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ELECTROMAGNETIC SURGICAL INSTRUMENT

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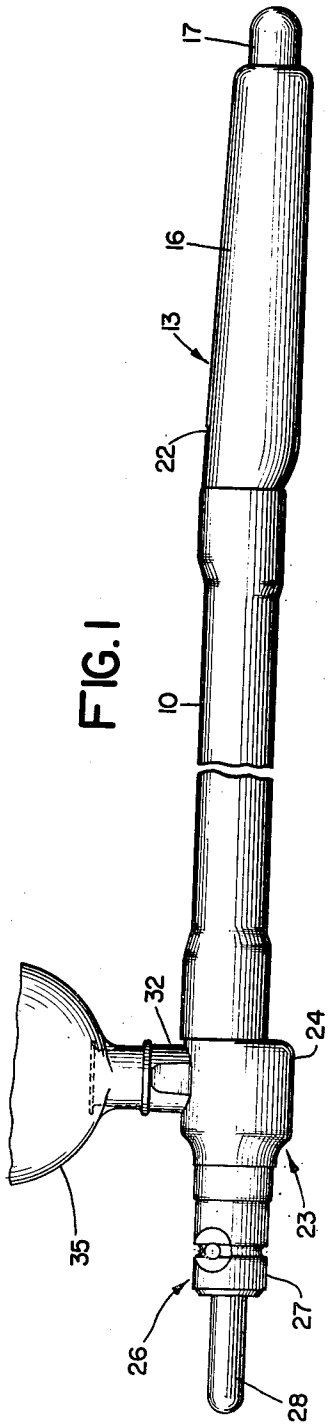

FIG. 1

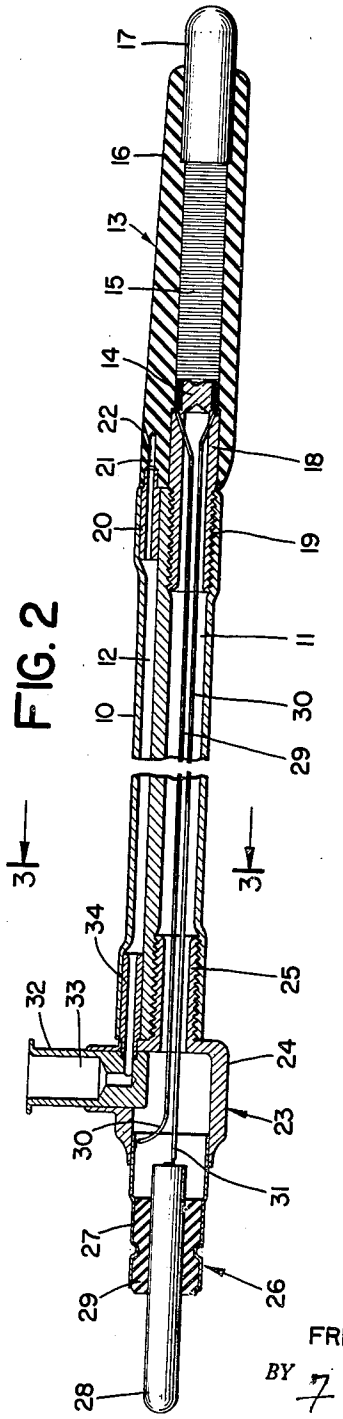

FIG. 2

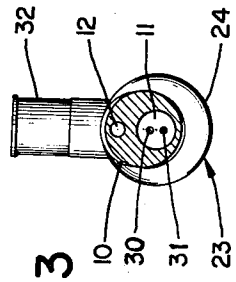

FIG. 3

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ELECTROMAGNETIC SURGICAL INSTRUMENT

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4 Claims. (Cl. 128—1.4)

This invention relates to a surgical instrument, and more particularly to an electro-magnetic surgical instrument for removing magnetic objects from body passages or cavities. The instrument of this invention is especially useful in removing magnetic objects from the bronchus, the esophagus or the stomach.

It has heretofore generally been the practice to remove ferro-magnetic foreign bodies or objects from body passages or cavities by means of forceps when such objects are accessible to a forceps, or by means of a permanent magnet when the objects are relatively difficult of access. Experience has demonstrated that there is considerable danger incident to removing ferro-magnetic articles, such as open safety pins, from remote locations in the esophagus or in the stomach with the aid of conventional magnetic instruments. This is due to the fact that once an open safety pin is contacted by a permanent magnet, it remains in engagement therewith, and if the pin is pointed in the wrong direction the tissue defining the wall of the stomach, esophagus or bronchus oftentimes becomes perforated with consequent injury to the patient.

A surgical instrument constructed in accordance with this invention obviates the difficulties and dangers inherent in the use of conventional instruments and permits of the ready and safe removal of ferro-magnetic objects from body passages. The instrument has its parts so constructed and arranged that the body passage or cavity may be distended or inflated in the region of the object. The object may thereupon be manipulated by actuating the instrument and alternately energizing and de-energizing the same so as to place the object in desired relative position to the leading end of the instrument whereby it may be withdrawn with minimum possibility of damage to the tissue that defines the cavity or the passage.

It is a primary object of the invention to provide an improved surgical instrument for removing magnetic objects from body passages or cavities, such as the bronchus, the esophagus or the stomach.

Another object of the invention is to provide an instrument of the character indicated that may be readily introduced into and advanced to the region of a body passage in which a magnetic object is lodged, next manipulated and energized so as to attract and retain the object in desired relative position to the leading end of the instrument, and then withdrawn, together with the object, with a minimum of danger of perforating the tissue that defines the body passage.

The invention has for a further object the provision of an electro-magnetic surgical instrument that is relatively small in transverse cross-sectional area, that is reasonable in manufacturing and maintenance costs, that is readily sterilizable, and that is capable of performing its intended functions in an efficient and dependable manner.

To the end that the foregoing objects may be attained, a surgical instrument constructed in accordance with this invention preferably comprises an elongated tubular member having first and second longitudinal through passages. An electro-magnetic unit, connected to the distal end of the tubular member, includes a sheath having an opening or conduit that establishes communication between its exterior and the first passage, a solenoid wholly within the sheath, and a magnetizable core member that extends through the solenoid. The core member projects forwardly beyond the sheath and

terminates in a rounded tip. The core member has a hollow rearward extension that is positioned in the distal portion of the second passage and forms a fluid-tight connection therewith. A connector unit is secured to the proximal end of the tubular member and comprises a housing, a conduit carried by the housing and communicating with the first passage, a hollow housing extension that is positioned in the proximal portion of the second passage and forms a fluid-tight connection therewith, and a pair of electric contact elements secured to the housing. Each of a pair of electric leads is connected at one end to a corresponding contact element, extends through the housing, the housing extension, the second passage in the tubular member and the hollow extension of the core member, and is connected at its other end to the solenoid. An insufflating bulb is connected to the conduit.

While the tubular member may be made of various materials within the purview of this invention, I find that when this member is made of certain synthetic plastics, including a polyvinyl compound, preferably a copolymer of vinyl chloride and vinyl acetate, or polyethylene, it is especially well suited for the purposes of the invention. These synthetic plastics afford a number of worthwhile advantages over conventional materials when used for the tubular member of my instrument. For one thing, polyvinyl compounds and polyethylene are chemically inert and resistant to acids and alkalis. Tubing made of these plastics is smooth, non-irritating and non-toxic when positioned in a body passage. Further, tubing extruded or molded from these plastics possesses requisite flexibility and tensile strength, all of which characteristics contribute appreciably to the value of the plastics as suitable materials for the tubular member of the instrument.

The objects, as well as the advantages attainable by the practice of this invention, will be apparent to persons skilled in the art upon reference to the following detailed description, taken in conjunction with the annexed drawing, which respectively describe and illustrate a surgical instrument constructed in accordance with the invention.

In the drawing, wherein like reference numerals denote corresponding parts throughout the several views:

Figure 1 is a view in side elevation of an electro-surgical instrument embodying the invention;

Figure 2 is a central vertical longitudinal cross-sectional view of the instrument shown in Figure 1; and

Figure 3 is a view taken along line 3—3 of Figure 2.

Referring now to the drawing, I have illustrated therein an elongated flexible tubular member **10**, preferably made of polyethylene or a copolymer of vinyl chloride and vinyl acetate and having a pair of independent longitudinal through passages **11** and **12**.

An electro-magnetic unit, generally indicated by numeral **13**, is connected to the distal end of tubular member **10** in a manner that will be described further along herein. Unit **13** comprises a readily magnetizable core member **14** made of a ferro-magnetic material, such as purified iron, around which there is wound a large number of turns of insulated and relatively fine copper wire that constitutes a coil or solenoid **15** of an electro-magnet. Core member **14** and solenoid **15** are imbedded in a sheath **16** of a suitable insulating material, such as rubber or the like.

The core member is generally circular in transverse cross-section and is provided at its distal end with a rounded extension or tip **17** that projects forwardly beyond the sheath. The core member also has a hollow rearward extension **18** that is externally threaded or otherwise grooved, as indicated at **19** (Figure 2), to effect a fluid-tight connection with the tubular member upon insertion in passage **11**. A nipple **20** is positioned partly in passage **12** and partly in a blind passage **21** in the sheath, which communicates with an inclined port **22** in the wall of the sheath.

Secured to the proximal end of tubular member **10** is a connector unit **23** which includes a housing **24** having a threaded or otherwise grooved hollow forward extension **25** that is positioned in the rear portion of passage **11** and forms a fluid-tight connection with the

tubular member. The housing carries an electric terminal **26** that consists of an electric contact ring **27** and an electric contact post **28** that is co-axial with ring **27** and is spaced therefrom by a rubber insulating sleeve **29**. Electric leads **30** and **31** are respectively connected at one end to contact ring **27** and contact post **28**, extend through hollow extension **25**, passage **11** and hollow extension **18**, and are connected at their other ends to solenoid **15**. Also carried by the housing is a conduit **32** that defines a right angle passage **33** of varying diameter. This passage communicates with passage **12** through the medium of a nipple **34** which forms a fluid-tight connection between the conduit and tubular member **10**. A rubber insufflating bulb **35** (Figure 1) is connected to conduit **32**.

For the purpose of briefly outlining the mode of operation of the illustrated instrument, it is first assumed that electric terminal **26** is connected to a suitable source of direct current (now shown) and that the current supplied to the instrument is controlled by a switch (not shown). It is also assumed that the instrument is to be used to remove an open ferro-magnetic safety pin that has become lodged in the stomach of an individual. The distal end of the instrument is introduced into the stomach by way of the esophagus, either directly or with the aid of an examining instrument of the character disclosed in J. E. Held Patent 2,479,237, dated August 16, 1949. Upon entry of the instrument in the stomach, bulb **35** is operated to transmit air, by way of conduit **32**, nipple **34**, passage **12**, nipple **20**, passage **21** and port **22** into the stomach, thereby inflating the stomach. The instrument is moved and core member **14** is energized, as required, to move the pin to a position whereby the portion thereof remote from its ends is engageable by core member tip **17**. The core member is then energized to effect engagement of tip **17** with the pin, and the instrument with the engaged pin is slowly withdrawn, the stomach remaining inflated during withdrawal of the instrument and pin from the stomach.

From the foregoing, it is believed that the construction, operation, and advantages of my present invention will be readily comprehended by persons skilled in the art. It is to be clearly understood, however, that various changes in the apparatus set forth above may be made without departing from the scope of the invention, it being intended that all matter contained in the description or shown in the drawing shall be interpreted as illustrative only and not in a limiting sense.

I claim:

1. In a surgical instrument for removing a metallic object from a body, a flexible tubular member having first and second longitudinal passages, an electro-magnetic unit connected to the distal end of the tubular member and comprising a sheath having a first conduit establishing communication between its exterior and the first passage, a solenoid wholly within the sheath and a magnetizable core member extending through the solenoid and the distal end of the sheath, a second conduit secured to the proximal end of the tubular member and communicating with the first passage, the opening of the first conduit being disposed rearward of the core, said second conduit being adapted to be connected to an insufflating bulb, a pair of electric contact elements secured to the proximal end of the tubular member, and a pair of electric leads extending through the second passage and connected at their opposite ends to a corresponding contact element and to the solenoid, respectively.

2. In a surgical instrument for removing a metallic object from a body, a flexible tubular member having first and second longitudinal passages, an electro-magnetic unit connected to the distal end of the tubular member and having a first conduit establishing communication between its exterior and the first passage, said unit comprising a solenoid and a magnetizable core member extending through the solenoid and projecting beyond the distal end of the sheath, the opening of the first conduit being disposed rearward of the core, a connector unit secured to the proximal end of the tubular member and comprising a housing, a second conduit carried by the housing and communicating with the first passage, said conduit being adapted to be connected to an insufflating bulb, and a pair of electric contact elements secured to the housing, and a pair of electric leads extending through the second passage and connected at their opposite ends to a corresponding contact element and to the solenoid, respectively.

3. In a surgical instrument for removing a metallic object from a body, a flexible tubular member having first and second longitudinal passages, an electro-magnetic unit connected to the distal end of the tubular member and comprising a sheath having a first conduit establishing communication between its exterior and the first passage, a solenoid wholly within the sheath and a magnetizable core member extending through the solenoid and the distal end of the sheath, the opening of the first conduit being disposed rearward of the core, a connector unit secured to the proximal end of the tubular member and comprising a housing, a second conduit carried by the housing and communicating with the first passage, said second conduit being adapted to be connected to an insufflating bulb and a pair of electric contact elements secured to the housing, and a pair of electric leads extending through the second passage and connected at their opposite ends to a corresponding contact element and to the solenoid, respectively.

4. A surgical instrument in accordance with claim 3, wherein the tubular member comprises a plastic material selected from the group consisting of polyethylene and a copolymer of vinyl chloride and vinyl acetate.

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