

[54] **DEVICE FOR ADVANCING MATERIAL THROUGH A TUBE**

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[51] Int. Cl... **F04b 43/08**; F04b 43/10; A61b 19/00

[58] Field of Search 417/394, 474, 475, 479; 128/1 D, 349 B, 344

[56] **References Cited**

UNITED STATES PATENTS

2,493,326	1/1950	Trinder	128/344 X
2,855,934	10/1958	Daughaday	128/349 B
3,406,633	10/1968	Schomburg	417/394
3,411,506	11/1968	Velasco	128/349 B
3,504,662	4/1970	Jones	128/1 D
3,560,114	2/1971	Boyle	474 X/
3,692,018	9/1972	Goetz et al.	128/1 D

Primary Examiner—C. J. Husar

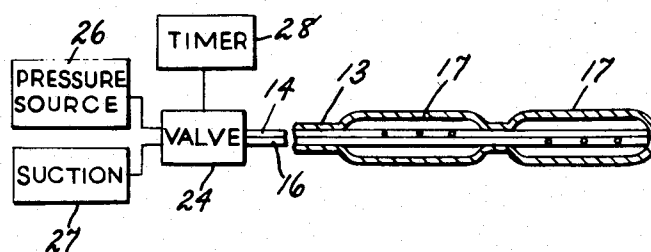
Assistant Examiner—Richard E. Gluck

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[57] **ABSTRACT**

A device for advancing material through a tube, particularly for advancing waste material through the intestinal tract in the absence or deficiency of peristalsis includes a pair of interconnected longitudinally spaced inflatable member each of which radially expands with increasing internal pressure initially at the proximal end with the expansion extending to the distal end. A biluminal elongated flexible shaft has lumens which extend from and communicate with respective expansion members and are connected to a fluid pressure source and exhaust through a periodically reversed four way sequencing valve to effect an inflation and deflation cycle in which the trailing expansion member is inflated with the deflation of the leading expansion member followed by the deflation of the trailing member and the inflation of the leading member to complete a single material advancing cycle which is periodically repeated.

8 Claims, 7 Drawing Figures



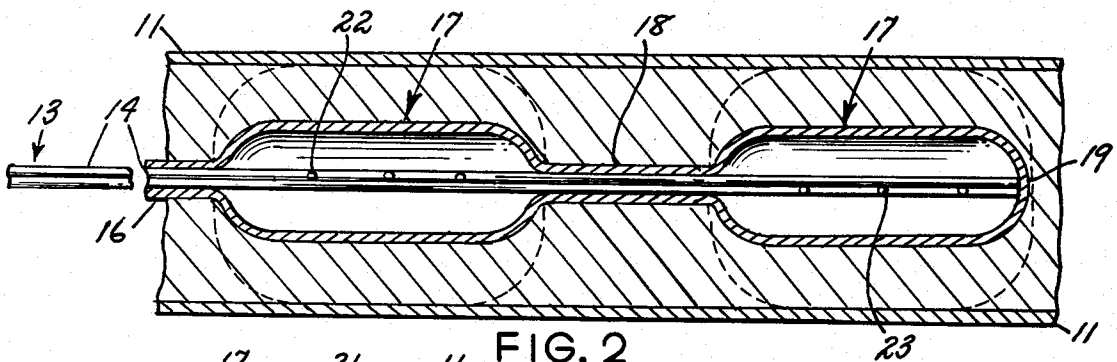


FIG. 2

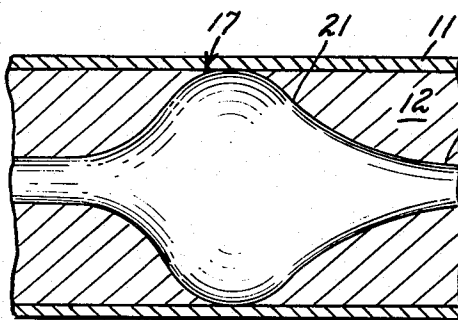


FIG. 3

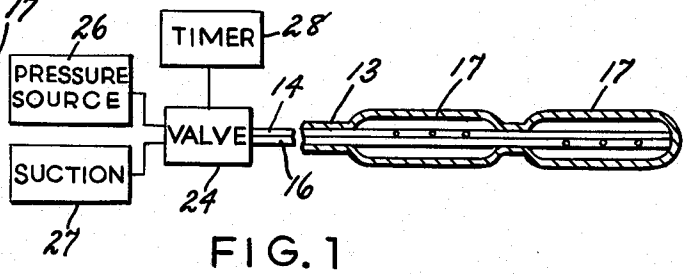


FIG. 1

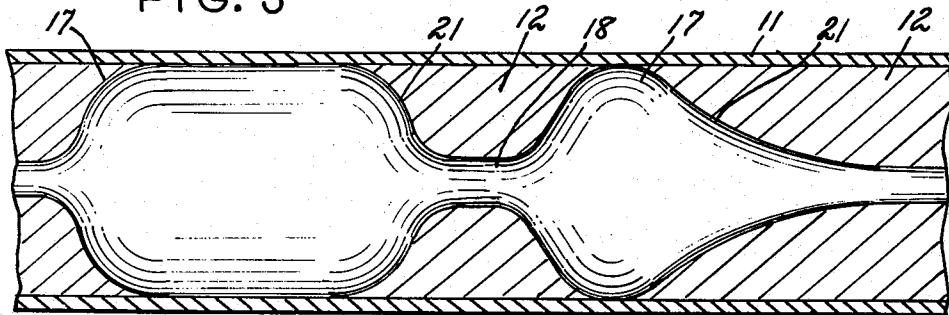


FIG. 4

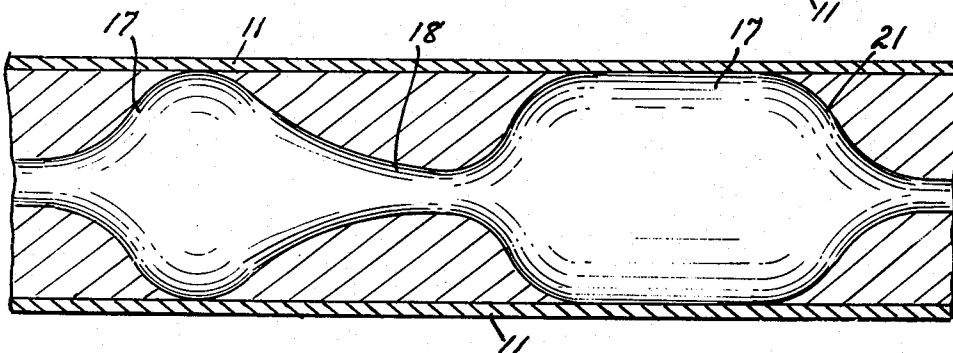


FIG. 5

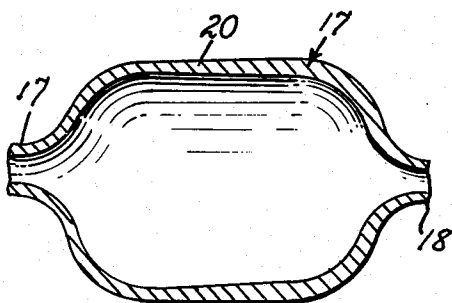


FIG. 6

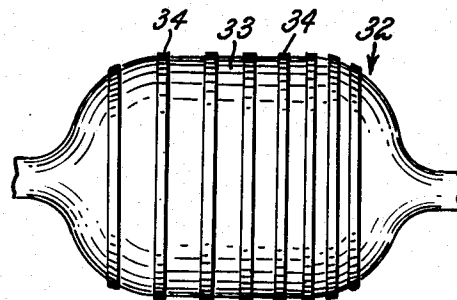


FIG. 7

DEVICE FOR ADVANCING MATERIAL THROUGH A TUBE

BACKGROUND OF THE INVENTION

The present invention relates generally to improvements in material conveying and pumping devices and it relates more particularly to an improved device for advancing a fluid solid material through a tube such as the intestinal tract or the like.

A commonly encountered consequence of surgery and many disorders is a complete or partial paralysis of the peristaltic movement along the intestinal tract with the accompanying inability to pass the feces out of the body and the accumulation of such feces within the intestinal tract with highly undesirable results. Many procedures and regimens have been practiced and proposed, both of a physical or mechanical nature and of a pharmacological or chemical nature, but these have proven generally unsatisfactory for many reasons. The procedures have often been ineffective or of a relatively uncomfortable inconvenient or harsh nature and have frequently been accompanied by highly undesirable side effects. As a last resort in removing the feces or waste materials, a pump is inserted in the nose and intestines to pump the waste material from the intestines, a procedure which leaves much to be desired.

SUMMARY OF THE INVENTION

It is a principal object of the present invention to provide an improved material conveying device.

Another object of the present invention is to provide an improved device for advancing a fluid solid material through a tube.

Still another object of the present invention is to provide an improved device for advancing waste material through the intestinal tract in the absence or deficiency of natural or normal peristalsis.

A further object of the present invention is to provide a device of the above nature characterized by its reliability, simplicity, ease, comfort and relative convenience of use, freedom from undesirable side effects and great versatility and adaptability.

The above and other objects of the present invention will become apparent from a reading of the following description taken in conjunction with the accompanying drawings which illustrate preferred embodiments thereof.

In a sense, the present invention contemplates a device for advancing material through a tube, particularly for advancing fluid solid waste material through the intestinal tract comprising two or more end-to-end connected longitudinally spaced longitudinally elongated inflatable members, each of the inflatable members expanding radially at a progressively decreasing rate from its proximal to its distal end under the influence of increasing internal pressure and contracting radially at a progressively decreasing rate from the distal to the proximal end with the subsequent decrease in such pressure and an elongated highly flexible shaft containing a pair of lumens each of which communicates with respective alternate inflatable members.

The shaft is advantageously coaxial with and supports the inflatable members, the shaft being formed of a substantially expansion free material and the inflatable members being formed of an elastomeric material. In one form the peripheral walls of the inflatable members increase in thickness from their proximal to their distal

ends and in another form they are provided with elastomeric peripheral ribs on their outside face which decrease in longitudinal spacing from their proximal to their distal ends. The lumens are connected through a periodically actuated valve system to a source of compressed air, or to exhaust or a suction source so that alternate inflatable members are periodically inflated while the other inflatable members are deflated.

The improved device affords a simple, convenient and reliable arrangement for effecting the advance of waste material through the intestinal tract and out of the body in the absence or deficiency of peristalsis.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic view of a system employing the improved device;

FIG. 2 is a longitudinal fragmentary sectional view of one form of the improved device illustrated in a deflated condition attendant to the insertion and positioning thereof in the intestinal tract, and showing by broken line the expanded conditions of the inflatable members.

FIG. 3 is a fragmentary side view thereof in a first stage of the material advancing cycle;

FIG. 4 is a view similar to FIG. 3 in the next stage of the cycle;

FIG. 5 is a view similar to FIG. 3 in the following stage of the cycle;

FIG. 6 is a longitudinal sectional view of the expanded inflatable member; and

FIG. 7 is a view similar to FIG. 6 of another embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, particularly FIGS. 1 to 6 thereof which illustrate a preferred embodiment of the present invention, the reference numeral 10 generally designates the improved material advancing device illustrated in its operative position within the intestinal tract 11 of a patient being treated and being employed in advancing a fluid solid waste material 12 along the intestinal tract 11 toward discharge from the body in the absence of deficiency of the normal peristaltic movement.

The device 10 includes a highly flexible tubular shaft 13 which permits the insertion and guiding of the operative end of the device 10 to the desired and optimum position within the tract 11 and is formed of any suitable material which is resistant to corrosion by the body fluids and is pharmacologically inert, such as polyethylene, teflon, or the like. The shaft 13 has a pair of lumens 14 and 16 formed therein and extending for the full length thereof and may be formed of a pair of side-by-side tubes joined to each other along their lengths.

Carried by the shaft 13 and coaxial therewith are two or more longitudinally end-to-end regularly spaced similar inflatable members 17 formed of an elastomeric material such as natural or synthetic rubber, only two of which members 17 are fully illustrated. Each of the inflatable members 17, in its normal deflated state, that is, with the same internal and external pressures is of elongated tubular shape of somewhat greater diameter than the maximum width of shaft 13. The confronting ends of successive inflatable members are necked down to form an interconnecting sleeve 18 which ensheaths

and is hermetically sealed to the other face of shaft 13 to isolate the successive inflatable members 17, the distal end of shaft 13 and the front end of the leading inflatable member 17 being sealed and rounded, as at 19.

The peripheral cylindrical wall 20 of each inflatable member 17 increases in thickness from the proximal to the distal end thereof so that upon increasing the internal pressure of the inflatable member 17, the trailing or proximal end portion thereof first expands to the full diameter of the surrounding tract 11 and with further increase in the inflatable device internal pressure, it progressively forwardly radially expands until the inflatable member is fully radially expanded along the full length thereof, a forwardly advancing forwardly facing peripheral shoulder 21 being formed and effected during inflation, the shoulder receding during deflation of the inflatable member 17. Ports or openings 22 are formed in the lumen 14 in the area of alternate inflatable members 17 to provide gaseous communication between lumen 14 and these alternate inflatable members 17, and ports or openings 23 are formed in the lumen 16 in the areas of the other inflatable members 17 so that one group of alternate members 17 communicate with the lumen 14 and the other interdigitating group of members 17 communicate with lumen 16.

The lumens 14 and 16 are respectively connected to a pair of ports of a conventional four way valve 24 which includes a second pair of ports, one of which is connected to a pressurized gas source 26 which may be an air pump and the other port of which is connected either to exhaust to the atmosphere or to suction 27, which may be the inlet port of the air pump. An adjustable timer 28 is provided for periodically reversing the valve 24 in any known fashion so that the lumens 14 and 16 communicate respectively with pressure source 26 and suction 27 and are periodically reversed to communicate with suction 27 and pressure source 26 respectively. Accordingly, alternate inflatable members 17 are periodically inflated and deflated while the other inflatable members are deflated and inflated in opposite phase.

Considering now the operation and application of the improved device in the advancing of waste material 12 along the intestinal tract 11 to discharge the waste material, the deflated inflatable members 17 are inserted, guided and advanced by means of the shaft 13 along the intestinal tract 11 to any desired or optimum position, for example, by inserting the inflatable members 17 and shaft 13 into the patient's nasal cavity and advancing the shaft 13 and members 17 by pushing on, manipulating and guiding the shaft 13 to effect the progress thereof through the esophagus, stomach and intestine to the desired location. Thereafter, communication is effected between the gas pressure source and suction and the inflatable members 17 by way of the biluminal shaft 13 and valve 24, and the timer 28 is then energized to periodically reverse the valve 24.

At the initiation of the cycle, as shown in FIG. 3, the leading inflatable member 17, of a pair thereof, communicates with the exhaust or suction to completely contract the leading member 17 and the trailing member 17 communicates with the pressure source 26 to gradually inflate the trailing member 17 which initially fully expands at its proximal end to form shoulder 21 which progresses with the longitudinal advance of the radial expansion of trailing member 17 to forwardly advance the waste material 12 along the intestinal tract

11 by the progressing shoulder 21. After the full expansion of the trailing member 17, the timer 28 reverses the valve 24 to rapidly inflate the proximal portion of leading member 17, as shown in FIG. 4, and thereafter fully inflate the leading member 17 and deflate the trailing member 17 as shown in FIG. 5 to complete the cycle and advance the waste material 12 an increment along the intestinal tract 11. The timer 28 then reverses the valve 24 to start the following cycle and the cycle is repeated at regular intervals as determined by the timer 28.

Another embodiment of the present invention is illustrated in FIG. 7 of the drawing and differs from that first described only in the construction of the inflatable member 32 which corresponds in function to the inflatable member 17, the devices being otherwise similar. Specifically, the inflatable member 32 includes an expandable elastomeric cylindrical peripheral wall 33 of uniform thickness and having integrally formed therewith on its outer face a plurality of longitudinally spaced elastomeric peripheral ribs 34. The spacing between the successive ribs 34 at the proximal end of wall 33 is greater than the spacing between the ribs 34 at the distal end thereof, the spacing gradually decreasing from the proximal to the distal end. Thus, with the inflation of the inflatable member 32, the proximal end first expands to produce a forwardly facing shoulder, corresponding to shoulder 21 which advances and recedes with the inflation and deflation of the inflatable member 32 as explained in connection with inflatable member 17.

The operation and application of the device last described is similar to that first described.

While there have been described and illustrated preferred embodiments of the present invention, it is apparent that numerous alterations, omissions and additions may be made without departing from the spirit thereof.

I claim:

1. A device for advancing material through a tube comprising a pair of end-to-end longitudinally spaced proximal and distal longitudinally elongated inflatable members, each of said inflatable members having means permitting each of said inflatable members to expand radially at a progressively decreasing rate from the proximal to the distal portions thereof under the influence of an increase in internal pressure therein and to contract radially at a progressively decreasing rate from the distal to the proximal portions thereof with the decrease in said internal pressure, an elongated flexible shaft having a pair of lumens, each of said lumens communicating with a respective inflatable member, and means simultaneously communicating with said inflatable members through respective lumens for alternately connecting one of said members to a source of pressurized fluid and the other of said members to exhaust.

2. The device of claim 1 wherein said inflatable members are formed of an elastomeric material.

3. The device of claim 2 wherein each of said inflatable members has a peripheral wall which increases in thickness from the proximal to the distal end thereof.

4. A device for advancing material through a tube comprising a pair of end-to-end longitudinally spaced proximal and distal longitudinally elongated inflatable members formed of elastomeric material, each of said inflatable members having longitudinally spaced pe-

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ripheral elastomeric ribs formed on the wall thereof, the spacing between successive ribs decreasing from the proximal to the distal end of said inflatable member, and an elongated flexible shaft having a pair of lumens, each of said lumens communicating with a respective inflatable member.

5. The device of claim 4 wherein said ribs are formed on the outside face of said wall.

6. The device of claim 1 wherein said shaft extends coaxially through said inflatable members.

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7. The device of claim 1 comprising a plurality of longitudinally spaced pairs of said inflatable members, said shaft extending coaxially through said inflatable members and each of said lumens communicating with alternate of said inflatable members.

8. The device of claim 1 including a source of pressure and means for periodically connecting said source of pressure alternately to said inflatable members.

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