MEDICO-SURGICAL TUBES HAVING FROSTED SURFACE

FIG. 4.

FIG. 5.

FIG. 6.

FIG. 7.

FIG. 8.

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ABSTRACT OF THE DISCLOSURE

Medico-surgical tubes of the disposable type made of non-fibrous, waterproof, plastic material are provided with a frosted surface on at least part of the interior wall, the exterior wall or both of the tubes. Such surface frosting reduces dry surface sticking and wet surface slippage of the tubes, namely, (a) permits tubes of smaller size, e.g., a suction catheter, to pass through a larger tube without applying lubricant, e.g., endotracheal tube, without sticking, (b) keeps tubes when in contact with one another from sticking together, (c) reduces tendency of the tube to slip through an operator's fingers when wet, and (d) permits anchor stitches to maintain a firmer grip on the tube when sutured in position in a patient.

Field of the invention

The modern trend in medical and surgical practices is toward the use of medico-surgical tubes of the disposable type which may be used a single time on one patient and then discarded. This type of procedure mitigates problems of cross-infections which constitute a serious problem in hospital operations and it also eliminates the cost of sterilizing tubes of the reusable type. A wide variety of medico-surgical tubes of the disposable plastic type are required to meet modern medical and surgical needs, e.g., catheters, feeding tubes, oxygen connecting tubes, anesthesia administration tubes, endotracheal tubes, doudenal tubes, nasal cannulae, rectal tubes, sump drain tubes, post-surgical drainage tubes, suction catheters and the like. The present invention concerns improvements which may be applied to any of these types of medico-surgical tubes.

Disposable medico-surgical tubes must be waterproof, flexible over a relatively wide range of temperatures, resistant to attack by body fluids, capable of being sterilized, e.g., by exposure to ethylene oxide or gamma radiation, and capable of production at high speeds and volume and at relatively low cost. Various thermoplastic materials are capable of providing these requirements and by far the greatest percentage of disposable, single use medico-surgical tubes commercially available today are formed of non-fibrous plastic material. For the most part, such disposable medico-surgical tubes are made by extrusion from unpigmented plastic material so that relatively transparent tubes are produced. However, in some cases, pigments are employed to give either visual or X-ray opacity to the extruded medico-surgical tube. Probably the bulk of plastic material used for this purpose is plasticized polyvinyl chloride although other thermoplastic material to some extent has been used, e.g., nylon, polyolefins and equivalent materials. The present invention is contemplated for use in connection with medico-surgical tubes formed of any plastic material known or found to be useful for this purpose.

By way of example of the many varieties of medico-surgical tubes of the plastic disposable type which are known and to which the present invention may be applied include those having a non-sparking feature (see U.S. 3,070,132), those having an X-ray line feature (see U.S. 2,929,215), those having a tapered section feature (see U.S. 2,940,126). In terms of specific types of medico-surgical tubes to which the invention could be applied include nasal cannulae (see U.S. 2,931,358), medico-surgical tubes having integral connectors formed in their ends (see U.S. Re. 25,788), infant feeding tubes (see U.S. 3,153,415), intercostal catheters (see U.S. 3,192,290 and 3,295,257) and sump drain catheters (see U.S. 3,314,430).

Although disposable plastic catheters and other medico-surgical tubes have provided physicians, surgeons and others engaged in medical and surgical practices with useful tools plus the opportunity to reduce cross infections while at the same time actually reducing costs by eliminating on-location sterilizations, sortings and handlings, the plastic medico-surgical tubes have created some new problems of their own.

One problem associated with plastic catheters and other medico-surgical tubes, particularly such tubes which are made from plasticized vinyl plastic, is the tendency of these tubes to stick together along contacted tube surfaces when in a dry condition. Conversely, such tubes have increased slippage relative to other surfaces when the plastic tube surface is wet. Then tendency to the sticking of dry surfaces of such tubes is so great that it is generally necessary in the manufacture and handling of such tubes to apply a non-toxic anti-stick coating of silicone material or the like to the surface of catheters or other medico-surgical tubes almost immediately upon their formation. If this is not done, the tubes have a tendency to adhere strongly to one another as they are being handled in the initial stages of manufacture and packaging, preventing satisfactory manipulation of the tubes.

Another problem associated with dry surface sticking is the extreme difficulty encountered in trying to pass a smaller tube through a larger tube. This procedure may be called for in a number of medical or surgical operations. For example, with a plastic endotracheal catheter or a tracheotomy tube installed in a patient, it is almost always necessary to pass a smaller tube through the larger tube, e.g., a smaller disposable plastic suctional tube. For example, with a plastic endotracheal tube being formed with surfaces which are of a polished or glossy type, i.e., a so-called "plate" finish. When an attempt is made to pass the smaller tube through the larger tube, great difficulty is encountered due to the tendency of the two tubes to adhere to one another and prevent relative movement between them. Furthermore, once the smaller tube has been inserted through the larger tube, and the time comes to remove the smaller tube from the patient while allowing the larger to remain, great difficulty is encountered in pulling out the smaller tube. Twisting of the tubes relative to one another may alleviate this tendency toward sticking, but still it may be so great as to cause pain or damage or both to the patient.

The tendency of the extruded plastic medico-surgical tubes towards wet surface slippage manifests itself in several ways. For example, a surgeon may be accustomed to the use of catheters or similar devices made of rubber which exhibit considerably less tendency to slip through the surgeons' fingers when wet as compared to the tendency of the extruded plate-finish tubes made of extruded plastic material. This may cause surgeons or other users to reject the extruded plastic type of medico-surgical tubes for certain applications where, on the basis of economics or other considerations, the use of the inexpensive disposable plastic tube would be advisable.

The wet slippage feature of the polished surface extruded plastic tubes is also manifested in another way. For example, many forms of catheters, drainage tubes or the like, particularly those used for post-surgical purposes, must be secured firmly in the patient while the tube is in place to serve its intended purpose, e.g., the discharging or draining of air, enzymatic fluids, blood, serum or the like. This is done by a so-called anchor stitch which
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The objects are further accomplished in accordance with the invention by creating the frosted surface upon the disposable plastic medico-surgical tubes by several methods. The preferred method is to mechanically impose microscopic deformations in the surface of the plastic material of which the tubular member is formed. This can be attained by controlling cooling of the surface of the tube as it is being extruded from the extrusion die used in the formation of the tube.

In a concluding method according to the invention, the frosted surface of the tube derives from the presence along the surface of the plastic material of which the tubular member is formed of plate-like microscopic particles of material that are insoluble in the plastic material. This can be obtained, for example, by incorporating a small amount of plate-like particles of inorganic material, e.g., mica, having a size of between about 100 to 1000 mesh in the plastic material from which the extruded tube is formed prior to extrusion of the tube.

Description of the drawings

A more complete understanding of the new methods and articles of the invention may be had by reference to the accompanying drawings in which:

FIGURE 1 shows an endotracheal tube made in accordance with the invention and, for the purposes of comparison, a similar tube of the prior art.

FIGURE 2 illustrates the positioning of a smaller diameter suction catheter having a frosted surface in accordance with the invention inserted through an endotracheal tube positioned in a patient. (It will be understood by those skilled in the art that FIGURE 2 is illustrative only and that an endotracheal tube when actually positioned in a patient will be bent in a more complex configuration than is actually shown in FIGURE 2.)

FIGURE 3 is a fragmentary plan view of a catheter having a partial frosted surface in accordance with the invention on the distal end of the catheter.

FIGURE 4 is an enlarged fragmentary view, partially in section, of a medico-surgical tube in accordance with the invention having an interior frosted surface.

FIGURE 5 is an enlarged fragmentary view, partially in section, of a medico-surgical tube in accordance with the invention having an exterior frosted surface.

FIGURE 6 is an enlarged fragmentary view, partially in section, of a medico-surgical tube in accordance with the invention having interior and exterior frosted surfaces.

FIGURE 7 is a diagrammatic, fragmentary, sectional, highly magnified view of a portion of a medico-surgical tube in accordance with the invention in which the frosted surface of the tube derives from the presence along the surface of the plastic material of which the tubular member is formed of plate-like microscopic particles.

FIGURE 8 is an enlarged fragmentary view partially in section of the exit end of an extrusion die diagrammatically illustrating the formation of a medico-surgical tube having a frosted surface by controlled cooling of the exterior end of the extrusion die through which the plastic material passes in formation of the tube.

Referring in detail to the drawings, the endotracheal tube 2 comprises a non-fibrous tubular member 4 having a distal end 6 and a proximal end 8, the tubular member 4 having an arcuate form characteristic of these tubes. Markings 10 are provided on the tubes to designate the distance from the distal end to aid the physician or surgeon in wall of the tube. As will be clearly understood by one skilled in the art, these distance markings will vary with the tube size, e.g., with a 5.5 mm, I.D., tube marks will generally designate 12, 13.5 and 15 cm. distance from the distal end and with a 7.0 mm, I.D., tube will designate 18, 20 and 22 cm., from the distal end.

The endotracheal tube 2 formed in accordance with the invention has a frosted exterior surface 12 and a

Objects

A principal object of the present invention is the provision of new improvements in medico-surgical tubes of the disposable type made by extrusion of non-fibrous, waterproof plastic material. Further objects include the provision of:

1. New methods for the production of plastic medico-surgical tubes of improved type.
2. New forms of extruded plastic medico-surgical tubes which permit tubes of smaller size to be passed through tubes of larger size without tendency to stick together.
3. Improved medico-surgical tubes of extruded plastic type which do not tend to stick together when in contact with one another.
4. New extruded plastic medico-surgical tubes made of non-fibrous, waterproof plastic materials having a reduced tendency to slip through an operator's fingers when wet as compared with disposable plastic medico-surgical tubes available heretofore.
5. Plastic disposable medico-surgical tubes which enable anchor or placement sutures to obtain a firmer grip on the tube when sutured in position in a patient.
6. New extruded plastic medical stylets, either hollow or solid, with a froster exterior surface which are rigid or semi-rigid so that they can be inserted in many types of catheters to initially stiffen them, for various purposes, and then can be easily withdrawn from the catheter when desired.

Other objects and further scope of applicability of the present invention will become apparent from the detailed description given hereinafter; it should be understood, however, that the detailed description, while indicating preferred embodiments of the invention, is given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

Summary of the invention

These objects are accomplished according to the present invention by provision of medico-surgical tubes comprising a non-fibrous tubular member consisting essentially of waterproof, plastic, material and having exterior and interior walls at least a part of at least one of which has a frosted surface. In some embodiments of the invention, only the exterior wall of the medico-surgical tube will have a frosted surface. In other embodiments, only the interior wall of the tube will be frosted, while in yet other embodiments, all of the exterior and interior walls will be frosted. In special forms of medico-surgical tubes in accordance with the invention, a portion only of one or both walls of the tube will have a frosted surface.

is taken in the skin of the patient immediately adjacent the catheter or other tube and then the suture material is tied tightly around the tube to hold it in place. This, together with the dressing that may be applied to the patient, must be sufficient to hold the tube in its required location and is extremely critical. Because of the wet slippage feature of the extruded plastic medico-surgical tubes known heretofore, it has been difficult for surgeons or other users of the tubes to obtain a sufficiently tight connection between the suture material of the anchor stitch and the outside surface of the medico-surgical tube.

In view of the problems associated with medico-surgical tubes of the disposable extruded plastic material type as discussed above, their efficiency in use, extent of application for medical and surgical purposes and probably their acceptance as opposed to possible alternative types of devices by surgeons and physicians would be increased if the dry surface sticking and wet surface slippage tendencies of the plastic medico-surgical tubes known heretofore could be mitigated or completely eliminated.

FIGURE 1 shows an endotracheal tube made in accordance with the invention and, for the purposes of comparison, a similar tube of the prior art.

FIGURE 2 illustrates the positioning of a smaller diameter suction catheter having a frosted surface in accordance with the invention inserted through an endotracheal tube positioned in a patient. (It will be understood by those skilled in the art that FIGURE 2 is illustrative only and that an endotracheal tube when actually positioned in a patient will be bent in a more complex configuration than is actually shown in FIGURE 2.)
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frosted interior surface 14. In contrast, a similar endotracheal tube 16 of the prior art possesses a polished or plate surface on both the interior wall 18 and exterior wall 20. As previously indicated, one of the unique advantages of medico-surgical tubes prepared in accordance with the present invention is the ability of a smaller size tube to be passed internally through a larger size tube without sticking or blocking. This is illustrated in FIGURE 2 in which an endotracheal tube 16 positioned within the patient 22 has a suction catheter 24 possessing a frosted exterior surface 26 extending through the endotracheal tube 16. As will be apparent from FIGURE 2, in order to attain the advantages of this non-sticking feature, it is not necessary that the surfaces of both the large and small tubes be frosted, i.e., it is sufficient that the exterior surface of the smaller tube 24 or the interior surface of the larger tube 16 be frosted. However, there is no detriment to the non-sticking feature of the new tubes if both the contacting surfaces of the smaller and larger tubes are frosted. With a combination of tubes as shown in FIGURE 2, the suction catheter 24 can be quickly and easily inserted through the endotracheal tube 16 with just sufficient pressure to guide the smaller tube through the larger. In contrast, an attempt to do this with an endotracheal tube 16 having a polished exterior surface of such extruded plastic tubes of the prior art and a suction catheter also having a polished or plate surface would result in substantial sticking of the smaller tube within the larger tube as the user would attempt to pass the suction catheter through the endotracheal tube. This sticking characteristic is so great that special steps must be taken to permit the smaller tube to be passed through the larger such as twisting of the smaller tube as it is forced through the larger tube. Not only does this require more time on the part of the physician, surgeon or other operator, but there is the added problem of possible pain or injury to the patient because of the force which must be used to overcome the sticking between surfaces of tubes having a polished or plate surface characteristic of the extruded plastic in medico-surgical tubes known heretofore.

FIGURE 3 shows a catheter 28 having a distal end portion 30 provided with a pair of vents or openings 32 and a central portion 34 which extends towards the proximal end (not shown). Openings 32 may be of any standard form and made in accordance with any suitable procedure known in the art (see for example, U.S. 2,972,779). The catheter 28 is characterized by the frosted exterior surface 36 which extends along the distal end portion 30 of the catheter while the central portion 34 possesses the usual polished or plate exterior surface characteristic of extruded medico-surgical plastic tubes of the prior art.

A special construction in accordance with the invention as shown in FIGURE 3 can be useful in a variety of applications. It will be understood by those skilled in the art that the frosting of the surface of a plastic catheter or other medico-surgical tube in accordance with the invention reduces somewhat the ability of a user of the tube to view contents in the interior of the tube, i.e., the frosting renders the tube translucent rather than transparent. The majority of extruded disposable plastic medico-surgical tubes are made of unpigmented plastic, such as plasticized polyvinyl chloride, so that the tubes possess a completely transparent or crystal appearance. A medico-surgical tube produced from the same plastic material in accordance with the invention will not be completely transparent, but instead is translucent. As a result, it is still possible to view objects such as blood clots, fibrous sections or the like through the translucent walls of a frosted tube of the invention although not with the same clarity as through a polished surface tube such as tube 16 of the prior art. Hence, it may be advantageous in certain applications of medico-surgical tubes to retain the full transparency of a polished surface along part of the tube while utilizing the advantages of a frosted surface in accordance with the invention. An example of this would be where it is desired to obtain the firmest possible grip on the tube by anchor stitches or placement sutures when the tube is sutured in position in a patient while leaving the portion of the tube which would be external of the body of the patient transparent, thereby enabling the surgeon or other user to view material passing through the tube with the greatest clarity. The catheter 28, for example, could be an intercostal catheter or an abdominal sump catheter.

In the embodiment of the invention shown in FIGURE 4, the medico-surgical tube 38 possesses an interior wall 40 which has a frosted surface in accordance with the invention and an exterior wall 42 having a polished or plate surface characteristic of extruded plastic medico-surgical tubes known heretofore.

In the embodiment shown in FIGURE 5, medico-surgical tube 44 has an interior wall 46 having a polished or plate surface and an exterior wall 48 having a frosted surface in accordance with the invention.

In the embodiment of the invention shown in FIGURE 6, the medico-surgical tube 50 has an interior wall 52 provided with a frosted surface and an exterior wall 54 likewise provided with a frosted surface in accordance with the invention.

FIGURES 7 and 8 illustrate two different techniques by which frosted surfaces on medico-surgical tubes in accordance with the invention can be attained. FIGURE 7 attempts to explain the limitation of the graphic arts to illustrate, in highly magnified manner, a portion of a medico-surgical tube having frosted surfaces on both the interior and exterior walls due to the presence in the plastic material of which the tube is formed of plate-like microscopic particles of material that are insoluble in plastic material. These can, for example, nics which has been ground to a very small size as 100 to 1000 mesh of a standard screen sieve. Other subdivided materials of plate-like structure could be used for this purpose so long as they are non-toxic, e.g., ground vermiculite. The plate-like microscopic particles 56 being dispersed in the plastic material 58 of which the tube 60 is formed will have a number of their total adjacent or at the exterior surface 62 and interior surface of the tube 60. Incorporation of up to about 2% of such plate-like particles of inorganic material in the plastic material of which the tube is formed has been found sufficient to create the frosted surface required to provide the unique advantages of the new medico-surgical tubes of the invention. A tube of this type as illustrated in FIGURE 7 possesses a slight degree of translucency as compared with a comparable plastic extruded tube made of plastic material without the presence of the plate-like inorganic particles. Moreover, such a tube exhibits a spectral luster when viewed by reflected light, particularly if the tube is slowly rolled or turned about its longitudinal axis relative to a viewer. Consequently, it is a relatively simple matter to visually distinguish a tube of the invention made by the method illustrated in FIGURE 7 when compared with a tube having a polished or plate surface in accordance with the prior art. There is a slight reduction in clarity of objects viewed by light transmitted through the tubes of the type shown in FIGURE 7 as compared with a prior art polished surface tube although this reduction in clarity is so slight that for the purpose of exposing the where the ability to inspect fluids or other materials passing through the tube would be of importance, the clarity reduction of the tubes of the type shown in FIGURE 7 would be insignificant.

FIGURE 8 illustrates another way in which a frosted surface can be created upon an extruded medico-surgical tube made of plastic material. This involves the imposing of microscopic deformations in the surface of the plastic
material by controlling the cooling of the surface of the tube within the extrusion die just before it exits from the end of the extrusion die. This is a preferred method of accomplishing the frosting in accordance with the invention since it can be effectively regulated so that only portions of the tube will be frosted (see FIGURE 3) or only one surface of the tube will be frosted (see FIGURES 4 and 5). In contrast, frosting accomplished as illustrated in FIGURE 7 renders both surfaces of the tube frosted and although only portions of the tube could be frosted using the technique associated with FIGURE 7, e.g., by sequential introduction of plastic material containing the plate-like microparticles to form segmented tubes, this would be difficult to attain in actual commercial practice. Furthermore, it permits control of the extent of frosting, i.e., the height of translucency or diminution in transparency which in turn is apparently caused by the extent, quantity and quality, of deformations created in the surface of the plastic material by this cooling technique.

FIGURE 8 illustrates in diagrammatic manner the production of frosted medico-surgical tubing using the controlled cooling procedure of the invention. The extrusion die 66 comprises an exterior forming portion wall and an interior wall forming portion 70. The annulus 72 between these two portions generates, in fashion well known to the art, the plastic tube 74 which issues from between the ends 76 and 78 of the extrusion die 66. To attain the frosted surface or surfaces in accordance with the invention, one or both of the die portions 68 and 70 are cooled to a controlled degree at their ends 76 and 78 and for a slight distance upstream thereof as compared with the temperature which is maintained on the major portion of the extrusion die in the shaping of the plastic material creating the extruded tube 74. Such controlled cooling can be accomplished in a number of ways, one method is to provide cooling coils 60 adjacent the end 76 of the outer die portion 68 for cooling the die of the die portion 68. For cooling the inner-die portion 70, there can be provided a tube 82 located within the die portion 70 as an inlet tube for cooling fluid and a second tube 84 as an outlet for the cooling fluid, these tubes 82 and 84 being constructed relative to the inner-die portion 70 so that the cooling fluid is applied to the end of the member 70 adjacent the exit end 78 thereof. By regulating the amount and temperature of a cooling fluid circulated through the cooling coils 80 and the cooling tubes 82 and 84, controlled regulation of a temperature difference of the extrusion die 66 adjacent the exit ends 76 and 78 thereof can be attained.

The degree of cooling to produce frosting in accordance with the invention will depend in part upon the extent or intensity of frosting desired and in part upon the formulation of the plastic material used in the creation of the medico-surgical tube. Provided with the information as supplied herein, those skilled in the art of plastic tube extrusion will be able to determine with a little experimentation the degree of cooling most suitable to attain the extent of frosting desired for the required end use of the medico-surgical tube, the plastic composition being employed and the particular characteristics of the extrusion equipment being used. For standard plasticized polyvinyl chloride formulations used in creation of disposable medico-surgical tubes where normal extrusion temperatures of about 350° F. are employed, it has been found that a cooling of the end of the extrusion die adjacent the portion 68 in FIGURE 3 provides a very satisfactory frosting of the tube surface. Other degrees of cooling, however, will be found effective, eg., 10° to 100° F. below the prevailing or predominant extrusion temperature of the extrusion die.

With both the exterior die portion 68 and interior die portion 70 cooled in the manner described, a tube with both interior and exterior frosted surfaces such as shown in FIGURE 6 will be obtained. With only the exterior die portion 68 cooled, a frosted exterior surface only will be produced (see FIGURE 5) while with only the interior die portion 70 cooled as described only the interior wall of the extruded tubing will be frosted (see FIGURE 4). By controlled periodic cooling and reheating of the exit end of the extrusion die, alternate sections of tubing with frosted surfaces and polished surfaces (see FIGURE 3) may be obtained. If special applications for the medico-surgical tubes would require it, frosting could be alternated between the surface of an interior wall and the surface of an exterior wall or frosting of more pronounced degree providing a higher amount of translucency. As opposed to this, the invention may be alternated with areas of frosting giving a lower degree of translucency, i.e., a higher amount of transparency.

Medico-surgical tubes as provided by the present invention can be distinguished from the prior art in other ways than by appearance. Thus, the new medico-surgical tubes have a critically different "feel" to them than the prior art products. In the dry condition, the new frosted tubes possess a satin smooth surface which is pleasant to the touch. In comparison, the polished surface tubes of the prior art have a sticky quality which is somewhat clammy to the hand. Also, when the frosted product is wet, when the prior art tubes are wet, there is a high degree of slippage between the tube and the fingers or hand of a user. There is, in contrast, considerably less tendency towards slippage when the tube is wet with frosted tubes of the present invention. It is possible with tubes made in accordance with the invention having an optimum frosting particularly of the type produced by controlled cooling of the exit end of the extrusion die, to distinguish between the polished surface tubes of the prior art and the frosted surface tubes of the invention simply by touch or feel.

Medico-surgical tubes with frosted surfaces only at selected portions of the tubes may be created in other ways than by temperature control variations during extrusion. For example, tubes made in accordance with the invention with the mechanical deformation frosting can be "defrosted," i.e., rendered again transparent with a glossy or plate finish, by dipping, wiping or spraying any desired area of the medico-surgical tube with a solvent that will soften the plastic of which the tube is formed. By proper application of solvent in this manner, followed by its evaporation, the frosted surface may be converted back to a plate finish surface. Obviously, this solvent procedure may be easily used to create plate finish sections or areas of any desired extent upon the extruded tubing made with an entirely frosted surface.

Another way of defrosting areas of the frosted surface tubes is by controlled application of heat. In a preferred form, this is accomplished by flame polishing. Thus, selected areas of a frosted tube of the invention can be made transparent with a polished surface by controlled application of a flame to the frosted surface. This can be done by intermittent application of flame to the tube as it passed away from the extrusion machine. Alternatively, the flame polishing can be applied as a completely separate operation at another fabrication station.

The frosted surface feature for medico-surface tubes provided by this invention is advantageously applied to tubes that are of the flexible type. With such tubes, the non-sticking of dry surfaces and non-slipping of wet surfaces is most significant. However, this improvement may also be applied with advantage to tubes that are semi-rigid and rigid, e.g. styletes or trocars as previously indicated.

The new frosted surface features of medico-surgical tubes can be used to advantage on the interior surface of flexible female connectors or on the exterior of flexible or rigid male connectors. Thus, the frosted structure makes it much easier to connect and disconnect these connectors, such as in joining and separating a catheter from a connecting tube. Plastic medico-surgical tubes with a glossy or plate finish surface are quite difficult to connect
together in an air or fluid tight joint because of the explained tendency to stick together as one tries to slide one tube section into another. Once such sticking occurs, it is extremely difficult to push the separate tube sections any further together. While connector sections having the frosted feature go together more easily, they also can be forced in further, thus assuring a tight joint.

The new frosted surface of the invention may be applied to any of the large variety of medio-surgical tubular devices known to the art. Examples of such tubes have been mentioned previously. The new tubes may be made and sold in very long continuous lengths of uniform O.D. and I.D. or with tapered sections therein. Alternatively, the tubing as it is withdrawn from the extrusion die with the frosted surface or frosted sections, can be cut into short lengths required for the particular medico-surgical device ultimately involving the tube. In the case of catheters, cannulae and the like, eyes or openings in the required number can be drilled, punched or melted into the tubing to form necessary inlet openings in the distal ends of the tube or vacuum release openings in the proximal ends of the tube (see U.S. 3,375,828). The new frosted tubes of the invention are capable of withstanding substantially all conditions normally encountered in use and adverse treatment as with any other plastic medico-surgical tubes. They have an advantage over the prior known polished surface extruded plastic tubes because of the lack of tendency for the tubes to stick together when handled in bundles such as encountered during initial stage of manufacture and packaging, in the conventional production operations. Accordingly, the application of anti-sticking coatings such as of silicone compounds, can be eliminated. The new tubes may be manufactured to professional specifications and may be produced in various degrees of flexibility or rigidity by varying the formulation of the plastic material from which the tubes are extruded. They may be used interchangeably with similar medico-surgical tubes which do not incorporate the frosted surface feature of the new articles of the invention.

The embodiment of the invention in which an exclusive property or right as claimed are defined as follows:

1. A catheter comprising a tubular member having a proximal end, a distal end and a lumen connecting said ends for transport of fluid to or from the body of a patient into which the catheter may be inserted, said distal end being adapted for the insertion of the catheter into the body of a patient, said tubular member consisting essentially of non-fibrous, waterproof plastic material and having exterior and interior walls, at least a part of at least one of said walls having a frosted surface, said frosted surface being derived from microscopic deformations in the surface of the plastic material of which the tubular member is formed.

2. A catheter as claimed in claim 1 wherein said microscopic deformations are mechanically imposed deformations.

3. A catheter as claimed in claim 1 wherein said microscopic deformations are formed by the inclusion in said plastic material of plate-like microscopic particles of material that are insoluble in said plastic material.

4. A catheter as claimed in claim 3 wherein said plastic material contains up to about 2% by weight of said plate-like particles which have a size between about 100 to 1000 mesh.

5. A catheter as claimed in claim 1 wherein both said exterior and interior walls are frosted through the length of the tube.

6. A catheter as claimed in claim 1 which is a suction catheter having a frosted exterior surface and a glossy interior surface.

7. A catheter as claimed in claim 1 having a frosted surface which extends only part way back along the catheter toward its proximal end.

8. A catheter as claimed in claim 1 which is formed of extruded plasticized vinyl chloride polymer.

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