N72-31494

NASA SP-5908(04)

TECHNOLOGY UTILIZATION

HAND TOOLS

A COMPILATION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Foreword

The National Aeronautics and Space Administration has established a Technology Utilization Program for the dissemination of information on technological developments which have potential utility outside the aerospace community. By encouraging multiple application of the results of its research and development, NASA earns for the public an increased return on the investment in aerospace research and development programs.

Presented in this compilation are a selection of new hand tools, modifications of existing tools, and techniques developed in the course of NASA research and development projects. The items are presented in two sections: Tools for Cable and Connector Applications, and Tools for Welding Applications. Safety is emphasized, together with ease of operation and use in restricted areas or hazardous environments. The discussions are directed primarily toward the technician engaged in assembly or maintenance of mechanical or electrical equipment.

While it is possible that items similar to some of those included in this compilation have been independently developed by other organizations or personnel, they are all believed to be useful.

Additional technical information on individual tools and techniques can be requested by circling the appropriate number on the Reader Service Card included in this compilation.

Unless otherwise stated, NASA contemplates no patent action on the technology described.

We appreciate comment by readers and welcome hearing about the relevance and utility of the information in this compilation.

Ronald J. Philips, *Director*
Technology Utilization Office
National Aeronautics and Space Administration

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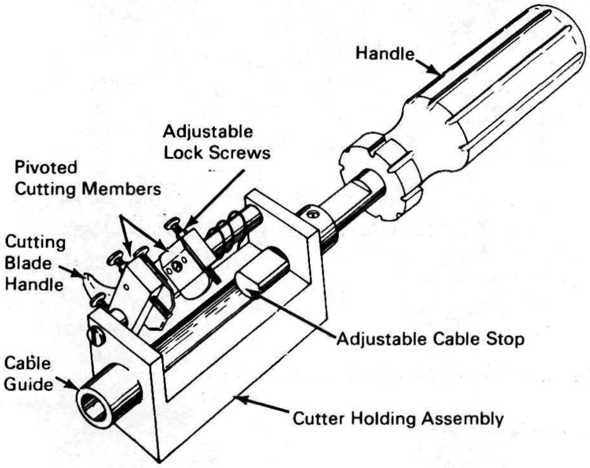
Contents

Section 1. Tools for Cable and Connector Applications

COAX CABLE STRIPPER FOR CONFINED AREAS

The manual coax cable stripper provides a quick and accurate method for preparing coax cable for connector attachment in confined areas. Most cables are prepared by hand because existing tools are too large and inconvenient to handle, and they require a high proficiency level to operate. The task is time consuming, and the cable is frequently improperly prepared, due to human error. With this tool, preparation time is greatly reduced, and the operation can be performed by inexperienced technicians. The tool is small and easy to handle. It allows the depth of cut to be preset, and has spring-loaded cutting members which give a constant cutting rate.



The improved coax cable stripper, shown in the figure, consists of a cable guide, a cutter holding assembly, pivoted cutting members, an adjustable cable stop assembly, and a handle.

Two spring-loaded pivoted cutting members are positioned on the shaft in the cutter holding assembly. Lock screws are used to ensure that only the required length of insulation is removed from the cable. The cutting members also have adjustable lock screws to limit the depth of cut. The cutting member nearest the handle is adjusted to cut through the outer insulation, shield, and inner insulation, exposing the conductor. The second cutting member is adjusted to cut through the outer insulation, exposing only the copper shield.

To operate the tool, the cutting members are raised by depressing the handle with the index finger. The coax cable is inserted into the end of the tool until the end of the cable is against the cable stop. The cutting members are then lowered until they rest against the outer cable insulation. The cable is held with the left hand, and the tool is rotated counterclockwise around the cable. When both cutting members have cut to the adjusted depth (3 to 4 revolutions), the cable is pulled out of the tool. The cable end is now properly prepared for a coax connector.

Source: J. D. Brown and W. G. Lipscomb of The Boeing Company under contract to Kennedy Space Center (KSC-10167)

Circle 1 on Reader Service Card.

GROMMET INSERTION TOOL FOR COAX CONNECTOR CONTACTS

A standard plier has been modified by the addition of a spring-loaded side lever to force the plastic grommet onto the inner contact of a typical, commercially available, coax cable connector contact. The plier features special gripping faces and a side lever to force the contact grommet into

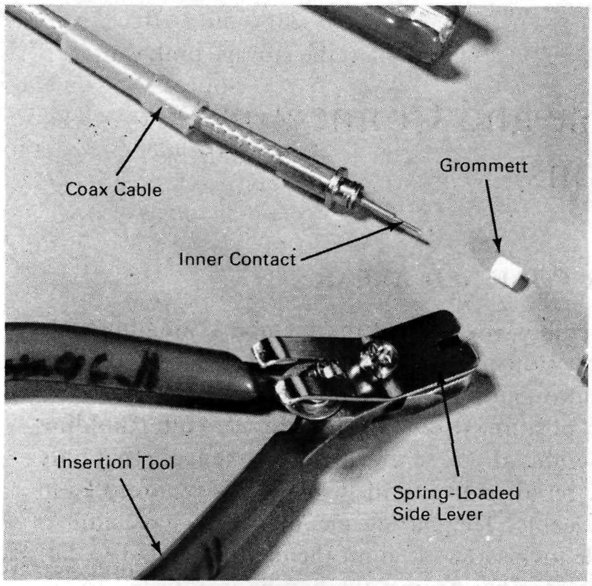


Figure 1

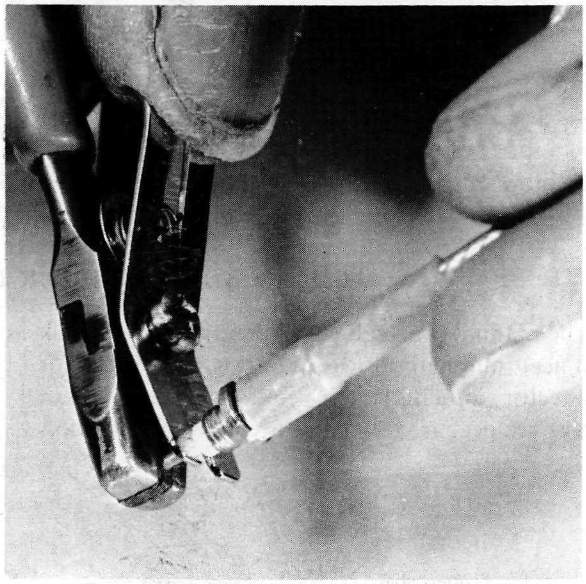


Figure 2

place. Force is applied only to the male connector pin, thereby protecting the more delicate wire connection from compression forces.

Figure 1 shows the items involved in the operation, and Figure 2 shows the tool being used to force the grommet onto the coax inner contact.

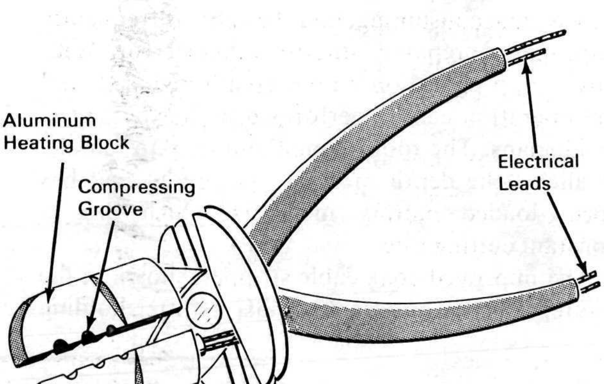
Source: Maurice A. Vanasse of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-15883)

No further documentation is available.

TOOL SEALS CONDUCTORS WITH COMBINATION OF PLASTIC SLEEVES

Electrical conductors connecting instrumentation within tanks used for liquid storage at cryogenic temperatures must be sealed to prevent liquid contamination or liquid leakage through the conductors. Tests proved that even slight damage to the FEP (fluorinated ethylene-propylene) insulation on 20 AWG wires results in a high leakage rate at the wire ends outside the tank.

A special tool permits heating and forming an inner sleeve of FEP and an outer sleeve of TFE (tetrafluoroethylene) about the bundle of conductors to accomplish a leak-tight seal. The tool consists of a pair of end cutters fitted with machined aluminum blocks containing heating elements. The blocks are cut out to accommodate several sizes of plastic sleeves. A powerstat is used in conjunction with a temperature indicator to maintain proper temperature in the aluminum blocks.



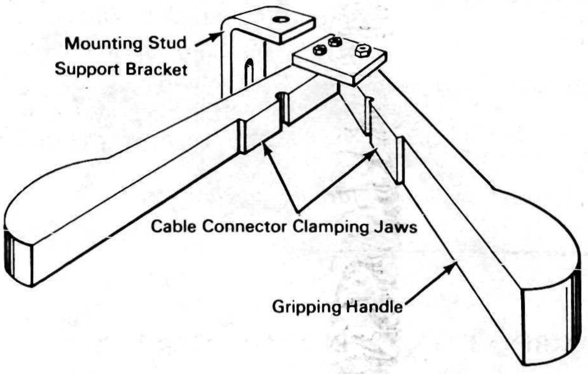
The FEP-insulated conductors are enclosed in a close fitting sleeve of FEP, and a larger sleeve of TFE is slipped over this assembly. The aluminum heating blocks are then placed over the sleeved assembly and compressed. The FEP, both sleeve and conductor insulation, tends to melt and flow at the control temperature, while the outer sleeve of TFE shrinks at this temperature to compress the two FEP components and thus achieve an excellent seal. The tool is used progressively, the largest opening first and the smallest that will accommodate the assembled sleeved conductors last. Only a small longitudinal area need be sealed, and the seal is most effective at the feed-through point in the storage tank wall.

Source: S. Young of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-00579)

Circle 2 on Reader Service Card.

TOOL FOR MATING ACCELEROMETER AND CABLE CONNECTOR

In mating an accelerometer and a cable connector, ordinary hand tools can cause component damage or can result in a union that permits the components to work loose under sustained high-level vibration. This becomes a greater concern as technology develops transportation media (airfoil boats, supersonic transports (SST), etc.) that, because of increasing speeds, generate such high-level vibrations.



A tool (see fig.) has been designed to support the accelerometer in axial alignment with the cable connector while they are fastened with a torque wrench. The accelerometer cable connector is secured finger-tight to the accelerometer. This assembly is then placed in the tool, with the accelerometer mounting stud held in the support bracket and the connector aligned between the contoured clamping jaws. The bracket supports the accelerometer in axial alignment with the connector and prevents side loading that could cause component damage during torquing. Hand-grip pressure is applied to the tool to clamp the connector and prevent it from turning while the specified torque is applied with a standard torque wrench to flats on the accelerometer body.

Source: C. N. Steed of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-00611)

No further documentation is available.

STRING CUTTER FOR ELECTRONIC WIRE BUNDLES

Spot ties on cable bundles must sometimes be removed when rerouting or adding wires. In the past, knives, hem rippers, end cutters (dikes) and bandage scissors have been used for this purpose, but careless handling has resulted in damage to individual wires.

A simple, hand-held cutter accomplishes the task quickly and easily without the danger of wire damage. The cutter has a finger hole to anchor it in the hand while a spring-loaded cutting blade is moved forward by the thumb to cut the cable tie. The tie is captured in a hook-and-eye type aperture in the forward end of the tool. The aperture is wide enough to receive a spot tie string but narrow enough to exclude receiving a wire at the same time.

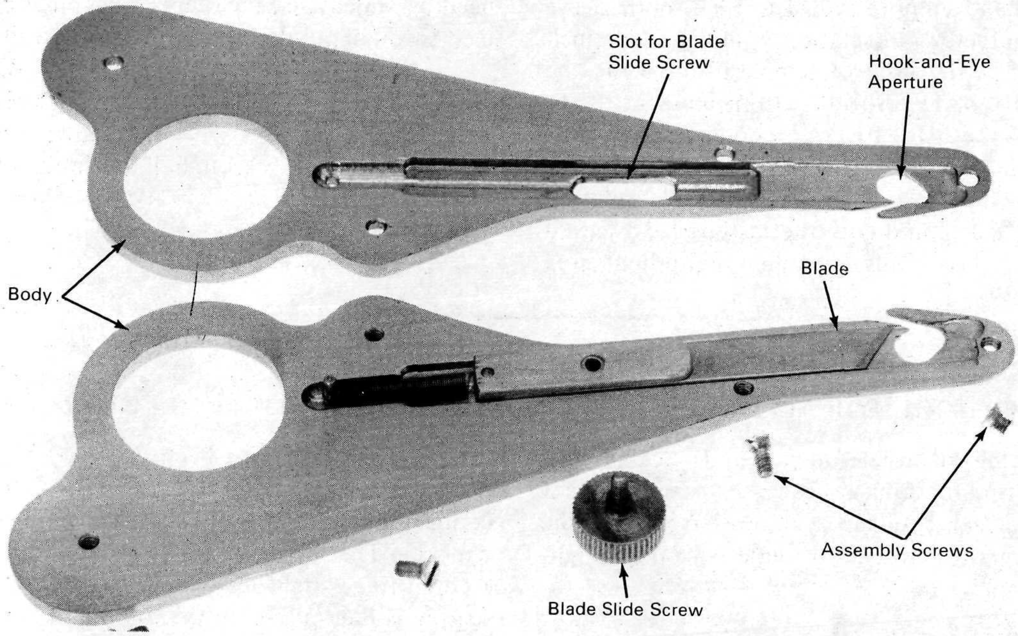


Figure 1

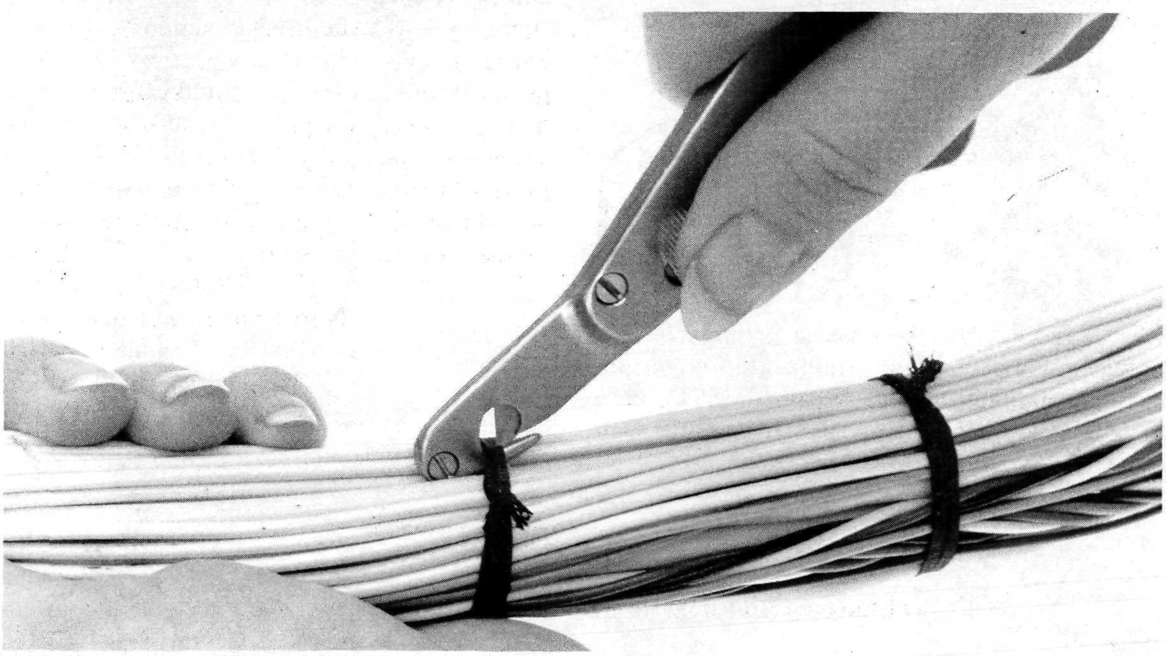


Figure 2

Figure 1 shows the cutter disassembled and Figure 2 shows it being used. Inserting the hook-and-eye aperture axially with the wires further eliminates any possibility of inadvertent wire damage.

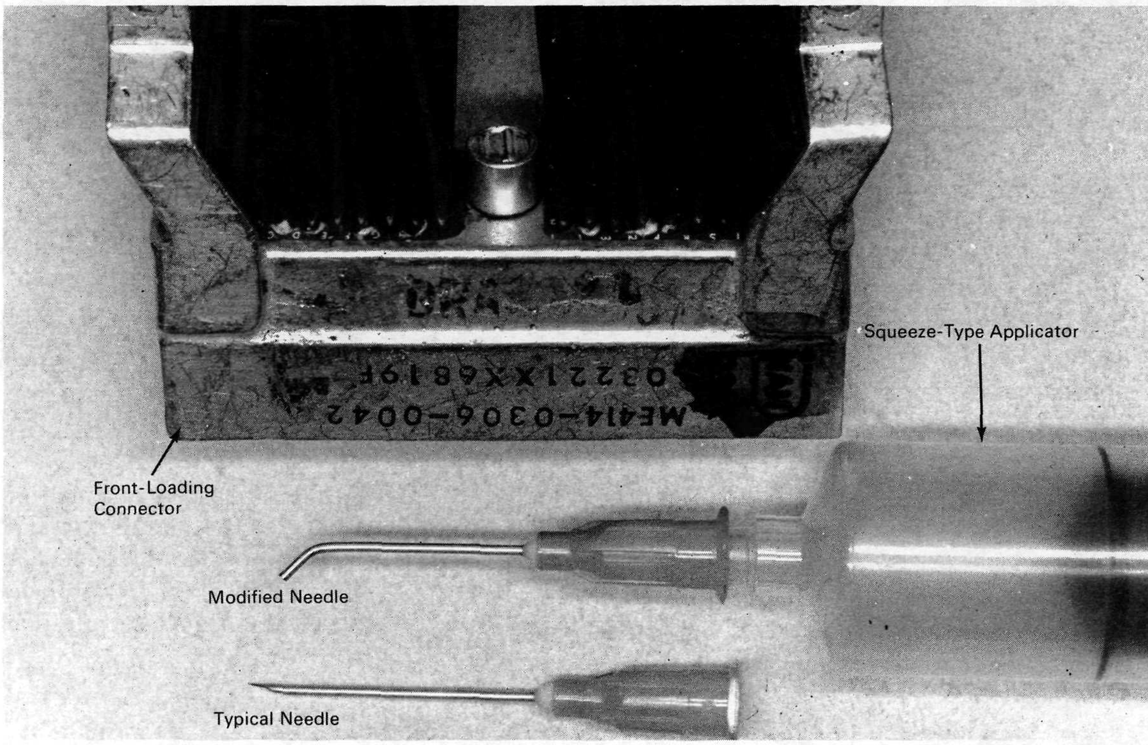
Title to this invention has been waived under the provisions of the National Aeronautics and Space Act 42 U.S.C. 2457 (f), to the North American Rockwell Corp., 12214 Lakewood Boulevard, Downey, California 90241.

Source: (MSC-11403)

MODIFIED NEEDLE FOR REPAIR OF FRONT-LOADING CONNECTOR GROMMETS

Front-loading type connectors have come into wide use because of their small size and ability to accommodate high density wiring. Due to shock, vibration, and wire flexure encountered in normal usage, the plastic grommets anchoring the wire contacts are subject to frequent cracking, thus endangering connector reliability.

In order to repair such cracks, an ordinary hypodermic needle has been modified for use with a squeeze-type applicator to inject silicone cement into the cracked areas. As shown in the illustration, the needle end is squared and then bent to an angle that permits improved access to the grommet area while simultaneously limiting its penetration to a safe depth.



Source: Frank E. Stoner of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-15722)

No further documentation is available.

CIRCUIT BREAKER INSTALLATION PROTECTIVE TOOL

A special, internally-threaded stainless steel sleeve protects the push-pull actuator of panel-mounted circuit breakers during assembly, installation, and test. In the past, appreciable damage to circuit breakers has been caused by the socket wrench slipping while the panel locknut was being tightened.

Figure 1 shows a circuit breaker, the internally-threaded sleeve, and the socket wrench used to tighten the panel locknut. Figure 2 shows the socket wrench in place for attaching the circuit breaker to the equipment panel. The sleeve is screwed on over the push-pull actuator and advanced to a finger-tight condition. The circuit

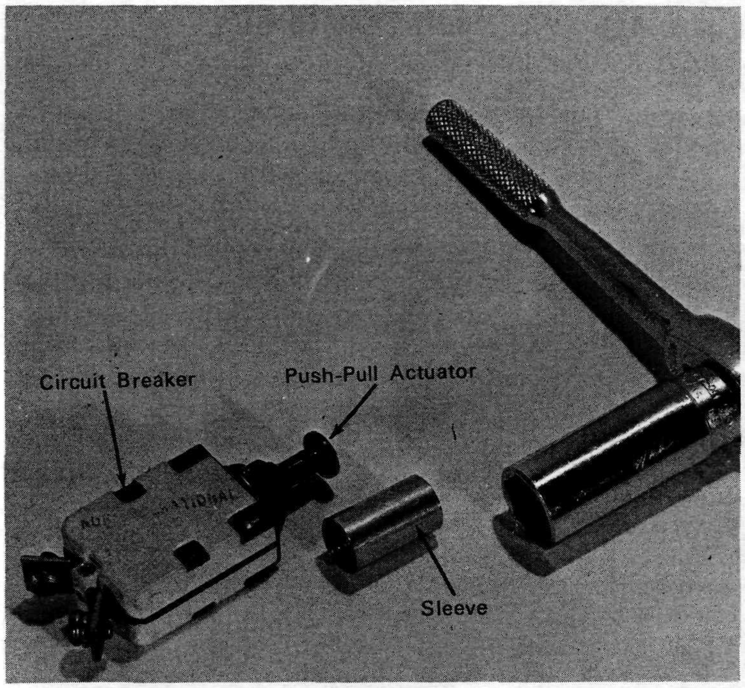


Figure 1

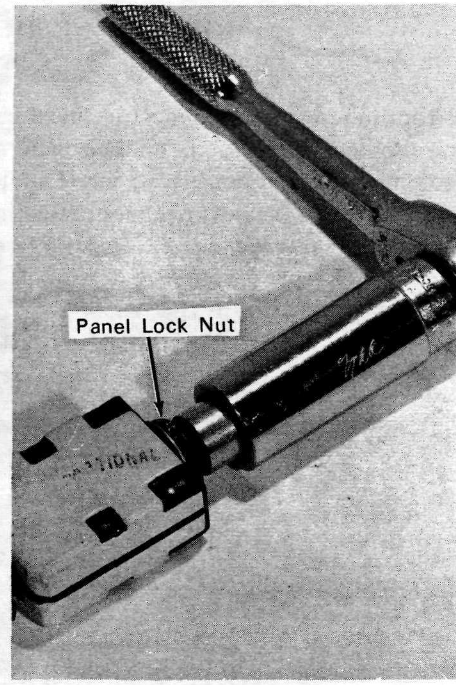


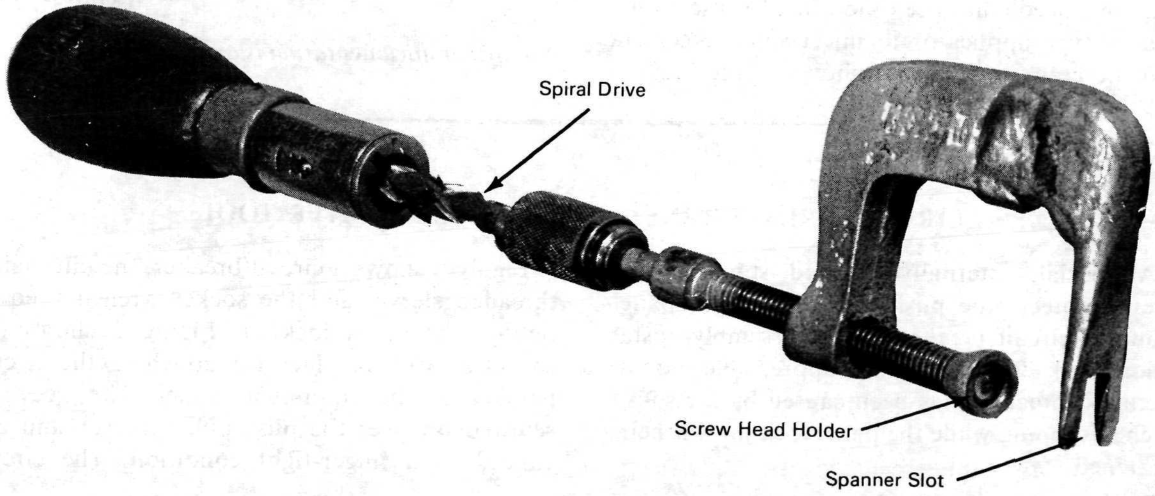
Figure 2

breaker is placed in the panel hole and the panel locknut is started on the breaker body threads. The socket wrench is then placed over the sleeve to engage the panel locknut. The locknut is tightened and the socket wrench is removed. The sleeve may either be removed immediately or left in place if adjacent activity might endanger the push-pull actuator.

Source: Austreberto Z. Campoy and
Richard D. Deskin of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-15020)

No further documentation is available.

DOUBLE CABLE CLAMP INSTALLATION TOOL

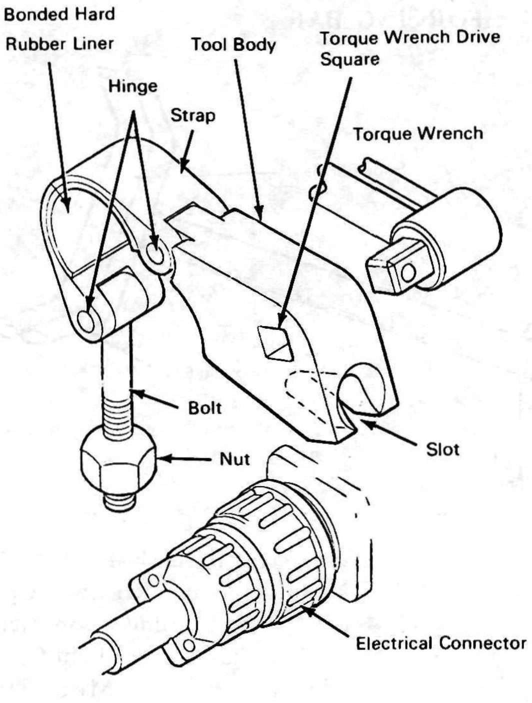


A special cable clamp installation tool incorporates a spiral driver on a special "C" clamp with a screw-holding swivel cup and a slotted foot. The double cable clamp is aligned and the fastening screw is started through one side. The tool is placed so that the screw head holder engages the screw head and the slotted foot is positioned below the opposite side of the clamping surface. The spiral driver is operated with one hand while clamp and screw alignment are adjusted with the other. As the tool is closed, the screw end projects through the slotted foot and the assembler starts the nut on the screw. The tool is then removed and final tightening of the clamp screw is accomplished in the normal manner.

Source: Vernon C. Hadley of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-16883)

No further documentation is available.

CABLE CONNECTOR NUT TORQUING DEVICE: A CONCEPT



Cable connector nuts in limited-access areas are often difficult to torque to design specification because strap-type torquing devices were used for cable connector fasteners that lacked wrench flats.

A new torquing tool (see fig.) provides positive clamping by a stainless steel strap around the cable connector fastener. A square lug on the tool permits attachment of a torque wrench to secure the connector to the required tightness. A hard-rubber liner is bonded to the inner surface of the stainless steel strap. When used in conjunction with a special hinged bolt and nut, this liner affords positive clamping of the cable connector fastener.

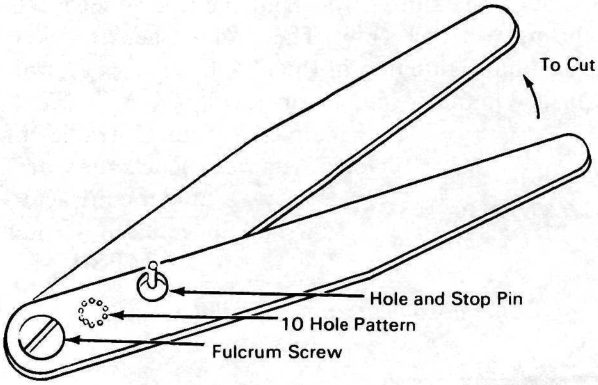
Source: O. King and M. Alexander of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-13973)

No further documentation is available.

SHAPING AND CUTTING TOOL FOR INTEGRATED CIRCUIT CASE LEADS

Ordinary tools used to cut integrated circuit case header leads to equal lengths tend to leave wedges or burrs on the cut ends. This makes smooth, efficient connections difficult where impedance matching is of paramount importance.

A prototype of a scissors-type tool accomplishes clean, right-angled cuts in such leads. Two blades are made to the appropriate width and length from flat ground high carbon steel. A steel pin is pressed into one blade and, when the blades are assembled (see fig.), the pin is captive in an oversized hole that permits but limits movement of the two blades. The blades are held by a fulcrum screw on which they pivot. Appropriately sized

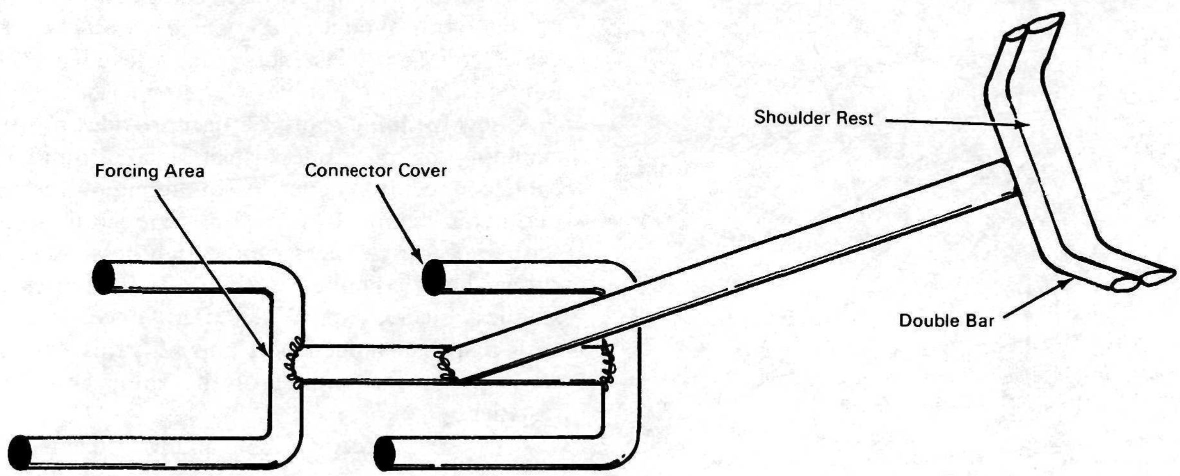


holes for receiving the integrated circuit case leads that are to be cut are drilled in the required pattern through both blades. The tool is opened against the pin stop, the leads are inserted to the desired depth into the hole pattern, and the blades are squeezed to the opposite pin stop position.

Source: E. D. LaBounty of
The Boeing Company
under contract to
Marshall Space Flight Center
(MFS-14726)

No further documentation is available.

WRAPPED WIRE BUNDLE FORCING BAR



Bulky wire bundles that must be forced through conduits or structural members pose handling problems and are a threat to safety because of possible injuries.

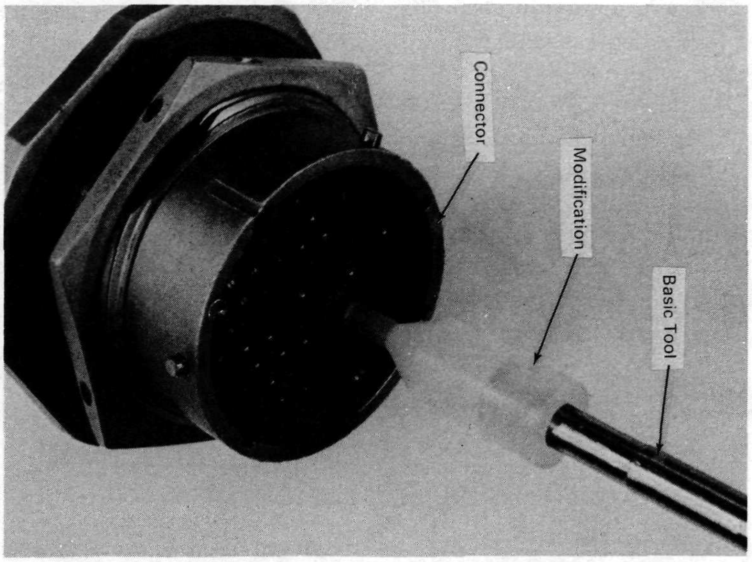
A special tool permits the movement of large wire bundles by body thrust delivered from the shoulder to one end of the tool. This leaves both hands free to guide the bundle as it is forced into place.

Source: Charles E. Fitzgerald of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-13165)

No further documentation is available.

CONNECTOR PIN LOAD-TEST TOOL

In communications equipment, many multiple-contact cable connectors are used. These are subject to unreliable performance caused by manufacturing faults, shipping damage, and careless installation, all of which can cause low connector pin integrity.



To cope with this situation, a commercially available, off-the-shelf tool has been modified to permit precise pin loading in quality assurance testing. The tool, shown in the photograph, is modified by replacing the original tip with a spring-loaded stainless steel shaft that is scale marked to indicate specific load pressures.

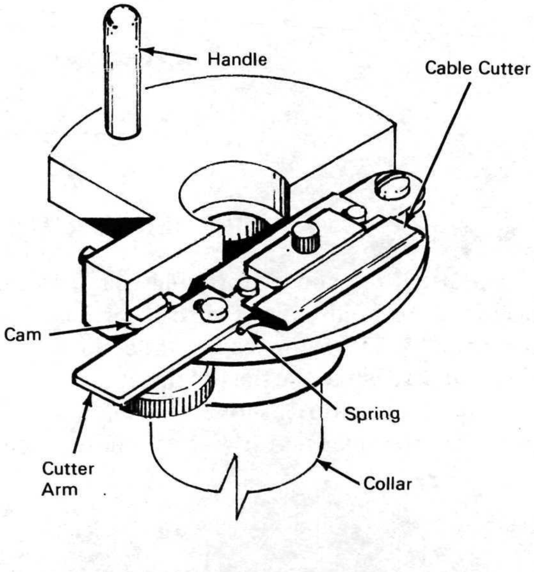
A soft adapter on the forward end of the shaft prevents abrasion of the plated connector parts being checked. By using various sizes of soft adapters, precise loading can be imposed on a wide range of both pins and receptacles. Periodic calibration of the tool is easily made through the well known gage crib operation.

Source: L. Z. Carpenter, C. J. Duggan, and S. K. Goodwin of North American Rockwell Corp. under contract to Marshall Space Flight Center (MFS-13874)

No further documentation is available.

COAX CABLE STRIPPING TOOL

Optimum performance of communications equipment requires that the interconnecting rf cables (coax) have a low VSWR (voltage standing wave ratio). Additionally, the cable-to-connector interfaces must maintain good mechanical stability. The initial step in producing these conditions is to have the outer coax covering accurately cut perpendicular to the axis of the cable, without scoring the strands of the shield immediately beneath it. In the past, the use of basic hand tools such as knives or end cutters has resulted in connection failures under vibration, poor mechanical interfaces, and an increased VSWR.

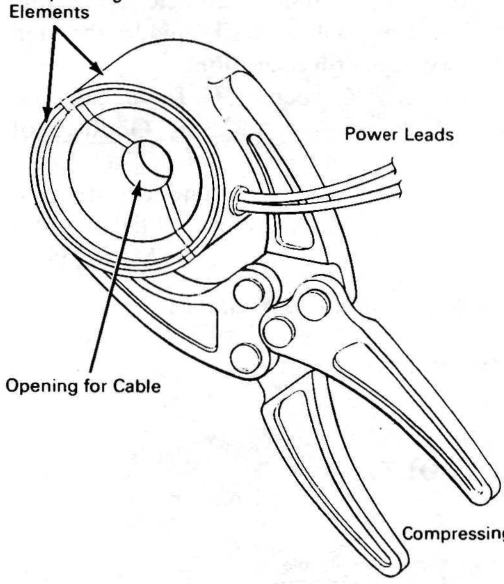


A coax cable stripping tool (see fig.) permits the covering to be accurately cut, trimmed, and removed, and requires only a minimum of skill. The cable to be trimmed is inserted through the tool collar so that the cable end protrudes the required distance beyond the cutter. The cutter arm is lowered against the cable and held there by the spring. The handle is used to rotate the cutter about the cable until the cover, shield, and inner insulator have been cut through to expose the inner conductor. The cutter is then retracted and the cable is moved further into the collar to expose the desired length. The outer insulator (cover) alone is then removed by limiting the depth of cut so that the shield is not touched but is clearly exposed. The cable end is then assembled to the connector.

Source: Robert S. Hughes and
Robert A. Tobias of
Caltech/JPL
under contract to
NASA Pasadena Office
(NPO-10315)

Circle 3 on Reader Service Card.

TOOL FOR CURING FILAMENT WINDINGS



Diametrical impregnated filament wound rings (sleeves) are used to strengthen cables and cable bundles at points where they experience flexure against a support or feedthrough. These sleeves must be cured in place after installation, and a hand tool has been devised that accomplishes the cure quickly and efficiently. The tool is a scissors type that can be used with various sized heating and compressing elements to accommodate a range of cable sizes. The two heating and compressing elements are placed around the sleeve, current to the elements is switched on, and the handles are pressed together for a specified time with a force sufficient to effect proper curing.

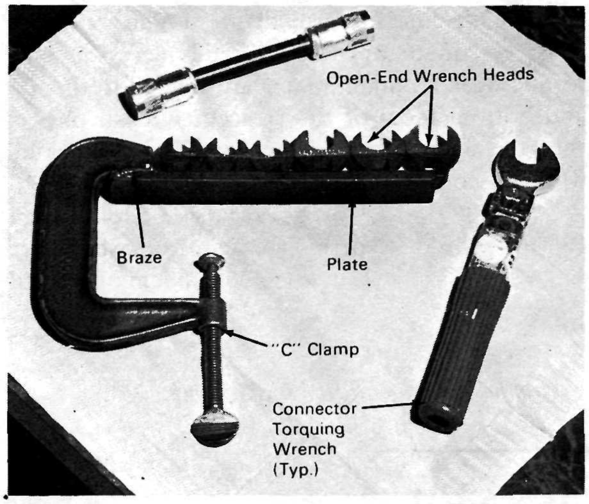
Source: Imrich Bobb of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-18885)

No further documentation is available.

HOLDER FOR TORQUING COAX CONNECTORS

The usual method of torquing coax cable connectors is to hold either the male or female connector flats in one wrench while applying the torquing wrench to the flats of the other.

A holding fixture, shown in the illustration, provides the means for faster, more accurate torquing of these connectors. A steel plate is brazed to the anvil of a standard "C" clamp, and a series of open end wrench heads are brazed to the plate. The "C" clamp can be secured to any flat member (bench surface, structural member, etc.).



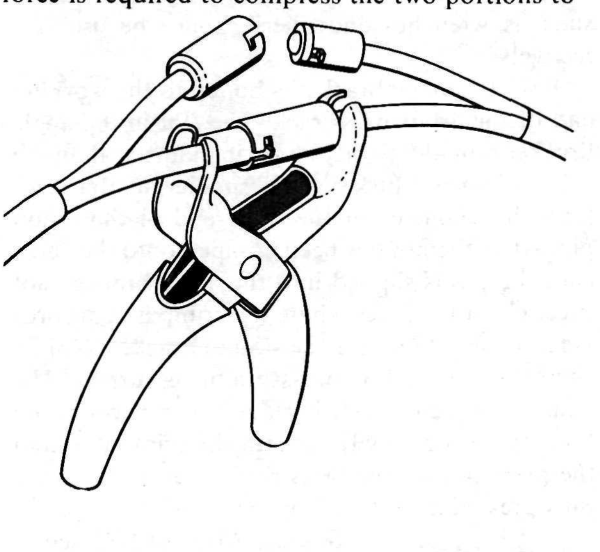
A variety of connectors can then be torqued rapidly and accurately by placing the flats of one half in one of the stationary open end wrench heads and torquing the flats of the other half. The tool should find use in shops performing production-type assembly and in the field where a variety of connector sizes may be encountered.

Source: Robert F. Anderson of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-16775)

No further documentation is available.

MODIFIED PLIERS ASSIST IN COUPLING BAYONET-TYPE CONNECTORS

Spring-loaded bayonet-type connectors are small and hard to grasp. In addition, considerable force is required to compress the two portions together and then twist-lock them while so compressed.



A modified single-tube hole punch or grommet-setting pliers simplifies and speeds up this operation. The pliers are modified by removing the anvil and the tube or punch and machining a slot in the tips of the jaws. The male and female connector members are brought into contact, placed between the jaws of the pliers and pressed together. While compressed, the members are easily twist-locked. Unlocking is equally quick and simple using this tool.

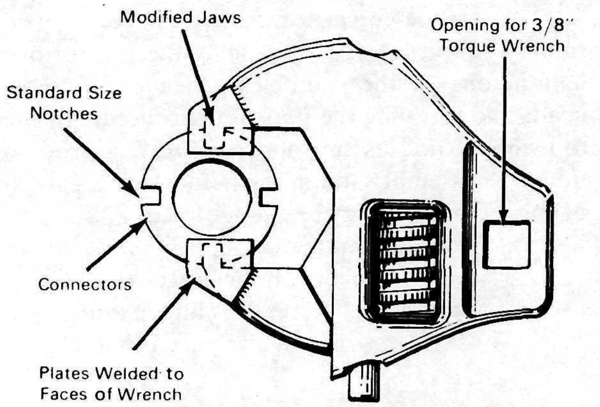
Source: F. Harris of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-01344)

No further documentation is available.

ADJUSTABLE WRENCH FOR ELECTRONIC CONNECTORS

A modified standard crescent wrench can be used with all sizes of electronic connectors. Previously, because several different connector sizes were available, and because each connector had to be torqued to a specific value, a considerable number of wrenches were needed. However, with the advent of uniformly slotted connectors and their increasing application, a single tool is more desirable.

The figure illustrates a standard crescent wrench reworked for use with any size electrical connector having uniformly slotted flanges. The wrench

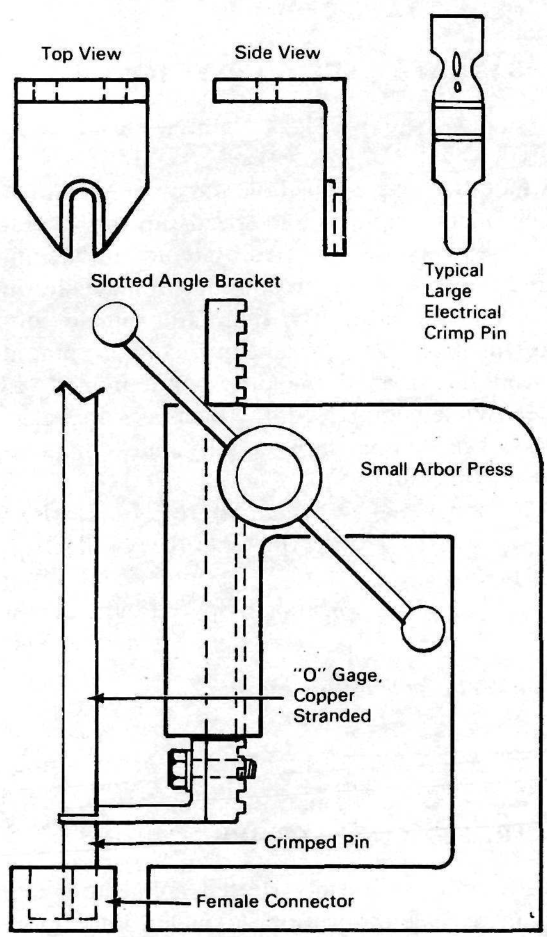


jaws are machined to provide lugs for engaging the slots. A square opening provides access by the torque wrench. Small plates are welded to the top and bottom faces of the crescent wrench to prevent the wrench head from dropping or rocking while the connector is being torqued.

Source: W. C. Johnson of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-18547)

No further documentation is available.

INSERTION TOOL FOR LARGE CRIMP PIN CONNECTORS



A conventional shop arbor press has been slightly modified to provide a means for rapid, straight insertion of large diameter electrical crimp pins into female connector bodies. Due to the weight and bulk of the connector members and the force required to achieve a tight press fit, tools such as wrenches and pliers cannot be used effectively.

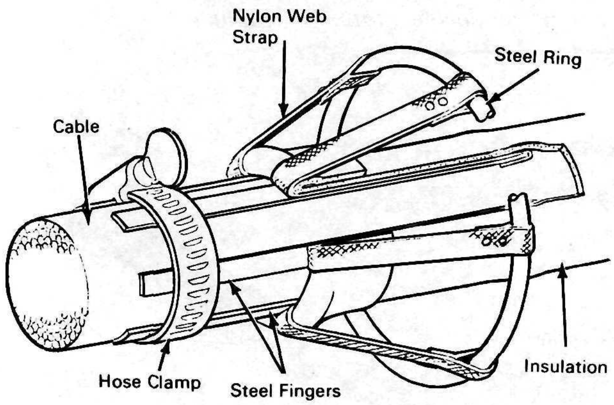
A slotted angle bracket is bolted to the working end of the arbor press rack. The slot in the angle bracket is made slightly larger in diameter than the cable diameter but slightly smaller in diameter than the diameter of the open end of the crimp pin. After the pin has been crimped onto the cable end, the pin is slipped into the angle bracket slot precisely at the place where the crimp is. This provides a "shoulder" for the slotted bracket to press against as the arbor press pinion is turned. The female connector body is placed in an appropriate holding device (anvil) beneath the crimp pin, and the press pinion handle is rotated until the pin is fully pressed into place.

Source: Michael J. Cuseo of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-90510)

No further documentation is available.

TOOL FOR TURNING CABLE INSULATION INSIDE OUT

To secure molded fittings on the ends of rubber-insulated cables, it is necessary to turn the rubber insulation inside out at the cable ends. After the molded fittings are installed, the rubber insulation is turned back again so that it overlaps the inboard ends of the fittings.

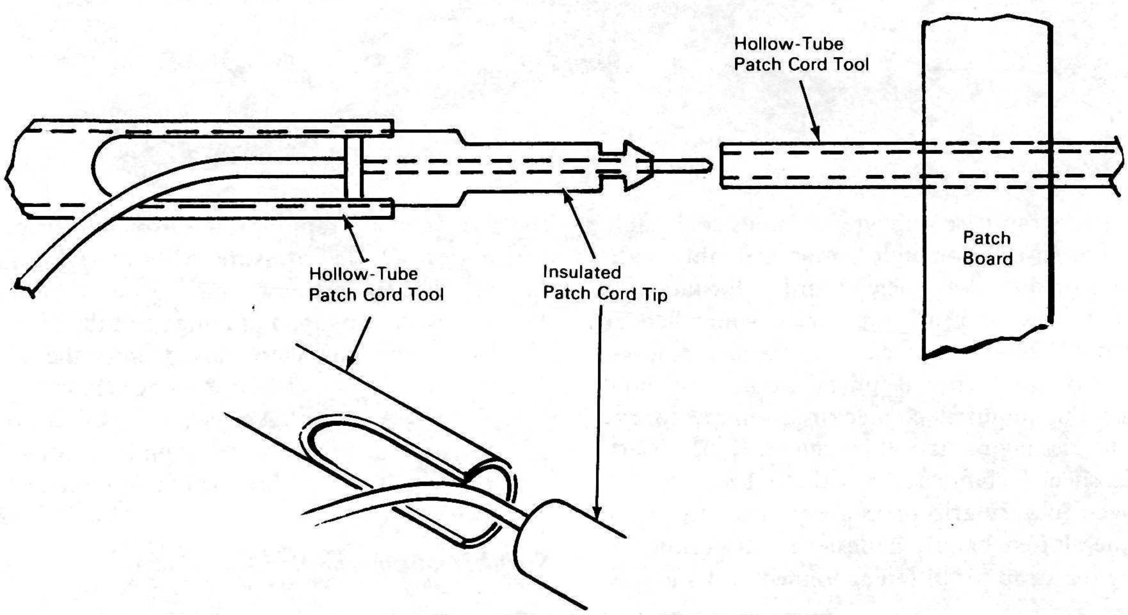


A tool developed for this operation uses spring-steel fingers with nylon web straps bonded around the ends. The fingers are inserted between the cable and insulation, and a hose clamp is placed over the outboard ends of the steel fingers to hold them in place. A steel ring passing through the outer end loops of the nylon web is pulled and the insulation is turned inside out. After attaching the fittings, the insulation is easily pulled back to its original position to cover the fitting end. Neither cables nor insulation are damaged using this tool.

Source: C. F. Kennedy of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-14049)

No further documentation is available.

PATCH CORD CHANGE TOOLS



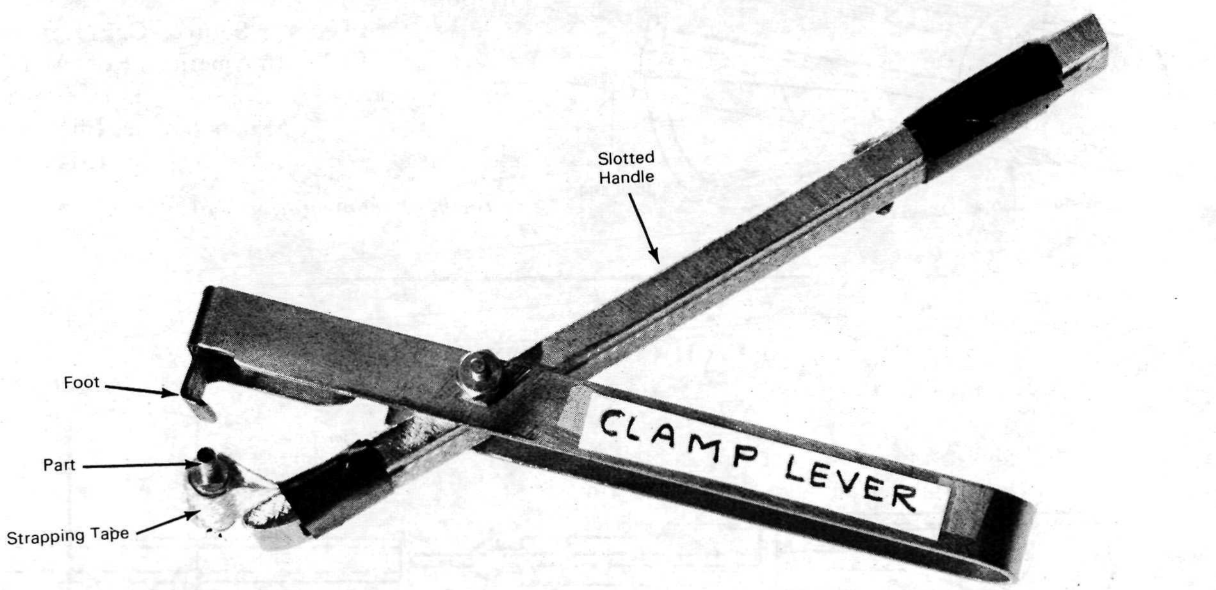
Operations boards (terminal boards) can become congested as patch cords are added. As a result, changes that require patch cord removal can result in loosening or disconnecting patch cords that should not be disturbed.

Two simple tools have been fabricated that permit the removal or installation of patch cords on congested terminal boards without disturbing adjacent members. In removal, a small hollow tube is used to push the patch out while a larger tube covers the plastic end of the patch, preventing other patch cords from catching on the plastic end and being pulled loose. During installation, the small hollow tube is inserted through the proper patch hole from the back of the board. The metal tip of the patch is inserted into the tube and the larger tube is slipped over the plastic end of the patch cord. The patch is then guided into place.

Source: F. Haines and R. Pyles of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-14258)

No further documentation is available.

SPECIAL WRENCH FOR COAX CONNECTOR ASSEMBLY



A small strap-type grip wrench holds coax cable connector inserts for high torque assembly without mar or distortion. The strap is adjustable for different sizes, and grip pressure is controlled by hand pressure on a special handle clamp lever. Previously used special pliers would not hold against the required connector assembly torque without damaging the thin shell of the insert.

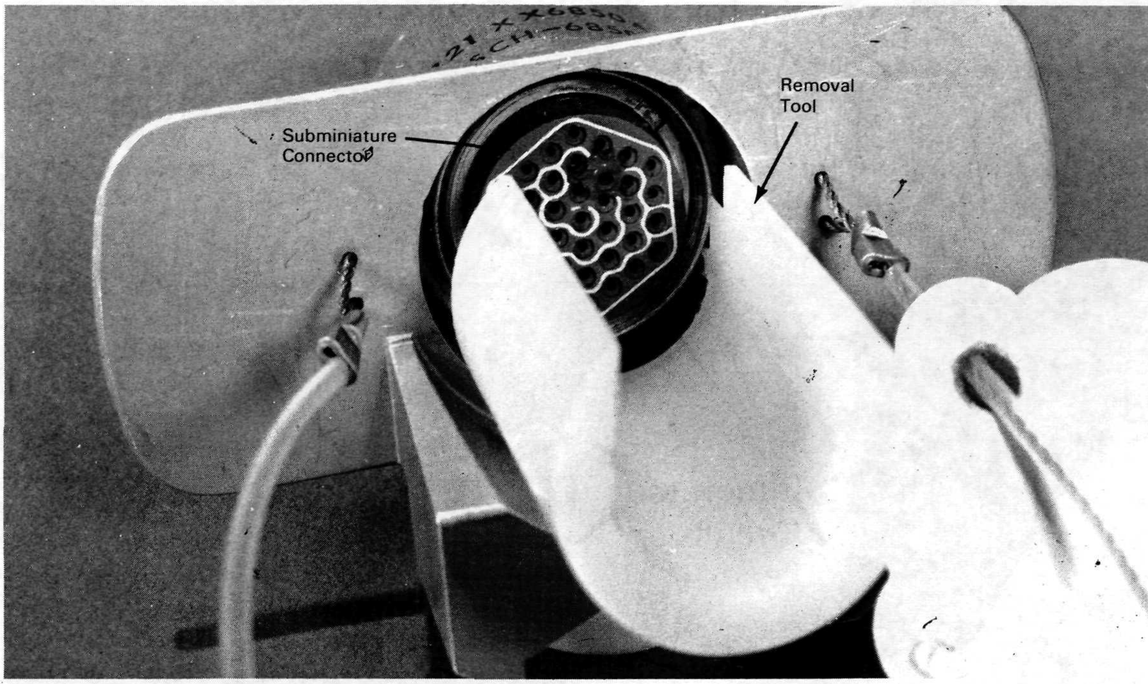
The special clamp lever with foot (see fig.) is arranged to vary grip pressure on a plastic strap, and the slotted handle is designed to permit adjusting the strap for different connector diameters. The use of box strapping tape provides an even distribution of the pressure without deforming the part. The figure shows the method of holding the strap with two taped bindings and the manner of placing the connector insert into the grip.

Lewis P. David of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-15824)

No further documentation is available.

LOCK RING REMOVAL TOOL FOR SUBMINIATURE CONNECTORS

Subminiature electrical connectors, like the one shown in the photograph, are normally replaced rather than repaired, with the replaced item being discarded. In some situations, however, due to



critical schedules and delivery delays, it has been necessary to disassemble and repair certain connectors by whatever means possible.

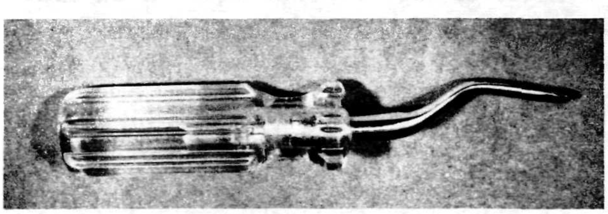
To accomplish this disassembly, a new U-shaped spanner wrench has been fabricated. The wrench has lugs to engage the lock ring slots and is made of nylon to avoid damage to the lock ring and adjacent wiring. The U-shape of the tool permits its use with the wiring bundles in place.

Source: Austreberto Z. Campoy of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-15599)

No further documentation is available.

CABLE BOOT REMOVAL TOOL

When rework is required on cable bundles, the shrink sleeves and boots that shield the terminals must be removed. In the past, heat was applied and a knife blade or blade-type screwdriver was



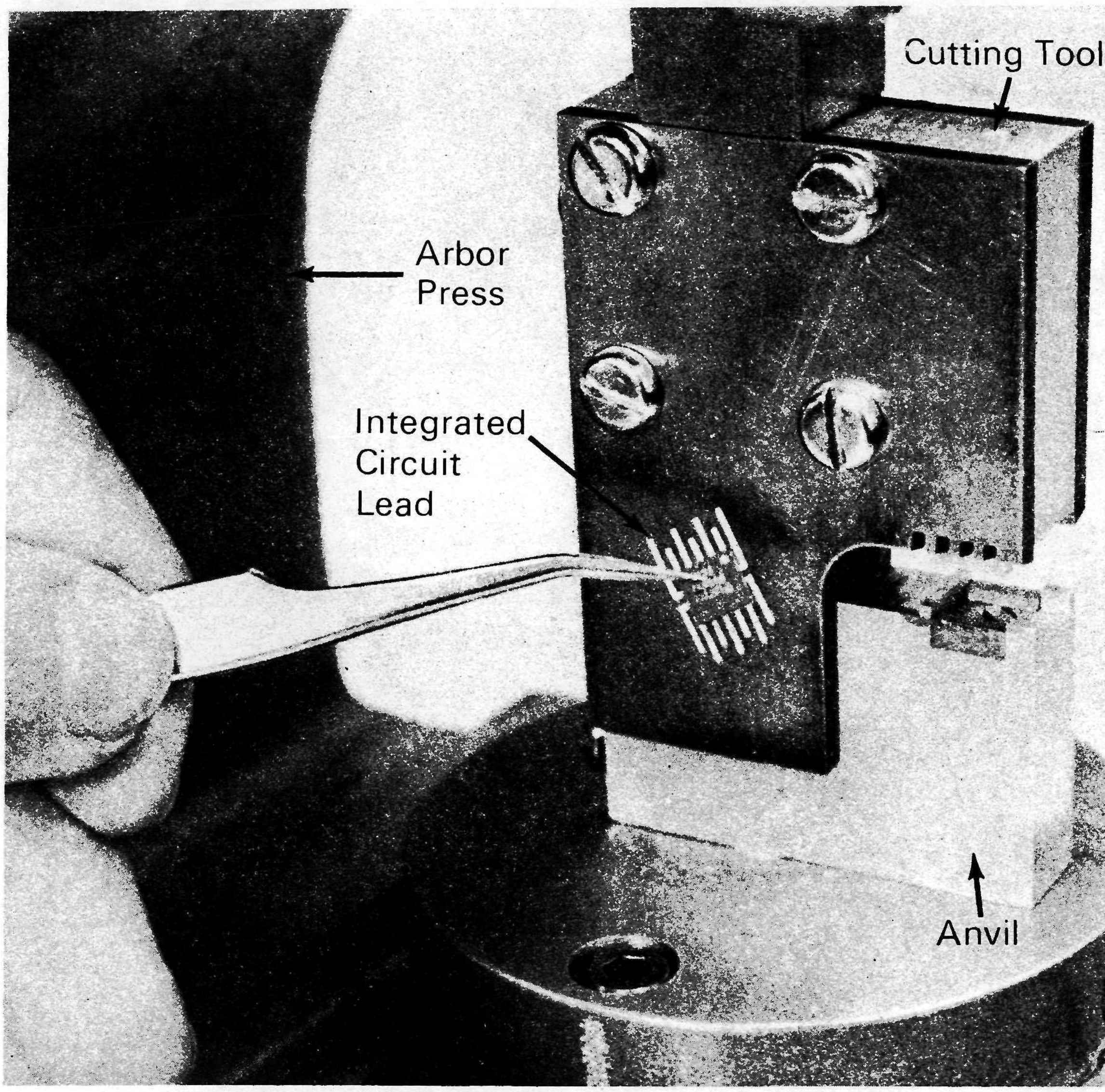
inserted between the boot and cable cover to pry the boot loose so it could be removed. This procedure tended to cut or tear the cable cover and caused damage to individual conductors because of the sharp edges of the tools and the angles at which they had to be employed.

An ordinary blade-type screwdriver was modified to do away with sharp edges and difficult working angles. The shaft of the screwdriver is heated and then bent to an offset configuration. The blade of the screwdriver is ground to a rounded contour and then deburred to present a smooth surface free of sharp edges.

Source: R. S. Owens of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-01324)

No further documentation is available.

TRIMMING TOOL FOR INTEGRATED CIRCUIT LEAD WIRES



A special tool uses a standard shop arbor press as an inexpensive cutting machine to trim integrated circuit (flat pack) lead wires to a specific pattern, permitting close tolerance spacing on high density (magnet wire) circuit boards. This approach avoids imposing cutting stresses on flat pack lead wires, and eliminates possible damage to the flat pack itself.

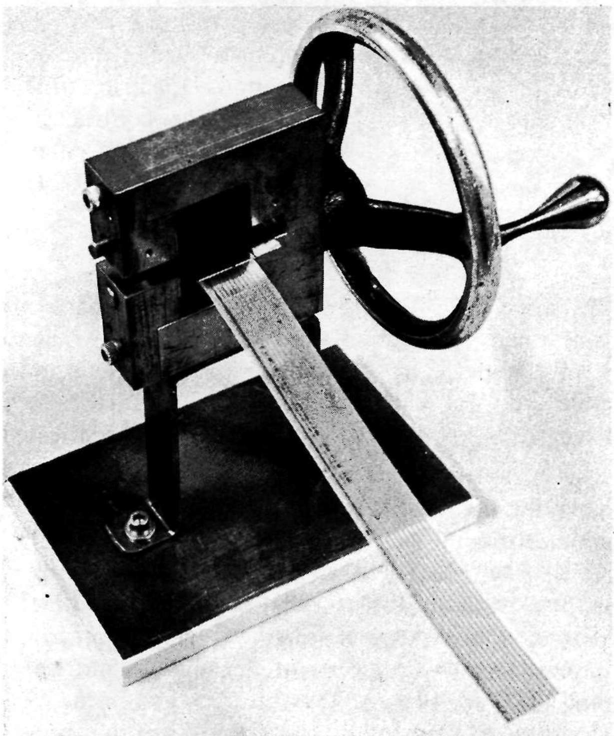
The illustration shows the tool in place in an arbor press. Cutting tools have been made in several configurations so that flat pack leads may be cut in a variety of standard patterns for close tolerance spacing. The flat pack leads are inserted into the openings in the lower portion of the cutting tool, and the arbor press arm is rotated to lower the cutting tool onto the anvil. In each assembly, mating faces of the cutting tool and anvil are designed to achieve the precise lead configuration required.

Source: Larry Edward Pack of
North American Rockwell Corp.
under contract to
Goddard Space Flight Center
(GSC-10869)

Circle 4 on Reader Service Card.

TOOL FOR APPLYING LEAD TAPE TO FLAT CONDUCTOR CABLES

Flat conductor cables (FCC) are gaining favor in circuit design applications where high packaging density (maximum number of conductors in minimum space), low cost, short supply lead time, high reliability, and uniform electrical characteristics are major considerations. One method of preparing FCC for use involves stripping the insulation from the cable ends with a chemical solution. Adhesive lead tape applied to the FCC adjacent to the ends to be stripped is an effective protection against chemical damage to the non-stripped insulation. However, the tape must be pressed into very tight, intimate contact with the insulation. Production volume requirements have resulted in the development of two tools for the tape application.



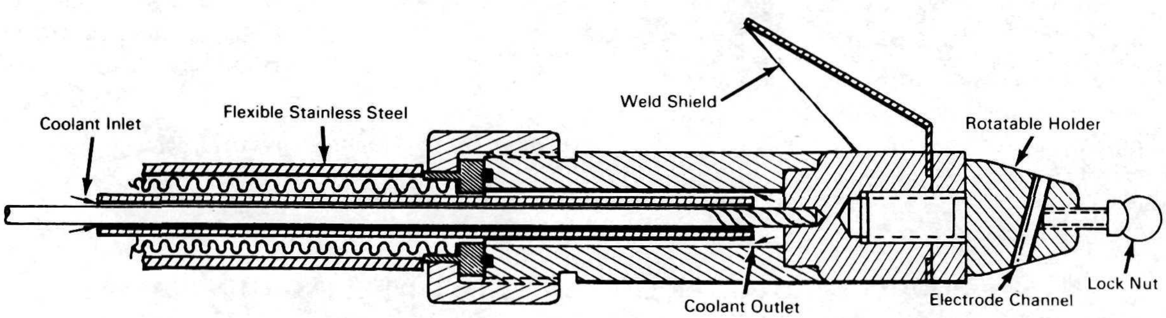
The tape is applied to the FCC by a taping fixture (not shown), which has an adjustable stop for exposing the desired length of FCC for stripping. The lead-taped cable is then rolled through a tape presser (see fig.), which is equipped with two rubber rollers for applying the required pressure. The lower roller is driven by a hand wheel and moves the lead-taped FCC through the tool. The upper roller is adjusted by means of a locking cam and sets the desired pressure to be applied.

Source: W. Angele
Marshall Space Flight Center
(MFS-20429)

No further documentation is available.

Section 2. Tools for Welding Applications

IMPROVED TORCH INCREASES WELD QUALITY IN REFRACTORY METALS



Alloys of metals such as zirconium, titanium, columbium, and tantalum are ideally welded in a vacuum purged, inert gas back-filled welding chamber (weld box). Tooling, or the coatings and finishes of items to be used in the weld box, must contribute only a minimum of contamination to the atmosphere, whether through outgassing or permeability. Commercially available manual welding torches have been found to contribute undesirable contamination to the weld atmosphere.

A specially designed welding torch is made of tooling that is essentially impermeable, so that practically zero contamination results from its use in the weld box.

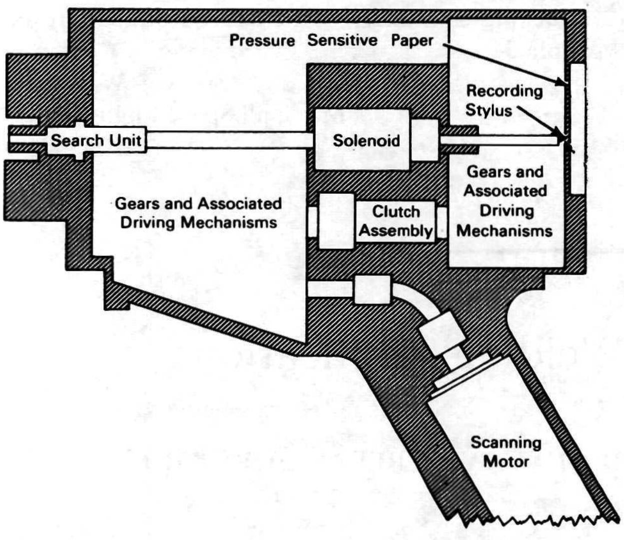
As shown in the figure, the torch consists of an electrode holder, lock nut, and torch body. The torch body includes a center-bored copper rod with the welding cable brazed into one end. A flexible, stainless steel hose surrounds the cable and carries cooling water to the electrode holder. The electrode holder and lock nut arrangement permits radial movement of the electrode without breaking the coolant connection or subjecting the cable to torsional strain. This feature reduces operator fatigue, and a radiation shield protects the operator's hands at high amperages.

Source: G. G. Lessman and R. Sprecace of
Westinghouse Electric Corp.
under contract to
Lewis Research Center
(LEW-00324)

Circle 5 on Reader Service Card.

ULTRASONIC TOOL FOR SCANNING SPOT WELDS

A small, portable, electrically powered hand tool, coupled with auxiliary ultrasonic equipment, can be used for conveniently scanning small spot



weld areas. Previous ultrasonic techniques could not be used in areas not readily accessible to bulky equipment.

The hand-held tool consists of an ultrasonic search unit with a solenoid inside a housing assembly. The solenoid plunger is fitted with an extension, and a recording stylus attached to the end of the extension contacts pressure sensitive paper located in the cavity at the rear of the unit. The scanning motor causes the mechanism to rotate about the centerline of the main cylindrical body. While rotating, the clutch assembly causes an outward translation in a radial direction, producing a spiral motion.

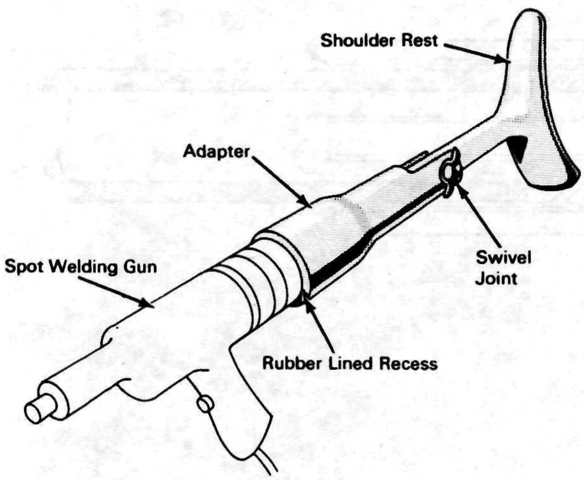
In operation, the front end of the scanner is placed on the area being examined. The spiral scanning motion of the ultrasonic search unit is recorded as a spiral pattern on the pressure sensitive paper. Discontinuities will appear as breaks in the spiral pattern.

Source: D. K. Mitchell of
The Boeing Company
under contract to
Marshall Space Flight Center
(MFS-00539)

No further documentation is available.

SHOULDER ADAPTER STEADIES SPOT WELDING GUN

A relatively new, compact, hand-held spot welding gun has proved difficult to hold in steady contact with the workpiece. Involuntary lateral movements and the unsteady pressure of the gun nozzle on the workpiece tend to produce cracks and deformities in the spot welds. A shoulder



adapter, made to fit on one end of the gun, affords greater control.

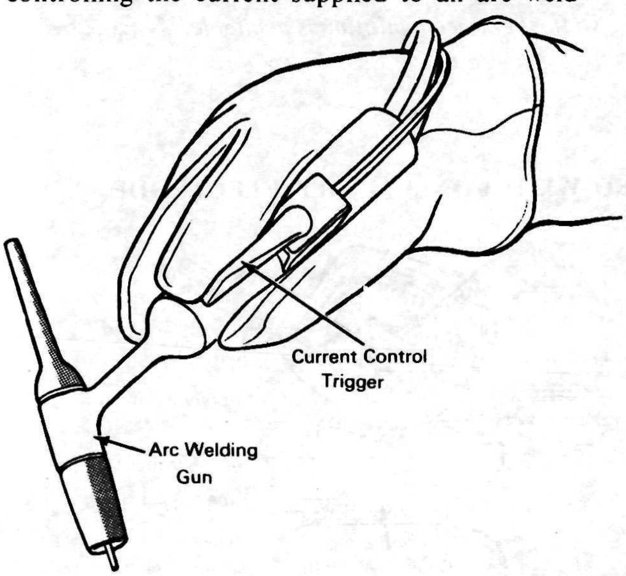
The adapter, about 15 to 20 inches long, is made of lightweight metal. One end is recessed to fit snugly over the gunstock and the other end is shaped to fit the shoulder. An adjustable swivel joint enables the adapter to be used at any convenient angle with respect to the operator's shoulder. With this adapter, the operator can hold the gun steadily at uniform pressure against the workpiece, expediting the welding process and ensuring defect-free welds.

Source: T. H. Love
Marshall Space Flight Center
(MFS-00321)

No further documentation is available.

FINGERTIP CURRENT CONTROL FOR ARC WELDING GUN

A sensitive trigger was needed for accurately controlling the current supplied to an arc welding gun. Pedal devices used for controlling arc current cannot be operated with sufficient precision by foot pressure. These devices are also inconvenient or impossible to use in confined areas. A fingertip-operated current control trigger mounted directly on the handle of the welding gun was therefore devised.



The spring-loaded trigger is connected to a rheostat and is mounted on the handle of the arc welding gun. Depressing the trigger with the index finger controls a remote, transistorized amplifier circuit that regulates the current supply to the welding electrode.

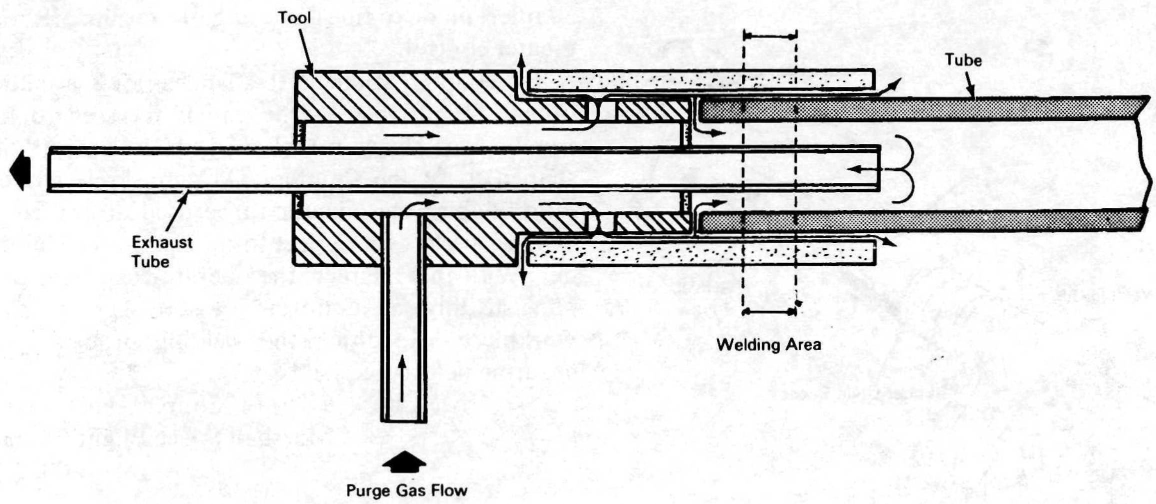
Source: Benjamin Roth of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-00289)

No further documentation is available.

TOOL PROVIDES CONSTANT PURGE DURING TUBE WELDING

During in-place welding of tubular components, contamination and oxidation control is normally dependent upon individual operator technique. A new tool provides a constant purge of inert gas in the weld area to prevent contamination and oxidation.

The tool is designed with an inlet for the purge gas and an exhaust tube to carry the gas. The tool

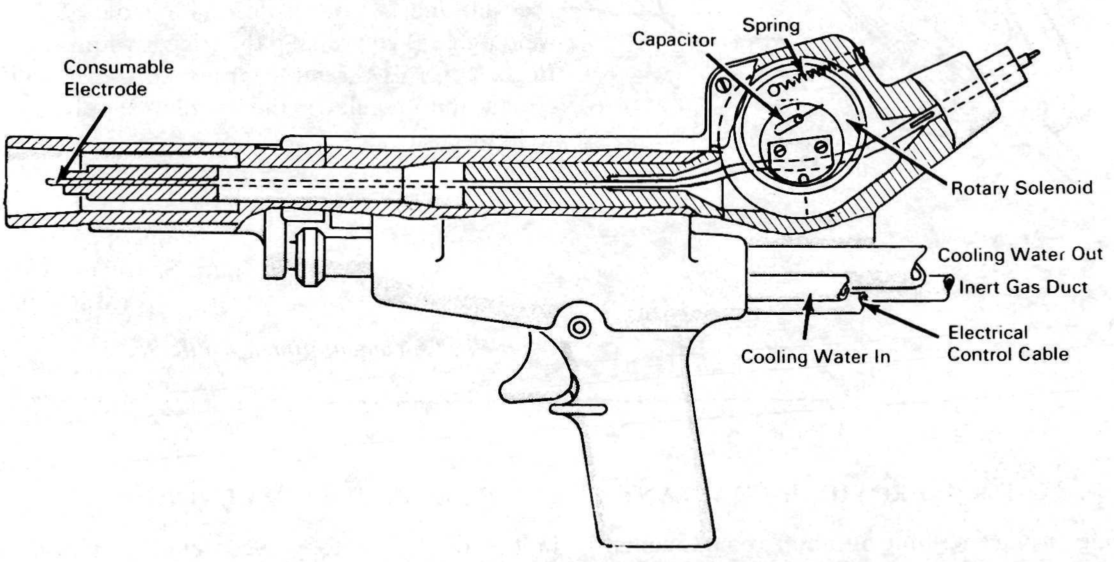


permits self-jigging of the tube and sleeve to be welded. Prior to welding, the parts are positioned by inserting the small exhaust tube of the tool into the tube to be welded. The larger diameter section of the tool then engages the sleeve to orient the tool, sleeve, and tube for the welding operation. The purge gas enters the weld area between sleeve and tube by way of ports in the tool. The ports are near the sealed end of the tube, within the sleeve. These ports keep the adjacent area of the sleeve free from contamination and oxidation.

Source: E. R. Lang of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-00547)

No further documentation is available.

POWER ARC WELDER TOUCH-STARTED WITH CONSUMABLE ELECTRODE



A power arc welder, fabricated in the form of a hand-held welding gun, touch-starts, retracts a consumable electrode a distance sufficient to create the desired arc, and feeds the consumable electrode at the rate required to form the intended bead or spot. The unit satisfies the requirements for a simple, inexpensive apparatus for touch-starting a power arc using a consumable electrode. In addition, it is small and light enough to be hand-held for spot welding in confined areas.

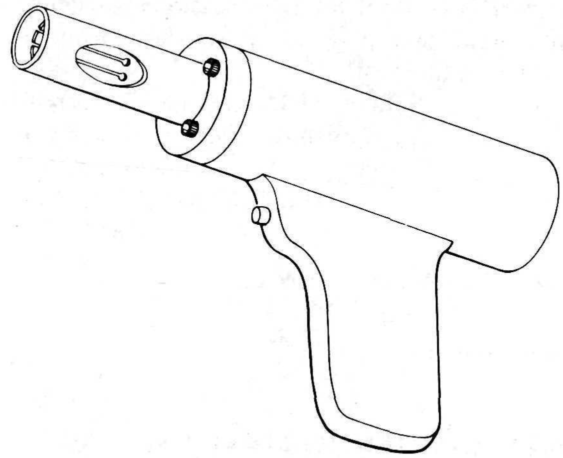
Initially, basic techniques are adhered to in that the workpiece and consumable electrode are connected to the terminals of a welding power source. As the welding gun with protruding consumable electrode is moved toward the workpiece, the electrode contacts the workpiece and strikes an arc. Simultaneously, a capacitor in the gun is charged and discharged, driving a rotary solenoid in the gun housing in a counterclockwise direction. A retracting plate on the solenoid withdraws the consumable electrode a sufficient distance to establish the desired arc. Upon completion of capacitor discharge, counter polarity current is applied to the rotary solenoid, causing it to rotate clockwise and drive the consumable electrode towards the workpiece at a rate that maintains the arc and achieves the desired weld penetration depth. This device has proven an excellent tool for repeatedly achieving spot weld uniformity in weld deposit and penetration depth.

Source: Joseph C. Jeannette of
Air Reduction Company,
subcontractor to
The Boeing Company
under contract to
Marshall Space Flight Center
(MFS-01485)

Circle 6 on Reader Service Card.

MODIFIED FACEPLATE ASSEMBLY FOR STUD-WELDING GUN

A ventilated barrel assembly, 2.54 cm (1 in.) in diameter, replaces the present faceplate on percussion stud-welding guns. The innovation enables studs to be installed on areas that have either short-edge distances or distorted surfaces, without additional tooling.



Standard faceplate assemblies did not provide a means for making acceptable stud welds on the weld land of a specific bulkhead meridian weld. The weld land was too narrow—2.54 cm (1 in.)—and had an uneven surface due to weld peaking. The modified faceplate assembly (see fig.) is smaller and makes possible completely satisfactory stud welding to the narrow, uneven weld land. The principal difference between the two faceplates is that the modified one permits proper aligning and positioning of the percussion stud-welding gun on a much smaller surface area than does the standard one.

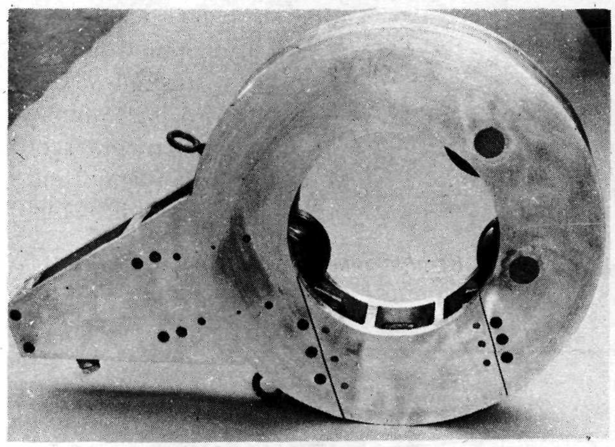
Other features that make the assembly superior to available standard assemblies include: (1) the gap setting may be set and maintained without any other adjustment; (2) the stud-welding gun can be used in any position; and (3) verification samples can be made on a 2.54 cm (1 in.) square instead of a 7.62 cm (3 in.) square.

Source: Robert E. Johnson of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-16725)

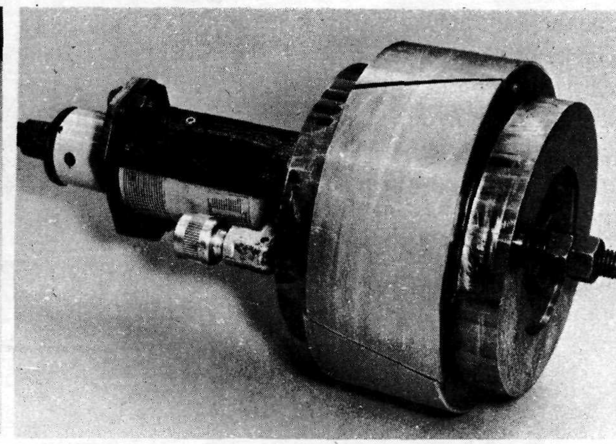
No further documentation is available.

TOOL REPAIRS WELD DEFECTS IN THIN-WALL STAINLESS STEEL TUBES

A hand-operated tool repairs weld defects, such as weld peaking and offset, in 20.32 cm (8 in.) thin-walled stainless steel tubes. The tool consists of a three-roll external planisher and an internal backup mandrel, both hydraulically pressurized by hand pumps, and an external air-pressurized restraining mandrel, which keeps the tube from turning during the planishing operations.



External Planisher



Internal Backup Mandrel

First, the three-roll planisher is installed on the tube to be repaired, and the backup mandrel is located at the weld seam in the defective area. The restraining mandrel is then inserted over the tube and air-actuated to keep the tube from turning. Sufficient hydraulic pressure is applied to both the backup mandrel and the planisher (before spike bars are inserted in the latter) to enable the planishing operation.

Tube specimens were intentionally welded so as to contain weld offset and peaking, simulating production parts with such defects. In every instance, use of the planishing tool on these specimens brought the weld joints within the specified tolerance. Subsequent X-ray examination of the repaired tubes showed no cracking or malformation of the metal.

The tool not only provides a new, inexpensive method for correcting the weld defects in thin-walled tubing, but also reduces the sophistication required in aligning tube ends and controlling weld distortion. It should be a useful, as well as corrective, tool for the occasional inadequate tube weld that may occur even with precision welding equipment.

Source: D. D. Kern and F. Fiorelli of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-16293)

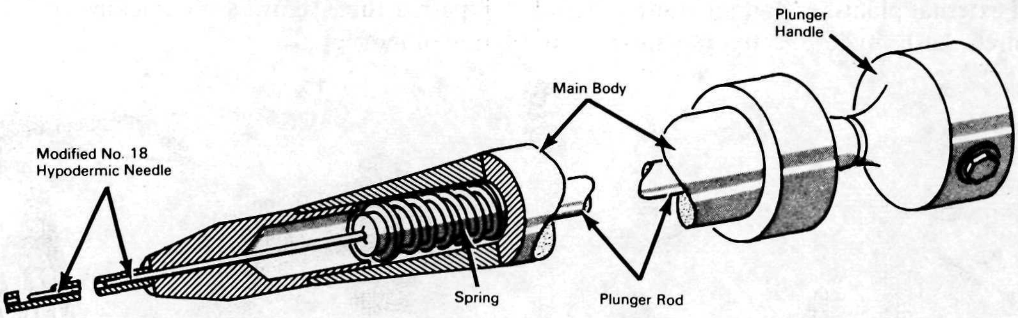
Circle 7 on Reader Service Card.

MICROMANIPULATION TOOL IS EASILY ADAPTED TO MANY USES

A special micromanipulation tool equipped with a plunger mounted in a small tube was designed so that the tip of the tube could be varied to accommodate a variety of work operations, such as cutting, precision clamping, and spot welding microscopic filaments or other parts.

The main body of the tool is made so that a plunger handle can be inserted at one end and a modified No. 18 hypodermic needle can be mounted at the other end. A cylindrical hollow inside the main body permits a spring to be placed around the plunger. By moving the spring from one side of a stop (a washer soldered into place) to the other, the plunger rod can be moved down the tube to act as a clamp, or held in an open position. For greater ease of handling, a flexible cable release may be used instead of a plunger.

This tool is particularly useful where extreme steadiness at high magnification is required, where the work area is inaccessible to bulkier tools such as jewelers forceps, and in the repair and assembly of instruments which have fine watchlike parts.



Several tips may be made using a thin tube or a modified hypodermic needle. For cutting actions, a slot is cut at the tip of the tube and the end of the plunger rod is ground to a diagonal cutting edge. For use as a clamp, the end of the tube is plugged with a soft metal and the end of the plunger rod is ground flat. Small jaws can also be fixed to the tube and the plunger rod.

Specific tips and plunger rods could be designed for particular operations.

Source: Paul J. Schlichta of Caltech/JPL under contract to NASA Pasadena Office (NPO-00129)

Circle 8 on Reader Service Card.

NASA-Langley, 1972

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