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TECHNOLOGY UTILIZATION

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MACHINE TOOLS AND FIXTURES

A COMPILATION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Foreword

The National Aeronautics and Space Administration and Atomic Energy Commission have established a Technology Utilization Program for the dissemination of information on technological developments which have potential utility outside the aerospace and nuclear communities. By encouraging multiple application of the results of their research and development, NASA and AEC earn for the public an increased return on the investment in aerospace research and development programs.

This publication is one of a series intended to provide such technical information. A selection has been made of machine tools, jigs, and fixtures that have been produced, modified, or adapted to meet requirements of the aerospace and nuclear research and development programs.

The compilation is divided into three sections. The first section presents a variety of machine tool applications that offer easier and more efficient production techniques. Section two deals with methods, techniques, and hardware that aid in the setup, alignment, and control of machines and machine tools to further quality assurance in finished products. The third section has to do with jigs, fixtures, and adapters that are ancillary to basic machine tools and aid in realizing their greatest potential.

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

Unless otherwise stated, NASA and AEC contemplate 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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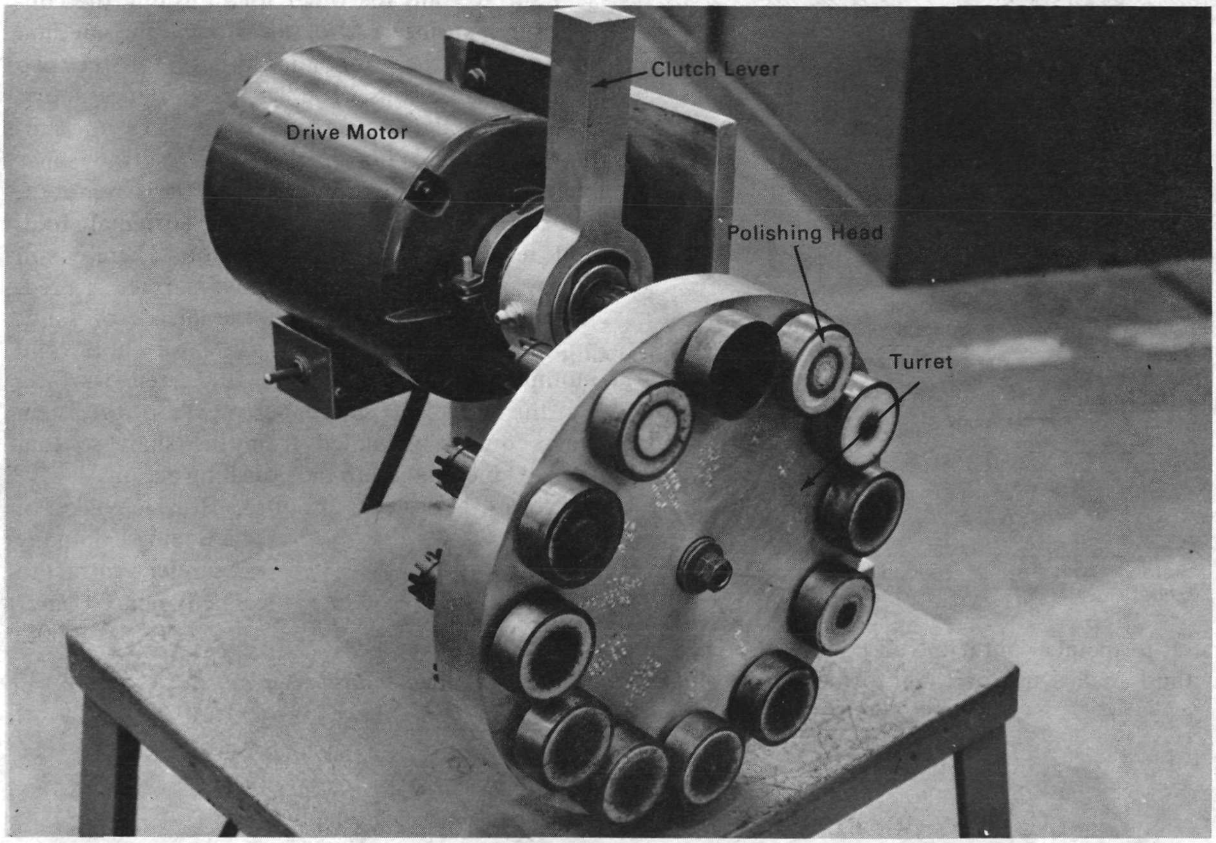
Contents

Section 1. Machine Tool Applications

MULTIPLE TURRET POLISHING HEAD



In preparing aluminum or corrosion-resistant steel (CRES) tubing for flaring that must meet rigid quality control standards, all traces of oxides must be removed from the tubing surfaces prior to the flaring operation. Previous methods involved using strong chemical reagents, rinsing and then applying protective coatings.

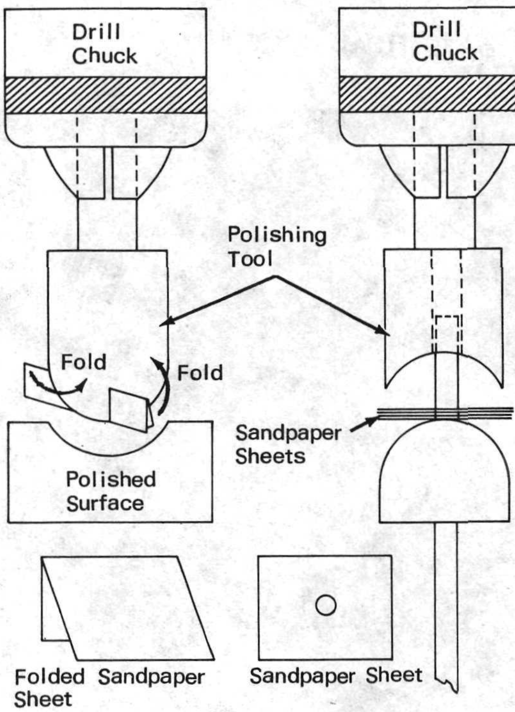
A new device accomplishes this preparatory cleaning quickly and efficiently without the chemical reagents, rinsing and attendant handling. The device is a turret that mounts twelve (12) polishing heads, each containing a grooved felt pad coated with aluminum oxide. The heads, which can handle most standard tube sizes, are selectively driven by an electric motor through an overrunning clutch mechanism. In use, the tube end is pressed into the appropriate polishing head, which was previously indexed with the motor driven clutch.

Source: William A. Pesch of
Hayes International Corp.
under contract to
Marshall Space Flight Center
(MFS-12187)

No further documentation is available.

POLYMER FACING MAKES SAFE POLISHING TOOL

In polishing relief valve stems and seats, brass tools faced with sandpaper or an abrasive paste have caused scoring of the critical surfaces when metal-to-metal contact took place. A better method makes use of tools formed from blocks of polytetrafluoroethylene (PTFE), a polymer that is strong enough for the job but soft enough to eliminate any possibility of scoring the critical valve surfaces.



The figure illustrates the two polishing tool configurations, one for polishing the concave seat surface and the other for polishing the convex stem surface. Also, as shown, the method of applying the sandpaper differs for the two tool configurations. The left-hand figure shows a tool slotted to receive a folded piece of sandpaper, used to polish the seat. As the sandpaper reaches a worn condition, it is removed, folded at an angle opposite the original fold, and reinserted into the tool slot. Thereby, all the available sandpaper abrasive surface is used. In the stem-polishing tool, the pieces of sandpaper are pierced with a center hole and mounted between the tool and stem surface. As the piece of sandpaper next to the stem wears out, it is pulled from the shaft so that the next piece takes up the polishing action.

Source: Joe D. Walker of
The Boeing Company
under contract to
Kennedy Space Center
(KSC-10008)

No further documentation is available.

VARIABLE-SPEED, PORTABLE ROUTING SKATE

A lightweight, portable router with a variable-speed driving mechanism can be used on large, heavy, metal subassemblies, such as cylindrical tank sections, which are often impractical to move to a stationary machine. The portable machine tool, called a variable-speed, portable routing skate, has been successfully used in the construction of an aluminum alloy multicell fluid storage tank. The entire skate assembly, consisting of the housing with rollers, router, and driving mechanism with transmission, weighs approximately only 40 pounds.

Designed to follow a desired cutting path, the routing skate housing is supported on an aluminum alloy track set alongside the path. Four sets of rollers are attached to the skate housing. Two of these sets are positioned on each double-beveled edge of the track. All four sets of rollers are adjustable to allow for track width variations, to permit leveling of the skate, and to facilitate skate mounting and removal. Skate travel along the track is powered by an electric motor. When the track is on or near the horizontal, the motor drives a simple sprocket whose teeth engage a roller chain fastened to the track. When the track is vertical, the motor drives a "caterpillar belt." The male cogs of the belt engage the roller chain, providing more points of contact between the belt and the chain and making skate travel smoother. The roller chain is located in a groove of the track to keep the chain aligned and prevent it from sagging. The track is supported by a number of special adjustable brackets. One end of each bracket is bolted to the back face of the track and the other to a vacuum pad or chuck, which is held to the workpiece by a vacuum.

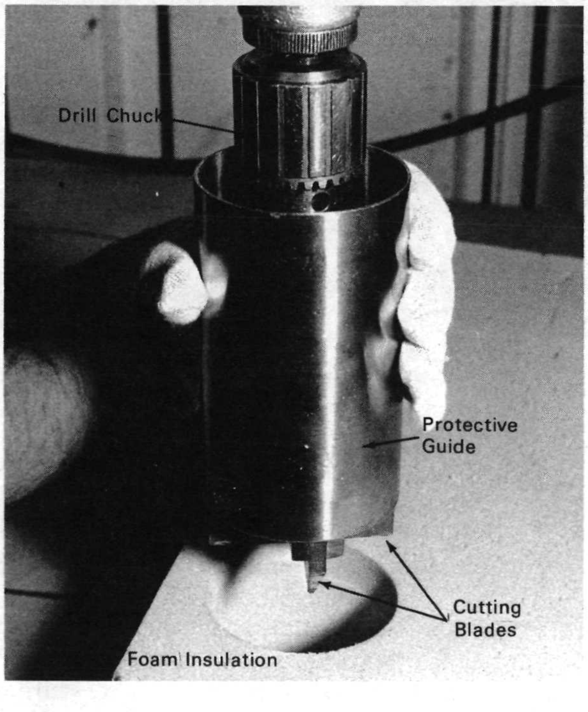
When a cut is to be made on a piece of aluminum alloy sheet or plate, or on a subassembly, the vacuum chucks with the brackets and track are set on the workpiece first and the vacuum is drawn. The brackets are adjusted and tightened to align and maintain the track at a proper distance, vertically and horizontally, from the path of the cut. Next, the skate is mounted on the track, with the caterpillar belt engaging the chain, and the rollers are adjusted to grip the track. With the tungsten carbide-tipped cutter of the router set at the desired depth of cut, the air motor which drives the cutter is turned on. The skate, driven by the electric motor, travels along the track at a desired speed while the router makes the cut. The skate speed and depth of cut are both adjustable while the skate is in motion.

Source: W. A. Pesch of
Hayes International Corp.
under contract to
Marshall Space Flight Center
(MFS-13772)

Circle 1 on Reader Service Card.

FOAM PROFILE EXTRACTOR

Core foam monitors (temperature, strain, vibration sensors) must sometimes be installed in the foam insulation of tanks used to store fluids at cryogenic temperatures. In order to obtain the best results, the sensor must fit snugly in an opening made through the foam insulation, and the tank wall must present a smooth, unscored surface. Prior methods used conventional metal hole saws to make the opening, and a hand-held knife for the cleanup. This resulted in scoring of the tank surface plus an imprecise opening in the insulation.



Use of a phenolic-faced rotary cutter in conjunction with a metal tubular guide has been successfully used to produce precise and concentric openings in the foam insulation without damaging the tank wall surface. The illustration shows the protective guide, phenolic-faced cutter, and drill above an opening partially made through a slab of foam insulation. The blade diameter is the same as that of the protective guide, thus assuring a smooth, even cut.

Source: August N. Anderson of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-16040)

Circle 2 on Reader Service Card.

POWER-OPERATED, HEAVY DUTY TORQUE WRENCH

A special, power-operated, heavy duty wrench can quickly and accurately torque a large number of bolts in an end cap assembly of large diameter. Standard impact wrenches have objectionable noise and vibration characteristics, and conventional torque wrenches are cumbersome and difficult to use where bolts are located high above a shop floor.

The wrench shown in the figure is mounted on a balanced universal arm assembly suspended from a mobile overhead hoist. This eliminates weight and handling problems, permitting the wrench to be moved easily on three axes.

The prime mover in the wrench is a heavy duty electric drill with integral gear reduction. The drill shaft is extended to drive a 3:1 roller chain torque multiplier through a dual clutch unit. In the bolt tightening direction, an electrospring clutch permits declutching and motor turnoff when the preselected torque value is reached. The remainder of the power train includes two 4:1 socket-wrench type geared torque multipliers, a universal joint, and a conventional drive. A restraining socket for the bolt head is also provided, along with a torque reaction bar.

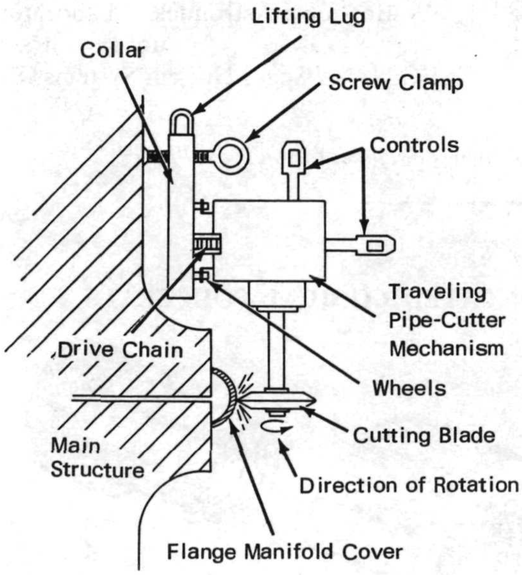
Within the main frame of the wrench, the geared torque multipliers are mounted so that the multiplier housing can be moved through only a fraction of a degree. A calibrated spring holds the housing to one side of its travel. When the reaction torque transmitted through the torque reaction bar exceeds the preset spring force, the housing rotates slightly and switches off the motor and clutch. Torque release of the wrench is therefore set by the preload setting on the calibrated spring.

Source: Charles Richardson of
Sperry Rand Corp.
under contract to
Goddard Space Flight Center
(GSC-11189)

No further documentation is available.

REMOTELY-OPERATED, LARGE-DIAMETER PIPE CUTTER

A commercially available, air-operated cutter "walks around" the structure to be cut, following a drive chain attached to the structure along the path of the cut to be made. In certain situations, it is unsafe for personnel to get sufficiently close to a structure to mount or operate the cutter. Such situations require a remote manipulation technique that is as positive and uncomplicated as possible.



The cutter has now been modified by mounting the chain and travelling cutter to a ring that can be positioned over the structure by remote manipulators, and by modifying the cutter controls for remote manipulation. The diagram shows the modified drive chain and travelling cutter preattached to a collar. In this case, the assembly is fitted into position to cut a flange manifold cover and the collar is fastened to the main structure by screw clamps. The cutter controls have been modified by adding heavy duty extension rods with eyelets that permit movement by remote manipulators.

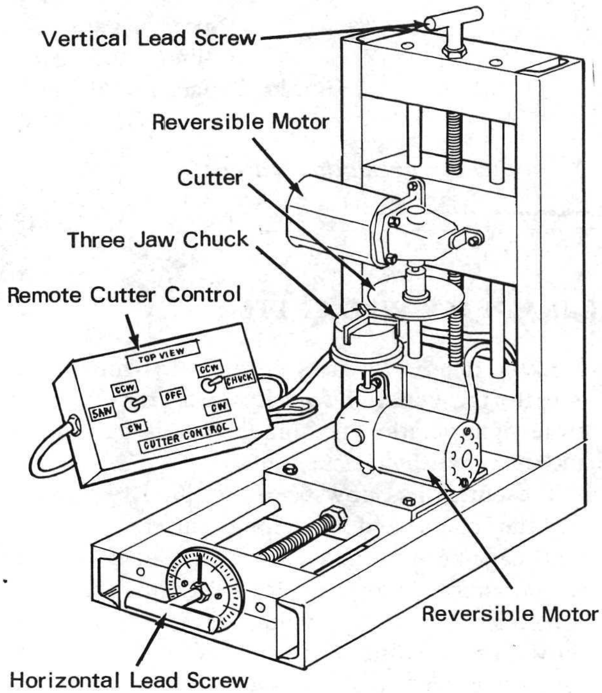
Source: F. R. Pecoraro of
Aerojet-General Corp.
under contract to
AEC-NASA Space Nuclear Systems Office
(NU-0058)

Circle 3 on Reader Service Card.

MACHINE OPENS CANS IN HAZARDOUS ENVIRONMENT BY REMOTE CONTROL

An accurate, less expensive, remotely controllable "can opener," constructed from readily available parts, opens small containers in hazardous environments without damage to the contents. Tube cutters cause internal flaring of the container wall, thus interfering with content removal, while hack saws may cause content damage. Both techniques are excessively time consuming and are very difficult to control from remote locations.

In the new device, two carriages, one vertical and one horizontal are mounted on a frame of welded angle-iron. Each carriage is movable by a lead screw that can be operated either by hand,



using a rigid or flexible extension shaft, or by a servo-controlled drive. The horizontal carriage supports a three-jaw chuck which holds the container to be opened and is rotated by a drive motor. The vertical carriage supports an arbor, to which a variety of cutting devices may be attached, and a drive motor similar to that for the three-jaw chuck.

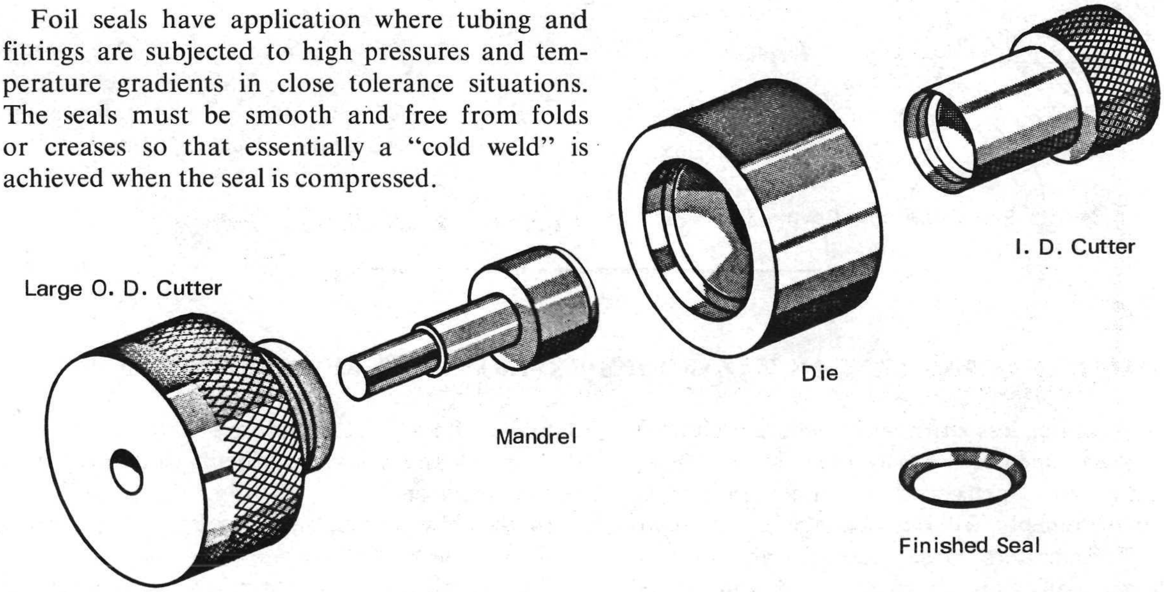
In operation, the vertical carriage lead screw is rotated to position the cutter, and the horizontal carriage lead screw is rotated to advance the three-jaw chuck until the container and cutter are engaged. At this point, both drive motors are started and the container is quickly opened with a neat incision so that its contents can be readily removed intact.

Source: R. C. Ackerman and L. D. Palmer of Westinghouse Astronuclear Laboratories under contract to AEC-NASA Space Nuclear Systems Office (NU-0050)

No further documentation is available.

SIMPLE TOOL SHAPES AND CUTS TRUNCATED CONICAL FOIL SEALS

Foil seals have application where tubing and fittings are subjected to high pressures and temperature gradients in close tolerance situations. The seals must be smooth and free from folds or creases so that essentially a "cold weld" is achieved when the seal is compressed.

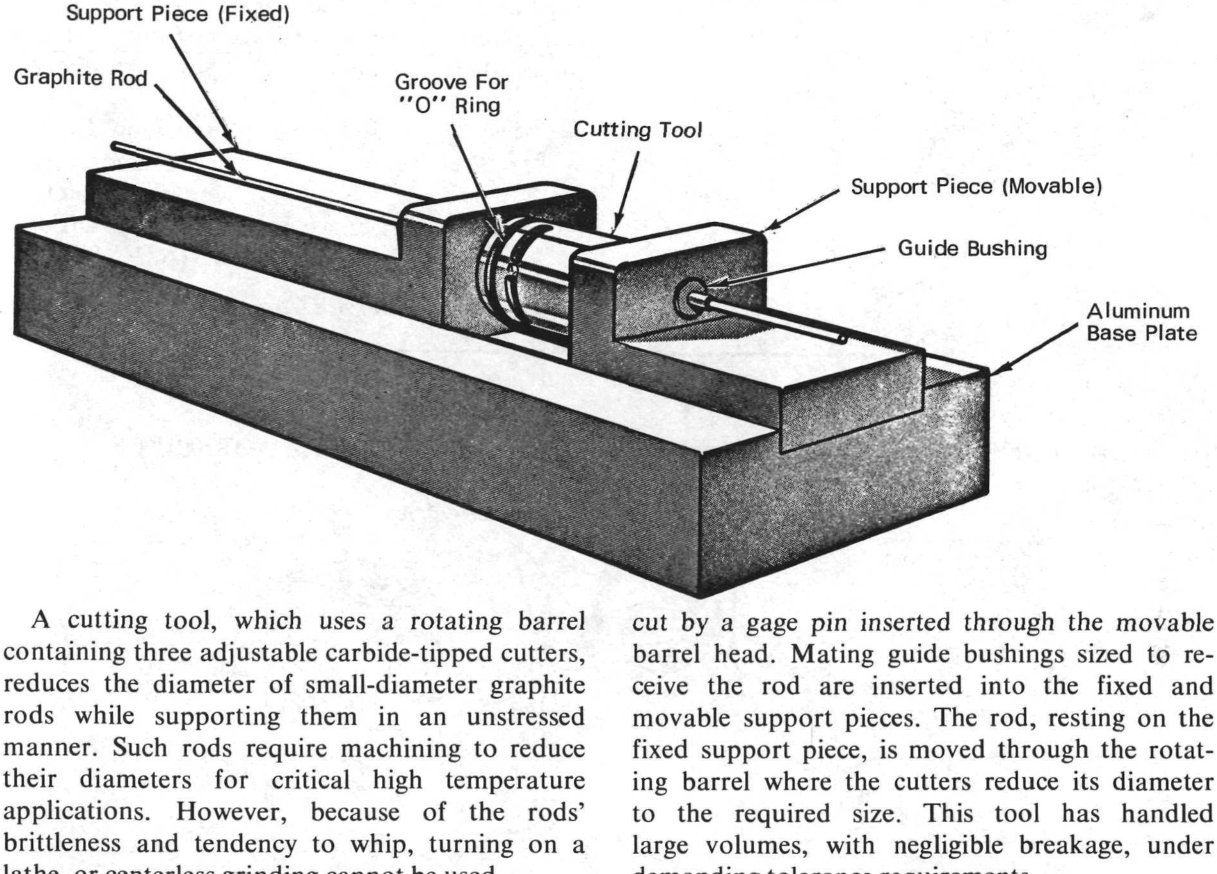


Such seals are quickly and inexpensively formed with the illustrated tooling. A conical die is mated to a truncated conical mandrel. A solid foil blank is extruded into the die by the mandrel. Progressive pressure and slow rotation are applied to finish the surfaces and form the seal free of any folds or creases. Excess material is removed by mechanical cutters, first from the outside diameter and then from the inside diameter, to produce a seal as illustrated. Original thickness of the foil blank is reduced in the operation but may be compensated for, if necessary, by stacking a number of seals.

Source: W. L. Jacob, R. J. Steffen, and N. J. Wilds of Westinghouse Astronuclear Laboratory under contract to AEC-NASA Space Nuclear Systems Office (NUC-10167)

Circle 4 on Reader Service Card.

TOOL MACHINES THIN, BRITTLE RODS WITHOUT BREAKAGE



A cutting tool, which uses a rotating barrel containing three adjustable carbide-tipped cutters, reduces the diameter of small-diameter graphite rods while supporting them in an unstressed manner. Such rods require machining to reduce their diameters for critical high temperature applications. However, because of the rods' brittleness and tendency to whip, turning on a lathe, or centerless grinding cannot be used.

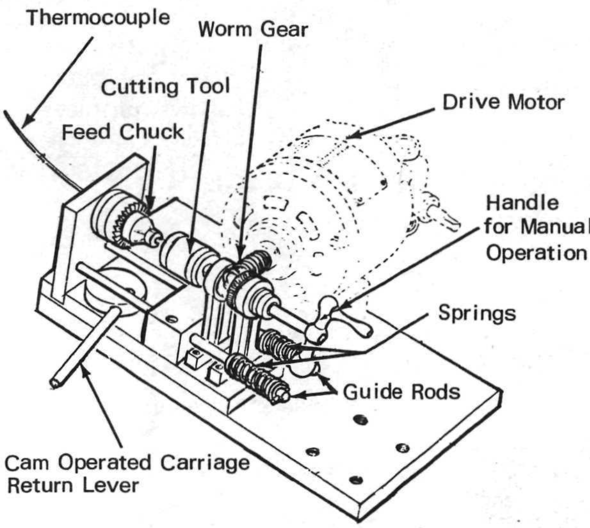
The new tool consists of an aluminum base plate grooved to receive two support pieces, one fixed and one movable. The supports are separated by the rotating barrel containing the cutters for the rod diameter reduction. The cutters are carbide-tipped blades adjusted to the depth of cut by setscrews and set to the desired cut by a gage pin inserted through the movable barrel head. Mating guide bushings sized to receive the rod are inserted into the fixed and movable support pieces. The rod, resting on the fixed support piece, is moved through the rotating barrel where the cutters reduce its diameter to the required size. This tool has handled large volumes, with negligible breakage, under demanding tolerance requirements.

Source: W. W. Fahrion and G. H. Jucha of Westinghouse Astronuclear Laboratory under contract to AEC-NASA Space Nuclear Systems Office (NUC-10140)

Circle 5 on Reader Service Card.

MACHINE AUTOMATICALLY STRIPS METALLIC SHEATHS FROM THERMOCOUPLES

A sheath stripping tool and fixture accurately strips the metal sheath from thermocouples without damaging the delicate wires or reducing the insulation efficiency. The sheath is stripped away in linear increments, and close tolerances in millimeter length can be accommodated.

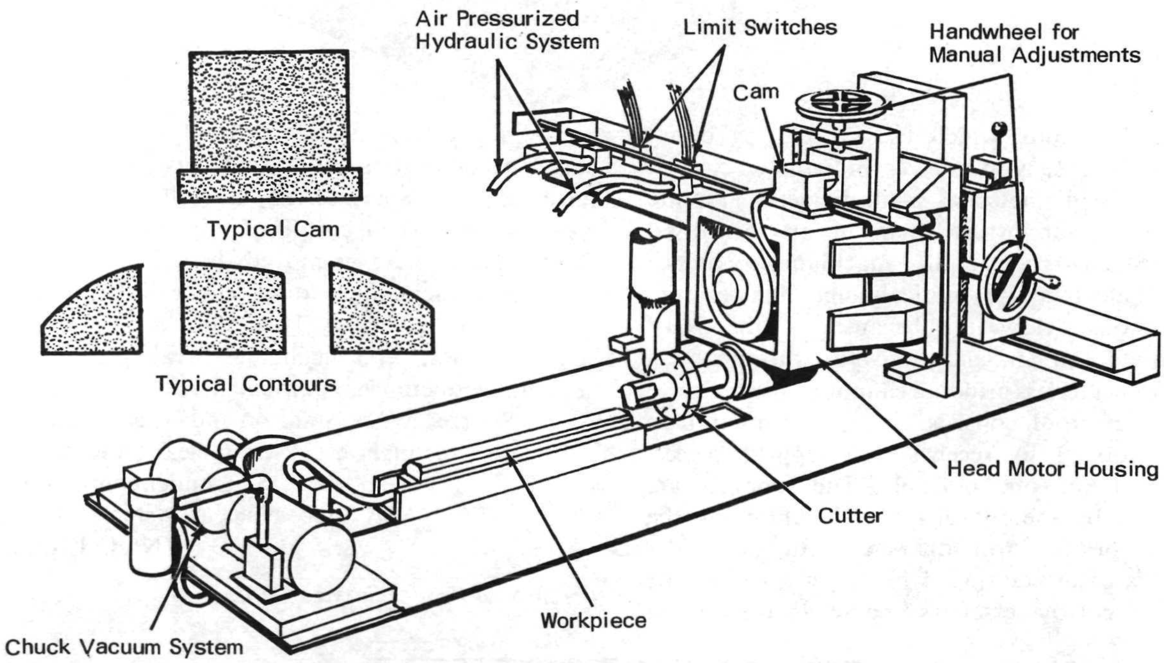


Either manually operated or driven by an air or electric motor, the stripping tool and fixture uses springs installed on dual guide rods to feed the sheathed thermocouple into the cutting tool. The thermocouple is drawn through a standard feed chuck by the spring action, and, after the required cut is made, a cam operated carriage return lever reloads the springs for the next cut. The tool has been used successfully to strip sheathed thermocouples in most standard diameters.

Source: E. P. Baumann, Jr., of Westinghouse Astronuclear Laboratory under contract to AEC-NASA Space Nuclear Systems Office (NUC-10063)

Circle 6 on Reader Service Card.

MODIFIED PLANER MACHINES CURVED CONTOUR ON LONG WORKPIECE



A conventional planer, modified by the addition of a specially designed cam-operated head and a rotary cutter with orthogonal vertical and horizontal motion capability, can machine a curved contour of large radius on one side of a long workpiece. Machining such a contour by rotating the workpiece in a conventional lathe operation is not feasible because of the extreme length involved.

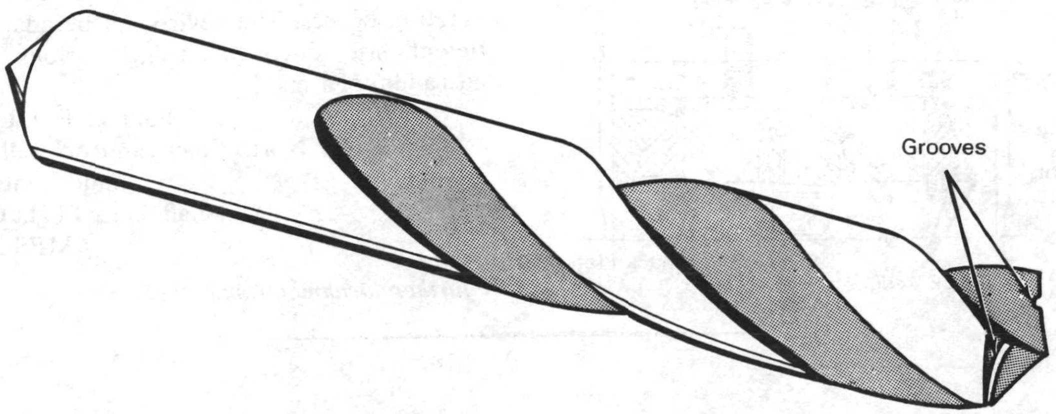
In operation, the workpiece is vacuum-held and is chuck-mounted on the planer table. Motion of the table past the cutter may be in either direction. Horizontal longitudinal head and cutter movement is provided by an air-driven hydraulic system controlled by limit switches. Vertical movement is provided by a cam mounted on the head, with the head and cutter duplicating the cam contour as it moves across a stationary pattern.

Hand wheels are provided for adjusting the head with respect to the workpiece, and cam design can be varied to produce a range of workpiece contours.

Source: J. T. Burns of
Penn. Tool & Gage Co.
Subcontractor to
Westinghouse Astronuclear Laboratory
under contract to
AEC-NASA Space Nuclear Systems Office
(NUC-10041)

No further documentation is available.

MODIFIED DRILL PERMITS ONE-STEP DRILLING OPERATION



The cutting faces of a drill having the same diameter as that of the desired hole were modified to provide a non-chattering, one-step drilling operation for drilling medium-diameter holes in hard materials. Previously, drilling with an undersized drill, deburring, and then reaming the hole to the required size was the practice.

The modification employed consists of a groove across the bottom of each drill flute cutting face. The area from the point of the drill to the groove, which is in essence a built-in center drill, functions to eliminate chatter. All drills with flutes of adequate size to contain a groove can be modified in this manner.

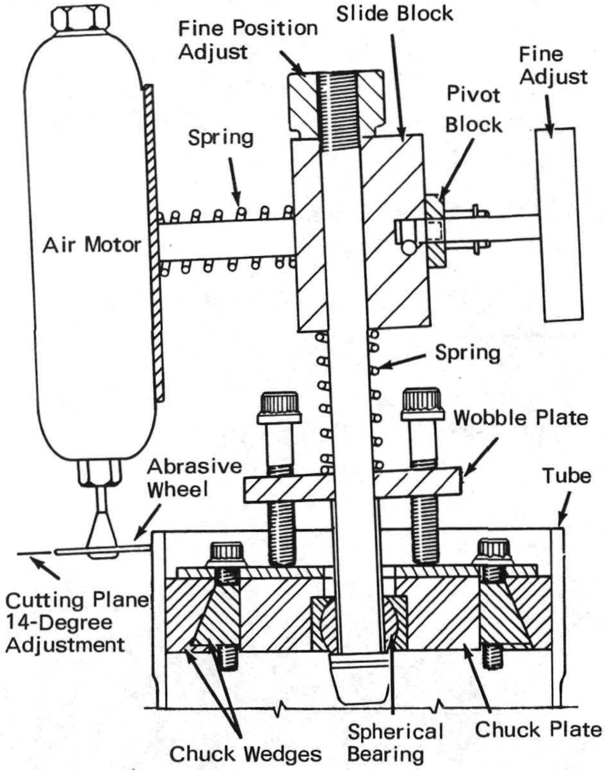
Source: Charles Libertone of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-559)

Circle 7 on Reader Service Card.

LOW-COST ORBITING GRINDER FOR CUTTING DUCTS

A low-cost, simple, portable machine can be used for straight and offset "on-the-spot" cutting of ducts made from various heat-treated alloys, without the use of jigs, fixtures, or hand tools. Previously, such operations required the use of hacksaws and files.

The machine features an abrasive wheel powered by a small, high-speed air motor. The motor is mounted on an expandable plug which is placed inside the duct and set flush with the inner wall of the duct. The motor then rotates around the center axis of the plug, making a precise cut in the duct (see figure).



After the cutting plane has been established and has been scribed on the duct surface, a support plug is inserted into the duct and secured by means of expanding wedges. A small high-speed air motor with a directly-mounted grinding wheel is installed on the tool arm in the approximate cutting location. The axial position is set by adjusting a knurled nut at the end of the main support shaft. The angular position is set by adjusting the three screws in the wobble plate. For the cutting operation, the arm-mounted knurled nut is tightened, bringing the grinding wheel into the surface of the duct, and the wheel is repeatedly orbited around the duct until separation occurs. The device can be adapted to different size ducts by using various chuck plates and tool arms.

Source: E. J. Lang of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-20684)

No further documentation is available.

HIGH-TORQUE POWER WRENCH: A CONCEPT

A power torque wrench which exerts a controlled amount of pressure is small enough to be handled by one or two men and has sufficient torque to remove 3.81 to 10.16 cm (1-1/2 to 4 inch) nuts from high-pressure tanks and valves. Frequently, such nuts are "slugged" on the studs, making the nuts extremely difficult to remove should the necessity arise. Torque wrenches of the size required are not commercially available.

The design concept consists of a 6.81 MN/m (10,000-psi) hydraulic ram that operates a dual-pawl and ratchet assembly. The ratchet contains a square hole for an adapter to receive regular power-drive sockets. A counteracting arm is connected to the ram and is adaptable to a hex-socket-wrench to receive nuts or round female adapters for studs. This is a power-stabilizing arm to counteract the torque output from a selected fixed point. The arm can be pivoted from the body of the wrench to adjust to various anchor points.

With a regulated hydraulic power supply, the "on torque" may be uniformly applied and may be monitored by a high-pressure gage. The "on" or "off" motion is accomplished merely by turning the wrench over. The wrench stroke drives the link arm through a $\pi/6$ rad (30-degree) arc, and it is used only in the final stages of torque (either on or off). If desired, the action can be made automatic by using solenoid-operated valves and suitable switches.

Two wrenches have been designed, one weighing 27 kg (60 pounds) and having a 9928 J (7300 ft-lb) capacity and the other weighing 54.5 kg (120 pounds) with a 24,480 J (18,000 ft-lb) capacity. Analysis of this design indicates a minimal deflection of the hydraulic cylinder about the fixed pivot point during the stroke of the piston-ram. This deflection results in an error of less than 0.02 percent of the rated torque value; i.e., at 9928 J, the error, not including friction, would be less than 2.04 J (1.5 ft-lb).

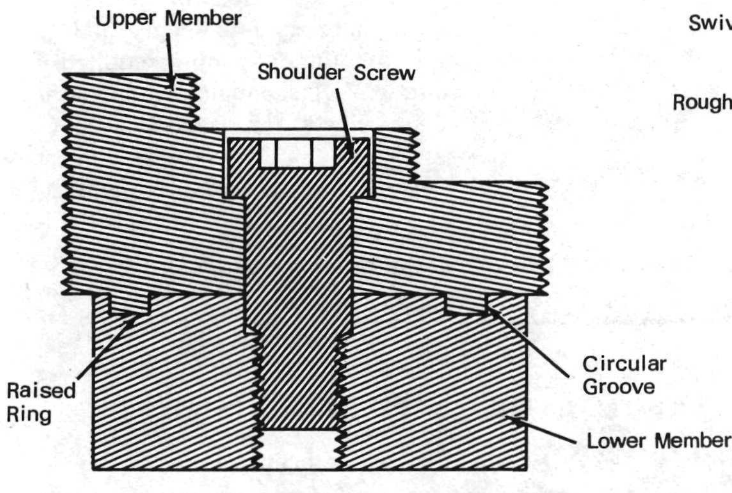
This development is in conceptual stage only, and, as of date of publication, neither a model nor prototype has been constructed.

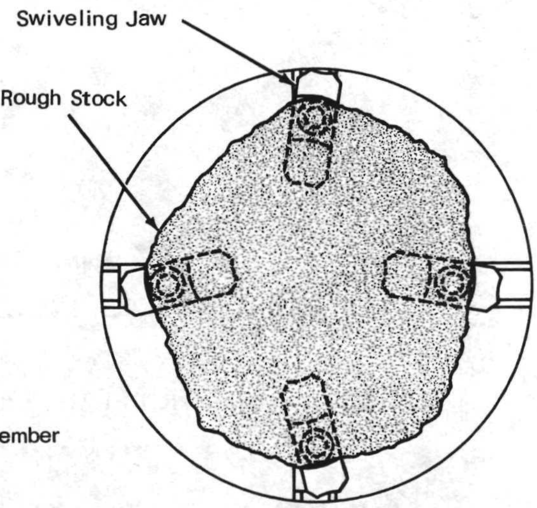
Source: Edward F. Cox of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-18194)

Circle 8 on Reader Service Card.

Section 2. Setup, Alignment, and Control Devices

SWIVELING LATHE-JAW CONCEPT FOR HOLDING IRREGULAR PIECES





A new lathe chuck concept features interchangeable swivel jaws that ride in the standard jaw slots but swivel so that the jaw faces bear evenly against the workpiece surface regardless of its contour. In the past, it has been difficult to securely clamp irregularly shaped pieces in a lathe chuck without damaging the piece or using excessive time. With standard chuck jaws, the fixed faces move only in straight lines. This can cause uneven stress, resulting in distortion or warpage in other than concentric pieces. In addition, considerable time is wasted in determining the optimum mounting position for the workpiece.

The swiveling jaw consists of a lower member that rides in the chuck slot, an upper member with three stepped, knurled faces, and a shoulder screw connecting the two. A raised ring on the bottom face of the upper member is concentric to the shoulder screw and fits into a circular groove in the mating face of the lower member. The socket head shoulder screw is slip-fitted through a counterbored hole in the upper member so that, when it is loosened, the jaw may be rotated to the proper angle to bear evenly against the workpiece.

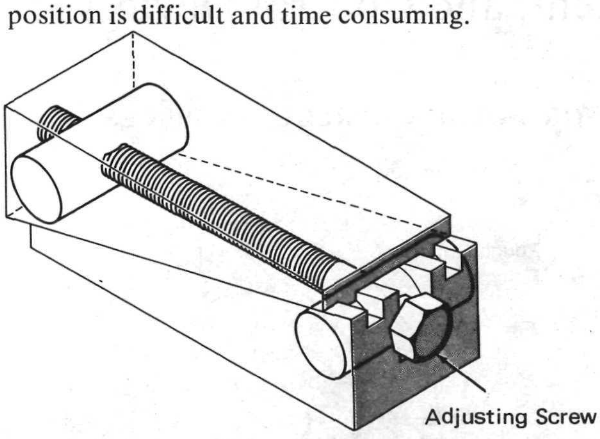
In mounting an irregular or eccentric workpiece, the jaws are moved toward the workpiece in the conventional manner, and the upper members are rotated to their optimum positions to bear evenly against the adjacent workpiece surfaces when the shoulder screws are tightened securely.

Source: Jerome David of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-783)

No further documentation is available.

LEVELING JACK SHORTENS SETUP TIME ON HORIZONTAL BORING MILL

A leveling jack has been designed to provide precise alignment control for expediting the setup of extremely heavy components or assemblies on horizontal boring mills. The use of wedges and blocks to shim such components to proper position is difficult and time consuming.

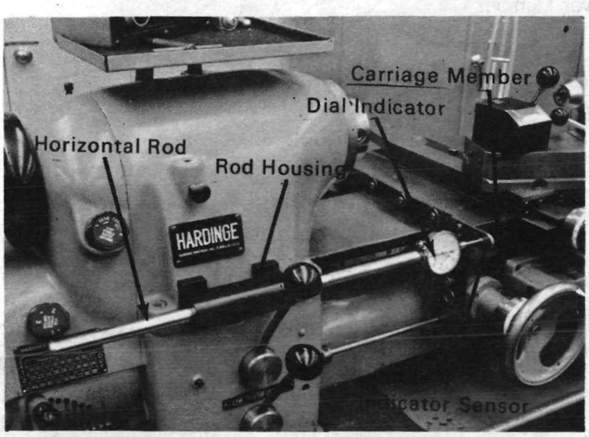


The jack is capable of handling loads up to 1135 kg (2500 pounds). The number of jacks used depends on the configuration of the component or assembly to be worked on. Usually, a leveling jack is placed under each corner of the component, and alignment is obtained by turning the adjusting screw. This causes the inclined face of one-half of the leveling jack to travel along the inclined face of the other half, raising or lowering the height of the jack. The jack eliminates the need for wedges and shims and reduces the amount of handling required.

Source: W. Dellenbaugh and C. Jones of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-1084)

No further documentation is available.

DIAL INDICATOR PERMITS FINITE LATHE CARRIAGE ADJUSTMENT



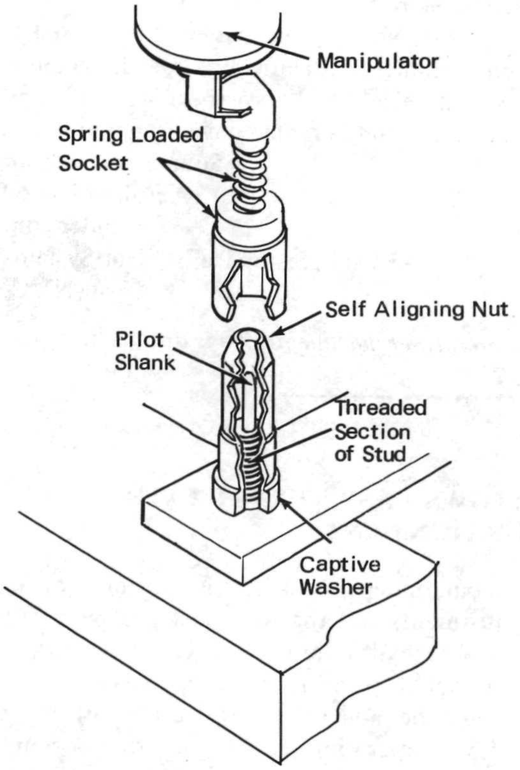
A superior dial indicator support system for lathe applications reduces the possibility of indicator damage due to incorrect movement of the lathe carriage. Dial indicators are usually used when extremely small, discrete cuts must be made on the face of a workpiece. Previous support devices, which use a notch and pawl arrangement to position a horizontal bar supporting the dial indicator, are so rigid that careless, inadvertent movement of the lathe carriage may damage the indicator.

The new support consists of a horizontal rod, force-fitted into a plastic bearing which is supported in a housing attached to the lathe (see fig.). A dial indicator is mounted on one end of the rod, and the indicator sensor engages the member on the lathe carriage in such a way that finite, discrete movements of the carriage can be recorded by the indicator. The close tolerance interference fit of the rod in its housing bushings is sufficiently tight to permit valid measurements of lathe carriage travel, yet sufficiently free to permit rod movement within the bushings without damaging the dial indicator should the carriage be moved beyond the full range of the dial.

Source: Robert E. Lee of
Caltech/JPL
under contract to
NASA Pasadena Office
(NPO-11274)

Circle 9 on Reader Service Card.

SELF-ALIGNING NUT/STUD DESIGN ELIMINATES CROSS-THREADING PROBLEMS IN REMOTE OPERATION



Cross-threading in the fastening step has been a problem in applications where a nut and washer are fastened to or removed from a stud or captive bolt by a remotely-operated manipulator. In a special design to eliminate this problem, the nut was fabricated with a close-tolerance mouth designed to engage a pilot shank machined on the outboard end of the stud. A captive washer was made an integral part of the nut in order to achieve a controlled preload.

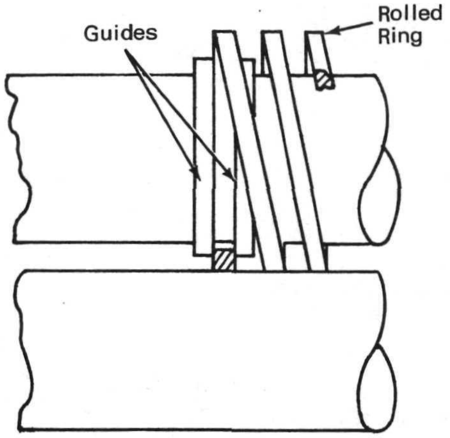
Referring to the figure, the manipulator places the nut and captive washer assembly on the stud pilot shank, which has three flats machined on it to prevent binding of the nut. The remote manipulator is equipped with a spring-loaded deep socket that prevents damage to the initial thread due to excessive downward force.

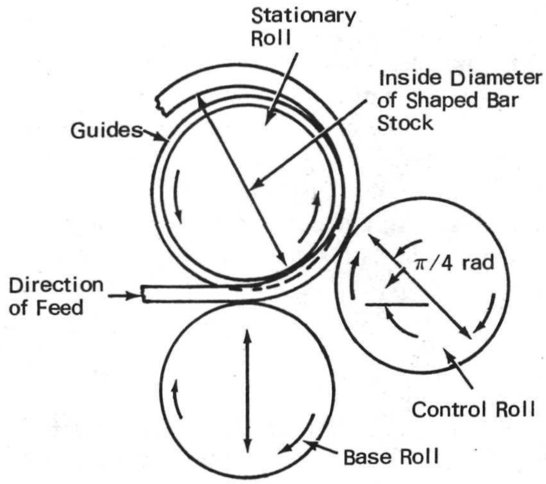
Source: H. H. Christopherson
and Richard Paus of
Aerojet-General Corp.
under contract to
AEC-NASA Space Nuclear Systems Office
(NUC-10085)

No further documentation is available.

GUIDES AID IN ROLL FORMING OF BAR STOCK RINGS

Specifications for a piece of equipment required several sets of rings made from rectangular bar stock. A problem was posed by a requirement that the rectangular bar stock be rolled with the small dimension forming the inside and outside dimensions of the finished rings. Using standard steel rolling equipment, guides were provided to hold the bar stock in





edge position (small dimension) as the rings were formed.

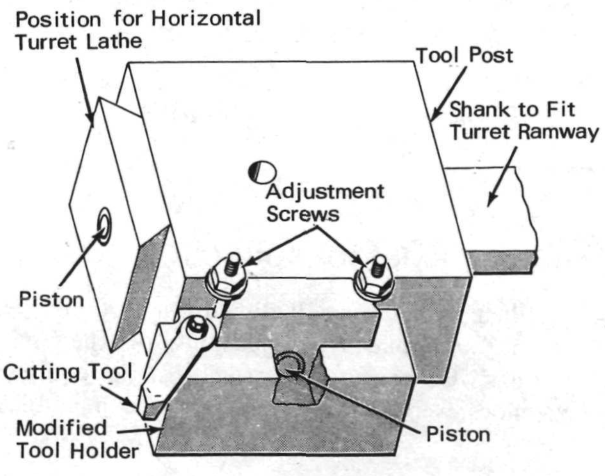
As illustrated, the guides are split-ring type, fabricated to fit the stationary roll diameter of the standard three-roll, pyramid type steel rolling machine. The guide perimeter height cannot exceed the width of the rectangular bar stock to be formed. The guides are attached to the stationary roll, with a separation distance equal to the edge width of the rectangular bar stock. The base roll, adjustable by vertical movement, is set to accept the bar stock to be formed. The control roll, adjustable in a $\pi/4$ rad angle swing, is adjusted to achieve the desired finished ring diameter. Relatively large diameter rings of 305 stainless steel have been formed, and close dimensional tolerances have been maintained.

Source: G. E. Leonard of Aerojet-General Corp. under contract to AEC-NASA Space Nuclear Systems Office (NUC-10078)

No further documentation is available.

TOOL POST MODIFICATION ALLOWS EASY TURRET LATHE CUTTING-TOOL ALIGNMENT

An existing turret lathe cutting-tool holder has been modified to allow for necessary alignment, independent of the cutting-tool angle adjustment, and the tool post has been redesigned with a hydraulic lock-in feature to keep the tool holder in position. Cutting tools on turret lathes must be aligned on the center of the spindle. Long operation causes the turret ramways to wear, resulting in tool misalignment, and proper alignment has previously required time consuming adjustments of the tool angle.



The modified tool holder has two adjustment screws that move the tool holder up or down along the tool post until the tool is aligned with the spindle, as required.

The tool post contains a hydraulic system. When the cutting tool is aligned with the spindle, the hydraulic system is actuated by a valve to transmit pressure to a piston. The piston in turn bears against the tool holder, locking it in place.

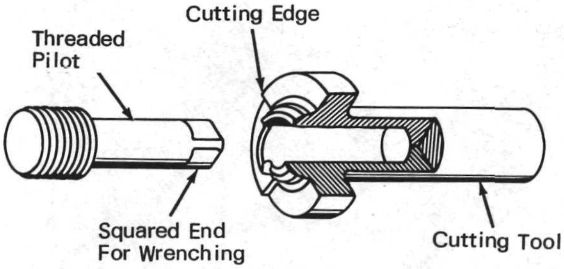
The modified tool post can be used on horizontal and vertical turret lathes and on other engine lathes.

Source: Lee Fouts of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-00581)

Circle 10 on Reader Service Card.

THREADED PILOT INSURES CUTTING TOOL ALIGNMENT

A threaded pilot can be used to align cutting surfaces with boss threads. The technique permits machining after threading, insures precision alignment, and retains perfect threads.



The standard practice in machining a port component or boss requires that the hole be threaded after the piece has been drilled and machined, and the machined surface of the boss must be normal and concentric in relation to the threads. If the boss has to be reworked, considerable time and care are required to remachine, retain perfect threads, and not scrape the boss itself.

The threaded pilot is screwed into the boss after the boss is drilled and threaded. A cutting tool that fits over the threaded pilot shaft is used to machine the boss surfaces. The use of the threaded pilot keeps the machined surfaces normal and concentric to the threads. For rework, the threaded pilot is screwed in and the surfaces are machined in the same manner as that used for the original work.

This device is recommended for use wherever precision alignment of port threads and boss face is required.

Source: William E. Schneider
and Reuben Goldman of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-00527)

No further documentation is available.

BRAZING TOOL SIMULATOR CHECKS CLEARANCES ON FLUID SYSTEM PROTOTYPES

Tube segments are fitted at the braze point by allowing a radial clearance, but this method does not provide accurate tooling clearances through adjacent lines or possible obstructions. In addition, the cost of the braze tool (Figure 1) and its relative fragility prohibit its use for fitting up the tube segments prior to the brazing operation.

An inexpensive simulator tool (Figure 2) accurately checks fluid line clearances for subsequent induction braze tooling. The result is an appreciable reduction in fitting-up rework and schedule time in the production of extensive high-pressure fluid system prototypes.

The increasing use of induction brazed tubing in industry indicates an increasing application

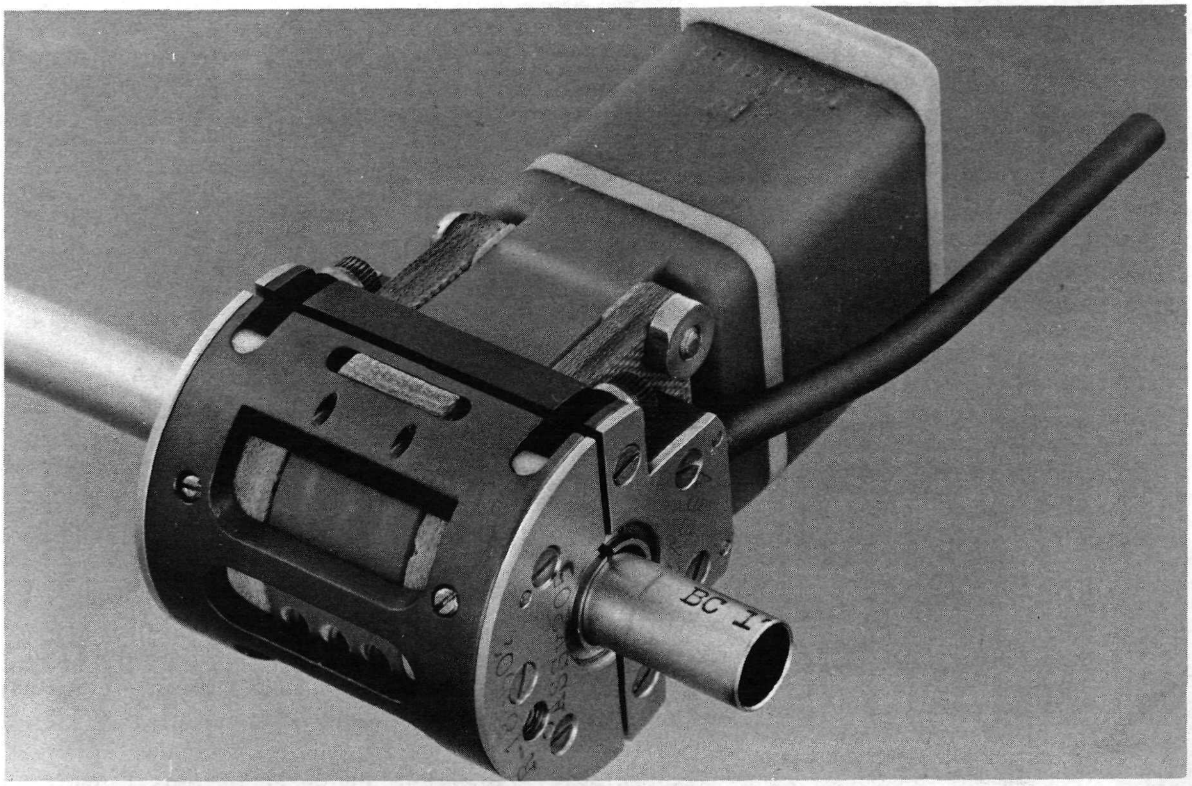


Figure 1

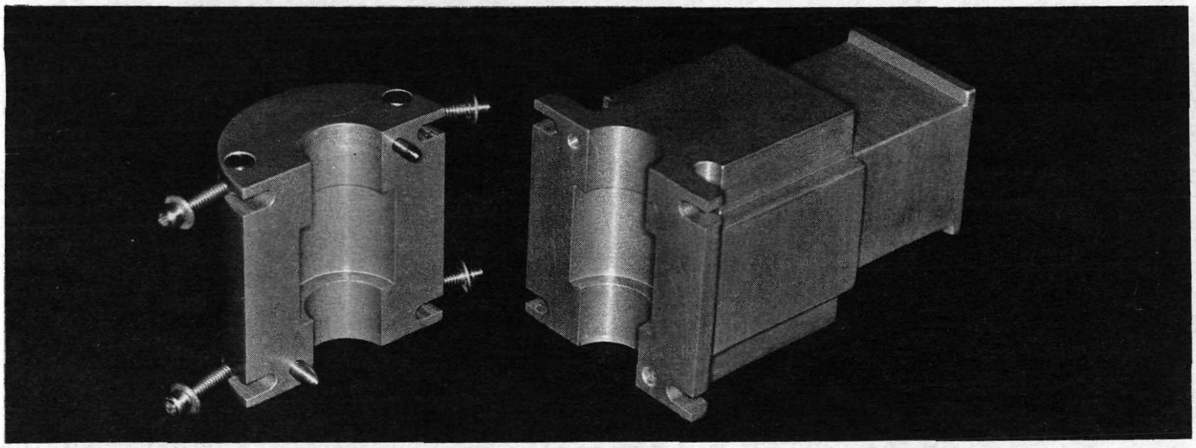


Figure 2

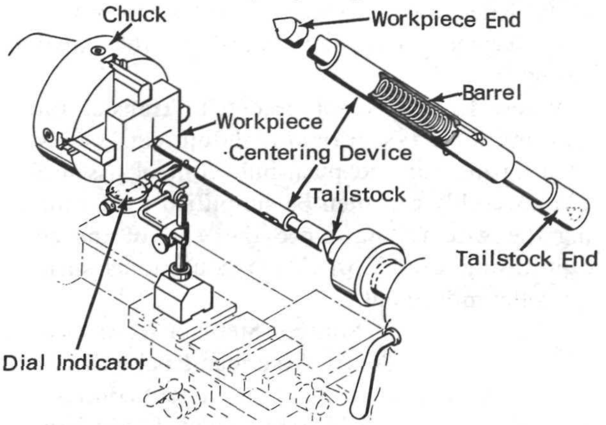
potential for this new technique. For instance, manufacturers of induction brazing units could provide simulators as accessory items.

Source: J. A. Klein and J. A. Stein of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-17262)

No further documentation is available.

DEVICE SIMPLIFIES CENTERING OF WORKPIECES IN LATHE CHUCK

A device has been designed to simplify centering the workpiece in an independent four-jaw lathe chuck. Present workpiece centering methods involve either visually sighting the intersection of



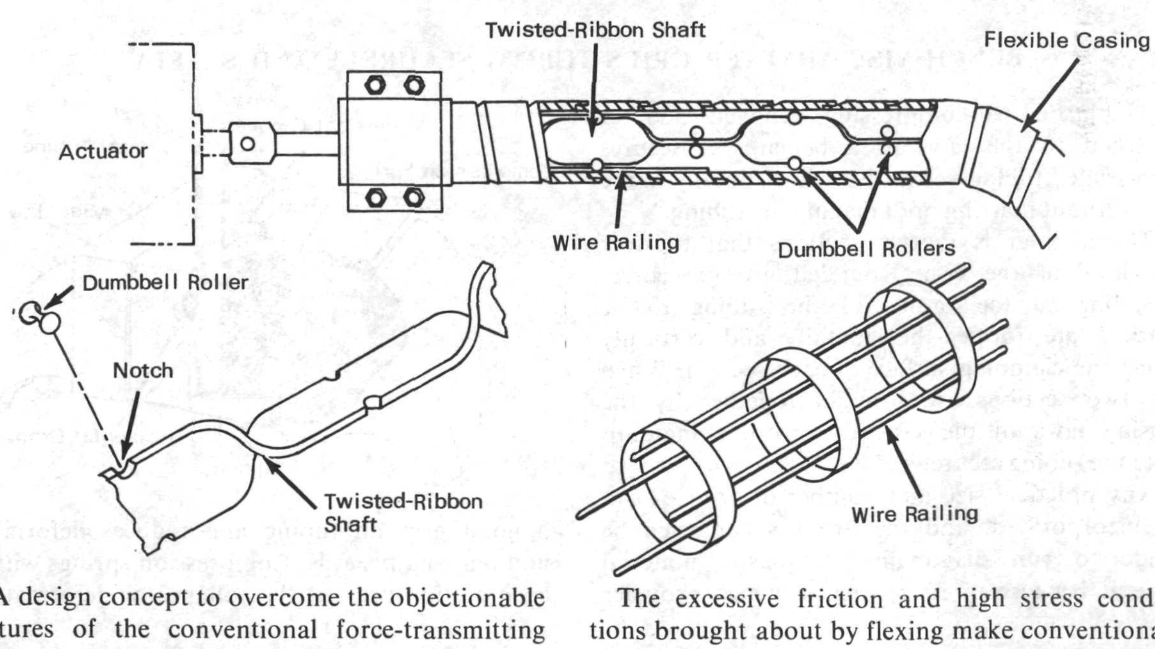
layout lines on the workpiece to a tailstock center, or using a wiggler. Both are time consuming and unreliable.

With the new technique, the pointed end of the device is set on the punched center of the layout lines of the workpiece, and the drilled end is positioned to engage the lathe tailstock center. The device is held in place by advancing the tailstock until the spring is partially compressed. The ball end of the feeler arm of a dial indicator mounted on the crossfeed tool turret is then brought in contact with the periphery of the centering device near its pointed end. The chuck is rotated by hand and the four jaws are sequentially adjusted until the desired readout is obtained on the dial indicator. This then denotes that the center of the workpiece is aligned with the center of the chuck. The centering device is released by grasping the barrel and exerting an axial push toward the tailstock.

Source: Lee Prater of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-00685)

No further documentation is available.

IMPROVED MECHANICAL REMOTE CONTROL ASSEMBLY: A CONCEPT



A design concept to overcome the objectionable features of the conventional force-transmitting shaft of push-pull mechanical remote controls is shown in the illustration.

The excessive friction and high stress conditions brought about by flexing make conventional push-pull mechanical remote controls inefficient. For example, a particular push-pull remote control with a round spring-wire rod as the force-transmitting shaft required an input of 25 percent over the output in a straight line. When the push-pull control was bent into a specific arc, the input exceeded output by 30 percent. The force-transmitting shaft in the proposed design consists of a flat metal ribbon twisted in a configuration of paired, mutually perpendicular segments. A stress analysis of the twisted-ribbon shaft shows that it is significantly better than the round spring-wire rod as a push-pull actuating shaft.

The proposed assembly consists of four basic components: The twisted-ribbon shaft, a set of rollers, a wire railing, and a flexible casing. Force would be efficiently transferred around bends because the twisted-ribbon shaft readily flexes without being overstressed. The shaft moves in the casing on dumbbell rollers, which eliminate the sliding friction that is inherent in conventional push-pull control assemblies. A dumbbell roller is seated in a central notch on each edge of the shaft segments. The notch is made wide enough to allow back and forth sliding of the roller to prevent possible binding when the shaft is flexing in an arc. The rollers are guided by a wire railing, which provides smooth rolling surfaces over the joints of the flexible casing.

Where flexing is not needed to transfer force and motion, a semirigid conduit can be used as a casing for the push-pull control assembly. The assembly can then be simplified by eliminating the wire railing, since the wall of the conduit casing would provide a continuous surface for roller movement.

Source: Stephen W. Matica of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-16249)

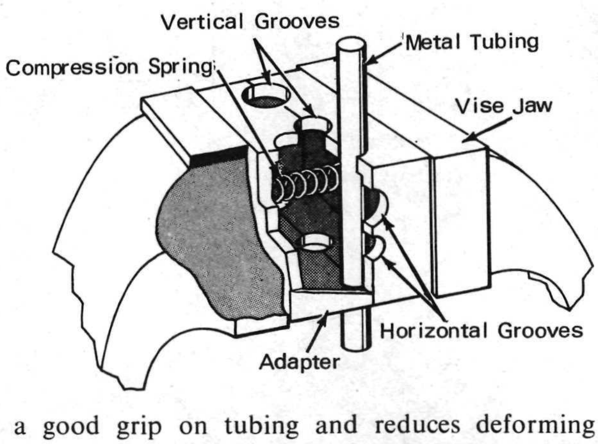
Circle 11 on Reader Service Card.

Section 3. Jigs, Fixtures, and Adapters

BENCH VISE ADAPTER GRIPS TUBING SECURELY AND SAFELY

A plastic self-compressing grooved adapter attached to the jaws of a bench vise secures thin-walled tubing vertically or horizontally in the vise without marring or damaging the tubing.

The adapter is in two sections that fit over the jaws of the vise. Rounded grooves corresponding to the radius of the tubing to be worked are formed horizontally and vertically along the clamping surface of each section. When the two sections are brought together by the closing jaws of the vise, the grooves mate to hold the tubing securely.



Any practical size and number of grooves can be incorporated, and the grooves can even be made to run diagonally. A plastic material is used because of its resilience, which provides a good grip on tubing and reduces deforming and marring hazards. Compression springs within each section prevent the collapse or deformation of the tubing under excessive vise pressure, and ensure that the work remains in place when vise pressure is partially released.

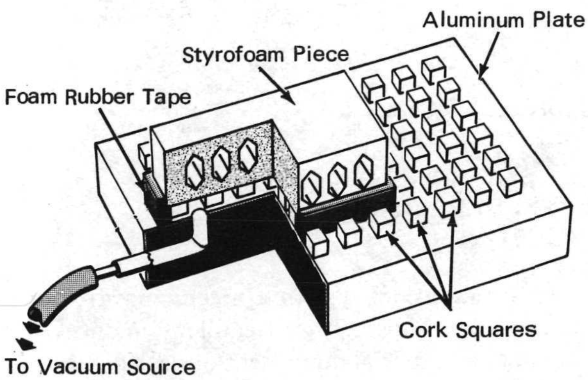
Magnets could be incorporated in both sections to prevent adapter detachment from the jaws when the vise is opened.

Source: B. T. Howland and A. S. Jones, Jr., of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-00279)

No further documentation is available.

FIXED VACUUM PLATE CLAMPS STYROFOAM FOR MACHINING

An aluminum plate assembly with rubber or cork pads on its surface and an internal vacuum system securely holds styrofoam or other soft material for machining operations, without damaging or soiling the material. Clamping methods previously used caused crushing or soiling of the soft material.



The aluminum plate is cut to size, and cork or rubber squares are glued to the top surface of the plate with uniform separation. A hole is drilled from one edge of the plate, and a second hole is drilled from the top surface to meet the first hole at right angles. A tubular fitting with an adapter is inserted in the first hole.

In operation, foam rubber tape of greater thickness than the cork or rubber squares provides the vacuum seal. The tape is placed between the squares on the plate in a pattern which corresponds to the outline or perimeter of the styrofoam piece to be machined. This foam rubber outline is positioned over the hole in the top face. The styrofoam is then placed on the foam rubber, and the tubular fitting is connected to a vacuum pump by a rubber hose. Air is removed from beneath the styrofoam so that the material can settle on the foam rubber until it rests on the squares. A seal is thus maintained between the compressed foam rubber and the styrofoam, and the material is securely held to the square pads for any machining operation.

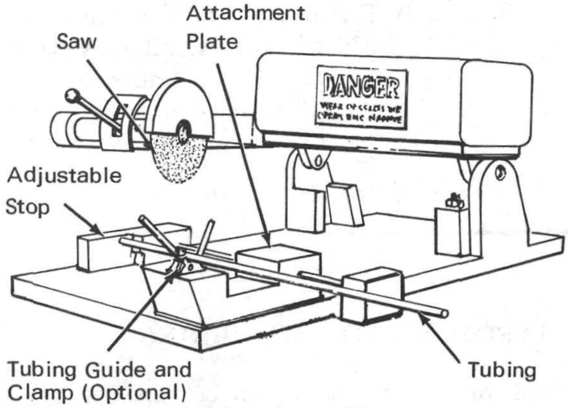
An alternate application employs an open-web rubber mat in place of the cork or rubber squares to accommodate items with other than flat surfaces.

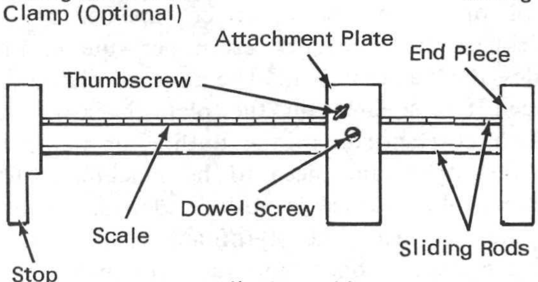
Source: J. A. Rauschl of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-00683 & 00726)

No further documentation is available.

ADJUSTABLE SAW JIG PROVIDES UNIFORM TUBING LENGTHS

An adjustable jig attached to a saw table permits uniform sizing of plastic and metal tubing used in making cable transitions and protective shields for instrumentation leads and transducers. Previously, each tube had to be manually measured, marked, and aligned for sawing. Even the greatest care could not prevent variations in the size of the items so produced.





Jig Assembly

The adjustable jig is attached to the saw table by a flat attachment plate, dowel, and thumbscrew. The jig assembly consists of a stop and two rods that slide in the attachment plate. One of the rods is scaled to provide a gage for measuring the length of tubing to be cut. Adjustments are made by loosening the thumbscrew, sliding the rod and stop assembly (essentially, the jig) to the desired position, and tightening the thumbscrew. The tubing is fed into the saw groove, against the preset stop, and then sawed. Each operation at this stop setting results in precisely the same length tube. Various shapes and materials other than tubing may also be cut to exact lengths using this technique.

Source: Linn J. Similer of
Westinghouse Astronuclear Laboratory
under contract to
AEC-NASA Space Nuclear Systems Office
(NUC-10025)

No further documentation is available.

HEAT TREATMENT STABILIZES WELDED ALUMINUM JIGS AND TOOL STRUCTURES

In the production of welded aluminum jigs and tool structures, certain treatment is required after welding and before machining in order to make each device suitable for its intended use. Welding may introduce residual stresses in the aluminum that alter initial properties.

Special treatment processes applied after welding but before machining, impart above normal stability to welded aluminum jigs and tool structures.

Two basic categories of tools to be treated, established from intended use requirements are:

(1) Tools that control critical dimensions, locations, or configurations exceeding a span of 91.44 centimeters (36 inches). In this category, rigidity and stability are of prime importance, strength is secondary, and good machine finishes are assumed to be nonessential. These devices are partially annealed for one hour, then furnace cooled before machining or setting critical locations. This treatment reduces the aluminum material to a near-annealed but very stable condition. When the material returns to room temperature, the ultimate strength is reduced by approximately 33%, yield strength is reduced by about 50%, while rigidity is unaffected. Due to temperature effects or to the size and configuration of the device, the structure must be amply supported to prevent sag.

(2) Tools in which less reduction in mechanical properties is important (ultimate strength reduced 13.3% and yield strength reduced 16.3%), and tools used in an autoclave to control a plane or surface of adhesive bonding area exceeding 55.88 by 132.08 centimeters (22 by 52 inches). In this category, rigidity and stability remain important, but machinability acquires greater importance since a finer finish is required. These devices are heat aged for two to three hours and air cooled before machining. When the

material returns to room temperature, it is left hard enough to obtain a 125 (rms) finish suitable for bonding surfaces.

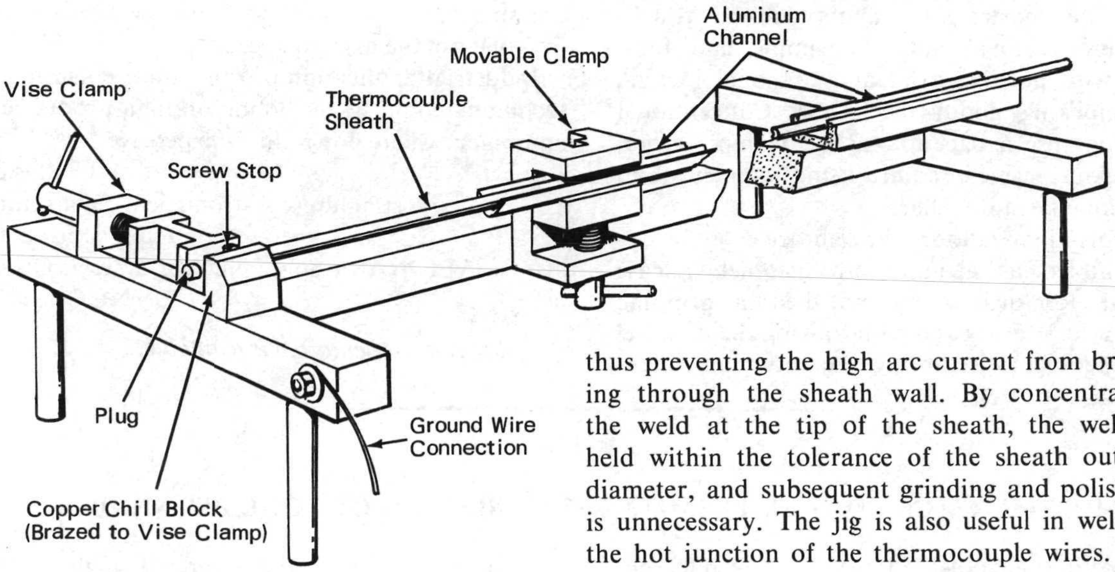
Weight saving will not be realized in these categories of tools if rigidity equal to that of a comparable steel tool is required. Jigs or tool structures that do not fall in the above use requirements areas need no treatment, although material in the weld areas will be annealed and will exhibit less strength per unit area, requiring heavier material at these locations.

Source: R. S. Mehnert of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-00800)

Circle 12 on Reader Service Card.

JIG AIDS IN WELDING HIGH TEMPERATURE THERMOCOUPLE TIPS OR HOT JUNCTIONS

A specially designed jig for high temperature thermocouples with tungsten, molybdenum, or tantalum sheaths provides precision support for tip welding or hot junction operations. Sheaths of this nature have extremely thin walls, are quite fragile, and can be costly because sizes run to as long as 114.3 cm (45 in.) and close fabrication tolerances must be observed.

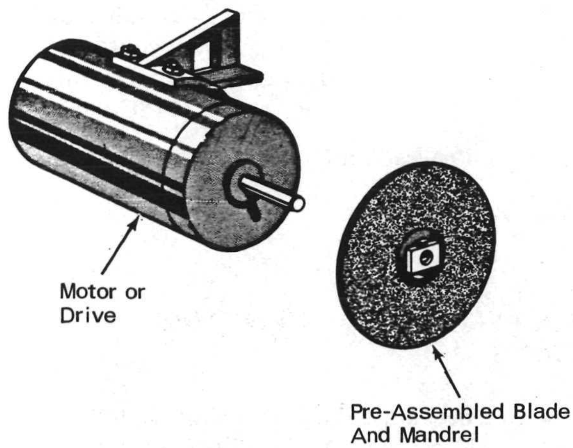


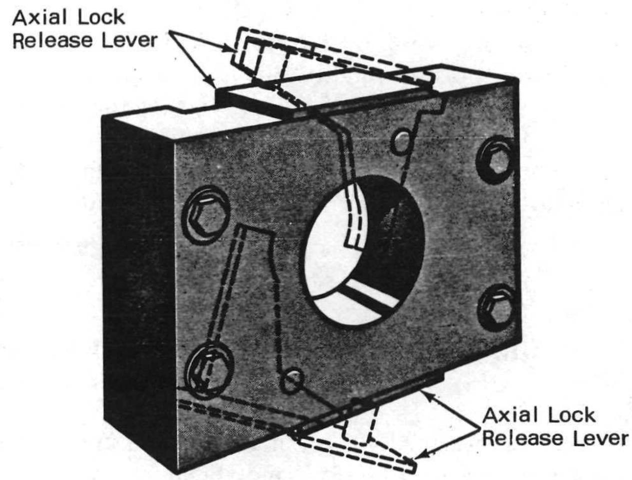
The jig provides support for the thermocouple along its entire length, minimizes crystallization of the sheath metal and its welded tip, and provides a heat sink to dissipate the heat produced by the arc. A clamp near the center of the jig can be adjusted up or down so that the thermocouple tip may be readily placed in the chill-block vice at the end of the jig. The heat sinking is done on the depth of the plug material, thus preventing the high arc current from breaking through the sheath wall. By concentrating the weld at the tip of the sheath, the weld is held within the tolerance of the sheath outside diameter, and subsequent grinding and polishing is unnecessary. The jig is also useful in welding the hot junction of the thermocouple wires. The simplicity of the jig's design permits satisfactory welds to be made without extensive experience or complex training.

Source: R. D. Kautz of
Westinghouse Astronuclear Laboratory
under contract to
AEC-NASA Space Nuclear Systems Office
(NUC-10072)

No further documentation is available.

QUICK RELEASE MANDREL ALLOWS RAPID REPLACEMENT OF REMOTE CUTTERS





Remote replacement of abrasive cutters in a hostile environment requires rapid, easy handling by the master slave manipulators. Attachment and removal must be simple and foolproof, with positive axial and torsional locking and unlocking about the arbor. Conventional mountings use a backup washer, clamp washer, and locknut, which require using wrenches and restraining the motor shaft.

In this innovation, the abrasive cutter is preassembled as a unit with a quick release mandrel. Removal is accomplished by gripping the axial lock levers and withdrawing the mandrel from the arbor. Replacing the cutter and mandrel is accomplished by aligning the mandrel slot with the motor shaft key and pushing on the shaft until the axial lock release levers snap into place in the axial lock grooves.

Industrial application of this rapid replacement technique could be in tooling on high-production equipment where downtime is expensive.

Source: R. M. Collins of
Westinghouse Astronuclear Laboratory
under contract to
AEC-NASA Space Nuclear Systems Office
(NUC-10127)

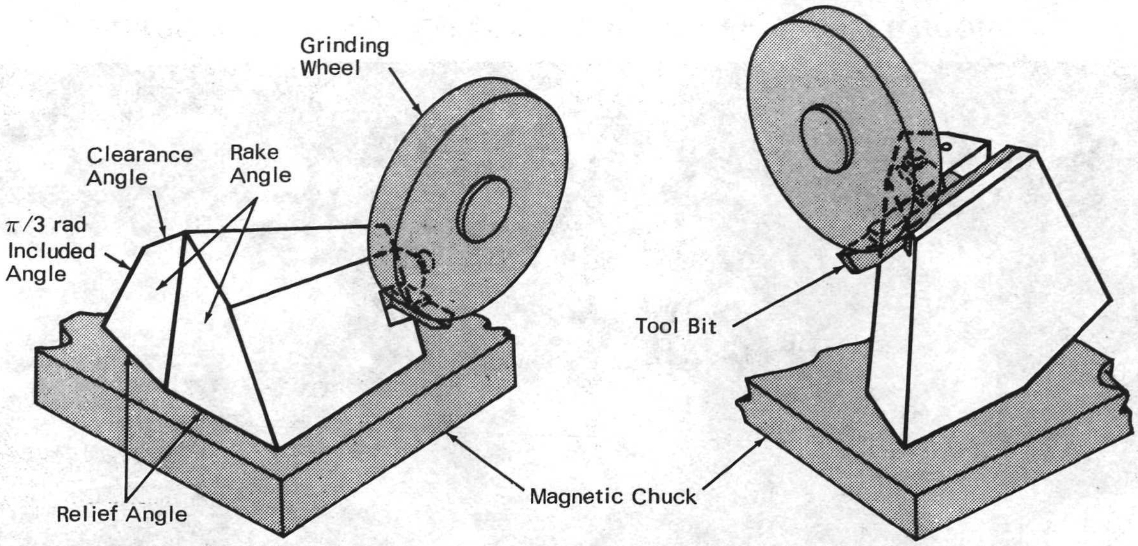
No further documentation is available.

MULTISURFACE FIXTURE PERMITS EASY GRINDING OF TOOL BIT ANGLES

A fixture and tool holder with seven reference surfaces permits accurate grinding and finishing of right- and left-hand single point threading tools, including clearance and relief angles. Cutting $\pi/3$ rad included-angle threads on the shoulders of stainless-steel fittings on a production basis requires frequent grinding, resharpening, and positioning of the threading tool bit. Previously, much time was consumed in restoring the cut, rake, relief, and clearance angles and in repositioning the restored tool for the thread cutting operation. With the new tool, all angles are ground by changing the fixture position to rest at various reference angles without removing the tool from the tool holder.

A heavy, solid steel block is machined to a geometry which has eight surfaces, seven for reference and an eighth which is further machined to accommodate an overarm-clamp tool bit holder. The fixture is placed on an electromagnetic chuck that can be energized to hold it rigidly in place in any desired position.

The three surfaces that relate to the $\pi/3$ rad included angle are duplicated symmetrically in mirror-image fashion on opposite sides of the



Grinding Relief Angle

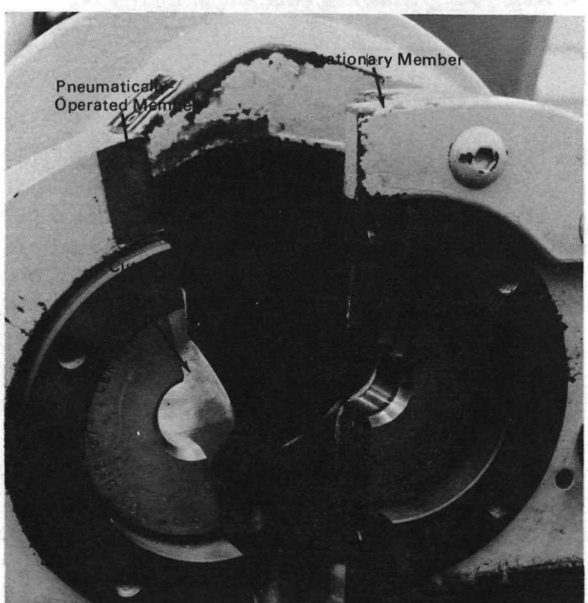
Grinding Rake Angle

block. This is done in order to accommodate both right- and left-hand tools. A single surface is used for establishing the relief angle for both right- and left-hand tools. The fixture is hardened and polished to assure perfectly flat critical surfaces.

Source: C. R. Jones of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-00586)

Circle 13 on Reader Service Card.

CUTOFF TOOL FOR HEAVY-WALLED PLASTIC TUBING



A tube flaring machine has been modified by the addition of an extremely sharp knife blade cutter that slices through heavy-walled tubing, leaving a clean burr-free right-angle cut. In the past, knives, shears, and saws have been used, but these frequently leave burrs which are not acceptable in certain environments. The cutter of the machine is pneumatically powered. The tube is inserted into the stationary member as the powered member closes. Several hundred tubing lengths have been cut cleanly and neatly by the prototype illustrated.

Source: Donald R. Lange of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-15472)

Circle 14 on Reader Service Card.

MODIFIED MICRO-STOP CAGE FOR PRECISION COUNTERBORING

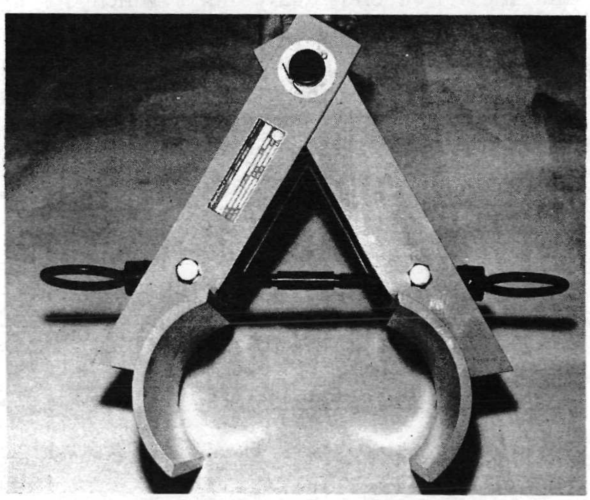
A new counterboring method uses a subland drill with separate cutting edges and flutes for performing the counterboring operation in one step. Previously, six steps were required, using a starter drill, depth drill, bottom drill, starter reamer, final reamer and counterbore reamer.

The innovation couples the subland drill with a micro-stop cage that can be set to extremely small depth increments for precision counterboring. The illustration shows the drill being used in the micro-stop cage.

Source: Ronald L. Badger of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-11384)

Circle 15 on Reader Service Card.

PIPE LIFTING SCISSORS CLAMP OPERATED BY REMOTE MANIPULATORS



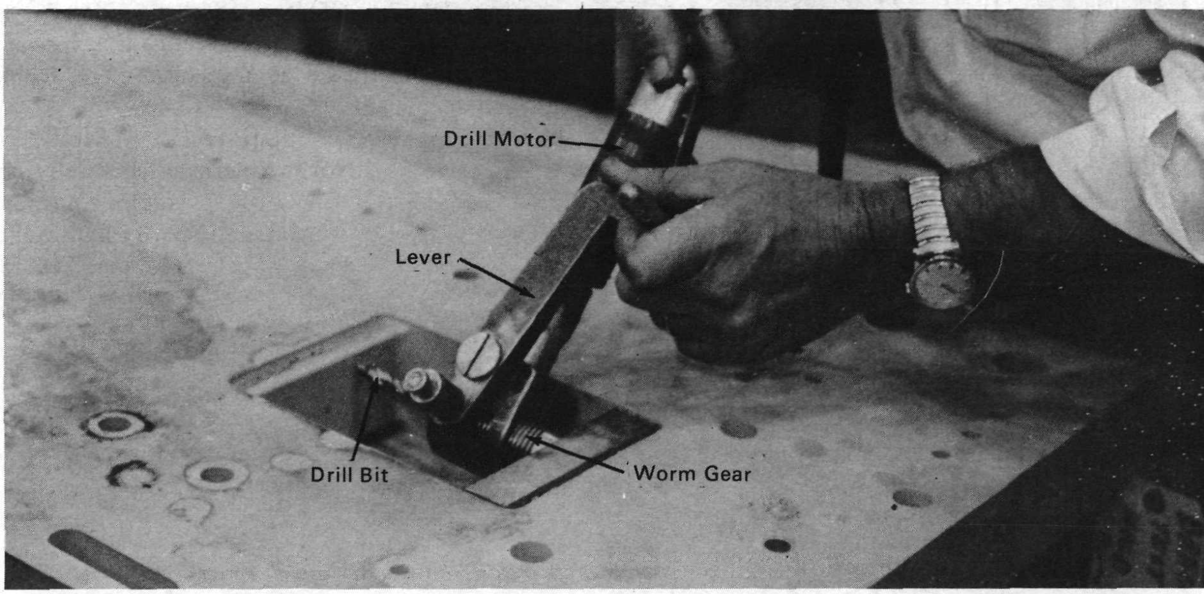
An improved scissors clamp (see fig.) opens and closes through the use of drive screws that may be remotely manipulated. Scissors clamps that close around the object to be lifted are frequently used to clamp and lift pipes and cylinders. These clamps are very useful in a hostile environment where the placement of slings would expose personnel to hazardous conditions. The two clamp halves of the improved device are mounted on a common pivot. The drive screws that accomplish the opening and closing forces are equipped with open loops which are easily engaged by remote manipulators to operate the turnbuckle arrangement. A lifting bail is included for engagement by a crane hook.

This technique may be used with clamping devices in a variety of configurations to handle a wide range of jobs where remote manipulation is required.

Source: S. G. Harbison of
Aerojet-General Corp.
under contract to
AEC-NASA Space Nuclear Systems Office
(NU-0038)

No further documentation is available.

SPECIAL DRILL FEED ADAPTER



A special drill feed adapter permits drilling in areas that are inaccessible to conventional drilling equipment. As shown in the illustration, the feed adapter consists of a pivoted lever that engages the right angle worm gear drive head of an electric drill.

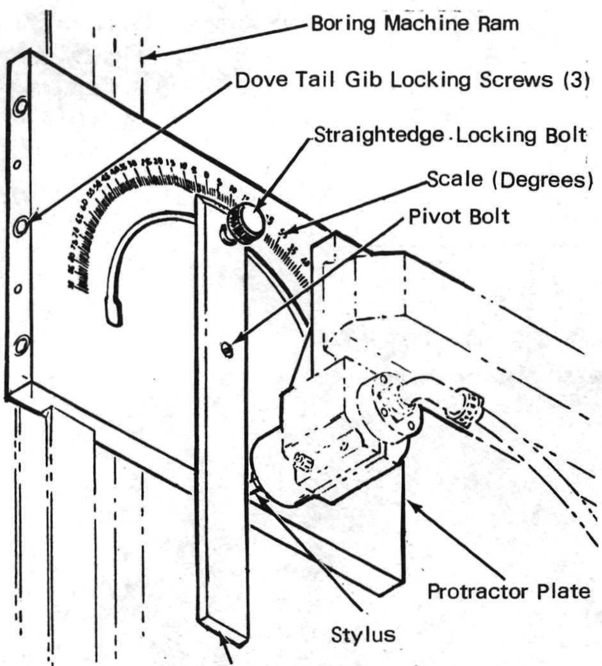
The feed is actuated by a ratchet, and is released by a cam built into the ratchet and head of the feed unit. The unit is reversible from left to right, and heavy feed pressures can be applied, if required. Different extensions can be used on the rear of the feed drive to extend its capabilities, and drill bits of varying lengths can be employed.

Source: H. O. Bernitt of
Chrysler Corp.
under contract to
Marshall Space Flight Center
(MFS-12329)

Circle 16 on Reader Service Card.

PROTRACTOR-TEMPLATE AND TRACER PROVIDE STRAIGHT TAPERS ON VERTICAL BORING MACHINES

To machine straight tapers on vertical turret lathes equipped with tracer controls, individual templates are normally fabricated by machining accurately to the prescribed degree of taper and referencing to some baseline. The template must then be mounted accurately on the machine, with



its reference baseline exactly parallel to the vertical axis of the machine.

A more simple and straightforward method is to fabricate a protractor plate and straightedge template bar for mounting on the machine to provide tracer path control that will automatically produce the desired straight taper. In this technique, the stylus of the tracer is deflected from its null position against the template and the machine slide is traversed so that the stylus travels the required distance against the template bar. This method provides for the tracer duplication of a straightedge that has been accurately positioned at a specific angle from a given machine axis.

Source: D. A. Moulsby of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-14159)

No further documentation is available.

NASA-Langley, 1971

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