Feb. 7, 1967 M. W. MAZELLAN 3,302,634

INFLATABLE STRING FOR MARKING INTERNAL BLEEDING

Filed Sept. 13, 1963

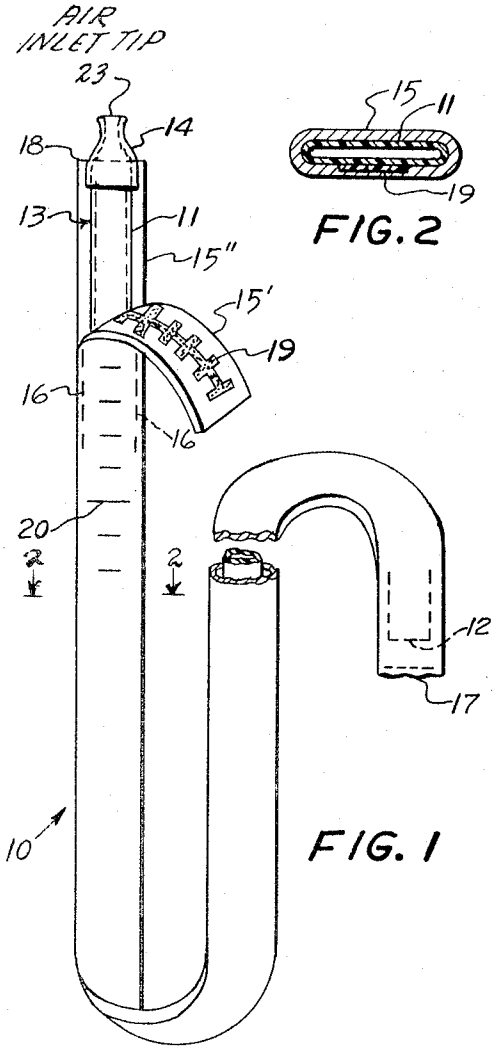


FIG. 1

FIG. 2

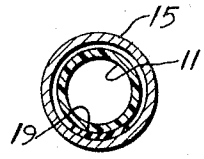


FIG. 3

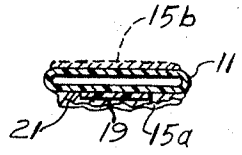


FIG. 4

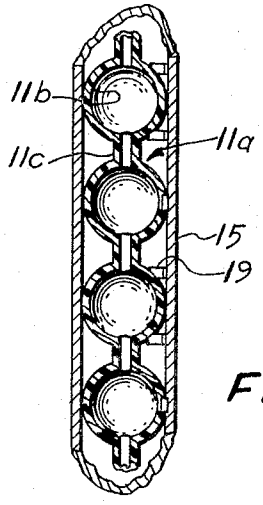


FIG. 6

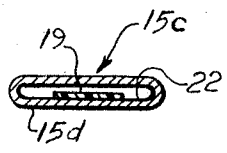


FIG. 5

INVENTOR.
MYRON W. MAZELLAN
BY Peter J. Saylor
ATTORNEY

United States Patent Office

3,302,634
Patented Feb. 7, 1967

3,302,634

INFLATABLE STRING FOR MARKING INTERNAL BLEEDING

Myron W. Mazellan, 517 Milltown Road, North Brunswick, N.J. 08846

Filed Sept. 13, 1963, Ser. No. 308,866
5 Claims. (Cl. 128—2)

This invention deals with an inflatable string to be swallowed by a patient for locating the area of gastro-intestinal tract in which bleeding is taking place. More specifically, it relates to an orally-introduced string comprising an elongated, narrow, inflatable, sausage-like string, made of radio-transparent film, of plastic or similar material, and coated or covered with similarly-transparent blood-absorbent material, and having X-ray opaque markings thereon or therewith, for pin-pointing the bleeding area.

There is described in Patent 3,097,636 a string for marking internal bleeding, consisting of an absorbent tape having a weighted, orally-insertable end, and carrying radio-opaque markers. Such a tape, which is non-fluorescing under ultra-violet light, is swallowed by the patient, with the aid of sips of water. Once the weighted end reaches the stomach, the patient is instructed to continue swallowing segments of the tape, until the required length of string has entered the gastro-intestinal tract. Thereafter, a roentgenogram of the upper abdomen is taken to clearly outline the characteristic "C-loop" of the abdomen. Then, while the patient is lying on the X-ray table, a dose of fluorescein dye is injected into an antecubital vein, and the dye is allowed to circulate for four minutes before the string is pulled out of the patient's mouth. Gloves are worn prior to withdrawal of the string to reduce the danger of possible contamination with dyed fingers. After the string is removed, it is examined under ultra-violet light for fluorescence. If the patient has been bleeding actively at the time of the test, both blood and fluorescence will be readily located on the tape. The dye is visible as a yellow spot on the tape when examined under ultra-violet light, and the situs of the bleeding is pin-pointed by counting back the number of markers from the weighted end, and comparing this with the roentgenogram. Use of such a string has been successful in locating the bleeding site within a distance of one or two inches.

There have been some difficulties encountered with the use of such a string, including the swallowing of the limp tape, particularly by children and persons unable to swallow because of profuse bleeding, for example, and because of the highly limber and flaccid nature of the tape. One method for avoiding such difficulties is in the use of a semi-rigid flexible core, such as a plastic tube, within or attached to the tape. Such a unit can be introduced by the physician, thus saving time.

As already mentioned, the duodenum contains the upper abdominal "C-loop" which readily allows passage therethrough of a tape, but does not permit passage within a rapid time, without possible damage thereto, of a rigid material. Once passage is effected past this "C-loop," there is little difficulty of further passage of even a limp tape. An ideal string, therefore, would be one which is semi-rigid and flexible until it is swallowed up to the "C-loop" (since it is much easier to force down such a string, rather than a limpid one), after which it would become limpid, since the limpid string offers the minimum of discomfort and resistance to remove out of the gastro-intestinal tract.

An object of the present invention is to provide a string which can be swallowed in inflated form and then deflated. The invention will be more readily understood

by reference to the accompanying drawing in which a preferred embodiment is described, and in which FIGURE 1 illustrates a side view, with upper tape portion partly cut open or torn away, of a deflated string of the present invention. An enlarged cross-sectional view taken along line 2—2 in FIGURE 1 is shown in FIGURE 2. FIGURE 3 depicts the view shown in FIGURE 2, in inflated condition, while FIGURE 4 is a similar view of another embodiment of the invention, in deflated condition. A similar view of still another embodiment, in deflated condition, is depicted in FIGURE 5. FIGURE 6 presents an enlarged vertical cross-sectional view of a portion of an articulated string, in inflated condition. Similar numerals refer to similar parts in the various figures.

Referring again to the drawing, numeral **10** indicates generally a string of the present invention comprising an elongated radio-transparent, continuous, thin-walled, inflatable, flexible tube **11**, in collapsed condition, and made of any suitable material, such as polyethylene, polyvinyl chloride, fluoropolymer, and the like. This tube is sealed off at its swallowing end **12**, whereas its upper held end **13** is cemented, or otherwise attached, to plastic tip **14** having inlet **23** through which air may be introduced by blowing, insertion of a syringe-type bulb, an air bulb having a one-way valve, or the like, for the purpose of inflating tube **11**.

Around tube **11** is coated, or woven, a radio-transparent absorbent cover **15**, which may be of a single piece woven around tube **11**, or may consist of two cloth tapes **15'** and **15''**, sewn together at the edges, as at **16**, it being understood that the sewing is done carefully enough so as not to puncture tube **11**. Cover **15** is sewn at end **17**, and anchored to closed end **12** of tube **11** by cement, cord, or the like, or sewn onto an appendage of the plastic tube. Also, upper end **18** of cover **15** is attached to the lower end of top **14** in a similar manner.

If two tapes, **15'** and **15''** are employed for the cover, the radio-opaque markers **19** are best attached to the inner surface of a tape, such as tape **15'**, by cementing, heat-sealing, or by any other means, the markers being in the form of a radio-opaque thermoplastic sheet. Also, visible, non-fluorescing and non-toxic markers, such as lines **20**, or thread of another color, may be applied to the outer surface of tape **15'**, in juxtaposition with markers **19**, to facilitate orientation of the bleeding spot with respect to the end of the string.

When in use, the string is first soaked in cold water, and is then inflated through tip **14**. If a one-way valve air bulb is not employed, the inflated string may be clamped with a clamp near the upper portion **13** of the tube, so as to keep the string inflated while it is being swallowed by or inserted into the patient. After the string has been swallowed for the required distance, the tube is deflated to enable it to proceed past the duodenum and "C-loop," and thereafter removed in deflated condition.

An articulated tube such as tube **11*a*** in FIGURE 6 is particularly advantageous because it can be bent (e.g., while passing through curvatures) much more readily than a continuous tube which has a tendency to straighten out. This articulated tube comprises inflatable spherical or cylindrical sections **11*b*** connected with narrow tubular sections **11*c***.

In FIGURE 4, there is shown a deflated inflatable tube **11**, having cemented or otherwise attached to one side, at **21**, a cloth or other similar absorbent layer **15*a***. The radio-opaque markers **19** are disposed between the tube wall and the cover. If desired, the other side of tube **11** also may be similarly coated with a layer **15*b*** of absorbent material.

FIGURE 5 discloses a cloth tube **15*e***, the inner surface of which is coated with a layer **22** of gas-impermeable

material, such as rubber or plastic. In this case, the cloth tube itself may be inflated, and its outer surface 15*d* is adequately absorbent for string use. Markers 19, in this case, may be cemented to the inside surface of the tube. Provision for an air inlet, such as tip 14, and a sealing of the swallowed end would be made, as in FIGURE 1.

The string 10 may be made in 30" and 50" lengths, while the inflatable tube may have an outside diameter of 5/32" or 7/32" (in two separate sizes), with a wall 0.0001–0.0004 inch, more or less, the tube being free of any rigidity when in inflated condition.

Although the strings of the present invention are adapted to be generally inflated with a gas, it is to be understood that inflation with liquids may be partially or completely effected and shall be considered the equivalent of gas-inflation.

I claim:

1. In a blood-absorbing string taken orally for locating bleeding in the gastro-intestinal tract, as described, and provided with radio-opaque markers along the length thereof, the improvement comprising

a continuous, radio-transparent elongated, collapsible thin-walled tube, serving as the core for the string, and having an open end and a swallowable closed end,

a layer of absorbent, radio-transparent material attached to the outside of said tube, and

inflation medium-receiving means attached to the open end of said tube.

2. In a blood-absorbent string taken orally for locating bleeding in the gastro-intestinal tract, as described, and provided with radio-opaque markers along the length thereof, the improvement comprising:

a continuous, radio-transparent, elongated, collapsible thin-walled flexible tube, serving as the core for the string, and having an open end and a swallowable closed end, and

a cover of absorbent, radio-transparent material attached to the outside of said tube and serving as an expansion-limiting means for said tube.

3. A blood-absorbent string according to claim 2 in which the layer of absorbent material comprises a cloth cover.

4. A blood-absorbent string according to claim 2 in which the layer of absorbent material is attached to at least one side of said tube.

5. In a blood-absorbent string taken orally for locating bleeding in the gastro-intestinal tract, as described, and provided with radio-opaque markers along the length thereof, the improvement comprising:

a continuous, radio-transparent, elongated, collapsible thin wall tube, said tube being articulated so as to provide wide and narrow portions, when in inflated condition, and serving as the core for the string, and having an open end and a swallowable end, and

a cover of absorbent, radio-transparent material attached to the outside of said tube and serving as an expansion-limiting means for said tube.

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RICHARD A. GAUDET, *Primary Examiner.*

SIMON BRODER, *Examiner.*