

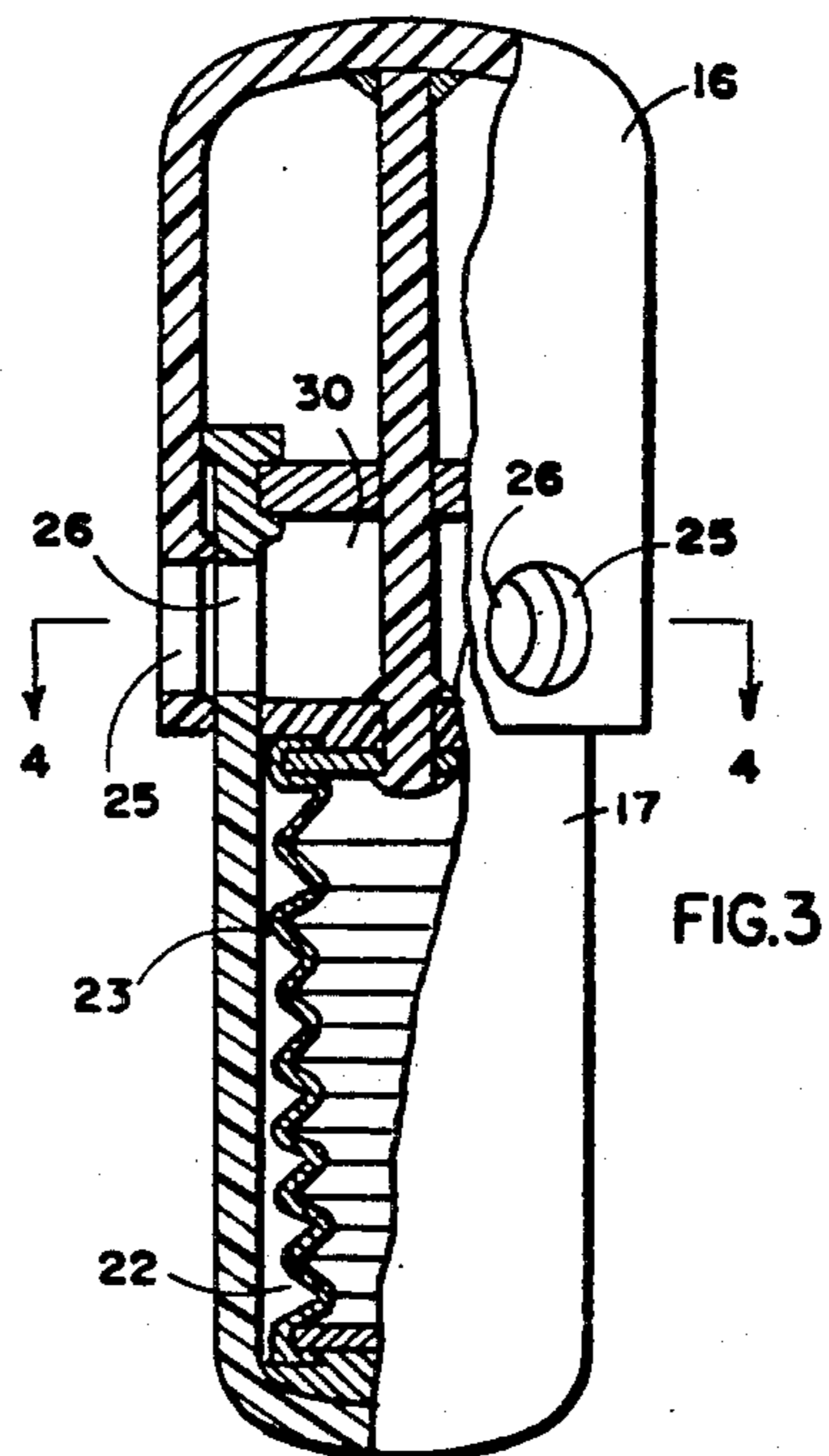
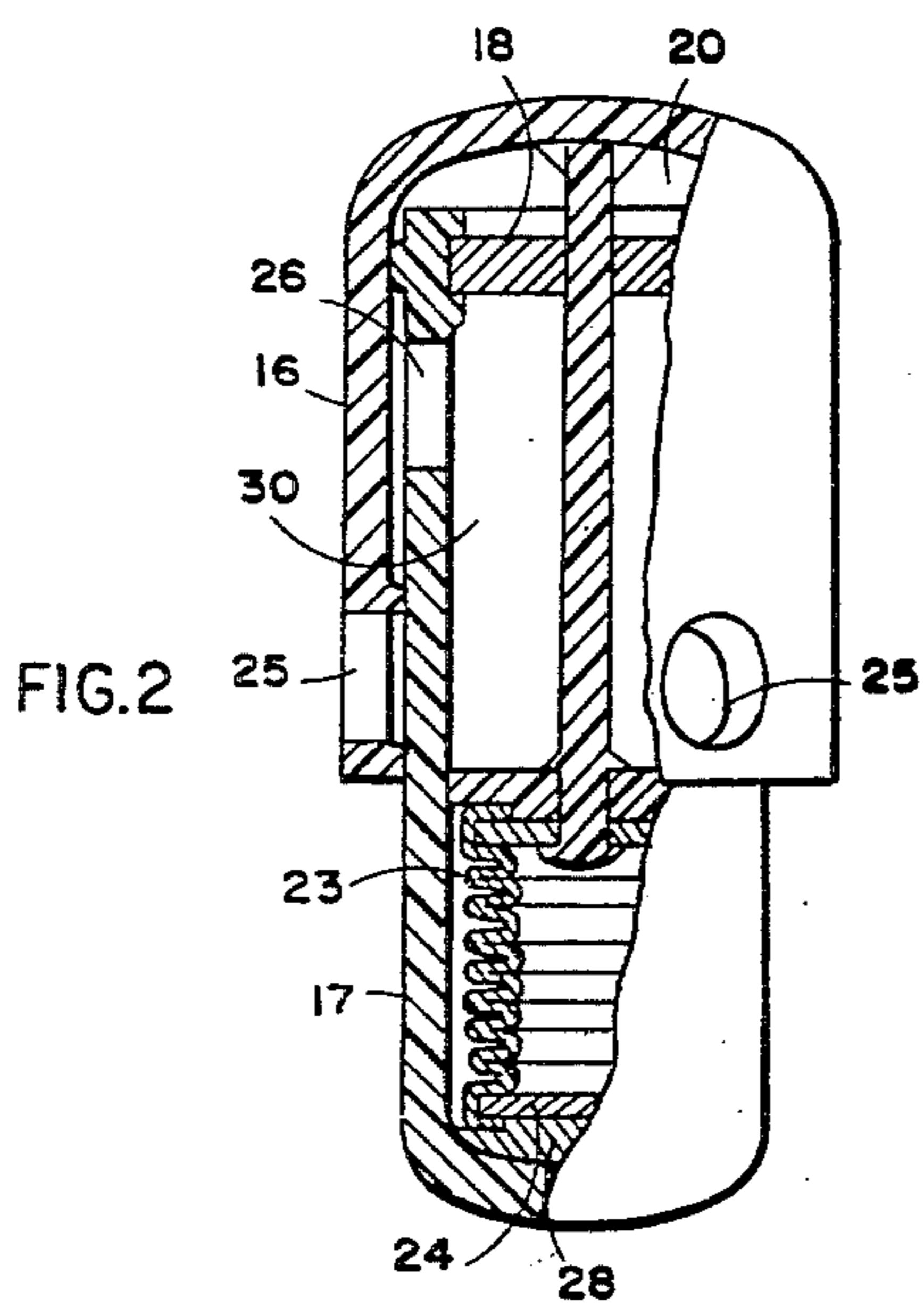
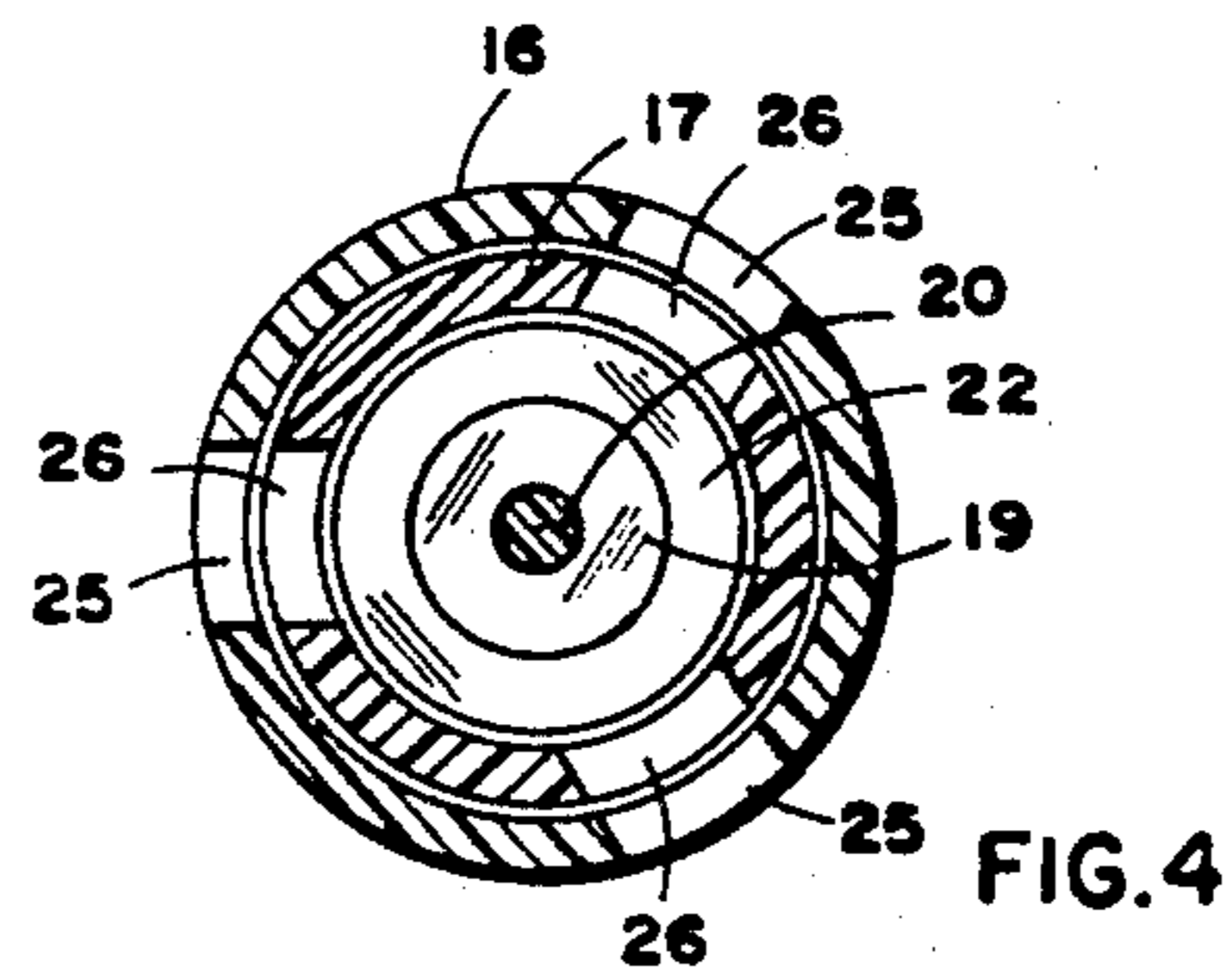
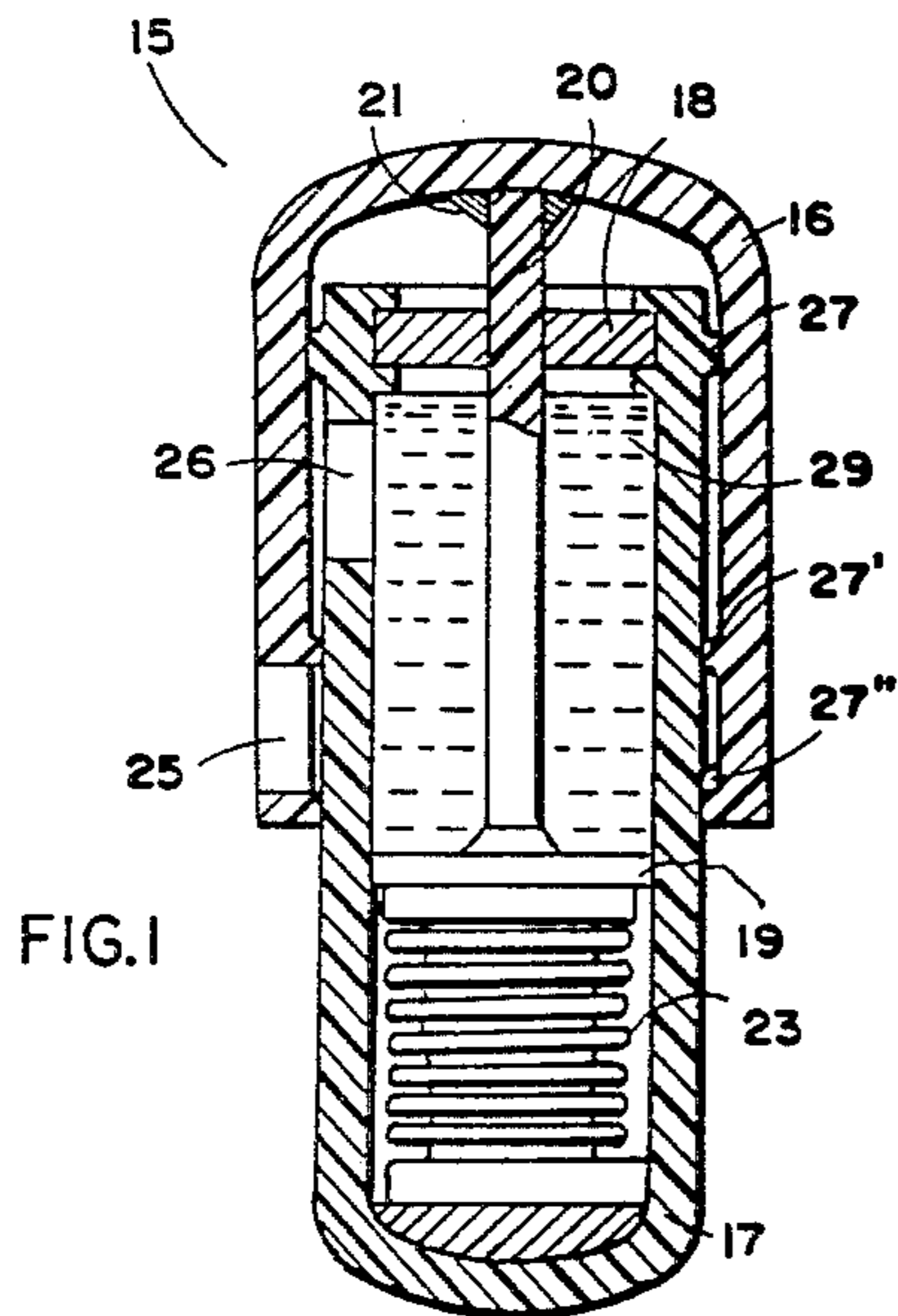
Dec. 23, 1969

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3,485,235

CAPSULE FOR THE STUDY AND TREATMENT OF THE DIGESTIVE TRACT

Filed Dec. 4, 1967



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3,485,235
**CAPSULE FOR THE STUDY AND TREATMENT OF
 THE DIGESTIVE TRACT**

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Filed Dec. 4, 1967, Ser. No. 687,895

Int. Cl. A61b 5/10; A61n 1/42

U.S. Cl. 128—2

7 Claims

ABSTRACT OF THE DISCLOSURE

The longitudinal expansion and contraction of a swallowable telescopic plastic casing is accomplished by heating an ether-filled bellows contained in said casing. The casing parts have openings acting as a valve so the casing is closed when in contracted condition, and open when expanded. The capsule so constituted in contracted condition, is ingested empty or filled with a medicament. The passage of the capsule through the digestive tract is observed with an X-ray apparatus, and when it reaches a certain level, a heat is produced in the patient's body by electrical means creating a high frequency magnetic field, which is controlled to operate the bellows to open and close the casing. If the capsule used was empty, it will receive a sample of the fluid of the digestive tract at the zone wherein the capsule was operated. If the capsule used was originally laden with a medicament, the latter will be discharged into said tract, at the selected zone. Later, the capsule is recovered from the feces with the aid of a magnet. The bellows structure includes as its extensible, contractible member, a circumferentially corrugated steel foil tube.

The present invention relates to a capsule to be used for the clinical, physiological and physiopathological examination, study and treatment of the digestive tract and more particularly to a type which is easily swallowed by the patient and then recovered in the feces. Its movement in the body can be observed by X-rays and it can be operated to extract a sample at any level in its travel, of the fluids in the zone of interest or it may carry some chemical or medicament to be discharged into such zone. Essentially, the construction of the capsule affords its opening and closing by controlled radiant heat induced in the body.

Various complicated and costly capsule constructions have heretofore been suggested. Laden with room-filling mechanism, leaving hardly any available capacity for sample gathering or medicament carrying, and being slow in action, besides being expensive, hinders their adoption.

It is therefore the principal object of this invention to provide a novel and improved construction for a capsule of the character described, which is simple in structure, easy and reasonable in cost to manufacture, quick to assume open and closed condition and avoiding the objectionable features mentioned, makes for efficient accomplishment of the purposes for which it is designed.

Other objects and advantages will become apparent as this disclosure proceeds.

For one practice of this invention, part of the interior of a swallowable casing made up of two telescopically-associated shells, is taken up by a normally contracted, ether-filled bellows-form chamber whose resilient, longitudinally extensible and contractible member is a circumferentially corrugated steel foil tube. One end of the bellows is fixed at the bottom of one of the shells, and its other end serves as a slidably fitted piston in such one shell, which is provided with an end wall so it is a cylinder structure for said piston. The piston rod extends slidably through such cylinder end, and its distal end extends and is secured to the bottom of the other shell

which serves as a cap on the first one. Each shell at mouth end has openings. When the bellows is in contracted condition, which is the normal, said openings are non-communicative, and the cylinder's interior is confined. But upon extension of the bellows, said openings come into registry. So these openings form a sort-of valve construction. Passage of the capsule, empty or containing a medicament, through the digestive tract, is observed by means of X-ray apparatus. The expansion and subsequent contraction of the bellows to open and close the casing, is accomplished by controlled electrically induced heat caused to occur in the patient's body when the capsule has reached a predetermined zone in the digestive tract, whereupon the empty capsule will receive a sample, and the initially laden capsule will have its contents discharged. Later, the capsule is recovered in the feces with the aid of a magnet.

In the accompanying drawing forming part of this specification similar characters of reference indicate corresponding parts in all the views.

FIG. 1 is a magnified, central elevational section showing a capsule embodying the teachings of this invention, in closed condition, holding a supply of a medicament.

FIG. 2 is a view like FIG. 1, shown only partly in section, but empty.

FIG. 3 is a view like FIG. 2, showing the capsule in open condition.

FIG. 4 is a section taken at line 4—4 in FIG. 3.

In the drawing, the capsule indicated generally by the numeral 15, is made of the two telescopically associated shells 16 and 17, to form an expandible and contractible envelope of swallowable size. The shell 16 serves as a cap on the shell 17, while the latter is provided with an end wall 18 near its mouth, so it is a cylinder for the slidably fitted piston 19, whose rod 20, extends slidably through the cylinder end 18, to the floor of the cap shell 16, where it is secured at 21. To the floor of the shell 17, is secured the lower end of a bellows-form chamber indicated generally by the numeral 22, comprised of a cylindrical wall 23, closed at both ends, as shown at 24, and the piston 19 may serve as its top end; said cylindrical wall being a resilient, longitudinally expandable and contractible circumferentially corrugated tube. The bellows chamber is filled with a gas as ether for instance, which quickly expands, when heated. The corrugated tube 23 is preferably made of steel foil plated exteriorally with gold. The piston rod 20 may be of fiberglass. The shells 16 and 17 may be of Teflon or other suitable material which is inert to the contents of the digestive tract and to chemicals and medicaments which in some instances are intended to be carried by the capsule in the space above the bellows chamber, and discharged therefrom into said tract; said shells near mouth end, having openings, which register respectively when the bellows chamber expands as shown in FIG. 3, but are noncommunicative when said bellows chamber is in its contracted condition, as shown in the FIGS. 1 and 2. Said openings in the cap 16, are indicated by the numeral 25, and in the other shell, by the numeral 26. Seals as 27, 27', 27'' are provided to maintain the openings 25 non-communicative with the interior of the shell 17, while the bellows 22 is in contracted condition. Said bellows in such condition which is the normal, occupy about one-third of the shell 17 in the embodiment illustrated, leaving the space 30 which is shown vacant in FIG. 2, but in FIG. 1, it is shown containing a medicament 29. In expanded state, the bellows 22 reaches to about the openings 26. The numerals 21 and 28, denote suitable cement as Epoxy for example, to effect assembly.

The capsule 15, is prepared in contracted condition, "loaded" as in FIG. 1, when it is desired to discharge the medicament 29 into the digestive tract, or empty as in

FIG. 2, when it is desired to have the capsule receive a sample of the fluid in said tract. In use, the capsule is swallowed by the patient and its passage is observed by means of X-rays. When it has reached the desired zone in the digestive tract to be investigated or treated, heat is induced in the body by electrical generation so the capsule is heated sufficient to work on the bellows to cause expansion of the ether and hence the bellows expand to the condition as shown in FIG. 3, whereupon the shells 16 and 17 will move in relation to each other to elongate the envelope they comprise, so the openings 25 and 26 will become communicative. Used in this art to induce the required heat for operation of the capsule, is apparatus creating a high frequency magnetic induction field which raises the temperature of the ferro-magnetic material, which here, is the corrugated tube 23. Said heating apparatus and its manipulations and use, is well known in this art, as well as the use of the X-ray apparatus, so further illustration of explanation thereof is believed unnecessary.

If the capsule used is as in FIG. 1, then the medication will be discharged by action of the piston 19, into the digestive tract. If the capsule used is as in FIG. 2, a sample of the fluids in the selected zone of the tract, will be free to enter through said valve openings 25, 26, into the space 30. In either case, upon removal of the heat influence, the bellows will contract, whereupon piston movement will cause a sucking in of tract fluid into the shell 17, which is aided by the slight vacuum caused by the piston's retraction. Later, the spent or laden capsule, as the case may be, is retrieved from the feces. Aid can be had for this, by use of a magnet to attract the capsule, since it bellows's tube 23 is of ferrous material.

The capsule 15, when to be ingested empty as in FIG. 2, for gaining a sample, may be prepared with its interior rarified by vacuum apparatus. This will insure in inrush of tract fluid when the capsule is extended, through the valve openings 25, 26.

Other suitable fillers for the bellows, are acetone, alcohol and methylenechloride.

This invention is capable of numerous forms and various applications without departing from the essential features herein disclosed. It is therefore intended and desired that the embodiments shown herein shall be deemed merely illustrative and not restrictive and that the patent shall cover all patentable novelty herein set forth; reference being had to the following claims rather than to the specific showing herein and the description given, to indicate the scope of this invention.

1. In a swallowable capsule of the character described, an envelope consisting of two shells associated in slidable telescopic relation, hole structure in at least one of the

shells, so positioned that the interior and exterior of the envelope are non-communicative, and as the shells move to expand the envelope, the opening provides fluid passage means between the interior and exterior of the envelope, a bellows normally in contracted condition, positioned within the envelope; said bellows comprising a longitudinally extensible and contractible tubular member closed by end elements, means securing the ends of said bellows to said shells respectively, so that upon expansion of the bellows, the envelope will expand and then upon contraction of said bellows, said envelope will contract; at least part of said bellows being of a ferrous material adapted to be heated by action of radiant energy generated externally of the capsule; said bellows being filled by a gas which readily expands, causing the bellows to expand, when said radiant energy is applied to influence said ferrous material.

2. A capsule as defined in claim 1, wherein said tubular member of the bellows is a circumferentially corrugated tube, which is longitudinally resilient.

3. A capsule as defined in claim 2, wherein said tube is of steel foil.

4. A capsule as defined in claim 1, wherein one of the shells is a cap on the second shell; said second shell having an end wall closing its mouth end so that said second shell constitutes a cylinder; the means securing the end element of the bellows to the cap, being a piston rod slidably mounted through said cylinder end wall, and said last mentioned end element of the bellows being a piston slidably fitted in said cylinder; said hole being in the cylinder, near its end wall through which the piston rod is positioned.

5. A capsule as defined in claim 4, wherein said tubular member of the bellows is a circumferentially corrugated tube which is longitudinally resilient.

6. A capsule as defined in claim 4, wherein said tube is of steel foil.

7. A capsule as defined in claim 1, wherein the gas has the expansion and contraction properties of ether when heated and then cooled.

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U.S. Cl. X.R.

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