NASA SP-5910 (03)

TECHNOLOGY UTILIZATION

MACHINE TOOLS AND FIXTURES

A COMPILATION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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TECHNOLOGY UTILIZATION OFFICE 1970
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Foreword

The National Aeronautics and Space Administration and Atomic Energy Commission have established a Technology Utilization Program for the rapid 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 part of a series intended to provide such technical information. A selection has been made of machine tools and fixtures currently used by manufacturers. In many cases, use or modification of these tools and fixtures can result in considerable cost savings. Industry should find these items economical, efficient, and time saving, as well as contributory to better quality products.

This compilation is divided into three sections. The first section includes devices and techniques for cutting, drilling, and machining of various metals and other materials. Several fixtures which improve efficiency and quality when used in conjunction with welding equipment are also included. The second section contains devices and techniques for measuring, aligning, and marking materials and equipment used in many industries. The last section presents machinery for removal, surfacing, and smoothing of a wide selection of materials used in manufacturing and research.

Additional technical information on individual devices and techniques can be requested by circling the appropriate number on the Reader's 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

Contents

Section 1. Cutting, Drilling and Machining

TECHNIQUE FOR ABRASIVE CUTTING OF THICK-FILM CONDUCTORS FOR HYBRID CIRCUITS

This cost saving technique permits laboratory fabrication of prototype designs without screening and fixing procedures. The estimated cost of the facility set-up is less than $15,000, with equipment which includes a pantograph, a thick-film resistor trimmer, and a chip-and-wire bonder. A conventional facility set-up would cost more than $50,000.

The abrasive jet method used to produce prototype conductor networks for thick-film hybrid microcircuits requires a pantograph engraver to perform abrasive cutting of the conductor network. The abrasive cutting operation is effected by adapting the nozzle of a thick-film resistor trimmer to the spindle of a pantograph. Cutting parameters are 80 psi pressure, a nozzle tip distance of approximately 0.015 inch, and a powder flow of about 10 grams per minute. Cutting time for each network is less than 20 minutes.

A cleaning process is required to remove all traces of the powder before assembly. Tweezers should be used when handling the units. Subsequent to ultrasonic cleaning, the components are bonded to the substrate and wire interconnections are made by conventional methods. The final operation before testing is trimming of the resistor chips.

Source: J. Nugent and J. Palermo of
Massachusetts Institute of Technology
under contract to
Manned Spacecraft Center
(MSC-13242)

Circle 1 on Reader's Service Card.

MANUAL OF INDUSTRIAL DIAMONDS AND GRINDING AND DRESSING CRITERIA FOR MACHINING SUPERALLOYS

The wheels on grinding machines used for cylindrical outer and inner surfaces, and tool and cutter grinding, must be dressed repeatedly to provide optimum performance. Prior to this time no single source of information has been available to industry offering guidelines for proper selection and use of available diamond wheels.

This manual combines the dominant controlling factors in the form of an acceptance standard for the selection and use of stones for cutting and dressing grinding wheels. The empirical data have been assembled from various trade journals, publications, and technical reports, providing available machining criteria for specific types of grinding on superalloys. An original companion treatise on the physical descriptions of the diamond stones accompanies the manual which includes their grading and application for dressing, suggested nib-to-wheel attitudes, and grinding wheel, stone, and stone-mount recommendations on 14 selected standard diamond wheel dressing mounts. The extensive knowledge provided in this document should be useful in machine shops throughout the country.

Source: W. Carr of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-14582)

Circle 2 on Reader's Service Card.

FREON, T-B1 CUTTING FLUID

An improved cutting fluid that completely controls the heat generated from machining operations has been developed. The use of this clean nonoily fluid will prolong tool life, increase product quality, and clean the cutting tool and the material being worked. Because of the removal of material buildup on tool edges, Freon, T-Bl has a greater consistency than other cutting compounds. Loading (galling) is completely eliminated with a measured application of the fluid. Decontamination of tools and materials is not required. Until recently, contaminating oils were used in most machining operations, and this compound could replace less efficient contaminating oils, particularly where structural and nonstructural plastics and honeycombed materials are used. The compound should be particularly valuable to companies engaged in machining operations conducted in "clean rooms."

Freon, T-Bl is based on a double-acting principle in which cooling is accomplished by rapid evaporation of the solvent giving an instantaneous refrigerating action. Lubrication balance by 2-butoxyethanol provides a slightly more lasting liquid feature.

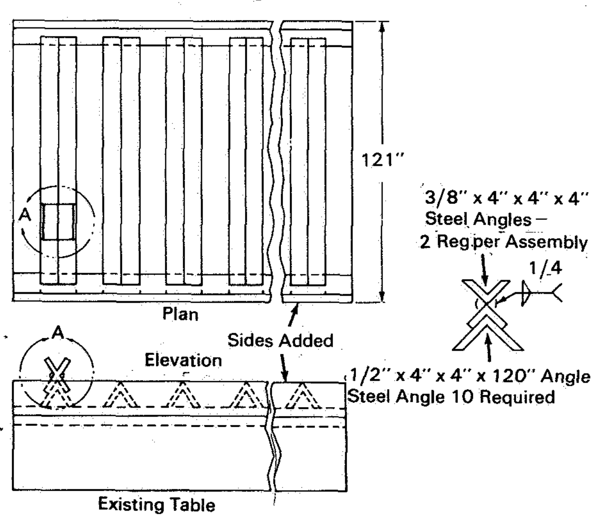
Dispensers for T-Bl are designed to utilize fully the characteristics of this compound, resulting in an economical operation as well as product improvement. Two such dispensers have been developed: a plastic bottle with a gravity feed from simple needle valves, the fluid being directed on the tool by accessory tubing and nozzles; and a Gelman pressure can (Kelite dispenser) fitted with regulators for shop air (2 to 15 psi) and related accessories.

Source: R. Peters of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-11486)

Circle 3 on Reader's Service Card.

IMPROVED TABLE FOR CUTTING AND WELDING

An improved welding table has been designed for use during cutting of various types of metals with different thicknesses. The 10-foot-square table is covered with parallel inverted 10-foot steel angles (1/2 × 4 × 4 inches) centered about 9.25 inches apart or as required. Surrounding them are box sides, tacked to the sides of the table, of the same height as the apexes of the angles.



Pairs of short lengths of angle approximately 4 × 3/8 × 4 inches are welded together, apex to apex, to form X-sectioned riders. These riders are placed astride the long angles and slid to their required location.

Very few riders are damaged when metal is cut on the table, and they can be replaced very cheaply —usually made from scrap. The table does not require meticulous cleanup before work can be placed dead-level on the surface.

Source: D. Oliver and M. Ramirez of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-15537)

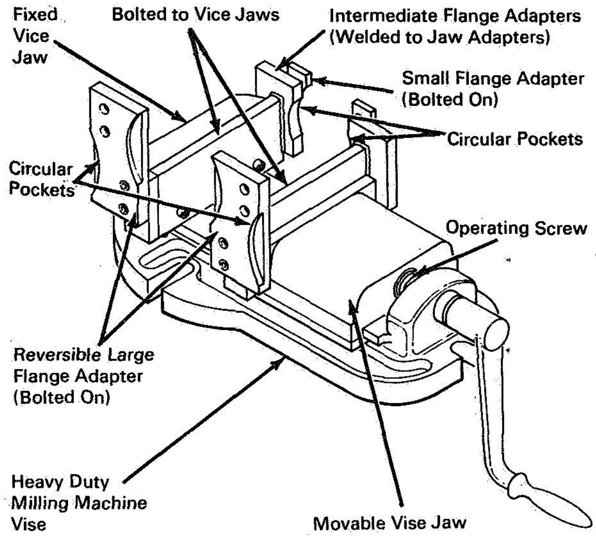
Circle 4 on Reader s Service Card.

VISE JAW ADAPTER

A two-jaw clamping device can be used as a holding fixture for drilling, back spotfacing, counterboring, facing, lapping, polishing, counter sinking and tapping on a milling machine or radial drill. It provides a quick means of holding circular workpieces of different diameters while specific machining operations are performed, and can be used on any flange up to 10 inches in diameter. Usually, separate tooling is required to clamp and hold the part in place.

To use this adapter, the existing machined jaw plates are removed from the milling machine vise. Fabricated jaws having ear extensions are bolted to the stationary and movable vise jaws, respectively. The flanged circular workpiece is placed in the circular pocket, which has been machined in one set of the ears of the adapter. The movable vise jaw is closed until the adapter clamps and holds the workpiece sufficiently immobile to prevent slippage.

This type of adapter is currently being used in manufacturing job shops where numerous lots of various sized circular workpieces require specific machining operations.



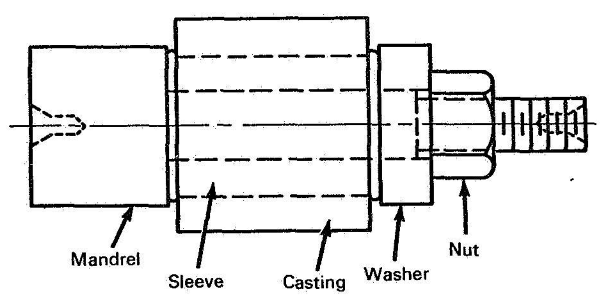
Source: W. Dalsing of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-12716)

No further documentation is available.

COMPRESSIBLE SLEEVE PROVIDES AUTOMATIC CENTERING FOR GRINDING OR TURNING OF CYLINDERS

An elastomeric sleeve, supported on a threaded mandrel, has been designed to support a rough, hollow, cylindrical casting which permits the outside diameter to be ground or turned parallel to the theoretical center line (see fig.). The sleeve is slipped into the cast center hole of the part. By expanding the diameter of the sleeve with pressure against the ends, the casting becomes rigidly supported and the surfacing operation can be completed. The mandrel can be secured for machining by a collet or held between centers. This method could be used in the production of any cylindrical object. Since the sleeve can be reused, only the initial preparation of the mold and elastomeric sleeve would require appreciable time to prepare.

A metallic mold is first made in which elastomeric materials can be shaped into functional mandrel sleeves. The diameter of a sleeve is 0.010 to 0.015 inch smaller than the cast hole and the length may be 1/8 inch longer. As the length is reduced by tightening a nut, the diameter in-



creases, with the volume of the sleeve remaining constant. As the pressure of the compressed sleeve increases, the casting becomes secure on the mandrel. The soft sleeve yields, conforming closely to the rough surface of the casting; rough cast wall thicknesses will be nearly equal across a diameter. This effect approximates automatic centering of hollow cylindrical shapes.

The technique was used originally to grind hollow cylindrical magnets. An aluminum mold was made for casting the sleeves, which in this case were made of silicone RTV. Other materials that could be used include vulcanized rubber and polyurethane.

Source: J. A. Rohrer
Sandia Office of
Industrial Cooperation
(SAN-10021)

Circle 5 on Reader's Service Card.

BATTERY CASE SHEAR

Analysis of the performance of charged battery components (plates, electrolyte, and insulators) during test requires the removal of the case. Nickel-cadmium cells are normally clad in 0.020- to 0.030-inch 304L stainless steel. While the electrolyte is of the paste type, and will not be lost when the case is opened, it must not be contaminated or disturbed in any way during the case removal process.

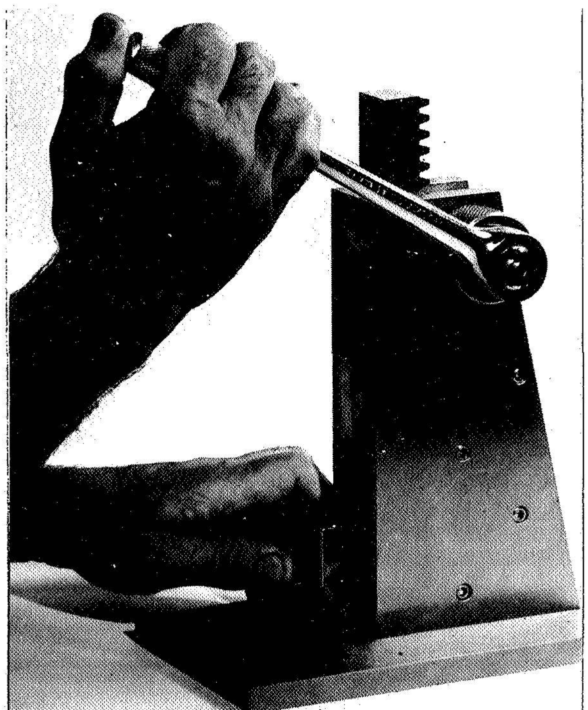


Figure 1

To accomplish battery case removal while maintaining internal component integrity, a hand operated shear, as shown in Figure 1, has been fabricated. The blade assembly consists of three tool-steel elements, two stationary and mounted vertically in parallel with their cutting edges separated by 0.065 ± 0.001 inch. Between these elements, the cutter blade, approximately 0.062-inch wide, operates at a cutting angle of 45° from the vertical by means of a rack and pinion driven by a hand-held lever that provides the mechanical advantage required to cut steel.

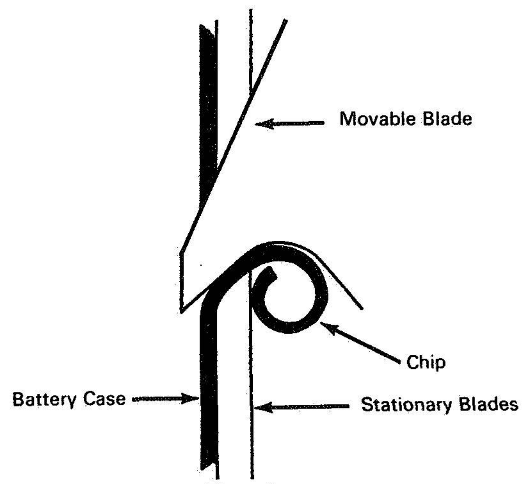


Figure 2

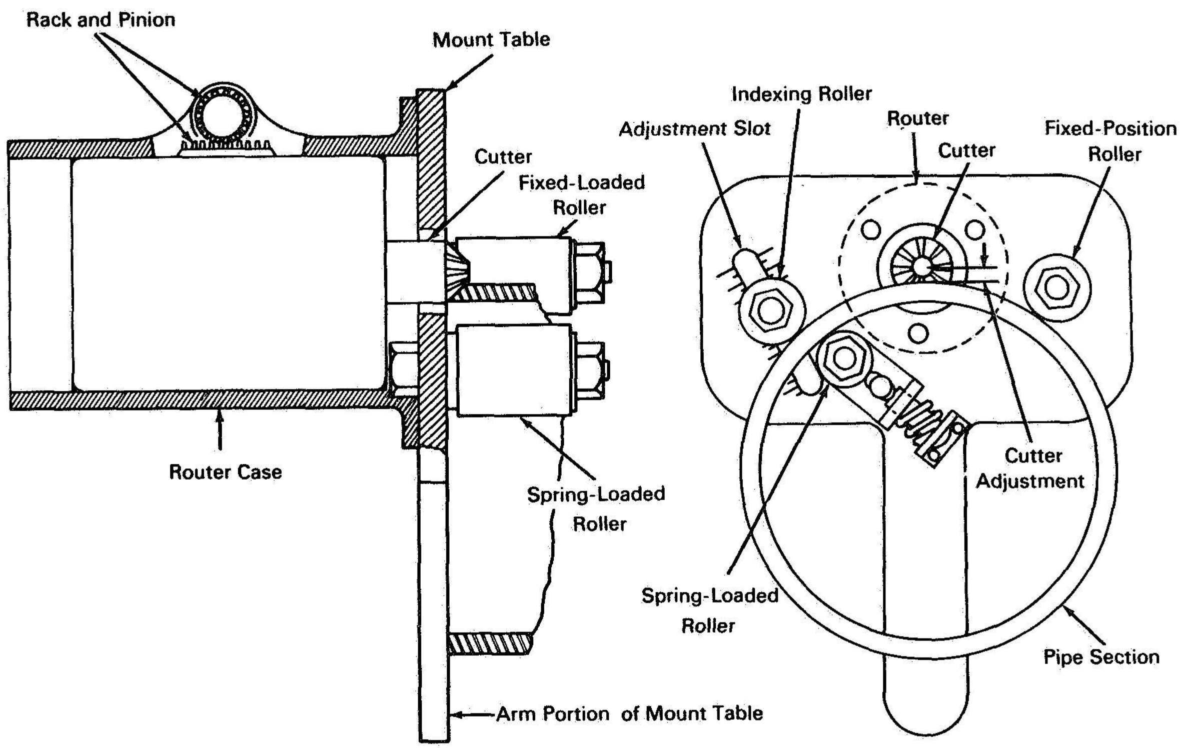
In operation, the angle of cut produces a continuous strip that curls away from the battery case into the slot formed by the two stationary blades, as shown in Figure 2, thus protecting internal components from contamination. Initial downward movement of the lever punctures the case at point of contact. Continued downward movement peels a strip from the case, which is rotated by hand 90° each time the cutter blade reaches a corner, until a continuous strip has been moved. The case below the cut is then easily removed. When the sidewalls of the case are deformed, two cuts are necessary. After the initial cut around the case just below its top, a second cut is made down one of the narrow sides, across the bottom, and up the other narrow side. The case is then easily separated and removed in two sections.

Several cutter blades may be machined with different exposure lengths to provide a set with shearing capability for a wide variety of battery cases.

Source: S. Patro
Goddard Space Flight Center
(GSC-10783)

Circle 6 on Reader's Service Card.

WELD PREPARATION TOOL



This device is an improved scarfing tool, consisting of a mount table, roller-guided assembly, which can convert a conventional routing machine for relatively precise field preparation of pipes for welding. The tool is inexpensive, highly portable, and requires a minimum of training and skill to operate.

Weld joining geometry on the ends of large diameter piping or tubing is usually prepared by hand filing, torch cutting, grinding, or machining. These techniques require relatively cumbersome track-guided or center-chuck-guided devices, often necessitating the moving of pipe sections to shops with large equipment for machining. Present field equipment is very large or imprecise, and the use of shop equipment is often expensive and time consuming.

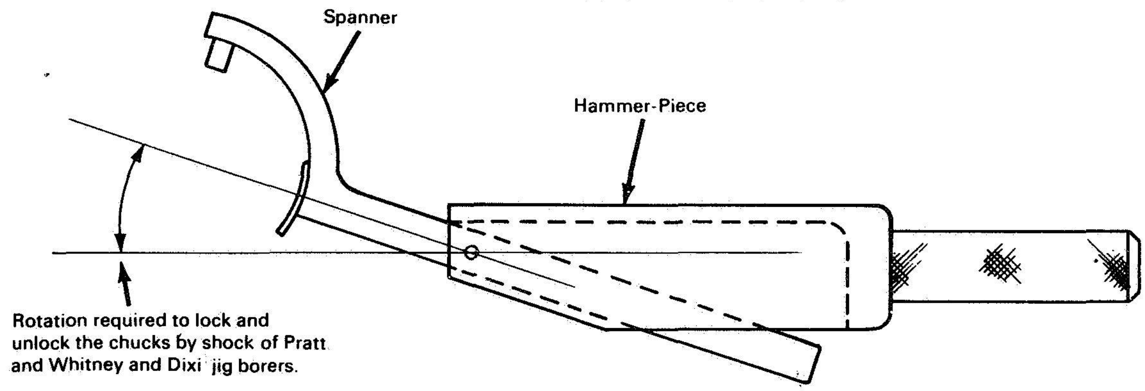
As illustrated, the mount table and a series of rollers form a guiding assembly which, when attached to a conventional router or similar device, converts the tool into a pipe or tube weld-joint preparation device. The mount table is attached by recessed screws to the router case. A fixed-position roller, bolted to the mount table, and an indexing roller, attached to the table by a shaft-bolt through an adjustment slot, are used to adjust and maintain the radial depth of rout. Use of an appropriate cutter or grinder tool, adjusted to the proper depth by the rack and pinion, permits preparation of the precise geometric configuration required. The spring-loaded roller and the arm portion of the mount table are aids to the operator in maintaining the machine in proper position during the operation.

This device should interest companies with field installations requiring the preparation of large, weld-joined piping systems such as those used in process plants and refineries.

Source: E. Wallace
Kennedy Space Center
(KSC-09955)

Circle 7 on Reader's Service Card.

ONE-HANDED HAMMER-SPANNER FOR CHUCKS



A spanner wrench, modified by having a heavy hammer-piece hinged to its handle, has been developed that can be used with one hand for removal of a tool from a chuck (see fig.). Two hands are generally needed to hold the standard wrench and strike it with a hammer. A tool falling from the chuck may damage either itself or the workpiece, and this innovation leaves one hand free to grasp the released tool. No similar wrench is currently available. Although the standard spanner wrench has widespread use, this modification should find application in the machining, fastener and bearing industries.

With the spanner held in one hand engaging the chuck, the same hand causes the hammer-piece to tap the handle of the spanner and so loosen the chuck. The other hand is free to grasp the released tool. The hammer-piece may be made of any suitable material such as steel or aluminum.

Source: J. Martino and S. Seid of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-18581)

No further documentation is available.

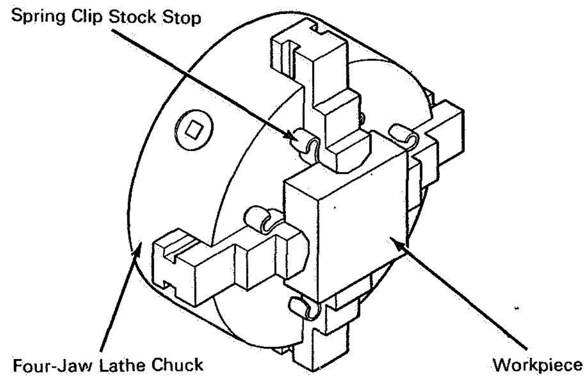
CHUCK JAW STOCK STOPS

Machining operations frequently include the reduction of the thickness of relatively small pieces of plate stock. To clamp the material on a milling machine table and fly-cut the pieces to proper thickness is time consuming and expensive.

The spring clips mounted on each chuck jaw, as illustrated, provide a quick and simple, accurate method of mounting short workpieces so that the face can be machined parallel to the registration surface. Quick mounting spring clips of equal widths, fashioned from pipe straps, are put on each chuck jaw to act as reference surface stock stops. Square or rectangular plates are faced on lathes using four-jaw independent chucks. Round and triangular plates having equal length sides are faced on either four-jaw independent or three-jaw universal chucks. Opposite faces of plate and bar stock can be machined flat and parallel quickly and accurately in this manner with a minimum of set-up effort. This general type of spring clip can be used advantageously in many machine shops for small lot runs. Clips of the required length can be stored in sets and used as needed.

Source: W. Sutton of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-13034)

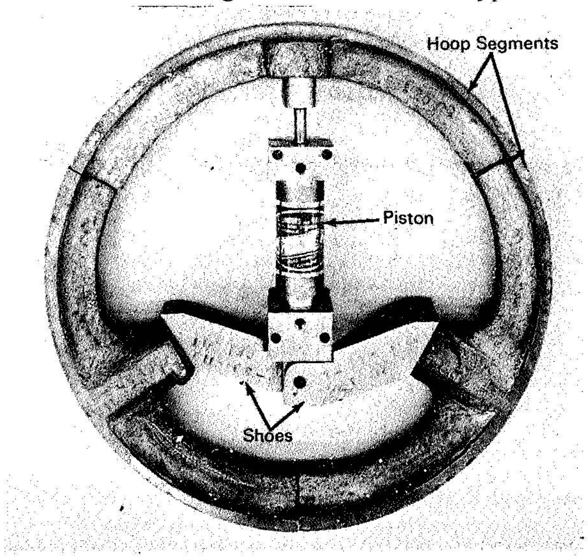
No further documentation is available.

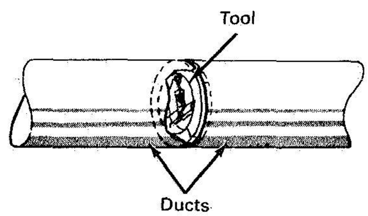


QUICK-ACTING BACKUP TOOL FOR WELDING DUCTS

This alignment and backup tool is designed to facilitate butt welding of large-diameter ducts. It consists of a circular three-place segmented hoop, a pneumatic piston, and two shoes.

The tool in the collapsed condition is inserted between the ends of the ducts to be welded, which are then butted together. Air is then supplied to the piston, which serves as a leg to one of the hoop segments. Action of the piston exerts a radial pressure on the three hoop segments through the connected leg and two shoes. The pressure of the piston expands the hoop segments against the inside walls of the ducts and holds them in place for the welding operation. The tool also acts as heat-sink, weld-chill bars. After the welding operation is completed, the tool is collapsed by releasing air from the cylinder and withdrawn.





Source: L. Johnson of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-18404)

Circle 8 on Reader's Service Card.

PREPARING CONTROLLED ROCK POWDER SPECIMENS

The apparatus shown in Figure 1 will grind the surface of rock specimens or other brittle materials, giving high yields in any desired particle size range without recourse to classification or sieving techniques. Petrographic testing laboratories, manufacturers of rock-sampling equipment, and geologists should find the device time saving and accurate. Conventional techniques produce mineralogically unrepresentative powder specimens and do not provide adequate yields in coarse size ranges (75 to 150 microns) suitable for analysis by a petrographic microscope.

Controlled size distribution is achieved by cutting grooves in the surface of the rock sample to provide thin, shallow, parallel ridges which are then milled to produce the powder specimen. Control of the particle size distribution is effected primarily by changing the height and width of the ridges.

The new apparatus includes a group of thin parallel diamond grinding wheels and a milling cutter; both are driven by a motor (not shown) mounted in the carriage which is advanced in the indicated direction over the rock sample. The milling cutter shaves the ridges down partially to produce a controllable yield of the required particle size. Only the milled powder is collected in a mounted cup.

A variation of the apparatus designed as a rock drill for taking a sample in a predrilled hole is shown in Figure 2. Diamond grinding wheels and a milling cutter are mounted on a common shaft. The grinding and milling tools are driven to traverse the same rotary path on the rock surface within the hole. These tools are individually rotated by gears.

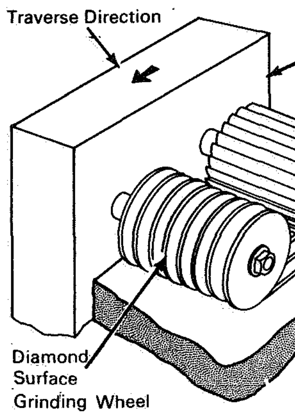


Figure 1

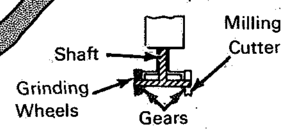


Figure 2

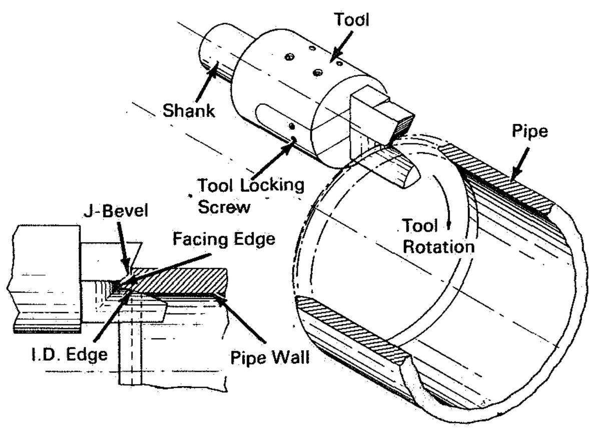
Source: Philip Blum of
Norton Research Corp.
under contract to
NASA Pasadena Office
(NPO-10007)

Circle 9 on Reader's Service Card.

TOOL SIMPLIFIES MACHINING OF PIPE ENDS FOR PRECISION WELDING

A single tool has been designed that prepares a pipe end for precision welding by simultaneously performing internal machining, end facing, and bevel cutting to specification standards. Machining of J-bevels on the ends of stainless steel and aluminum alloy pipe, to be joined by precision welding, will be simplified by this process. The machining operation with this new tool, requiring only one milling machine adjustment, can be performed in half the time required by earlier methods, and consistently produces high-quality pipe-end configurations.

As shown in the figure, the tool assembly is positioned at the proper turning diameter over the end of the pipe wall. It is then rotated and moved parallel to the wall until the innermost portion of the tool (the facing edge) is in contact with the rim of the pipe. The assembly can be fitted readily with interchangeable tools for cutting 25°, 30°, and 37.5° bevels.



Source: S. Matus of
The Bendix Corp.
under contract to
Kennedy Space Center
(KSC-10361)

Circle 10 on Reader's Service Card.

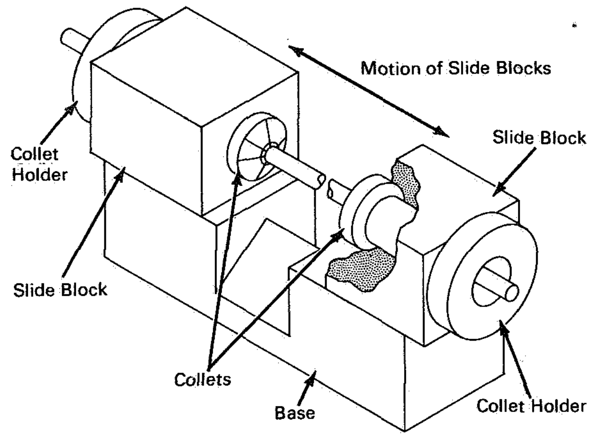
Section 2. Measuring, Aligning and Marking

TOOL REPAIR ALIGNMENT FIXTURE

This fixture was developed for use in repairing broken tools such as drills, taps, and reamers. It could also serve in welding extensions to drills, joining tube segments, welding of rods and similar applications, and provides an effective method of aligning two pieces of practically any standard size tool. In the past, vee blocks and other hold-down fixtures involved alignment problems when used to facilitate the welding of broken tools, particularly for sizes less than 1/2 inch in diameter.

As shown in the illustration, the mating surfaces of the slide blocks and the base must be machined so that the slide blocks are precisely aligned in the horizontal plane. Mounting provisions can be provided for the slide blocks to be rotated to any position in the horizontal plane. This feature permits secure positioning of stock for joining at any angle. Material should be sufficiently hard to minimize wear on the mating surfaces. Polishing mating surfaces will reduce friction and facilitate operation.

The combined shank length of the collets and the collet holders will determine the relative length of the slide blocks. The shank diameters will determine the size of the hole to be machined. The hole would need further machining to accept the backface of the collet, if required.



Source: J. S. Hover and E. J. Schufngel of Chrysler Corp. under contract to Marshall Space Flight Center (MFS-14141)

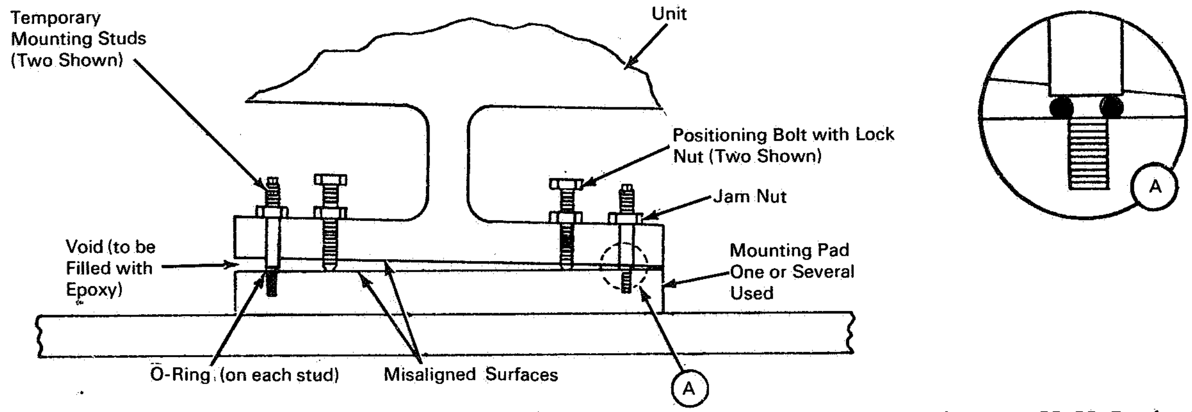
Circle 11 on Reader's Service Card.

COMPENSATION TECHNIQUE FOR MISALIGNED MOUNTING SURFACES

A technique for precision alignment of the mounting surfaces of a fabricated unit and mounting pad compensates for inaccuracies by using epoxy material to fill in the surface void. The usual method of aligning mounting surfaces requires specialized machinery, is time consuming, and becomes very complex when multiple pads and unit mounting surfaces are misaligned.

In the compensation technique, temporary mounting studs with jam nuts, as well as fine positioning bolts with lock nuts, are included in the base of the fabricated unit. The mounting studs each have a recessed O-ring, shown in the illustration, which prevents materials from entering the threaded hole. The fabricated unit is coarsely aligned to the mounting pad by tightening the jam nuts on the studs. A precise alignment is made with the positioning bolts, and the lock nuts are tightened.

When the unit is removed from the pad, the temporary mounting studs are left in place. The interface surfaces are cleaned and an epoxy release agent is applied to the two surfaces as well as to the exposed bolts, studs, and holes to permit their removal from the board. A paste of epoxy is applied to the mounting surfaces of the unit and pad;



the unit is replaced on the studs and realigned to the setting defined by the positioning bolts. After the epoxy dries, the studs are replaced with permanent bolts, and the positioning bolts are replaced by dowel pins secured to the pad. The two surfaces are matched and optimum alignment is maintained.

Source: H. H. Burk of
IBM Corp.
under contract to
Marshall Space Flight Center
(MFS-91373)

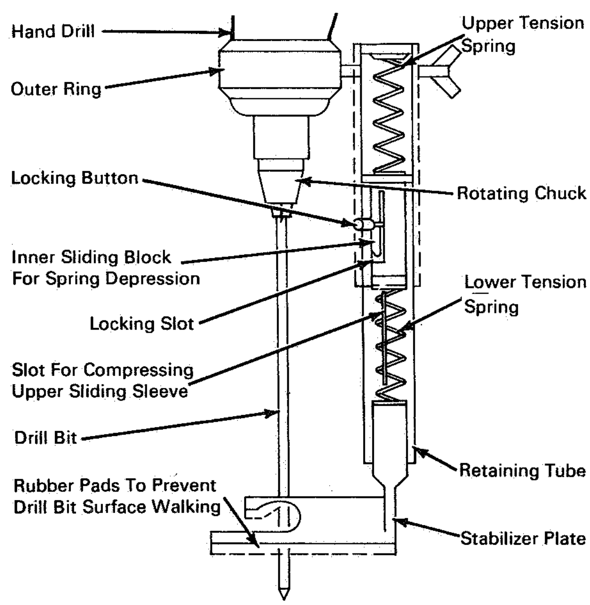
No further documentation is available.

DRILL ALIGNMENT GUIDE

The guide for hand drill alignment is an easily adjustable, simply constructed device, adaptable to most chucks, which can be utilized in close drilling areas. "Walking" of the drill bit can be eliminated, and the possibility of drilling elongated holes is reduced.

As shown in the illustration, chuck and drill bit slip into the ring from above. The drill bit then extends below the stabilizing plate. The depression of the button or arm downward into the appropriate locking slot advances the plates to the drill surface providing instant alignment of the entire tool. The stabilizer plate is bonded with rubber or an appropriate pad to prevent the drill bit from surface walking.

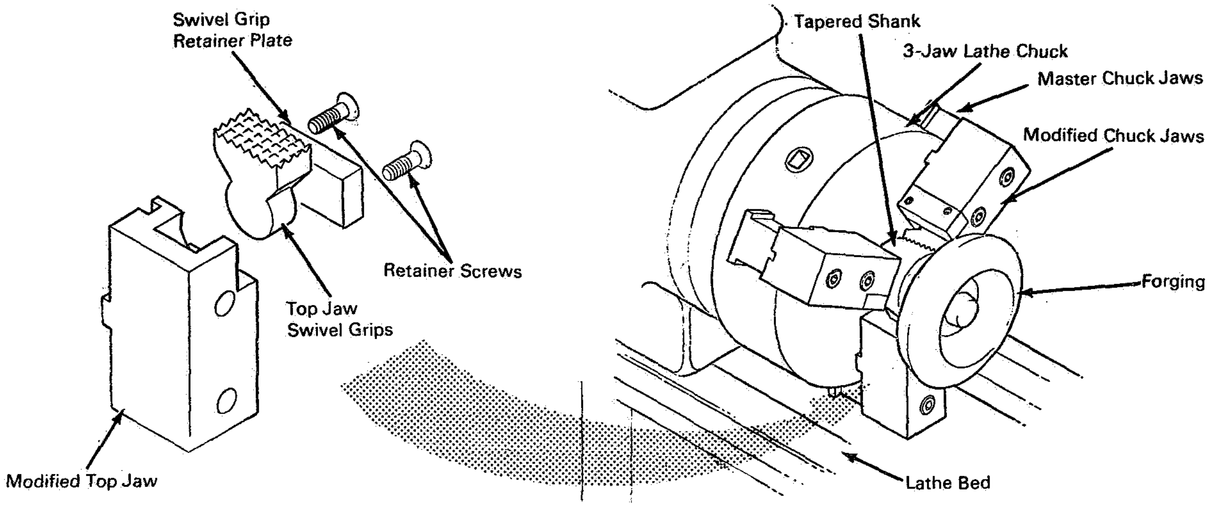
To drill through a surface, the bottom tension spring compresses as needed under pressure. The back pressure of the bottom tension spring prevents a drill bit from suddenly breaking through the surface being drilled, which could damage the tool and other surfaces, or cause personal injury. Retaining tubes may be manufactured with a series of locking slots for different lengths. Several sized rings may accompany each tool for chuck adaptability.



Source: C. E. Fitzgerald of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-12761)

No further documentation is available.

SELF-ALIGNING CHUCK JAWS



Similar to the chuck holding devices described earlier, these swiveling, self-aligning chuck jaws have been designed to grip angular or tapered workpieces. Conventional chuck jaws are unsatisfactory because of insufficient contact of the gripping area of the chuck jaws with the workpiece, due to the angle between the two surfaces.

Special swiveling, serrated chuck jaws fit into the inboard end of soft jaw blanks of a two-piece jaw chuck, as shown in the illustration. The soft jaw with the swivel jaws is bolted to the chuck master jaws. The swivel jaws can be rotated approximately 15° above and below the normal attitude. As the chuck jaws engage the work, the surfaces of the swivel jaws are forced to rotate in the soft blanks until each individual swivel jaw aligns itself with the workpiece. Additional closing pressure on the master jaws causes the swivel jaws to grip the part firmly. Also, more area of a forging can be gripped, increasing the margin of safety for the machine operator. The jaws (swivel pads) can be hardened and serrated with dry film lubricant applied to the bearing area of the pads.

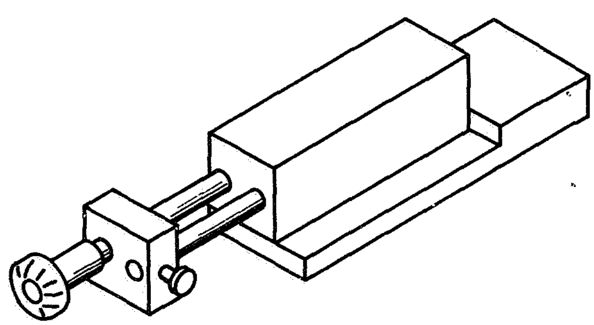
This device may be used on engine lathes, turret lathes, dividing heads, rotary tables, automatic chuckers, forgings, castings, or premachined angular or tapered-body workpieces.

Source: J. C. Thomas of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-12355)

No further documentation is available.

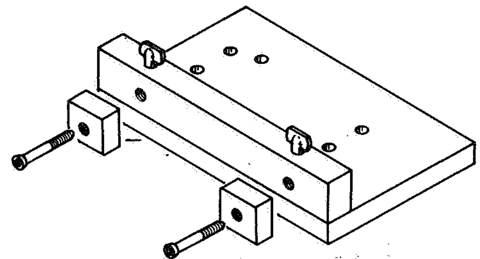
SPRING LOADED SCRIBE TOOL AND INCREMENTED ADAPTER

The spring loaded scribe is a very flexible, timesaving device which can be used where lines are required on irregular surfaces, or where lines are required for true width and depth, particularly on plaster masters, molds and aluminum. The incremented adapter, used for locating the scribe in an accurate position, can be applied where incremented set-up or incremented tooling bars are required.



The scribe is machined to close tolerances which permit its use with the incremented adapter. The adapter is also machined to close tolerances with the grid holes for indexing. Both tools are attached to a beam and held in place on the beam with guide pins. By swinging the beam around the circumference of the plaster master, scribe lines are produced in the plastic. The spring loading of the scribe permits lines to be scribed regardless of any irregularities in the plastic, such as flat spots.

These devices, shown in the two illustrations, should find application in all industries utilizing layout techniques.



Source: J. H. Coventry of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-15609)

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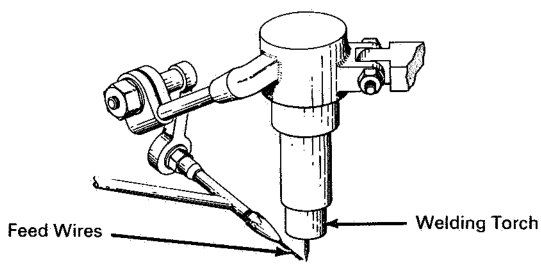
DUAL WIRE WELD FEED PROPORTIONER



A dual feed mechanism has been devised to enable proportioning of two different weld feed wires during automated tungsten inert gas welding to produce a weld alloy deposit of the desired composition. The wires are fed into the weld simultaneously, each wire having an independently controlled feed system. The relative feed rates of the wires and the wire diameters determine the composition of the weld deposit.

This system would be useful in shops or laboratories requiring special weld alloys on short notice or in limited quantities.

Source: R. F. Nugent of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-18037)

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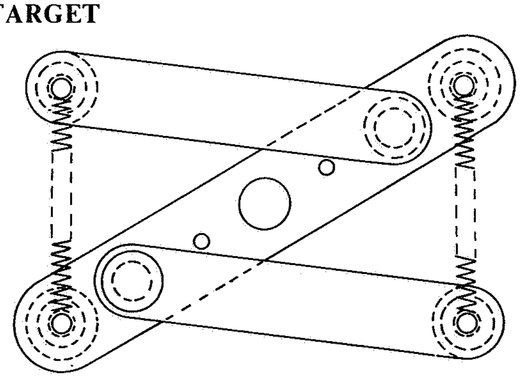
CLAMP-ON TARGET

The assembling of large machinery sometimes requires the use of optical equipment for positioning. This clamp can be used to position a target on a rib or T-section to assure that the target is always over the center of the section.

The target holder is an N-shaped, 3-bar linkage with pivot points at the ends of the diagonal bar. An opening in the center of the diagonal bar serves as the recess for a plug-type optical target. A gage is attached to the horizontal flange of the T-stiffener by opening the legs, permitting the springs to exert pressure against the pins at the diagonal ends, and bringing the pins to bear against the opposte edges of the flange. This configuration maintains the target in position.

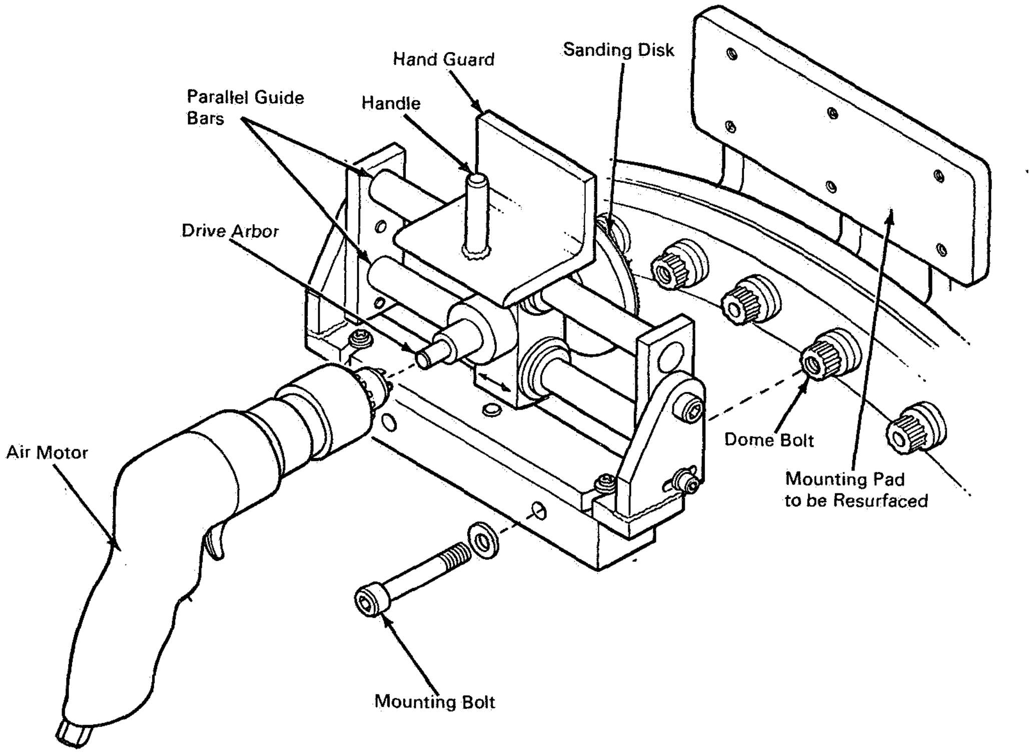


Source: T. Redding and D. Mitchell
Marshall Space Flight Center
(MFS-12273)

No further documentation is available.

Section 3. Removal, Surfacing and Smoothing

RESURFACING SKATE TOOL



This compact portable machine tool was developed for resurfacing areas on large inaccessible structures, such as producing flat boss surfaces that may have been distorted by subsequent welding operations. Prior to development of this tool, there was no commercial method available for resurfacing the distorted faces of sealing surfaces which may have been inaccessible to conventional machine tools because of physical size or field location.

The skate tool utilizes precision ball bearing ways to effect horizontal motion of a carriage across the top of the pressure switch boss. A vertical shaft powered by a lightweight drill motor running through a bearing is mounted to the horizontally actuated carriage. On the end opposite the drive motor, the vertical shaft has a plate attached, faced with adhesive-backed emery paper, which is used as the surface finishing media. The mechanism when set up is similar to a portable surface grinder. The carriage assembly can be moved back and forth, covering the area to be resurfaced.

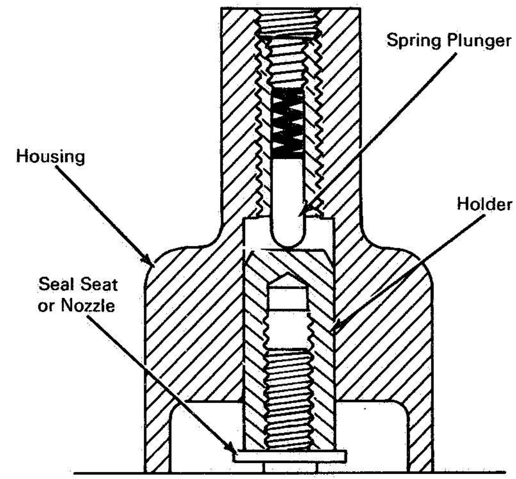
Source: G. H. Burow of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-13940)

No further documentation is available.

METALLIC SEAL SEAT LAPPING TOOL

Another device for surfacing is this simple, small, inexpensive and easily transportable metallic seal seat lapping tool. Unlike ordinary lapping machines which are large and expensive, this device requires no special skill to operate and is applicable wherever small components must be lapped flat and normal to another surface.

The tool can be used for either hand or machine lapping of small metallic seal faces to stringent finish and flatness requirements. It consists of a housing, a holder, and a commercially available spring plunger assembly. The holder is allowed to slide axially in the housing, but is restrained in all other planes by a large length-to-diameter ratio and small diametral clearance between holder and housing. The spring plunger transmits a continuous load between the holder-seat subassembly and lapping block, eliminating scrap, and simplifying procedures. Rocking of the tool during lapping operation is minimized because of the large-diameter housing flange in contact with the lapping block. The tool may be hand-held or retained in a drill chuck.



Source: R. A. Lotz of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-12514)

No further documentation is available.

REVERSING WORN LATHE BEDWAYS

Chucking operations over an extended period cause wear on the replaceable hardened and ground ways of lathe beds. This wear occurs at the headstock end of the bedways. Regrinding the bedways to correct for wear drops the carriage apron, which causes the engaging units to bow the feed rod and lead screw an amount equal to the stock that has been ground off. By turning the bedways end for end, the life and accuracy of the machine can be doubled, and considerable cost savings can be achieved. This simple method should be applicable to all engine lathes, ram-type turret lathes, and possibly to some saddle-type lathes which have replaceable, inserted-type, hardened and ground lathe bedways.

To operate, the mounting holes in the hardened bedways can be jig bored at approximately four-inch intervals. Dependent upon a specific lathe bed length, reversing may cause the ways to extend beyond the end of the bed by as much as four inches. This, however, will not prevent normal chucking operations. If the holes are not aligned, new holes may be provided economically by electrical discharge machining and then tapping. Reversing the bedways in this manner should not affect other operations, even if the lathe is used for operations other than chucking, because the area of wear will be transferred alongside the tailstock.

Source: C. S. Stra of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-12638)

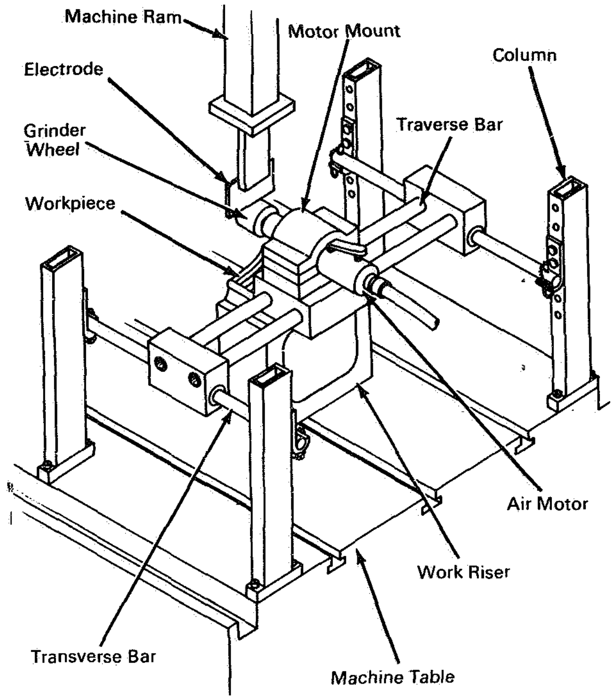
No further documentation is available.

ELECTRICAL DISCHARGE MACHINE ELECTRODE RESURFACER

Erosion of electrodes used during electrical discharge machining operations requires their frequent resurfacing. The electrodes, however, must be removed from the machine and then ground. The removable resurfacer was developed to permit resurfacing without repeatedly tearing down the tooling setup. The time-saving device can be mounted on four posts bolted to the work table. Each time an electrode regrind is required, the grinder and traversing mechanism are fastened to the posts; the grinder is then moved beneath the electrode and the resurfacing is accomplished. The grinding unit is mounted on a carriage, has a three-dimensional adjustment capability which can accommodate any electrodes, and is operated pneumatically.

Source: W. H. Carter and T. E. Gollihugh of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-13938)

No further documentation is available.



ROTARY-KNIFE STRIPPER FOR X-RAY FILM REMOVAL

The rotary-knife stripper, designed to facilitate removal of X-ray film from the daylight pack paper sleeve, would be useful in any industrial or commercial X-ray laboratory. Formerly, a thin blade was used to slit the paper from two sides to allow release of the film, or the paper was removed by hand. The stripper eliminates the need to sharpen and replace blades, and more important, prevents scratching or damaging of the film by handling.

This new device is rectangular, approximately 4 inches wide, 5 inches high, and 7 inches long. The lead end of the exposed X-ray film is fed into the stripper by means of rollers, which keep the film flat and centered as it meets the cutters. The rotary knives are self-sharpening, power-driven, and are mounted one above the other on each side of the film strip. The knives are positioned to trim 1/16 inch from each edge of the sleeve as it passes through the stripper. Upon emerging from the stripper, the film may be wound on a take-up reel; the paper strips and edge trimming fall into a trash receptacle.

The slitter can be mounted on the apron of an automatic film processor, and the film led directly into the developer, without being wound on a take-up reel.

Source: D. K. Mitchell of
The Boeing Company
under contract to
Marshall Space Flight Center
(MFS-14837)

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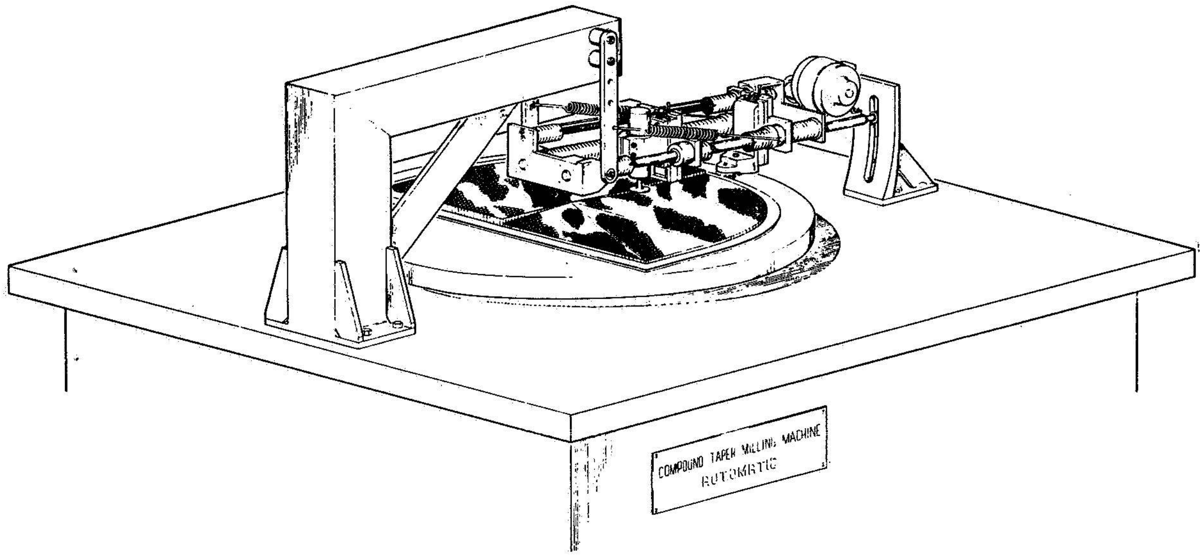
COMPOUND TAPER MILLING MACHINE



A milling machine has been designed to taper panels from a common apex to a uniform height at panel edge regardless of the panel perimeter configuration. While this operation can be achieved by expensive and sophisticated equipment having at least three-axis motion, the new device is simple and cheap to construct and operate, performs efficiently, and can be automated.

The machine consists essentially of an adjustable angled beam upon which the milling tool moves back and forth above a rotatable table which holds the workpiece. The tool moves down the beam from workpiece center to perimeter, machining a predetermined cut; the table is rotated as required, and the tool moves up to the beam to the workpiece center and machines another cut. For workpieces with other than round bases, the beam angle is adjusted for each cut in accordance with the desired finished pattern. On nonround workpieces, the shape at the apex is theoretically round, regardless of the shape at the base, because all tapered cuts pass through a common apex.

This device can be operated successfully by technicians with skill levels well below the requirements for operating three- or five-axis machines of conventional design.

Source: N. R. Campbell of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-15174)

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MACHINING HEAVY PLASTIC SECTIONS

A technique for surfacing polyester pressure windows eliminates distortion produced by conventional machining methods. Severely distorted surfaces, as a result of time-dependent stress relaxation after completion of the parts, have been eliminated. Also, severe residual stresses, as well as heat and mechanical loads imposed during machining which added to the original stresses, have been avoided.

The new technique permits fabrication of parts with plane-parallel surfaces having required optical properties. The surfaces are not subject to degradation from stress relaxation over periods as long as 6 months. A number of unconventional techniques were employed to ensure distortion-free surfaces on the finished parts. The machining was accomplished on a vertical spindle mill. A carefully balanced double flycutter of sufficient length to sweep the stock width with two 180° opposed cutting bits was prepared.

The stock was laid on the milling table and held down by its own weight. The ends and sides were blocked, not clamped, to prevent lateral movement. The blocking was firm to prevent vibration and chatter, but did not impose any measurable compressive load on the stock.

The depth of cut was stringently limited to less than 0.060 inch per pass (nominal 0.050 inch from touch-off). The stock was turned over on the table between each pass so that material was removed evenly from both sides. Minimum feedrate was used to minimize heat buildup in the stock. Each cut was continuous, i.e., no interruption of cutter rotation or table travel was permitted between the start and finish of any pass. When the thickness reached 0.030 inch over the finish dimension, the stock was removed from the machine for a minimum of 48 hours. During this period it was stored on edge with no restraint of any type and no protection from the ambient conditions in the shop. It was then returned to the mill and one-half of the remaining surplus (0.015 inch) was removed from each side. This was followed by polishing, using conventional processes and preventing any heat buildup in the part.

Source: O. Stalkup of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-12720)

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NASA-Langley, 1971

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