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Paulin

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[54] **APPARATUS FOR STRIPPING COAXIAL CABLE**

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[52] **U.S. Cl.** **156/345,** 156/3, 156/16

[51] **Int. Cl.** **C23f 1/02**

[58] **Field of Search** 156/3, 7, 16, 345; 134/200

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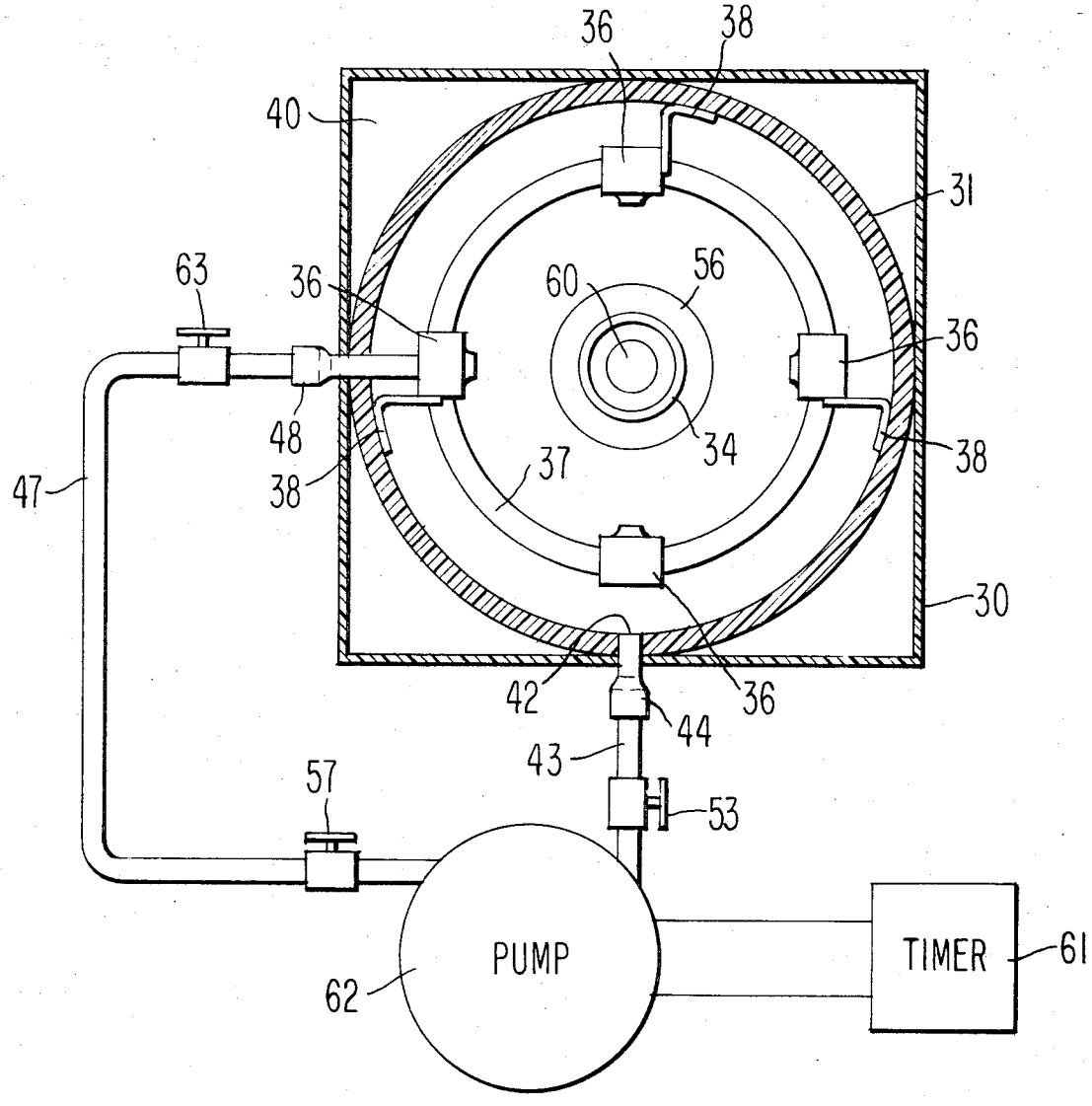
Primary Examiner—William A. Powell

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[57] **ABSTRACT**

An apparatus and method for removing a measured portion of insulation from the end of a miniature solid-jacketed, coaxial cable, the apparatus including a spray chamber having an orifice containing a hermetic seal assembly for the insertion and support of the end of the cable, a precisely adjustable stop member for determining the length of cable to be inserted into the chamber, a spray assembly for applying etchant to the inserted portion, a switch in the face of the stop member for automatically actuating the spray assembly upon insertion of the proper length of the cable into the chamber and an adjustable timing mechanism for controlling the amount of etchant applied to remove the metal sheath. The exposed dielectric insulation is thermally removed, and the conductor cleaned and trimmed to the desired length.

9 Claims, 8 Drawing Figures



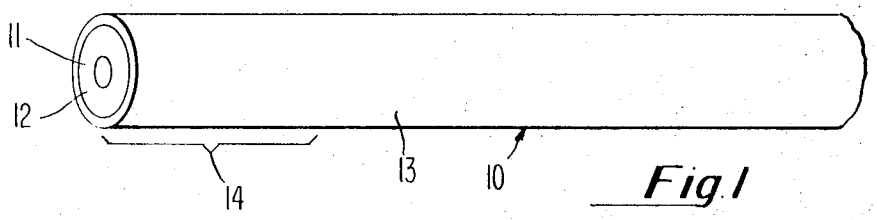


Fig. 1

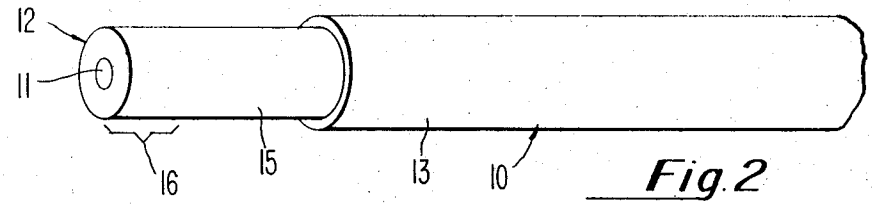


Fig. 2

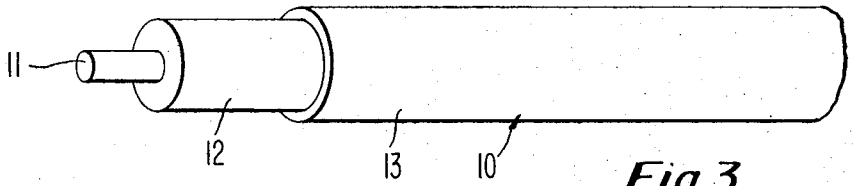


Fig. 3

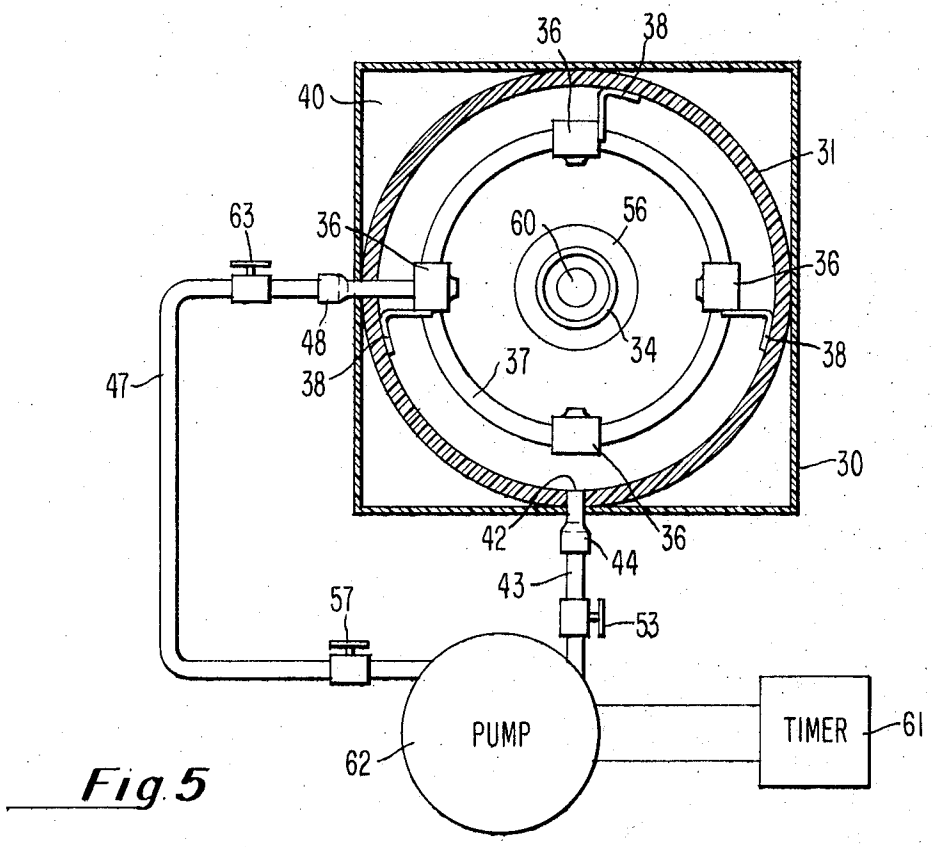


Fig. 5

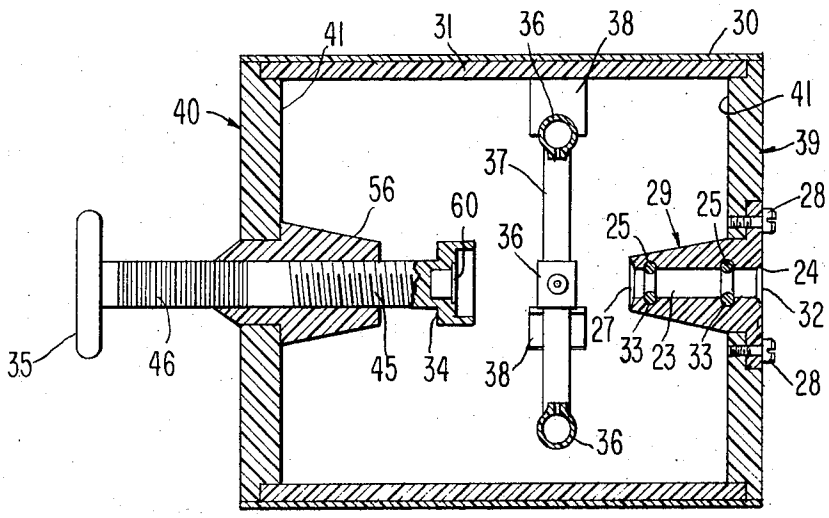


Fig. 4

Fig. 6

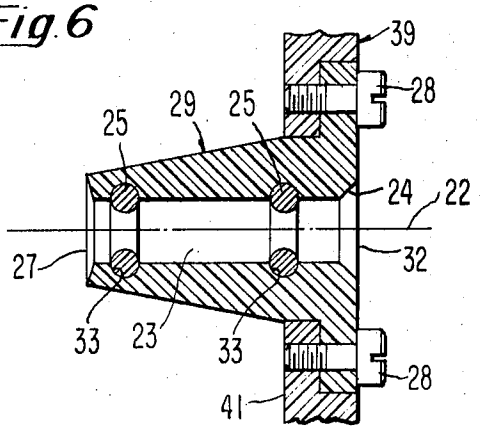
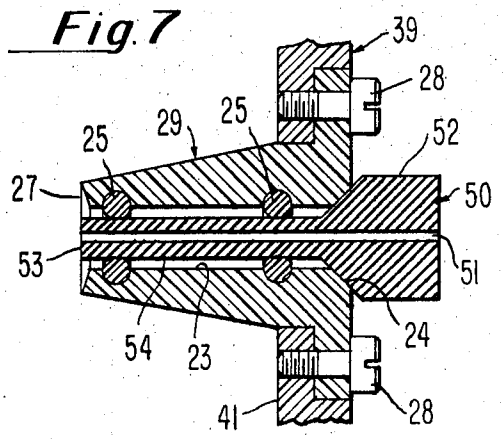


Fig. 7



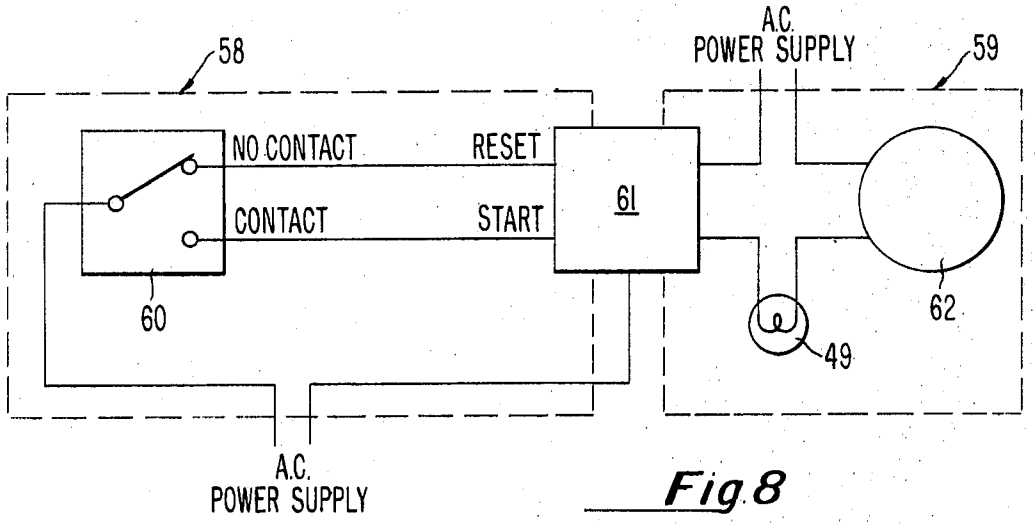


Fig. 8

APPARATUS FOR STRIPPING COAXIAL CABLE

BACKGROUND OF THE INVENTION

The invention relates generally to an improved apparatus and method for preparing cables for connection to associated electronic apparatus, and more particularly to a process for removing concentric insulation and of severing, without deformation, a concentric conductor around a central conductor, such conductors being in the field of solid-jacketed coaxial cables.

With the advent of micro-miniaturization and high speed pulse networks, such as those found in present day computers, the trend towards lighter and more compact electronic assemblies has led to a demand for thinner electrical conductors. Miniature solid-jacket coaxial cables have met this demand. However, regardless of the diameter of the type of conductor the difficulties encountered in preparing insulated conductors for connection to associated apparatus are still ever present.

As a standard practice in the manufacture of complex electronic systems, considerable care and energy is expended in stripping the insulation from the ends of an electrical conductor in a manner whereby there is no degradation of the electrical characteristics of the conductor. This aspect is especially important when working with solid-jacket coaxial cables, and becomes more acute as the diameter of this type of cable becomes smaller.

Solid-jacketed coaxial cables presently used in the electrical and electronic industry generally consist of a single center conductor, such as a copper wire, surrounded by a dielectric plastic material such as neoprene, nylon, tetrafluoroethylene (Teflon — Trademark of the DuPont Company), etc. The plastic material is enclosed in a very close and accurate relationship with a solid metal jacket or sheath, which, in most instances, is essentially an outer conductor of copper tubing. The insulating material serves not only as insulation, but also to accurately maintain a given distance of the center conductor from the outer jacket conductor. This spatial relationship between the center conductor and the outer jacket conductor is extremely important in those situations where two conductors are required to transmit a high frequency signal accurately. It is because of this spatial relationship that the cable possesses a uniform electrical impedance, which is a prerequisite in high speed pulse networks. Any physical degradation of the cable would destroy this uniformity of impedance, and, thus, its applicability in a given circuit.

In making connections to solid-jacketed coaxial cables, a length of the center conductor must be completely exposed from its insulation and the surrounding metal jacket or sheath. Presently, the most prevalent method of stripping smaller diameter solid-jacket coaxial cables is by simply cutting the outer metal jacket or sheath with a sharp blade or like apparatus, and then by brute force pull the outer sheath or jacket from the insulation. The uncovered insulation is then removed to expose the center conductor. With larger diameter cables, it is the practice in the art to utilize cutting pliers, cable cutters, pocket knives and similar apparatus for cutting and stripping both the outer jacket and the insulation from the cable. Also, mechanical strippers,

which automatically perform the manual function of cutting and stripping are popular with cables of sufficient diameter.

However, irrespective of the diameter of the cable, in order to maintain the proper electrical characteristics of the cable, it is essential that the remaining outer metal jacket or sheath not be damaged as, for example, by being deformed or having its edges flared as will result from a tubing cutter, or having any other distortion which affects the uniform distribution of the outer metal jacket about the center conductor. Moreover, it is desired that the center conductor be undamaged, as the slightest nick or scratch caused by penetrating too deeply with the cutting apparatus drastically increases the susceptibility of the conductor to breakage.

Furthermore, considering present day requirements, it is readily apparent that as the diameter of the cable decreases, the slightest damage to the cable has a greatly amplified effect on the cable. The probability of such damage occurring is likely when the method and apparatus presently found in the art are utilized. Thus, the present invention is primarily directed towards a method and apparatus which efficiently and economically prepares small diameter or miniature solid-jacket cables for connection without any degradation to the cable.

Accordingly, it is a primary object of this invention to reduce the possibility of physical distortion to solid-jacketed coaxial cables during stripping.

Another object of this invention is the simple, efficient and reliable removal of the outer sheath or jacket from solid-jacketed cable with particular reference to miniature coaxial cables.

Another object of this invention is to insure uniformity of stripping of terminal portions of coaxial cables.

A further object of this invention is to provide a work-actuated apparatus for removing the sheath or jacket from solid-jacketed cable.

A still further object of this invention resides in the provision of a spray apparatus for exposing a predetermined portion of a solid-jacketed cable to a chemical etchant.

Other and further objects of the present invention will become apparent to those skilled in the art upon a study of the following specifications and appended claims.

SUMMARY OF THE INVENTION

The apparatus of the invention removes the outer metal jacket or sheath of the cable with the aid of chemical action. The end of the cable is inserted into an orifice of a seal assembly, mounted in a side wall of a spray chamber, until the end cross sectional surface of the inserted cable abuts a stop, which has been prepositioned to the length of the outer jacket desired to be removed. Physical contact of the cable with the stop actuates a pump for urging a spray of chemical etchant against the outer metal jacket of the cable. Simultaneously, a pre-set timing mechanism is actuated which controls the duration of the pumping cycle. The seal assembly provides not only support for the inserted cable but also screens a portion of the outer jacket which is not to be removed.

In accordance with the method of the invention, the outer metal jacket and inner plastic insulation are removed from the solid-jacketed coaxial cable with a

minimum degradation to the impedance characteristics of the cable. First, the outer metal jacket or sheath of the cable is removed by chemically etching away the jacket, followed by the removal of a portion of the exposed dielectric with a suitable commercial thermal stripper. The exposed center conductor, when washed and trimmed to the desired length, is then ready for connection.

BRIEF DESCRIPTION OF THE DRAWINGS

A clear conception of the features constituting the present improvement and of the construction and operation of the apparatus embodying the invention may be gained by referring to the drawings accompanying the specification, wherein like reference characters designate the same or similar parts in the various views.

FIG. 1 is a perspective view of the end of a solid-jacketed coaxial cable;

FIG. 2 is a perspective view of the end of the solid-jacketed cable of FIG. 1 after having the outer metal jacket removed by the apparatus of this invention;

FIG. 3 is a perspective view of the end of a solid-jacketed coaxial cable of FIG. 1 prepared through the method of this invention;

FIG. 4 is a side-sectional view of the apparatus of the invention;

FIG. 5 is an end-sectional view of the apparatus of the invention;

FIG. 6 is an enlarged sectional view of the seal assembly of FIG. 4;

FIG. 7 is a sectional view of an insert for the seal assembly of FIG. 6;

FIG. 8 is a schematic diagram of the electrical circuitry for the apparatus of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A solid-jacketed coaxial cable **10** (FIGS. 1–3) is normally comprised of a copper center conductor **11** surrounded by a plastic insulation **12** and a copper-jacketed sheath **13** enclosing the plastic insulation material **12** and concentric to the center conductor **11.** In preparing the cable **10** for connection to the associated circuitry or apparatus, an area **14** of the outer sheath **13** and a portion of the plastic insulation material **12** must be removed to expose the center conductor **11.**

An apparatus for etching a selected portion of the outer jacket **13** of the cable **10** is shown in FIGS. **4** and **5.** The apparatus includes a suitable housing **30** for a cylindrical etching chamber **31,** having circular end panels **39** and **40.** The end panels **39, 40** have raised internal circular portions **41** which are designed to form a hermetic seal with the cylindrical portion of the etching chamber **31.** The etching chamber **31,** as well as other parts of the apparatus to be described, which are exposed to a chemical etchant, are fabricated from a material, preferably Teflon or characteristically similar material, which is inert to the etchant.

The solid-jacketed cable **10** which is to have a selected end portion **14** of the outer metal jacket **13** removed, is axially inserted into the etching apparatus through an orifice **32** of a seal assembly **29** which is mounted in the front panel **39** by cap screws **28** or other suitable means. Orifice **32,** FIG. **6,** has a tapered mouth portion **24** leading into an axial bore **23,** which serves to guide the cable **10** into the chamber **31.** Located near the mouth **24** and an exit **27** of the axial bore **23** are annular recesses **25** in which are seated O-rings **33.** With the insertion of the cable **10,** the O-rings **33** are forced into the recesses **25** to form an air-tight seal around the outer jacket **13** of the cable **10.** Seal assembly **29** serves not only to position and align the selected end portion **14** of the cable **10,** but also supports the cable **10** while inserted in the apparatus.

While the diameter of the axial bore **23** of the seal assembly **29** is the limiting factor as to the size of cable that can be inserted into the apparatus, a plurality of seal assemblies **29** having axial bores of various diameters may be selectively utilized. For very small diameter cables a flexible insert **50** shown in FIG. **7,** having a stem portion **52,** a shank portion **54,** and an axial bore **51** can be inserted into the seal assembly **29.** The stem portion **52,** which is larger than the shank portion **54,** is provided for easy insertion and removal of the flexible insert **50.** The O-rings **33** of the seal assembly **29** form an air-tight seal around the shank portion **54** of the insert **50.** Insert **50** is specifically designed so that the end cross sectional surface **53** of shank portion **54** is flush with the exit end **27** of seal assembly **29.** It is preferred that the insert **50** be fabricated from an inert flexible material, such as rubber, so that the axial bore **51** of insert **50** may be expanded to accommodate cables slightly larger than the diameter of axial bore **51.** Moreover, the etching apparatus is designed so that the pressure inside the etching chamber **31** is at approximately the atmospheric pressure, to reduce the danger of etchant's being forced around the cable **10** into the axial bore **51** of the insert **50.**

The travel of cable **10** into the etching chamber **31** is regulated by a movable stop **34** secured to one end of a rod **45.** Rod **45,** having calibrations **46** thereon, passes through the rear panel **40** of the etching chamber **31,** and is threaded through a casing and a seal assembly **56.** A hand knob **35,** external to the etching chamber **31** is secured to the outer end of the rod **45** to provide precise manual control for the positioning of the movable stop **34.** The calibrations **46** on the rod **45** coincide with the selected length of the outer jacket **13** to be removed. In addition, the longitudinal axis of the rod **45** coincides with the longitudinal axis of the axial bore **23** of the seal assembly **29.**

The movable stop **34** houses a microswitch **60** which is electrically connected in series with a timing mechanism **61** (FIG. **5**). The timing mechanism **61** is set according to the thickness of the selected portion of the copper-jacket to be removed, which in turn is ordinarily dependent upon the cable size. Upon contact of the end portion **14** of the cable **10** with the movable stop **34,** microswitch **60** completes an electrical circuit **58** (FIG. **8**) which activates a cycle of the timing mechanism **61.** Similarly, activation of the timing mechanism **61** completes an electrical circuit **59,** which supplies electric current to a pump **62** which urges a flow of chemical etchant to a circular spray manifold **37.** An indicator lamp **49** may be lighted for the duration of the timing cycle. Upon completion of the timing cycle, the supply of electrical current is discontinued to pump **62** and the flow of etchant to manifold **37** is stopped. However, timing mechanism **61** is not reset until the cable **10** is removed from contact with the movable stop **34.**

The circular spray manifold **37** is mounted on the cylindrical portion of the etching chamber **31** as by brackets **38.** The manifold **37** feeds a plurality of spray

nozzles **36** oriented in quadrants to provide complete coverage of the end portion **14** of cable **10** inserted in the apparatus. The nozzles **36** are positioned so as to direct a spray of chemical etchant inwardly toward the center of the etching chamber **31** and the selected portion of the outer jacket **13** of the cable **10.** The center of the circular manifold **37** coincides with the longitudinal axis of the seal assembly **29.**

A flow of chemical etchant is supplied to the manifold **37** through a hose **47** which is connected at one end to the manifold **37** via an inlet port **48** to the etching chamber **31,** and at the other end to pump **62.** The chemical etchant emanates from the pump **62** and is returned to pump **62** through a return hose **43** via outlet port **44** located near the bottom of the housing **30.** The chemical etchant, after being discharged from the spray nozzles **36** and directed towards the selected end portion **14** of the cable **10,** collects at the bottom of the etching chamber **31.** A drain **42,** located at the bottom of the etching chamber **31,** feeds the outlet portion **44.**

The chemical etchant may be recycled many times before the quantity of dissolved copper adversely affects the etching properties of the etchant. In such a situation, fresh chemical etchant is admitted into the system via a control valve **57** connected in hose **47,** while spent chemical etchant is discharged through a control valve **53** connected in the return hose **43.**

To insure the complete removal of all etchant from the cable **10** before extracting the cable **10** from the apparatus, a stream of air may be directed toward the end portion **14** of cable **10** after the etching cycle. Air may be supplied directly to the spray manifold **37** through an appropriate control valve **63** located near the inlet port **48,** and escape from the etching chamber through air vents of known design.

A neutral liquid may also be used to remove all remaining traces of the chemical etchant. However, if it is desired that the etchant be recycled for use again, a control valve (not shown) must be provided in return hose **43** to divert the neutral liquid. If ordinary tap water is used, it would be quite easy to utilize control valve **63** so that water directly from the tap may be fed to the spray manifold after the flow of etchant without an additional pump.

In operation, the apparatus disclosed could easily be bench mounted or portable. Flexible housing can be provided for facilitating ease in movement for the apparatus.

It will be noted that although this apparatus is primarily designed to accommodate small diameters and miniature size solid-jacketed cables, it will be apparent to those familar with the art that the invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof.

In carrying out the method of the invention the portion of the outer jacket **13** of the cable **10** which is not to be removed is screened to prevent exposure to an etchant spray. A precisely measured unscreened portion **14** of the outer jacket **13** of the cable **10** is then exposed to a spray of chemical etchant, such as chromic sulphuric acid or any other suitable commercial chemical stripper for copper, to uncover a section **15** of the plastic insulation material **12.** Following the removal of the measured portion of the outer jacket **13,** a portion **16** of the uncovered plastic insulation material **12** is removed by a suitable commercial thermal-stripper or in the alternative, high frequency heating (e.g., infrared radiation) can be utilized. After removal of a portion of the insulation material **12,** the exposed center conductor is cleaned, rinsed and trimmed to the desired length.

The process of this invention virtually eliminates any possibility of physical damage to the solid-jacketed coaxial cable **10** during the preparation of the cable for connection. The removal of the outer metal jacket **13** is achieved without the aid of any sharp instruments or apparatus which can smash or deform the concentric distribution of the outer jacket **13** around the center conductor **11,** or which can damage the center conductor **13** itself.

This method is particularly useful with small diameter or miniature solid-jacketed coaxial cables, where ease in handling becomes an important consideration. As the diameter of cable **10** decreases the use of mechanical tools to remove the outer jacket **13** becomes less desirable or practical, whereas the probability of damage to the cable is greatly increased. It should not be construed, however, that larger diameter cables are not equally suitable for the method of this invention.

Although the preferred embodiment is addressed to a copper conductor jacket, the scope of the method of the invention is applicable to any suitable electrical conductive material for a sheath.

The embodiment disclosed, is therefore, to be considered in all respects as illustrative rather than restrictive, the scope of the invention being indicated by the appended claims.

What is claimed is:

1. An apparatus for removing a selected length of the outer metal jacket of solid-jacketed type cable comprising:

a chemical etchant spray chamber;

orifice means for sealably inserting an end of said cable into said spray chamber; and

adjustable means mounted in a wall of said spray chamber for predetermining the length of said cable to be inserted into said chamber.

2. The apparatus of claim **1** wherein said adjustable means is mounted in a wall of said spray chamber opposite said orifice means and wherein said adjustable means includes a rod extending outside said chamber and threadably engaged therewith.

3. The apparatus of claim **2** including calibration on the portion of said rod extending outside said chamber for measuring the predetermined length of the jacket to be removed.

4. The apparatus of claim **2** wherein said orifice means has a longitudinal axis for positioning and supporting said cable and wherein said longitudinal axis is aligned with the longitudinal axis of said rod.

5. The apparatus of claim **1** wherein said orifice means include means for accommodating cables of different diameters.

6. The apparatus of claim **5** wherein said means for accommodating cables of different diameters includes selectable inserts having cylindrical apertures of circular cross section, and including O-rings emplaced in said cylindrical apertures.

7. The apparatus of claim **6** wherein said means for accommodating cables of different diameters also includes one plug having a bore of circular cross section therethrough for insertion into the cylindrical aperture of a selected one of said inserts.

8. The apparatus of claim 1 wherein said spray chamber includes:

means for urging a flow of said etchant spray against said inserted predetermined length of said cable; and

means for regulating the duration of said urging means.

9. The apparatus of claim 3 wherein said adjustable means include:

means responsive to the insertion of said selected length of said cable for actuating said urging means.

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