

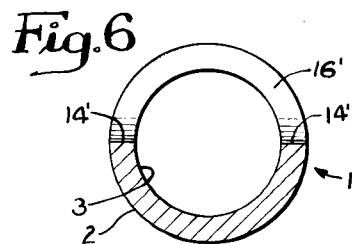
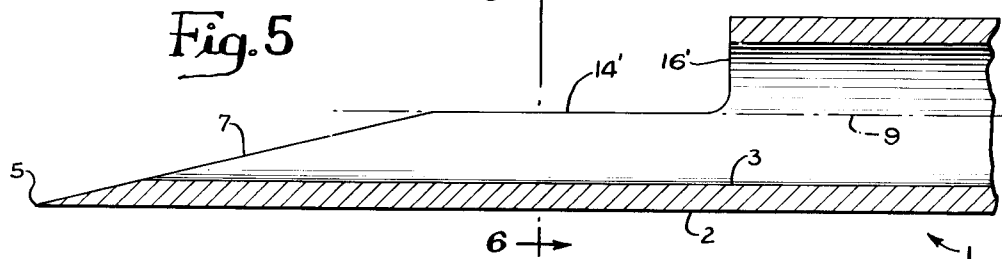
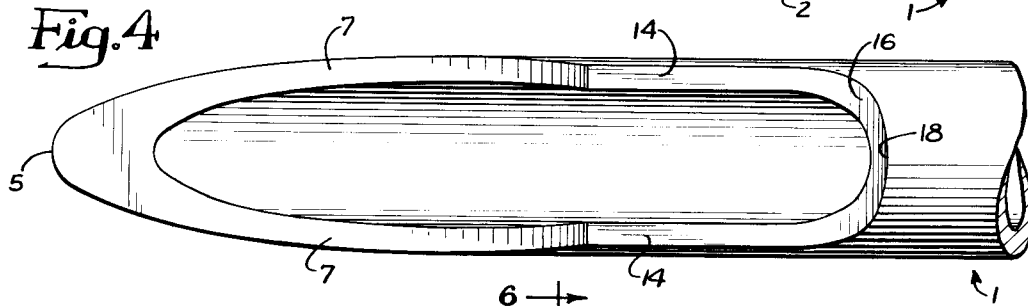
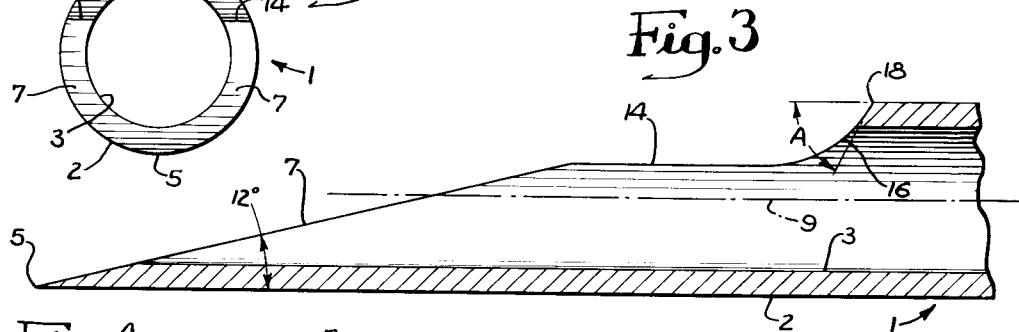
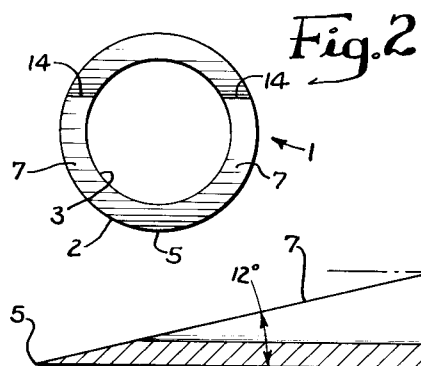
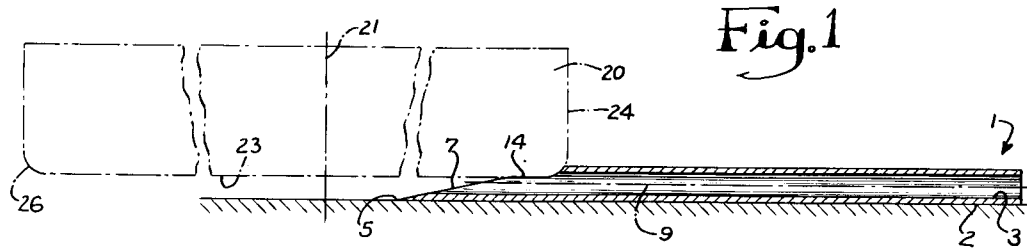
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E. F. WINDISCHMAN ET AL

2,716,983

PIERCING NEEDLE

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INVENTORS
EDWARD F. WINDISCHMAN
WILLIAM LIONEL HARTOP, JR.
GEORGE RICHARD RYAN

by: John H. Schneider *Atty.*

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2,716,983

PIERCING NEEDLE

Edward F. Windischman, Waterbury, Conn., and William Lionel Hartop, Jr., and George Richard Ryan, Waukegan, Ill., assignors, by direct and mesne assignments, to Abbott Laboratories, Chicago, Ill., a corporation of Illinois

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This invention relates to needles and particularly to needles for use in the medical arts, such needles being provided with a cannula through which fluid can flow.

When a needle of the above mentioned character, which has a piercing point at an end thereof, is caused to pierce a diaphragm, such as a rubber closure plug of a sterile container, or a piece of epidermal tissue, it is important that the piercing action of the needle shall not result in tearing or otherwise removing a small piece of diaphragm or skin where the needle enters and thereby causing the cannula to become clogged or the solution to become contaminated. This problem has long been recognized but no satisfactory solution to the problem has been provided. The solutions heretofore suggested have been either impractical, expensive, result in substantially weakening of the needle or increasing the needle's resistance to penetration.

It is therefore one of the objects of the present invention to provide a piercing needle designed to inhibit coring.

Still another object of the invention is to provide a piercing needle which requires less pressure in order to penetrate a diaphragm or the like.

A further object of the invention is to provide a piercing needle which reduces the discomfort and difficulty of inserting the needle.

Another object of the invention is to provide a rubber piercing needle which induces better resealing properties in rubber diaphragms after withdrawing the needle.

Still further objects of this invention will be evident from the detailed description and claims to follow.

The attainment of the above and other object of the invention will be apparent from the following specification taken in conjunction with the complete drawings and claims.

In the drawings:

Figure 1 is a longitudinal sectional view of a cannula embodying the present invention and showing also one method of performing the grinding thereof;

Figure 2 is an enlarged end elevational view of the penetrating end of the cannula of Figure 1;

Figure 3 is an enlarged longitudinal sectional view of the penetrating end of the cannula of Figure 1 and drawn to a larger scale;

Figure 4 is a fragmentary plan view of the cannula of Figure 1;

Figure 5 is a longitudinal sectional view of a modified form of cannula; and

Figure 6 is a sectional view taken along the line 6—6 of Figure 5.

Reference may now be had more particularly to the accompanying drawings wherein like reference numerals designate like parts throughout.

In the drawings are shown several embodiments of the invention incorporated in the cannula of a rubber-piercing needle which is used in the medical arts for piercing and penetrating a rubber closure plug of a receptacle and which is normally mounted in a standard needle hub or coupling member. The cannula 1 of the needle com-

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prises a stainless steel tube 2 having the usual lumen 3 extending longitudinally therethrough. The end of the cannula is pointed to form a rubber piercing point 5 by an obliquely extending bevel surface 7 formed by grinding the end of the cannula at the desired angle to the longitudinal axis 9 of the cannula. The rearwardly and upwardly extending bevel 7 may have a plane surface or may be formed by a grinder of a radius which is extremely large in comparison with the radius of the cannula. After the cannula has been ground to form the bevel surface 7, the cannula is then straight ground by a surface grinder to produce a rearwardly extending ledge surface 14 which is preferably substantially parallel with the longitudinal axis of the cannula and is preferably at about the longitudinal axis 9. The ledge 14 merges at its trailing edge with the surface 16 which extends upwardly to form what is referred to as the heel 18 of the discharge opening of the cannula. The grinding action for producing the ledge 14 and the surface 16 may be formed by a procedure indicated diagrammatically in Figure 1, wherein a surface grinder wheel 20 which forms the ledge 14 and the surface 16 is rotatable about an axis 21 perpendicular to the longitudinal axis 9 of the cannula, said grinder having a flat, circular grinding face 23 and a peripheral edge 24 joined thereto by a surface 26 which has the same configuration and radius of curvature as the surface 16 of the cannula. The grinder wheel 20 is of a diameter that is very large with respect to the diameter of the cannula.

During the edge grinding by the grinder wheel 20 the cannula 1 rests on a support and is held against turning as the grinder wheel 20 advances toward the support and into contact with the cannula, the grinder surface 23 being parallel to the support. The grinding surface 23 is advanced on the cannula until it comes to about the longitudinal axis 9 of the cannula.

In one improved structure wherein the cannula had an outside diameter of 0.072 inch and an inside diameter of 0.054 inch, the bevel surface 7 made an angle approximately 12 degrees with the longitudinal axis of the cannula and was formed by a 10 inch cylindrical grinder in the usual manner. The grinder 20 used to grind ledge surface 14 and surface 16 had a diameter of six inches. The surface 16 at the heel 18 of the cannula forms an angle, indicated at A in Figure 3 greater than about 45 degrees and of the order of about 65 degrees. The radius of curvature of the surface 16 was of the order of about 0.06 inch. The ledge surface 14 was 0.011 inch above the longitudinal axis 9, as in Figure 3. The above dimensions are cited not by way of limitation but by way of illustration of one improved construction.

In another preferred embodiment of the invention which has been found most satisfactory as an anti-coring rubber piercing needle, the cannula of a 15 gauge needle having an outside diameter of 0.072 inch and an internal diameter of 0.054 inch with the bevel surface 7 forming an angle of about 13 degrees with the longitudinal axis of the cannula, the angle A at the heel 18 was very approximately 90 degrees and the ledge surface 14 was about .033 inch below the upper surface of the cannula and thus at about the longitudinal axis of the cannula. In the latter embodiment the surface 16' intersected the heel surface 18 and ledge 14 at almost 90 degrees.

It has been found that considerable variation can be made in the length of the bevel surface 7 without interfering with the desirable improvements. Thus, changing the angle which the bevel surface 7 forms with the longitudinal axis of a 15 gauge needle from between about 11 degrees to 17 degrees and thus varying the length of the bevel of the said needle, for example from between about 3/8 inch to 1/4 inch, has given improved results in piercing needles used in conjunction with the rubber

stoppers of blood collection containers which have a durometer of between about 45 and 70. It is also possible to vary the depth of grinding of ledge surface 14 from slightly above to slightly below the longitudinal axis of the cannula. Similarly, the radius of curvature of surface 16 has been varied upwardly from less than $\frac{1}{8}$ inch. In some instances, as in anti-coring rubber piercing needles for the above blood containers it is desirable to employ a radius of curvature close to infinity, as illustrated in Figure 5, thereby making the heel surface 16', which corresponds to the surface 16 previously described, substantially perpendicular to the longitudinal axis of the cannula and substantially perpendicular to the ledge 14'. In the embodiment illustrated in Figure 5, the ledge 14' is shown as located in a plane that includes the longitudinal axis 9 of the cannula. It may be above the longitudinal axis, as illustrated in Figure 3, or even slightly below that longitudinal axis.

It will be evident from the foregoing description and drawings that the improved needle of the present invention embodies features heretofore not found in any previous penetrating needle. Thus, one of the novel features of the present invention is the configuration of the heel of the discharge opening of the cannula. The heel of the cannula forms an angle at 18 of approximately 90 degrees with the longitudinal axis of the cannula and which merges into a ledge surface lying in a plane extending across the cannula preferably substantially parallel with the longitudinal axis of the cannula. By providing a heel structure which presents a dull, relatively flat surface area as disclosed herein to the object or part being pierced, the tendency to sever a portion of the object or part is substantially eliminated and the resealing and anti-coring properties of the needles are greatly improved.

Another important feature of the present invention is the manner of positioning the ledge surface 14 with respect to the longitudinal axis of the cannula. As disclosed herein the ledge surface 14 is disposed preferably in a plane substantially perpendicular to the plane passing through the piercing point and the longitudinal axis of the cannula about which the said beveled surface is symmetrically disclosed and preferably about the said longitudinal axis, although the ledge surface may be disposed so as to lie either above or slightly below the longitudinal axis and having slight pitch or slope thereto without departing from the broad scope of the invention. The needle will tend to cut the surface into which it is forced along an arc which cannot exceed 180 degrees and in practice the arc cut rarely exceeds 90 degrees and generally is much less than 90 degrees as the needle is advanced into the material to the extent of the length of the bevel surface 7. If there were no ledge surface 14 or if the said surface 14 were in a plane very substantially above the longitudinal axis of the cannula, the needle would tend to cut an arc substantially more than 180 degrees and consequently the force required to sever or tear the relatively smaller segments of material which completes the 360 degrees of material normally contacted by the needle is relatively small when compared with the force required when the arc does not exceed 180 degrees, particularly when the unsevered segment is encountered by the sharp, knife-like heel portion of the prior art cannula. When the ledge surface 14 is in a plane substantially below the longitudinal axis of the cannula there is danger of unduly weakening the penetrating point. However, should it be found economical to make the cannula of a particularly strong material, it would be possible to have the ledge surface 14 a greater distance below the longitudinal axis than in the applicant's preferred embodiment.

While particular reference has been made herein to anti-coring rubber piercing needles of the type used in administering intravenous solutions, it should be understood that the improved structure of the present invention can be incorporated in needles for use with dental cartridges, hypodermic needles and the like or wherever

it is desirable to have a needle which requires less pressure to effect penetration, produce less coring and induce better resealing properties in the material penetrated thereby.

In compliance with the requirements of the patent statutes we have here shown and described a preferred embodiment of our invention. It is, however, to be understood that the invention is not limited to the precise construction here shown, the same being merely illustrative of the principles of the invention. What we consider new and desire to secure by Letters Patent is:

1. A needle useful in the therapeutic arts comprising a cannula through which a fluid-like material is conducted having a piercing point at one end of said cannula formed by an oblique bevel surface extending rearwardly across the cannula from said point, a ledge surface extending rearwardly along opposite side walls of the cannula from the upper ends of the said bevel surface a distance less than half the length of the said cannula, and upwardly inclined surfaces extending along the cannula wall from the trailing edges of the said ledge surface defining a heel surface which presents a relatively blunt surface area to the material being penetrated thereby.

2. A piercing needle useful in the therapeutic arts comprising a cannula through which a fluid-like material is conducted having a piercing point at one end of said cannula formed by an oblique surface extending rearwardly across the cannula from the said point, a ledge surface extending rearwardly along opposite side walls of the cannula from the upper ends of the said bevel surface a distance less than half the length of the said cannula, and upwardly inclined surfaces extending along the cannula wall from the trailing edges of the said ledge surface defining a heel surface, said upwardly inclined surfaces forming an angle with respect to the longitudinal axis of the cannula which is sufficiently large to provide a relatively blunt heel surface area.

3. A piercing needle useful in the therapeutic arts comprising a cannula through which a fluid-like material is conducted having a piercing point at one end of said cannula formed by an oblique bevel surface extending rearwardly across the cannula from said point, a ledge surface extending rearwardly from the upper ends of the said bevel surface a distance less than half the length of the said cannula, and upwardly inclined surfaces extending along the cannula wall from the trailing edges of the said ledge surface defining a heel surface, said upwardly inclined surface at the said heel forming an angle with respect to the longitudinal axis of the cannula which is at least about 45 degrees.

4. A rubber piercing needle useful in the therapeutic arts comprising a cannula through which a fluid-like material is conducted having a piercing point at one end of said cannula formed by an oblique bevel surface extending rearwardly across the cannula from said point, a ledge surface extending rearwardly from the upper end of the said bevel surfaces a distance less than half the length of the said cannula, and upwardly inclined surfaces extending along the cannula wall from the trailing edges of the said ledge surface defining a heel surface, said upwardly inclined surface at the said heel forming an angle with respect to the longitudinal axis of the cannula which is approximately 90 degrees.

5. A piercing needle useful in the therapeutic arts comprising a cannula through which a fluid-like material is conducted having a piercing point at one end of said cannula formed by an oblique bevel surface extending rearwardly across the cannula from the said point and forming a relatively small angle with respect to the longitudinal axis of the cannula, a ledge surface extending rearwardly along opposite side walls of the cannula from the upper ends of the said bevel surface a distance less than half the length of the said cannula, and upwardly inclined surfaces extending along the cannula wall from the trailing edges of the said ledge surface defining a heel sur-

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face, said upwardly inclined surfaces forming at the said heel an angle with respect to the longitudinal axis of the cannula which is relatively large as compared with that formed by the said bevel surface.

6. A piercing needle useful in the therapeutic arts comprising a cannula through which a fluid-like material is conducted having a piercing point at one end of said cannula formed by an oblique bevel surface extending rearwardly across the cannula from the said point, a ledge surface extending rearwardly along opposite side walls of the cannula from the upper ends of the said bevel surface a distance less than half the length of the said cannula in a plane approximately parallel to the longitudinal axis of the cannula, and upwardly inclined surfaces extending along the cannula wall from the trailing edges of the said ledge surface defining a heel surface, said upwardly inclined surfaces forming, at the portion of the heel remote from the ledge, an angle with respect to the longitudinal axis of the cannula which is at least about 45 degrees.

7. A piercing needle substantially as defined in claim 6 wherein the said angle is approximately 90 degrees.

8. A piercing needle useful in the therapeutic arts comprising a cannula through which a fluid-like material is conducted having a piercing point at one end of the cannula defined by an oblique bevel surface extending rearwardly across the cannula, said bevel surface symmetrically disposed with respect to the plane through the said piercing point and the longitudinal axis of the cannula and forming an angle with respect to the said longitudinal axis between about 11 and 17 degrees, a ledge surface extending rearwardly along opposite side walls of the cannula from the upper ends of the said bevel surface a distance less than half the length of the said cannula, and upwardly inclined surfaces extending from the trailing edges of the said ledge surface along the circular cannula wall defining a blunt heel surface, said upwardly inclined surfaces at the said heel surface lying in a plane forming an angle with respect to the longitudinal axis of the cannula which is at least about 45 degrees.

9. A piercing needle useful in the therapeutic arts comprising a cannula through which a fluid-like material is conducted having a piercing point at the forward extremity of the opening at one end of the said cannula defined by a bevel surface extending rearwardly across the said end of the cannula and a heel surface at the trailing edge of the said opening, said bevel surface symmetrically disposed with respect to the plane through the said piercing point and the longitudinal axis of the cannula and forming an angle with respect to the said axis of about 12 degrees, a ledge surface extending rearwardly along opposite side walls of the cannula from the upper ends of the said bevel surface a distance less than half the length of the said cannula to a point adjacent the said heel surface, said ledge surface being in a plane substantially perpendicular to the plane through the said point and said axis and slightly above the longitudinal axis, and upwardly and inwardly inclined surfaces extending from the trailing edges of the said ledge surface along the circular cannula wall and intersecting the upper cannula wall at the said heel surface, said upwardly inclined surfaces at the said heel surface lying in a plane forming an angle with respect to the said longitudinal axis of about 60 degrees.

10. A piercing needle useful in the therapeutic arts comprising a cannula through which a fluid-like material is conducted having a piercing point at the forward extremity of the cannula opening at one end thereof defined by an oblique bevel surface extending rearwardly across the said end of the cannula and a heel surface at the trailing edge of the opening in the cannula, said bevel surface symmetrically disposed with respect to the plane through the said piercing point and the longitudinal axis of the cannula and forming an angle with

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respect to the said axis of about 13 degrees, a ledge surface extending rearwardly along opposite side walls of the cannula from the upper ends of the said bevel surface a distance less than half the length of the said cannula to a point adjacent the said heel surface, said ledge surface lying in a plane substantially perpendicular to the plane through the said point and axis and approximately at the said axis, and upwardly inclined surfaces extending from the trailing edges of the said ledge surface along the circular cannula wall and intersecting the upper cannula wall adjacent the said heel surface, said upwardly inclined surfaces at a point adjacent the part of the heel surface lying in a plane forming an angle with respect to the said longitudinal axis of about 90 degrees.

11. An anti-coring needle useful in the therapeutic arts comprising a cannula through which a fluid-like material is conducted having a lumen therethrough, the end of the cannula being beveled to a penetrating point, the bevel terminating in a ledge that is parallel with the longitudinal axis of the cannula, said ledge extending first axially a distance less than half the length of the said cannula and then curving along a smooth curve away from the longitudinal axis.

12. An anti-coring needle useful in the therapeutic arts comprising a cannula through which a fluid-like material is conducted having a lumen therethrough, the end of the cannula being beveled to a slender penetrating point, the bevel extending symmetrically on opposite sides of the penetrating point to substantially half the diameter of the cannula and terminating in ledges that are parallel with the longitudinal axis of the cannula, said ledges extending first axially a distance less than half the length of the said cannula and then being joined by smooth curves constituting the edge of the cannula wall.

13. An anti-coring needle useful in the therapeutic arts comprising a cannula through which a fluid-like material is conducted having a lumen therethrough, the end of the cannula being beveled to a penetrating point by a bevel that follows a cylindrical surface the axis of which is at right angles to the longitudinal axis of the cannula, the bevel terminating in a ledge that is parallel with the longitudinal axis of the cannula and also parallel to said cylindrical axis, said ledge extending first axially a distance less than half the length of the said cannula and then curving along a smooth curve away from the longitudinal axis.

14. An anti-coring needle useful in the therapeutic arts comprising a cannula through which a fluid-like material is conducted having a lumen therethrough, the end of the cannula being beveled to a penetrating point, the bevel extending an amount of the order of 90 degrees on each side of the penetrating point and terminating at each side of the penetrating point in a ledge portion that extends axially a distance less than half the length of the said cannula, the two ledge portions merging along smooth curves that meet 180 degrees from the penetrating point.

15. An anti-coring needle useful in the therapeutic arts comprising a cannula through which a fluid-like material is conducted having a lumen therethrough, the end of the cannula being beveled to a penetrating point, the bevel extending an amount of the order of 90 degrees on each side of the penetrating point, the part of the cannula wall that is 180 degrees from the penetrating point terminating in a smooth curve that extends both circumferentially and axially in each direction towards the penetrating point and which in a circumferential extent of less than 90 degrees has a curvature in an axial direction at least 60 degrees to a position where said curve is substantially parallel to the longitudinal axis of the cannula; the portion of the said curve which is substantially parallel to the said axis extending a distance less than half the length of the said cannula.

16. A needle useful in the therapeutic arts comprising: a cannula through which a fluid-like material is con-

ducted, a piercing point at one end of the cannula defined by a surface lying in a plane which extends rearwardly and upwardly across the said cannula and which intercepts the longitudinal axis of the said cannula at an acute angle; a ledge surface extending rearwardly along opposite 5 sidewalls of the cannula from the said piercing point a distance less than half the length of the said cannula; and upwardly inclined surfaces extending along the cannula wall from the trailing edges of the said ledge surface defining a heel which presents a relatively blunt surface 10 to the material being penetrated thereby.

17. A needle substantially as defined in claim 16 wherein the said upwardly inclined surfaces have at least a portion thereof lying in a plane which forms an acute angle with the longitudinal axis of the said cannula.

18. In a needle useful in the therapeutic arts which has a cannula through which a fluid-like material is con-

ducted and a piercing point at one end of the said cannula, the improvement comprising: a ledge surface extending rearwardly along opposite sidewalls of the said cannula from the said piercing point a distance less than half the length of the said cannula, said ledge surface 5 lying substantially in a plane substantially parallel with the longitudinal axis of the said cannula; and upwardly inclined surfaces extending along the cannula wall from the trailing edges of the said ledge surface defining a heel surface which presents a relatively blunt surface to the 10 material being penetrated thereby.

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