MAGNETIC ENDOSCOPE FOR PROBING THE ESOPHAGEAL, STOMACHIC AND DUODENAL REGIONS OF THE BODY

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MAGNETIC ENDOSCOPE FOR PROBING THE ESOPHAGEAL, STOMACHIC, AND DUODENAL REGIONS OF THE BODY

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This invention relates to endoscopes and more particularly to improved endoscope constructions which provide greater facility in the removal of ingested or swallowed magnetic objects from the human body.

It will be appreciated that the majority of foreign objects that become lodged in the alimentary and duodenal regions normally make an uneventful exit. There is, however, always the danger of intestinal perforation, this being particularly true of long, jagged and sharp-pointed objects that have a prolonged sojourn in the stomach.

In the past, before the development of high energy magnets, the retrieval of foreign bodies from the esophageal, stomachic or duodenal regions was usually a tedious procedure. The stomach, for example, being a hollow viscous and in constant peristaltic movement results in the foreign bodies being continuously shifted in all directions. For their removal, it was necessary to employ esophagoscope under bimanual fluoroscopy before proper forceps application could be made. The entire procedure at its best was traumatic and time-consuming. Then too, in many instances, the patient became exposed to an overdose of radiation.

It is a principal object of the present invention to provide improved endoscope constructions utilizing permanent magnet means which markedly improve the facility with which magnetic foreign objects can be removed from the human body. An additional object of this invention is to provide an endoscope having a retrieval head assembly including a permanent magnet which can in essence be turned on or off while inserted in a patient. An additional object of this invention is to provide an endoscope having a retrieval head assembly including a permanent magnet which can effectively be steered to the site of the swallowed magnetic foreign object. Other objects and advantages of this invention will be in part obvious and in part explained by reference to the accompanying specification and drawings.

In the drawings:

FIG. 1 is a partially sectioned side elevation of an endoscope according to the present invention, with part of the elongated cable means removed, showing the construction utilized to effect steering of the retrieval head.

FIG. 2 is a side elevation of the device of FIG. 1, with parts removed illustrating the manner in which the retrieval head moves arcuately from its original position;

FIG. 3 is a section taken along the line 3—3 of FIG. 1;

FIG. 4 is a section taken along the line 4—4 in FIG. 3 showing the operator shaft in full;

FIG. 5 is a partially sectioned side elevation of a modified form of endoscope similar to that of FIG. 1 in which the permanent magnet means can be turned "off or on" by reciprocatory movement; and

FIG. 6 is a partially sectioned side elevation of an endoscope in which the retrieval head assembly can be both moved and rotated.

Generally, the improved endoscope of this invention comprises elongated cable means which include an outer tube-like envelope having a longitudinal opening extending therethrough, operator shaft means which is of greater length than the envelope and is slidably disposed therein and a retrieval head assembly which is operably attached to one end of the operator shaft means so that it can be moved back and forth by the person using the endoscope to effect retrieval of the foreign object.

Turning now to a more complete description of the construction and operation of the device, reference is made to FIG. 1 of the drawings. In this figure, the endoscope comprises elongated cable means 10 which has an outer diameter on the order of 0.25 inch and is about 27 inches long. Obviously, these sizes can be deviated from and are mentioned only to give some indication of the relative dimensions of the parts of the device.

Cable means 10 includes an outer tube-like envelope 11 which has a longitudinal opening such as 12 extending therethrough. This envelope can be suitably constructed of any flexible material, such as plastic. Within the longitudinal opening 12 is an operator shaft means 15 which is of greater length than the tube-like envelope so that it can be connected to the retrieval head assembly 16 at one end and to a convenient control knob 17, or similar device, on the other end. This shaft means 15 is advantageously constructed of a corrosion-resistant material such as stainless steel so that sliding or reciprocable movement thereof becomes in no way impaired by corrosion products.

Since the cable means is generally of small diameter and must be forced down through the esophageal passages, it is necessary that it be flexible and yet it must possess a reasonable degree of stiffness. Obviously, if the cable were completely flexible, it would be virtually impossible to push it down toward the stomach area. To insure the necessary degree of stiffness and provide a good bearing surface for the sliding of operator shaft 15, a wire helix 18 is located between envelope 11 and the shaft 15. The shaft 15 includes a connector 19 on its outer end which extends through locking means 20. Suitable operator knob 17 is attached to the outer end of connector 19 as by means of the screw 21.

The locking means 20 can be best be seen by referring to FIGS. 3 and 4 of the drawings. This means comprises a first member 25 which is provided with a thread thumb screw 26 that extends radially inwardly for contact with the connector 19. It will be noted from FIG. 3 that connector 19 has a generally square cross-sectional configuration, this shape being used to facilitate easy locking engagement between thumb screw 26 and the connector 19 so that shaft 15 can be rotated.

This first member 25 enables the operator to adjustably lock the operator shaft means against sliding movement within envelope 11 and includes an annular track 27 formed by the flange 27. Cooperating with first member 25 is a second member 28 which is attached to the end of the outer tube-like envelope 11 and which has joined thereto a rotatable ring portion 29, the two parts being held together by means of screws 30. Portion 29 is split for reception into track 27 and has a small guide finger 31 which is received within an arcuate track 32 present in one surface of member 25, as shown. A second thumb screw 33 is provided in second member 28 for fixing its rotation with respect to first member 25 through locking engagement with flange 27.

In FIG. 1, the retrieval head assembly 16 includes permanent magnet means 35 which is constructed of a strong permanent magnet material such as Alnico-5. A magnet constructed of this material with an outside diameter of 0.25 inch will lift a maximum of 160 grams whereas a magnet with an outside diameter of 0.31 inch will lift a maximum of 350 grams. These lifting powers are, of course, maximum values achieved by lifting an object with a large, flat face. Therefore, the useable flux density when inserted into the body will be somewhat less due to less than perfect contact with the swallowed foreign object.
Magnet 35 is joined to a coupling piece 36 as by brazing or the like and coupling 36 is integrally attached to the outer end of operator shaft 15 by similar means. Thus, by loosening thumb screw 26, the operator can move shaft 15 longitudinally and cause retrieval head assembly 16 to move away from the outermost end of envelope means 10. Conversely, by pulling knob 17 in the opposite direction, the retrieval head assembly 16 is returned to its original position adjacent tube 10. It is this type of reciprocable movement which enables the retrieval head assembly to be guided into contact with the magnetic foreign object.

Guiding or steering of retrieval head assembly 16 is effected by means of a flexible wire, or the like, which joins the retrieval head assembly to the tube-like envelope. This wire is indicated in FIG. 1 by the numeral 90 and is shown joined to connector 36 and to a terminating plug 91 which is secured to the outer end of envelope 11. By depressing the knob 17 from the position shown in FIG. 1 to the position shown in FIG. 2, the retrieval head assembly 16 is moved outwardly to the point where wire 40 becomes taut. Additional pressure on knob 17 moving it to the position A causes the retrieval head assembly to move arcuately to the dotted assembly. This sort of arcuate movement or “steering” of the magnet enables the doctor, while fluoroscopically viewing the involved area, to contact the foreign object at the location best suited for the safest removal of the foreign object. For example, an opened safety pin can be contacted at the smaller end away from the point so that it can be drawn upwardly with the head assembly being held in a downward position.

Additional guidance of the retrieval head 16 can be effected by placing it in the position A of FIG. 2 and then rotating the member 25 of locking means 20 which causes the assembly 16 to rotate. These two cooperating movements, that is the arcuate and rotational, of retrieval assembly 16 provides the doctor with significantly greater control in magnetically grasping foreign objects in the human body than has previously been possible. A modified form of endoscope construction according to the present invention is shown in FIG. 5 of the drawings. The construction of the elongated cable means 40 is identical to the construction of cable means 10 discussed earlier and therefore need not be described again. The hand engaging means on the outer end is of slightly different construction, circular finger rings 41 being provided.

Two of the rings 41 are joined directly to the end of the cable means and the other two ringed to the outer end of the operator shaft 42 by means of the screw 43. Obviously, the means of attaching these parts together is not critical and may be done by any other suitable means well known in the art.

At the opposite end of cable means 40 is the retrieval head assembly 45 which differs in significant respects from the corresponding assembly discussed in connection with FIG. 1. In this instance, the assembly is constructed of a hollow non-magnetic casing 46 which is attached to the outer end of the tube-like envelope of cable means 40 and which has its outer end closed by a soft magnetic pole tip 47 magnetically communicating with the hollow interior of casing 46. Also contained within casing 46 and located immediately adjacent to the end of cable means 40 is a magnetically soft ferromagnetic tube 48, a non-magnetic spacing tube 49 and a permanent magnet 50 which may be used for reciprocable movement to the end of operator shaft 42. The function of tube 48 is to shield the magnet 50 and effectively shunt the magnetic field thereof. The nonmagnetic spacer tube 49 is provided to preclude contact between magnet 50 and tube 48.

When the magnet 50 is moved toward the left as viewed in FIG. 5 by depressing the outer finger ring 41 toward the end of cable means 40 the magnet 50 moves into contact with pole tip 47 and causes it to become magnetic. Thus, the operation is one wherein the retrieval head assembly is inserted into the human body to the region of object entrapment and when the pole tip is positioned adjacent to the object to be engaged the magnet is moved to its outermost position and pole tip 47 energized. By having this “on-off” arrangement, it is possible for the doctor to grasp the object at a selected site rather than running the risk of having a magnet engage a foreign object in an uncontrolled and therefore hazardous position.

The endoscope construction shown in FIG. 6 of the drawings is one that combines the functions of each of the two endoscopes described earlier and the construction of the various components is basically similar. Specifically, the cable means includes an outer envelope 60, a wire helix 61, and an operator shaft 62. Locking means 63 corresponding in construction and operation to the locking means 20 discussed in FIG. 1 is attached to the end of the tube-like envelope. Envelope 60 has a knob 64 attached to its outer end so that the operator can conveniently effect reciprocable movement of the shaft.

Since in this device the retrieval head assembly 70 can be both guided and turned off and on, it is necessary that the cable means include a second operator shaft. As shown in the drawings, this second operator shaft is constructed as a hollow cable as indicated by numeral 71 and is of a braided construction. This particular form of construction was chosen because it minimizes frictional forces while at the same time providing a greater flexibility. Operator shaft 71 terminates in a connector 72 which carries an operating knob 73 on its outer end, this knob including a thumb screw 74 for fixing the movement of shaft 62 and being joined to connector 72 by means of the screw 75. At the other end of the elongated cable means, the retrieval head assembly 70 is attached to shaft 72 as by means of brazing or the like and the permanent magnet 80 is attached to the end of shaft 62 in a similar fashion. Thus, movement of knob 73 toward locking means 63 causes the entire retrieval head assembly to move away from the end of the elongated cable means and if pushed far enough, will enable the head to move arcuately in the fashion described in connection with FIG. 2. Movement of knob 64 causes relative movement of the permanent magnet 80 into either the “on” position in contact with pole tip 81 or into the “off” position within the soft ferromagnetic tube 82, as desired.

I believe that the endoscopes described provide the doctor with greater mobility in the removal of magnetic foreign objects from the human body. Depending upon the location site and the type of foreign object involved, the doctor can choose the particular endoscope best suited for the safe and effective removal of the object. No anaesthesia is required and the foreign body can be removed within three to four minutes without hospitalization of the patient. The quick and successful removal of the foreign body will eliminate the danger of perforation, hospitalization and the repeated X-rays generally ordered to watch the daily progress of the foreign body.

Although the present invention has been described in connection with preferred embodiments, it is to be understood that modifications and variations may be resorted to without departing from the spirit and scope of the invention, as those skilled in the art will readily understand. Such modifications and variations are considered to be within the purview and scope of the invention and the appended claims.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. An endoscope for removing swallowed, magnetic foreign objects from the esophageal, stomachic or duodenal regions of the human body comprising:

(a) an outer tube-like envelope having a longitudinally opening extending therethrough,

(b) operator shaft means of greater length than said envelope slidably disposed within the longitudinal opening thereof; and
5 (2) a retrieval head assembly including;
(a) permanent magnet means operably attached to one end of said operator shaft means for reciprocable movement with respect to said tube-like envelope,
(b) a non-magnetic elongated casing attached to the end of said envelope and having a hollow interior receiving said permanent magnet means, said interior being of greater length than said magnet means so that said magnet means can be moved axially between operative and non-operative positions therewithin,
(c) a soft ferromagnetic pole tip closing the end of said casing opposite said envelope and being in magnetic communication with the hollow interior of said casing.

2. An endoscope for removing swallowed, magnetic foreign objects from the esophageal, stomachic or duodenal regions of the human body comprising:
(1) elongated cable means including;
(a) an outer tube-like envelope having a longitudinal opening extending therethrough,
(b) operator shaft means of greater length than said envelope slidably disposed within the longitudinal opening thereof;
(2) a retrieval head assembly including;
(a) permanent magnet means operably attached to one end of said operator shaft means for reciprocable movement with respect to said tube-like envelope,
(b) operator shaft means of greater length than said envelope slidably disposed within the longitudinal opening thereof;
(3) locking means fixed to said tube-like envelope on the end removed from said retrieval head assembly and including;
(a) a first member for adjustably fixing longitudinal movement of said operator shaft means within said outer tube-like envelope,
(b) a second member for adjustably controlling rotational movement of said operator shaft means and
(4) means joined to said outer tube-like envelope and to said retrieval head assembly effecting connection therebetween on an axis spaced from the axis of said operator shaft means to enable arcuate movement of said retrieval head assembly.

3. An endoscope for removing swallowed, magnetic foreign objects from the esophageal, stomachic or duodenal regions of the human body comprising:
(1) elongated cable means including;
(a) an outer tube-like envelope having a longitudinal opening extending therethrough,
(b) operator shaft means of greater length than said envelope slidably disposed within the longitudinal opening thereof;
(2) a retrieval head assembly including;
(a) a hollow non-magnetic casing attached to the end of said envelope and having an opening providing for entry of said operator shaft means thereinto,
(b) a soft magnetic pole tip closing the end of said casing opposite said envelope and being in magnetic communication with the hollow interior of said casing,
(c) a magnetically soft ferromagnetic tube positioned within said hollow nonmagnetic casing defining flux shielding means and
(3) permanent magnet means operably attached to one end of said operator shaft means for reciprocable movement between a shielded position within said flux shielding means and a position effective to magnetize said soft magnetic pole tip.

4. An endoscope as defined in claim 3 wherein said permanent magnet means is separated from said flux shielding means by a nonmagnetic spacer.

5. An endoscope for removing swallowed, magnetic foreign objects from the esophageal, stomachic or duodenal regions of the human body comprising:
(1) elongated cable means including;
(a) an outer tube-like envelope having a longitudinal opening extending therethrough,
(b) operator shaft means of greater length than said envelope slidably disposed within the longitudinal opening thereof;
(2) a retrieval head assembly including;
(a) a hollow non-magnetic casing attached to the end of said envelope and having an opening providing for entry of said operator shaft means thereinto,
(b) a soft magnetic pole tip closing the end of said casing opposite said casing opposite said envelope and being in magnetic communication with the hollow interior of said casing,
(c) a magnetically soft ferromagnetic tube positioned within said hollow nonmagnetic casing defining flux shielding means and
(3) permanent magnet means operably attached to one end of said operator shaft means for reciprocable movement between a shielded position within said flux shielding means and a position effective to magnetize said soft magnetic pole tip.

References Cited

UNITED STATES PATENTS
2,095,976 10/1937 Foreman 128—1.4
2,517,325 8/1950 Lamb 128—1.4
2,753,869 7/1956 Muffy 128—356

FOREIGN PATENTS
1,063,457 12/1955 France.
320,122 4/1957 Switzerland.

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