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TECHNOLOGY UTILIZATION

MATERIALS HANDLING

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A COMPILATION



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

# MATERIALS HANDLING

## A COMPILATION



TECHNOLOGY UTILIZATION OFFICE  
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
1970  
*Washington, D.C.*

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## Foreword

The National Aeronautics and Space Administration has established a Technology Utilization Program for the rapid dissemination of information on technological developments which have potential utility outside the aerospace research and development program.

This publication is part of a series intended to provide such technical information. Coverage of the materials handling area is illustrative of the recent advances resulting from laboratory research and practical applications in the field. Emphasis is placed on items reflecting reliability as well as cost efficiency.

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 contemplates no patent action on the technology described.

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

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

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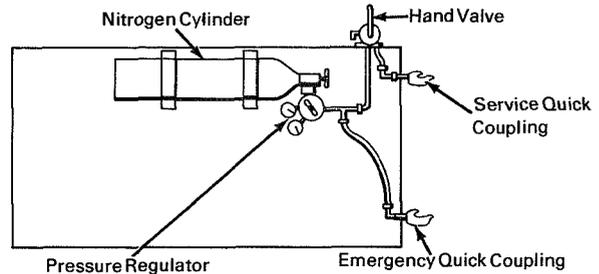
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## Section 1. Lifting Operations

### COMPRESSED GAS SYSTEM OPERATES SEMITRAILER BRAKES DURING WINCHING OPERATIONS

An auxiliary braking system mounted on a dolly converter is used in conjunction with power winch operations. A Q-type cylinder charged with nitrogen at 2000 psig is strapped beneath the frame of a standard service dolly converter and connected through a pressure regulator to one service quick coupling and one emergency quick coupling. As shown in the diagram, pressure to the service quick coupling is further controlled by a hand valve mounted on the forward left-hand side of the dolly chassis. The semitrailer is coupled to the dolly and the semitrailer brake system is attached to the dolly service quick coupling for loading or unloading operations. The emergency quick coupling is used for long periods of inactivity such as overnight or weekend shutdowns. During loading or unloading operations, one person stays beside the dolly and operates the hand valve to activate the

semitrailer brakes as required. Since this method requires no wheel blocking, expedites operations,



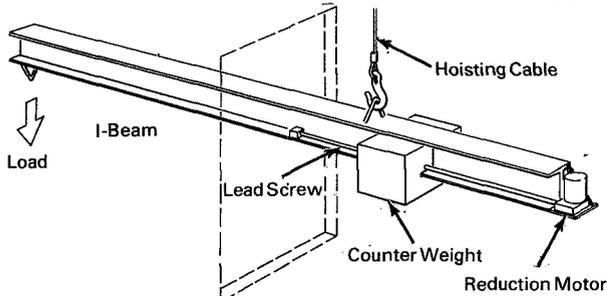
and increases personnel safety, it should interest individuals concerned with material transportation and handling.

Source: William E. Tupper  
NASA Pasadena Office  
(NPO-90036)

Circle 1 on Reader's Service Card.

### SELF-BALANCING BEAM PERMITS SAFE, EASY LOAD HANDLING UNDER OVERHANG

The movement of heavy machine parts or other loads through passageways or under overhangs which normally prevent the direct employment of a crane, may be accomplished by using an I-beam with a motor-driven balance positioned to balance the load. The size and weight of the load determine the selection of the I-beam and counterweight. As shown in the diagram, a hoisting eye is mounted near the center of the selected beam. One



end of the beam is constructed to hold the load while a motor is placed at the other end and geared to drive a lead screw. By turning the lead screw, the counterweight is moved along the beam.

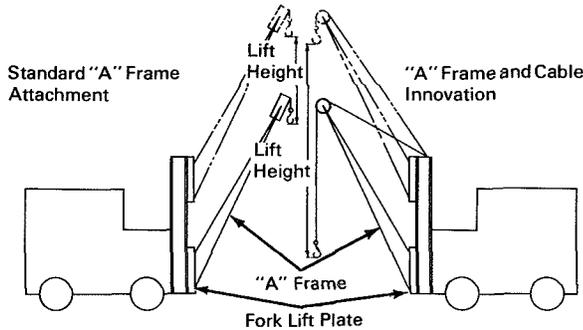
Operation of the balancing beam begins by securing the load to the beam. The counterweight is then moved to a point on the beam which exactly balances the load. The load is then guided into place. Since the counterweight cannot balance overloads, this innovation provides an automatic safety factor. Additionally, many types of load-moving operations in manufacturing and storage processes performed in limited spaces may be expedited by the use of this beam.

Source: O. H. Edwards  
Marshall Space Flight Center  
(MFS-90084)

Circle 2 on Reader's Service Card.

### PORTABLE HOIST WITH LIFTING MULTIPLIER

The lifting range of a portable hoist, consisting of an "A" frame mounted on a standard fork lift, may be increased by the addition of a novel cable and pulley arrangement. As illustrated, the



"A" frame, made of aluminum tubing, is bolted to the lifting section of the unit. After a pulley (lifting multiplier) is attached to the apex of the "A" frame, a wire rope and a lifting hook are installed and then attached to the back of the unit.

The capability of the modified hoist to raise objects higher than designed levels should be of interest to users of portable hoists in shops, assembly plants, and other industrial environments.

Source: Charles C. Walsh of North American Rockwell Corp. under contract to Manned Spacecraft Center (MSC-15243)

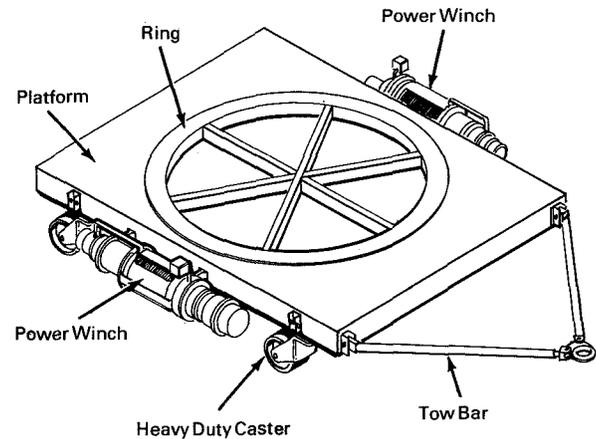
*No further documentation is available.*

### VERTICAL INSTALLER OF HEAVY OVERHEAD EQUIPMENT

Relatively precise positioning of heavy objects at ground level prior to controlled hoisting is possible with this mobile, rotating stand. Dual hoists on the sides of the stand are used with overhead pulleys to raise the stand above ground. The 4700 lb stand has a holding capacity of about 4000 lb.

The stand consists of a rectangular base mounted on free-swiveling casters which incorporate dual wheels, parking brakes, and position locks. A support ring is bearing-mounted on a three-point suspension, and can be manually rotated 360 degrees. The hand brake attached to the base holds the support ring in position. The support ring may be lowered to allow an overhead gimbal clearance of 160 inches. Two motor-driven hoists, fastened to the sides of the base, are used with overhead pulleys attached to the stage or the stand to raise or lower the load from the stage. The hoists may be operated individually or simultaneously, at either slow or fast speed. As an integrated safety feature, an alarm connected to the hoist electrical system is sounded whenever the installer frame exceeds a 3-degree tilt during installation. An explosion-proof controller box, which houses the electrical relays, terminal blocks, and alarm system switch-

es, is at one end of the vertical installer. The remote control station containing hoist operating



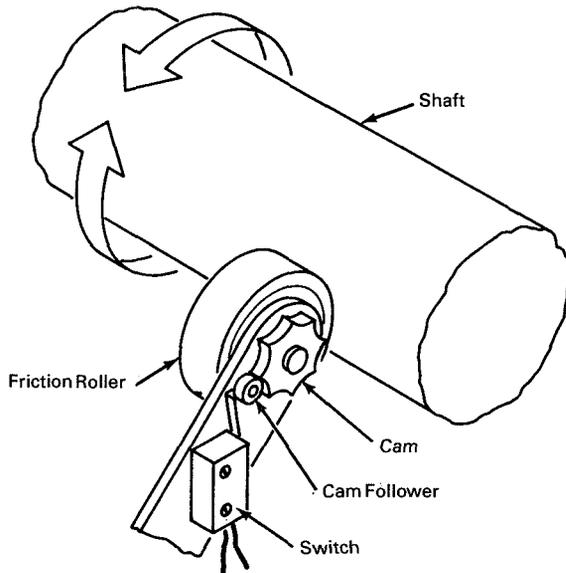
switches is mounted on a 75-foot electrical cable enabling the operator to control the load from any position.

Source: Hugo R. Santora of North American Rockwell Corp. under contract to Marshall Space Flight Center (MFS-18672)

*Circle 3 on Reader's Service Card.*

### SPEED-SENSING DEVICE AIDS CRANE OPERATORS

Operational difficulties arising from obstructions in the crane operator's vision when hoisting loads around towers, gantries, antennas, bridge



support members and other structures, may be reduced by a newly developed speed-sensing device. Visual and audible signals are produced in the crane cab to indicate rate of load movement to the operator.

As shown in the diagram, a multilobed cam is friction-driven by the cable-drum drive shaft. The cam engages a follower to operate a switch energizing both a buzzer and indicator lamp in the crane cab. The frequency of the buzzer and lamp signals accurately indicates load movement in very small increments. A sensor has been developed to react to a hoist movement of  $1/8$  inch. If cable reeving is changed, a different cam with the appropriate number of lobes is substituted to retain the approximate ratio between drum speed and load movement.

Source: Edward L. McFord  
Wallops Station  
(WS-90004)

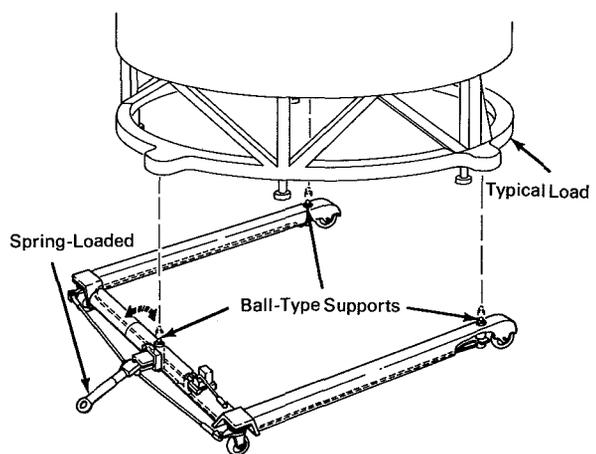
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## Section 2. Moving Operations

### UNIVERSAL TRANSLOADER MOVES DELICATE EQUIPMENT WITHOUT STRESS

Heavy or delicate items may be moved over irregular surfaces, without transmitting stress to the load, by a newly devised transloader. The device is supported on three pivot points to produce a warp-free base, supported in turn by an articulated four-wheel frame. The transmission of distortion forces experienced by the transloader is thus eliminated by the independent three-point support. One side member of the trailer is free to rotate about the longitudinal axis of the cross member to insure full wheel contact over uneven terrain and produce an evenly distributed load. The motive power always provides a direct pull due to the universal joint connection to the cross member:

The support bases of the load to be moved are equipped with three extension arms which mate with the transloader pickup points. When the transloader is in position around the support base, the ball-



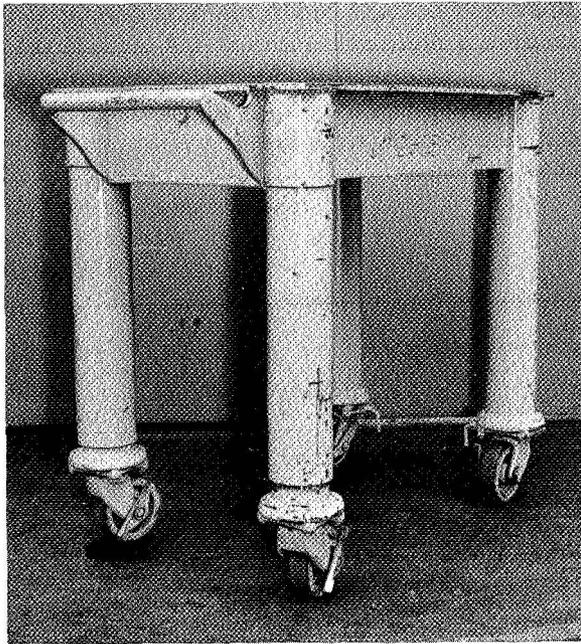
socket extension arms are aligned with the three pick-up points. The supports are then raised into position and the load is lifted for transporting.

Vertical travel of the support points can be independent or synchronous and can be activated by mechanical, hydraulic, or electrical means. When the load has been moved to the desired location, it is set down by lowering the ball-type supports on the transloader and then moving the trailer out from under the item's cradle or base.

Source: P. N. Kessler and J. R. Barbour of  
North American Rockwell Corp.  
under contract to  
Manned Spacecraft Center  
(MSC-90654)

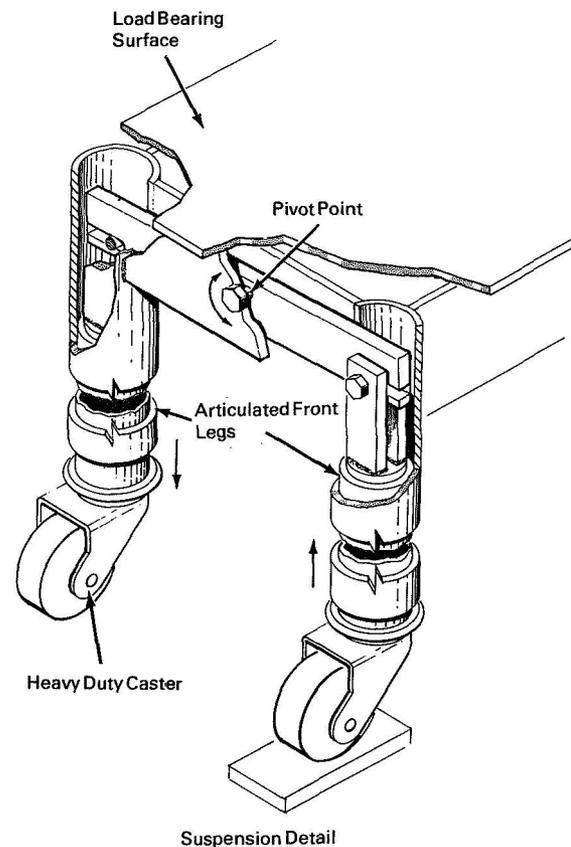
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### HAND CART CONCEPT WITH SELF-LEVELING WHEELS



Incorporation of a pivot in the front legs of a heavy duty hand cart provides a smooth ride over irregular surfaces. Previous leveling methods included spring mounting, varying numbers of wheels, and a fifth wheel design with compensating king-pins. The proposed inclusion of the pivotal system enables all four wheels to find their own contacting surface regardless of irregularities. In contrast, many former hand cart designs had rigid constructions which prevented all wheels from contacting irregular surfaces simultaneously. The resultant rough ride was a potential cause of damage and a safety hazard.

As evident from the diagram, this heavy duty hand cart may be adapted to fit the requirements



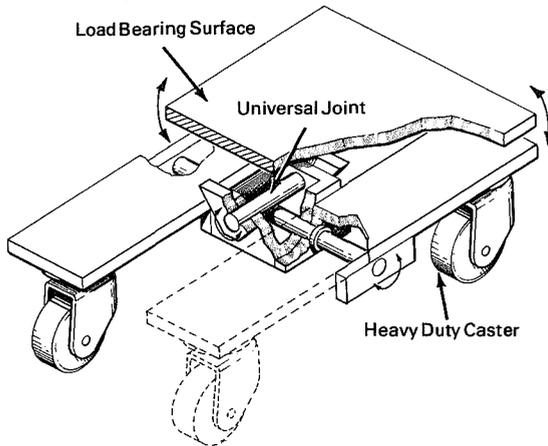
of shops or industrial areas where heavy tools, dies, and bulky materials are moved short distances over uneven surfaces.

Source: Ronald J. Mohr of  
North American Rockwell Corp.  
under contract to  
Manned Spacecraft Center  
(MSC-15640)

*Circle 6 on Reader's Service Card.*

### MULTI-WHEEL DOLLY WITH UNIVERSAL JOINT

Constant load leveling of heavy cargoes is achieved by a novel low-level four wheel dolly



operating on the fulcrum principle. The dolly is capable of moving from 10,000 to 30,000 lb over irregular surfaces while maintaining the load level during transit. The double acting system of this innovation may be used in industrial areas where heavy materials or objects must be moved in limited space prohibitive to more bulky transportation equipment. The illustration provides an explanation of the dolly's construction, wherein the universal joint furnishes the leveling effect.

Source: Ronald J. Mohr of  
North American Rockwell Corp.  
under contract to  
Manned Spacecraft Center  
(MSC-15610)

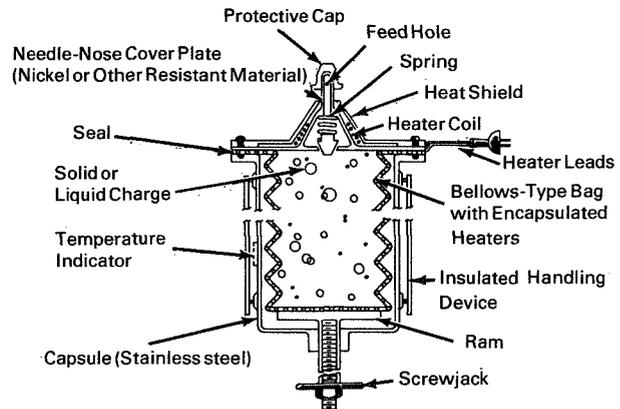
*Circle 7 on Reader's Service Card.*

## Section 3. Handling Operations

### FILLER DEVICE FOR HANDLING HOT CORROSIVE MATERIALS

Hot caustic acids or other corrosive liquids may be safely handled or injected into modules by a combination storage and injection device. The corrosive material is poured into a bellows-type bag equipped with encapsulated heaters. The bag is made of a suitable corrosion-proof material such as polytetrafluoroethylene. As shown in the diagram, the filled bag is placed in the capsule and the cover plate with safety cap and heat shield is attached. The unit is then connected to a 115 V ac source and the contents heated to the desired temperature range.

To fill or charge a module with the corrosive material, the protective cap is removed and the feed hole is inserted into the module. The screwjack is turned down, forcing the ram against the bellows-type bag and compressing it. This action unseats the check valve and injects the hot corrosive material into the module. The combination storage and injection device, which incorporates its own heating element, provides a safe handling



method for corrosive liquids in industrial applications.

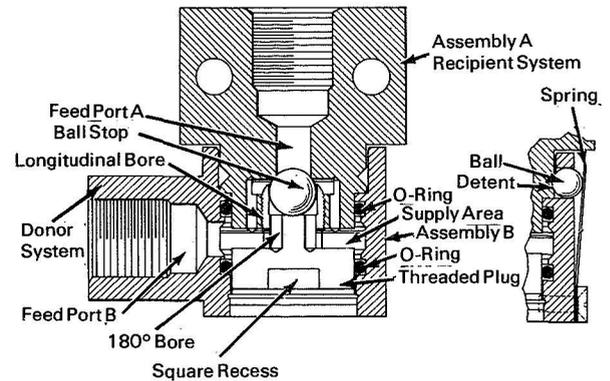
Source: T. E. O'Rourke and M. J. Diotalevi of  
United Aircraft Corp.  
under contract to  
Manned Spacecraft Center  
(MSC-90085)

*No further documentation is available.*

## TWO-PART VALVE ACTS AS QUICK COUPLING

Former product loss and time expenditure associated with fluids transfer from small to large tanks have been substantially reduced by using a new two-part valve. One part of this valve remains integral to the recipient system, acting as a check valve when filling is not taking place, while the other part remains integral to the donor system. The valve part, integral to the recipient system, consists of assembly A with a feed port A, into which a ball stop is pressed by a threaded plug, and in which the ball stop is captive. As shown in the diagram, movement of the plug and ball stop in and out is accomplished by means of a socket wrench drive engaging a square recess in the base of the threaded plug.

The valve section integral to the donor system consists of assembly B with a feed port B which mates with the supply area in the recipient system assembly A when in place. Two O-ring seals entrap the fluid under pressure within the supply area so that pressure is equalized when the two parts of the valve are assembled. Twelve longitudinal bores at 30° intervals around the periphery of the movable plug direct the fluid under transfer from the supply area into feed port A. Assembly B is re-

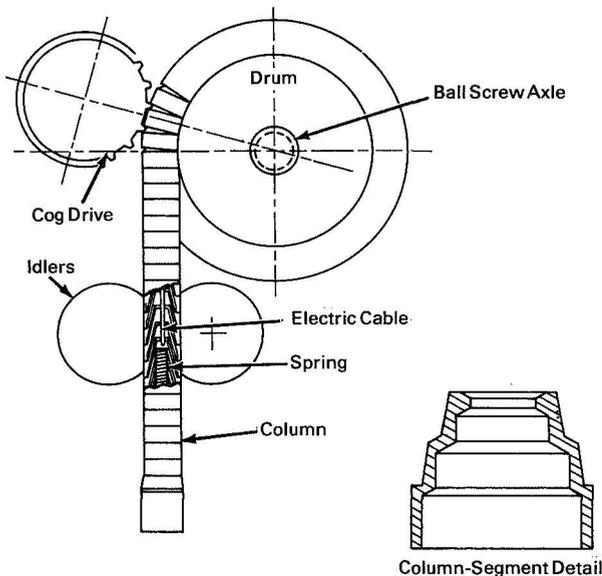


tained in a position connected to assembly A by means of two spring and ball devices which mate with detents on each side of assembly A. Two bores 180° apart within the threaded plug buoy up the ball stop to prevent chattering in the open position. Because of its pressure-balanced design (up to 3000 psig), this valve has potential value in any industrial operation involving fluid transfer under pressure.

Source: William F. MacGlashan, Jr.  
NASA Pasadena Office  
(NPO-90478)

Circle 8 on Reader's Service Card.

## EXTENDIBLE COLUMN CAN BE STOWED ON DRUM



A column or mast has been designed which is rigid in compression but is sufficiently flexible to be coiled for storage on a circular drum. The column is formed from a series of nesting segments held together by an internal spring and/or an internal cable. When the column is extended by the drive mechanism, the spring through the center holds the segments together. The column is stiff in compression because an axial force on the free end is transmitted through the column by the nesting segments. Bending rigidity in the column may be increased by a corresponding increase in the spring tension, or by tightening a cable through the center. If electrical instrumentation is required at the free end, electrical wires may be conducted through the center of the spring or tension member. The contact surfaces may be lubricated to reduce friction.

The column can be coiled on a drum or extended into a rigid structure of variable length. Diameter of the drum is dependent on the internal and external cone angles of the segments. Thus, for a column with an angular deflection of  $10^\circ$  per segment, the drum diameter is approximately 4 times the column diameter.

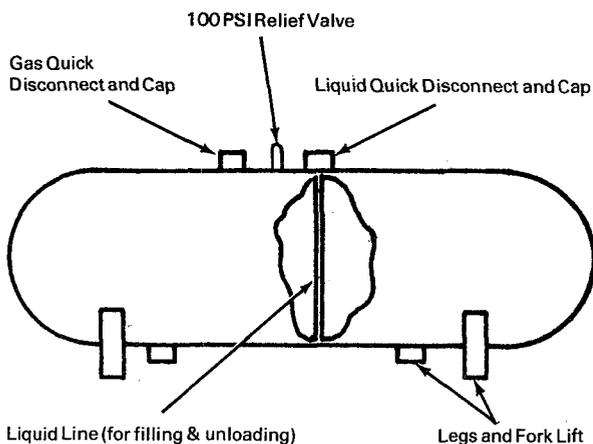
This stowable column may be utilized for taking soil or water samples under remote conditions, or supporting electronic or optical sensors.

Source: E. A. Howard and G. M. Holtz  
NASA Pasadena Office  
(NPO-90686)

Circle 9 on Reader's Service Card.

### ALTERNATE METHODS OF HANDLING AND TRANSPORTING A HYDRAULIC TEST AND CHECKOUT FLUID

The utilization of 55-gallon drums for the transportation of a hydraulic test and checkout fluid was considered undesirable because of contamination and handling costs. Therefore, a study was initiated to consider alternate methods of fluids handling before choosing an optimum method.



Consideration was given for the use of: a nitrogen purge in the 55-gallon drums, large 6000 to 15,000-gallon commercial tankage, 1000-gallon propane tanks for transportation, and the use of 1000-gallon propane tanks for both transportation and as a launcher-umbilical tower reservoir tank. The best fluid handling method consisted of the 1000-gallon transportation and reservoir container concept. This method allowed the reservoir tank to be pressurized with nitrogen to 25 psi, and precluded possibilities of fire and explosion.

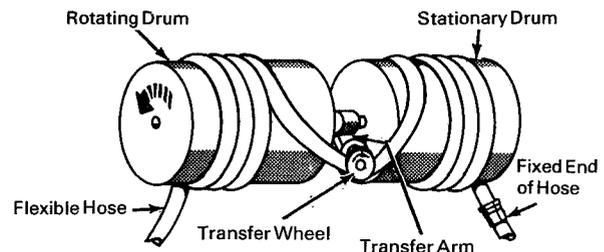
Industrial handlers of combustible fluids should be interested in this study either to improve their existing handling procedures or to implement new improvements.

Source: L. H. Collins and R. H. Smith of  
The Boeing Company  
under contract to  
Marshall Space Flight Center  
(MFS-12957)

Circle 10 on Reader's Service Card.

### DISPENSING SYSTEM ELIMINATES TORSION IN DEPLOYED HOSES

Torsional moments are reduced in a dispensing system which uses a rotating drum, transfer arm, and a stationary drum to deploy, reel in, and store an attached hose. The rotating drum winds or unwinds the hose, the stationing drum stores the hose, and the transfer arm regulates the hose movement between the rotating drum and the stationary drum. As depicted, the transfer arm is normal to the axis of the two drums and revolves about the axis as the rotating drum turns. A trans-



fer wheel, turning freely on the end of the transfer arm, allows the hose to move smoothly past the

arm. In the winding (storing) operation, the rotating drum and transfer arm move in a clockwise direction. As the rotating drum turns, it takes in the hose at one end. At the same time, the transfer arm, rotating at a velocity designed to maintain proper hose tension, takes the hose from the opposite end of the rotating drum and wraps it onto the stationary drum for storage. In the unwind or deploying operations, the rotating drum and transfer arm move in a counterclockwise direction.

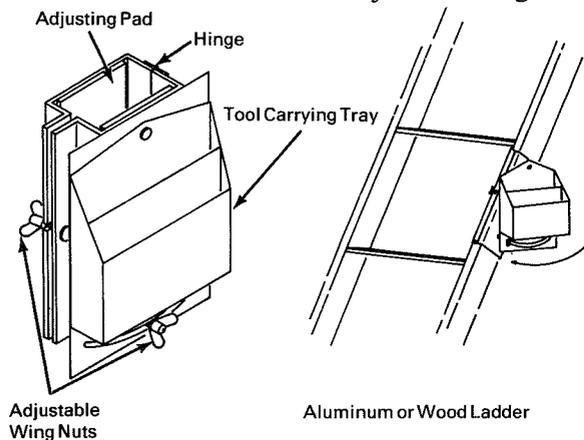
Since this dispensing system minimizes strain and wear during the handling of flexible hose, it is useful for handling flexible cables or conduit where one end must remain permanently attached to an outlet.

Source: I.I.T. Research Institute  
under contract to  
Manned Spacecraft Center  
(MSC-90080)

*Circle 11 on Reader's Service Card.*

### TOOL CARRIER FOR USE WITH EXTENSION LADDER

Hand tools may now be stored in an easily accessible, orderly and safe position on any aluminum or wood extension ladder by a new lightweight tool carrier. The carrier has adjustable wing nuts



which fasten it to either the left or right leg of the ladder, and also permit adjustments in height and angle of attachment as desired. The tool carrier allows the tools to be conveniently arranged and securely held in their designated place by utilization of appropriate spring clips. The previous practice of carrying hand tools in a belt pouch was undesirable because of interference with body movements and the possibility of dropping tools on persons in the immediate vicinity. The tool carrier is easily modified in size and tool arrangement.

Source: Carl C. Starbeck of  
North American Rockwell Corp.  
under contract to  
Marshall Space Flight Center  
(MFS-16106)\*

*No further documentation is available.*

### IMPROVED CLEAN ROOM SAMPLING TECHNIQUE

Sampling of clean room parts may be accelerated by placing up to 50 items on a stainless steel mesh rack, flushing them with a high volume of pressurized freon or approximately 5 to 6 minutes, and then sampling the collected freon to evaluate the results. Trays are constructed to allow drainage of flushing freon into a sampling beaker, with the parts separated from the pan bottom by a stainless steel screen.

The new single step technique requires approximately 7.2 seconds per item as compared with 30 seconds per part for a previously used four-step

method. Additionally, it presents far less possibility of contamination as well as costing less in terms of manpower and equipment. Industrial firms concerned with clean room sampling techniques may revise the presented technique to conform with their requirements of clean parts volume and specifications of cleanliness.

Source: Texatron Incorporated  
under contract to  
Manned Spacecraft Center  
(MSC-13347)

*No further documentation is available.*

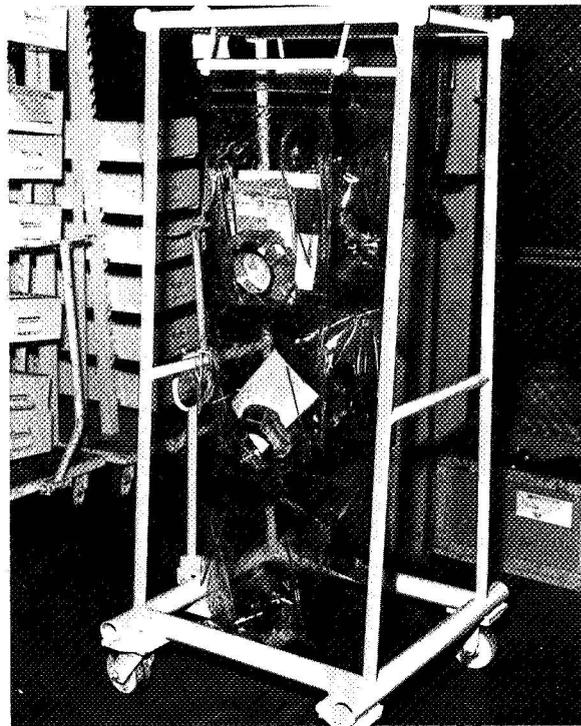
### VISA-POCKET HANDLING SYSTEM

Machined parts may now be protected from damage during transit between work stations by newly designed heavy-duty clear plastic aprons. The plastic aprons have patch-type pockets with flaps to hold workpieces of nominal size and weight (limited to approximately 25 pounds for optimum service life). As illustrated, the plastic aprons are mounted on hangers which may be attached to a cart, rack, or monorail, for conveyance of parts through a manufacturing process or storage.

This method of protecting machined parts is easily modified to conform with the requirements of any industrial process which would not exceed the strength specifications of the plastic materials. Choice of material and apron design would depend upon the working environment and the degree of protection desired for the machined products.

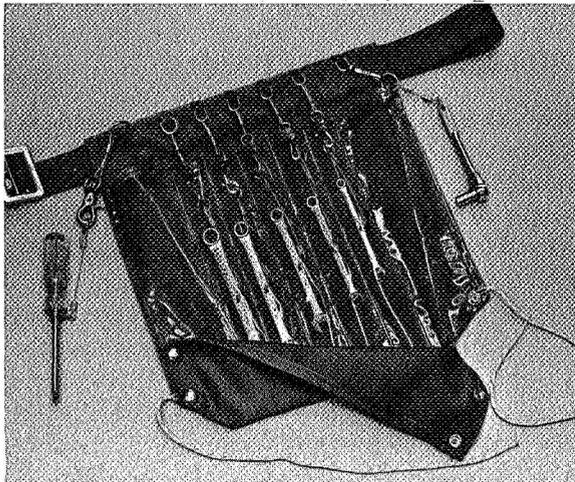
Source: T. S. Dowe of  
North American Rockwell Corp.  
under contract to  
Marshall Space Flight Center  
(MFS-20676)

*Circle 12 on Reader's Service Card.*



### HANDTOOL POUCH AND RETAINING MEANS

The use and safeguarding of small tools and equipment in a liquid oxygen (LOX) clean room environment have led to the development of suitable



tool pouches and aprons. As illustrated, the newly devised carriers provide positive attachment for the items, are made from materials acceptable to LOX clean room environment, and are completely washable. These pouches have tool pockets which are sized to fit various tool configurations, and may be partially opened to facilitate thorough cleaning. Additionally, the pouches have permanently attached, quick opening, mechanical fasteners to secure lanyards from each tool to the carrier, thereby eliminating the possibility of dropping or mislaying the tools.

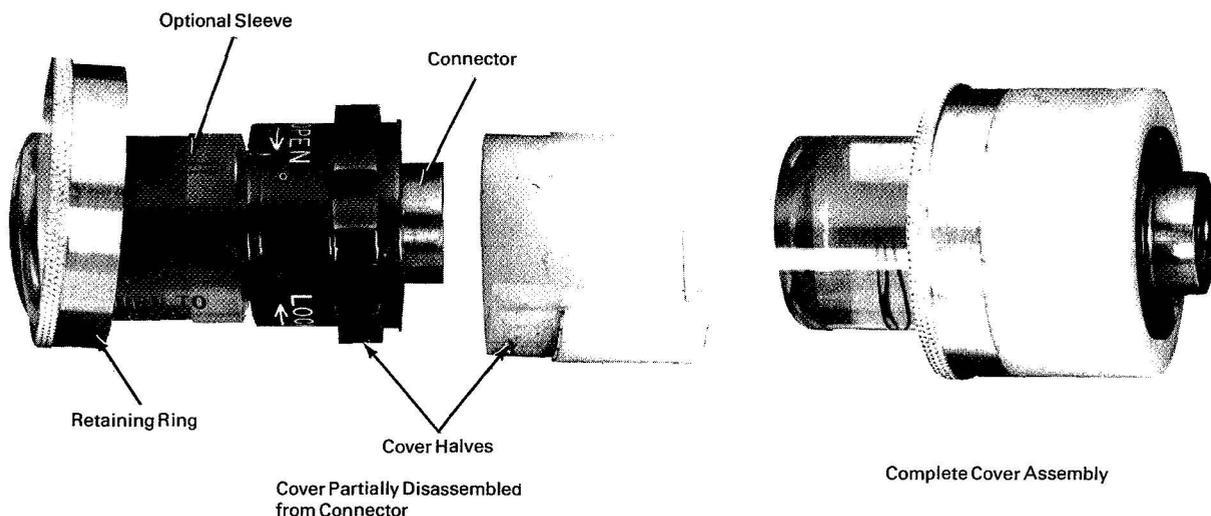
Source: Andrew Raiz of  
North American Rockwell Corp.  
under contract to  
Marshall Space Flight Center  
(MFS-90863)

*No further documentation is available.*

### COVER PROTECTS CRITICAL ELECTRICAL CONNECTORS AGAINST DAMAGE DURING HANDLING

Expensive cable connectors may be protected from damage during handling by a split-half cover. The cover eliminates surface marring and dirt penetration previously encountered during handling

cap is provided for the open cable end of the connector. Split-half covers may be designed in any shape, weight, or material to meet the requirements of industry in materials handling.



and cable assembly. To protect a connector, the two plastic halves of the protector are mated to the unit and a metal retaining ring is slipped over the assembly to lock the two halves in place. As illustrated, the transparent plastic sleeve is an optional component which may be used for grommet and pin protection. For full protection a dust

Source: A. Z. Compoy of  
North American Rockwell Corp.  
under contract to  
Manned Spacecraft Center  
(MSC-15662)

*Circle 13 on Reader's Service Card.*

### DEVELOPMENT AND TEST OF A STERILE INSERTION TECHNIQUE

A sterile insertion technique has been developed for the installation of heat-sensitive components in a sterile container. An experimental investigation was conducted on the effects of varied heat sealing conditions on plastic films contaminated with known concentrations of *Bacillus subtilis* var. *niger*. Pseudo seams were used to ascertain the extent of biological kill; original seals were evaluated for entrapment of biota during cutting of the seams. The pseudo seam data indicated approximately three orders of magnitude reduction of

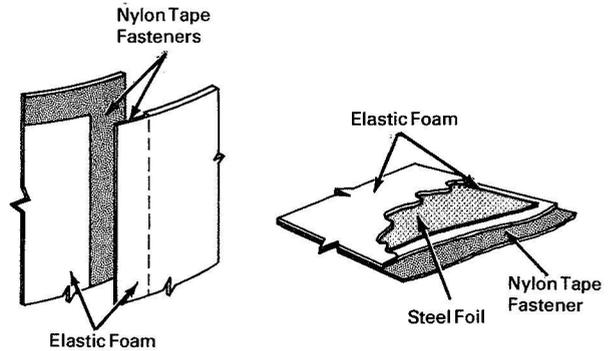
contamination level with 5 mil FEP sealed at temperatures in the range of 525° to 550°F at pressures of 20 psi and 25 psi for times of 1 through 20 seconds. These data demonstrate the achieved level of biological security of a heat-sealing concept for sterile insertion using plastic film.

Source: Martin Marietta Corp.  
under contract to  
Marshall Space Flight Center  
(MFS-20131)

*Circle 14 on Reader's Service Card.*

### IMPACT AND PUNCTURE-RESISTANT MATERIAL PROTECTS PARTS FROM DAMAGE

Delicate parts and equipment may be protected from damage during transportation and storage by a lightweight impact and puncture resistant covering material. As illustrated, the material consists of uniformly sized, laminated panels of steel foil bonded between sheets of elastic foam. The panels are made in convenient sizes and provided with adhesive coated nylon tape at the edges to enable joining individual panels into a protective blanket or enclosure in practically any size or shape. Impact absorption and puncture resistance result from the laminated elastic foam and steel foil construction of the panels. Lateral components of forces contacting a panel surface are transmitted through the elastic skin to adjacent panel areas and dissipated. Orthogonal force components on the outer skin are transmitted to the steel foil core whose bearing strength is supported by the elastic skin on the opposite face of the panel. This skin



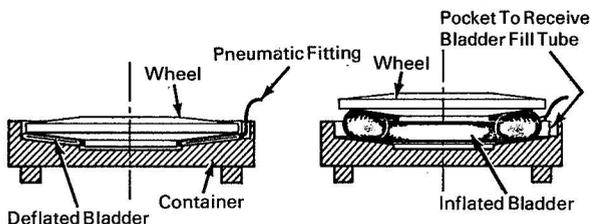
transmits the orthogonal force components elastically as distributed loads on the enclosed part.

Source: Don D. Sheriff of  
North American Rockwell Corp.  
under contract to  
Manned Spacecraft Center  
(MSC-90747)

Circle 15 on Reader's Service Card.

### INFLATABLE BLADDER TO FACILITATE HANDLING OF HEAVY OBJECTS: A CONCEPT

Removal of heavy objects from containers is facilitated by utilization of inflatable bladders. In this concept, heavy or highly finished metal parts are raised to more advantageous removal positions



by inflating rubber bladders previously positioned under the container contents. Users of this technique would modify bladder size and air pressure according to the requirements presented by the moving operations.

Source: M. J. McGoldrick of  
North American Rockwell Corp.  
under contract to  
Marshall Space Flight Center  
(MFS-14272)

Circle 16 on Reader's Service Card.

### AIR BEARING LIFT PAD

Extremely heavy or fragile equipment may be moved for short distances across slightly undulating surfaces, cracks and discontinuities by an air bearing lift pad. An inflatable bladder is mounted

under the rigid pad to provide an airgap of several tenths of an inch. The bladder is inflated with air which subsequently escapes through passages into a cavity in the center of the bladder to produce the

lifting energy. As the air escapes about the perimeter of the bladder, balance and equilibrium are imparted to the pad as it moves a limited weight across slightly uneven surfaces.

Source: Dan H. Dane and  
Herman T. Blaise  
Marshall Space Flight Center  
(MFS-14685)

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