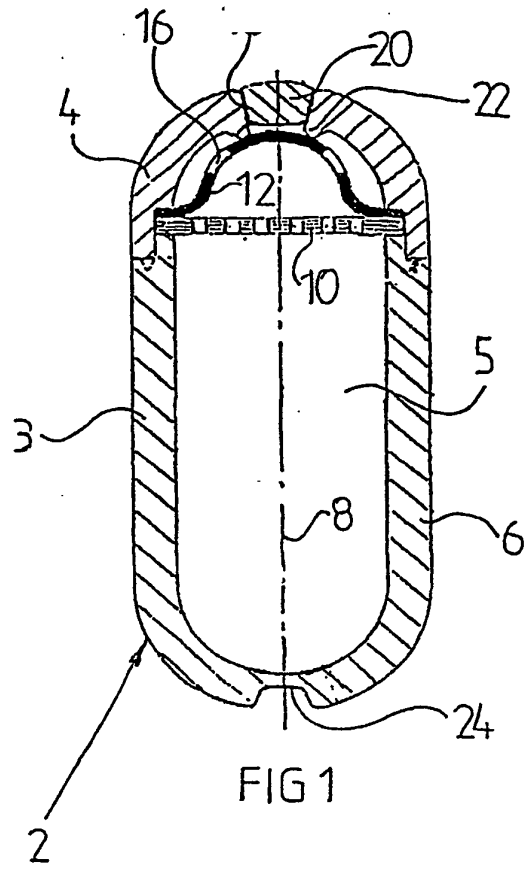


FIG 1

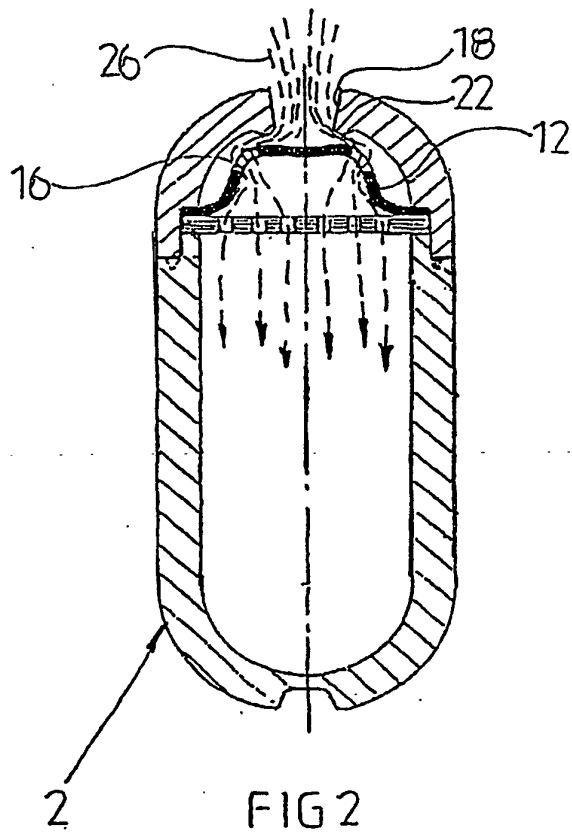


FIG 2

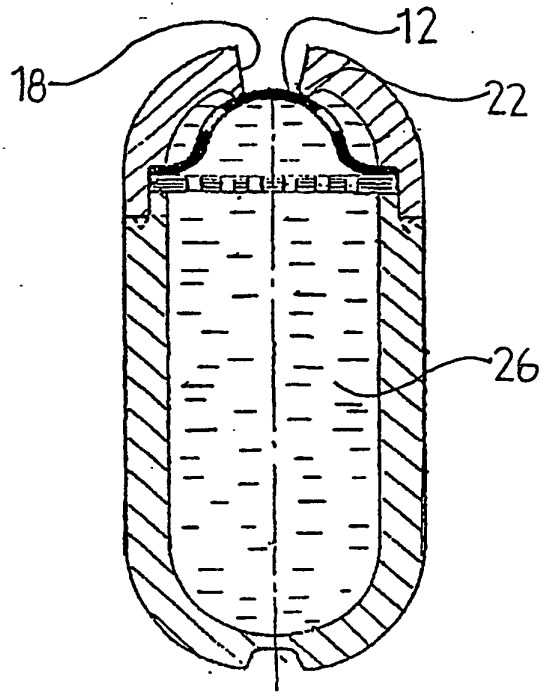


FIG 3

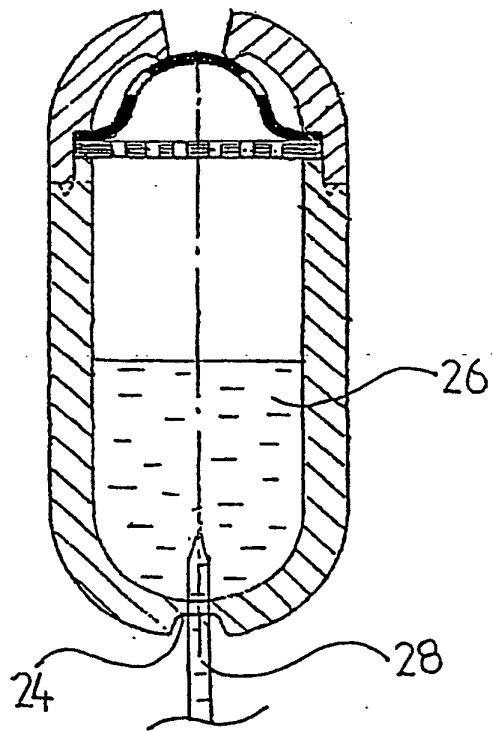


FIG 4

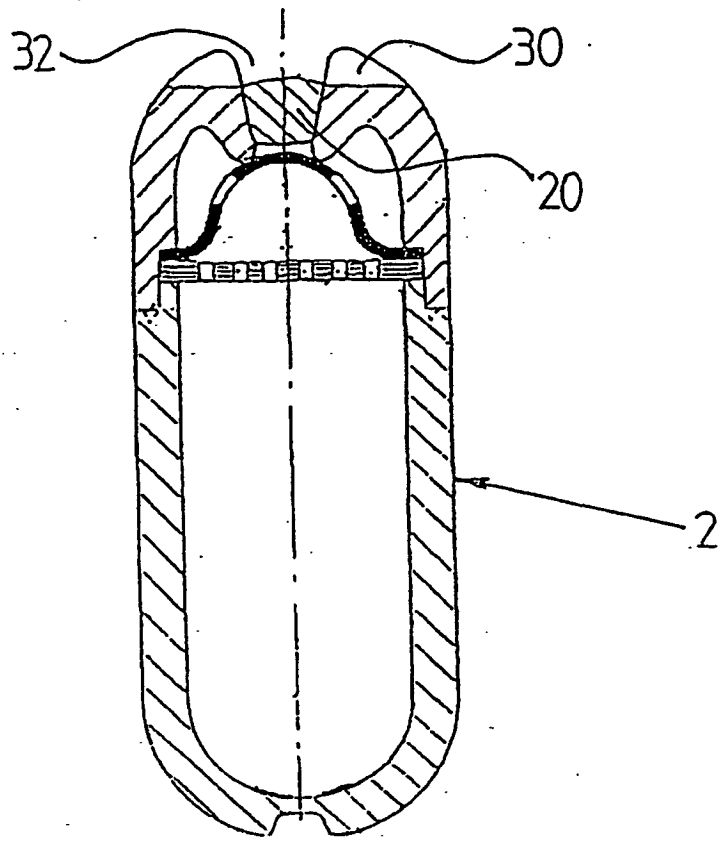


FIG 5

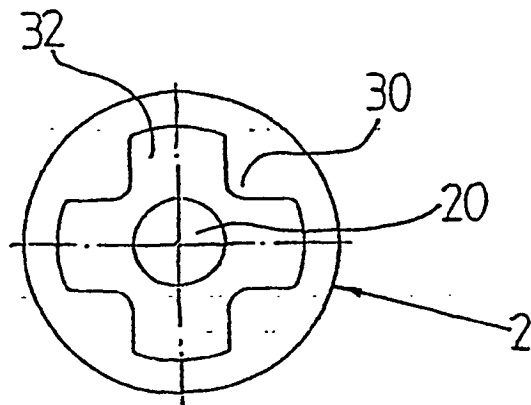


FIG 6

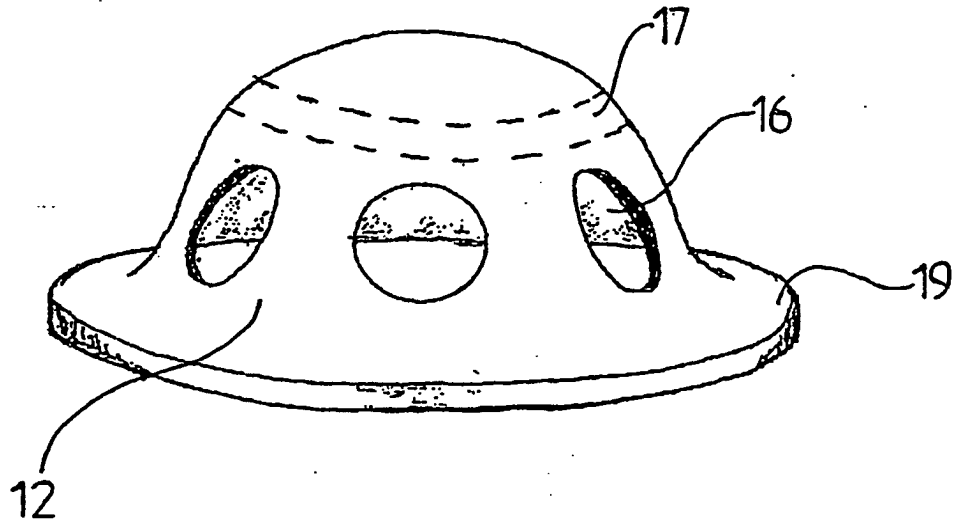


FIG 7

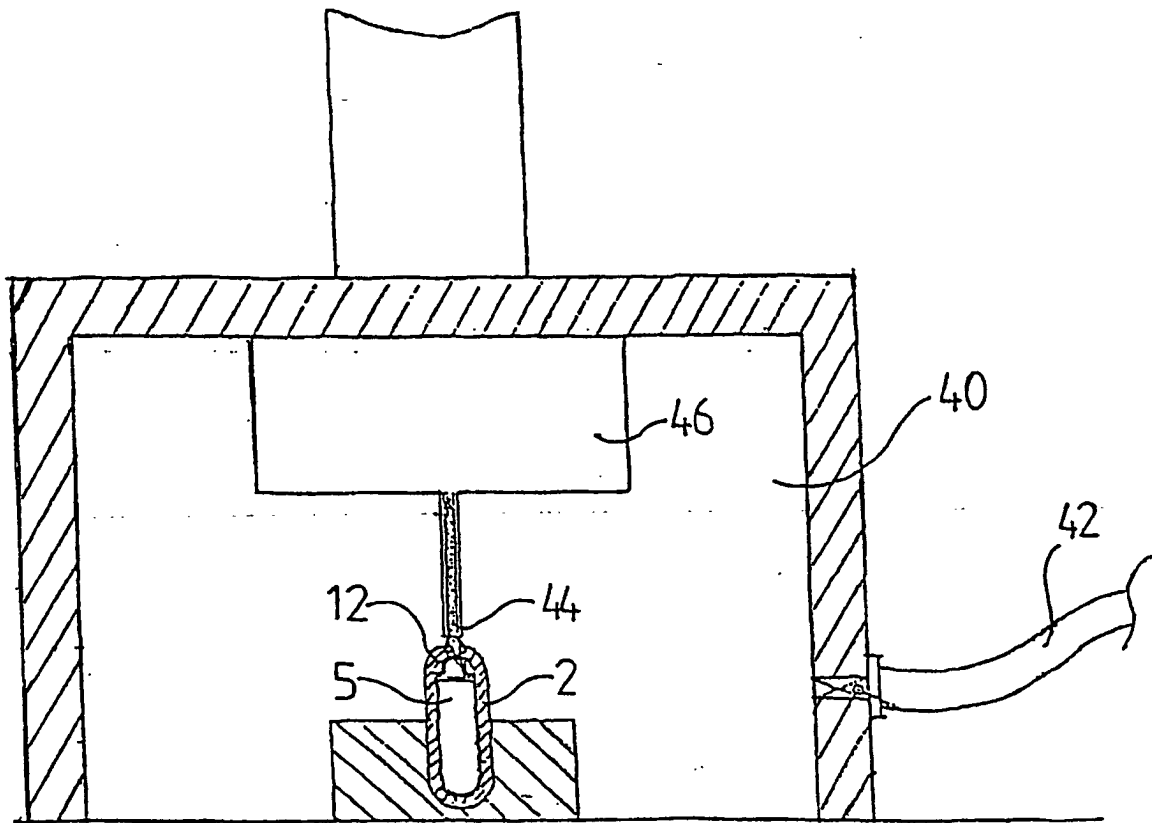


FIG 8

专利名称(译)	用于获得体内物质样品的取样装置和方法以及用于制备取样装置的方法		
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摘要(译)

采样装置和方法本发明涉及一种采样装置和一种获取人或动物消化系统中体内物质样品的方法。采样装置具有可吞咽的胶囊(2)的形状,其允许身体物质(26)的样品通过入口开口(18)进入胶囊。入口开口(18)在与待收集的身体物质接触之后在消化道的预定位置打开。胶囊(2)包括内腔,该内腔设置成在入口开口(18)被密封时保持显著的负压。当入口开口(18)打开时,只要内室(5)与胶囊的外部环境(2)之间存在压力差,阻挡构件(12)就允许体内物质流入内室。)。

