

United States Patent [19]**Kristensen et al.**[11] **3,835,912**[45] **Sept. 17, 1974**[54] **METHOD OF JOINING A FILAMENT TO A METAL ROD**[75] Inventors: **Paul A. Kristensen**, St. James;
William F. Simon, Duluth, both of Minn.[73] Assignee: **S.K.S. Limited**, Barbados, British W. Indies[22] Filed: **June 25, 1973**[21] Appl. No.: **373,399**[52] U.S. Cl. **163/5**, 29/471.7, 29/474.4,
128/339, 219/121 LM[51] Int. Cl. **B21g 3/18**[58] Field of Search 29/471.1, 471.7, 474.4;
219/121 LM; 163/1, 5; 128/339[56] **References Cited****UNITED STATES PATENTS**

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Assistant Examiner—Victor A. Di Palma
Attorney, Agent, or Firm—Thomas G. Devine

[57]

ABSTRACT

A metal tube is butted against a metal rod. The rod and tube are welded together using a laser energy source. A filament is inserted into the tube and secured therein. The rod may then be sharpened to serve as a needle.

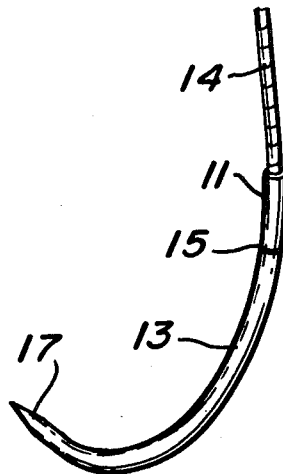
12 Claims, 4 Drawing Figures

FIG. 1

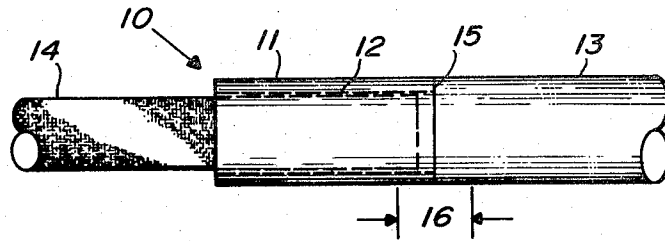
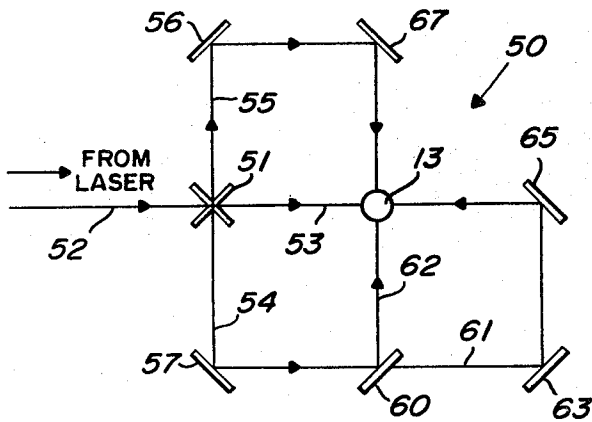


FIG. 2

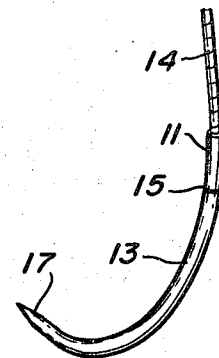


FIG. 4

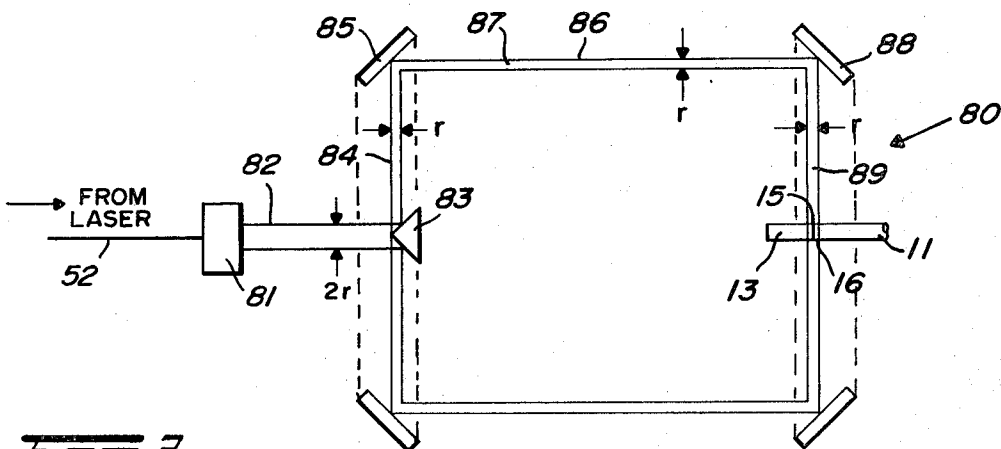


FIG. 3

METHOD OF JOINING A FILAMENT TO A METAL ROD

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to attaching a filament to a small, metal rod. Specifically, it deals with the problem of securing a filament to a needle without having to pass the filament through an eye in the needle.

2. Description of the Prior Art

Prior to this invention, needles of this type, commonly referred to in the trade as swage or suture needles to differentiate them from the eyed type, consisted of two main classes generally known in the trade as the channel type and the drill end or seamless type.

The channel type has a groove struck at the extremity of the needle, the end opposite the point. Raised triangular protrusions or corrugations extend across the bottom of the groove and after the filament has been inserted into the groove, the side walls of the groove are crimped or swaged around the filament, thereby effecting a gripping action on the filament by the corrugations. In the channel type, it is difficult to form a cylindrical shape at the channel in the end section to a smooth tight closure because of metal flow characteristics and shape of the groove. If this channel type needle is to be used as a surgical needle, then metal flaking or burrs caused by metal flow may leave a residue in the living tissue through which the surgical needle passes. Furthermore, packing fluids could be carried over to the tissue to cause irritation, and sharp edges along the channel clip-off walls as well as the corrugation could fracture the filament (suture) during the closing of the channel or in the use of the needle. Also, such a needle requires cold working to attach the filament. The channel end must be annealed after heat treatment of the needle to allow the metal to flow without cracking severely, resulting in a weak wall and therefore poor gripping force, a non-uniform heat treatment or a soft end which could bend excessively during use.

The drill end type is an improvement over the channel type in that the tapped hole, having radial protrusions, located at the extremity of the needle at the end opposite the point, is crimped or swaged around the filament resulting in a stronger one piece, seamless wall and a better gripping action. However, this type of needle requires minimum size drilling and tapping to relatively close tolerance diameters.

Another type needle has a hole drilled at the end opposite the pointed end and then has the filament inserted, together with a bonding agent to cement the filament in place. This type does not require the minimum tolerances of the type having radial protrusions and it does not cause metal flaking resulting from the crimping action. Both of these drill end types have the disadvantage of requiring the needle to be drilled.

Applicants' invention solves the above problem by using commercially available stainless steel hypodermic stock for welding to a stainless steel rod, using a laser as the means of welding. The hypodermic stock can either be crimped against the filament which has been inserted, or a bonding agent can be used to secure the filament within the hypodermic stock. The disadvantageous step of drilling a bore into the needle is eliminated.

BRIEF SUMMARY OF THE INVENTION

A filament is connected to a small, metal rod through a process wherein a section of metal tube is attached to a metal rod of a diameter approximating that of the tube, the welding being accomplished using a laser. The filament is subsequently secured within the tube either by crimping or by cementing the filament to the inside wall. The rod may be sharpened and configured as desired. Use of the finished article is ideally suited for medical purposes. That is, if the rod is stainless steel, the tube is stainless steel hypodermic needle stock, and the filament is suture material, the combination is excellent to serve as a surgical needle and suture. Fish hook assemblies and common sewing needle assemblies are other applications which are obvious but certainly not limiting to the many possibilities to which this invention lends itself. The welding step, using the laser, enables fast and efficient welding without having to move the joint to be welded.

It is therefore an object of this invention to provide an improved method for securing a filament to a metal rod.

It is another object of this invention to provide a method of securing a metal tube to a metal rod and then affixing a filament to the metal tube.

It is also an object of this invention to provide an improved means of welding a metal tube to a metal rod.

These and other objects will be made evident in the detailed description that follows.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates the metal tube and metal rod in place with the filament inserted into the tube.

FIG. 2 illustrates one embodiment of welding a metal tube to a metal rod using a laser.

FIG. 3 illustrates another embodiment of welding a metal rod to a metal tube using a laser.

FIG. 4 illustrates a sharpened and shaped metal rod with a filament attached.

DETAILED DESCRIPTION OF THE INVENTION

Referring first to FIG. 1, metal rod 13 is shown butted up against metal tube 11 forming a junction 16 therebetween. An area 16 surrounding the junction 15 is shown upon which light energy from a laser may be applied. The tube 11 has an inside bore 12 into which filament 14 is inserted. Filament 14 may be secured by crimping or by being cemented in place.

FIG. 4 shows rod 13 having been curved and having been sharpened to a point 17. FIG. 4 illustrates a typical surgical needle having a filament (suture) 14 attached thereto. The needle could, of course, be straight or shaped as desired for the particular application.

MODE OF OPERATION

FIG. 2 diagrammatically illustrates one method of using a laser to weld metal rod 13 to metal tube 11. A laser beam 52 from a laser (not shown) is directed to a beam splitter 51. Beam splitters are well known and simply reflect some of the incoming light and permit some of the incoming light to pass through. Light beams 54 and 55 are reflected while light beam 53 passes through beam splitter 51. Light beams 54 and 55 are reflected by mirrors 57 and 56, respectively. Light beam 54 is split into beams 61 and 62 by beam splitter

60, light beam 62 impinging on surrounding area 16. Light beam 55 is reflected from mirror 67 to also impinge on surrounding area 16. Light beam 61 is reflected by mirror 63 and again by mirror 65 to impinge on surrounding area 16. Light beam 53, passing through beam splitter 51 also impinges on area 16. Thus, area 16 is subjected to a number of light beams of high energy originating from a laser. By using different configurations of beam splitters and mirrors, the surrounding area 16 could obviously be attacked by more or less light beams at varied angles.

FIG. 3 diagrammatically illustrates another embodiment of the method of welding metal tube 11 to metal rod 13. Laser beam 52 from a laser (not shown) enters lens 81 and is broadened into light beam 82 having a diameter of $2r$. Light beam 82 is directed to conical mirror 83 which forms light disc 84 having a thickness r . Light disc 84 is reflected from the inside surface of conical mirror 85 forming hollow cylinder 86 having a wall 87 of thickness r . Hollow beam 86 is reflected by the inside surface of conical mirror 88 forming light disc 89 having a thickness r . Junction 15 between metal tube 11 and metal rod 13 is illustrated within thickness r so that the light energy of light disc 89 is applied to surrounding area 16. The light energy is thereby applied uniformly around junction 15.

FIG. 4 is a resultant structure from the steps of butting tube 11 against rod 13, welding tube 11 to rod 13 by applying light energy from a laser, inserting filament 14 into tube 11 and securing filament 14 within tube 11. In the preferred embodiment, the tube is of hypodermic stock, is stainless steel and may vary in diameter from approximately 0.01 inches to 0.05 inches. The metal rod is stainless steel and may also vary from 0.01 inches to 0.05 inches. When the resultant structure is intended for medical purposes, the filament 14 is suture material. Those having skill in this art appreciate that the dimensions and materials are illustrative only and are not limiting to the scope and intent of this invention.

We claim:

1. The method of joining a filament to a metal rod via a metal tube, using a laser energy source, comprising the steps of:

- a. butting the tube against the rod;
- b. welding the tube to the rod by applying light from the laser energy source to an area surrounding the junction between the tube and the rod;
- c. inserting the filament into the tube; and
- d. securing the filament within the tube.

2. The method of claim 1 wherein the step of welding further comprises:

- b.
 - i. providing a beam of laser light from the laser energy source;

ii. splitting the beam of laser light into a plurality of light beams; and

iii. directing each of the plurality of light beams to a predetermined point on the area surrounding the junction between the tube and the rod.

3. The method of claim 2 wherein the step of splitting the beam of laser light further comprises applying the beam to a beam splitter, and the step of directing the plurality of light beams further comprises reflecting at least some of the plurality of light beams from reflective surfaces to predetermined points on the surrounding area.

4. The method of claim 3 wherein the step of securing the filament further comprises cementing the filament within the tube.

5. The method of claim 3 wherein the step of securing the filament further comprises crimping the tube against the filament.

6. The method of claim 1 wherein the step of welding further comprises:

- b.
 - i. providing a beam of laser light from the laser energy source;
 - ii. converting the beam of laser light into a disc of light; and
 - iii. positioning the disc of light to form a ring of light converging on the junction of the tube and the rod.

7. The method of claim 6 wherein the step of converting the beam of light further comprises broadening the beam of laser light to a beam of light having a diameter of $2r$, and applying the broadened beam to a conical reflective surface to provide the disc of light having a thickness of r .

8. The method of claim 7 wherein the step of positioning the disc of light further comprises translating the disc into a hollow beam having a wall thickness of r by reflecting the disc from a first inside, conical reflective surface, and re-translating the hollow beam into a disc of light converging on the junction, having a thickness of r , by reflecting the hollow beam from a second, inside, reflective conical surface.

9. The method of claim 6 wherein the step of securing the filament further comprises cementing the filament within the tube.

10. The method of claim 6 wherein the step of securing the filament further comprises crimping the tube against the filament.

11. The method of claim 8 wherein the step of securing the filament further comprises cementing the filament within the tube.

12. The method of claim 8 wherein the step of securing the filament further comprises crimping the tube against the filament.

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