SOUTHWEST RESEARCH INSTITUTE
Post Office Drawer 28510, 6220 Culebra Road
San Antonio, Texas 78284

FEASIBILITY STUDY FOR ASSISTIVE FEEDER

FINAL REPORT

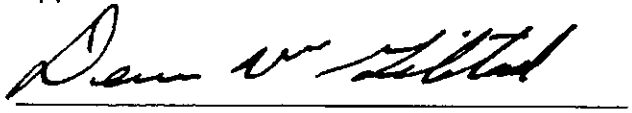
SwRI Project No. 14-1164

Prepared by:
Guy N. Phillips
Senior Engineering Technologist

Prepared for:
Department of Research and Program Services
Association of Retarded Citizens
National Headquarters

January 9, 1987

Approved:



Dennis W. Gilstad, Director
Department of Bioengineering

Introduction

The National Association for Retarded Citizens (NARC) Research Division, Bioengineering Project, has identified a need for a semi-automated means of feeding individuals who are severel physically challenged and profoundly mentally retarded (SPCPMR). This population is described by the Staff Development Department, Austin State School, as being a retardation degree of profound (AB level IV). The school-age population (6-21) is further defined as having obvious delays in all areas of development; these people show basic emotional responses; they may respond to skillful training in use of arms, legs, jaws but needs close supervision. The adult population (21 and over) may walk or need nursing care; people in this group have primitive speech and benefit from regular physical activity. Adults can learn simple self-care (feeding, toileting and dressing) but need a great deal of care and supervision.

A need exists for a device which would allow these individuals to express a greater degree of independence during mealtimes, thus allowing the caregiver (attendant) to address other important matters. NARC Research Division contracted Southwest Research Institute to conduct a feasibility study to ascertain what could be realistically proposed as a feeding device. The goal of this feasibility study is to develop two or more alternative design concepts for consideration. The issues of concern are the food delivery system and the resolution of the food texture or consistency.

To help formulate the conceptual design, a set of criteria was mutually created by NARC and SwRI staffs. Although the following are the minimum criteria applied to the design concepts, some statements may necessarily need to be modified or deleted to fit a given conceptual circumstance.

- User independence from attendants or caregiver.
- Considerations for faster operation than existing automated feeders.
- Considerations for up to three different food substances.
- Feeder system must be capable of being actuated by individuals having minimal head movement functions (These individuals are described as having no apparent hand or arm function, thus leaving head movement as prime source for system actuation).
- Ease of loading foods into the device.
- Adjustable for varying mouth heights.
- Ease of cleaning and sterilizing.

- Resistance to damage and wear.
- Suitable for dispensing semi-solid foods with adaptations for solid foods.
- Affordable to consumers with unit costs from $200 to $500.
- Considerations for keeping some foods warm while others are cold.
- Provisions for beverage access.
- Device to be used on a table or a wheelchair.
- Device design to be as visually pleasing as possible so as not to attract attention.

On November 5, 1986, staff members of National Headquarters, Association for Retarded Citizens (NARC), met with representatives of Southwest Research Institute (SwRI). The meeting was held to discuss design concepts associated with assistive feeding devices. Numerous eating-related issues were discussed, including identification of specific features assistive feeding devices should have. The following is an overview of subject matter discussed.

- The range of head motion was defined as being 12 inches wide by 12 inches high (1 ft. sq.) envelope.
- Delivery system was to incorproate a spoon shape with interchangeability for different sizes and shapes.
- The size of each food bite was to be related to the spoon size and shape.
- Different spoons were to be used for various foods and textures.
- Adjustable lip and chin guards were to be incorporated.
- The device was to be insulated to maintain either hot or cold food substances (at least 2 of 3 sections).
- The volume of each food substance was to be approximately one cup.
- The user was to be able to view the food substance (transparent containers).
- The device was to be adjustable in height as well as depth.
- The user was to be able to have clear vision over the device (no obstructed vision).

- The device could be powered by rechargeable batteries or pneumatics (air).
- The estimated time for feeding was set at 30 to 40 minutes with provisions to extend the period to 90 minutes.
- Foods were to be prepared in home or institution kitchen facilities and placed in self-contained single food dispensers.
- Self-contained disposable food dispensers would be a part of the total assistive feeding system.
- Feeding would be self-paced.
- Food textures would be chopped, ground, and pureed (i.e., applesauce consistency).

The feasibility study assumes that the SPCPMR population is wheelchair assisted and the appropriate seating system is used in all cases.

Commercially Available Feeding Devices

A survey of durable medical equipment (DME) publications and catalogs was conducted. Generally, devices offered by these publications ranged from simple eating utensils (knives, forks, spoons, and plates) to relatively complex automated feeding systems (see Appendix A). Accommodation for most disabilities seems to be adequately covered.

Several automated devices found in the survey might be considered appropriate for some SPCPMR populations. However, careful selection of the user and skillfully executed training will be required. The devices are the Winsford Feeder, "Beeson" Automaddak® and BACO CP3 Series feeders (see Appendix B). These semi-automated feeders could be considered as candidates for institutional as well as home implementation. All of these devices are switch activated (closures) and are powered either by a rechargeable battery or 110 volt 60hz household current. Adjustments for height variation were found only in the Winsford feeder.

The Winsford Feeder has been clinically evaluated by the Veteran's Administration using spinal cord injured quadriplegics (see Appendix C). We found no indications that the "Beeson" Automaddak® or BACO CP3 devices had been clinically evaluated for safety and effectiveness.

In addition to the powered semiautomated feeders, there are several mechanical feeders developed for the Cerebral Palsy populations. It appears these types of feeders might be useful in some SPCPMR populations. Those individuals who have gross movements or minimal motor control would have extreme difficulty using the mechanical feeder.

FEASIBILITY STUDY FOR ASSISTIVE FEEDER

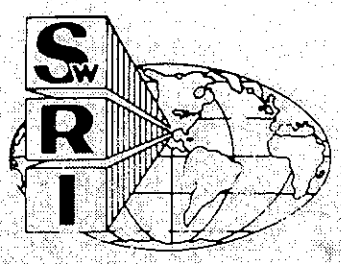
FINAL REPORT

SwRI Project No. 14-1164

Prepared for:

Department of Research and Program Services
Association of Retarded Citizens
National Headquarters

January 9, 1987



SOUTHWEST RESEARCH INSTITUTE
SAN ANTONIO HOUSTON

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

Executive Summary

A need has been identified to develop a dining aid which will provide populations having multiple disabilities a greater degree of independence during mealtime activities. The target disability, severely physically challenged (cerebral palsy) and profoundly mentally retarded, is truly a difficult population to address. The combination of these two disabilities imposes severe restrictions and limitations upon design approaches to a dining aid.

The National Association for Retarded Citizens solicited Southwest Research Institute Rehabilitation Engineering Center to propose a design study to address the dining aid issue. Rather than proposing an engineering design effort, the Rehabilitation Engineering Center proposed a feasiibility study. This feasibility study proposed investigations into past and present technologies and the formulation of design concepts which might be used in future designs. This proposal was submitted on August 16, 1985.

Upon subsequent funding from the National Association of Retarded Citizens, Southwest Research Institute Rehabilitation Engineering Center gathered a core group of scientists and engineers to conduct the feasibility study. This report delineates the work accomplished during the study.

Introduction

The National Association for Retarded Citizens (NARC) Research Division, Bioengineering Project, has identified a need for a semi-automated means of feeding individuals who are severel physically challenged and profoundly mentally retarded (SPCPMR). This population is described by the Staff Development Department, Austin State School, as being a retardation degree of profound (AB level IV). The school-age population (6-21) is further defined as having obvious delays in all areas of development; these people show basic emotional responses; they may respond to skillful training in use of arms, legs, jaws but needs close supervision. The adult population (21 and over) may walk or need nursing care; people in this group have primitive speech and benefit from regular physical activity. Adults can learn simple self-care (feeding, toileting and dressing) but need a great deal of care and supervision.

A need exists for a device which would allow these individuals to express a greater degree of independence during mealtimes, thus allowing the caregiver (attendant) to address other important matters. NARC Research Division contracted Southwest Research Institute to conduct a feasibility study to ascertain what could be realistically proposed as a feeding device. The goal of this feasibility study is to develop two or more alternative design concepts for consideration. The issues of concern are the food delivery system and the resolution of the food texture or consistency.

To help formulate the conceptual design, a set of criteria was mutually created by NARC and SwRI staffs. Although the following are the minimum criteria applied to the design concepts, some statements may necessarily need to be modified or deleted to fit a given conceptual circumstance.

- User independence from attendants or caregiver.
- Considerations for faster operation than existing automated feeders.
- Considerations for up to three different food substances.
- Feeder system must be capable of being actuated by individuals having minimal head movement functions (These individuals are described as having no apparent hand or arm function, thus leaving head movement as prime source for system actuation).
- Ease of loading foods into the device.
- Adjustable for varying mouth heights.
- Ease of cleaning and sterilizing.

- Resistance to damage and wear.
- Suitable for dispensing semi-solid foods with adaptations for solid foods.
- Affordable to consumers with unit costs from $200 to $500.
- Considerations for keeping some foods warm while others are cold.
- Provisions for beverage access.
- Device to be used on a table or a wheelchair.
- Device design to be as visually pleasing as possible so as not to attract attention.

On November 5, 1986, staff members of National Headquarters, Association for Retarded Citizens (NARC), met with representatives of Southwest Research Institute (SwRI). The meeting was held to discuss design concepts associated with assistive feeding devices. Numerous eating-related issues were discussed, including identification of specific features assistive feeding devices should have. The following is an overview of subject matter discussed.

- The range of head motion was defined as being 12 inches wide by 12 inches high (1 ft. sq.) envelope.
- Delivery system was to incorproate a spoon shape with interchangeability for different sizes and shapes.
- The size of each food bite was to be related to the spoon size and shape.
- Different spoons were to be used for various foods and textures.
- Adjustable lip and chin guards were to be incorporated.
- The device was to be insulated to maintain either hot or cold food substances (at least 2 of 3 sections).
- The volume of each food substance was to be approximately one cup.
- The user was to be able to view the food substance (transparent containers).
- The device was to be adjustable in height as well as depth.
- The user was to be able to have clear vision over the device (no obstructed vision).

- The device could be powered by rechargeable batteries or pneumatics (air).
- The estimated time for feeding was set at 30 to 40 minutes with provisions to extend the period to 90 minutes.
- Foods were to be prepared in home or institution kitchen facilities and placed in self-contained single food dispensers.
- Self-contained disposable food dispensers would be a part of the total assistive feeding system.
- Feeding would be self-paced.
- Food textures would be chopped, ground, and pureed (i.e., applesauce consistency).

The feasibility study assumes that the SPCPMR population is wheelchair assisted and the appropriate seating system is used in all cases.

Commercially Available Feeding Devices

A survey of durable medical equipment (DME) publications and catalogs was conducted. Generally, devices offered by these publications ranged from simple eating utensils (knives, forks, spoons, and plates) to relatively complex automated feeding systems (see Appendix A). Accommodation for most disabilities seems to be adequately covered.

Several automated devices found in the survey might be considered appropriate for some SPCPMR populations. However, careful selection of the user and skillfully executed training will be required. The devices are the Winsford Feeder, "Beeson" Automaddak® and BACO CP3 Series feeders (see Appendix B). These semi-automated feeders could be considered as candidates for institutional as well as home implementation. All of these devices are switch activated (closures) and are powered either by a rechargeable battery or 110 volt 60hz household current. Adjustments for height variation were found only in the Winsford feeder.

The Winsford Feeder has been clinically evaluated by the Veteran's Administration using spinal cord injured quadriplegics (see Appendix C). We found no indications that the "Beeson" Automaddak® or BACO CP3 devices had been clinically evaluated for safety and effectiveness.

In addition to the powered semiautomated feeders, there are several mechanical feeders developed for the Cerebral Palsy populations. It appears these types of feeders might be useful in some SPCPMR populations. Those individuals who have gross movements or minimal motor control would have extreme difficulty using the mechanical feeder.

Study of Literatures

Literature searches were conducted to retrieve information pertaining to eating issues associated with the mentally retarded population. Articles found do not address issues which would be helpful to the designer. Studies addressing range of motion of the upper trunk and head were not found, but they are important when considering human/machine interfaces.

There were several publications which addressed the assessment of oral functions and subsequent training. These articles were reviewed for relevancy to the human/machine interface. Although interesting, they did not have content of engineering interest.

During the literature search, we were interested in differentiating between solid and blended types of food. It is important to know whether the profoundly mentally retarded individuals can consume solid food substances or whether they are limited to chopped or pureed food substances. If solid foods are not an option for the SPCPMR population, then design parameters must be focused on the chopped or pureed food textures. The articles were not specific on this issue; therefore, it is assumed that chopped or pureed foods are the most appropriate for this population.

Site Visits to San Antonio State School

SwRI staff visited the San Antonio State School to observe residents during mealtimes. Approximately 45 individuals resided within the unit seen. It was noted that various levels of physical and mental capabilities were present. The population was identified as being profoundly mentally retarded. We did not observe any ambulatory residents and wheelchair assistance was quite common. The purpose of the visits was to observe the mealtime activities and assess problems and difficulties being encountered by the caregivers and residents.

Mealtime activities varied from caregiver feeding services to self feeding. Those who were self feeding generally were using a cuff assisted utensil. Food textures varied between pureed and chopped. We did not observe all individuals in this unit, and some solid foods may have been consumed without our notice.

One resident (21 years old) successfully demonstrated the Winsford Feeder. Activation of the device was accomplished using a foot/hand switch. The food texture was a pureed variety. When using the Winsford device with pureed foods, the problem of the spoon ramping up and over the food was evident. This caused the operator to attempt retrieval several times before success was achieved. Modification to the angle at which the spoon (utensil) attacks the food substance could decrease the incidence of ramping.

Another problem observed was seating and positioning during mealtimes. In some cases the seating and positioning was adequate

while in others it appeared not to be. Any design concept for a feeding device will necessarily assume that proper seating and positioning are present.

Overview of Semiautomated Feeding Devices

Individuals in the SPCPMR population groups who have identifiable upper limb or head motor control and oral functions, and can respond to training may be able to successfully operate a semiautomated feeder device. Candidates must, at a minimum, have enough head control to either operate a head stick (wand) or chin switch. A viable alternative might be "sip and puff" switching device. Oral functions should be sufficient to handle chopped or pureed types of food. The user must be able to differentiate and activate two or more switching functions.

The following overview will address features of the Winsford Feeder, "Beeson" Automaddak®, and the BACO CP3 series devices. The overview was formulated from a study of the manufacturer's specifications and other available literatures (see Appendix B).

Winsford Feeder

This feeder is classified as an electric self-feeder which is powered by a 6 volt rechargeable battery. Individuals can feed themselves at their own speed by using a slight head motion to activate a chin switch. The chin switch is mounted to the device at the front left corner near the feeding plate. The switch stem projects upwards towards the face and can be positioned near the chin. Pushing the chin switch in one direction moves food onto the spoon and raises the spoon to mouth level. Repeating the same switch motion, the spoon lowers to the plate. Pushing the chin switch in the opposite direction rotates the plate to the desired food position.

A hand/foot switch is also provided for individuals having some lower or upper limb control. This switch is basically a rocker type, momentary switch. This switch functions like the chin switch. By positioning the switch in either direction, certain functions within the device are activated.

A scissor type mechanism is mounted to the base to allow height adjustments. A knob, placed behind the beverage holder, moves the scissor type action legs to adjust the height. This adjustment must be made by the caregiver.

A beverage holder is mounted at the right hand front of the device. The holder can be adjusted for height and diameter. A standard bendable straw is recommended.

The Winsford Feeder system includes plate, spoon, pusher, glass holder, chin switch rod, hand/foot switch, battery and charger. An optional transportation or storage case is available. The base is

12" wide x 18" long and weighs approximately 18 lbs. Market price for this unit is approximately $1300.00. This device has been subjected to clinical or field trials by the Veteran's Administration (see Appendix C).

"Beeson" Automaddak® Feeder

This feeder is similar to the "Winsford Feeder" in that it also places the food close to the mouth of the individual. This device utilizes two control pad switches. One switch pad operates the spoon mechanism while the other switch pad controls the plate rotation. The switches are primarily activated using head movement and a head stick (wand). The switches are normally mounted at eye level on the device but can be located at other convenient locations. Unlike the battery powered "Winsford Feeder," this device is powered by 110v 60hz household current. The fluidic switch pads isolate the user from harmful voltages.

This device appears not to have provisions for height adjustments. This may be acceptable because spoon delivery mechanisms can be stopped at pre-selected positions. Actual demonstrations of this device have not been witnessed by our staff.

This device is manufactured and distributed by Maddak Inc., Pequannock, New Jersey 07440-1993 and can be locally purchased at most Abbey Medical stores for approximately $570.00. No approximate weight was given.

BACO CP3 Series

This assistive feeder is similar to the other semi-automated devices previously described. This unit is also powered by 110v 60hz hosuehold current. Control or activation of the switches is accomplished by a head stick (wand). Additionally, this unit can be operated by a light sensitive receiver unit or can be connected to remote controls and accessories.

It is not clear whether this device can be adjusted for height. However, the device may be very similar to the "Beeson Automaddak®" having selected stopping positions to regulate the height.

There is some concern about the safety of this device. The mechanical linkage on the lift arm is exposed to the user. Since the arm linkage is unguarded, the likelihood of pinching is relatively high.

This device is manufactured and distributed by The Bay Company, P.O. Box 16, Panama City, Florida 32401. Prices are F.O.B. Panama City, Florida and range from $755.00 to $845.50 depending upon which model is selected. Actual demonstrations of this device have not been witnessed by our staff. No approximate weight was given.

Non-Powered Mechanical Feeders

The following mechanical feeding devices were reviewed for relevancy:

Cerebral Palsy Feeder - Distributed by Abbey Medical, Fred Sammons and J. A. Preston

Mila One-Step Mechanical Feeder - Mila Engineering Corp.

Dine Aid and Buffet Eating Aid - Both distributed by TASH (Canadian)

Eatery - Distributed by Maddak

The above cited devices probably will not appropriately address the needs of the SPCPMR population. Staff members at the State School in San Antonio have tried some mechanical feeders without success. The main objection to these devices is the amount of upper body control needed to operate them. One staff member witnessed a demonstration of the Cerebral Palsy Feeder and concluded this type of device would not be suitable for the population we wish to address.

Future Alternative Feeding Devices or Techniques

The introduction of robotic arms for self-feeding holds future promise. This technology will probably be available to select groups of disabled individuals during the 1990's. Affordability still looms as its biggest drawback. Along with the enormous expense, the unit size poses many questions.

Safety and control might well be the main underlying factors in non-acceptance within the SPCPMR community. Robots can probably be adapted to various physical disabilities, but a relatively high degree of intellect will be required to safely operate such a device. The robotic technology for self-feeding relies heavily upon reasonable intellect and recognizable voice input. Neither attribute is present in the SPCPMR population.

Some clinical evaluations have already been conducted using robotic arms (see Appendix D). Blanket acceptance by users still remains a problem as illustrated by clinical trials. The probability of use by SPCPMR individuals remains very low at this time.

The training of capuchin monkeys to serve as attendants is beginning to gain momentum. There is evidence that capuchin monkeys can function well as attendants (see Appendix E). Although capuchin monkeys cannot replace all functions of humans, they can be trained to feed individuals. One human supervisory attendant could conceivably oversee several capuchin monkeys during a mealtime activity for institutionalized SPCPMR individuals thus reducing the work load of human caregivers.

Consideration for this method of caregiving has merit. As expertise is gained in this method, the capuchin monkey may hold the key to caregiving problems being experienced today. Like robotics, some intelligent means of communication will be required.

Concept Proposals

There were three categories of design proposals to be considered in this study. The categories are:

(1) Simple modification of, or combination of, currently available products.

(2) Implementation of conceptual designs offered in the scientific literature.

(3) Innovative new designs that have no prior history of attempted use.

Eating also? Our studies under Category 1 did not reveal any feasible feature combinations or simple modifications for available products. Therefore, further in-depth studies under Category 1 criteria were abandoned.

Research into conceptual designs found in the scientific literature (Category 2) were then conducted. Although some pertinent literature was found (see Appendix F), its relevance to SPCPMR population was only speculative. The four devices examined were the Robot Arm from John Hopkins University School of Medicine, Microcomputer-Aided Eating Device from University of Virginia, Spoon Plate from Rancho Los Amigos and the Motorized Solid and Liquid Food Feeding Mechanism from Tennessee Technological University. The above citations are only a few of the many literatures reviewed by SwRI staff.

The above conceptual designs meet most of the criteria previously noted. However, these designs probably will not meet the cost limitations proposed nor be pleasing visually. Since the speed of operation in existing automated feeders has not been clearly reported, the conceptual designs cited may or may not be significantly better operationally than existing feeding devices.

Most feeders purport to be designed so the user's own pace of eating is maintained. No unambiguous criteria for faster operation were found during our research.

An investigation into conceptualizing innovative new designs for assistive feeding devices has also been performed using the criteria described above. In considering Category 3 proposals, the following SwRI professional personnel actively participated in formulating conceptual designs.

Institute Medical Scientist (1)
Senior Engineering Technologist (1)
Senior Research Scientist (2)
Research Biomedical Engineer (1)
Research Engineer (1)
Senior Technician - Consultant (1)
Fellow of National Science Foundation (1)

An overview of each concept generated is given in the following text. Where warranted, the issues of minimum criteria were addressed. These concepts are not necessarily presented in the chronological order in which they were investigated.

Conceptual Design 1.

In the version shown in Figure 1, three different types of food could be selected plus one liquid beverage. The food is placed in disposable or reusable "collapsible" plastic bags by an attendant (they also could be commercially produced), and then slid into the clear plastic housing. Each bag has a flexible plastic "straw" that is threaded through the apparatus and out the side. Either the straw or the apparatus could be adjustable so that the diameter of the straw could be controlled to match the viscosity of the food substance being presented (e.g., blended carrots or potatoes would require a large diameter tube while soup would require a small diameter tube). The clear plastic bag and encasement would allow the individual to view and discriminate the contents of the bag. Another option would provide color-coded or shape-coded encasements to provide a salient discriminative cue for severely mentally retarded individuals or to obscure the view of "unnatural appearing" blended combinations for other individuals. The plastic bags could be mass-prepared, frozen, and placed in a microwave oven for quick delivery and for the convenience of the support staff. If necessary, the amount of nutritional composition of a person's diet could be precisely monitored by weighing the bags before and after mealtimes.

Concept 1 was introduced to the National Headquarters of ARC on 19 August 1986 by an Invention Disclosure Acknowledgement prepared by SwRI. This type of disclosure instrument was issued to protect the concept for ARC. ARC reviewed this concept and offered their comments. The comments were accompanied by ARC concept papers, plus a one-page description and graphic rendering of their concept of the dining aid (see Figure 2).

A developmental prototype is estimated to cost approximately $1000.00-$1250.00. Depending upon the materials and manufacturing process used (tooling, assembly, packaging, etc.), this unit might be marketed in the range of $250.00 or less. Actual final costs would be dependent on production techniques used and the number produced.

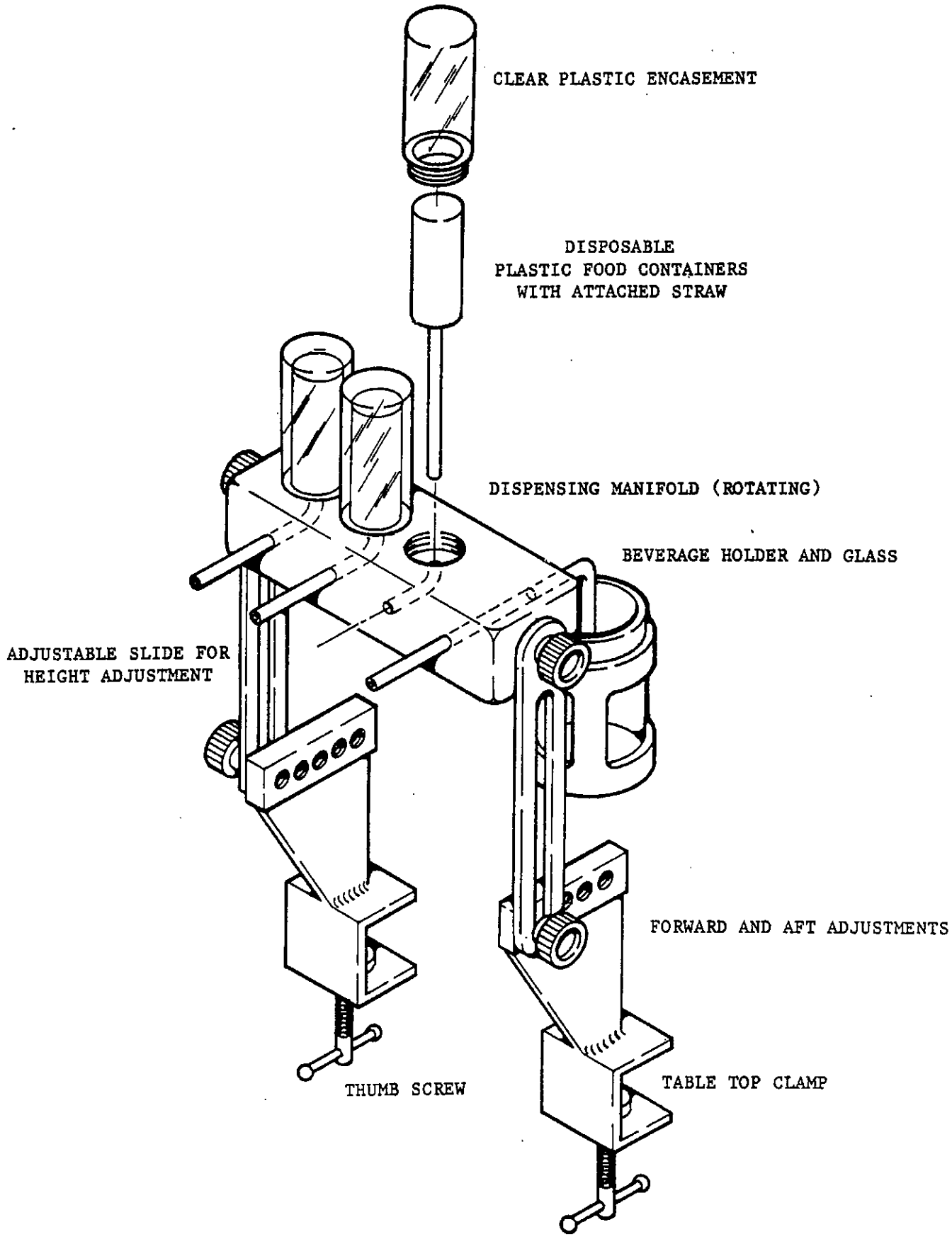


FIGURE 1. PUREED FOOD DISPENSER

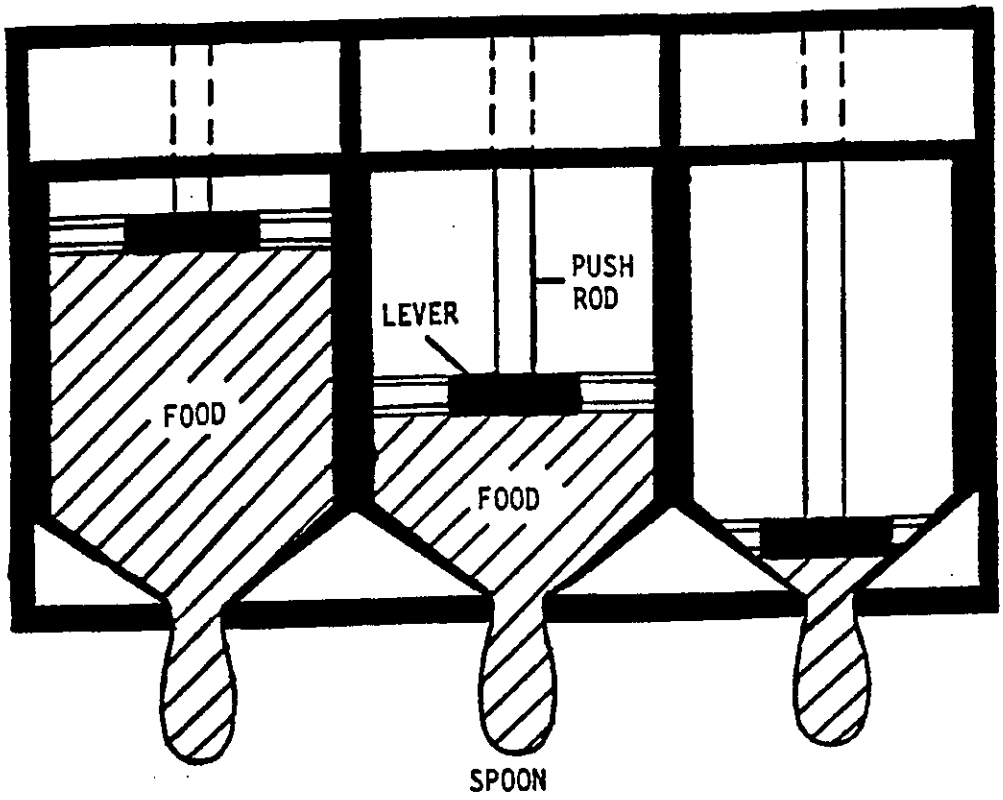


FIGURE 2. ARC DINING AID CONCEPT

Conceptual Design 2. Two Unit, Powered Dispenser Module (see Figures 3 and 4)

The individual module concept incorporates the use of a power unit which extrudes food substances from a self-contained pliable bag. This unit can be either electrically or pneumatically driven. The power unit is detachable from the main module so that the module can be cleaned after use. Features incorporated into this module concept are:

General Characteristics

- A replaceable spoon, in varied configurations, mounts to the module front face.
- A pliable food bag, either in a bellows or plain configuration, is heat sealed after food has been loaded. In this configuration, foods can be preprocessed and stored for future use. The bag must be punctured at the spoon interface just prior to the delivery cycle.
- Electrical or pneumatic drives extrude food from pliable bags.
- The power unit and module are separable for cleaning.

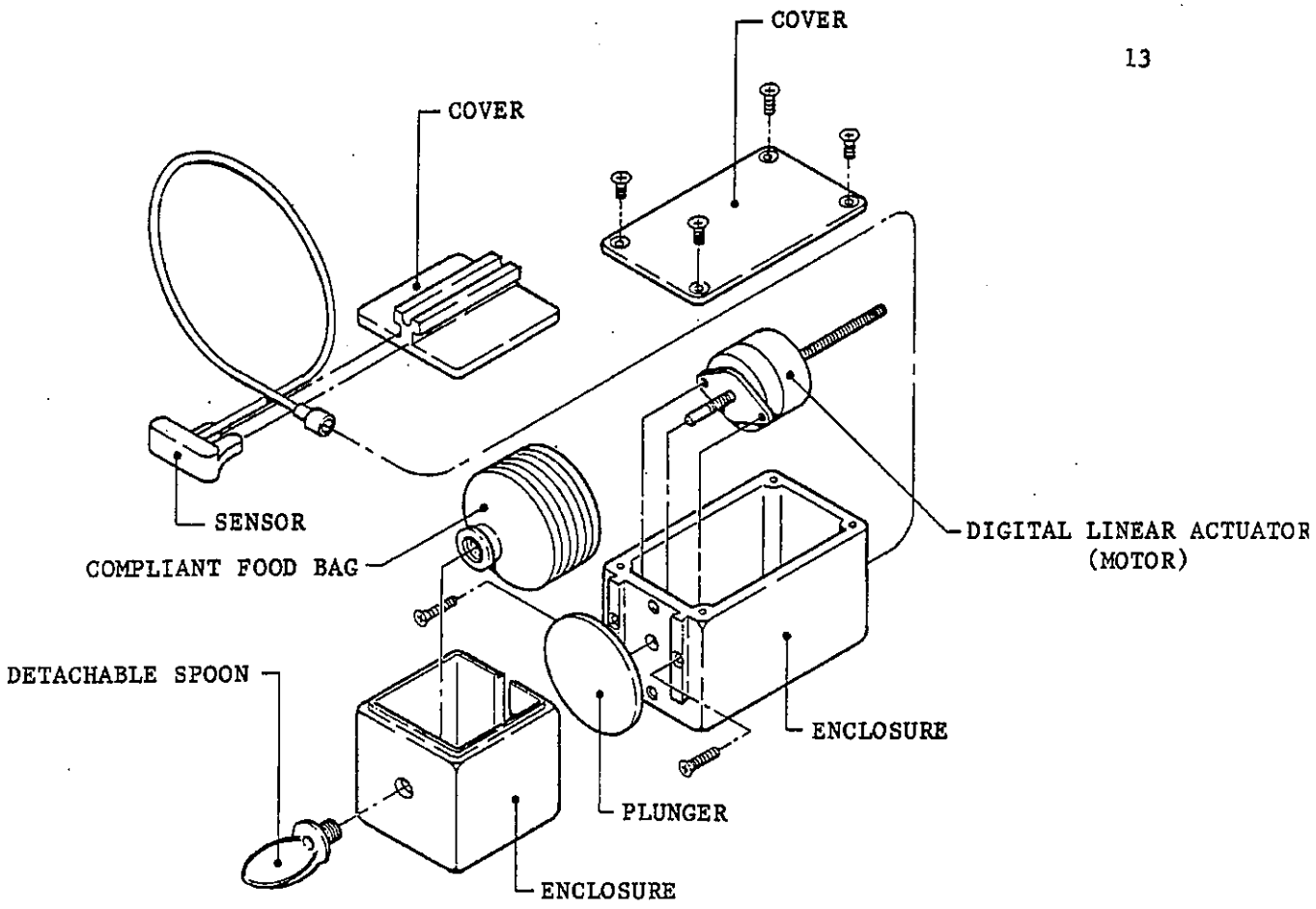


FIGURE 3. TWO UNIT MODULE - LINEAR ACTUATOR

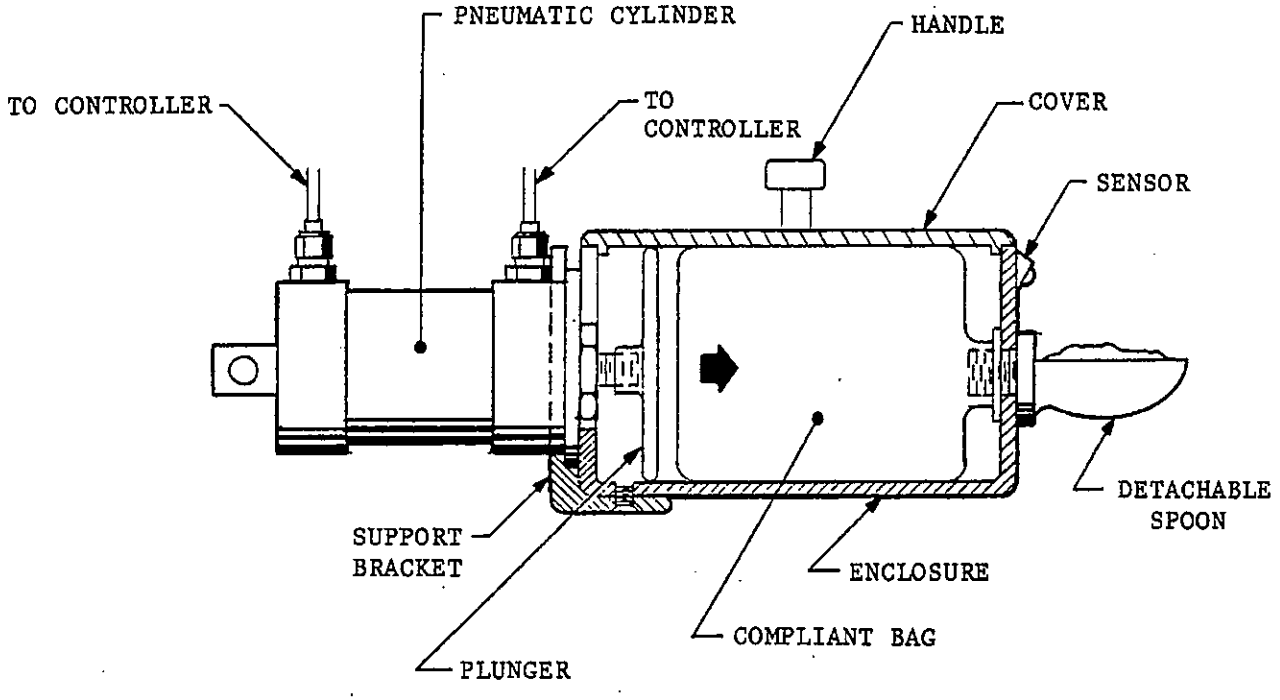


FIGURE 4. TWO UNIT MODULE - PNEUMATIC ACTUATOR

- A sensor is used to detect presence or absence of food substance in the spoon. An electrical cable from the sensor is connected to the power unit to furnish the necessary control.
- Individual modules can be used alone or be grouped into two or more units to form an array.
- An insulated lid or cover is furnished to sustain the required food temperature.
- Provisions for accommodating a beverage holder are incorporated into the support platform.

Power Drive

- The electrically driven power unit would utilize a digital linear actuator (stepper motor). A 12 VDC rechargeable battery pack (nickel cadmium or sealed lead acid batteries) would power the motor. A 12 VDC plug-in taper charges would be used to keep the batteries at full charge. Linear stroke is 2.5 inches.
- The pneumatically driven power unit would utilize a streamlined stainless steel air cylinder. A regulated 40-60 PSI air source would be required. This drive unit would be controlled by a pneumatic logic circuit, soleniods and regulators. Linear stroke of cylinder is 2.5 inches. Cylinder bore 1 to 2 inches in diameter.

Electronics

- An electronics package would be required to control the drive unit. Control would be provided through a sensor arrangement. A light emitting diode (LED) would be used to indicate the end of the feeding cycle. The electronics would be interfaced with an air logic controller when pneumatic drive is used.

Adjustable Support Platform (see Figure 5)

- Platform to accommodate up to three individual modules.
- Adjustable in height as well as fore and aft.
- Attach to a table by clamping or to a wheelchair with special accessories.

Power Source

The power sources, either electrical (12 VDC) or pneumatic (40-60 PSI), are remote and are not integrated into the module.

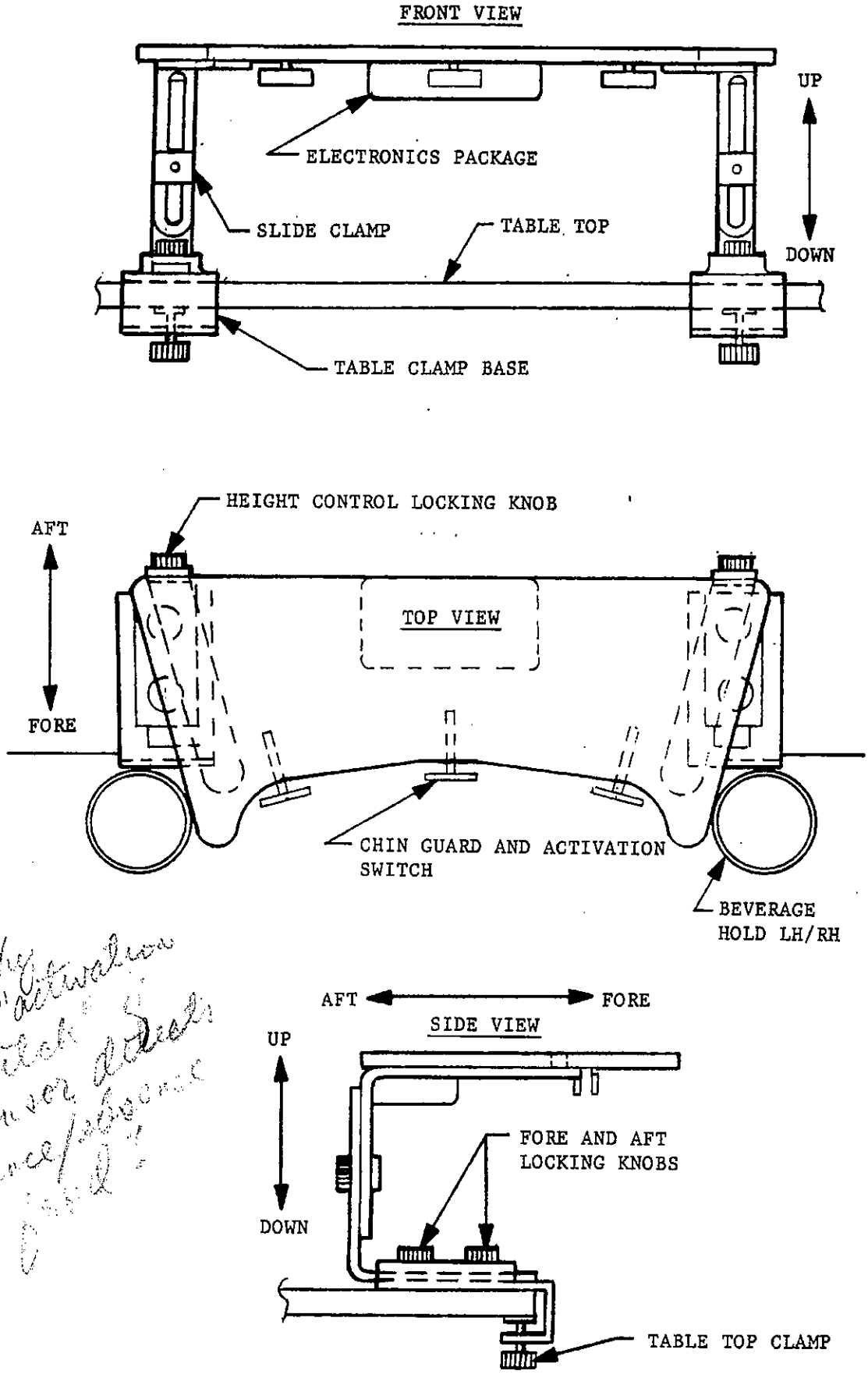


FIGURE 5. ADJUSTABLE PLATFORM

A developmental prototype is estimated to cost $2,500.00-$3,000.00 for the initial module and $1,500.00 for a platform. Additional modules will cost $1,000.00-$1,250.00 each. Depending upon the materials and manufacturing process used (tooling, assembly, packaging, etc.), a three unit array with platform might be marketed in the range of $500.00 to $750.00. Final cost would depend upon the numbers produced and the production techniques used.

Conceptual Design 3. Single Unit Powered Dispenser Module (see Figure 6)

Like Conceptual Design 2, the single unit incorporates a power unit which extrudes food substances from a self-contained pliable bag. It is powered with either electrical or pneumatic devices. The power unit is housed within the enclosure along with the food substance. The drive mechanism is isolated from the food substance by a partition. Features incorporated into this module concept are:

General Characteristics

- A replaceable spoon, in varied configurations, mounts to the module front face.
- A pliable food bag, either in a bellows or plain configuration, is heat sealed after food has been loaded. In this configuration, foods can be preprocessed and stored for future use. The bag must be punctured at the spoon interface just prior to the delivery cycle.
- Electrical or pneumatic drives extrude food from pliable bags.
- A sensor is used to detect presence or absence of food substance in the spoon. An electrical cable from the sensor is connected to the power unit to furnish the necessary control.
- Individual modules can be used alone or be grouped into two or more units to form an array.
- An insulated lid or cover is furnished to sustain the required food temperatures.
- Provisions for accommodating a beverage holder are incorporated into the support platform.

Power Drive

- The electrically driven power unit would utilize a digital linear actuator (stepper motor). A 12 VDC rechargeable battery pack (nickel cadmium or sealed lead acid batteries) would power the motor. A 12 VDC plug-in taper charger would be used to keep the batteries at full charge. Linear stroke is 2.5 inches.

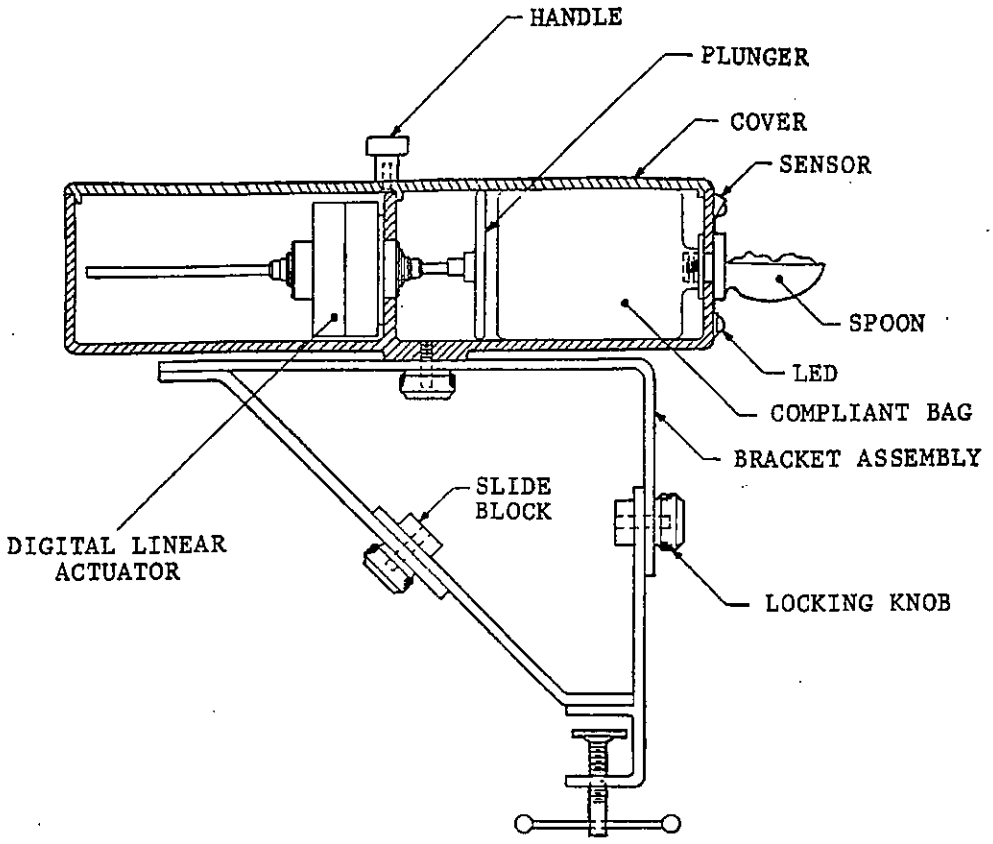


FIGURE 6. SINGLE UNIT MODULE WITH BRACKET

Electronics

- An electronics package would be required to control the drive unit. Control would be provided through a sensor arrangement. A light emitting diode (LED) would be used to indicate the end of the feeding cycle. The electronics would be interfaced with an air logic controller when pneumatic drive is used and would be remotely placed to accommodate three single unit modules.

Adjustable Support Platform

- A support platform is incorporated into each individual module.
- It is adjustable in height as well as fore and aft.
- The platform attaches to a table by clamping or to a wheelchair with special accessories.
- An alternative platform mounting method (shown in Figure 5) provides for a unitized array of three modules.

Power Source

The power source, either electrical (12 VDC) or pneumatic (40-60 PSI), are remote and are not integrated into the module.

A developmental prototype is estimated to cost $2,000.00-$2,750.00 for the initial module and $1,500.00 for a platform. Additional modules will cost about $1,000.00. Depending upon the materials selected and the manufacturing process used (tooling, assembly, packaging, etc.), a three unit array with platform might be marketed in the range of $500.00 to $600.00. Final cost would depend on production quantities and techniques.

Conceptual Design 4. Three Module Array with Variable Angular Adjustment (See Figure 7)

Angular adjustment of the two outer modules is advantageous in that 45° is the degree of natural head movement. However, 60° is the degree of head movement which can be achieved by conscious force (see Figure 8). It is not known whether the SPCPMR population could achieve a degree of movement greater than 45°. Therefore, considerations for adjusting the modules to meet the users' capabilities has some merit. Features incorporated into the module array concept are:

General Characteristics

- Three single modules are used to form the array.
- The center module is stationary while the outside modules can be adjusted to the desired angle.
- An electronics and battery enclosure is interfaced to the holding platform to provide the necessary power and control functions of each module.
- Two strut assemblies are used to support the holding platform. The struts are height adjustable.
- Fore and aft adjustments are accomplished through a locking slide mechanism which interfaces the strut assemblies with the holding platform.
- Interchangeable clamping mechanisms are used to stabilize the holding platform to a table or wheelchair.

Modules

- Modules are described in Conceptual Designs 2 and 3.

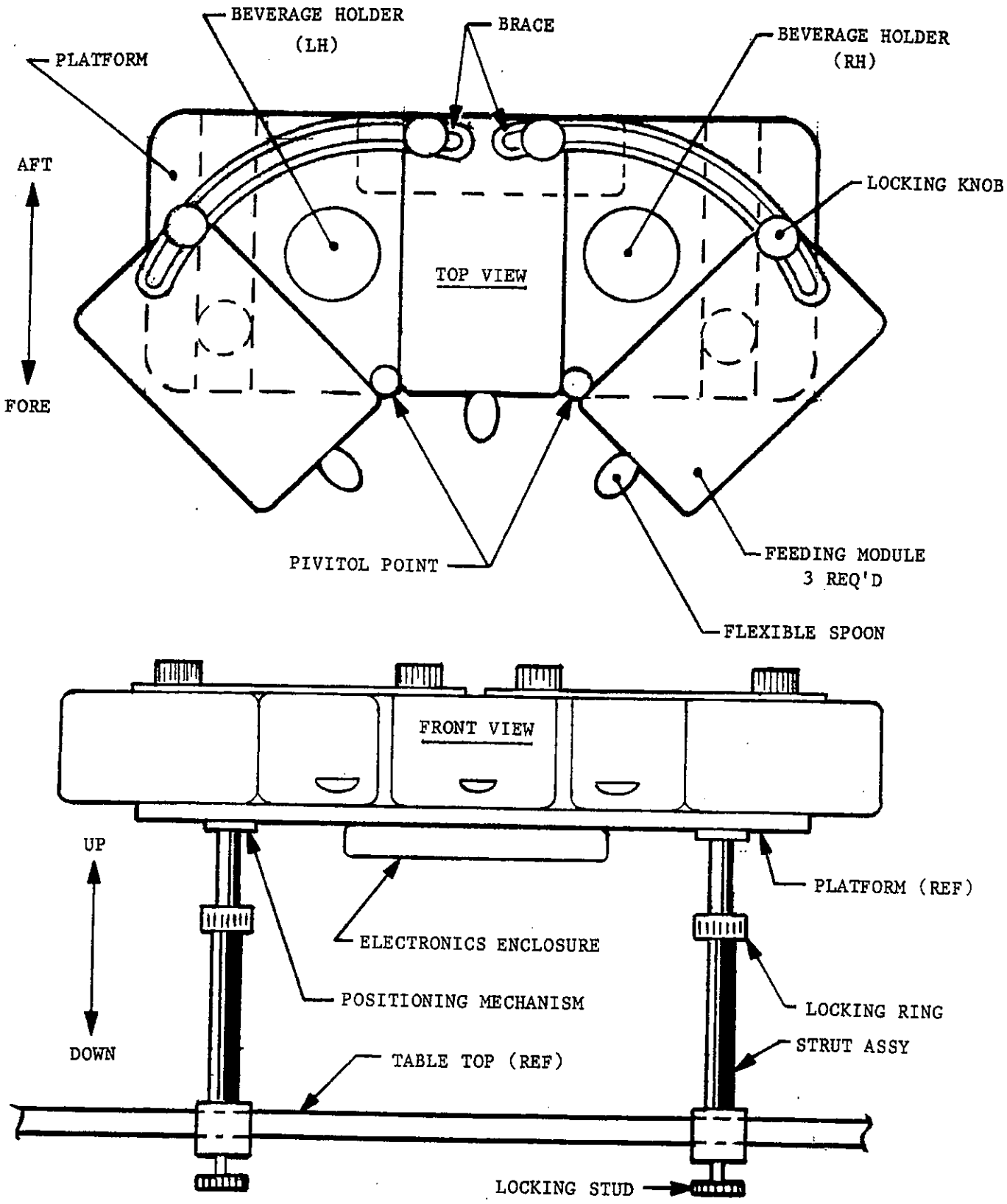
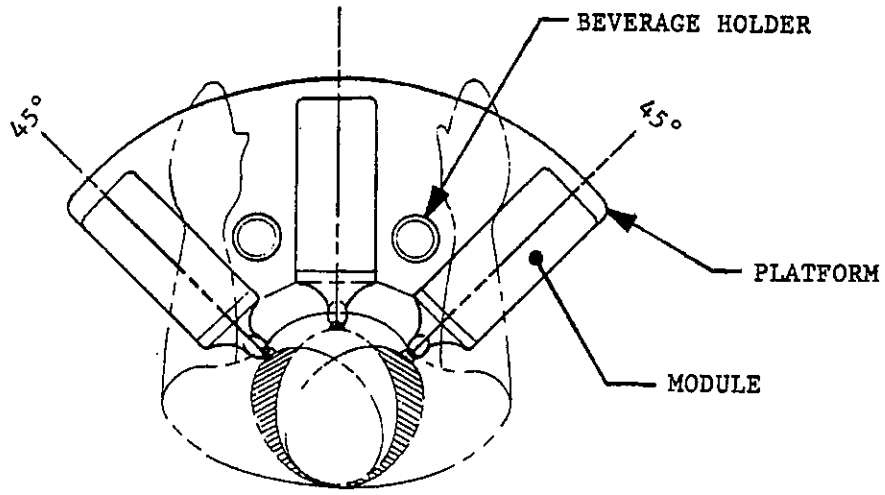
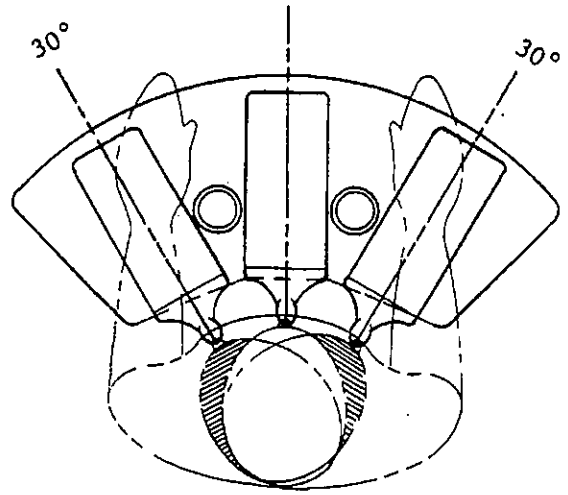
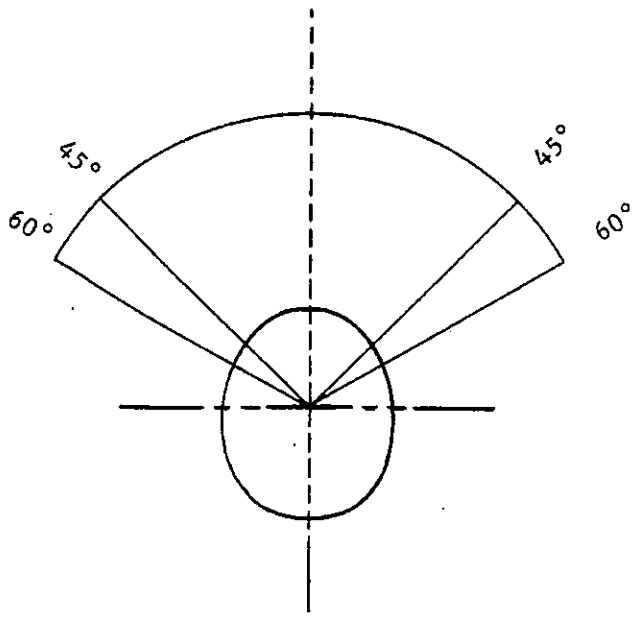


FIGURE 7. THREE MODULE ARRAY WITH ANGULAR ADJUSTMENT

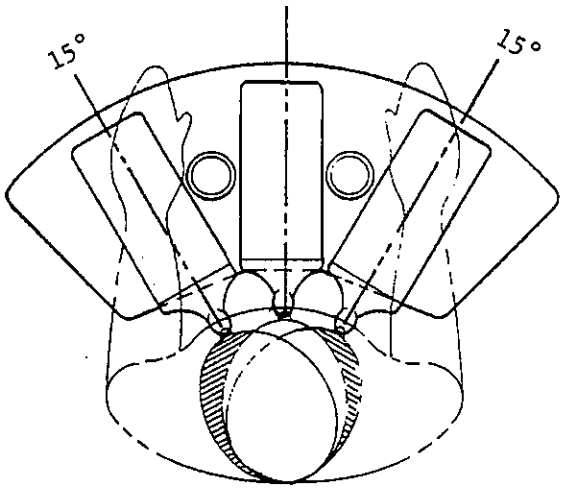


OUTER MODULES ARE INCIDENT TO THE CENTERLINE OF THE CENTER MODULE





HEAD POSITION ANGULAR DIMENSIONS



ANTHROPOMETRIC DIMENSIONS TAKEN FROM ANTHROPOMETRICS FOR DESIGNERS BY JOHN CRONEY. PUBLISHED BY VAN NOSTRAND REINHOLD COMPANY, NEW YORK 1971 LIBRARY OF CONGRESS CATALOG CARD NUMBER 73-130690

FIGURE 8. ANGULAR HEAD MOVEMENT FOR DINING AID INTERFACING

Conceptual Design 5. Unitized Three Dispensing Unit Module with Positioning Arm (See Figures 9 and 10)

This design incorporates three dispensing units into one enclosure. The enclosure houses the 12 VDC power supply, electronics package, digital linear actuators and the removable food containers. The power and fast digital linear actuator "in-out" are controlled by rocker type switches. The travel of the digital linear actuator can be adjusted by potentiometers to provide for consistencies of different food substances. An adjustable chin guard is provided to aid in controlling gagging. A sensor is mounted on the chin guard to control the delivery system. The sensor can be either an infrared device or a microswitch. A recharger and receptacle are provided to charge the batteries. An arm assembly supports the module as well as providing the necessary positioning. Indicator lights monitor all food dispensed.

General Characteristics

- Unitized packaging reduces costs and parts redundancy.
- Removable food dispensers allow easy cleaning and refilling.
- A swing arm allows for correct positioning in the up-down and in-out axes and for tilt of the unitized module. The swing arm is most suitable for table mounting.
- An interchangeable adapter is provided for wheelchair mounting.

Power Source and Drives

- Batteries are 12 VDC rechargeable (nickel cadmium or sealed lead acid).
- Travel of digital linear actuators is 2.5 inches.
- A plug in taper charger is provided to recharge batteries.

Electronics

- The electronics package controls delivery functions incrementally.
- A light emitting diode (LED) indicates the end of a food delivery cycle.
- An infrared sensor or microswitch detects the beginning or end of individual delivery cycles.
- A microswitch on each digital linear actuator tail shaft stops the unit and transmits the "food out" condition to an LED indicator.

NOTE: ALL SWIVEL AND PIVOT POINTS TO HAVE POSITIVE LOCKS

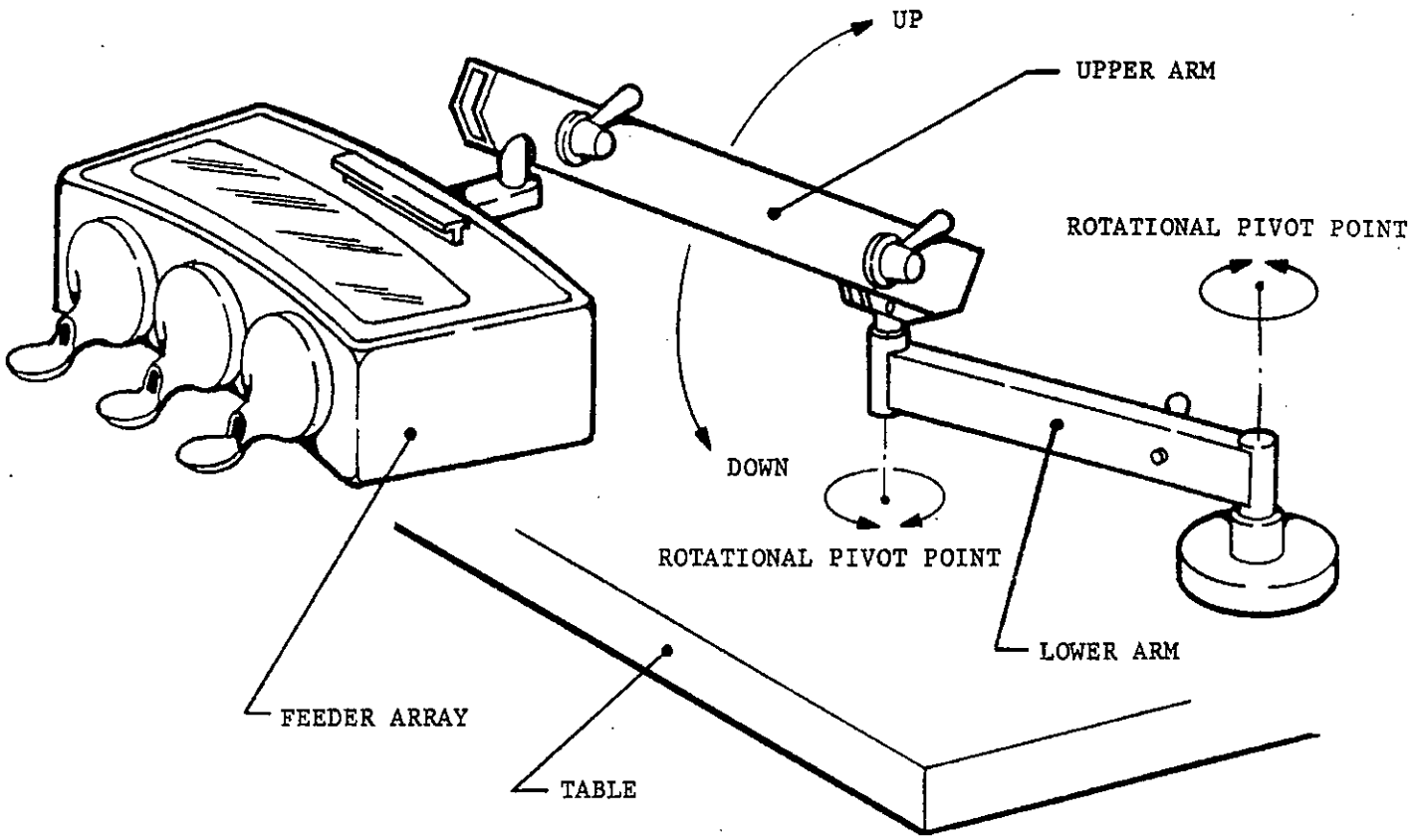


FIGURE 9. UNITIZED THREE DISPENSING MODULE MOUNTED ON POSITIONING ARM

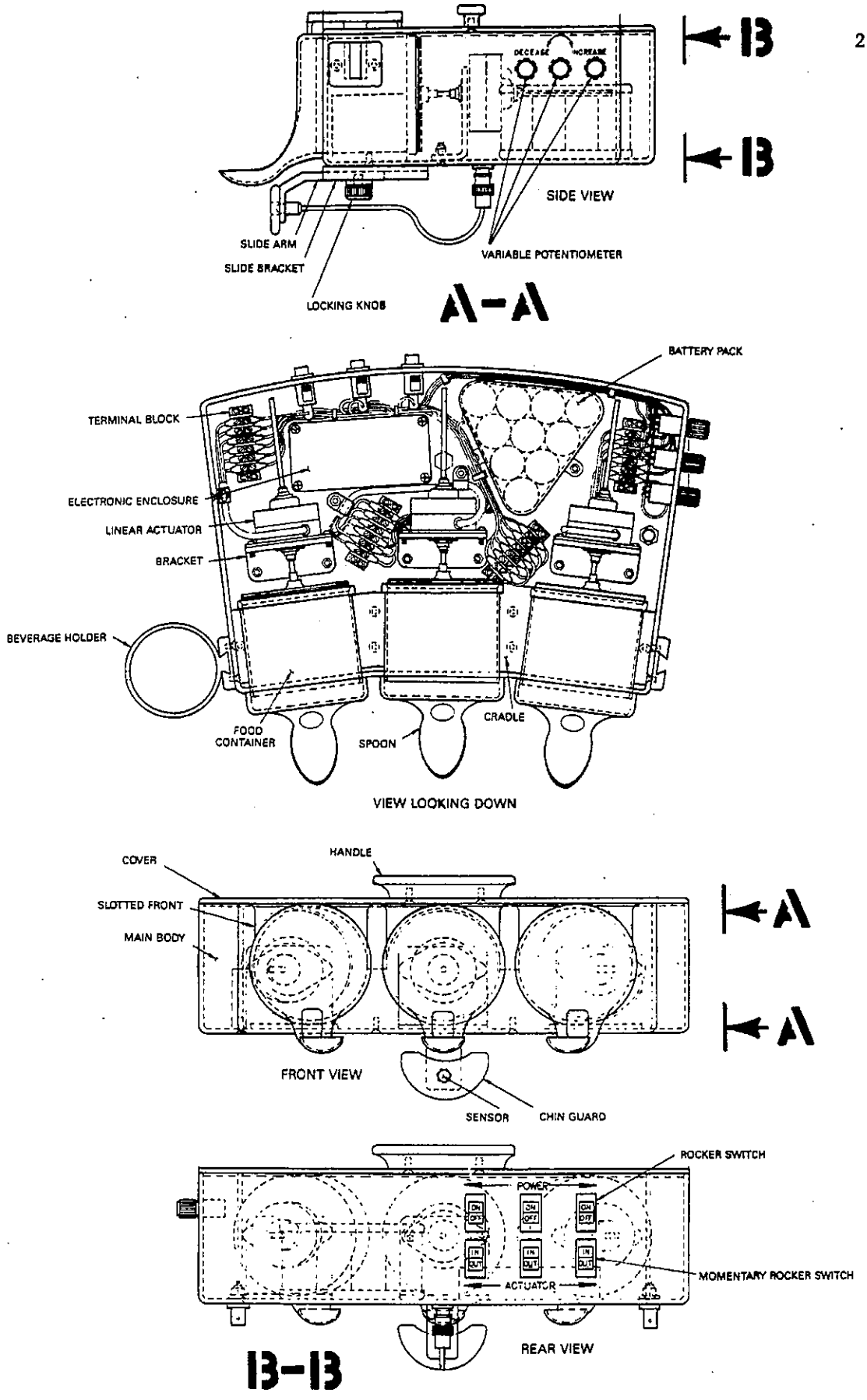


FIGURE 10. UNITIZED THREE DISPENSING MODULE PACKAGING AND ENCLOSURE

A developmental prototype less the commercially available swing arm is estimated to cost $4,500.00-$6,000.00. Final prototype costs would be furnished upon completion of detailed engineering piece part drawings. Depending upon the materials selected and the manufacturing process used (tooling, assembly, packaging, etc.). The module and swing arm might be marketed in the range of $1,250.00 to $1,750.00. Final cost would depend on production quantities and techniques.

Discussion

Some concepts generated during this feasibility study appear to be reasonably achieveable while others are less desirable. It is natural to assume that some engineering concepts will be dismissed by clinicians because they are not entirely appropriate for clinical situations and applications. Nevertheless, the concepts developed for this report have some individual elements that should be considered carefully for possible incorporation into a prototype design. Both the engineering and clinical discussions have resulted in some adjustments to the concepts. The natural order of conducting a feasibility study has been used as follows:

- Review literature for appropriate research pertaining to dining aids and the feeding process.
- Review existing devices for their appropriateness for target population.
- Visit an institution which accommodates the target population.
- Conceptualize designs from feedback accumulated from all sources available to the designer.

Many design considerations are specific to the multiple disability population of the SPCPMR groups. Limitations (physical and mental) of the users eliminate many quick, easy and simple solutions. This disability group is truly unique; many problems associated with it are not present in other disability groups, and adaptations are generally complex and costly to implement. For the same reasons, conceptualized designs tend not to be simple. Complex and costly designs are required to satisfy this population's needs. We, therefore, believe that a consumer cost of $200.00 to $500.00 per unit will probably not be achievable.

The early stages of development arise from conceptualized ideas. These ideas progress into bench models or primitive prototypes. Later, a demonstration prototype is developed for field trials. All along this chain of events, components and packaging are revised by adding and subtracting. Likewise, a vast amount of change may occur in the overall configuration. While visually pleasing prototypes are desirable, early prototypes are necessarily limited in the amount of eye-pleasing manufacturing technology (such as injection molding) which can be used.

Most prototypes will be constructed using relatively inexpensive weldments or (occasionally) expensive milling operations. Whatever conceptual design is ultimately chosen for prototyping, more attention should be paid to its economics of manufacture than to its preliminary appearance. The ultimate production design will address stylization aspects after all functional and component packaging issues are resolved.

The conceptual design utilizing a trough like delivery system to a spoon receptacle has merit. Some further research will be needed to ascertain what food substances and textures can be realistically used. The drive system will also have to be likewise tested. These two components should be designed together to determine the optimum delivery system. Likewise, the sensing system needs further research and development. Although it would be desirable to have the sensing system and delivery system investigated concurrently, the research for a viable sensor could be conducted independently.

The ability to correctly position the dining aid for use is an underlying issue. Conceptually, the positioning mechanism (height, fore and aft) has been limited to a series of mechanical brackets clamped to a suitable surface. These brackets are most generally simple to produce, but may be less than pleasing to the eye. We suggest that a search for an economical and commercially available swing arm be considered. The degree of freedom offered by these devices might well outweigh their additional costs. A swing arm capable of sustaining 20 pound loads should be suitable. The functional specifications must address height adjustment, tilt adjustment and provide fore/aft movement. All axes must have locking features to stabilize the dining device with respect to the user.

Recommended Future Project Activities

The following outline is a suggested course of action for further work on the dining aid.

- Select from the conceptual designs the desired attributes and alternatives.
- Conduct developmental research pertaining to the sensing and delivery system.
- Develop a comprehensive and detailed set of prototype engineering mechanical and electrical (electronics) drawings.
- Procure fixed price quotations to manufacture a prototype(s).
- Contract to have the dining aid built from prototype drawings.
- Field test prototype(s).
- Adjust the design in accordance with the results of field tests.

- Solicit participation from manufacturers in the conduct of clinical evaluations.
- Finalize product design and license the design to a manufacturer.

Conclusion

The research efforts being supported by the National Association of Retarded Citizens (NARC) and directed towards the severely physically challenged and profoundly mentally retarded (SPCPMR) are a major step towards addressing issues confronting this disability group. Upon completion of our literature search, we felt there was a notable absence of research which could assist in solving the dining aid problems confronting this group. Most articles reviewed addressed issues of chewing, swallowing and related activities. What is now needed is research which deals with upper body range-of-motion and semi-automated food substance delivery systems.

Costs for engineering design efforts are not given in developmental costs. These costs will need to be developed as the conceptual design attributes and alternatives are selected. All estimates pertaining to development costs and market prices may or may not be realistic. A more definitive cost can only be given after final prototype drawings are completed.

Southwest Research Institute Rehabilitation Engineering Center greatly appreciates the opportunity to participate in the early stages of this research.

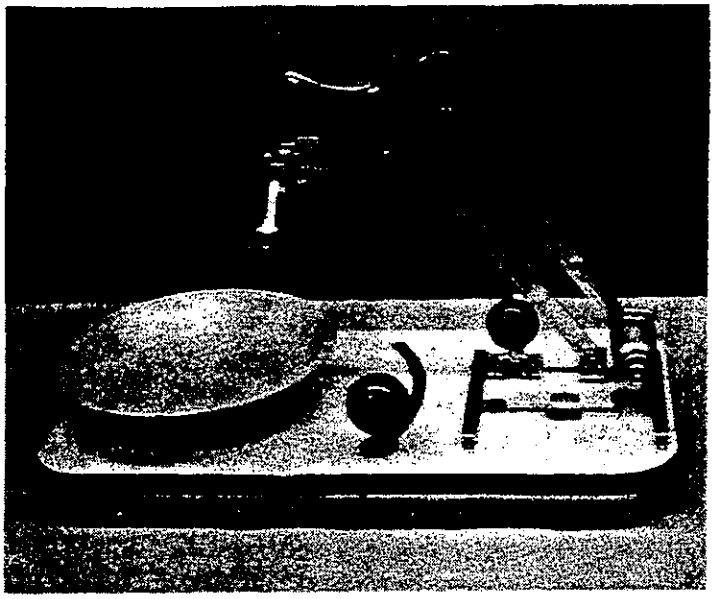
Appendix A

Commercially Available Dining Aids

7/86

FEEDING APPARATUS
INDEPENDENTLY CONTROLLED

ORTHOPOP
P.O.Box 272
APTOS, CA 95003
(408) 688-6272



F-06 Feeder for RH/LH operation is useful for evaluation purposes. Spoon direction, spoon-arm controls, rotation mode -- all can be shifted to accommodate RH or LH operation.

F-07 Feeder for either RH or LH operation (not shown) is closely similar to F-06, except for single-knob control and fixed spoon-arm control assembly.

FEATURES

Concave pad on spoon arm positions the hand, or fist, or wrist, to control the downward motion of the spoon toward the plate. Pressure on the pad also causes the spoon to drop, so that it can scoop the food against the edge of the plate. In the bottom position, the spoon is locked into horizontal position, filled with food. Light tap on spoon-arm release latch causes spoon to rise to feeding position. Plate can be rotated to center or select food, by means of a knob or pad.

Maximum spoon height for feeding is adjustable up to approx. 10" from table or tray. (Higher spoon levels can be accommodated by raising the feeder, or by optionally available longer spoon arms.)

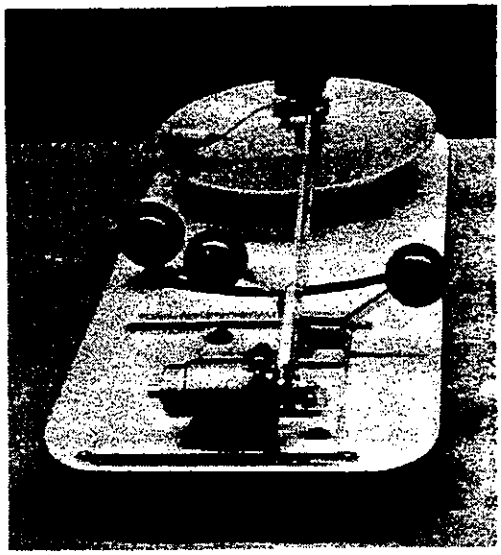
Heavy-duty aluminum plate, 9.5" diameter is standard. Broad-lipped or narrow-lipped stainless-steel plates are optionally available.

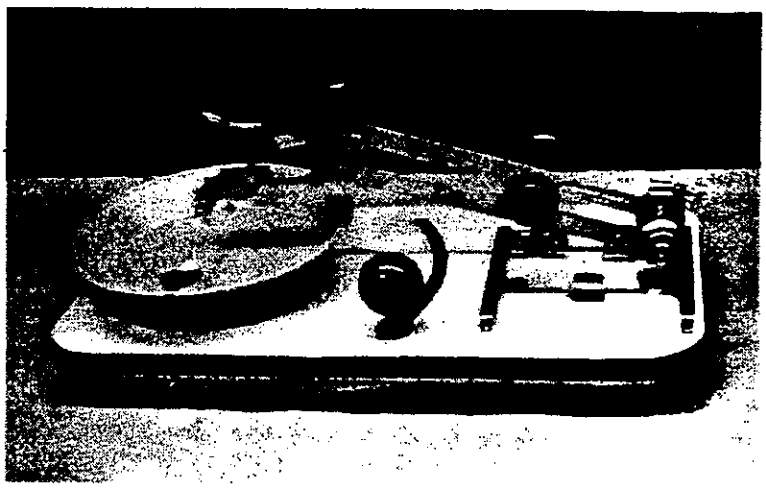
Specially formed stainless-steel spoon provides good scooping action and food retention for a broad variety of foods.

Mounting pads on either side of feeder are furnished with multiple suction cups to minimize slippage on tray or table.

Special location or configuration of controlling knobs or pads can often be considered, for specific needs.

Virtually maintenance-free. Surfaces can be kept clean by wiping, as with counter-tops. WD-40 is occasionally of value in sliding or rotating members.





FEEDING APPARATUS
INDEPENDENTLY CONTROLLED

OPERATION
INSTRUCTIONS
MAINTENANCE

ORTHOPOP
P.O.Box 272
APTOS, CA 95003
(408) 688-6272

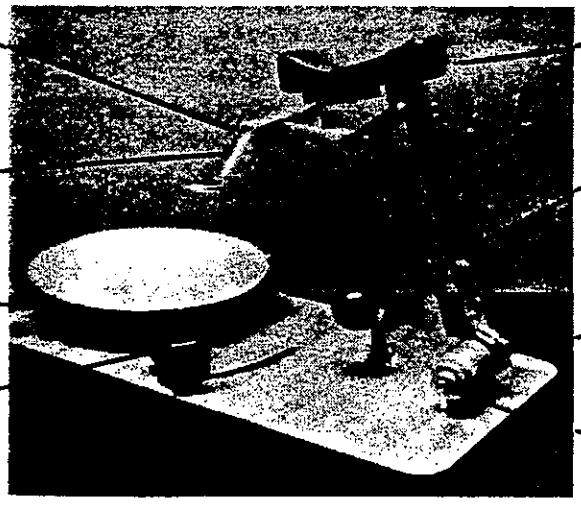
The ORTHOPOP Independently Controlled Feeding Apparatus is designed so that individuals with manual disabilities, but with some head and lip control, can independently feed themselves. Models are available for either right- or left-hand control; an "ambidextrous" evaluation model is also available for general institutional use.

ORTHOPOP Feeders are entirely mechanical in operation, and require active participation by the feeding individual. The advantage in the feeder lies in the fact that relatively uncontrolled motions by the individual can be guided and controlled to sequentially scoop food from a plate and present the filled spoon for the individual to accept.

Because these feeders are mechanically designed, there are several pivoting or sliding components. These interfaces have been pre-set at assembly with as little friction as possible, even to the point of apparent "looseness". These interfaces or joints should <u>not</u> be tightened, because the resulting friction might create a misfunction of the unit.

Food can lodge into the crevasses of these joints. In general, damp-sponge cleaning after usage should be adequate. If some friction develops over a period of time, a slight application of WD-40 can alleviate the problem. In extreme cases, the joints can be taken apart for cleaning -- but should be re-assembled loosely. Lock-nuts should be tightened only to the point of binding the joint.

The mechanical design of these feeders is essentially simple, and maintenance is straight-forward. Occasionally, an unusual effect is observed: spoon latch does not operate, spoon-arm does not raise after release, plate does not rotate, etc. More often than not, a telephone call is sufficient to cure the problem. Very rarely is it necessary to send the feeder to ORTHOPOP, unless damage has occurred.



ORTHOPOP
P.O.Box 272
APTOS, CA 9500
(408) 688-6272

Spoon: To fasten the spoon onto the spoon arm, insert the spoon into its slot and gently push it to the depth of the slot. The notch in the spoon handle should engage with the pin in the slot to minimze sideward movement. Tighten the thumb screw, making sure that the spoon is straight in its holder. To remove the spoon, reverse the above procedure.

Plate: With the spoon arm in its upper position, the plate can be guided onto the pedestal of the lazy-susan rotation system, in the direction of the arrow marked underneath the plate, toward the black dot on the pedestal. It may be necessary to push the plate rotation knob to be sure that the plate and knob do not interfere. The plate should be pushed firmly over the rubber friction pad until the plate guide is seated against the pedestal. To remove the plate, reverse the above procedure, pulling the plate away from the edge marked by a black dot.

DO NOT TURN THE PLATE BY HAND ON THE PEDESTAL. Use the plate rotation knob; otherwise the mechanism can be damaged.

Spoon Height: The height of the spoon can be adjusted by rotating the spoon-arm stop. Loosen the arm-stop clamp with a screwdriver, while holding the spoon arm. When the spoon is in the proper upper position, tighten the clamp.

Spoon Arm Speed: A certain amount of adjustment of the speed of elevation of the spoon can be made, but in general the speed as initially adjusted should be adequate for most cases. If adjustment is desired, the slotted shaft at the base of the hydraulic control can be moved by screwdriver, by pushing the shaft inward and simultaneously turning the shaft to the right or left, to the next position. (This adjustment requires a large screwdriver and a strong arm, to resist the spring action in the mechanism.)

Maintenance: The plate should be washed by hand; the epoxy glue on the guides may not withstand the heat of automatic washers. The base can be wiped clean in the same manner as for counter tops. Do not immerse the base in water; the mechanisms may become damaged.

The arm-release latch may become rough with long or hard usage. Occasionally polish the latch with very fine sand paper or steel wool, also the spoon arm where it contacts the latch.

FEEDING APPARATUS
INDEPENDENTLY CONTROLLED

PRICE LIST
JULY 1986

ORTHOPOP
P.O.Box 272
APTOS, CA 95001
(408) 688-6272

TERMS & CONDITIONS

ORTHOPOP Equipment is, in general, customized to the specifications of the requesting physician or therapist. Consequently, each item is made to order, with little or no inventory on hand. Dimensional Specification Forms are available on request, to assure complete description of the equipment and any pertinent accessories or options.

PRICES are subject to change without notice. Verification of current prices is recommended before a formal purchase order.

QUOTATIONS are valid from 30 days from the date of the specific quotation.

SHIPPING CHARGES are included in the Net Prices for Northern California. Elsewhere, a surcharge is made, to cover additional packing and shipping costs.

CALIFORNIA SALES TAXES (if applicable) are additional to the Net Prices.

Payment Terms

Cash on delivery (COD) or prior to shipment, unless other arrangements have been made, including the following:

Purchase order from accredited organizations.

Authorization from recognized state or federal organizations.

Letter order from charitable organizations.

ORTHOPOP regretfully declines to accept orders for equipment to be provided to MEDI-CAL patients, unless assurance can be given that payment will be received from Medi-Cal within 90 days from claim submittal, or that payment will be made by an alternate funding source. If Medi-Cal ultimately were to make payment on a particular claim, ORTHOPOP would of course reimburse the alternate funding source promptly for any payments made.

PRIVATE INSURANCE is not billed by ORTHOPOP. Instead, an invoice is sent to the client (or client's parents) for submittal to insurance. However, unless the individual order is backed by purchase order or authorization (listed above), prepayment or COD terms prevail.

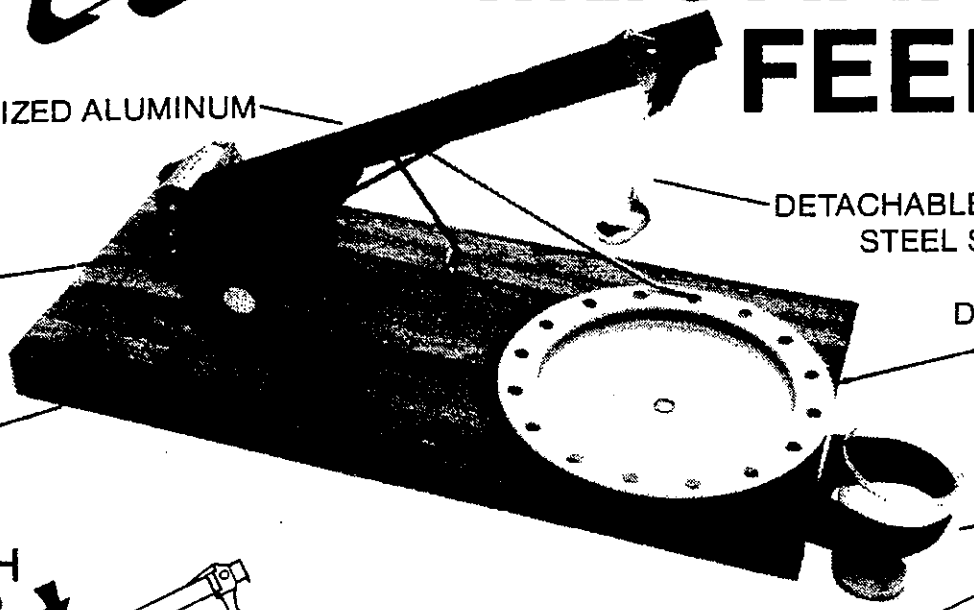
PAYMENT TERMS are Net, 30 Days from date of invoice, unless otherwise arranged.

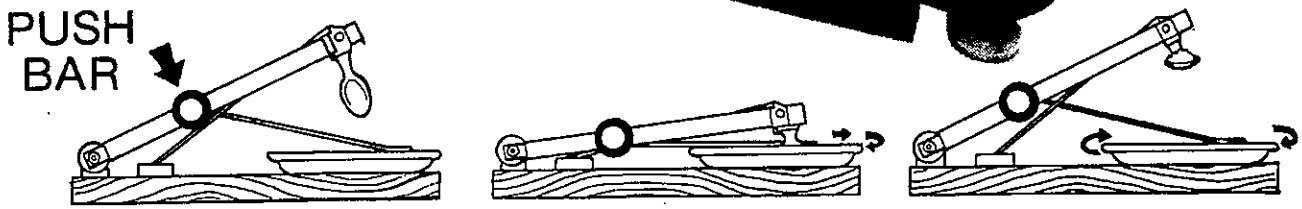
F-06	Feeding Apparatus, Ambidextrous, for both right- and left-hand operation, through adjustments of controls; base approx. 21" x 10.5"; max. spoon height 10" from tray or table.	$ 300.00
F-07	Feeding Apparatus specifically for either right- or left-hand operation (please specify at time of order); base approx. 21" x 10.5"; max. spoon height 10" from tray or table.	225.00
F-08	Feeding Apparatus with controlled spoon advance toward the individual, for either right- or left-hand operation (please specify at time of order); base approx. 21" x 10.5"; max. spoon height 10" from tray or table.	325.00
F-10A	Stabilizing Knob, 1.75" dia x 3" high, with bracket for side-mounting to base; usually mounted on plate side, to control idle hand.	17.00
F-10B	Stabilizing Post, 1" dia x 3" high, with bracket for side-mounting to base; usually mounted on plate side, to control idle hand.	20.00
F-11A	Spoon-Arm Side Pad, 1.5" wide x 5" long, mounted on upper spoon arm for alternative leverage in spoon-arm control.	25.00
F-11B	Spoon-Arm Side Pad with direct coupling to spoon latch, 1.5" wide x 5" long; mounting on upper spoon arm; pressure on side pad triggers spoon drop; provides alternative in spoon-arm control.	45.00
F-13	Bracket for Drinking Glass or Cup (please specify mounting position on side of feeder base).	20.00
F-14	Concave Pad for Plate Rotation, 1.5" high x 3" wide; replaces normal plate-rotation knob, for more positive positioning of hand.	20.00

8/85

INTRODUCING

THE ALL NEW Mila ONE-STEP MECHANICAL FEEDER





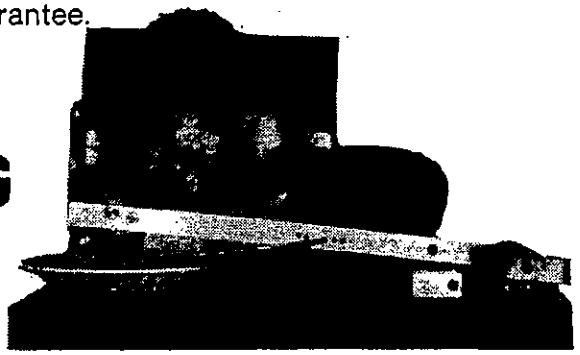
PUSH BAR TO LOWER ARM AND SPOON

SPOON SCOOPS UP FOOD WHILE PLATE AUTOMATICALLY ROTATES TO NEW POSITION

ARM RAISES SLOWLY BRINGING FOOD TO LEVEL OF EATING POSITION

The Mila One-Step Mechanical Feeder now gives independence and dignity to disabled individuals at the lowest price in the field.

- Scientifically engineered simple, safe and indestructible, then tested with great success on difficult cases.
- Requires the least physical control.
- Activated by hand, arm, shoulder, or head in one simple motion to scoop food and automatically rotate plate.
- User has complete control and eats at his or her own pace.
- Suitable for children or adults with a wide range of disabilities.
- Easy to clean, store, and carry.
- Right or left handed versions available.
- 100% money-back guarantee.



FOR INFORMATION CALL OR WRITE:

Mila ENGINEERING CORPORATION

11554 ENCINO AVE. GRANADA HILLS, CA 91344

(818) 363-1908

Mila

ORDER FORM

MILA ONE-STEP MECHANICAL FEEDER

MILA ENGINEERING CORPORATION

11554 ENCINO AVE.

GRANADA HILLS, CA 91344

(818) 363-1908

Name _____

Address _____

City _____ State/Zip _____

Telephone _____

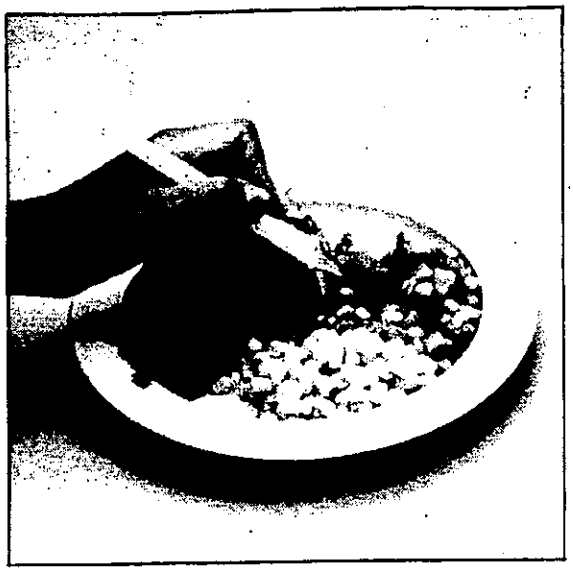
Quantity _____ per unit $249.00 _____

California residents add 6½% 16.19 _____

Shipping and handling charges 30.00 _____

TOTAL ENCLOSED _____

Aids For Daily Living



Maddak Inner-Lip Plates

The Inner—Lip Plate is designed for use by the elderly or handicapped person as an aid in self-feeding. The inner lip holds the food on the plate while the user brings the fork or spoon to the edge of the plate. The deep inner lip prevents spills and makes eating more enjoyable. 9" (229 mm) in diameter, 1" (25 mm) high. Available in ceramic or poylpropylene.

Ceramic — Off-White. Catalog Number ..... AM 13-3164
Polypropylene — Off-White. Catalog Number ..... AM 13-3165
Polypropylene — Blue. Catalog Number ..... AM 13-3166
Polypropylene — Gold. Catalog Number ..... AM 13-3167

Maddak Non-Skid Inner-Lip Plate

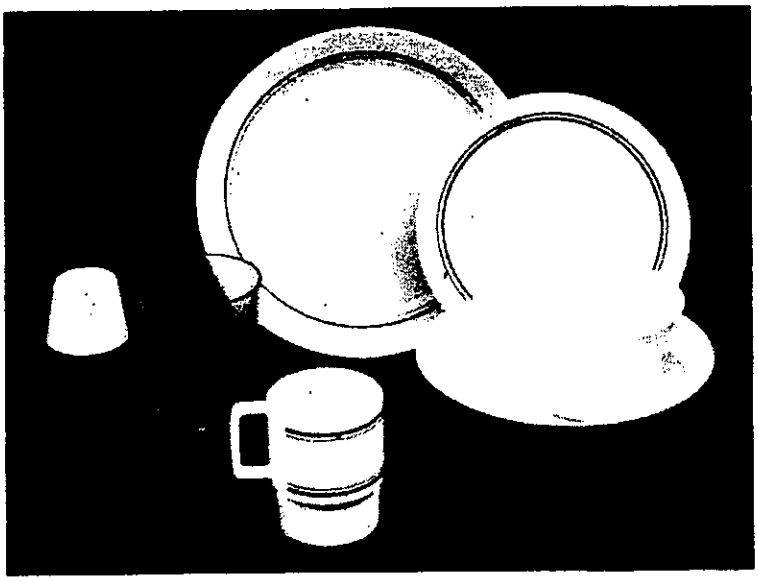
Inner-Lip Plate with a 6" (152 mm) diameter foam rubber disc bottom support which helps to keep plate stationary.

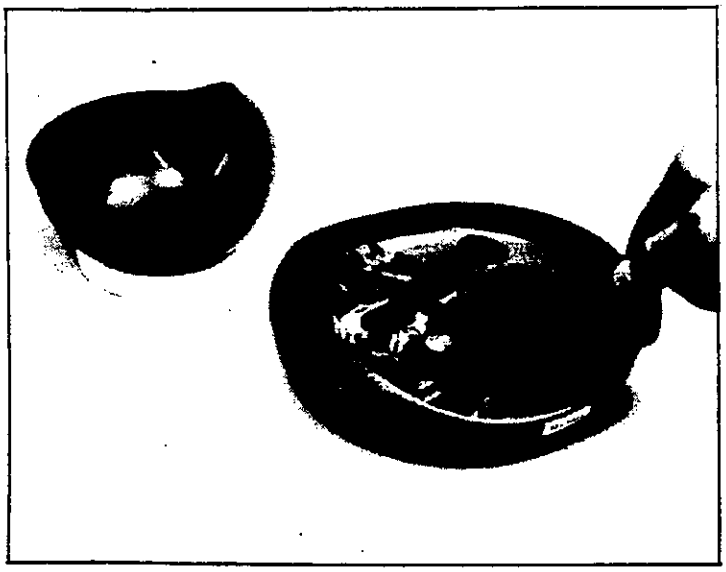
Ceramic — Off-White. Catalog Number ..... AM 13-3169
Polypropylene — Off-White. Catalog Number ..... AM 13-3168

Maddak Non-Skid Dinnerware

Molded melamine plates, bowls, and cups, and high-impact clear plastic tumbler and salt shaker are dishwasher safe and have soft, non-skid rings at the bottom which prevent sliding even on a 25 degree incline.

10" (25cm) Diameter Dinner Plate. Cat. No. . . AM 13-1976
8" (20cm) Diameter Salad/Dessert Plate. Catalog Number ..... AM 13-1977
5¼" (13cm) Diameter x 2¾" (7cm) Deep Drink-Or-Spoon Soup Dish. Catalog Number ..... AM 13-1978
8½" (21cm) Diameter x 2" (5cm) Deep Cereal or Serving Dish. Catalog Number ..... AM 13-1979
9 Ounce (266cc) Drinking Cup with Handle. Catalog Number ..... AM 13-1980
14 Ounce (414cc) Tumbler, Transparent. Catalog Number ..... AM 13-1981
2½" (6cm) Diameter x 3⅞" (9.8cm) High Salt & Pepper Shaker, Clear. Catalog Number ..... AM 13-1982





Maddak Scooper Plate

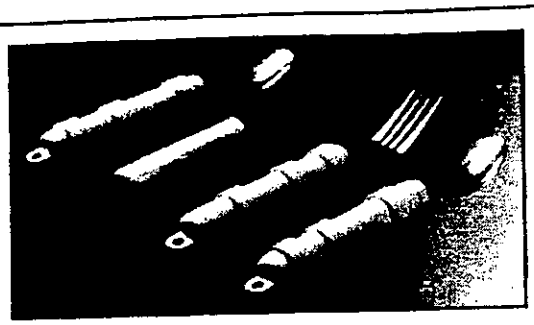
Heat resistant plastic with a smooth finish make this 6½" (16.5cm) flat bottomed plate an attractive and useful eating utensil. 11/16" (17mm) high sides and reverse curve edge on one side are a help in preventing spills and overflowing. The base has a rubber ring and foam rubber disc to prevent slipping and tipping. Washable in hot soapy water.

Catalog Number ..... AM 13-1837

Maddak Scooper Bowl

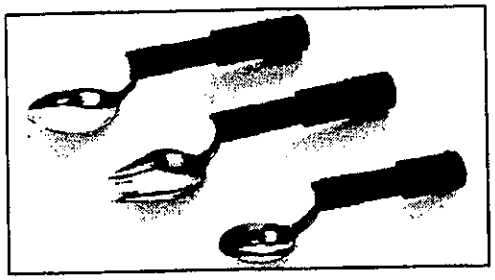
Molded of heat resistant rigid plastic, this smooth hemispherical bowl has a high return curve on one side to prevent spilling and slopping. The bottom of the bowl has a ring base with a removable rubber ring. The center of the base has a foam rubber disc which aids in keeping the bowl from sliding or tipping. A perfect bowl for soups, cereals, puddings, etc. Washable in hot, soapy water.

Catalog Number ..... AM 13-1836



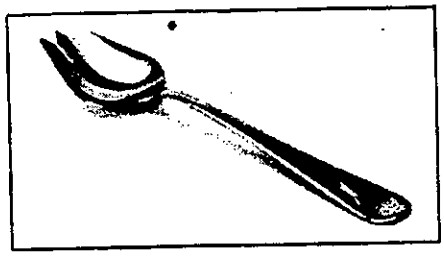
Built-Up Hand Utensils

Stainless steel eating utensils are cemented into filled bicycle-type handles with finger grip knobs. Will withstand dishwasher heat. **Built-Up Teaspoon. Cat. No.** ..... **AM 13-1274**
Built-Up Soup Spoon. Catalog Number ..... **AM 13-1275**
Built-Up Knife. Catalog Number ..... **AM 13-1276**
Built-Up Fork. Catalog Number ..... **AM 13-1277**
Complete Set of Four Built-Up Utensils. Catalog Number ..... **AM 13-1278**



Plastic Handle Swivel Utensils

Grey plastic handles make utensils attractive and improve the delicate swivel action. Easier to grasp with a three point pinch. Handles have built-in stops. Stainless steel.
Adult Swivel Teaspoon. Catalog Number ..... **AM 910079**
Adult Swivel Soup Spoon. Catalog Number ..... **AM 910149**
Adult Swivel Spork. Catalog Number ..... **AM 910219**
Junior Swivel Teaspoon. Catalog Number ..... **AM 910709**
Baby Swivel Spoon. Catalog Number ..... **AM 910609**

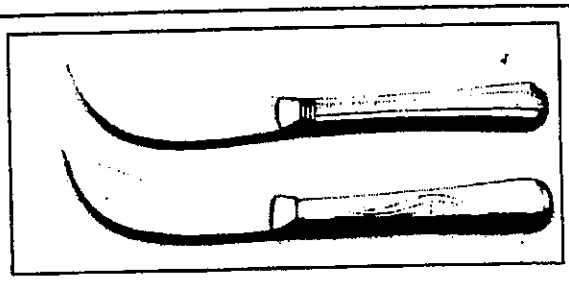


Sporks

Combination spoon and fork, with some of the advantages of each. This helps in gathering food onto the bowl. Bowl holds semi-liquids better than a fork. Stainless steel.
Small, 5". Catalog Number ..... **AM 910599**
Medium, 6". Catalog Number ..... **AM 910589**
Large, 7". Catalog Number ..... **AM 910569**

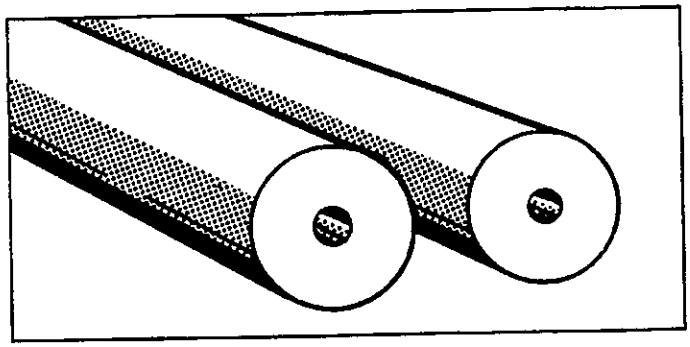
Built-Up Utensils

These utensils have improved end caps for easier maintenance. For right or left hand. Stainless steel.
Teaspoon. Catalog Number ..... **AM 910289**
Fork. Catalog Number ..... **AM 910359**
Knife, Serrated. Catalog Number ..... **AM 910399**
Soup Spoon. Catalog Number ..... **AM 910429**
Set of Four Utensils. Catalog Number ..... **AM 910439**



Knife & Knife/Fork

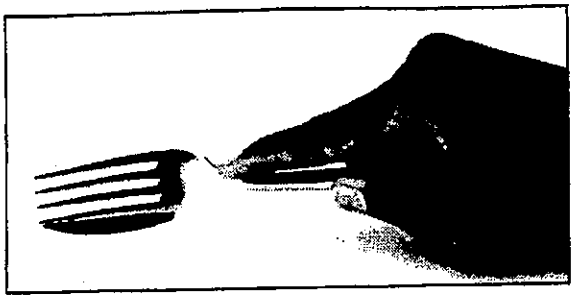
Forged stainless steel blade, precisely curved to provide rocker motion for ease in cutting with right or left hand.
Knife. Catalog Number ..... **AM 13-1080**
Knife/Fork. Catalog Number ..... **AM 13-1081**



Cylindrical Foam Padding

Foam padding in continuous lengths to build up spoons and other self-help aids. Black closed cell foam with ⅜" hole and an outside diameter of 1⅜". One yard per package.
Catalog Number ..... **AM 962529**

Aids For Daily Living



Side Cutter Fork

Special eating utensil which provides an edge along the side of fork. Curved blade is only semi-sharp so there is no danger of cutting oneself. Edge will cut up average food but not all meats.
Right Side Cutter Fork. Catalog Number ..... **AM 910491**
Left Side Cutter Fork. Catalog Number ..... **AM 910492**

One Hand Cutlery Set

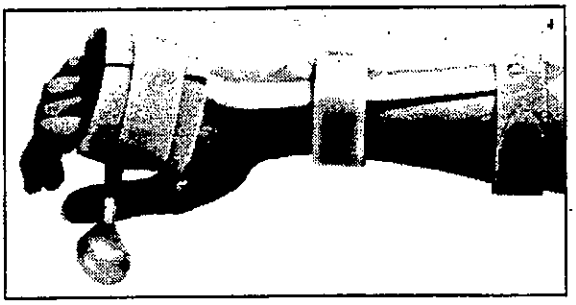
Single unit consists of a fork and knife combination which is a very invaluable aid to persons having only one useful hand. When pressure is exerted on the fork in vertical position, it retracts into the handle and the knife bears down on the food to be cut. When the pressure is released, the fork, under the spring pressure emerges from the handle and is used in the normal manner.
Cat. No. ..... **AM 13-1670**

Utensil Holders

Holders are basically bands which fasten around the palm of the hand to substitute for grasp. One model is all plastic, the other has elastic portion. Both have velcro closures.
Plastic Utensil Holder. Catalog Number ..... **AM 910509**
Elastic Utensil Holder. Catalog Number ..... **AM 910529**

Horizontal Palm Self-Handle Utensil

Utensil extends forward, plastisol covered handgrip is bendable for adjusting the hand size.
Teaspoon. Catalog Number ..... **AM 912669**
Long Teaspoon. Catalog Number ..... **AM 912739**
Soup Spoon. Catalog Number ..... **AM 912809**
Fork. Catalog Number ..... **AM 912879**
Set of Four. Catalog Number ..... **AM 912909**



Dorsal Feeding Splint

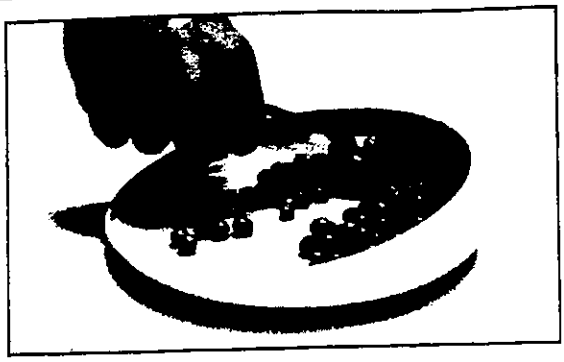
Vinyl covered steel splint with a 2" wide palmar cuff of velcro loop, allows velcro hook utensil holder to be angled and positioned as to best help plate-to-mouth pattern. Wrist extension easily changed by bending. Comes complete with one utensil holder.
Dorsal Feeding Splint. Catalog Number ..... **AM 910809**
Utensil Holder. Catalog Number ..... **AM 910819**

Quad-Quip Utensil Holder

Has continuous loop of velcro with the thumb hole and D-ring for getting hand in place and tightening it easily. Wooden base that angles the spoon away from the palm to make the eating pattern easier. Washable nylon and wooden construction. **Catalog Number** ..... **AM 913739**

Economy Utensil Holder

Economy utensil holders have a strong elastic band, a velcro pouch and velcro closures at the back. Velcro pouch allows varying length of utensils by how far it is slid into pouch. Washable. *Specify small (2½-3"), medium (3-3½") or large (3½-4").*
Small. Catalog Number ..... **AM 910539**
Medium. Catalog Number ..... **AM 910549**
Large. Catalog Number ..... **AM 910559**



Scoop Dish

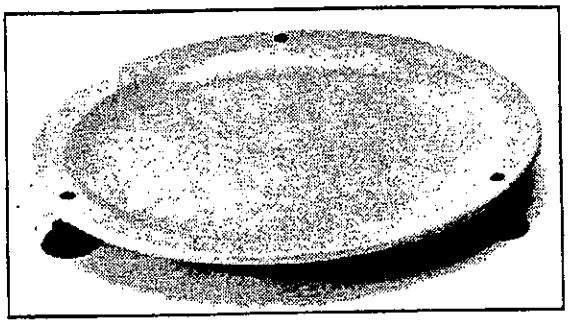
High curved edges helps fill utensil, low edge affords easy access to food. Features no-slip bottom. Can be washed in automatic dishwasher. Unbreakable. No-slip bottom made of closed-cell neoprene foam rubber. Yellow finish. 8" diameter.
Catalog Number ..... AM 13-1118

Food Bumper

A curved rail designed to keep food from sliding off the plate, even when eating with only one hand. Made of autoclavable polycarbonate with strong clips of same material. Snaps onto plate. Fits plates 9" to 11" in diameter.
Catalog Number ..... AM 13-1117

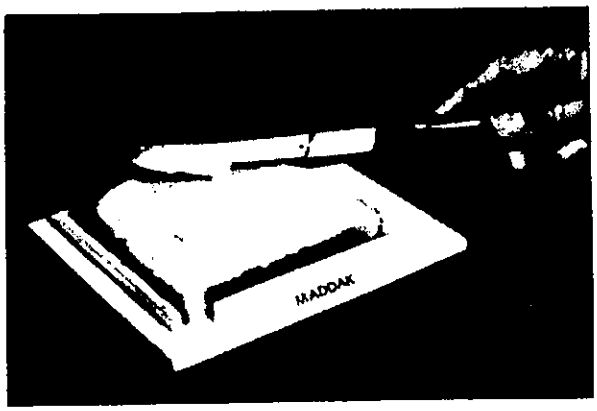
Vinyl Non-Skip Disc and Pad

An excellent cushioned base for holding plates, glasses, bowls, cups, instruments, etc. Prevents them from sliding. 7¼" diameter disc, ¼" thick flexible vinyl.
Catalog Number ..... AM 13-1119



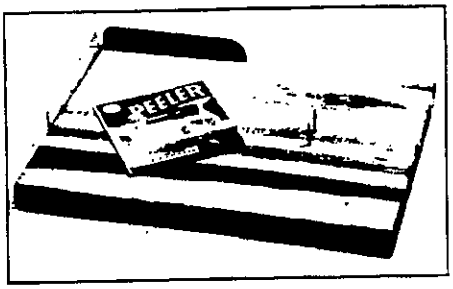
Triangular Suction Plate

Three suction cups are positioned at the outer edge of plate. When moistened and pressed firmly to a formica table top, it will not move. Unit makes a sturdy set-up for feeding training.
Catalog Number ..... AM 913879



Bread Slice Holder

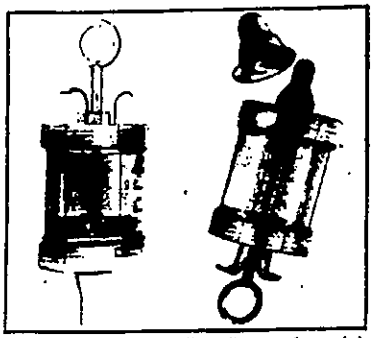
Hard plastic board with rubber feet and two raised sides. Holds slice of bread, prevents it from moving when being buttered. 5½" x 5¾". **Catalog Number** ..... AM 13-1158



Maple Paring Boards

Regular Model. Smooth maple with rounded edges. Has rubber suction cup feet and stainless steel vegetable holders. Size: 10" x 14". **Catalog Number** ..... AM 930449
Deluxe Model. Laminated maple in a chopping block thickness of one full inch. Coated with paring board finish to resist staining. Rubber feet. Stainless steel holders. Avovado color plastic corner guard with silicone seal along edge.
Catalog Number ..... AM 930469

Aids For Daily Living



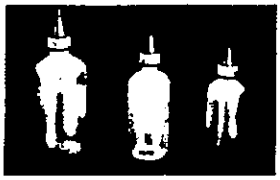
Semi-Solid Food Feeder

An easy way to feed patients unable to feed themselves. An ideal way to feed the 3-week to 9-month old baby. A transparent 4 oz. cylinder filled with semi solid food allows recipient to "eat" comfortably by his own suction. Plunger at one end, expels air and pushes food into mouthpiece. Clean and easy to use with no air swallowed, no food wasted. Perforated control disc prevents food from flowing too fast. Different foods can be "layered" in the order they are to be eaten.

Adult Feeder. With mouthpiece. **Cat. No.** ..... **AM 13-1121**

Infant Feeder. With 3 nipples and nipple cover.

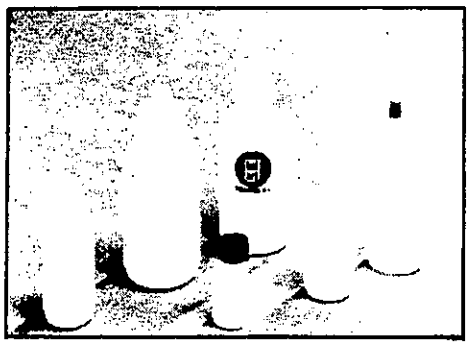
Catalog Number ..... **AM 13-1122**



Dispensers

Heavy wall polyethylene bottles with dispenser top and sealer cap that snaps on easily.

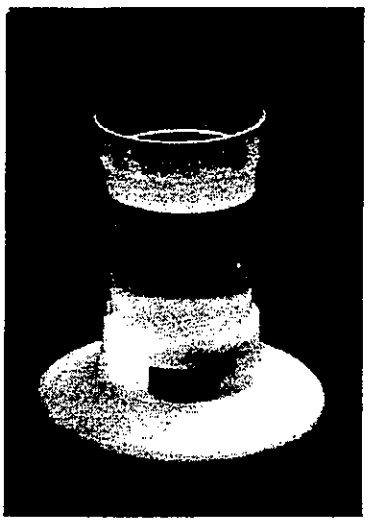
1 Oz. 18mm Cap. Catalog Number ..... **AM 13-1134**
2 Oz. 18mm Cap. Catalog Number ..... **AM 13-1135**
4 Oz. 24mm Cap. Catalog Number ..... **AM 13-1136**
6 Oz. 24mm Cap. Catalog Number ..... **AM 13-1137**
8 Oz. 24mm Cap. Catalog Number ..... **AM 13-1138**
16 Oz. 28mm Cap. Catalog Number ..... **AM 13-1140**



Squeeze Bottles

All polyethylene leakproof dispenser unit. Easy to squeeze.

4 Oz. 24mm Cap. Catalog Number ..... **AM 13-1141**
8 Oz. 24mm Cap. Catalog Number ..... **AM 13-1143**
16 Oz. 28mm Cap. Catalog Number ..... **AM 13-1144**
32 Oz. 38mm Cap. Catalog Number ..... **AM 13-1145**



No-Tip Cup Keeper

Large diameter base grips cup, making it impossible to tip. 4⅞" diameter linear polyethylene base, fits drinking cup and any other glass having the same diameter.

Cat. No. ..... **AM 13-1127**

Vacuum Feeding Cup

Allows patient to control flow of liquid intake without help or raising head. Finger pressure on soft rubber bottom releases small amount of fluid, permits controlled feeding even for semi-conscious persons. Fluid will not spill from cup even when lying on its side. Sturdy attractive design. Autoclavable.

Vacuum Feeding Cup. Catalog Number ..... **AM 13-1123**
Rubber Replacement Button. Catalog Number .... **AM 13-1124**

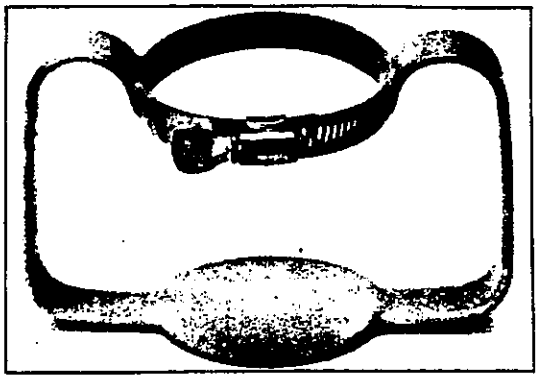
Folding Cup

Cross dam keeps liquid from spilling when cup is tipped. Linear polyethylene 7 oz. cup, with 7/16" drinking nozzle hole. 3¼" diameter x 1¾" high, with side handles for easy two hand grip.

Catalog Number ..... **AM 13-1125**

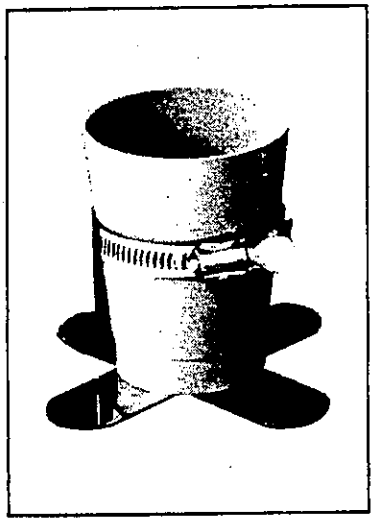
Sure-Grip Glass Holder

Fastens to glass to provide handle that is strong, yet can be bent to fit patient's hand. Stainless steel welded construction with plastic cover on handle. Thumbscrew adjusts easily to all glass sizes. **Catalog Number** ..... **AM 911179**



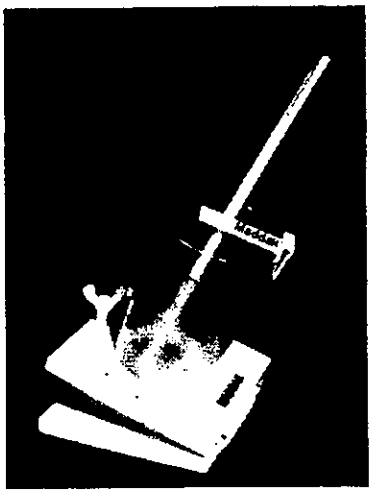
Bilateral Glass Holder

Heavy duty steel-handled glass holder with soft vinyl coverin Clamp at top adjusts to fit any glass.
Catalog Number ..... **AM 9114**



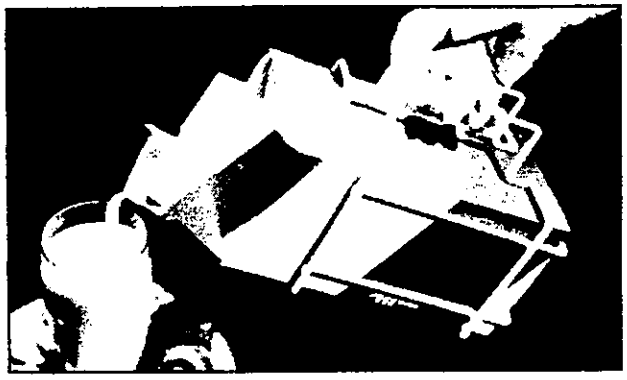
No-Tip Glass Holder

Adds 4" base to glass to prevent it from being tipped over. Excellent for use with long drinking straws. Glass can be clamped securely in place.
Catalog Number .....
..... **AM 911189**



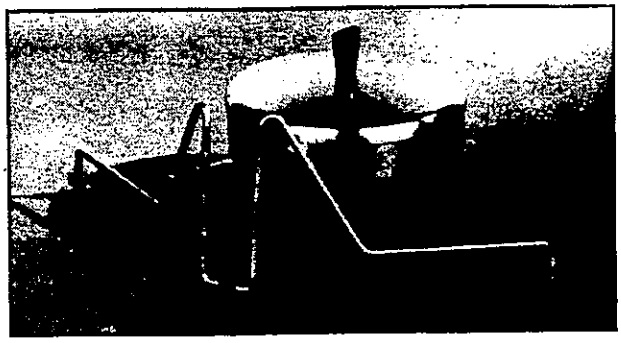
Tilting Glass Holder

A plastic hinged tilti platform (4" x 4") which ti from 0 to 24 degrees. Cup glass fits snugly into t well in the top plate. adjusting screw perm alteration of angle to ma straw more accessible patient.
Catalog Number .....
..... **AM 13-17**



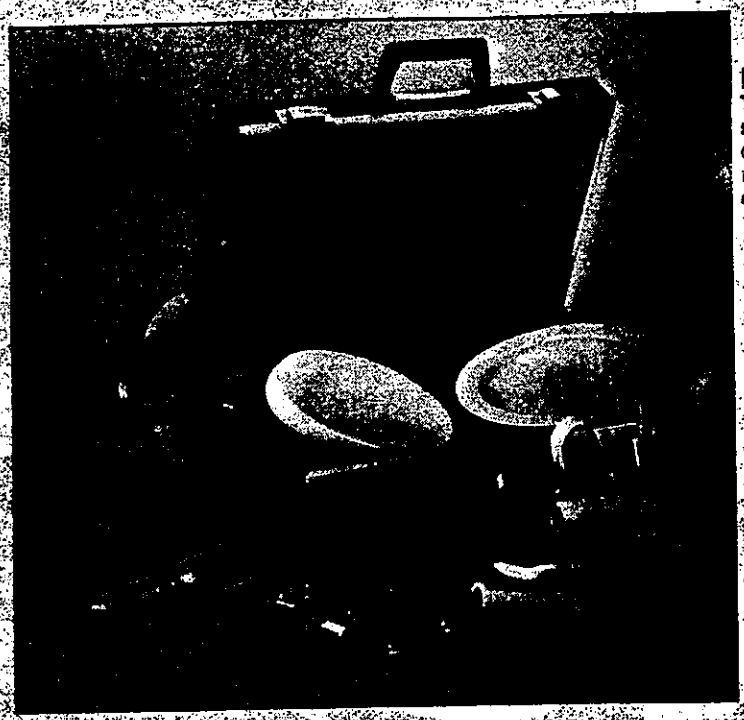
Milk Carton Holder

Provides sure grip feature. ½ gallon carton will not fall out when pouring. Handy for little children, too. Cushion-coated. Washable. Rack size. 4½" x 5⅞" x 6¼".
Catalog Number ..... **AM 13-1302**



Pan Holder

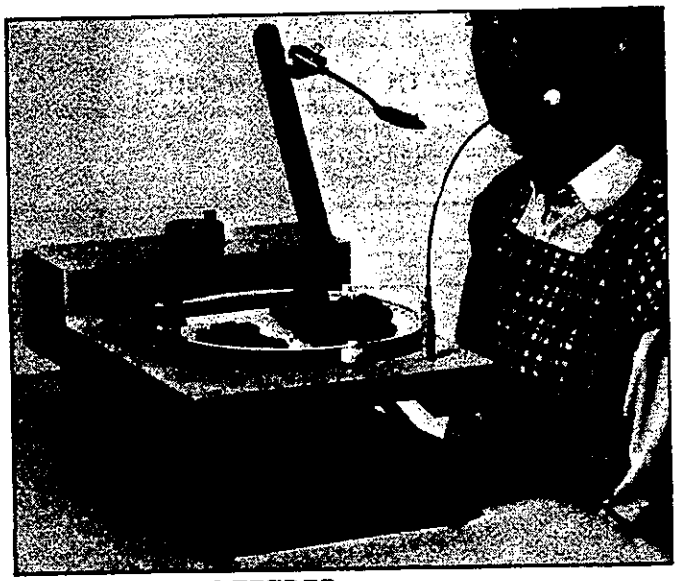
Pot handle is held between rods so that contents can be stirr with one hand. Chrome plated rod frame attaches to stove suction cups and has two vertical rods which keep a cooking p from spinning during stirring. Various heights of pots can accommodated. Size: 10" x 10" x 5".
Catalog Number ..... **AM 13-11**



BeOK® FEEDING EVALUATION KIT

This kit contains a variety of special eating utensils selected to help explore and solve the problems which delay or prevent self-feeding. Sixteen items included represent all areas of need. Kit is packaged in an attache case for convenient usage.

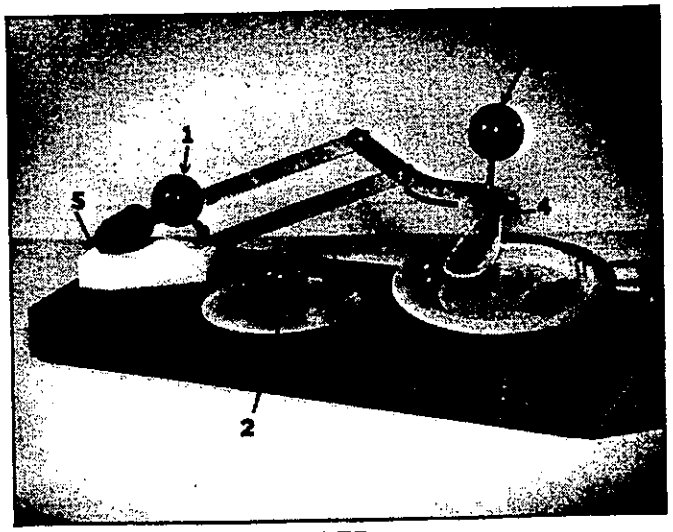
1021 Adult Swivel Spork
1035 Built-Up Handle Fork
1039 Built-Up Handle Knife, Serrated
1042 Built-Up Handle Soup Spoon
1048 Meat Cutter Knife
1050 Utensil Holder, Plastic
1105 Food Guard, Large
1117 Sure-Grip Glass Holder
1503 Coated Built-Up Handle Teaspoon
1104 Extension Handle Teaspoon
1254 Convalescent Feeding Cup
1259 Suction Holder, 1 only
1405 Rocker Knife with Solid Handle
1425 Inner Lip™ Plate, Plastic
1848 Round Scoop Dish
5252 Cylindrical Foam Padding, 1 yd.
Dycem Matting, 8" x 8" Square
One Attache Case with Keys
BK-1400 BeOK® Feeding Evaluation Kit



ELECTRIC SELF-FEEDER

Enables people to feed themselves at their own speed without using their arms. Requires only slight head motion on the chin switch to activate the motorized pusher that fills the spoon. Spoon automatically moves to the mouth. Select food for the next spoonful by controlled rotation of the Corelle-ware plate. Special knob for adjusting height of feeder. Operated by a 6-volt rechargeable battery. Feeder includes spoon, dish, chin switch, glass holder (not shown), battery and charger, and a remote hand/foot control for those unable to operate the chin switch. Carrying case separate.

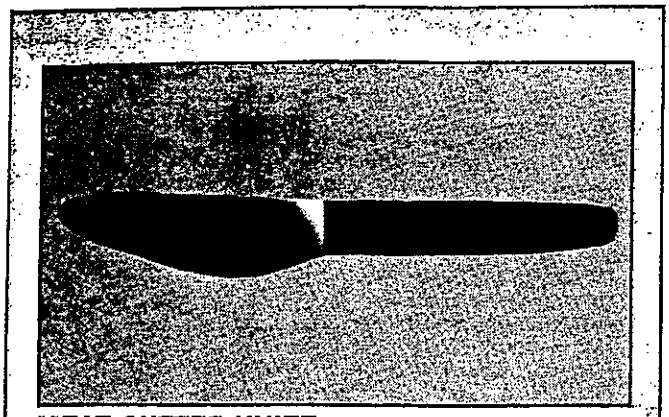
BK-1245 Electric Self-Feeder with Hand/Foot Control
BK-1245-02 Carrying Case



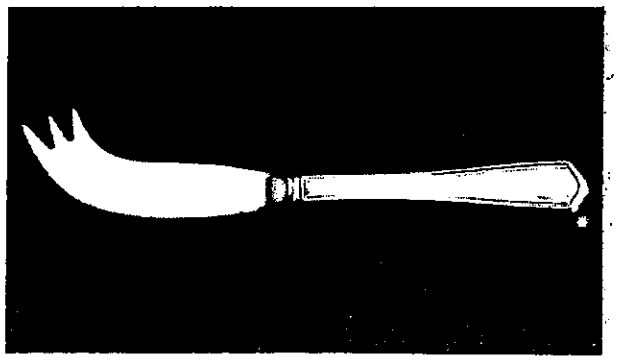
CEREBRAL PALSY FEEDER

A ruggedly made device that will enable a cerebral palsy person with some arm function to feed himself. Easy to clean, durable plastic base. Cellular rubber pads on the bottom prevent sliding. Includes a Stonybrook™ Hi-Wall ceramic plate, which inhibits heat loss, and a custom-made plastic spoon. Both are dishwasher safe. Note the numbers on the photo. #1 unlocks the lift mechanism; #2 rotates the plate; #3 unlocks the pivot at #4 as the spoon lowers to scoop up food; pushing on #3 brings it back down to the lock at #1. #5 indicates the tension adjustment on the lift mechanism. Available in right or left hand models. Guarantee invalid unless returned in original shipping container.

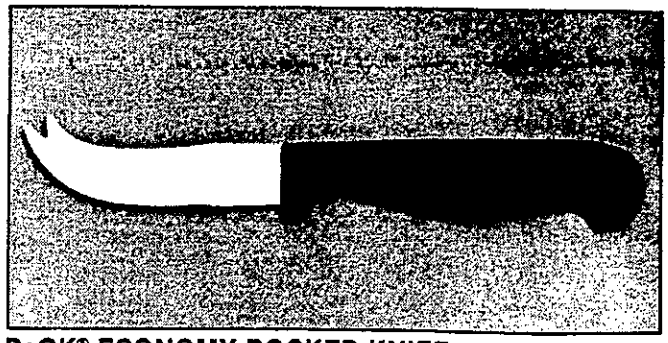
BK-1249 Cerebral Palsy Feeder, for Right Hand Operation
BK-1250 Cerebral Palsy Feeder, for Left Hand Operation
BK-1251-02 Replacement Spoon for Cerebral Palsy Feeder



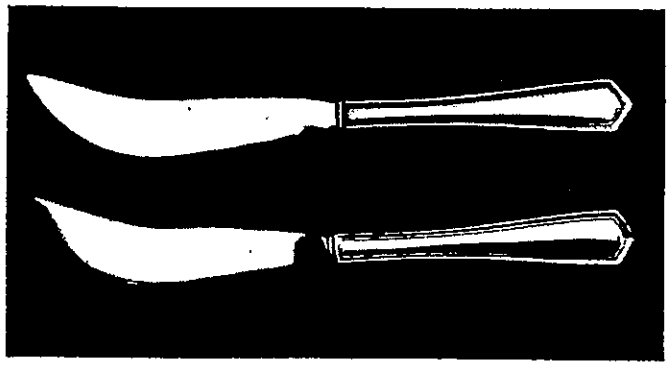
MEAT CUTTER KNIFE
A knife with a long curved blade for cutting meat with only one hand. Sculptured wooden handle. Stainless steel blade.
BK-1048 Meat Cutter Knife



ROCKER KNIFE-FORK
Rocker Knife-Fork has three prongs for picking up food. Stainless steel blade and hollow handle.
BK-1414 Rocker Knife-Fork

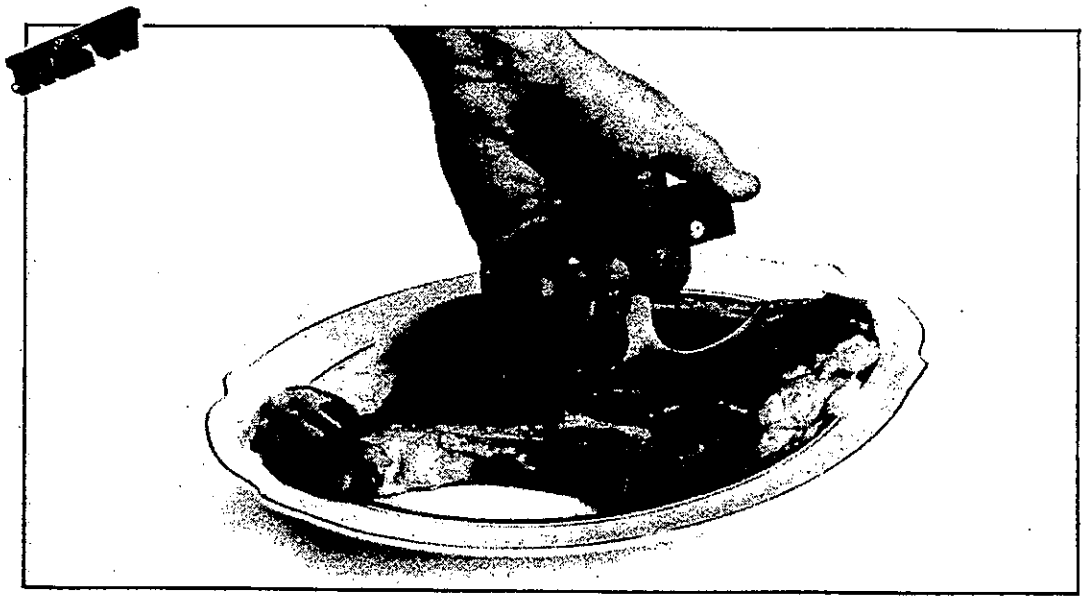


BeOK® ECONOMY ROCKER KNIFE
A high quality rocker knife at a reasonable price. Pleasant black plastic handle. Prongs are not as easy to use as the ones on the rocker knife-fork.
BK-1047 BeOK® Economy Rocker Knife

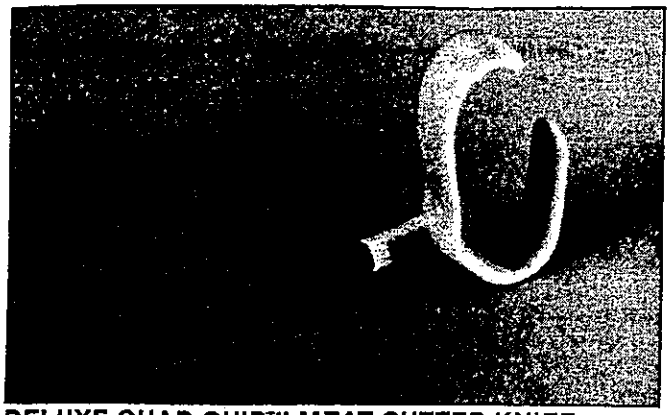


ROCKER KNIFE WITH SOLID HANDLE
Rocker Knife for the one-handed individual has sharp curved blade with solid handle. All stainless steel.
BK-1405 Rocker Knife with Solid Handle

ROCKER KNIFE WITH HOLLOW HANDLE
Stainless steel Rocker Knife for the one-handed person with a sharp curved blade and a hollow handle.
BK-1407 Rocker Knife with Hollow Handle

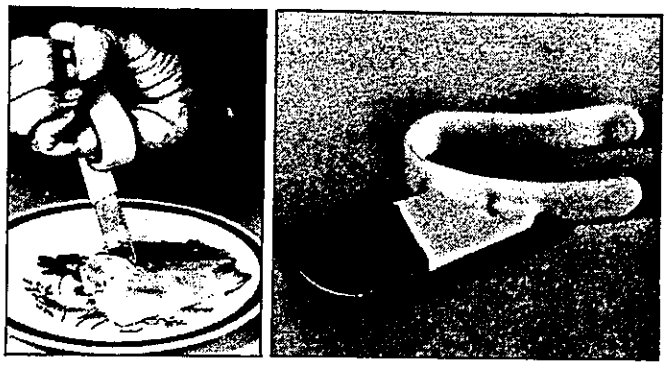


ROCKING T KNIFE
This rocker knife has a large, wooden handle with a stainless steel, single-edged blade approximately 3½" x 3¼". Because pressure is applied directly above the object to be cut, less strength and dexterity is needed by the user. Will cut up meat and other foods.
BK-1411 Rocking T Knife



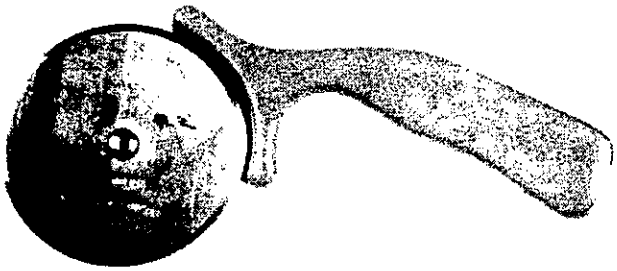
DELUXE QUAD-QUIP™ MEAT CUTTER KNIFE

The fully serrated thin, sharp stainless blade will easily slice through food that is held in place.
BK-1397 Deluxe Quad-Quip™ Meat Cutter Knife



QUAD-QUIP™ MEAT CUTTER KNIFE

A cuff type utensil that slips over the palm of the hand. A quad uses wrist extension to stabilize the wrist as the sharp stainless steel blade cuts by rocker action. Cuff is plastic coated steel that can be bent to fit the hand.
BK-1396 Quad-Quip™ Meat Cutter Knife

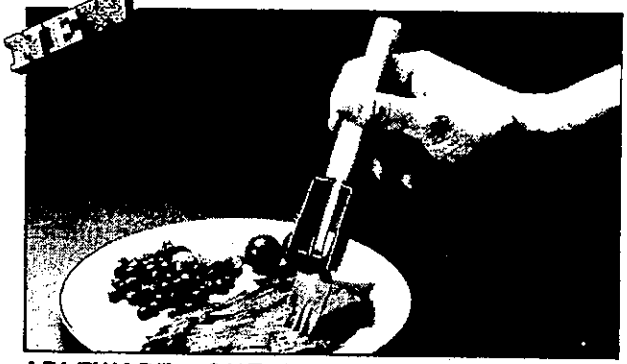


ONE-HANDED ROLLER KNIFE

An especially sharp roller knife for the one-handed or the individual with weakness. Roll the cutter wheel back and forth across the food to cut it. Protective guard molded into the handle assures safe operation. Stainless steel blade. Large aluminum handle.
BK-1398 One-Handed Roller Knife

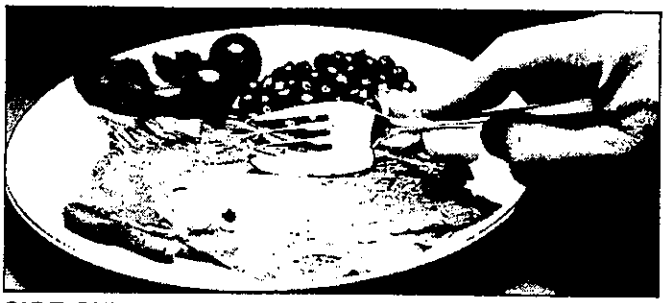
DELUXE ONE-HANDED ROLLER KNIFE

All metal roller knife for the one-handed or those lacking strength. White plastic handle is large and easy to grasp. Stainless steel blade is 2¾" in diameter.
BK-1399 Deluxe One-Handed Roller Knife



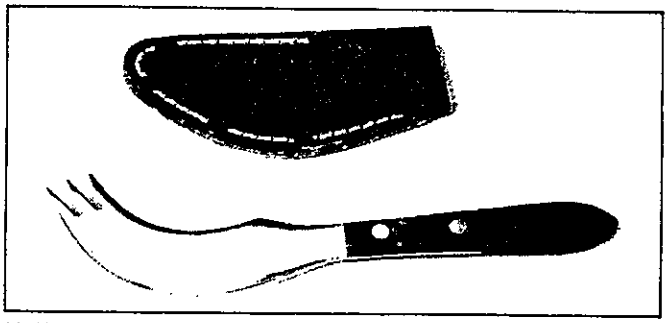
ABLEWARE™ ONE-HANDED CUTLERY SET

Single unit consisting of a fork and knife combination. The fork and handle can be removed and all parts disassembled for thorough cleaning. 8¾" long x 1¼" wide.
BK-1044 Ableware™ One-Handed Cutlery Set



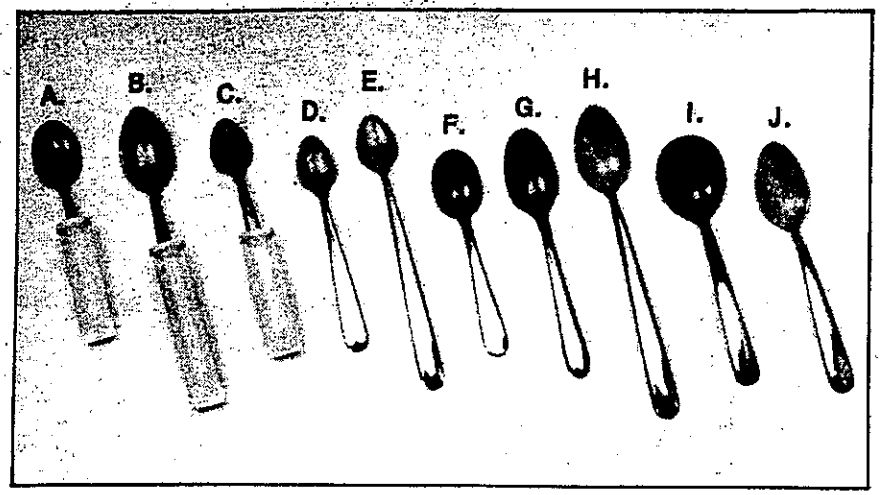
SIDE CUTTER™ FORK

A special eating utensil which provides an edge along the side of the fork. The curved blade is only semi-sharp so there is no danger of cutting oneself. The edge will cut up average foods but not all meats.
BK-1049-01 Side Cutter™ Fork, Right
BK-1049-02 Side Cutter™ Fork, Left



KNIFE-FORK COMBO

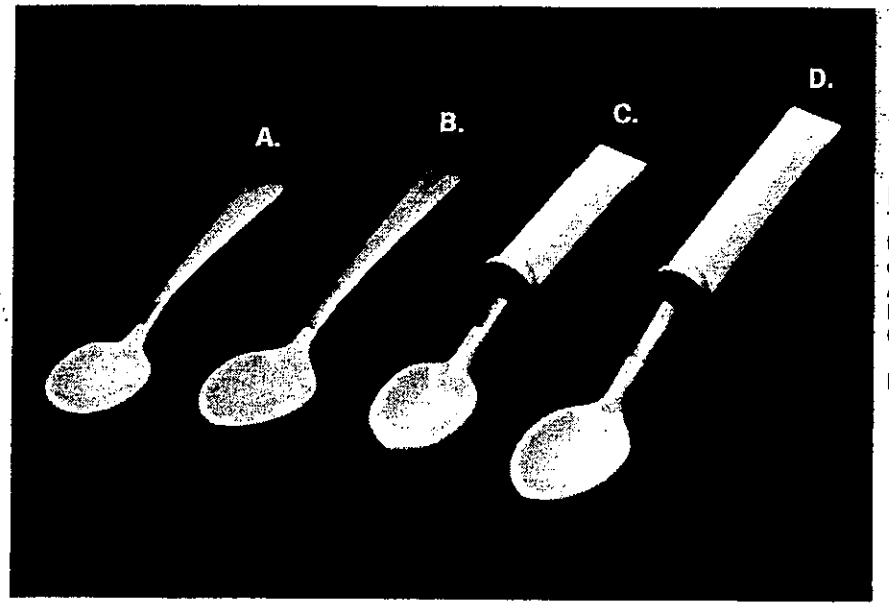
A 4¼" long, sharp stainless steel blade with a 4" brown staminawood handle. Comes with a protective leather sheath. Not to be used indiscriminately.
BK-1045 Knife-Fork Combo



NYLON COATED SPOONS

Spoons are coated with durable nylon for long wear and heavy duty use. Certain spoons feature plastic built-up handles (see below).

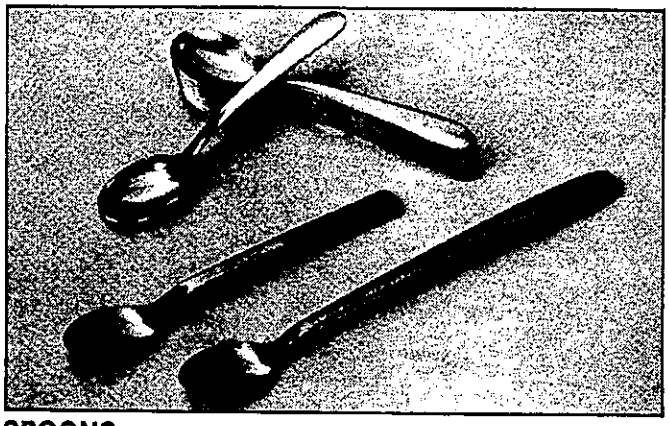
A. BK-1074-01 Nylon Coated Built-Up Handle Youthspoon
B. BK-1075-02 Nylon Coated Built-Up Handle Teaspoon
C. BK-1076 Nylon Coated Built-Up Handle Infant Spoon
D. BK-1077-01 Nylon Coated Infant Spoon
E. BK-1077-02 Nylon Coated Long Infant Spoon
F. BK-1077-03 Nylon Coated Youthspoon
G. BK-1077-04 Nylon Coated Teaspoon
H. BK-1077-05 Nylon Coated Long Teaspoon
I. BK-1077-06 Nylon Coated Soup Spoon
J. BK-1077-07 Nylon Coated Tablespoon



PLASTISOL COATED SPOONS

These plastic coated spoons provide protection for the teeth and lips. With or without plastic built-up handles (see below).

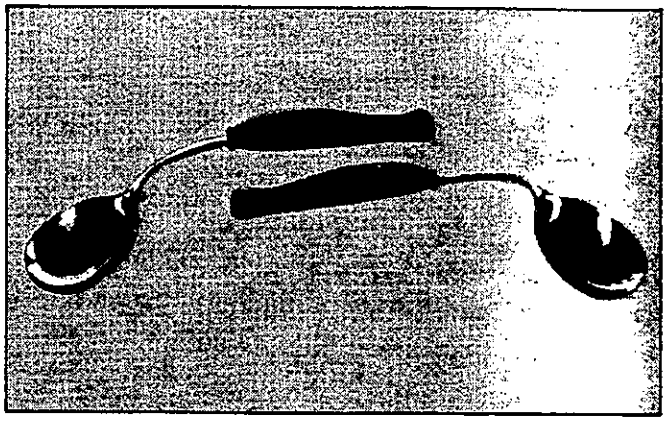
A. BK-1071 Plastisol Coated Youthspoon
B. BK-1072 Plastisol Coated Teaspoon
C. BK-1074 Plastisol Coated Built-Up Handle Youthspoon
D. BK-1075 Plastisol Coated Built-Up Handle Teaspoon



SPOONS

Plain metal spoons in two bowl sizes: youth and infant plus a long-handled infant spoon. One dozen to a package.

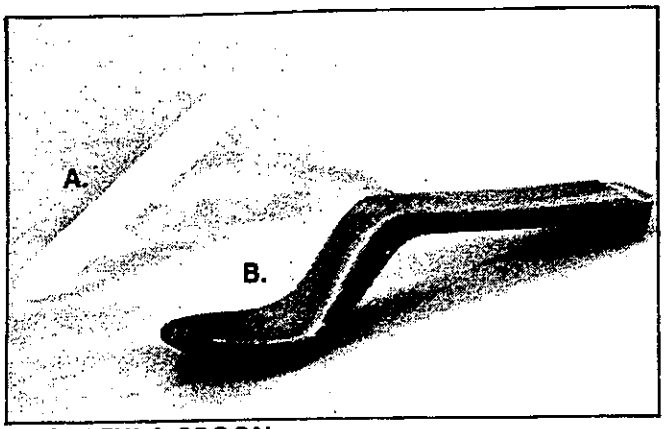
BK-1011 Youthspoons, Package of 12
BK-1012 Infant Spoons, Package of 12
BK-1013 Long Infant Spoons, Package of 12



CHILD'S BENT SPOONS

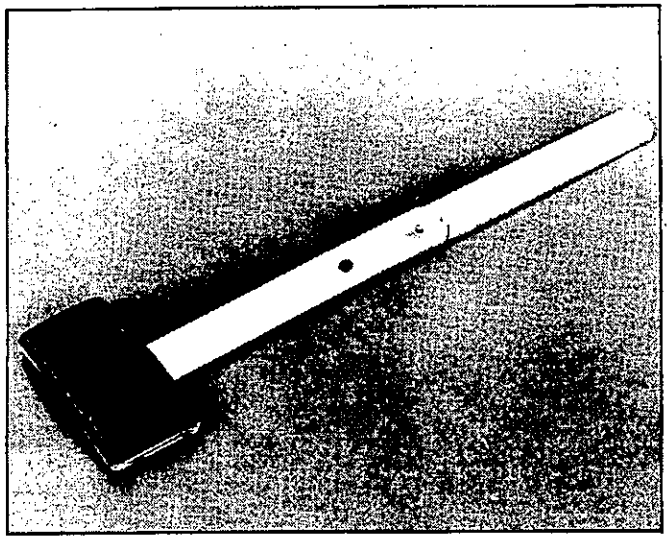
These spoons are angled just right for children. The handle is shaped for a good hand grip. Molded of durable plastic Available for right or left hand.

BK-1463 Child's Bent Spoon, Right
BK-1464 Child's Bent Spoon, Left

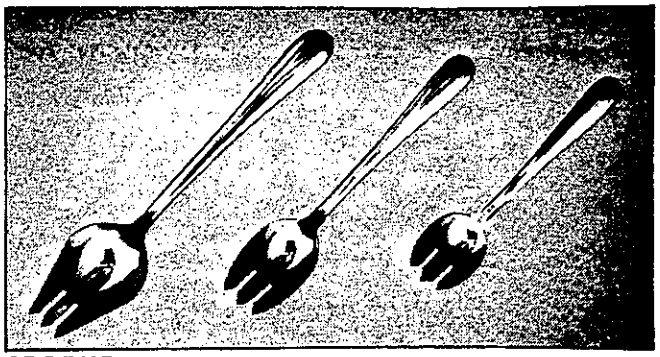


A. SPATULA SPOON
This flat polyethylene spatula spoon is designed to be used in a feeding training program. It has a shallow bowl near the end to contain a small quantity of soft food.
BK-1472 Spatula Spoon

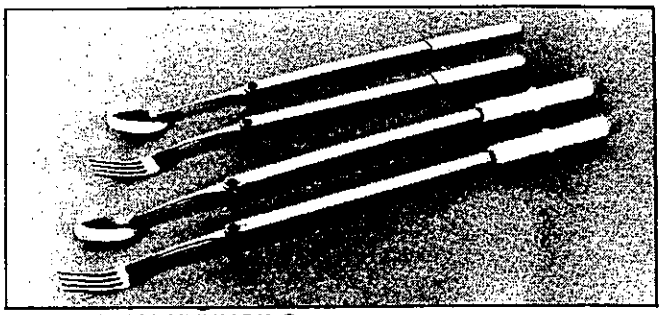
B. RUBBER SPOON
Full size silicone rubber spoon designed for both adults and children to protect the teeth and lips. Easy to hold. Gray color. Safe for commercial dishwashers.
BK-1073 Rubber Spoon



FOLD-UP EXTENSION HOLDER
A compact extension holder that fits in your shirt pocket or purse when not in use. The "Your Utensil" pocket turns for getting the best angle. Holds a variety of ADL tools in addition to eating utensils. Polished aluminum. Length extended is 10½".
BK-1539 Fold-Up Extension Holder



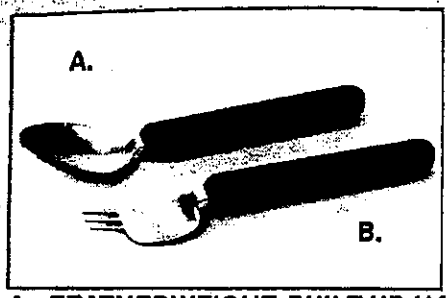
SPORKS
A stainless steel combination spoon and fork.
BK-1056 Spork, Large, 7"
BK-1058 Spork, Medium, 6"
BK-1059 Spork, Small, 5"

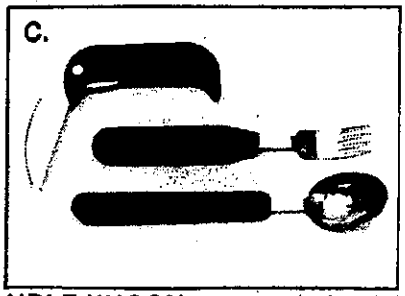


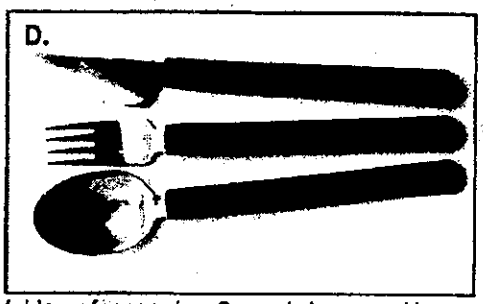
EXTENSION UTENSILS
A long spoon or fork for individuals with limited range of motion. Choice of handles includes vinyl-tipped or plastic-grip handle. Aluminum wing nut holds the spoon or fork securely. Extension portion of handle is 10" long.
BK-1194 Extension Teaspoon, Vinyl Handle
BK-1195 Extension Fork, Vinyl Handle
BK-1198 Extension Teaspoon, Plastic Handle
BK-1199 Extension Fork, Plastic Handle

QUAD-QUIP™ SANDWICH HOLDER
A plastic holder grips the sandwich while the unit is inserted into a utensil holder. A rubber band provides clamping action. Assembly is locked together. Molded of Royalite. Can be washed in commercial dishwasher. Suggested by a Kansas rehabilitation center.
BK-1394 Quad-Quip™ Sandwich Holder

GLOSSECTOMY PUSHER SPOON
A cast aluminum pusher spoon with a stainless steel pusher for patients who have had surgery of the tongue. Total spoon length is 9". The bowl is 2" long by 1¼" wide. Pusher is ¼" high and tapers at each end.
BK-1471 Glossectomy Pusher Spoon







A. FEATHERWEIGHT BUILT-UP HANDLE KNOON

Same features as the Knork except it is a combination knife and spoon. Bowl of the spoon is deeper than a regular teaspoon. It is sharpened on both sides and serrated at the top of the bowl. Can be used either right or left hand.

BK-1006 Featherweight Built-Up Handle Knoon

B. FEATHERWEIGHT BUILT-UP HANDLE KNORK

Functions equally well as either a knife or a fork. Made of the same lightweight plastic as the other Featherweight utensils. Oval handle. Stainless steel head. Comes in either right or left hand models.

BK-1005-01 Featherweight Built-Up Handle Knork, Right
BK-1005-02 Featherweight Built-Up Handle Knork, Left

C. FEATHERWEIGHT OVAL BUILT-UP HANDLE UTENSILS

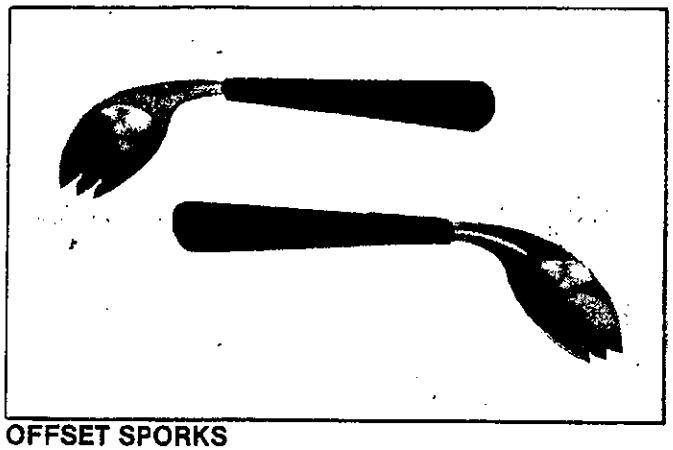
Super lightweight built-up oval handle utensils that are easy to grasp for persons with hand disabilities. No utensil weighs more than 1½ oz. Polycarbonate plastic handles are made of the same material used in astronauts' space helmets. Completely dishwasher safe. Stainless steel heads of utensils designed to require minimum force. Knife is angled, has a serrated edge and folds up for carrying. Spoon is larger and has a deeper bowl than a regular teaspoon. Can be ordered separately or as a set.

BK-1003-01 Featherweight Oval Built-Up Handle Fork
BK-1003-02 Featherweight Oval Built-Up Handle Spoon
BK-1003-03 Featherweight Oval Built-Up Handle Foldup Knife
BK-1003-04 Featherweight Oval Built-Up Handle Utensils, Set of 3

D. FEATHERWEIGHT SLIM BUILT-UP HANDLE UTENSILS

Made of lightweight, durable, dishwasher safe polycarbonate plastic with stainless steel eating heads. Handles are thinner than the Featherweight Oval Built-Up Handle Utensils. Fork head is slightly angled to make it easier to pick up food. Spoon is larger than a regular teaspoon. Knife has a serrated edge and is designed to be used effectively with either a thumb-base or volar grip. Available individually or as a set.

BK-1004-01 Featherweight Slim Built-Up Handle Fork
BK-1004-02 Featherweight Slim Built-Up Handle Spoon
BK-1004-03 Featherweight Slim Built-Up Handle Knife
BK-1004-04 Featherweight Slim Built-Up Handle Utensils, set of 3



OFFSET SPORKS

A stainless steel spork with black plastic handles. Gives as nearly a flat approach as the offset spoons. Designed for right or left hand.

BK-1442 Offset Spork, Right Hand
BK-1443 Offset Spork, Left Hand

SOFT BUILT-UP HANDLE UTENSILS

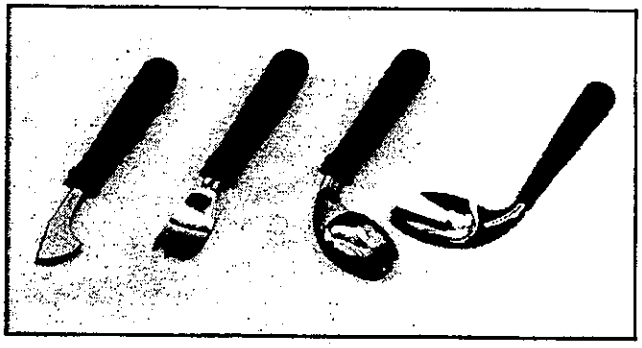
The soft design built-ups have a plastic core and a comfortable foam padded handle 1½" in diameter. The foam is closed cell so it will not absorb moisture. Stainless steel utensils. Sold individually or as a set.

BK-1028 Soft Built-Up Handle Teaspoon
BK-1035 Soft Built-Up Handle Fork
BK-1039 Soft Built-Up Handle Knife, Serrated
BK-1042 Soft Built-Up Handle Soup Spoon
BK-1043 Soft Built-Up Handle Utensils, Set of 4

MELAWARE

Designed in England to make gripping of tableware as effortless as possible. All products feature polypropylene handles. Knife blade will cut in both slicing and rocking motion. Angled heads of the offset spoons (for right or left hand) help reduce pressure on the wrists.

BK-1438 Melaware Knife
BK-1439 Melaware Fork
BK-1440 Melaware Offset Spoon, Right Hand
BK-1441 Melaware Offset Spoon, Left Hand



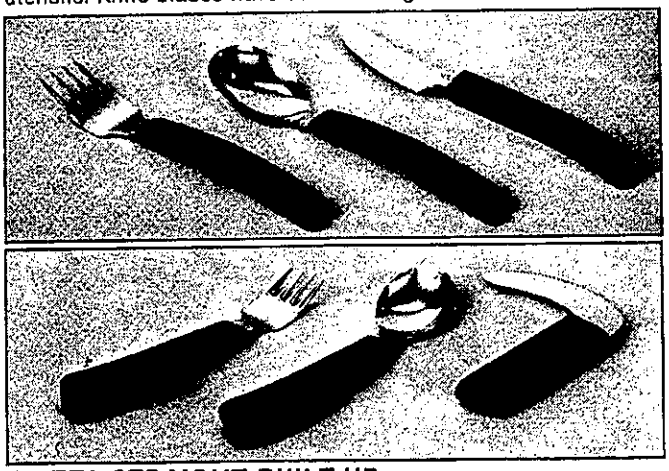
VERTICAL PALM SELF-HANDLE UTENSILS

The handle of the utensil has been bent 90° to allow the hand in mid-position to function in a table-to-mouth pattern. Plastic covered handle is bendable for adjusting to hand size, and the utensil can be bent to improve the pattern.

BK-1301 Vertical Self-Handle Teaspoon
BK-1308 Vertical Self-Handle Long Teaspoon
BK-1315 Vertical Self-Handle Soup Spoon
BK-1322 Vertical Self-Handle Fork
BK-1329 Vertical Self-Handle, Set of 4

AMEFA CUTLERY

Lightweight stainless steel cutlery with black plastic built-up handles. Spoon bowls and fork heads are larger than standard utensils. Knife blades have serrated edge. Dishwasher safe.



AMEFA STRAIGHT BUILT-UP HANDLE UTENSILS

Handles on the spoon and fork are slightly curved and are tapered toward the eating end. Knife blade is slightly curved for rocker action. Length of each utensil is 7". Sold separately or in a set of 3.

BK-1008-01 Amefa Straight Built-Up Handle, Fork
BK-1008-02 Amefa Straight Built-Up Handle, Spoon
BK-1008-03 Amefa Straight Built-Up Handle, Knife
BK-1008-04 Amefa Straight Built-Up Handle Utensils, Set of 3

AMEFA CURVED BUILT-UP HANDLE UTENSILS

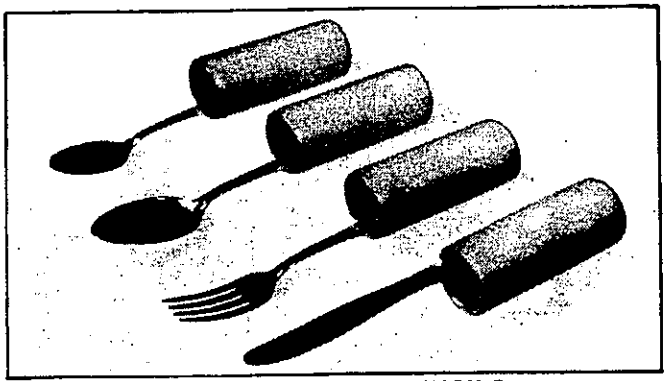
Fork and spoon have curved handles that taper toward the eating end and are angled for easy grip. Length of both is 9". Knife handle is straight and measures 3¼" long by 1" wide by ½" thick.

BK-1009-01 Amefa Curved Built-Up Handle, Fork, Right Hand
BK-1009-02 Amefa Curved Built-Up Handle, Spoon, Right Hand
BK-1009-03 Amefa Curved Built-Up Handle, Knife, Right Hand
BK-1009-04 Amefa Curved Built-Up Handle Utensils, Right Hand, Set of 3
BK-1010-01 Amefa Curved Built-Up Handle, Fork, Left Hand
BK-1010-02 Amefa Curved Built-Up Handle, Spoon, Left Hand
BK-1010-03 Amefa Curved Built-Up Handle, Knife, Left Hand
BK-1010-04 Amefa Curved Built-Up Handle Utensils, Left Hand, Set of 3

HORIZONTAL PALM SELF-HANDLE UTENSILS

These utensils feature plastic covered hand grips which can be bent easily to adjust for the hand size of the individual.

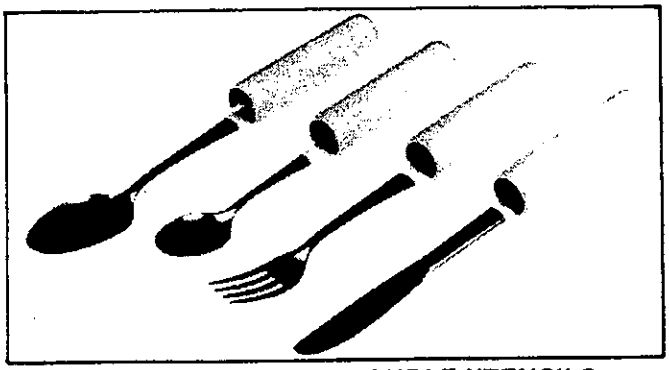
BK-1266 Horizontal Self-Handle Teaspoon
BK-1273 Horizontal Self-Handle Long Teaspoon
BK-1280 Horizontal Self-Handle Soup Spoon
BK-1287 Horizontal Self-Handle Fork
BK-1290 Horizontal Self-Handle, Set of 4



COATED BUILT-UP HANDLE UTENSILS

These sanitary, lightweight open ended steel cylinders are coated with tough plastic to provide improved grasp. Available in 3 diameters: 1", 1¼" and 1½", spoon, soup spoon, fork and knife to meet individual needs. Can be safely washed in institutional dishwashers. Available individually or in sets.

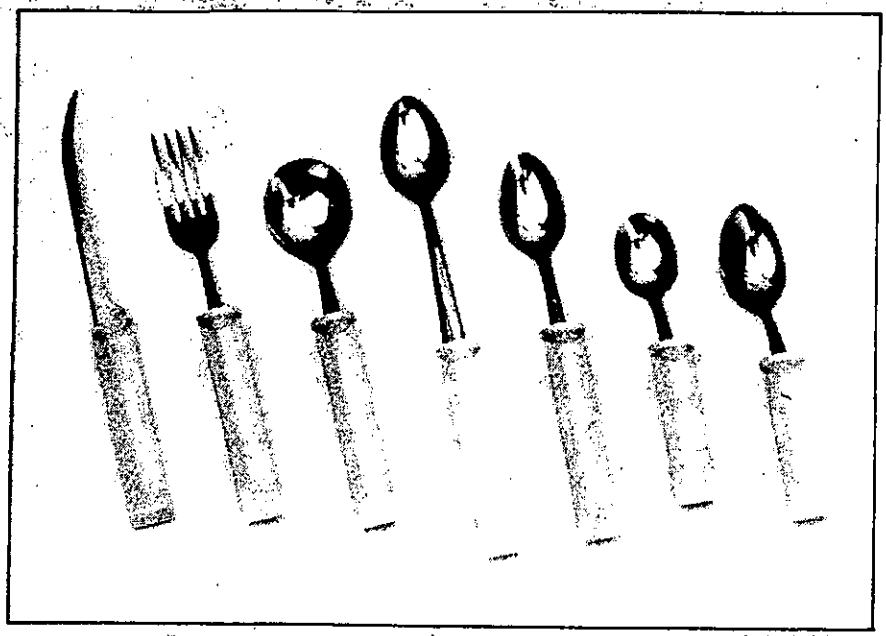
Diameter	Spoon	Soup Spoon	Fork	Knife	Set of 4
1"	BK-1603	BK-1610	BK-1617	BK-1624	BK-1631
1¼"	BK-1638	BK-1645	BK-1652	BK-1659	BK-1666
1½"	BK-1673	BK-1680	BK-1687	BK-1694	BK-1699



LONG COATED BUILT-UP HANDLE UTENSILS

Same as Coated Built-Up Handle Utensils except that these are about an inch or more longer. Available in 1" diameter only.

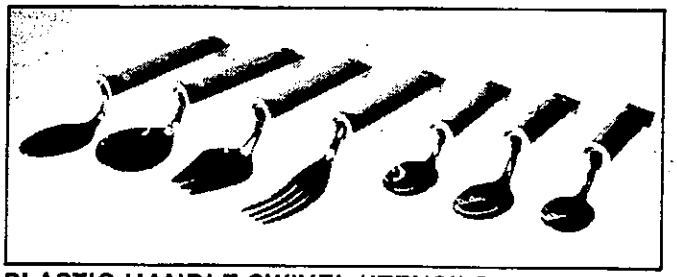
BK-1706 Long Coated Built-Up Handle Teaspoon, 1" dia.
BK-1709 Long Coated Built-Up Handle Soup Spoon, 1" dia.
BK-1712 Long Coated Built-Up Handle Fork, 1" dia.
BK-1715 Long Coated Built-Up Handle Knife, 1" dia.
BK-1718 Long Coated Built-Up Handle Utensils, Set of 4, 1" dia.



PLASTIC HANDLE UTENSILS

Dishwasher safe, molded plastic oval handles that improve grasp and holding patterns. Stainless steel utensils. Knife has a slight curve and a serrated edge. All utensils available individually or in a set of 5 consisting of knife, fork, soup spoon, long teaspoon and regular teaspoon.

BK-1183 Plastic Handle Utensils, Set of 5
BK-1184 Plastic Handle, Knife
BK-1185 Plastic Handle, Fork
BK-1186 Plastic Handle, Soup Spoon
BK-1187 Plastic Handle, Long Teaspoon
BK-1188 Plastic Handle, Regular Teaspoon
BK-1189 Plastic Handle, Baby Spoon
BK-1190 Plastic Handle, Youthspoon



PLASTIC HANDLE SWIVEL UTENSILS

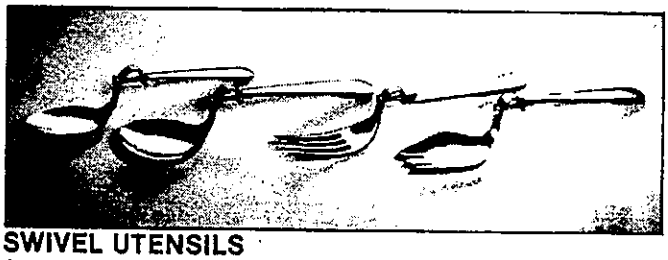
Custom molded oval handles will improve grasp and holding patterns. Closed end design for better balance and improved sanitation. Built-in stops. Dishwasher safe. Stainless steel utensils.

BK-1007 Adult Swivel Teaspoon
BK-1014 Adult Swivel Soup Spoon
BK-1021 Adult Swivel Spork
BK-1025 Adult Swivel Fork
BK-1060 Baby Swivel Spoon
BK-1070 Junior Swivel Teaspoon
BK-1063 Junior Swivel Youthspoon

ADJUSTABLE SWIVEL UTENSILS

Eating utensils with a swivel mechanism which keeps them level when wrist or finger motion is absent. Two stops can be adjusted to regulate the amount of swivel in either direction. Flat handle fits in a utensil holder. Stainless steel construction.

BK-1147 Adjustable Swivel Youthspoon
BK-1154 Adjustable Swivel Teaspoon
BK-1161 Adjustable Swivel Fork
BK-1168 Adjustable Swivel Soup Spoon
BK-1180 Adjustable Swivel Medium Spork
BK-1182 Adjustable Swivel Large Spork



SWIVEL UTENSILS

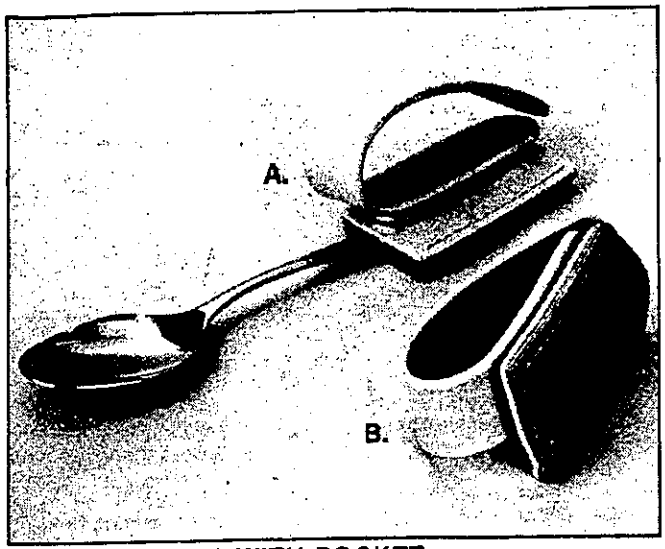
A regular stainless steel swivel utensil with a small amount of dip from handle to spoon. Does not have stops.

BK-1345 Swivel Teaspoon
BK-1352 Swivel Soup Spoon
BK-1359 Swivel Fork
BK-1366 Swivel Spork

WEIGHTED UTENSILS

Easy to grasp and shaped to fit the fingers, these plastic weighted utensils have 8 oz. of additional weight completely enclosed in the plastic handle.

BK-1082 Weighted Teaspoon, 8 oz.
BK-1083 Weighted Soup Spoon, 8 oz.
BK-1084 Weighted Spork, 8 oz.
BK-1085 Weighted Fork, 8 oz.
BK-1086 Weighted Knife, Serrated, 8 oz.



A. PALMAR CLIP WITH POCKET

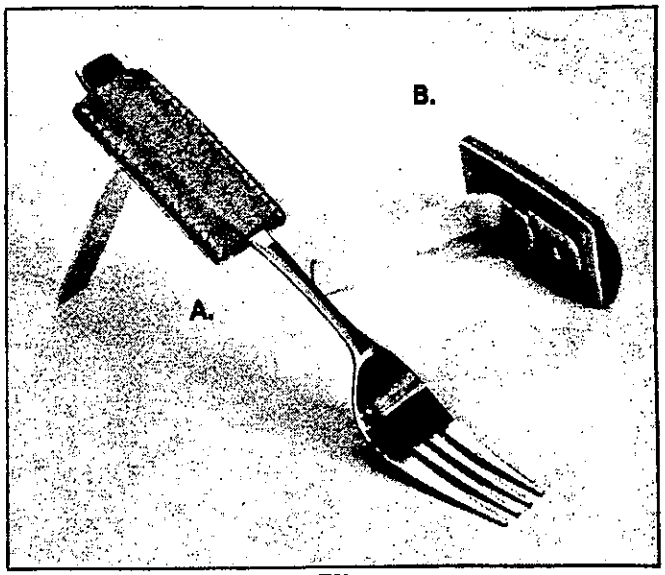
The hand can be slid into this Palmar Clip by a quad. No straps to fasten, yet it provides a firm base for the "Your Utensil" pocket. The pocket turns at any angle for best function. Molded of Kydex plastic, the fit can be adjusted with a heat gun. Fits right or left with offset position for either.

BK-1503 Palmar Clip with Pocket

B. PALMAR CLIP WITH DOUBLE POCKET

Two pockets, one standard size and one wider, to accommodate different thicknesses of utensils. Kydex plastic Palmar clip and pocket that turns at any angle for specific functions. Fits right or left hand.

BK-1534 Palmar Clip with Double Pocket



A. RIGHT ANGLE POCKET

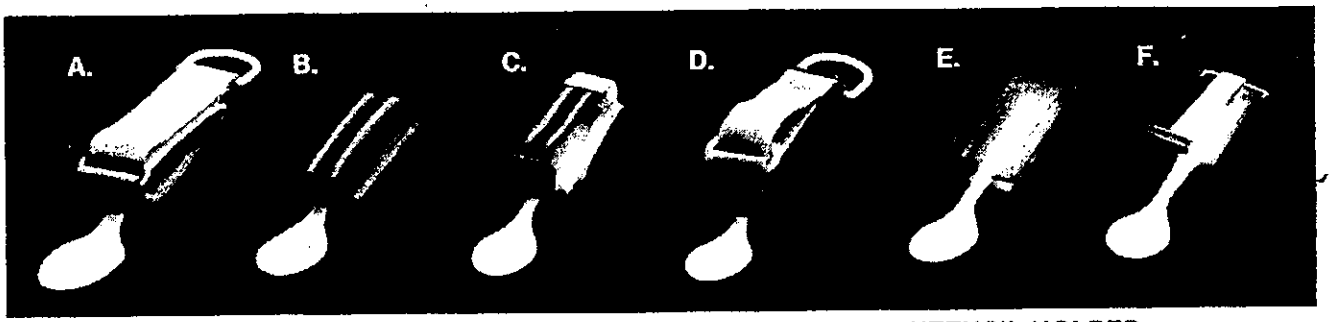
An important accessory that will become a part of most set-ups as you take advantage of the "Your Utensil" pocket at right angle to the palm. Made to slide into all the other pockets and utensil holders. Turns to the best angle for cutting meat, writing, etc. Holds most flat handled table knives. One size only. Fits right or left.

BK-1532 Right Angle Pocket

B. RIGHT ANGLE DOUBLE POCKET

Two pockets, one standard and one wider, to accommodate different thicknesses of utensils. Will slide into other pockets and utensil holders. Same leather and metal construction as BK-1532 Right Angle Pocket. One size only. Fits right or left hand.

BK-1533 Right Angle Double Pocket



A. BeOK® UTENSIL HOLDER

Manufactured from grey cotton webbing. Features grey Velcro® loop and hook.

BK-1481 BeOK® Utensil Holder

B. UNIVERSAL CUFF

The traditional high quality leather ADL cuff with an elastic strap. Holds various utensils as well as the right angle pocket.

BK-1485 Universal Cuff, Small
BK-1487 Universal Cuff, Medium
BK-1489 Universal Cuff, Large

C. COMFORT UTENSIL HOLDERS

An economy model with a strong elastic band, a Velcro® pouch and Velcro® closure at the back. The Velcro® pouch allows you to vary the length of the utensil by how far you slide it into the pouch. Washable. Color-coded. The three sizes are as follows: Small, Green, 2½" to 3" palm; Medium, Gray, 3" to 3½" palm; Large, Beige, 3½" to 4" palm.

BK-1053 Comfort Utensil Holder, Small, Green
BK-1054 Comfort Utensil Holder, Medium, Gray
BK-1055 Comfort Utensil Holder, Large, Beige

D. QUAD-QUIP™ UTENSIL HOLDER

Quad-Quip™ items are designed for quads. The Quad-Quip™ Utensil Holder has a continuous loop of Velcro® with thumb hole and "D" Ring for getting the hand in place and tightening it easily. An important feature is the plastic base that angles the spoon away from the palm to make the eating pattern easier. Washable nylon and plastic constuction. One size fits all. Suggested by an Arkansas rehabilitation center.

BK-1373 Quad-Quip™ Utensil Holder

PLASTIC UTENSIL HOLDERS

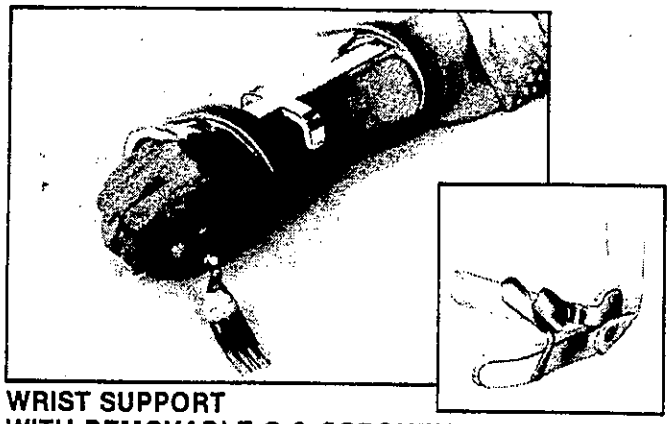
Electronically heat-sealed washable vinyl material with a pleasing matte finish. Pocket is notched to let the utensil enter easily. Both are adjustable with Velcro® closure.

E. BK-1050 Plastic Utensil Holder
F. BK-1052 Elastic Utensil Holder

GRIP MATE

Helps those with limited use of hands to hold such products as forks, knives and spoons with ease. Also ideal for toothbrushes, pens or pencils, or combs. Manufactured from lightweight, dishwasher safe vinyl. Comes with adjustable Velcro® strap.

BK-1483 Grip Mate



WRIST SUPPORT WITH REMOVABLE C & OPPONENS BAR

Combination of a traditional Long Opponens Splint and a feeding splint. The C/Opponens Bar slides out of the pocket during feeding to allow an eating utensil to be used. C/Opponens Bar holds thumb in abducted position. The clip has a "Your Utensil" pocket to allow a swivel or plain utensil to be used. Swivel fork not included.

BK-1526-01 Wrist Support with Removable C & Opponens Bar, Child, Right
BK-1526-02 Wrist Support with Removable C & Opponens Bar, Child, Left
BK-1528-01 Wrist Support with Removable C & Opponens Bar, Regular, Adult, Right
BK-1528-02 Wrist Support with Removable C & Opponens Bar, Regular, Adult, Left
BK-1530-01 Wrist Support with Removable C & Opponens Bar, Large, Adult, Right
BK-1530-02 Wrist Support with Removable C & Opponens Bar, Large, Adult, Left

QUAD-QUIP™ DORSAL FEEDING SPLINT

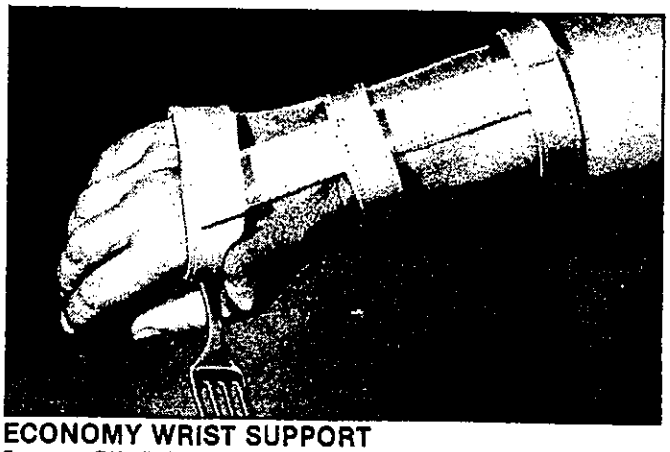
Plastic coated steel splint with a 2" wide Palmar cuff of Velcro® loop. Allows the Velcro® hook utensil holder to be angled and positioned as you experiment to get the best plate to mouth pattern. Wrist extension easily changed by bending. An important accessory is BK-1532 Right Angle Pocket. Comes complete with Velcro® straps and one utensil holder.

BK-1080 Quad-Quip™ Dorsal Feeding Splint
BK-1081 Utensil Holder for Quad-Quip™ Dorsal Feeding Splint

WRIST SUPPORT WITH PALMAR CLIP

Leather covered with metal splints. Has a plastic Palmar Clip riveted to the support at a comfortable angle. The clip can be heated and bent to change the angle for a more customized fit. The clip has the "Your Utensil" pocket for accepting utensils and the right angle pocket. (See Right Angle Pocket.) Wrist extension changed easily by bending for correct position.

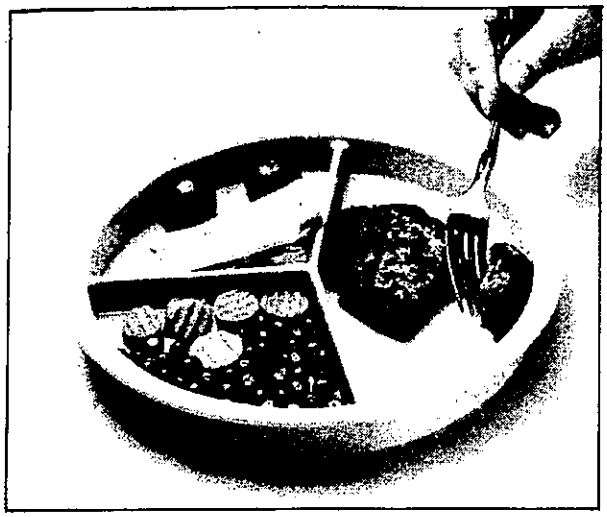
BK-1510-01 Wrist Support with Clip, Child, Right
BK-1510-02 Wrist Support with Clip, Child, Left
BK-1512-01 Wrist Support with Clip, Regular, Adult, Right
BK-1512-02 Wrist Support with Clip, Regular, Adult, Left
BK-1514-01 Wrist Support with Clip, Large, Adult, Right
BK-1514-02 Wrist Support with Clip, Large, Adult, Left



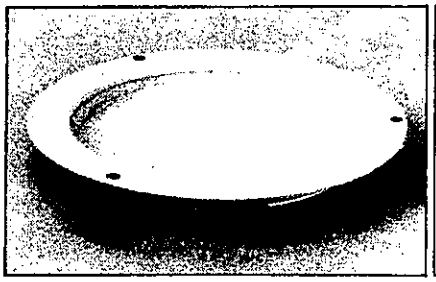
ECONOMY WRIST SUPPORT

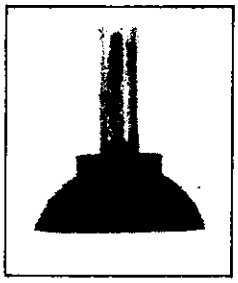
Same as BK-1510, 1512, 1514 only without Palmar Clip. Hand cuff is leather with a Velcro® closure, and the pocket angle is permanently fixed.

BK-1520-01 Economy Wrist Support, Child, Right
BK-1520-02 Economy Wrist Support, Child, Left
BK-1522-01 Economy Wrist Support, Regular, Adult, Right
BK-1522-02 Economy Wrist Support, Regular, Adult, Left
BK-1524-01 Economy Wrist Support, Large, Adult, Right
BK-1524-02 Economy Wrist Support, Large, Adult, Left

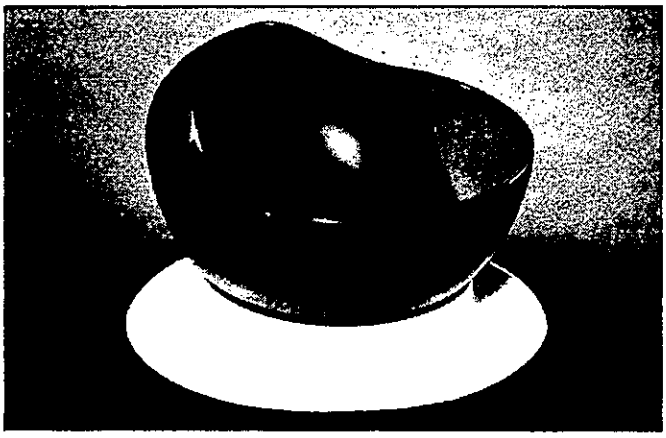


BeOK® PARTITIONED SCOOP PLATE
Heavy duty polycarbonate plate with thick 1" high outer wall. Ideal for institutional feeding. Textured eating surface resists scratching. Two 4 oz. and one 8 oz. capacity sections. Dishwasher safe. Beige color only.
BK-1392 BeOK® Partitioned Scoop Plate



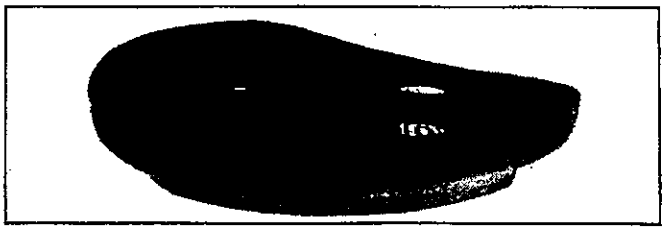


TRIANGULAR SUCTION PLATE
Three suction cups are positioned at the outer edge of BK-1425 Inner Lip Plate. When moistened and pressed firmly to a Formica® table top, it will not move.
BK-1387 Triangular Suction Plate
BK-1387-01 Suction Cup Replacement

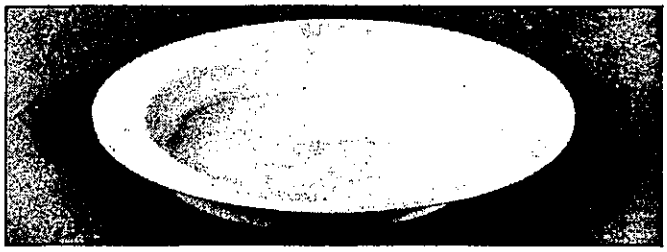


SCOOPER BOWL
One side of this 4½" diameter bright plastic bowl is rolled over to aid in getting the food on the utensil. Broad non-skid vinyl base removes from bowl for washing by hand or in top rack of domestic dishwashers.
BK-1548 Scooper Bowl

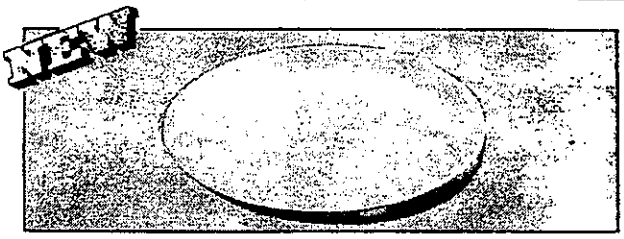
PARTITIONED SCOOP DISH
A white Melamine dishwasher safe plastic dinner size plate with ¾" high dividers and nearly vertical sides. Two compartments are 4 oz. capacity. One is 8 oz. Diameter, 8¾". Not for heavy institutional usage.
BK-1388 Partitioned Scoop Dish



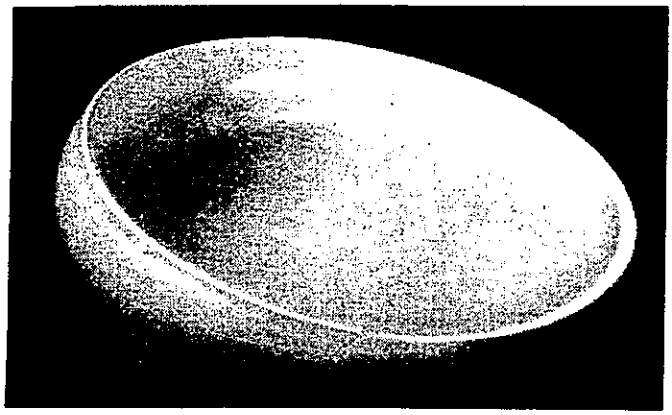
SCOOPER PLATE
One side of this 6½" diameter bright plastic plate is molded high and rolls over to aid in getting the food on the utensil. A non-skid plastic strip removes from the base for washing by hand or top rack of domestic dishwashers.
BK-1547 Scooper Plate



BeOK® SCOOP DISH
This round scoop dish is made of extra thick white Melamine plastic with a heavy-duty reinforced rim and base to withstand institutional usage. The groove in the lip can be used for resting the eating utensil or as a location notch for the visually impaired.
BK-1544 BeOK® Scoop Dish



MELAMINE SCOOP DISH
This 7¾" diameter round scoop dish is manufactured from heavy duty white Melamine plastic. It is dishwasher safe in both domestic and high volume institutional applications, and break resistant under normal usage.
BK-1545 Melamine Scoop Dish

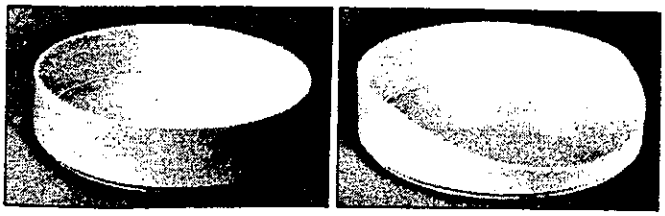


ROUND SCOOP DISH

Molded low in front and high in back, this unbreakable, bright, round scoop dish is especially useful. A non-skid rubber padded bottom provides control when using the scoop feature. Circular design is 8" in diameter. Washes in domestic dishwashers.
BK-1546 Round Scoop Dish

SCOOP DISHES

Two oval-shaped dishes with sloping fronts and vertical backs to hold the food for a one-handed person. Molded of Melamine plastic. Small dish measures 8½" long. Large dish measures 11" long. Break resistant under normal usage. No color choice.
BK-1428 Scoop Dish, Small
BK-1435 Scoop Dish, Large

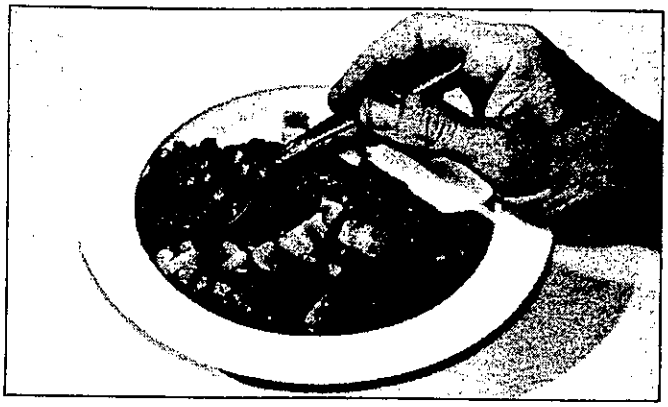


HIGH-SIDED DISH

This 7¾" Melamine plastic dish has 1¾" high sides to make scooping easy. Extra durable, dishwasher safe. White only.
BK-1430 High-Sided Dish

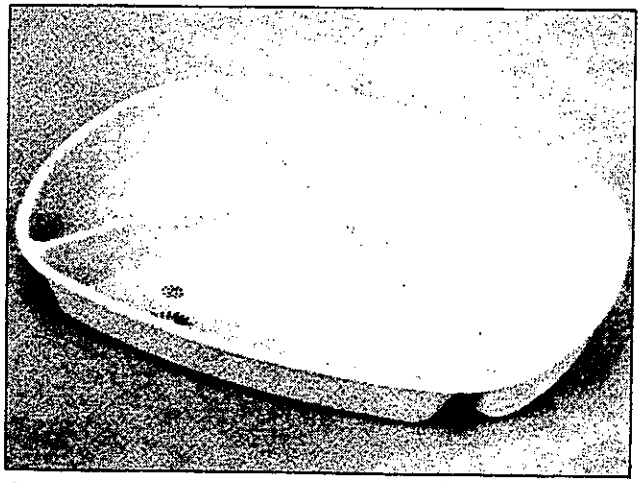
HI-LO™ DISH

This 7¾" diameter dish has a 1¾" high vertical wall around half its diameter to push food against. The low entry wall is ½" high at the lowest point. It gradually slopes toward the high wall for easy entry of the utensil. Constructed of dishwasher safe Melamine plastic.
BK-1429 Hi-Lo™ Dish



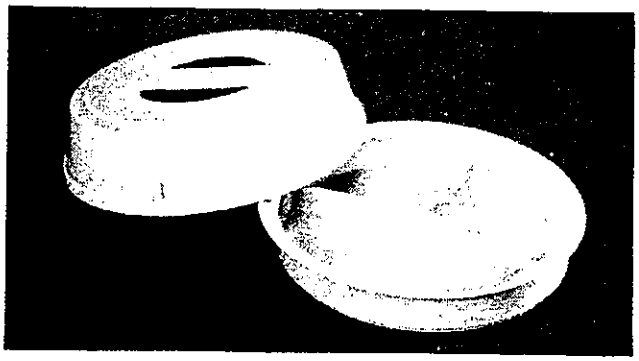
INNER LIP™ PLATE

Comes in both polypropylene plastic and ceramic. The special inner lip feature keeps the food from sliding off the plate to make self-feeding easier for children or adults. Plates are 9" in diameter with a 1" rim and a ½" high lip. Both are dishwasher and microwave safe. The porcelain ceramic plate weighs 1½ lbs. and is heavy enough to inhibit sliding. Off-white color.
BK-1424 Inner Lip™ Plate, Ceramic
BK-1425 Inner Lip™ Plate, Plastic



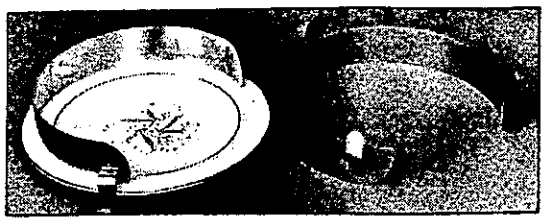
OVAL PARTITIONED DISH

A sturdy, four compartment Melamine dish, 8¾" x 11¼". Walls are 1¼" high. Compartments hold up to 2/3 of a cup and 7/8 of a cup of food. Dishwasher safe. Light beige only.
BK-1393 Oval Partitioned Dish



THREE-COMPARTMENT HEAT KEEPER DISH WITH LID

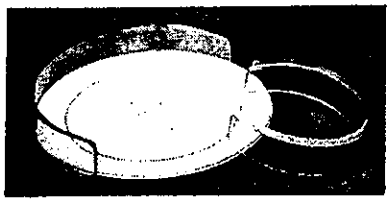
Ideal for institutional feeding. Heavy duty construction of polycarbonate with thick 1" high outer walls to assure excellent heat retention. Capacity of each section is 8 oz., 4 oz. and 4 oz. Textured eating surface resists scratching. The top features a recessed handle and see-through center section for food inspection. Dishwasher safe. Completely stackable: lids on base, lids alone, base alone or complete units. Beige color.
BK-1391 Three Compartment Heat Keeper Dish with Lid



BeOK® FOOD GUARDS

Best for general use. Our most popular model is made of stainless steel with electronic welding for maximum cleanliness and durability. Three clips hold the guard on by spring action. Small size fits 6" to 8" diameter plates. Large size for 9" to 11" diameter plates.

BK-1098 BeOK® Food Guard, Small
BK-1105 BeOK® Food Guard, Large



INVISIBLE™ FOOD GUARDS

Sturdy high temperature plastic rings are formed to snap onto plates. Large size fits 8½" to 10" diameter plates best. Small size fits 6" to 7½" plates. Crystal clear plastic is easy to keep clean. Will withstand all dishwashers. Suggested by an Iowa therapist.

BK-1115 Invisible™ Food Guard, Large
BK-1114 Invisible™ Food Guard, Small

A. SQUARE FOOD GUARD

This Square Food Guard is designed to fit the 6½" square plate of the 1216 System™. The food guard fits under the plastic cover and does not interfere with the stay hot metal base. Food guard is 1¼" high stainless steel with three holding clips.

BK-1480 Square Food Guard

B. PIGGY-BACK™ FOOD GUARD

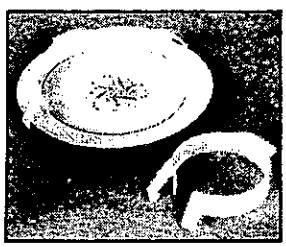
Clamps on the back of the plate. Adjusts easily to fit flat on the plate.

BK-1090 Piggy-Back™ Food Guard

C. SURE-GRIP™ FOOD GUARD

Sure-Grip model uses a rubber fastener for positive attachment to the plate. The rubber between the plate and table prevents the plate from sliding. Fits all sizes.

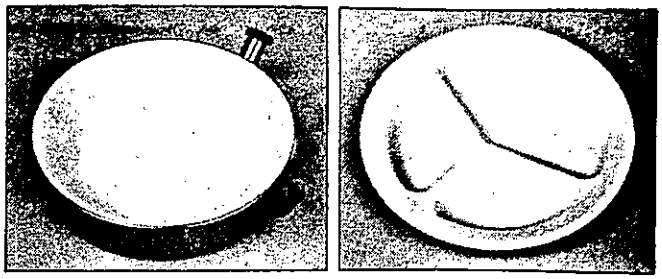
BK-1107 Sure-Grip™ Food Guard
BK-1107-01 Replacement Rubber Band for Sure-Grip™ Food Guard
BK-1107-02 Replacement Clip for Sure-Grip™ Food Guard



PLASTIC FOOD GUARD

A molded polyethylene plastic food guard that clips onto any size plate. The hook portion is molded right into the unit with no seams or joints. Smooth white plastic is easy to keep clean. Very lightweight and easy to use.

BK-1478 Plastic Food Guard



STAY WARM DISH

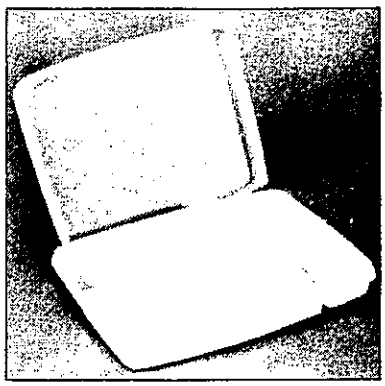
Designed for people who need to take a longer time in eating. Consists of a 7¼" diameter x 1¾" high Melamine dish attached to a stainless steel container. Fill the container with hot water to keep the food warm. Holds 1¾ cups of water. Weighs 20 ounces when completely filled. Weight empty is 4 ounces. Dishwasher safe.

BK-1433 Stay Warm Dish

SECTIONED JUMBO PLATE

A 10¾" diameter 3-sectioned plate with a sloping 1" lip. Section dividers are ¾" high. Made of lightweight Melamine. Dishwasher safe. Beige color only.

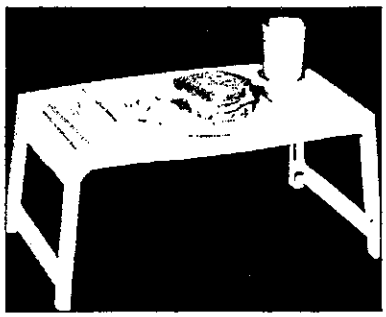
BK-1386 Sectioned Jumbo Plate



COMPARTMENTED TRAY

A food tray with 5 compartments made of unbreakable polyethylene plastic. The inside divider walls are 1" high. The outer sides are 1-3/8" high. It has a snap-on lid. Can be used with lid off to heat food in a microwave oven. Washes in a domestic dishwasher, top rack only.

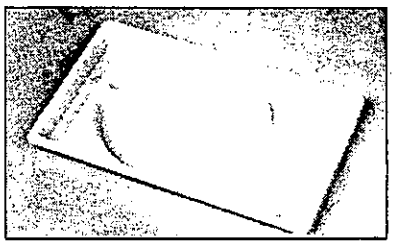
BK-1390 Compartmented Tray



BED TRAY

Made of lightweight high impact polystyrene, this 18" x 11" bed tray has compartments for dishes, cups, utensils, etc. It stands on legs that fold for easy storage. Cleans with mild soap and warm water. Can be used for eating, writing, table games, etc. No color choice.

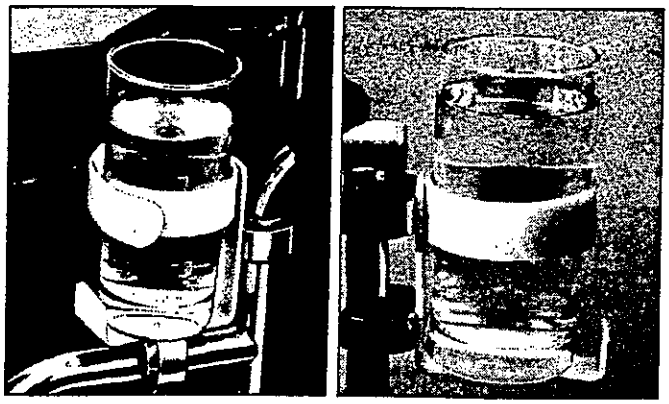
BK-1475 Bed Tray



TRAY PLATE

A 16" x 9½" tray that has extra compartments to hold a complete meal as well as eating utensils. Made of durable, lightweight ABS plastic. Dishwasher safe. Beige color only.

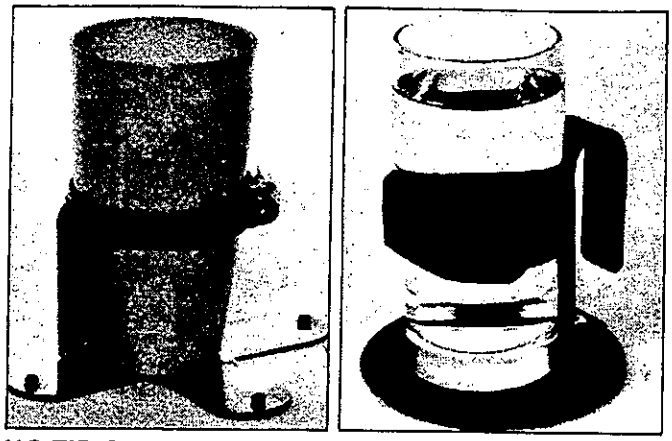
BK-1389 Tray Plate



WHEELCHAIR BEVERAGE HOLDERS

Clip-on plastic holders with Velcro® strap closure. Top part of holders will hold a glass or can from 2½" to 3½" in diameter. Grips are plastic coated for strong hold. Order for desk or standard arm.

BK-1143 Wheelchair Beverage Holder, Desk Arm
BK-1143-01 Wheelchair Beverage Holder, Standard Arm



NO-TIP GLASS KEEPER

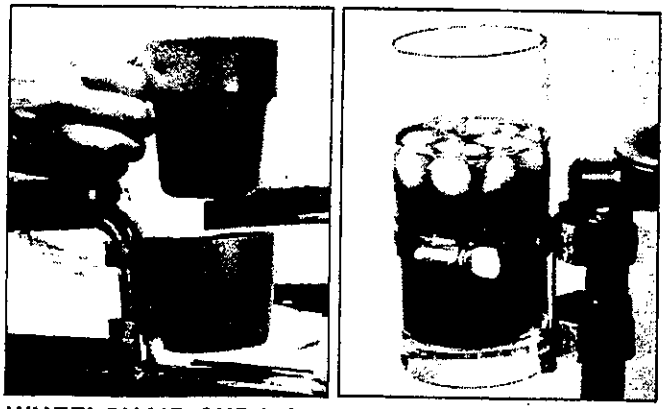
Adds a 4" base to a glass to prevent it from being tipped over. Excellent for use with long drinking straws. Glass can be clamped securely in place.

BK-1118 No-Tip Glass Keeper

BEVERAGE KEEPER WITH HANDLE

A plastic beverage holder with an easy-to-grasp handle. Velcro® strap adjusts to hold round glasses and cans from 2¼" to 3". Sturdy base with rubber non-skid feet.

BK-1116 Beverage Keeper with Handle



WHEELCHAIR CUP HOLDER WITH CUP

A clip-on cup holder and cup made of high-impact polystyrene that clips in place onto your wheelchair upright. The large-handled cup fits securely into the holder. To prevent liquids from spilling, the cup comes with a snap-on lid with an opening to drink through. Dishwasher safe. No choice of colors.

BK-1139 Wheelchair Cup Holder with Cup

WHEELCHAIR GLASS HOLDER

A clip-on glass holder that attaches to the upright of your wheelchair. Great for those who must have fluids readily available. Glass holder clamp has rubber grommets and is adjusted with a convenient thumbscrew. Plastic coated clips prevent scratching and provide a strong hold.

BK-1141 Wheelchair Glass Holder

SURE-GRIP™ GLASS HOLDER

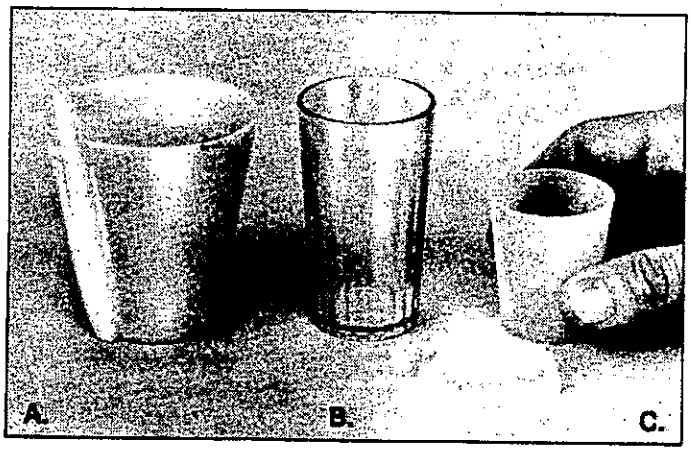
Sure-Grip™ Glass Holder fastens to a glass to provide a handle that is strong, yet can be bent to fit your patient's hand. Stainless steel welded construction with a plastic cover on the handle. Thumb screw adjusts easily to all glass sizes.

BK-1117 Sure-Grip™ Glass Holder

BILATERAL GLASS HOLDER

A heavy-duty steel-handled glass holder with a plastic coating. This model was recommended for individuals who have incoordination. The clamp at the top adjusts to fit any glass.

BK-1144 Bilateral Glass Holder



A. SNORKEL CUP

The 8 oz. plastic drinking cup with the built-in straw. Can be boiled to sterilize. The material is odorless, unbreakable and will not chip.

BK-1138 Snorkel Cup, Package of 3

B. TINY TUMBLER

A clear, 4 oz. tumbler that has a ribbed surface that is easy to grasp. Won't shatter or stain. Smooth lip allows for sanitary washing. Lugs on the side prevent tumblers from jamming together when stacked. Top diameter is 2". Package of 12.

BK-1128 Tiny Tumbler, Package of 12

C. TINY FLEX-GLASS

A soft, squeezable glass that holds up to 2 ounces. Squeeze to narrow the rim contour. Cut with scissors for a notch. Polyethylene plastic with a tight-fitting lid. Top diameter measures 1-7/8". Washable in top rack of dishwasher. Comes in a set of four with no color choice.

BK-1127 Tiny Flex-Glass, Set of 4

12 OZ. INSULATED MUG WITH LID

A 12 oz. polypropylene mug with an easy-to-grasp handle. Use for either hot or cold liquids. Lid regulates flow of liquids and keeps liquids from spilling. Meets the requirements for the blind and handicapped described in the federal laws governing LTC facilities. Can be used with BK-1123-02 Snorkel Lid. Institutional dishwasher safe. No color choice.
BK-1137 12 oz. Insulated Mug with Lid

INSULATED MUG

Foam insulated high impact polypropylene mug with handle. Holds either hot or cold liquid. 8-oz. capacity. Institutional dishwasher safe. No color choice. Snap-on BK-1123-02 Snorkel Lid or BK-1137-01 Mug/Tumbler Lid to help regulate intake of liquids.
BK-1121 Insulated Mug

INSULATED TUMBLER

A durable, long-lasting polypropylene plastic tumbler for either hot or cold liquids. 12-oz. capacity. Safe in institutional dishwashers. No color choice. BK-1123-02 Snorkel Lid or BK-1137-01 Mug/Tumbler Lid can be used with this tumbler.
BK-1122 Insulated Tumbler

CRYSTAL GLASS WITH SNORKEL LID

A clear polypropylene glass with a snug fitting snorkel lid that regulates intake of liquids. Place finger over hole in the lid and liquid must be sucked out. With hole uncovered, liquid flows in a steady stream. Both glass and lid are institutional dishwasher safe. 8-oz. capacity. Can be used with BK-1137-01 Mug/Tumbler Lid.
BK-1123 Crystal Glass with Snorkel Lid

LIDS

Snorkel Lids and Mug/Tumbler Lids will fit BK-1121, BK-1122, BK-1123 and BK-1137. Both lids regulate flow or intake of liquids. Dishwasher safe. Six to a package.
BK-1123-02 Snorkel Lids, Pkg. of 6
BK-1137-01 Mug/Tumbler Lids, Pkg. of 6

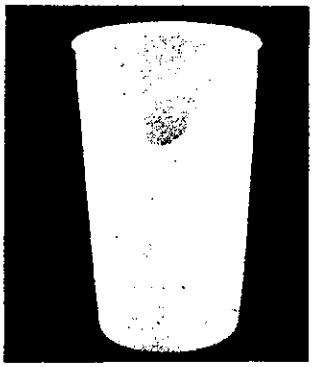
rfsu rehab

GOBLET

Lightweight, polycarbonate unbreakable plastic goblet with a broad base. Easy-to-grasp stem. Holds up to 10 oz. of liquid. Dishwasher safe. Scratch resistant.
BK-1124 Goblet

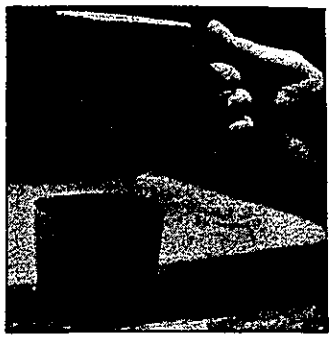
GLASS WITH HOLDER AND LID

Polypropylene holder designed to be held either by the handle or to insert hand between the handle and glass. Comes with a supporting lip where a second hand is needed to support glass. Base of holder is wide for greater stability. Glass is non-breakable polycarbonate. Comes with a snap-down lid with spout. Lid seals against inside of glass. 10-oz. capacity.
BK-1125 Glass with Holder and Lid



NOSEY CUTOUT GLASS

This unbreakable, boilable plastic glass has a cutout for the nose so a person can drink without tipping the head back or extending the neck. The glass fits around the nose instead. Available in assorted easy to identify colors (no color choice) and either 8 oz. or 12 oz. size.
BK-1145 Nosey Cutout Glass, 8 oz.
BK-1146 Nosey Cutout Glass, 12 oz.

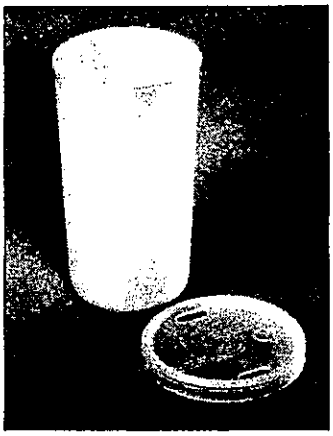


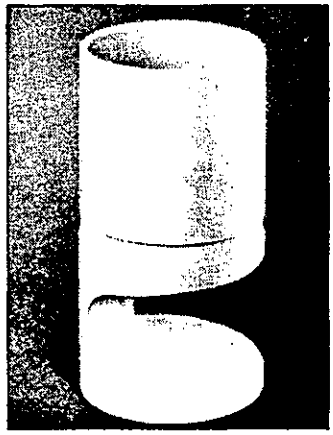
PLASTIC HANDLE MUG

The molded plastic handle on this 12 oz. mug is its most important feature. The handle will accommodate a variety of grasping patterns. Used with patients who have extreme weakness. Assorted colors. Package of 2.
BK-1120 Plastic Handle Mug, Pkg. of 2

CUP HOLDER WITH CUP

A cup holder that attaches with Velcro® to tabletop or lap tray surface. Comes equipped with large handled cup with cover plate and drinking opening to prevent spilling of liquids. Both constructed of dishwasher safe polystyrene. No choice of colors.
BK-1140 Cup Holder with Cup



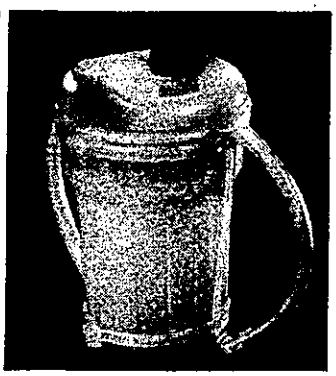


SIP 'N STRAW GLASS WITH LID

Enables you to drink without spilling. This covered, boilable, unbreakable 12-oz. plastic glass has a lid with a slot opening on each side to drink from. There is also a punchout on one side of the lid that can be pushed out to accommodate a regular or large size straw.
BK-1142 Sip 'n Straw Glass with Lid, 12 oz.
BK-1142-01 Lids for Sip 'n Straw Glass, Pkg. of 10

MELAWARE PEDESTAL CUP

This 8-oz. cup was designed to allow an individual to slip his thumb and index finger under the cup when finger grasp is absent. Molded plastic construction.
BK-1449 Melaware Pedestal Cup

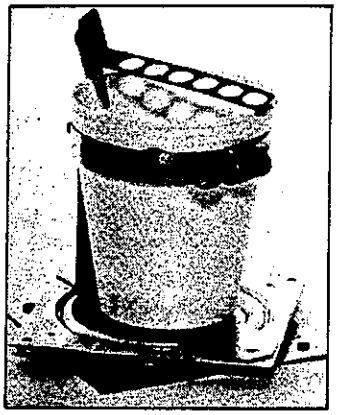


WONDER-FLO VACUUM CUP

This 8-oz. Wonder-Flo Vacuum Cup is made for drinking in a semi-reclined position. Tip the cup up and draw enough for one swallow. When you stop drawing, the liquid will stop flowing. Rubber button allows the release of small amounts of fluid for controlled feeding. Autoclavable nylon.
BK-1252 Wonder-Flo Vacuum Cup
BK-1252-01 Replacement Button for Wonder-Flo Vacuum Cup

MODIFIED DRINKING CUP

This 8-oz. modified drinking cup has a ¼" hole in the spout to accommodate liquids and soups. The cup is not intended for drinking while lying down. The soft plastic handles provide an easy grasp for persons with extreme weakness.
BK-1253 Modified Drinking Cup

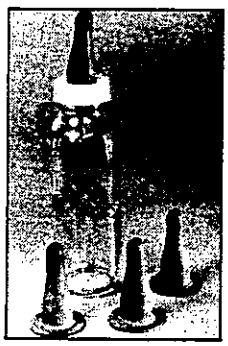


LAZY SUSAN™ GLASS AND STRAW HOLDER

Made to swivel the straw out of the way when eating. Ball bearing Lazy Susan™ has rubber feet and a tip-proof base. Recommended for quads who are in the beginning stages of feeding training. Outfit includes the straw holder.
BK-1119 Lazy Susan™ Glass and Straw Holder

DRINKING STRAW HOLDER

Designed to fit all sizes of straws. Cadmium plated spring clamp fastens to the lip of the glass to hold the long straw at the right angle. Retainer part is stainless steel.
BK-1126 Drinking Straw Holder



EXTRA LONG NIPPLES

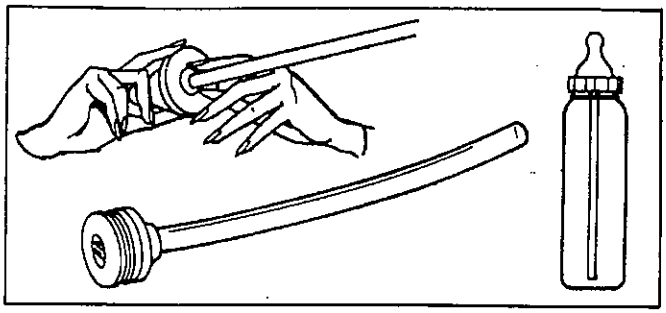
Solves a variety of feeding problems. Tapered rubber nipples are unpierced so you can make and adjust the opening to your needs. Fits any regular bottle. Length of nipple from flange is 2½". Comes in a package of 6.
BK-1132 Extra Long Nipples, Pkg. of 6

CONVALESCENT FEEDING CUP

Large mouthpiece allows liquid intake without dribbling. Hole in mouthpiece is large enough to hold a drinking straw. Autoclavable polypropylene with 4, 6 and 8 oz. graduations.
BK-1254 Convalescent Feeding Cup

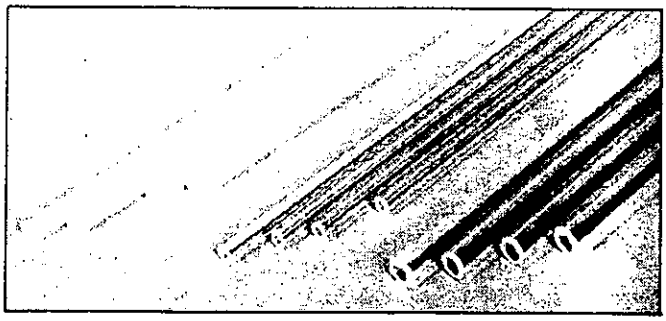
BASE FOR CONVALESCENT CUP

A 5" diameter polyethylene plastic base for the convalescent cup that makes it impossible to tip over.
BK-1255 Base for Convalescent Cup



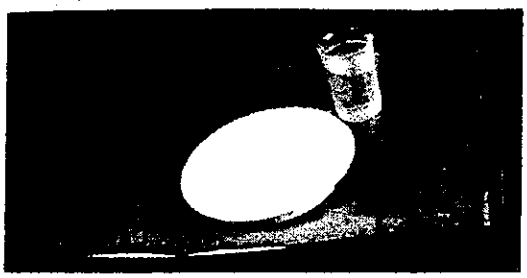
BOTTLE STRAW

Consists of a plastic tube that goes inside a baby bottle with a rubber plug on the end that fits into the nipple. The plug creates a resistive sucking pattern. The Bottle Straw allows the child to suck and swallow in a vertical position to encourage flexor tone of the neck, avoid neck hypertension, facilitate swallowing and better head control.
BK-1129 Bottle Straw, Package of 2



DRINKING STRAWS

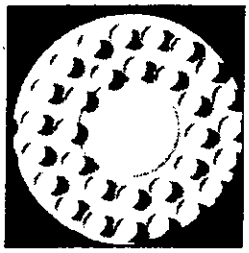
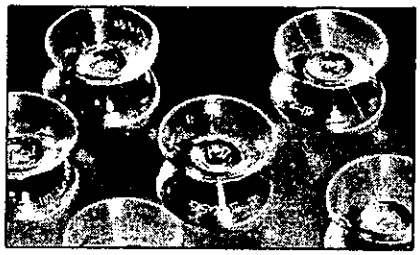
Plastic drinking straws 18" long that can be used over and over again. Flexible polyethylene straws on the left have a 3/16" hole that are the safest when there is a problem of incoordination. Center straws are crystal clear Plexiglas with a 1/8" hole. Right hand straws are also crystal clear Plexiglas with a 1/4" hole for soups and similar liquids. Packaged as shown below.
BK-1130 Clear Plastic Straws, Package of 10
BK-1133 Flexible Plastic Straws, Package of 10
BK-1136 Large Plastic Straws, Package of 5



NON-SLIP Dycem®

Dycem® is a non-slip plastic that helps solve many of the holding problems encountered by patients in the clinic, extended care facilities and the home. Use NON-SLIP Dycem® for holding plates, glasses and utensils; under seat cushions, therapy equipment and business machines; or anywhere it is necessary to prevent slipping and sliding. Available by the yard as a matting or in round and rectangular pads. The 8" x 10" diameter round pads and 10" x 14" rectangular pads are 3/16" thick and have a smooth surface. The 5½" and 7½" diameter pads and 10" x 7¼" rectangular pads are 1/8" thick and have a grid patterned surface to look like a place mat. Blue color only.

BK-6577 NON-SLIP Dycem® Matting, Pres. Sensitive, 16" x 1 yd.
BK-6584 NON-SLIP Dycem® Matting, 16" x 2 yds.
BK-6591 NON-SLIP Dycem® Matting, 8" x 2 yds.
BK-6612 NON-SLIP Dycem® Matting, Bulk Roll, 16" x 10 yds.
BK-6556 NON-SLIP Dycem® Pad, 10" x 14", Plain
BK-6563 NON-SLIP Dycem® Pad, 10" Diameter, Plain
BK-6570 NON-SLIP Dycem® Pad, 8" Diameter, Plain
BK-6613 NON-SLIP Dycem® Pad, 5½" Diameter, Patterned
BK-6614 NON-SLIP Dycem® Pad, 7½" Diameter, Patterned
BK-6615 NON-SLIP Dycem® Pad, 10" x 7¼", Patterned

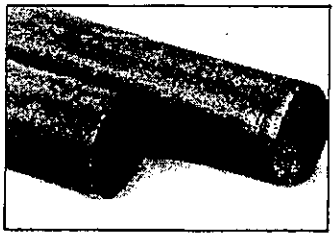
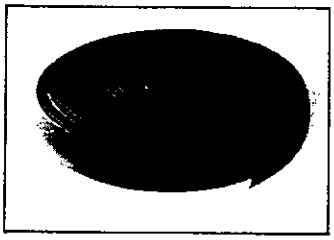



LITTLE OCTOPUS SUCTION HOLDERS

24 tiny suction cups on each side of the soft rubber base provides a double-acting grip to anchor dishes, glasses, bowls and many other items. 3" in diameter by 3/8" thick. Package of 3.
BK-1259 Little Octopus Suction Holders, Package of 3

DOUBLE FACED SUCTION CUPS

Little 1¼" diameter clear plastic suction cups for use wherever suction is needed on two surfaces. Will stick to any horizontal or vertical smooth surface. Packaged in bags of 20 or 100.
BK-1260 Double Faced Suction Cups, Package of 20
BK-1260-01 Double Faced Suction Cups, Package of 100

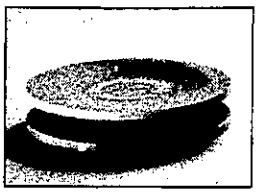



CYLINDRICAL FOAM PADDING

Purchase foam padding in continuous lengths to build up your spoons and other self-help aids. Black closed cell foam with 3/8" hole and an outside diameter of 1-3/8". One yard per package.
BK-6252 Cylindrical Foam Padding, 1 yd. Package

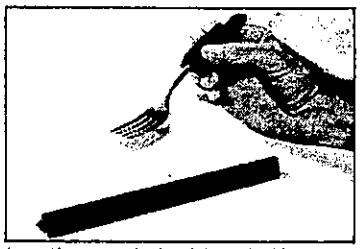
CUSHION GRIP TAPER TAPE

This non-skid, ¾" beveled edge synthetic rubber tape can be wrapped around utensil handles, tools, therapy equipment, canes, etc. to build up the handles. By spacing the wraps, finger grips can be created. Stays in place if directions are followed. Dishwasher safe. Black color only. Available in 20 and 100-foot rolls.
BK-7162 Cushion Grip Taper Tape, ¾" x 20' Roll, Trial Pack
BK-7162-01 Cushion Grip Taper Tape, ¾" x 100' Roll, Clinic Pack




STAY-PUT SUCTION DISC

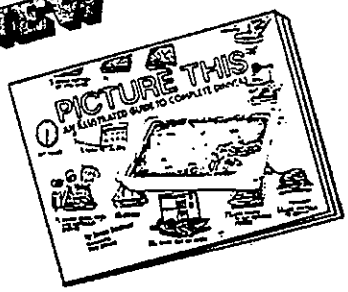
A compact, 3-7/8" x 9/16" twin rotatable suction disc for temporarily attaching one flat surface to another. Will attach to all smooth, hard surfaces. No wetting of the surface is necessary as the centers of both sides draw inward, creating a vacuum on both sides. Simply reverse movement and vacuum is released.
BK-1261 Stay-Put Suction Disc



TRIANGULAR FINGER GRIPS

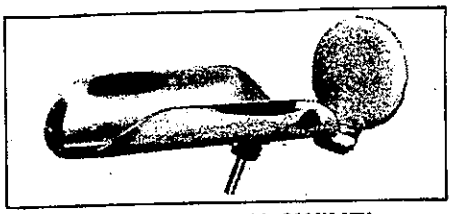
Make customized built-up handle utensils with Triangular Finger Grips. Made of soft, washable, dishwasher safe urethane rubber with a slot for inserting utensil handles. Available in two lengths: 1½" and 9". Cut lengths needed with a knife. 3/4" at base. 5/8" high.
BK-6250-01 Triangular Finger Grips, 1½" long, Package of 6
BK-6250-02 Triangular Finger Grips, 9" long, Package of 5

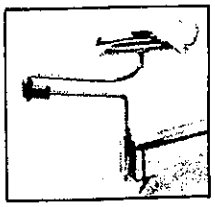
NEW



PICTURE THIS—AN ILLUSTRATED GUIDE TO COMPLETE DINNERS

A full color cookbook designed for the visually impaired or individuals who lack reading or memory/sequencing skills. Entire meals are illustrated by step-by-step pictures and large accompanying print. Table of contents is color-coded and symbolized for sixteen meals so that the desired section can be located by "matching". All recipes are designed for four or more people. 72 pages.
BK-3236 Picture This—An Illustrated Guide to Complete Dinners





ARM TROUGH WITH SWIVEL

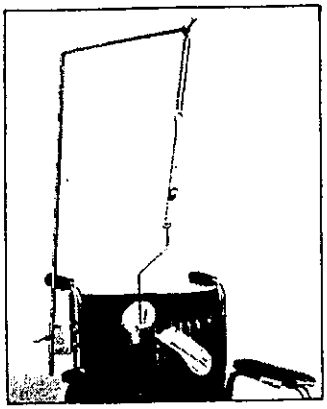
Arm troughs with swivels are now available separate from the Ball Bearing Feeder. Both regular and large size for right or left arm. See Ball Bearing Feeder chart for correct size.

BK-7124-01-01 Arm Trough with Swivel, Regular, Right
BK-7124-01-02 Arm Trough with Swivel, Regular, Left
BK-7124-02-01 Arm Trough with Swivel, Large, Right
BK-7124-02-02 Arm Trough with Swivel, Large, Left

TABLE CLAMP ARM POSITIONERS

For persons with shoulder girth weakness who are not confined to a wheelchair. An arm positioner is attached to a table or desk by a sturdy clamp. Comes complete with adjustable proximal arm, distal arm, arm trough and trough swivel. Two sizes for right or left hand. See Ball Bearing Feeder chart for correct ordering size.

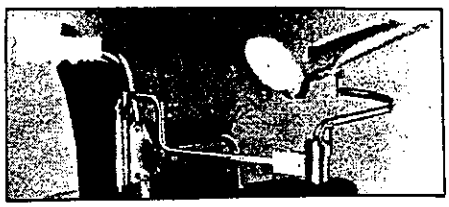
BK-7128-01 Table Clamp Arm Positioner, Regular, Right
BK-7128-02 Table Clamp Arm Positioner, Regular, Left
BK-7129-01 Table Clamp Arm Positioner, Large, Right
BK-7129-02 Table Clamp Arm Positioner, Large, Left



OFFSET SUSPENSION FEEDER

Rotation occurs at side of arm at the ball bearing joint to be close to the center of gravity. Adjusts to provide maximum function. Strap and spring included. Available in right and left models. For attachments, see Overhead Rod for Feeder or Sling and Wheelchair Brackets in Clinic section.

BK-7130-01 Offset Suspension Feeder, Reg., Adult Size, Right
BK-7130-02 Offset Suspension Feeder, Reg., Adult Size, Left



BALL BEARING FEEDERS

An aid for persons with severe shoulder girdle weakness. Supports the weight of the arm on ball bearings to increase its function. The elevating proximal arm model adds a new dimension. Rubber band powered ball bearing parallelogram arrangement assists humeral abduction. Rubber bands can be added or removed to accommodate various arm weights and muscle strengths. It is also adjustable to assist elbow flexion or extension. Both models are chrome plated or highly polished steel with Plastizote® padded elbow cushion. Three sizes for right or left arm. See chart for ordering the correct size. For proper installation and application information, purchase BK-7117 Mobile Arm Support Installation and Use manual. See book section.

THIS EQUIPMENT AND BOOK ARE INTENDED FOR SELECTION AND APPLICATION BY TRAINED PERSONNEL ONLY! PERSONS UNFAMILIAR WITH THIS EQUIPMENT SHOULD NOT ATTEMPT TO INSTALL IT!

DISTANCE FROM OLECRANON PROCESS TO ULNAR STYLOID IN INCHES

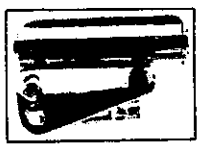
Child Size	Reg. Adult Size	Large Adult Size
8"	9"	10"

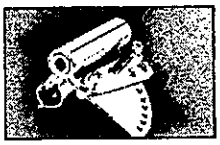
NOTE: IF PATIENT IS ½" OVER, GO TO THE NEXT LARGER SIZE.

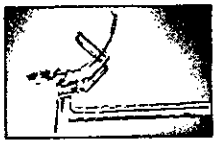
ORDER CHART

Size	Standard Proximal Arm		Elevating Proximal Arm	
	Right	Left	Right	Left
Child	BK-7118-01	BK-7118-02	—	—
Regular	BK-7122-01	BK-7122-02	BK-7122-01-02	BK-7122-02-02
Large	BK-7125-01	BK-7125-02	BK-7125-01-02	BK-7125-02-02

ACCESSORIES FOR FEEDER







EXTRA WHEELCHAIR BRACKET FOR FEEDER

This bracket comes with all sizes of the Ball Bearing Feeder. Users with more than one wheelchair find it helpful to have one installed on their extra wheelchair. Available in left or right models.

BK-7139-01 Wheelchair Bracket for Feeder, Right
BK-7139-02 Wheelchair Bracket for Feeder, Left

RECLINING WHEELCHAIR BRACKET FOR FEEDER

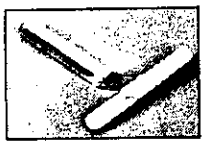
Spring plunger provides coarse reclining adjustment. Allen screw provides fine adjustment. Used to fit feeders to fully reclining wheelchairs. Available in right or left models.

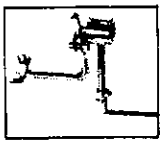
BK-7141-01 Reclining Wheelchair Bracket for Feeder, Right
BK-7141-02 Reclining Wheelchair Bracket for Feeder, Left

SUPINATOR

Supinates the forearm 30° when elbow is flexed. Replaces standard arm trough swivel. Available in right or left models.

BK-7132-01 Supinator, Right
BK-7132-02 Supinator, Left





RISER

This raises the trough of the ball bearing feeder 1" for activities around the neck and head. Fits between the pivot and distal arm.

BK-7127 Riser

T-BAR COCKUP

Supports hand when wrist extensors are weak. Attaches to front of feeder arm trough. Available in right or left models. One size only.

BK-7135-01 T-Bar Cockup, Right
BK-7135-02 T-Bar Cockup, Left

VERTICAL TROUGH STOP

Controls vertical motion of feeder trough by adjusting front or rear screw. Attaches to stem of trough pivot.

BK-7136 Vertical Trough Stop

OFFSET SWIVEL

Replaces standard arm trough swivel to be closer to center of gravity.

BK-7131 Offset Swivel

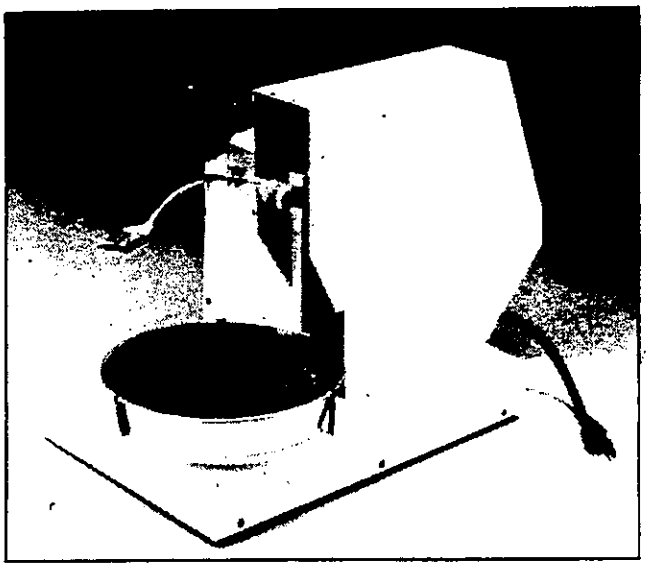
Appendix B

Commercially Available Semiautomated Dining Device

Winsford Feeder

Enables a person to feed himself, at his own speed, without using his arms. Uses a standard dinner plate and teaspoon. It is operated by a 6 volt, rechargeable battery and is controlled by a chin switch, or a remote rocker switch. When the chin switch is pushed to the left, the stainless steel pusher swings in from the edge of the plate and moves food onto the spoon. The spoon is then automatically raised to the mouth level. When the switch is again pushed to the left, the spoon returns to the plate for refilling. By moving the chin switch to the right, the plate may be rotated in order to place more food in front of the pusher.

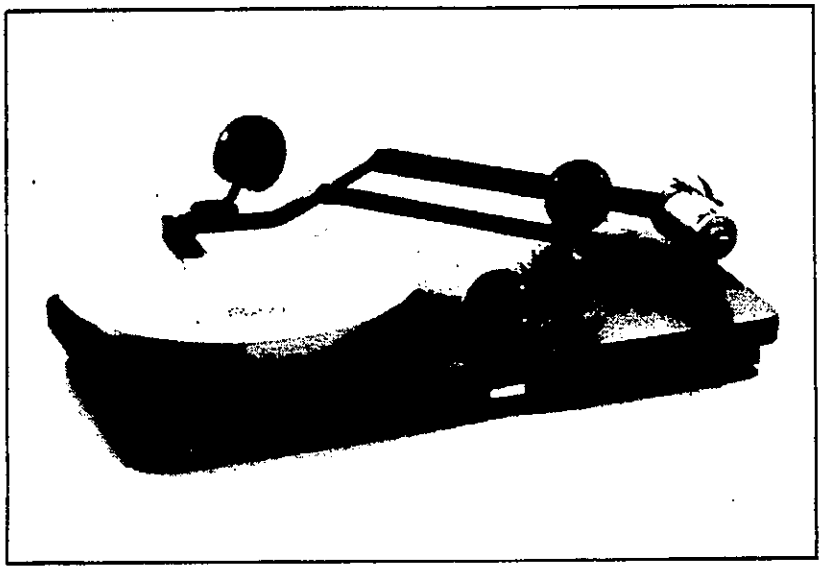
Catalog Number ..... **AM 13-1659**



"Beeson" Automaddak® Feeder

For persons having severly reduced manipulative facility due to birth defect, accident or disease. Places food close to the mouth, ready to be taken from the spoon. Electrically driven, but has fluidic controls which keep the user away from any direct electrical control apparatus. Control pads are mounted near to the top for use with head stick, or can be removed for placing at any other convenient position. One control operates the spoon which takes food from the plate and raises it to mouth level. The control pad can be pressed with any part of the body and requires very little force. Upon momentary switch contact, the spoon will cycle through its motion, picking up food and stopping at a pre-set position above the plate. The spoon will not move again until the switch is pressed. The second control rotates the plate. Removable aluminum plate and spoon. Drinking glass holder is mounted next to the plate. Size: 18½" x 9½" x 12".

Catalog Number ..... **AM 13-1273**



Cerebral Palsy Feeder

Though this feeder is suitable for all ages, it has been both particularly successful with handicapped children, both spastics and athetoids, between the ages of 5 and 18. There are three minimal physical requirements for the operation of the feeder: One, upper extremity must have sufficient coordination to depress, push or pull knobs — functional grasp is not essential; Two, the person must be capable of bringing his head forward toward the spoon in a fairly controlled manner; and Three, oral musculature must be sufficient to effect lip closure. Feeder is mounted on plastic surfaced board. The plate is standard pie plate fastened to an adaptor, and can be operated by pushing or pulling a knob. Four suction cups secure plate to flat surface. *Specify right or left hand model.*

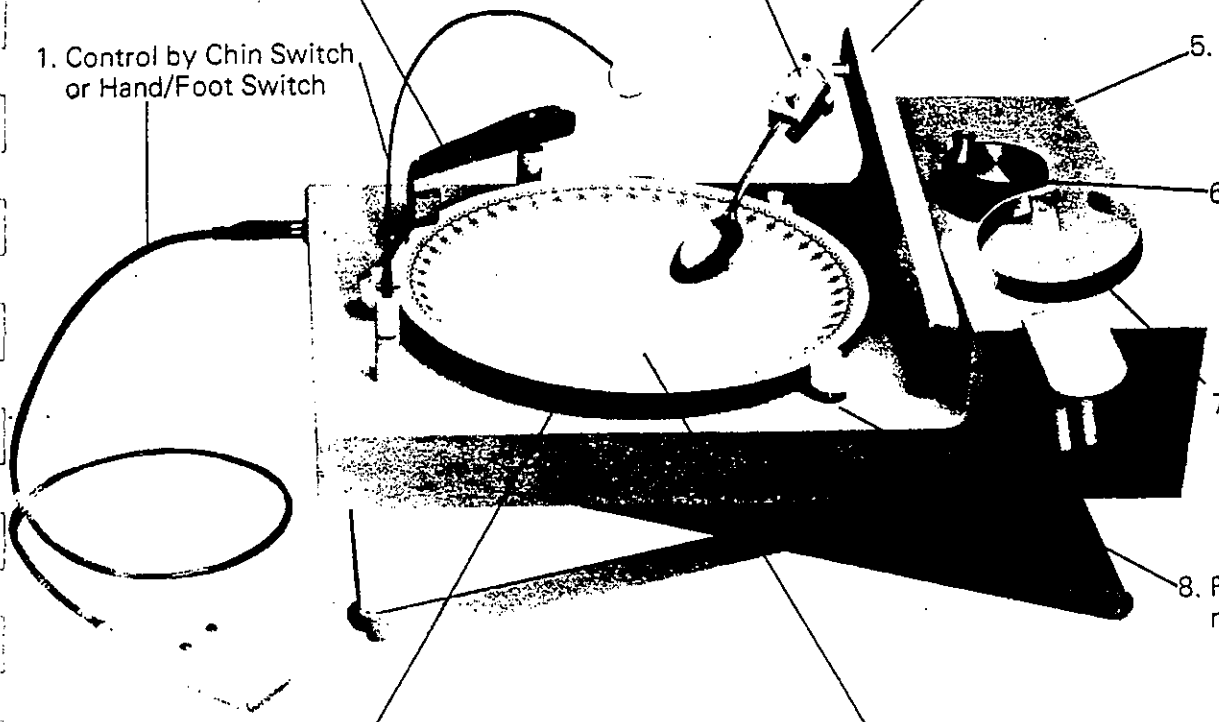
Catalog Number **AM13-1644**

THE WINSFORD FEEDER

Eating with a Winsford Feeder is a big step toward greater independence and dignity for a person whose arms are disabled.

The Winsford Feeder enables that individual to eat – unaided – with friends and family as an independent person. Meat. spaghetti, vegetables, potatoes, salad, dessert, coffee, milk or soft drinks – the Winsford Feeder gives the ability to handle them all effortlessly.

Here Are Ten Features That Make The Winsford Feeder Easy To Use



How It Works

The Winsford Feeder is simple to operate. It requires only two motions.

Pushing the switch one way moves food onto the spoon and raises the spoon to mouth level. Repeating that motion lowers the spoon to the plate.

Pushing the switch in the other direction rotates the plate to position food, selected by the user, in front of the pusher.

The user has complete control and can eat at his own rate.

Distributors

Abbey Medical
3216 El Segundo Blvd., Hawthorne, CA 90250

MED, INC.
1701 S. First Ave., Maywood, IL 60153

J. A. Preston Corp.
60 Page Rd., Clifton, NJ 07012

Fred Sammons, Inc.
145 Tower Drive, Burr Ridge, IL 60521

GUARANTEE

Winsford Products, Inc. will repair, free of charge, defects due to materials or workmanship, occurring within one year from date of purchase.

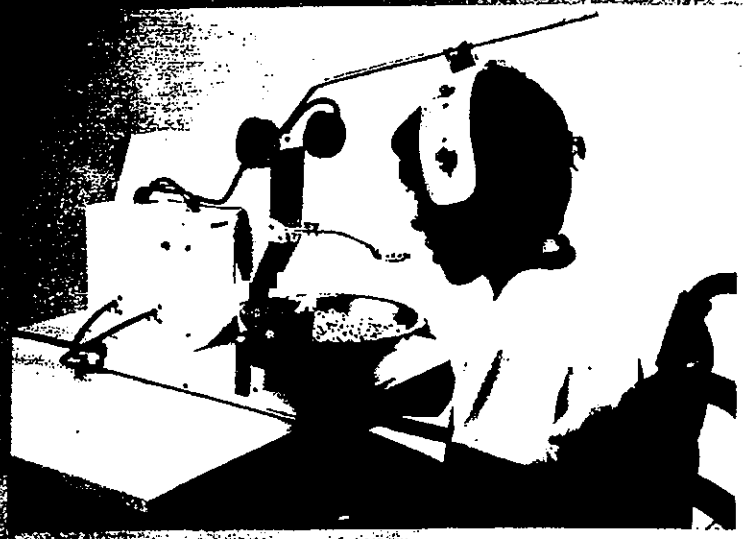
This guarantee does not cover the battery, damage due to misuse, or shipping charges.

SPECIFICATIONS

PLATE	Corning "Corelle" dinner size. Replacements available at local stores.
GLASS HOLDER	May be adjusted for height and diameter of beverage container. Use of standard bendable plastic straw is suggested.
BATTERY	6 volt. Recharge overnight once a week.
SPOON HEIGHT	Height adjustment provides for most short or tall individuals. However, since the feeder requires a minimum height of 11" from the surface on which it rests to the mouth level, it is not suitable for small children and some others.
SIZE & WEIGHT	Base is 12" x 18". Weight is 18 lbs.
INCLUDES	Plate, spoon, pusher, glass holder, chin switch rod, hand/foot switch, battery and charger.
CARRYING CASE	Available, as an option, for transportation or storage.

INTRODUCING

The Winsford Feeder



"BEESON" AUTOMADDAK® FEEDER

For persons having severely reduced manipulative facility due to birth defect, accident or disease the Automaddak® Feeder places food close to the mouth ready to take from the spoon.
The Automaddak® Feeder is electrically driven but has fluidic controls which keep the user away from any direct electrical control apparatus. There are two individual fluidic controls consisting of soft vinyl cushions 2¾"(57mm) in diameter. Control pads are mounted near top for use with head stick (see page 15), or can be removed for placing at any other convenient position.
One control operates the spoon which takes food from the plate and raises it to mouth level. The control pad can be pressed with any part of the body and requires very little force. Upon momentary switch contact the spoon will cycle through its motion, picking up food and stopping at a pre-set position 6½"(17cm) above the plate. The spoon will not move again until the switch is pressed. The second control rotates the plate to keep the food properly distributed for the spoon when it descends to the center of the plate and moves forward to pick up food. The plate rotating control must be pressed continuously for the plate to turn. When the control is released, the plate comes to rest.
The turntable supports a removable aluminum plate with spring clips. The aluminum plate and the spoon are removable for washing. A [illegible] drinking glass or cup is mounted next to the plate. For installation of the H74502 gooseneck a threaded well is provided.
The Automaddak® Feeder is 18⅝"x 9⅝"x 12" (47x24x30cm) high, the sloping edged plate is 9¾"(25cm) in diameter. The motor is 115 VAC 60 Hz. [illegible] under 50 watts. Supplied with a 3 wire grounded cord and plug, 6 ft. (1.8m) long, four suction cup feet and vinyl tubing for fluidic connections. Shipping weight 20 lb. (9Kg.). Available in 220 volt.
H74501

FLEXIBLE GOOSE NECK FOR FEEDER

[illegible]cm) long flexible plated metal goose neck screws into the Automaddak® Feeder base. This adapter can be used to mount the fluidic control switch bar so that the switches may be pressed with a shoulder, nose, or head where necessary.
H74502

FOOD BUMPER

This sanitary snap-on "Food Bumper" is a curved rail designed to keep food from sliding off the plate — even when eating with one hand. Made of autoclavable polypropylene, the bumper clips on to the edge of a standard dinner plate 9" to 11" (22.9 to 27.9cm) diameter. The standard color is natural, unpigmented, translucent, frosted off-white. An alternate color, white, is available for identification of the bumper for individual patients, dietary restrictions, dietary laws, etc.

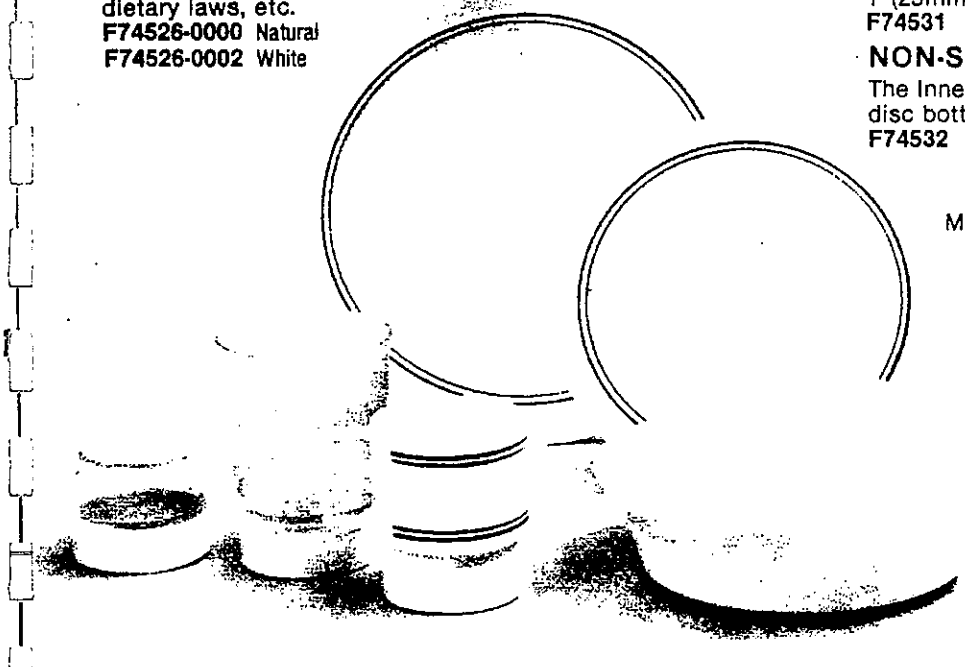
F74526-0000 Natural
F74526-0002 White

INNER-LIP PLATE

The Inner-Lip plate is designed for use by the elderly or handicapped person as an aid in self-feeding. The inner lip holds the food on the plate while the user brings the fork or spoon to the edge of the plate. The deep inner-lip prevents spills and makes eating more enjoyable. The plate is molded of smooth, durable polypropylene and is lightweight, easy to clean and dishwasher safe. Solid white, 9½"(241mm) diameter, 1"(25mm) high. Weight 6oz.(0.17Kg.).
F74531

NON-SKID INNER-LIP PLATE

The Inner-Lip plate with a 6"(152mm) diameter foam rubber disc bottom support which helps to keep plate stationary.
F74532



NON-SKID DINNERWARE

Molded melamine plates, bowls, and cups, and high-impact clear plastic tumbler and salt shaker are dish-washer safe and have soft, non-skid rings at the bottoms which prevent sliding even on a 25 degree incline.

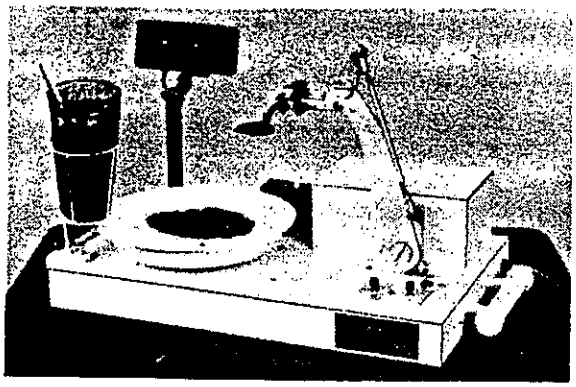
H74504	10" (25cm) diameter dinner plate
H74505	8" (20cm) diameter salad/desert plate
H74506	5¼" (13cm) diameter x 2¾" (7cm) deep drink-or-spoon soup dish
H74507	8⅛" (21cm) diameter x 2" (5cm) deep cereal or serving dish
H74508	9 ounce (266cc) drinking cup with handle
H74509	14 ounce (414cc) Non-Skid Tumbler, transparent
H74510	2½" (6cm) diameter x 3⅛" (9 8cm) high Salt-Pepper-Spice shaker, clear.

BACO CP3 SERIES ---- AUTOMATIC FEEDERS

BACO FEEDERS are easier for the patient to use and they have been judged better in comparative tests with other feeders

Manufactured and sold
by
THE BAY COMPANY
PO Box 16 904-265-8088
PANAMA CITY, FLORIDA - 32401

Available at selected dealers in self help aids.



CP3-D
Light control Feeder

the current is completely isolated from any possible contact by the patient.

Both CP3 models have a plug for connecting remote controls and accessories.

BACO FEEDERS are guaranteed for one year and have an extended limited warranty for four more years.

==========

The BACO CP3-C FEEDER is operated with a head pointer and is preferred by some because they are already familiar with the pointer. To operate the feeder- the Black button switch is pressed with the pointer this activates the feeding cycle- the spoon drops to scooping position and the spoon arm moves down scooping a bite of food from the plate, as the arm moves up to feeding position and stops, the plate rotates slightly to bring more food into the path of the spoon on the next cycle. If the patient wants a different food on the plate, pressing the Red button switch will rotate the plate until the desired food is in position for pickup. Pushing the Black button starts the feeding cycle again.

Jammie, using the first BACO CP Feeder we built

BACO CP3-D

Basically the same as the CP3-C model,the 3-D is controled by a beam of light.

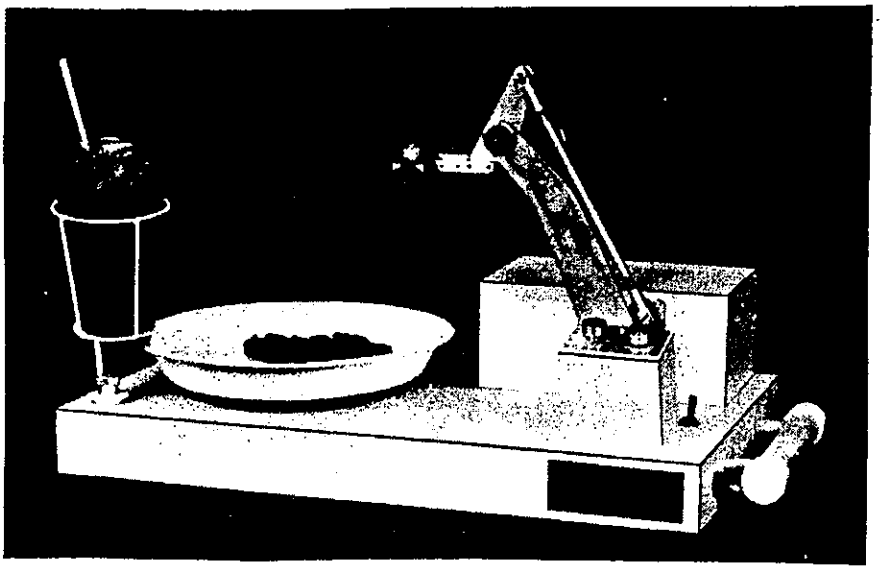
A small projector worn on the patients head is directed at a light sensitive receiver on the feeder, which responds as if a button switch were pressed.

The projector is powered by self contained rechargable batteries, and is charged by plugging into an outlet on the feeder, when not in use.

Using the light beam control is more satisfactory for many patients who find the head pointer troublesome to wear while eating.

Eating is fun.

NOTE! Ronny's arms and legs are restrained to reduce his spastic movements.



CP3-C

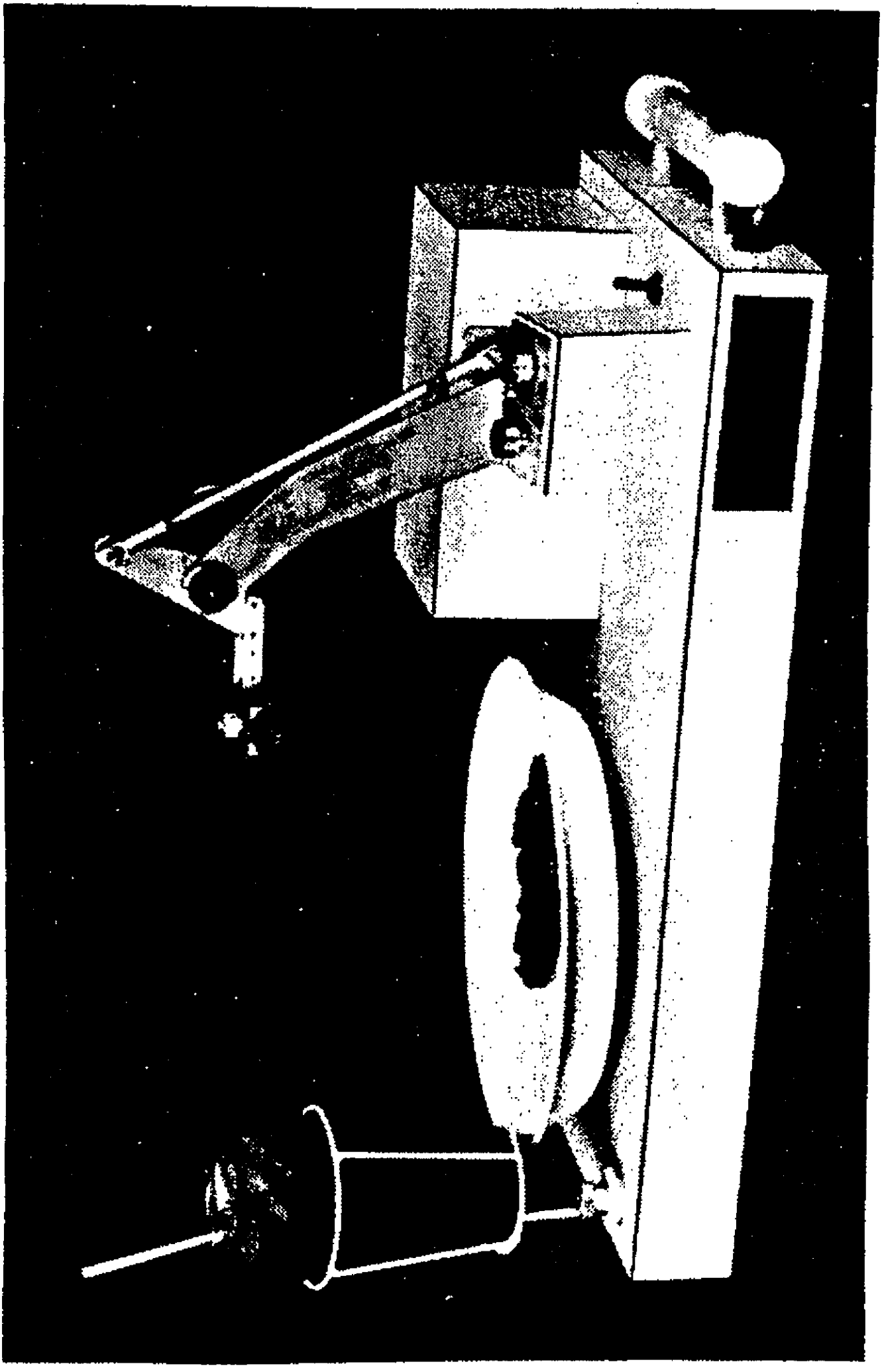
Touch controlled

BACO FEEDERS have been serving the needs of patients since 1980, and we have been constantly improving the design and operation of the unit. Beautifully designed and ruggedly built, they serve the needs of a wide range of persons,whose disability, skills, age, and mental capabilities vary.

Simple and easy to operate, our CP3 series BACO FEEDERS are ideally suited to patients who are severely injured, amputees, paralytic or cerebral palsy persons, allowing them to feed themselves without assistance. The patient is given a feeling of independence, a desire to feed themself and the ability to pace their eating speed to their own pleasure and comfort. This makes food and eating more enjoyable.

Plate, spoon and glass holder are easily removed for washing and the smooth plastic laminated base wipes clean and sanitary.

BACO FEEDERS operate on 110v 60hz house circuits but



THE BAY COMPANY

DEC 1982

P. O. BOX 16 904-265-8088
PANAMA CITY, FLORIDA 32401

THANK YOU for your interest in the BACO Automatic Feeder, for the severely handicapped persons who cannot feed themselves.

BACO Feeders have been in use since 1980.
We have made many improvements and now offer two models, which are described in the inclosed brochure.

Prices are FOB Panama City, Florida.

CP3-C	$755.00
CP3-D	$845.50

Shipping usually within two weeks after receipt of order.
5% discount for cash with order.
2% 10 days.

If you need any other information please let us know. Thanks again, we are looking for your order in the near future.

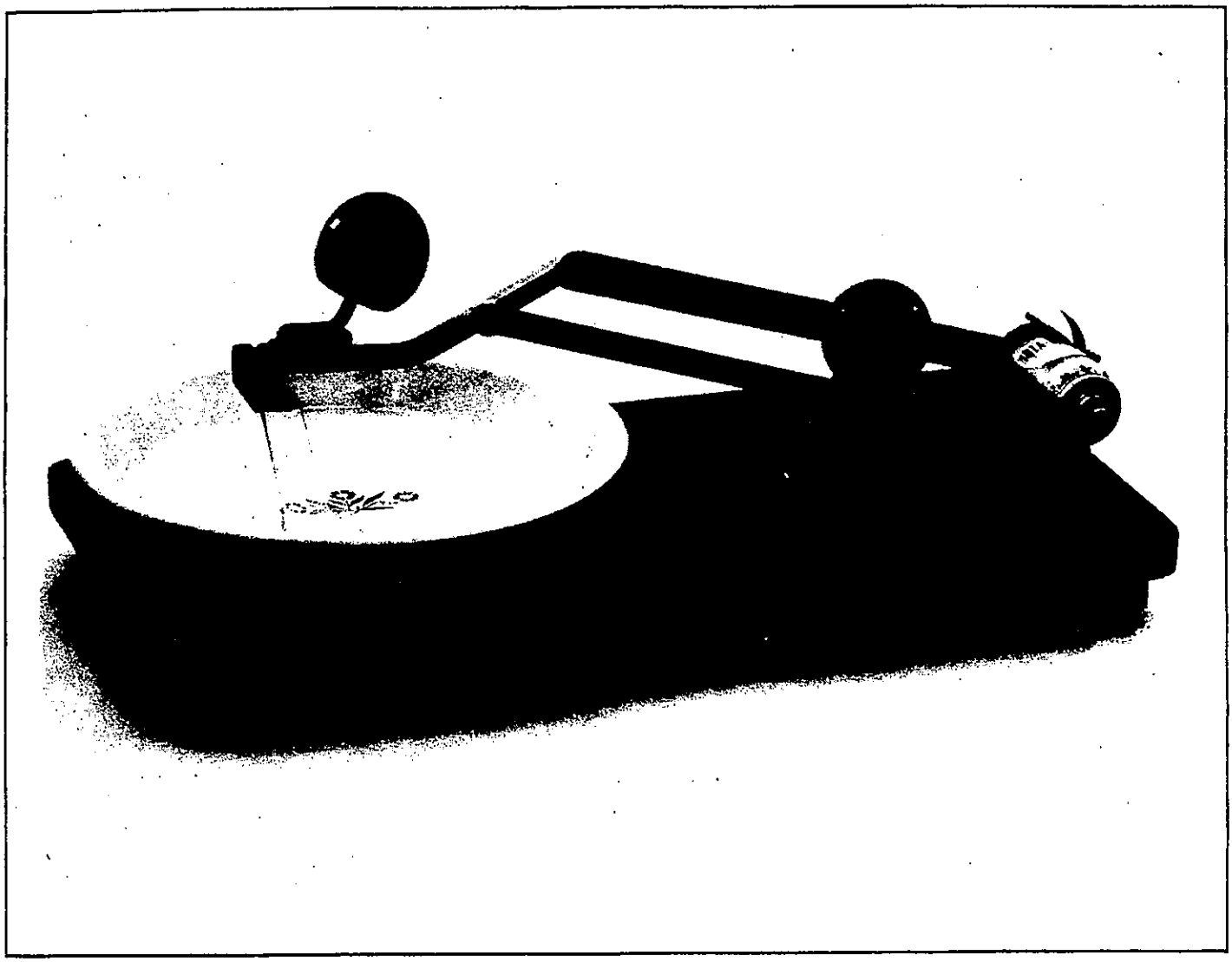
Sincerely,

J E Hanger for
THE BAY COMPANY

BACO

RESEARCH AND DEVELOPMENT

Cerebral Palsy Feeder



Medical Systems

FEEDER OPERATING INSTRUCTIONS

The C.P. Feeder is designed to enable handicapped people feed themselves independently or with minimal assistance.

REQUIREMENTS:

Two necessary requirements for satisfactory operation of the feeder are:

(1) The person must be satisfactorily seated. He must be sitting erect with his trunk well supported if necessary

(2) The feeder must be positioned correctly, so that the elevated spoon is in front of the subject's mouth, and at such a position that the mouth can easily reach the spoon. The position may be at the same level as the subject's mouth or lower, depending on the individual person. The feeder may be placed on a table, a counter, a wheelchair or a wooden chair-tray.

FOOD:

The food to be eaten should be soft, (e.g. mashed potatoes) or in small pieces (e.g. meat, peas, fruit). Foods such as spaghetti or macaroni are only practical if cut up very finely. Soup is not advisable.

The food should be placed around the edge of the plate. The feeder allows for the selection of desired food, so the different foods need not be mixed together.

OPERATION OF THE FEEDER:

The accompanying labelled diagram will assist in understanding the operation of the feeder.

Knob #1 - When pushed down will release the rod to which the spoon is attached.

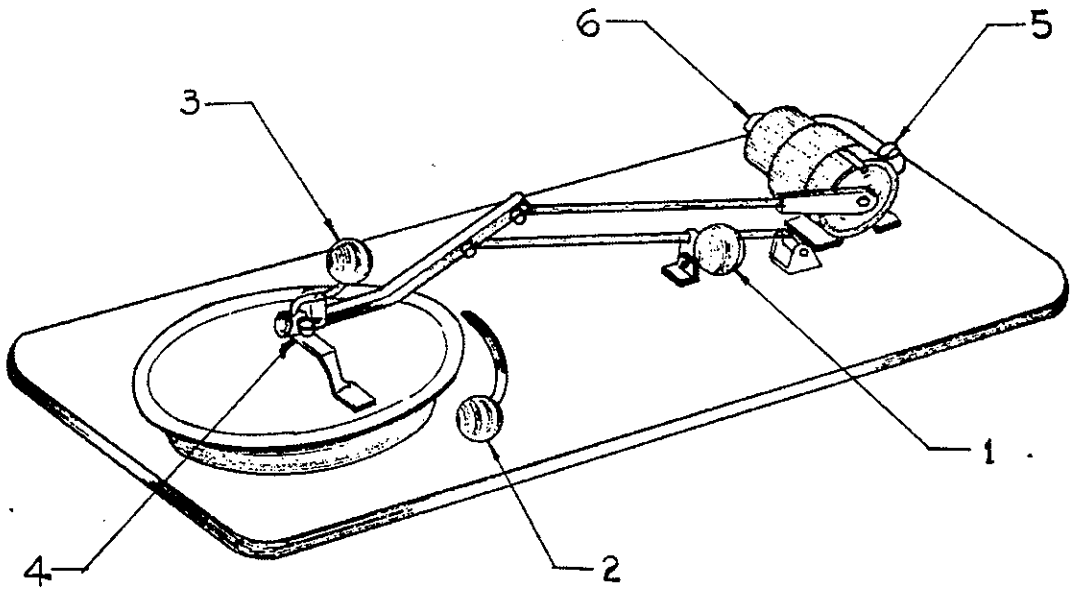
Knob #2 - When pushed either the entire length of the slot, or only part of it, will turn the plate counter clock-wise, Thereby positioni-- the food where the spoon can pick it up.

Knob #3 - Tips The CP Feeder ie food.

Picture with numbers

FEEDING PROCESS:

1. Depress Knob # od around the plat
2. Push Knob #2 - until desire .... be scooped up.
3. Press Knob #3 - and in doing so, push the spoon down into the plate.
4. Press Knob #1 - and bring mouth to filled spoon.



MAINTENANCE OF THE FEEDER

Proper handling and cleanliness will ensure that your feeder remains in good working order. After each meal, the plate should be removed and washed, and the arborite top wiped clean. Knob #4, when loosened, allows the spoon to be removed for washing.

ADJUSTMENTS:

Screw #5 - allows adjustment to the height to which the spoon rises. If this must be lowered, loosen the screw and push the metal stop closer to the rod. Similarly, if it is to be raised, push the stop farther away from the rod. Then, re-tighten the screw.

If the spoon is rising too slowly or too quickly, this can be altered by turning Screw #6.

Your feeder was checked before delivery and will hopefully not need adjustment.

Available in Left and Right Hand Models.

A FEEDING DEVICE

INTRODUCTION

Patients who are unable to feed themselves, due to limitations of control or movement in the upper limbs, may be helped by a feeding device recently developed at O.C.C.C.* Self feeding provides the individual with a degree of independence in a personal function and releases a parent or attendant from a time consuming task for three meals a day, seven days a week. The feeder described in this report is a rugged mechanical device developed from a design seen in Chailey,** England.

Although this feeder is suitable for all ages, to date, our results are based only on trials with handicapped children, particularly those with Cerebral Palsy 5 to 18 years of age These children each in their own way, have learned to manipulate the controls and feed themselves either independently or with minimal assistance.

INDICATIONS:

There are 3 minimal physical requirements for satisfactory operation of the feeder:-

(1) One arm must have sufficient co-ordination to depress, push or pull the knobs. Functional grasp of the hand is not essential; a fist, wrist, or forearm can be used to hit the knobs.

(2) The person must be capable of bringing his head forward toward the spoon in a fairly controlled manner.

(3) Oral musculature must be sufficient to effect lip closure Chewing and swallowing should be adequate, to ensure proper digestion

The subject must be satisfactorily seated in order that he use the feeder properly. He must be comfortable and sitting erect with his trunk well supported if necessary The feeder must be positioned correctly, so that the elevated spoon is in front of the subject's mouth. and at such a position that the mouth can easily reach the spoon. The feeder may be placed on a table wheelchair or chair-tray.

FEEDER COMPONENTS

The feeder is mounted on a plastic surfaced board made from kitchen countertop material. Four suction cups secure the board to a falt surface. The plate is a standard corning ware pie plate fastened to an adaptor, so that it may be quickly secured to a rotary spindle. The plate can be rotated by pushing* or pulling a knob (2) located near the side of the plate. A special acrylic spoon is mounted with a thumb screw to a linkage arm, which suspends it above the plate. The arm is mounted on a spring loaded hydraulic damper (door closer). Knob (3) is located on top of the arm near the spoon. When this knob is pressed down, the spoon is partly released so that it hangs downward. If the knob or any part of the arm is further depressed, the spoon contacts the plate and slides forward to scoop up the food. The arm and the spoon remain in this position until released, by pressing knob #1.

A spring-loaded damper then causes the arm with the spoon to rise to the appropriate level.

The feeder is available in both left and right hand models.

* Ontario Crippled Children's Centre,
350 Rumsey Road,
Special Devices Project, – Funded by the Ontario Hospital Services Comm.

** Chailey Heritage,
Experimental Workshop,
Chailey – Sussex, England.

* The spindle mechanism can be re-assembled so that the knob #2 is pulled to rotate the plate rather than pushed.

FOODS AND PREPARATION

The food to be eaten should be soft (e.g. mashed potatoes, pudding) or in small pieces (e.g. meat, peas, fruit). Foods such as spaghetti or macaroni are only practical if cut up very finely. Soup is not advisable.

The plate can be removed from the spindle by rotating about 30° while gently lifting upwards. The food should be placed around the edge of the plate. Each type of food should be separate so that the operator may make the desired selection by rotating the plate.

To place the plate back on the feeder, allow the arm holding the spoon to rise by pressing knob (1). Center the plate over the spindle so that the adaptor falls into the slot, then rotate the plate about 30° in a direction opposite to that produced by knob 2. The feeder is now ready for use

FEEDING PROCESS

1. Push Knob #2 until desired food is in position to be scooped up.
2. Press Knob #3 and in doing so, push the spoon down into the plate. Some people may find it easier to push the spoon into the plate by pushing down on the arm.
3. Press Knob #1 to raise the spoon, and bring mouth forward to the filled spoon. Continue this cycle until the meal is completed.

CARE OF THE FEEDER

Proper handling and cleanliness will ensure that the feeder remains in good working order. After each meal, the plate should be removed and washed in detergent and water, and the plastic top wiped clean. Thumb screw #4, when loosened, allows the spoon to be removed for washing.

ADJUSTMENTS

Screw #5 allows adjustment of the height to which the spoon rises. If this must be lowered or raised, the screw is loosened and the metal stop is pushed closer to or farther from the rod. The screw is then tightened.

RESULTS OF FEEDER TRIALS

Cerebral Palsy, children, both spastics and athetoids, are successfully using the feeder. Their reactions to the feeder are similar; they truly enjoy feeding themselves. For most, this is the first time they have ever fed themselves, and their feeling of excitement, pride and independence are very evident.

The parents of these children are similarly very delighted that their child can feed himself. Mother now can perform some of her mealtime chores as well as eat her own meal without having to constantly attend to this child. Some children still must have their mouths wiped after every few bites, but this takes considerably less effort on the mother's part than feeding her child every mouthful.

All in all, the results and the reactions we have observed of the feeder trials have been very satisfactory and promising.

- **Manufactured in Right Hand and Left Hand Configurations – When Ordering Please Specify.**

This device for young paraplegics has been developed by the Ontario Crippled Children's Center, Toronto, and it has been made available for distribution by the Canadian Government, Prosthetic Services, Department of National Health and Welfare, Sunnybrook Hospital, Toronto, Ont.

Printed in Canada

Tel.: (514) 739-1310

MEDICAL SYSTEMS
DIVISION OF
WOLSPAL INC.

4980 Bucran, Suite 205
Montreal, Que.
Canada H4P 1S8

MICHEL ROGER WOLFF

Appendix C

Clinical Evaluation Report of Winsford Feeder

ACTIVITIES OF DAILY LIVING

Winsford Feeder

JaneE Kreckman, B.A.
Saleem J. Sheredos, B.E.E.

The Winsford Feeder, originally known as the Morewood Spoon Lifter, developed by Mr. William H. Morewood and distributed by Winsford Products, Inc. of Pennington, New Jersey, is a semi-automatic feeding device that allows a quadriplegic individual to feed himself independently with only head motion, once food has been placed on the plate and he has been properly positioned at the machine.

A. Description

(1) Physical

The original Morewood Spoon Lifter (Fig. 20) consisted of a square polypropylene base approximately 12 inches by 12 inches (30.5 cm by 30.5 cm) which had four, one-inch (2.5 cm) steel legs attached under the base at the corners. The switch control was connected to the base on the upper left corner, and the switch rod, which required a downward touch, had to be installed by the attendant before each meal.

Fig. 20. The original model of the Morewood Spoon Lifter being demonstrated by the inventor.

The motor which operated on 110-volt AC was connected to the base on the lower right corner. A metal extension arm from the motor had an adjustable clamp attached to a steel disc at the end that held almost any size eating utensil. The arm moved between two positions, plate level and mouth level, in one continuous motion once the switch control activated the motor. On the lower left corner, there was a stainless steel glass holder with a stainless steel receptacle for a straw that would hold a standard 10-inch (25.4 cm) plastic straw at the same height as the spoon when the spoon was lifted to its highest level. The other component of the spoon lifter was an adjustable plastic head band that had a stainless steel band connected to it that went around the front of the user's head. The stainless steel band had a steel receptacle attached to it in the front which was used to hold a 14-inch (35.56 cm) non-adjustable, vinyl covered, metal rod with a pusher or shovel on the end of it.

The modified Morewood Spoon Lifter, known as the Winsford Feeder, (Fig. 21) has a rectangular, polypropylene base with a curve cut across the end closest to the user to allow the user to be positioned nearer to the plate. Under the base at each corner, the stationary legs were replaced with a receptacle designed to hold each of four sets of different length legs that range in size from one inch (2.54 cm) to five inches (12.70 cm). The switch control, connected to the base on the upper left corner, was enclosed, and the switch rod no longer has to be installed each time the device is operated. There were no changes made in the head band; however, the rod receptacle attached to the front of the stainless steel band was changed from steel to plastic to reduce the chance of electrical conductance to the user. The pushing rod was designed for continuously adjustable length to prevent pushing the head band off and so a person would be able to slide it to any position on the plate, by merely tilting or turning his head, without moving his shoulders. The glass holder and straw receptacle were not altered in

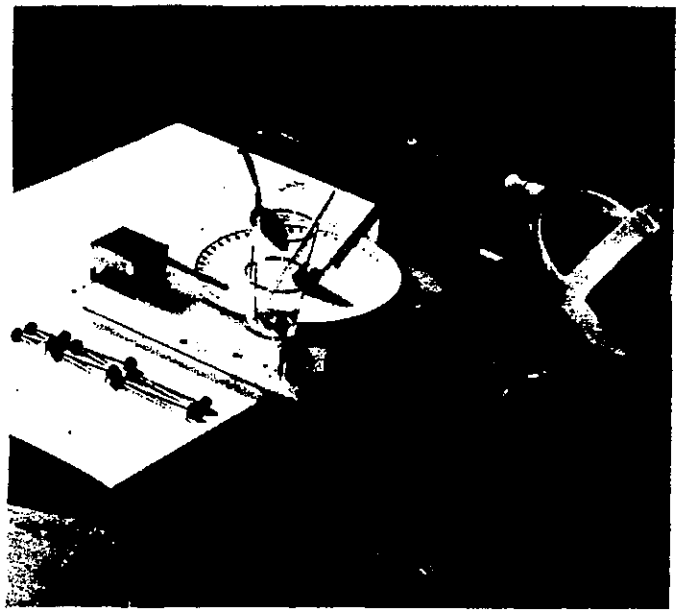


Fig. 21. The modified spoon lifter know as the Winsford Feeder.

any way on the model known as the Winsford Feeder. In June 1976, the feeder was further modified by removing the stainless steel disc at the end of the lifting arm and replacing it with a Delrin disc; and in July 1976, the stainless steel spoon clamp was replaced by a plastic spoon clamp. Both of these changes were initiated by Mr. Morewood to improve the device's insulation so there would be no possible electrical path between the user and the mechanism. The motor on the Winsford Feeder operates off 110-volt AC which is activated by a single pole, single throw microswitch. The microswitch is activated by a switch rod which moves to the side and must be held in position for a brief moment to activate the cam in the spoon drive.

(2) Functional

The user of the Winsford Feeder has to have someone assist him before he is able to feed himself independently. The assisting individual must cut foods such as meat or spaghetti into pieces that can be eaten with a spoon, place the plate of food on the base of the feeder, put the spoon in the clamp, and attach the head band with the shovel to the user. The attendant should then run the spoon to the upper end of its travel and position the person using the device so that sitting comfortably his mouth will be at the same height as the spoon. The subject should then use the pusher to hold the switch rod in position for a brief moment to activate the extension arm which moves the spoon to the lower position. Once the spoon is in the lower position, the attendant should adjust the spoon so the bowl of the spoon just clears the plate and the tip of the spoon touches the plate. Once this process is completed and the attendant has made all the adjustments necessary, the user shovels or pushes the food into the spoon with head motion. Another touch on the switch rod with the pusher (holding it is position, briefly) will lift the spoon in one continuous motion to its highest level where it will stop and allow the subject to eat. This process is followed until the subject has completed his meal. The attendant is needed to remove the head band when the subject has finished eating.

B. Evaluation Procedure

The original Morewood Spoon Lifter was submitted in March 1974 to the VA Prosthetics Center (now known as the VA Rehabilitation Engineering Center), New York, New York for testing. This spoon lifter was introduced and demonstrated to the evaluation staff by Mr. William H. Morewood. The original spoon lifter was sent to the VA Medical Center in Castle Point, New York for clinical evaluation, and the subject who used the device requested permission to take the device home when he was discharged from the hospital. Steps were taken by the Program Manager for the Veterans Administration to purchase the original spoon lifter as well as additional units with recommended modifications incorporated.

The original Morewood Spoon lifter was taken home for further evaluation in the home setting by the subject who was discharged from the VAMC in Castle Point, New York. Twelve modified spoon lifters, Wins-

ford Feeders, were purchased by the Veterans Administration, and 11 of them were distributed to VA Spinal Cord Injury Centers for clinical evaluation. The twelfth Winsford Feeder was retained by the VA Rehabilitation Engineering Center for reevaluation. Each Spinal Cord Injury (SCI) Service at the following VA Medical Centers: Castle Point, New York; Cleveland, Ohio; East Orange, New Jersey; Hines, Illinois; Long Beach, California; Miami, Florida; Palo Alto, California; Richmond, Virginia; Tampa, Florida; West Roxbury, Massachusetts; and Wood, Wisconsin was requested to evaluate the device with as many high level quadriplegics as possible and to send a monthly report to VAREC on the progress of their evaluations and their recommendations.

Throughout the evaluation period on the Winsford Feeder, there was on-going communication with the inventor who offered his cooperation to the Project Manager.

Every SCI Center that received a Winsford Feeder was requested to evaluate it clinically to determine the safety, utility, and efficacy of the device and to determine the accuracy of the manufacturer's claim that only head motion was needed for a quadriplegic to feed himself independently. Follow-up evaluation reports on the Winsford Feeder were received from six SCI Centers: Castle Point, Long Beach, Miami, Palo Alto, Richmond, and Wood. At these centers, a total of 16 quadriplegic individuals, level C_5 and above, tested the device. The test trials ranged from one attempt to repeated daily use in the home situation.

C. Results

Most users were able to operate the Winsford Feeder independently once the plate of food was placed on the base of the device and the head band was attached to their heads. However, very few subjects expressed interest in further use of the device, as they would rather be fed by someone than expend the energy and time required in doing it themselves.

(1) Castle Point

The staff reported that most individuals who were shown the original spoon lifter were negative towards gadgets and preferred to have someone feed them. However, one C_4 level quadriplegic subject was able to functionally feed himself a complete meal using the device. This subject requested permission to take the device home, and arrangements were made for him to do so. He continued to use it in the home situation for almost three years. This individual found it necessary to put Reston Foam under the front of the head band to relieve the pressure against his forehead and to help to keep the head band from slipping. The staff at this center made the initial suggestions that were incorporated in the modified feeder, and this subject's spoon lifter was modified. The staff also reported that the subject had to have good trunk balance in order to use the feeder and that the motor would stall if food was stuck to the bottom of the spoon.

(2) Long Beach

Reports from this center state that the Winsford Feeder was evaluated with five quadriplegic individuals, level C_5 and above, in the clinical setting. One of these individuals took the device home for a week's trial after learning to use it, and he was able to use it if he was up and in a wheelchair. A second subject who was interested in using the device had a sitting position of less than 90 degrees and a tracheotomy tube which did not allow him adequate range of motion to activate the device. The third and fourth subjects were able to functionally use the Winsford Feeder in the clinical evaluation setting; and the fifth individual, who used the device several times in the clinical setting was able to use it well and with consistency and was interested in using it at home.

Observations made by the staff at this center were:

a. Sticky foods such as baked beans and mashed potatoes did not work with the device.

b. The subject must have good range of neck motion and mobility.

c. Newly injured subjects were more receptive than ones with old injuries.

Suggestions made by the staff and subjects at this SCI Center were:

a. Lengthen the switch lever and spoon.

b. Adapt the legs with a spring loaded device to facilitate positioning the device.

c. Slow down the speed of the lifting arm.

d. A "scoop-shaped" spoon would be more advantageous.

e. Adapt the device for battery power for use away from home and outdoors.

(3) Miami

The staff at this SCI Center reported that the Winsford Feeder served the purpose it was designed for and that subjects were able to use it, but it was too strenuous for the subject and required too much training to handle it well. They further noted that the subject had to have good trunk balance, should not be too spastic, and should have good neck strength, control and coordination. Finally, they reported that the subjects rejected the head band, because of their appearance when wearing the device.

(4) Palo Alto

The staff at this SCI Center evaluated the Winsford Feeder using four C_5 level quadriplegic individuals, and they requested three more feeders be sent to them as all subjects were able to use the device.

(5) Richmond

The SCI Center's report stated that the Winsford Feeder was evaluated with four C_5 level quadriplegic individuals in the clinic setting and that the subjects were able to functionally use it. The staff was unable to find a subject who would accept the device and use it more than once as most of their subjects had developed a dislike for gadgets.

Suggestions made by the staff at this center were:

a. The pusher rod should be telescoping rather than of variable lengths.

b. The holding grip of the spoon clamp should be more secure.

c. The switch rod should be of adjustable lengths.

d. The head piece should be padded.

(6) Wood

This SCI Center's report stated that the Winsford Feeder was used successfully by a subject who was able to operate the control switch and load the spoon with his hands to his mouth. Other subjects at this center rejected the head device. The staff noted there were indications for use of the device with subjects just off Circ-Olectric beds.

D. Summary of Recommendations

Briefly, recommendations for improvement in the functional design of the "modified spoon lifter" as reported from the field stations included:

1. more comfortable head band that would maintain its position during "shoveling" and chewing.

2. The holding grip of the spoon clamp should be made more secure.

3. The legs should be made adjustable versus the legs of various sizes, as this would be more convenient when one unit is used by several individuals.

4. A longer and/or adjustable switch rod.

5. A slower and/or adjustable spoon speed.

6. Adaptation for battery power for use away from home and outdoors.

7. UL approval should be obtained.

E. Conclusion

The Winsford Feeder in the form that was evaluated was found useful by a small number of all the veterans who used it and may be prescribed when medically indicated as part of a treatment program for a veteran beneficiary.

Since the conclusion of this evaluation, the inventor has produced a new model of the Winsford Feeder (Fig. 22) that incorporates the seven recommendations listed above. The latest model of the Winsford Feeder is operated by a six-volt, rechargeable battery and is controlled by a chin switch. When the plastic ball (chin switch) is pushed to the right, the stainless steel pusher in the foreground swings in from the edge of the dish and moves food onto the spoon. The spoon is then automatically raised to the mouth level. Upon reactivation of the chin switch, the spoon is returned to the dish for refilling. The dish may be rotated, by moving the chin switch to the left, in order to place more food in front of the pusher.

According to the inventor, design features of the latest model include the following:

(1) The Winsford Feeder uses a standard teaspoon and dish.

(2) The spoon, dish, and pusher may be readily removed for washing.

(3) A bracket is provided to support a glass for liquids.

(4) Surfaces of the feeder may be easily cleaned with a damp cloth.

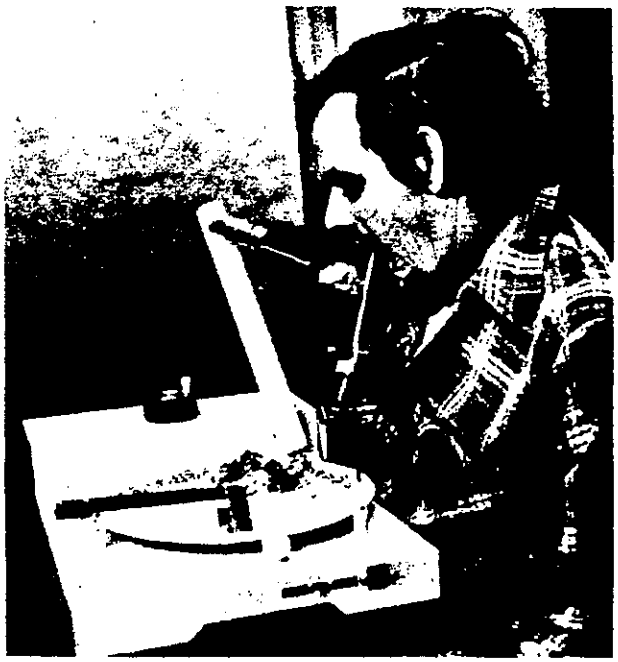


Fig. 22. The latest model of the Winsford Feeder.

(5) A large knob raises or lowers the legs to give a height adjustment of five inches (12.70 cm).

(6) The battery will run the feeder three meals a day for a week, after which it should be recharged by plugging the charger in overnight.

(7) An optional, remote switch may be used in place of the chin switch. This is advantageous for those individuals who have even a small amount of motion in a hand or foot.

(8) By holding the start switch closed, the spoon will not rise, and the pusher may be used two or more times, if necessary, to fill the spoon.

(9) The dish may be rotated any amount at any time regardless of the position of the spoon.

(10) Normal meals may be eaten provided bulky food is cut into small enough pieces to fit in a teaspoon.

(11) Should the spoon touch the user's face, it will exert only a small force before the lifting arm stops. The lifting arm will automatically reengage the next time the start switch is used.

The VAREC Technology a Performance Evaluation Service currently evaluating the new mod of the Winsford Feeder and will r port on whether it meets the man facturer's claims and is accepted the veteran population that tests i

EVALUATIONS CURRENTLY UNDERWAY

Described below are the devices currently undergoing evaluation. The list includes the name and manufacturer of each device, its description, where it is being evaluated, and its Bulletin of Prosthetics Research (BPR) reference number if the device has previously been reported.

Name & Mfr.	Description	Evaluation Site	BPR. Ref.
	MOBILITY AIDS		
Stand Aid Wheelchairs, Naval Ocean Systems Center, San Diego, CA	A type of powered wheelchair with the capablity of raising a user to a standing position.	ES at VAMC, Castle Point, NY	10-23 10-24 10-32
Med Quad Wheelchair System, Medical Equipment Distributors, Accurate Med. Service, Upper Darby, PA	Powered wheelchair with powered recliner whose flexibility makes it easily adaptable to suit various user requirements.	ES at VAMC, Albany, NY, Hines, IL Allenpark, MI	10-31 10-32
Insta Gaitor, Instrument Components Company, Inc. Mentor, OH	Electromechanical kit designed to convert a standard manually-propelled wheelchair to a powered wheelchair.	ES at VAMC, Castle Point, NY	10-28
Portascoot, Model 65000, C.F. Brewer Company, Menomonee Falls, WI	A low speed, three-wheel motorized, non-licensed vehicle	ES at VAMC, Castle Point, NY	
PRC Custom Sports Wheelchair, Production Research Corporation, College Park, MD	A lightweight manual wheelchair designed for sports and everyday needs	ES at VAMC, Castle Point, NY	

Appendix D

Clinical Evaluation of Robot Arm

Wheelchair Control and Robot Arm/Work Table System for High Spinal Cord Injured Persons

W. Seamone, B.A.E. and
G. Schmeisser, M.D.
Johns Hopkins University School of Medicine
Department of Orthopaedic Surgery
Baltimore, MD 21205

Sponsor: VA Rehabilitation Research and Development Service

Purpose—The objective of the project during this period (June 1984 through March 1985) has been the completion of an important phase of clinical evaluation of the Robot Arm/Work Table System at the Spinal Cord Injury Services at the VA Medical Centers in Richmond, Virginia and Cleveland, Ohio. In parallel with this testing, two important engineering improvements were made to the system. Development of a new, self-adjusting chin controller of the wheelchair was completed, and three axis simultaneous motion capability of the Robot Arm was achieved. Details of over two years of clinical testing were given in the technical article in the January 1985 Volume of the Journal of Rehabilitation Research and Development.

That report includes the experiences of users who evaluated the equipment during the first six months of the current report period, as well as those of users who evaluated the equipment during the previous year and a half. The current report summarizes those results and the results of an additional user who evaluated the equipment during the remaining months of the current report period.

Progress—Through December 1984, 20 male quadriplegics between 21 and 60 years of age at evaluation had been involved in the evaluation in three geographical areas, i.e., Baltimore-Washington, Richmond, and Cleveland. They ranged from five to 26 years between time of injury and evaluation. The levels of injury ranged from C-2 to C-5. Individual accumulations of time actually working with the equipment ranged from one hour to over 100 hours; 316 meals were eaten by these individuals using the Robot Arm. Among the nine quadriplegics who tested the equipment at the Richmond VAMC, seven indicated that they found the equipment gratifying to use, especially for self-feeding. Among the seven quadriplegics who tested the system at the Cleveland VAMC, none found the system useful. They cited a number of reasons. Regardless of the differences in overall assessments, agreement existed on two general problems.

One problem was lack of adequate adjustability of the wheelchair chin controller to enable the operator to compensate for changes in his posture in the wheelchair. This accounted for a degree of incompatability of the system with reclining users. There were also reliability and maintenance problems with the original design. The second problem was slowness of the Robot Arm in accomplishing repetitive tasks such as self-feeding. Both of these problems were addressed and engineering design changes were made to the hardware.

A new chin controller was designed to interface with the E&J Model 3P wheelchair. This design change addressed problems such as the lack of ruggedness, too much head motion required, lack of provisions for readjustment by the user, and too troublesome for attendants to mount and align on the wheelchair frame. In order to speed up the cycle time of the Robot Arm, a new multiaxial controller was designed based on the use of the 6809 microprocessor The 6809 microprocessor and its associated software allow additional flexibility for programming task trajectories and give the system greater operational reliability.

The user who evaluated the equipment during the final months of the current report period was a 27-year-old C3-5 quadriplegic with a motor residual of partial function of the deltoids, one pectoralis major, and one biceps. With the exception of the new multiaxial capability, he evaluated the Robot Arm/Work Table with all subsystems including an electric wheelchair with the new chin controller. He worked with the equipment over a three-month-period in the OT facility at the Richmond VAMC. He ate 24 complete meals with the Robot Arm. He had very positive comments about all aspects of the system and specifically about the new wheelchair chin controller's responsiveness and self-adjustability.

Future Plans — Clinical evaluation of the new simultaneous multiaxial motion feature for the Robot Arm is anticipated during the next report period.

G. Wheelchairs, Including Seating and Controls

[See also pgs. 110, 130, 147]

The Sunburst Tandem

Douglas Schwandt, M.S.; Larry Leifer, Ph.D.; Peter Axelson, M.S.; and Ronald Gaines, M.D.
VA Medical Center
Rehabilitation Research and Development Center
Palo Alto, CA 94304

Sponsor: VA Rehabilitation Research and Development Service

Purpose — Individuals with various physical disabilities resulting from paraplegia, low level and incomplete quadriplegia, amputation, muscular dystrophy, multiple sclerosis, stroke, cerebral palsy, blindness, etc., who endeavor to live healthy and meaningful lives may benefit greatly in their physical, psychological, and social well-being from participation in recreational activities with family and friends. With the development and subsequent availability of an appropriate design, tandem bicycling is one highly integrative activity which will promote participation by individuals with disability.

A tandem bicycle to be shared by individuals with and without disability will literally provide a vehicle for integrated mobility and recreation. On such a tandem, many excluded from the revitalizing activity of bicycling will experience the freedom, exhilaration and accomplishment of riding a bicycle.

The pre-production development of a single rider arm-powered bicycle, the *Handbike*, is essentially complete. As a spin-off from the development of the *Handbike*, the first prototype of a tandem called the *Handbike Tandem* for disabled and able-bodied to share, was completed in June 1983. Conceptually, the configuration of the *Handbike Tandem* consists of merging the *Handbike* in the front with a standard bicycle in the back. In the interest of independence and equality, this first tandem prototype was designed to be ridden by one rider alone in the front or back position. The experience gained by the development of the *Handbike* and the *Handbike Tandem* has led directly to the design of the second tandem prototype called the *Sunburst*.

Progress — Although similar to the *Handbike Tandem* in rider configuration, an alternative drive system and vehicle identity was planned for the *Sunburst*, completed in June 1984. On the *Sunburst*, arm- and foot-powered recumbent cycling in the front combines with a standard bicycle in the back.

Appendix E

Caupuchin Monkeys as Aides

VOAC to sequentially display its three basic control modes: "all on," "all off," and "select." When the desired mode is displayed, it is selected by saying "stop." The user executes the mode by saying "go ahead." Selecting "all off" or "all on" will turn all units off or on. Selecting "select" allows control of individual units. "Faster" and "slower" control the display rate at all times.

In the select mode, the VOAC sequentially displays the numbers of available units. A unit is selected by stopping the display when the unit's number appears. When the unit has been selected, the VOAC sequentially displays functions available for that unit. Possible functions are "on," "off," "bright," "dim," and "momentary." The latter will turn a unit on until the user says "stop." As before, functions are selected by stopping the display and saying "go ahead."

Training Capuchin Monkeys to Serve as Aides for High Level Quadriplegics

Mary Joan Willard, Ed.D.
Albert Einstein College of Medicine
Bronx, NY 10461

Sponsor: VA Rehabilitation Research and Development Service

Purpose — This project is an ongoing attempt to refine the procedures by which capuchin monkeys are trained to serve as aides for high level quadriplegics.

Progress — Work is underway to meet the following objectives:

1) Approximately three-fourths of the training procedures used in teaching a basic repertoire of skills have been standardized and described in a 100-page illustrated training manual as well as instructional videotapes.

2) A solid food dispenser designed to replace a liquid reward dispenser underwent field testing in the Fall of 1985.

3) Seven high level quadriplegics are now using simian aides. One cerebral palsy patient was paired with a simian aide in the Fall of 1985.

4) A breeding colony was established in 1985 at the Mannheimer Primatological Foundation in Florida to produce 20 to 40 infant Cebus per year. A breeding colony also has been located in Argentina and 16 female infants were purchased during the Fall of 1985.

6) A non-profit organization has been established to apply the knowledge gained from the simian aide research. Financial support for the organization has been secured via a corporate sponsor and as mature animals become available, placements of simian aides will begin at a rate of 20 to 40 per year in 1987.

7) An evaluation of the simian aide research is currently being conducted by the evaluation unit of the Department of Rehabilitation Research and Development. A second evaluation by the New York University Spinal Cord Injury Research Unit is planned for January of 1986.

8) A market survey testing the preferences of high level quadriplegics for simian aides versus robotic arm work tables was scheduled for the Fall of 1985.

9) An experimental program for teaching college students how to train monkeys was initiated in September of 1985. Efficiency and cost-effectiveness will be evaluated over the next two years.

10) Canada, Argentina, and Israel are now beginning their own simian aide programs; training material and primate selection information is being provided to them at no charge.

By J. Tevere MacFadyen

Educated monkeys help the disabled to help themselves

Once it was regarded with skepticism, but today a program that trains simian aides for quadriplegics is considered a solid success

Gary Finkle's monkey, Jo, sits on laser device used to point out such tasks as fetching food or magazines.

Try this: take the most comfortable chair you own into the pleasantest room in your house, arrange it in a convenient location and sit down. Don't move. Wait 15 or 20 minutes for your muscles to loosen up. Relax. Look around; take stock of your surroundings. If any visitors walk in, you can turn your head to greet them but you can't stand or shake hands. You can admire the view out your window, but you can't crack it open for a breath of fresh air if the room becomes stuffy or warm. Wait another hour. Are you bored yet? Hungry? Thirsty? Sorry, but you'll just have to wait until somebody happens by. Don't worry, it shouldn't be too long —probably no more than a couple of hours.

Welcome to the world of the quadriplegic, Gary Finkle's world ever since he was injured in a swimming-pool accident seven years ago. Gary is one of an estimated 90,000 Americans who have lost virtually all feeling and movement below their shoulders due to severe spinal-cord injuries. He lives with his wife, Micki, and a female capuchin monkey named Jo in a new home on a hilltop outside the village of Andes, New York, about three hours north of New York City. When I visited him there recently, Jo was perched protectively on the back of his wheelchair.

Gary Finkle is a charter participant in a remarkable enterprise called Helping Hands: Simian Aides for the Disabled. The nonprofit organization supplies quadriplegics with trained capuchins that increase their self-reliance and reduce their dependency on friends and family or hired attendants. Shortly after it started up eight years ago, Helping Hands received a spate of publicity in newspapers, magazines and on television. By now it has long since progressed from the novelty stage to become a proven success that makes a real difference in the lives of the people it serves.

Just look at Gary and Jo. Gary uses his mouth to control a small laser-pointer mounted on his wheelchair. With it, he directs Jo to open and shut doors, turn lights on or off, change books or magazines in a reading stand or audiotapes in a cassette player. She brings him prepared snacks and drinks from the refrigerator and clears away empties. She will even feed him. On command, Jo fetches the remote control for Gary's TV, placing it on the chair where he can manipulate it with his mouthstick. The mouthstick is a quadriplegic's primary tool. It is used for practically everything: turning the pages of a book, dialing the telephone, changing channels on the TV, working at a typewriter or computer. If Gary's mouthstick drops to the floor, Jo will retrieve it and gently reinsert it into his mouth. "I definitely cannot imagine living without her," he says.

Jo has been with the Finkles for more than three years. She has become so fully integrated into their lives that, in describing her, they tend to talk not

Quartet of capuchins clings to trainer Alison Pascoe at Albert Einstein Medical College in New York City.

Photographs by Jose Azel

Mary Joan Willard, director of Helping Hands, works with monkey as Alison Pascoe videotapes session.

about what she does but about who she is, her personality and style. "She's smarter than we give her credit for," Gary ventures fondly. "Sometimes she's too smart," adds Micki, who once located a missing tube of lipstick hidden in Jo's cage: she'd apparently found the stuff quite tasty.

"The main thing is independence," Gary reflects. He knows that he will always need human assistance for such things as getting in and out of bed, bathing or changing his clothes. But having Jo measurably lessens his reliance on Micki, enabling her to work afternoons in town without worrying about her husband's welfare. Above and beyond Jo's obvious utility, Gary prizes her companionship. "She's a constant source of entertainment," he marvels, "and she just keeps getting smarter. The more she's exposed to, the more she learns. I want to teach her to play backgammon."

Heavyset and bearded, with a mane of curly black hair, Gary came to Helping Hands by way of New York's Rusk Institute, a renowned rehabilitation center. "It seemed like a great challenge," he recalls. "I've been around animals all my life and I guess I just thought this would be fun." Nowadays Jo goes almost everywhere with him, indoors and out, on social calls or forays to the local tavern. Wherever they go they draw attention. "I've certainly met people I wouldn't have met without her," Gary says. When I ask if a robot might not one day be able to do many of the jobs Jo does for him now, Gary answers, "Robots won't play with you. They won't jump around your living room or wrestle with the dogs. They won't comb your hair and beard with their hands or sit on the laser, chewing at your face. A robot would be pretty dull."

On the sixth floor of Abraham Mazer Hall at the Albert Einstein College of Medicine in New York, the corridor resounds with shrieking chirrups and trills. Ringing bells punctuate a hubbub of hollers and howls, weird catcalls and cries, crashes, claps and bangs. The cinder-block walls are dull institutional yellow; the floor is faded linoleum. What little furniture there is appears to have taken quite a beating. Windows are missing from the doors to several offices and have been replaced with wire mesh. If the place looks a bit disheveled, there is good reason. Here, in cubicles where medical students once crammed for exams, "organ-grinder monkeys" are learning to help the handicapped. "We're very lucky to be here," Dr. Mary Joan Willard tells me as we step from the elevator to be greeted by a chattering capuchin chorus. An assistant professor of rehabilitation medicine at Einstein, Willard—who is called M. J. by just about everyone—is the founder and director of Helping Hands. "People kill for space at this institution," she explains. "If we weren't here, we'd probably be down in the basement or someplace awful."

In 1977, Willard was a postdoctoral fellow in psychology at Tufts New England Medical Center in Boston. There she befriended a 23-year-old quadriplegic who was paralyzed from the neck down. Visiting him, she confronted the central fact of paralysis: utter dependence. There was practically nothing he could do without help. "As a psychologist," she says, "I was obsessed with the notion that there had to be some way to increase his independence."

Willard had spent three years as a research assistant to B. F. Skinner, the eminent psychologist at Harvard University whose research pioneered the still controversial theories of behavior modification. It occurred to her that Skinner's reward-and-punishment techniques might be used to train primates to assist the disabled. "I was literally lying in bed one night when it hit me," she remembers. "Why not use chimps?" Chimpanzees, it emerged, had some practical drawbacks: they grow to be nearly as big as people and a good deal stronger, and adult chimps are prone to fractiousness. But Skinner thought the scheme had merit and suggested capuchins instead. Mature capuchins weigh roughly five pounds and stand less than 18 inches tall. They respond well to training and form loyal bonds with humans. After a preliminary investigation, Willard resolved to proceed. Armed with a small grant from Tufts Medical School, she purchased a quartet of laboratory-bred *Cebus albifrons*, and Helping Hands was on its way.

J. Tevere MacFadyen has written most recently for SMITHSONIAN *about the transportation of hazardous materials and Houston's ship channel.*

After removing drink from refrigerator, Jo takes off cap and inserts a tube for Gary Finkle to use as a straw.

The godmother of simian aides, M. J. Willard is a slim, small brunette who looks a decade younger than her 36 years. Her manner is direct and informal. When she convenes a lunchtime meeting in her office, everyone sits on the floor. Present are Alison Pascoe, Lauren Westbrook and Alice Levee, the three young women who form the core of the training staff at Einstein. Other key staffers are not based in New York. David Taylor, a high school science teacher from Byfield, Massachusetts, coordinates the "foster family" network which places infant capuchins in human homes before they're ready for training. Judi Zazula, a biomedical engineer in Boston, oversees the actual placement of monkeys and screens disabled applicants to check their suitability for inclusion in the program. Her partner, Doug Ely, a physicist with Arthur D. Little Inc., designs and constructs much of the specialized equipment the project requires.

On the agenda this noon are a review of current training and an evaluation of the volunteer trainers, 14 in all, most of them undergraduates at nearby Fordham University. Alison's pet capuchin, Amelia, nestles in my lap. "You'd never know how mean she was, would you?" Alison chuckles as Amelia attempts to relieve me of my pen. Amelia is a *Cebus apella*, a species of the genus *Cebus* that is considered more tractable and relaxed than the perpetually antic *albifrons*. The first monkey permanently placed with a quadriplegic was an *albifrons*, but the seven placed since have been calmer *apella/albifrons* hybrids. All but one of the simian aides thus far have been females, who are less aggressive, have fewer bad habits and seem to form stronger bonds than males.

Until recently, most of the animals obtained by the program have been adults with checkered pasts. Some are cast-off pets or zoo monkeys, others veterans of laboratory experimentation. A capuchin named Freeway was found loping alongside an interstate. As Helping Hands has gained visibility it has become known as a safe haven for refugee monkeys, but Alison notes some problems in working with animals from unknown backgrounds. "We never have any idea how they've been treated," she says. Cleo, for instance, a candidate for placement with a young cerebral-palsy victim, arrived at Einstein introverted and malnourished. As Alice Levee observes, "It's hard to expect food-motivated behavior from an anorexic animal."

While older animals will still be accepted, young monkeys, many of them born at the Mannheimer Primatological Foundation in Florida where Helping Hands has established a breeding colony, will constitute the majority in the future. Four of the six animals now at Einstein were raised specifically for Helping Hands, and another 25 or so are currently living with foster families. Foster care commences immediately after weaning, at six to eight weeks. Three years later, when the monkeys reach maturity, their teeth are extracted to guard against the chance that they might wound someone with a bite. Then they are ready for

Trainer at Einstein watches monkey put magnet on the page of a magazine it previously placed on a rack.

six months or so of training. The animals are trained as early as possible in order to prolong their useful life after placement. They live for about 30 years.

Down the hall in a battered training room a monkey named Marylin is burning off some excess energy. She vaults from table to chair to wardrobe to windowsill to chair, flicking the lights on and off, repeatedly testing the knob of the firmly locked door, yowling and cheeping and making faces. "She'll settle down," Alison promises, and soon enough she does. I sit immobile in a wheelchair, playing the role of a quadriplegic, as Alison puts the capuchin through her paces. After spending several months with a 54-year-old quadriplegic man in New Jersey, Marylin has returned to Einstein for a refresher course. "Change, Marylin," Alison instructs. "Change."

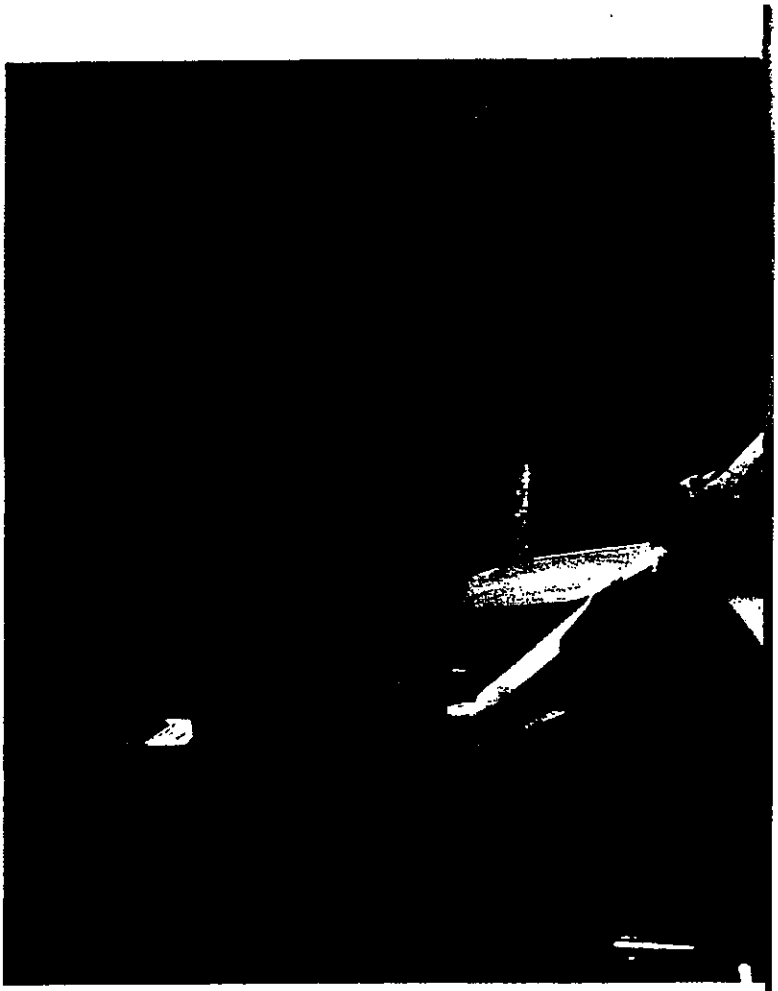
Marylin enjoys her sticky treat

With a laser-pointer the trainer indicates a magazine in a plastic binder on a shelf, which Marylin, after a brief hesitation, crosses the room to collect. She carries it to a nearby reading stand, removes the binder already on the stand and puts the new one in its place, clapping a steel washer attached to the binder onto a round magnet atop the reading stand. Alison rings a bell, signifying success, and Marylin scoots over to my chair for her reward—a sip of sticky, strawberry-flavored Nutrament—which I dispense by blowing into a plastic tube mounted beside my headrest. The tube descends into a bottle fixed to the chair's frame. Blowing into it forces a thimbleful of liquid into a cup in the bottle's cap, which Marylin greedily licks clean.

Whenever a monkey properly executes an assignment it receives a reward. If the task is not completed, or is done incorrectly, the reward is denied. An astonishing range of behaviors can be instilled using this system. The monkeys learn to respond to verbal commands like "Fetch" or "Change," as well as visual cues from the laser-pointer. Complex activities, such as bringing food and feeding, are subdivided into discrete tasks so that the animal's abilities expand as the components of a procedure are linked.

Trainers may bestow rewards in the form of a bit of peanut butter dabbed onto a finger, but quadriplegics use mouth-activated dispensers, either the liquid type or a sort of carousel loaded with pelletized chow. Negative reinforcement is administered by way of a tiny battery-powered backpack which can deliver a slight electric shock—Alison compares it to the static charge sometimes generated by touching a metal doorknob—should the monkey misbehave. Capuchins are endlessly curious and their natural inquisitiveness is what often gets them into trouble.

Willard remembers one early placement that had a



Sue Strong's helper, Henri, waits for reward after putting a sandwich in holder and opening container.

tendency to "tear up the house" when she wasn't working. The solution to that was the shock-pack, used in conjunction with little white circular stickers called coding dots. The animal quickly learned to associate the dots with an imminent shock and henceforth avoided touching anything with a sticker affixed to it. In practice, quadriplegics seldom shock their monkeys and some abandon the shock-pack altogether.

Capuchins sleep in large wire-mesh cages that are prominent features of their owners' households. Unlike most children, the monkeys will go to their "rooms" on command and obediently close the door behind them. They are housebroken, having been taught to eliminate only in their cages, but they occasionally make mistakes. Capuchins tend to be fastidious. "In general, they're very clean," Alison reports. "Some of them don't even like to eat bananas because they don't want to get their hands dirty. You have to wrap the fruit in napkins."

The animals are formidably bright. They can master new tasks in a single half-hour training session and once a procedure is learned, their performance reliability is close to 100 percent. When researchers were

If Strong doesn't quickly dispense treat by blowing into tube near face, Henri will push her chin toward it.

working on a new "toilet-training" technique, they devised a sort of stovepipe contraption with an electric eye in its base. After a monkey defecated into the pipe, the feces dropped through the optical beam and triggered dispensation of a sweet reward. One day the trainer left a capuchin alone with the device for 15 minutes and returned to discover that the electric eye had been tripped dozens of times. The animal had discovered that by dangling a strip of its bedding down the pipe it could gain an endless supply of rewards.

More than once in its formative years, Helping Hands came close to shutting down. Even after the initial experiments proved promising, 38 potential sponsors refused Willard's requests for financial help. When she turned to the Veterans Administration, an official there told her, "Look, this is a fantastic idea and if it works, great. But if it doesn't work you're going to get the Golden Fleece award, and we don't want to be funding you when you get it." The agency eventually went on to become the project's principal backer, but it was the Paralyzed Veterans of America that really got things going by awarding Willard her first major grant, late in 1979.

Sometimes pure good fortune seems to have intervened. The American Society of Rehabilitative Medicine rejected Willard's scientific paper on simian aides, but then mistakenly printed the abstract in its proceedings anyway. A flood of inquiries resulted. Willard developed a knack for public relations. "I've always known this project was borderline crazy in terms of people's perceptions of it," she says, "so I've learned to capitalize on its sexiness. I feel a little guilty about that but it works."

Though she admits to some frustration over the constant grind of fund raising, Willard finds some solace in history. After all, she points out, training guide dogs to lead the blind did not begin in earnest until a century after the idea was first proposed in 1819. Even today, only five percent of all blind persons use Seeing Eye dogs. "We expect to be placing ten to 20 animals a year soon, and expanding from there," she predicts.

Requests for helpers exceed supply

On the sixth floor of Mazer Hall, using mostly begged and borrowed equipment, the Helping Hands staff has just finished videotaping the entire training process. Along with a 108-page instructional manual, these tapes should go a long way toward helping others replicate Helping Hands' success. Already, rehabilitation centers in Canada, Argentina and Israel have initiated simian-aide programs of their own. In this country, requests for capuchin aides far outstrip the available supply. Willard has received more than 600 inquiries from quadriplegics or their families.

Some rehabilitation specialists argue that simian aides will be appropriate for only a fraction of the nation's disabled, and that research money might be better directed to other areas such as robotics. Willard disagrees. "We're training the animals to do some things that will be very difficult for robots to accomplish," she says. "Monkeys aren't for everyone, but dollar for dollar I can't think of anything that will have a greater positive impact on a quadriplegic's life." Monkeys are "all over their owners," says Alison Pascoe, "kissing and touching and exploring, and I think that's terribly meaningful."

Judi Zazula, who's been associated with Helping Hands almost from its inception, conducts an exhaustive evaluation of every applicant to the program. "Not all quadriplegics are super people," she says. "A lazy person before an accident will likely be a lazy paralyzed person." Zazula looks for people who are interested and energetic, and who have the kinds of particular needs that monkeys can help meet.

Quadriplegics need special equipment in order to work well with their monkeys. The feeding tray, for instance, is an apparatus fitted with attachments and

How monkeys assist the disabled

receptacles exactly matched to the drink bottles and food holders a quadriplegic will use. Now made of nearly indestructible molded plastic, earlier models were fashioned from Plexiglas, cardboard and duct tape. "We use off-the-shelf components whenever we can," Doug Ely tells me, "but some things have to be specially made." The socket into which a sandwich holder fits looks vaguely familiar. As well it might, Ely confirms. It's a modified vacuum-cleaner crevice tool.

Given her professional expertise, Judi Zazula might be expected to focus on Helping Hands' more pragmatic aspects: the ways in which capuchins can help disabled people accomplish basic tasks. But like everyone else I spoke with, she seems most profoundly affected by the monkeys' impact on the quality of the quadriplegics' lives. As part of the research for her master's thesis she watched people react to a quadriplegic in a shopping center. When he was alone, only two strangers approached the young man to talk in the course of an hour. When he was accompanied by his capuchin, 71 passersby paused to chat. Says Zazula, "Giving a quadriplegic a monkey makes him an 'expert' on something that fascinates able-bodied people." Sue Strong puts it this way: "When I go outdoors in my wheelchair, all that people see is the wheelchair. But when I go out with my monkey, the only thing they see is the monkey. Nobody notices the chair at all."

Sue Strong is an attractive 35-year-old woman with an engaging grin, swept-back chestnut hair and partial movement in her upper right arm. Fifteen years ago she was on her way West for a summer of fun when the steering wheel of the van in which she was riding separated from the steering column. The vehicle crashed and rolled, and Sue Strong awoke to the world of quadriplegia. She lives in a rent-controlled apartment on Manhattan's East Side. Her quarters are airy and light, eclectically decorated, hung with posters and art. Part-time attendants see to most of Sue's daily needs; her only full-time companion is a female capuchin named Henri, short for Henrietta. "Having her has completely changed my life," Sue says. "Before, I had to depend on people coming in to work, and worry about whether or not they'd show up on time. Now, if I'm up in my chair and feeling OK, Henri and I can get along fine on our own."

When Strong drops her mouthstick, she quietly says "Mouth, Henri. Mouth!" The capuchin searches until she locates the lost tool, then hops deftly up and returns it to Sue's mouth. "We've had to learn how each other thinks," says Sue. "I have to be careful not to expect too much. I forget that she can't read my mind."

Henri is dispatched to the kitchen for a sandwich. She returns with the food and positions it in the holder on the feeding tray so that Sue can eat, but she can't quite resist trying a small bite for herself. Instantly, she realizes she's screwed up, and almost before her owner gives the command she rushes yowling into her cage. "Door, Henri!" Sue intones with mock sternness. Henri yanks the door closed, then peers anxiously out, awaiting a reprieve. It is not long in coming.

"Oh, all right," Sue concedes, laughing as she guides her chair over to liberate the keening capuchin. Freed, Henri directly curls up on her mistress' ankles, craning her neck to gaze up at Sue, the very picture of contrition. Sue laughs out loud. "Look at that, will you!" she says. "A face only a mother could love."

Henri gives her mistress' finger a squeeze. Such touching moments endear monkeys to their owners.

At Einstein training facility, Alison Pascoe teaches future "helping hand" to get objects indicated by laser

Appendix F

Additional Automated Dining Devices

A MOTORIZED SOLID AND LIQUID FOOD FEEDING MECHANISM FOR THE INDEPENDENT FEEDING OF THE HANDICAPPED

Cemil Bagci
Professor of Mechanical Engineering

Tennessee Technological University
Cookeville, Tennessee 38501

ABSTRACT

A motorized mechanism for the independent feeding of the severely handicapped is presented. The mechanism is easily made to operate in two different modes using the same size spoon to feed solids in one mode and liquid food in the other mode. The spoon holds the food at the eating position in dwell for a certain period of time, or as long as the eater requires. In the latter case a signal from a usable limb of the eater starts the cycle. The spoon scoops the solid food at an inclined position as it passes through the food bowl which is automatically indexed, then it holds the food at the horizontal eating position. In case of the feeding of liquids the spoon always remains horizontal. The simple method of synthesis of the mechanism is discussed; and a sample working mechanism, which is very economical for industrial production, is shown.

INTRODUCTION

One of the major goals of rehabilitation of the physically handicapped is to obtain functional independence. Some physical disabilities are often cured through physical and occupational therapy techniques applied in conjunction with other therapeutic measures. Some handicapped have severe physical limitations due to fixed congenitial deformaties which do not respond to physical or occupational therapy. In such instances a therapist looks for solutions through the design of special equipment to attain independent or semi-independent functioning of the handicapped. There are many areas of intervention for the design of special equipment, such as seating, communication, mobility, feeding, hygiene, play, reading, writing, dressing, cooking and homemaking, and recreation [1-4].[1] For the cerebal palsied whose upper limb incoordination may always prevent getting food to the mouth and for other permanently or temporarily handicapped, who cannot use upper limbs, independent or semi-independent feeding becomes a very important activity and its solution is a very worthy goal for the mechanism and machine designers. Although there are some mechanical semi-independent feeders requiring sequence of hand operations for mounting and dismounting, there is no commercially available feeder for independent feeding [3, 4].

The mechanism presented in this article feeds solids as well as liquids such as soup. When feeding solids, the spoon is entered to the food bowl at an inclined position to scoop food, is raised, and brought forward and retained at dwell remaining in horizontal position for eating. The spoon either waits at this dwell position until a signal (from a timer or by a switch actuated by a usable limb of the handicapped) is generated, or it waits at this position through a preset dwell time, then it returns to pick food, feeding continuously. The solid food bowl is indexed during each feeding to maintain a spoon full of food. By disconnecting a pin and inserting it into another bearing joint, the feeding mechanism is altered to feed liquid food. In that case the spoon always remains parallel to the ground. The level of the food bowl is also adjustable.

THE MECHANISM GENERATING THE SPOON MOTION FOR FEEDING SOLID FOOD

The motion of the spoon is of a rigid-body in planar motion. The planar four-bar mechanism can generate the spoon motion in the simplest way. Although a computer-aided optimum synthesis of the four-bar mechanism may be performed to guid the spoon as a rigid body [5], the Hrones-Nelson Four-Bar Linkage Coupler Curve Atlas [6] can be used to determine the four-bar mechanism that generates an acceptable spoon motion. The latter case is used to simplify this design. Mechanical engineers who took undergraduate kinematics courses are familiar with the Hrones-Nelson Coupler Curve Atlas. Each page of it presents a four-bar mechanism and ten coupler curves traced by ten coupler points on a line parallel to the coupler link line AB. See Fig. 1. The mechanisms are shown at the reference positions in which AB is horizontal and AO_2 and O_2O_4 are in line. The position of each coupler point at the reference position of the mechanism is shown on the curve it generates. Each coupler curve is shown in 72 dashes defining the true displacement of the coupler point as the input crank O_2A rotates with 5° increments through the cycle. The four-bar mechanism O_2ABO_4 in Fig. 1 is shown at the reference position. It also shows the connection of the coupler point S that traces the egg-shaped coupler curve used to define a spoon

[1] Numbers in brackets designate References at the end.

path for the feeding mechanism designed.

To synthesize a spoon carrying mechanism one must choose a desirable spoon path first, and find page in [6] where such a coupler curve is generated. Since the Coupler Curve Atlas [6] does not furnish information on the angular positions of the coupler link, the designer must test to see if the angular displacements of the coupler link provides the desired inclination of the spoon as the spoon travels through the food bowl. This is easily performed by moving a transparent coupler link--which has the spoon geometry centered at the coupler point--to follow the chosen coupler point path as the mechanism moves. An egg-shaped curve having wider portion at the top is preferable to displace the spoon forward and pick food during the travel along the lower portion of the curve. Having wider portion of the coupler curve at the top causes the spoon to tilt very little backwards after feeding. Having the narrow portion at the bottom assures that the spoon experiences large angular displacements when scooping food. Also to be observed is that the coupler link must not experience large angular displacements during the return of the spoon so that the food does not scatter when the eater fails to consume the food. Choosing the wider protion of the curve at the top assures small angular displacements of the coupler link during the upper portion of the return cycle. Thus, Fig. 1 shows the mechanism chosen for this design and the spoon positions it generates from the page 265 of [6]. After deciding the feeding position (horizontal level) of the spoon, preferably close to the upper and wider part of the coupler curve, the frame of the mechanism is defined relative to this position of the spoon. In Fig. 1 the mechanism is shown at the feeding position where it will experience dwell.

The spoon motion generating mechanism shown in Fig. 1 is driven to provide continuous rotation of the input crank O_2A with a dwell at the feeding position shown. The dwell is accomplished by driving the crank O_2A by a coupler curve generated by another four-bar mechanism, where the coupler curve must have a cusp and the input shaft at O_2 of the spoon carrying mechanism of Fig. 1 must be inside this driver coupler curve to guarantee complete rotation of the crank O_2A; and the actuated extension of the crank O_2A must lie along the tangent of the cusp to assure spoon dwell [7]. The two four-bar mechanisms are positioned relative to each other and are connected such that the dwell is generated at the feeding position of the spoon, and that it is the position corresponding to the middle of the spoon dwell motion. The Coupler Curve Atlas [6] also presents many mechanisms generating coupler curves with cusps. The driving coupler curve should be chosen such that the coupler point travels along the cusp to provide dwell of sufficient duration when feeding is done continuously providing independent functioning of the eater. This dwell is also used to activate a control circuit to cause dwell indefinitely until the cycle is restarted by a signal. Figure 2 shows the spoon carrier four-bar mechanism of Fig. 1 connected to a four-bar mechanism generating the driver coupler-curve with a cusp, where their positions correspond to the middle of the spoon

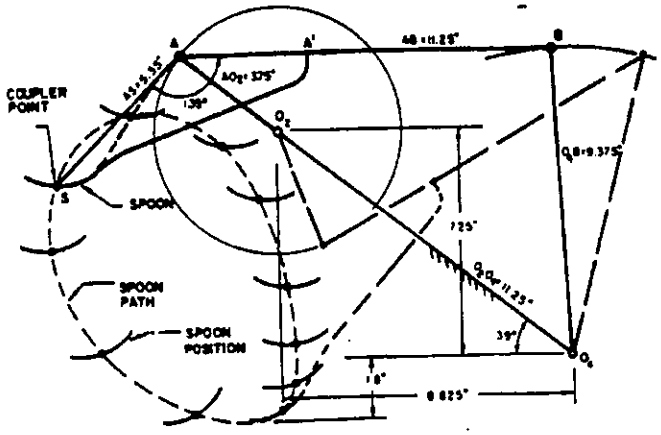


Figure 1 Spoon Carrier Mechanism for Feeding Solid Food, the Spoon Path, and Its Orientation

dwell motion at the feeding position. This driver mechanism is chosen from page 15 of [6]. The cusp provides dwell during 1/8 of the feeding cycle. The crank O_5C of the driving loop is driven at the speed desired. In the working model of the mechanism designed and shown in the photographs, and will be demonstrated during the presentation of the article, a 3.6 rpm electric motor drives the input crank O_5C through a gear reduction unit generating a speed ratio of 1/3.6, providing one continuous feeding (with a dwell at the feeding position) per minute. At E in Fig. 2 is a revolute-prism pair that permits E to slide along O_2F meanwhile rotate relative to O_2F.

The spoon can be connected to the coupler link AB in any convenient manner using an extension normal to AB to provide space between the spoon and the mechanism. It could be connected to some point A' on the coupler link as shown in Fig. 1. In this design as seen in the photographs of the mechanism, the spoon is connected to an extension connected to the coupler link at A. The spoon connection can slide on the spoon support in this design so that one mechanism and one spoon can be used for feeding both solids and liquid by the demonstration model designed as shown in the photographs in Figs. 4 and 7. The food bowl is positioned under the coupler path traced by the spoon on a wooden bowl support. The bowl support is supported by a threaded shaft which passes through a slotted nut that can be loosened or tightened, so that the level of the bowl support can be adjusted as desired according to the bowl used and food being fed. The slotted nut is connected to the indexing disk. See Fig. 3. Indexing is accomplished by means of a slider-crank mechanism displacing a rachet pawl activated by its own weight. The slider crank mechanism is driven by the output crank O_4B of the spoon motion generating four-bar mechanism. The slider-crank mechanism has 1 in. output stroke to displace the indexing pawl performing 20 indexings to cause one rotation of the bowl in the sample design. The stroke of the rachet pawl may be increased to increase the

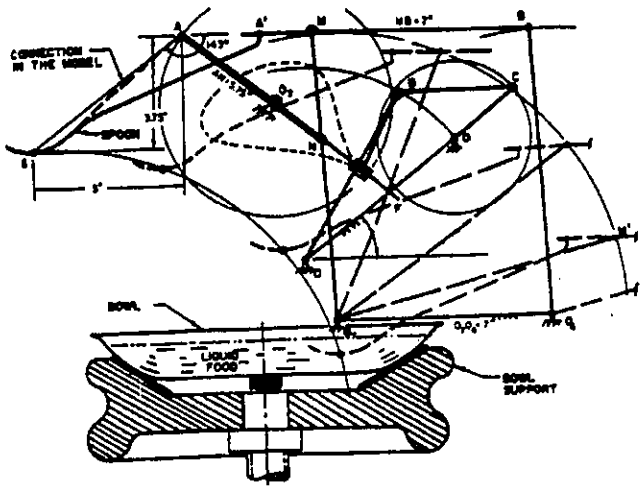


Figure 5 The Liquid Food Feeding Parallelogram Mechanism (O_7MBO_4), its Driving Loop (O_2ANO_7), and the Positions of the Spoon as it Feeds Liquid Food

shaft exists at O_7 then. When feeding liquid, the threaded pin shaft at A is removed and used as the shaft at O_7. This makes the revolute pairs at M and N active, forming the O_7MBO_4 parallelogram loop driven by the same input crank O_2A through the coupler link AN. Hence, the O_2ANO_7 is the driving loop of the parallelogram loop O_7MBO_4. The spoon path in this case becomes a circle of radius O_7M and any point on the coupler link AB can be used to center the spoon. In this design the spoon for liquid feeding is also connected to the spoon carrying extension at A as in the case of feeding solid food, except that a longer soup spoon is needed as shown in Fig. 5. Shown in Fig. 5 is also the path of the spoon when feeding liquid. The mechanism is shown at the dwell position of the spoon, which is the same dwell position used for feeding solid food. When feeding solids, the rigidified link $AMNO_7$ floats as a rigid body uselessly as seen in Fig. 4.

Figure 6 shows the mechanism when feeding liquid food. The control of the spoon motion follows the same circuit sequences as in the case of feeding solids. When feeding liquid, however, there is no need for indexing the bowl. So, the rachet pawl may be lifted to stop indexing. For a long-term liquid feeding, the crank of the indexing slider-crank mechanism may be disconnected at J (see Fig. 3). O_7 may be positioned closer to O_4 to increase the transmissivity of the driving loop O_2ANO_7.

The spoons in this mechanism for both cases of feeding are rigidly attached to the coupler link extension. However, an additional cam-follower mechanism may be used to rotate the spoon slightly when it is picking liquid food. After the spoon is lifted from the bowl, it is rotated to assume its horizontal position. This may be desirable to maintain partially full spoon when it is transferring liquid food. This spoon rotation can

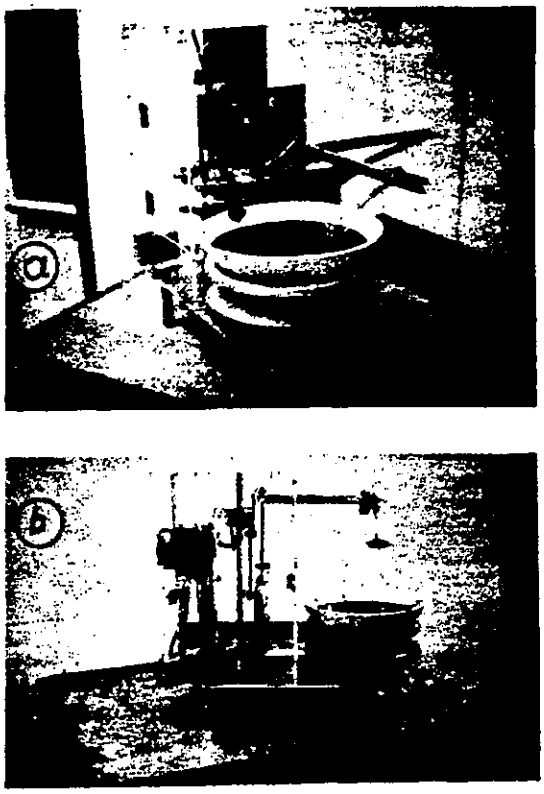


Figure 6 Sample Mechanism in the Liquid Food Feeding Mode; (a) When the Spoon is in the Food, (b) When the Spoon is in the Feeding Position

easily be achieved by connecting the spoon on a rotating head which is connected to a small four-bar mechanism. The coupler link of this four-bar mechanism functions as the follower to rotate the spoon holder 3° to 5° as the spoon travels through the end of the bowl during which the input crank O_2A rotates through 45°. See Fig. 7. The follower coupler link is acted upon by a compression spring to retain the spoon at its unrotated position. The cam that may provide 1/8 in. stroke for the follower coupler link can be mounted on the link AN within 2 in. from N. This addition may be costly but it provides cleaner liquid food feeding.

CONCLUSIONS

Illustrated in the foregoing is a simple design of an automatic feeding machine in demand for the physically handicapped to attain his complete functional independence or semi-functional independence when feeding himself. Simplified design approach using the available Four-Bar Linkage Coupler Curve Atlas leads to a low-cost system for marketing. The full size working sample model designed and shown in Figs. 4 and 6 is not optimized for industrial mass production. Even then, including covers, it weighs 20 lbs., where all the links, floor, and the frame are made of aluminum. It is portable and can be placed on

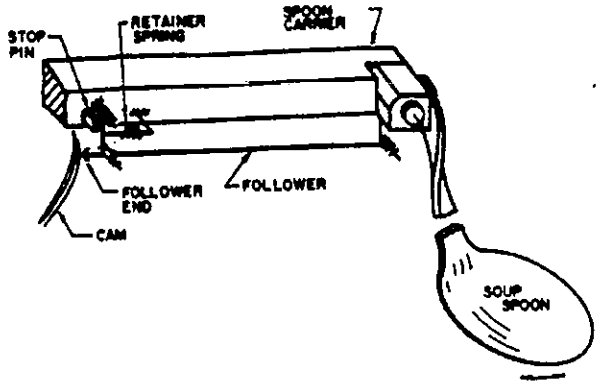


Figure 7 Spoon Rotating Attachment Mechanism to Maintain Partially Full Spoon When Transferring Liquid Food

any feeding table. Its manufacturing cost as a single unit stands about $400 which certainly can become much lower in mass production.[2]

This design example is an illustration of how industrial mechanism and machine designers can solve the problems of the physically handicapped providing them functional independence and fun. As stated in the introduction, there are many problem areas of the physically handicapped where the industrial machine designer can put his talent and creativity to use.

ACKNOWLEDGMENT

The author acknowledges the assistance of Mr. Walter S. Maxwell for the synthesis of the sample feeding mechanism as his senior level special problems project. The skillful work of the departmental shop technicians, Mr. L. K. Garrett and Mr. D. A. Walker, in manufacturing the feeding mechanism is acknowledged with many thanks.

REFERENCES

1. Culler, M. A., Brooks, P., and Roemer, R. B. "Systems and Devices for the Disabled's Occupational Therapist," Proceedings of the Fourth Annual Conference on Systems and Devices for the Disabled, Seattle, Washington, June 1-3, 1977, pp. 58-63.
2. Evachewski, P. O. T. and et. al. "Review of Technical Aids for Handicapped Children Provided by Shriners Hospital, Winnipeg Unit," Proceedings of the Fourth Annual Conference on Systems and Devices for the Disabled, 1977, pp. 31-36.
3. Levy, R. and Waksvik, K. "Simple Equipment for the Handicapped," Proceedings of the Fourth Annual Conference on Systems and Devices for the Disabled, 1977, pp. 14-18.
4. Be OK Self Help Aids, Fred Sammons, Inc., 1977 Catalog, 73 pages.
5. Bagci, C. and Lee, I. P. J. "Optimum Synthesis of Plane Mechanisms for the Generation of Paths and Rigid-Body Positions via the Linear Superposition Technique," Trans. ASME, Journal of Engineering for Industry, Vol. 97B, February 1975, pp. 342-346.
6. Hrones, J. A., and Nelson, G. L. Analysis of the Four-Bar Linkage and Its Application to the Synthesis of Mechanisms, The Technology Press of MIT and Wiley, New York, (1951).
7. Bagci, C. "Synthesis of Double-Crank (Drag-Link) Driven Mechanisms with Adjustable Motion and Dwell Time Ratios," Journal of Mechanism and Machine Theory, Vol. 12, No. 6, 1977, pp. 619-638.

[2]Patent for this feeding mechanism is pending.

The Spoon Plate: A Self-Feeding Device

Elizabeth Wyckoff Margaret Mitani

Self-feeding is the first self-care activity mastered by most people. When severe disabilities render the extremities nonfunctional, the individual is usually restricted to a lifestyle of physical dependence upon someone else for all personal care, including feeding. These individuals often have no cognitive deficits and may be acutely aware of their environment. However, all too often mealtime becomes a survival experience at best with little decision making or control given to the person being fed.

History of Spoon Plate Development. A 16-year-old girl with severe dyskinesia involving her total body requested an occupational therapy evaluation to meet her paramount goal of self-feeding. Her inability to control even gross arm movements had prevented success with other adaptive feeders that were either activated by the upper extremities or designed to dampen dyskinetic motion (1, 4, 6).

A device developed in Denmark (5) combined the features of a spoon and a plate and enabled individuals to select the desired food and take it directly off the specially designed rotating plate. The stainless steel plate was mounted on a gooseneck stand. From that idea a prototype was formed, using a low temperature thermoplastic material and placed on a can to rest at about the level of the patient's mouth. The patient rapidly demonstrated success with the prototype, and the orthotics department was contacted to make a more permanent device (Figure 1).

Description. The "spoon plate" is a portable device that can be adjusted to the level of the patient's mouth when set up on table surfaces of varied heights (Figure 2).

The plate described here is 25.4 cm (10 inches) in diameter and is made of Kydex.® This material has the advantage of being able to withstand the intense heat of institutional dishwashers, a requirement for use by patients in residential care settings. The Kydex is formed on a mold that has a rim bowled to the approximate depth and length of a spoon. Small ridges divide the plate into four sections to separate different types of food (Figure 3).

The plate is set on a telescoping rod. By using a collar with a set screw to prevent slipping, the height of the rod can be adjusted 8.8 cm (3½ inches) to rest at the level of the patient's mouth when the height of the table varies. Three types of bases are available. The free-standing base is simply set on the table. Another base with suction cup feet provides more stability. A base with a C-clamp that attaches to the table or lapboard edge is recommended for patients with severe motion disorder.

For long-term use, purchase of these devices is recommended because the time required to construct a definitive mold and fabricate the device may not be practical in most occupational therapy settings. However, temporary devices for trial use can be readily constructed by clinicians. Our prototype plate was formed by draping a round piece of Orthoplast® (or other thermoplastic material) over an inverted dinner plate of the same diameter. The rim was then shaped by hand into a "bowl." Ridges to serve as dividers may be added by using strips of the same material if self-bonding thermoplastic is used. A simpler and quicker method of simulation is to invert an aluminum pie plate and bend the edge upward to form the "spoon." Either plate can then be placed on a "lazy susan" base and set on an object of the appropriate height such as a coffee can.

Criteria For Use. There are three parameters to consider when de-

Elizabeth Wyckoff, *OTR, is Occupational Therapy Supervisor I, and*

Margaret Mitani, *OTR, is Occupational Therapy Supervisor II, Occupational Therapy Department, Rancho Los Amigos Hospital, Downey, California.*

Figure 1
"Spoon plate" adjusted to mouth level

Figure 2
Bowled rim serves as a spoon, while ridges divide plate into separate sections

Figure 3
"Spoon plate" being
under the toy rabbit

termining whether a patient is a candidate for use of a "spoon plate."

1. *Oral control:* There must be some degree of jaw, lip, and tongue control in order to take food from the rim of the plate. A trial using the patient's typical diet (pureed, mechanical soft, or regular) is indicated since patients with seemingly significant problems have been surprisingly successful in using the "spoon plate." Among the problems that may interfere with the use the device are a severe tongue thrust that can prevent intake of food into the mouth; inadequate lip closure that may permit the majority of food to escape down the chin; or a severely retracted jaw that may cause the food to be scraped off the upper teeth and dropped into the lap.

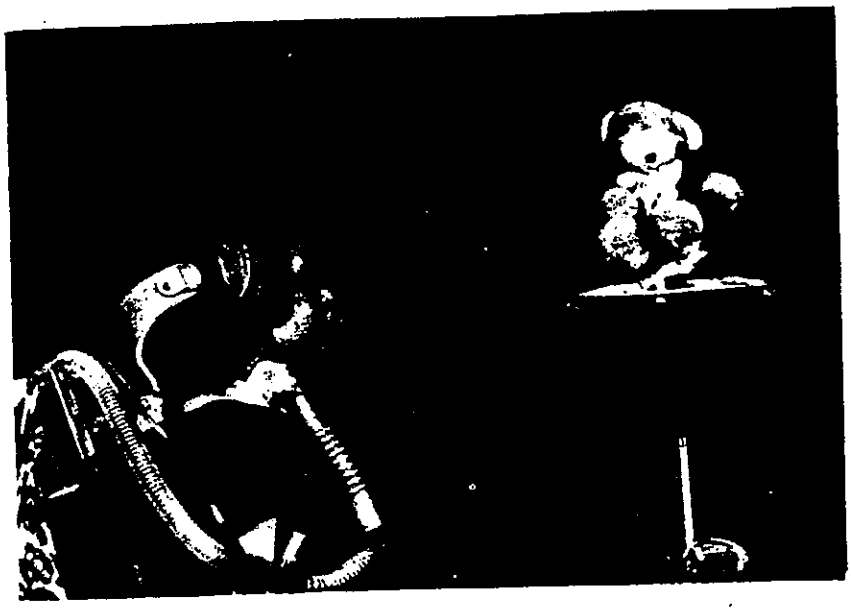
2. *Head and trunk control:* The patient must have sufficient motion and control to reach the plate and then to withdraw from it in order to chew. Minimal lateral movements are also needed to rotate the plate.

3. *Patient motivation, social, and environmental factors:* Since this method of self-feeding is novel and the appearance of the device is unusual, a desire to achieve some measure of independence in self-feeding is a prerequisite. Self-motivation will enable persistence during practice and advocacy when instructing others who will set up the device at mealtime.

Application. Individuals with cerebral palsy, high spinal cord injury, and arthrogryposis now use this device. Bilateral upper extremity amputees and possibly others may be candidates to consider. A sandwich holder, or a long straw in a holder, or both, have been included to complete the set-up. Some individuals and their families prefer to reserve the device for use at home or school while continuing with former feeding methods when out in public. Institutional personnel must be edu
up and cleanin
tance is usuall
staff aware of
reducing the
who must be
adaptive equip
to have patient
pational thera
family until
enough to neec
up only befor
personnel or i
use it on a regu

In addition
feeding, the "s
other purposes
been used with
spinal cord in
alternative su
play activities
been adapted
crease the stre
of neck muscu

Figure 3
"Spoon plate" being used for mouth stick play and neck strengthening (note weights under the toy rabbit)



nel must be educated about setting up and cleaning the device. Acceptance is usually gained by making staff aware of the time saved by reducing the number of patients who must be fed. As with most adaptive equipment, it is advisable to have patients practice with occupational therapists and with the family until they are proficient enough to need assistance with setup only before requesting school personnel or institutional staff to use it on a regular basis.

In addition to its use in self-feeding, the "spoon plate" can serve other purposes. For example, it has been used with children with high spinal cord injuries to provide an alternative surface for mouthstick play activities (Figure 4). It has also been adapted with weights to increase the strength and endurance of neck musculature.

Summary

The "spoon plate" has proved an effective device that offers a measure of independence to people who have been unable to feed themselves with their upper extremities or with other available feeding equipment. It provides users with an opportunity to make decisions and to have some control over their environment by being able to select the food they desire and to eat at their own pace. It frees caregivers either to attend to the needs of others or, in the case of a family, to enjoy their own meal and thus allow more typical socialization at mealtime. With this newly found independence, patients may now choose to be in the company of others at meals because they want to be, whereas before they had no choice in the matter.

To obtain information for fabricating the "spoon plate," write Tom Lundsford, C.O., Orthotics Department, 7450 Leeds St., Downey, California 90242.

The "spoon plate" or similar devices are available from: 1. "Easy-Feed," Newton Aids, Ltd., 2A Conway Street, London W1P 58E, England; 2. "Special Plate," Folkeskolens Materialelaboratorium, Bethaniagade 2B, DK 7400 Herning, Denmark; 3. "Spoon Plate," Orthotics Department, Rancho Los Amigos Hospital, 7450 Leeds Street, Downey, California 90242.

Acknowledgment

We thank Karen Rygaard, Occupational Therapist, Bakkeledet, Denmark, for first introducing the idea of a spoon plate to us; and Darrell Clark, C.O., and Robert Duer, Orthotics Department, Rancho Los Amigos Hospital, for designing and fabricating the permanent device from a prototype made in occupational therapy.

REFERENCES

1. Holser P, Jones M, Ilanit T: A study of the upper extremity control brace: Self-feeding with cerebral palsied athetoid adults. *Am J Occup Ther* 16:170-175, 1962
2. International Commission on Technical Aids: *Aids for Children: Technical Aids for Physically Handicapped Children*, ICTA Information Center, FACK S-161 03, Bromma 3, Sweden, April 1972
3. International Commission on Technical Aids: *Bulletin No. A2.32-2*, ICTA Information Center, FACK, S-161 25, Bromma 1, Sweden, 1978
4. Rife S, Kennedy E: A feeding device for cerebral palsy victims. Ontario Crippled Children's Centre, Prosthetic Services, Dept. of National Health & Welfare, Sunnybrook Hospital, Ontario, Canada (date not given)
5. Rygaard K, Sogaard O, Rygaard J: Aids for people without hand function. *Saertryk af Ergoterapeuten* 9: September 1973
6. Waylett J, Barber L: Upper extremity bracing of the severely athetoid mental retardate. *Am J Occup Ther* 25:402-407, 1971

A MICROPROCESSOR-CONTROLLED ROBOTIC ARM ALLOWS SELF-FEEDING FOR A QUADRIPLEGIC

Wolfger Schneider and Woodrow Seamone
The Johns Hopkins University Applied Physics Laboratory, Laurel, Maryland 20810
Gerhard Schmeisser, M.D.
The Johns Hopkins University School of Medicine, Baltimore, Maryland 21205

Abstract

It is possible to provide some degree of manipulative ability to the high-spinal-cord-injured person by using today's LSI technology. A programmable robotic arm based on only one second-generation microcomputer is described. A self-feeding program for quadriplegics is given as an example.

Introduction

Damage to the spinal cord is one of the most devastating forms of traumatic injuries to man. Depending upon where the injury has occurred in the spinal column, the resulting loss of motor and sensory function can lead to a life of total dependence on other persons. The annual incidence rate of traumatic spinal cord injury is estimated to be about 3 per 100,000 population (Ref. 1). Medical care following a spinal cord injury has now been improved to the point where the median life expectancy is at least 18 years. Improving the quality of the life of a quadriplegic is one of the goals of our project.

This medical research program is one of many joint projects being carried out by the Applied Physics Laboratory and The Johns Hopkins Medical Institutions. Sponsored by the Veterans Administration, this project is aimed at providing assistive devices for the high-spinal-cord-injured person that will increase his degree of self-sufficiency. Some of the devices developed in this program and now undergoing clinical tests and evaluation include a new low-profile chin controller for electrically powered wheelchairs for the quadriplegic with no hand function, a motorized pop-up mouthstick holder to provide this individual his mouthstick when needed and to keep it out of the way when not in use, and, finally, the robotic arm/worktable concept that is the subject of this paper.

The Problem Statement

In the past few years, several research groups in the United States and other parts of the world have been investigating the use of telemanipulators and robotic arms to provide a functional substitute for the paralyzed upper limbs of the quadriplegic (Refs. 2 to 5). The actuation portion of such systems can employ well-proven and available products of modern technology. On the other hand, the control problem, consisting of a command and feedback communication, presents a serious interface problem.

Duplication of the lost limb capabilities requires a multiaxis controller that communicates with multiple actuators multichannel, control-bandwidth quality command and feedback information. Exchanging this type of information with an external manipulative device in an unobtrusive manner is presently not feasible.

A simple means of controlling a manipulator uses visual capabilities for position and velocity feedback and sensed head motion for velocity commands. Single-axis commanding, proportional to chin motion, for example, is the easiest to learn and to sense in a relatively unobtrusive way.

However, commanding a manipulator one axis at a time is tiring and slow, especially for repetitive tasks such as eating. For this situation, it is best to have the manipulator act as a robotic arm, one that executes preprogrammed motion sequences when asked to do so. No multichannel command and control information needs to be exchanged between the user and the manipulator; this information is now received and processed internal to the robotic arm. The robotic arm is now commanded with single-channel, language-coded commands that are selected manually from a limited vocabulary list.

Technical Approach

There are several possible approaches one can take in the design and utilization of a robotic device to provide substitute manipulative functions for the high-spinal-cord-injured person. One choice is to mount the robotic arm on the wheelchair, thus having it available when needed. This may sound ideal until factors such as size and shape and the ability of the quadriplegic to reasonably position the wheelchair relative to objects to be manipulated are considered. The size and location of the robotic arm mounted on the wheelchair will make it more difficult to maneuver in tight quarters or closely approach a normal desk or table.

CH1596-6/80/0000-0031$00.75 © 19

sequencing pages and/or selecting the desired program.

An interpreter program will interpret the "pseudo-code" command sequence and sequence the manipulator appropriately. This sequencing will consist generally of initializing, executing, and terminating a digital position servo to achieve the desired motion sequences. Termination of motion can be achieved at any time by issuing a discrete command that will return the controller to the program selection phase.

Programs can reside in read-only nonvolatile memory or in battery-back-up volatile read-write memory. Programs in read-write memory can be changed by the user with a programming keyboard. If plugged into the manipulator at power up, control will be given to the programming keyboard. Programming is interactive using the alphanumeric portion of the display as feedback for queries and entries. Memory management during file creation, deletion, and editing is transparent to the user.

Program entry consists of specifying a page number (1-5) and a program number (1-5) on that page when requested. A 12-character name for that program must be given when requested. Then line-number prompting of commands continues until all commands are entered. All commands are translated into pseudo-code upon entry and stored in sequential locations.

Motion, program control, and input/output commands are entered via functional keys from three fields: action, object, and modifier (Fig. 3). Some of the programming capabilities available are:

- Easy exit from and re-entrance to programs requiring a manual phase,
- Program selection by external stimulus,
- Command of external devices by program, and
- Jumps to other programs.

The Self-Feeding Task

For the feeding task, the attendant must first cut the food into bite-size portions and place it into the three bowls appropriately located on the worktable (Fig. 4). The stored programs for the first two bowls are identical, whereas the program for the third bowl includes extra spoon motions to minimize dripping of foods such as soup. The spoon assembly is placed into the grippers of the robotic arm, and food is placed into the bowls. The quadriplegic must first drive up to the table until he is positioned appropriately. Self-alignment is provided by the lap board and the infrared receiver module. Chin-control functions are used to turn off control to the wheelchair motors and turn on control to the robotic arm. Manual or nonprogram control of the robotic arm is possible at all times, but the self-feeding task is done primarily in the programmed mode. The user may select food from an appropriate bowl by manually selecting one of three programs. The selected program then executes step-by-step motions, bringing the food to his mouth. A pause is provided when the food is near the mouth to allow the individual to take the bite when ready. Only a single-pulse (breath pulse or chin nudge) command is needed to send the spoon back for another bite of food.

The system has been evaluated in the laboratory with foods such as chopped hamburger, peas, green beans, beef stroganoff, soup, gelatin, and cookies; it has performed reasonably well. A typical meal requires approximately 20 minutes and does not require attendant help during that period. If the food bunches to one side of the plate and is out of reach of the preprogrammed spoon motion, a "rotate bowl" program may be called up that will automatically rotate the bowls into a more favorable position for food pickup. Only limited testing of this new self-feeding mode has been clinically evaluated.

One of the planned new features for the APL robotic arm that has not been incorporated in this model is simultaneous multiaxis capability. This will speed up the eating mode and allow food to be eaten as fast as the appetite, and not the arm, dictates.

Summary

The APL robotic arm illustrates that today's technology allows for a simple robotic arm implementation using only one second-generation microprocessor. The use of third- and fourth-generation microprocessors, possibly operating in a multiprocessor configuration, and the soon-to-be developed voice-generation and voice-recognition large-scale integration processors (Refs. 8 and 9) will allow for more sophisticated implementations of robotic arms that may consist of:

- Voice-selection programming and modification of preprogrammed motion sequences,
- Voice response of status and alarms, and
- Automatic terminal homing for grasping with more sophisticated "hands."

Acknowledgments

Much credit must be given to J. H. Loveless of the Applied Physics Laboratory for his contributions to the design and implementation of the electromechanical arm and the chin-controlled wheelchair.

References

1. Kurtze, J. F., "The Epidemiology of Spinal Cord Injjry," Exp. Neurol. 48 (No. 3 Pt. 2) 163-236, 1975.
2. Guittet, J. et al., "The Spartacus Telethesis: Manipulator Control and Experimentation," Proceedings of International Conference on Telemanipulators for the Physically Handicapped, IRIA, September 4-6, 1978.

Where is page 32?

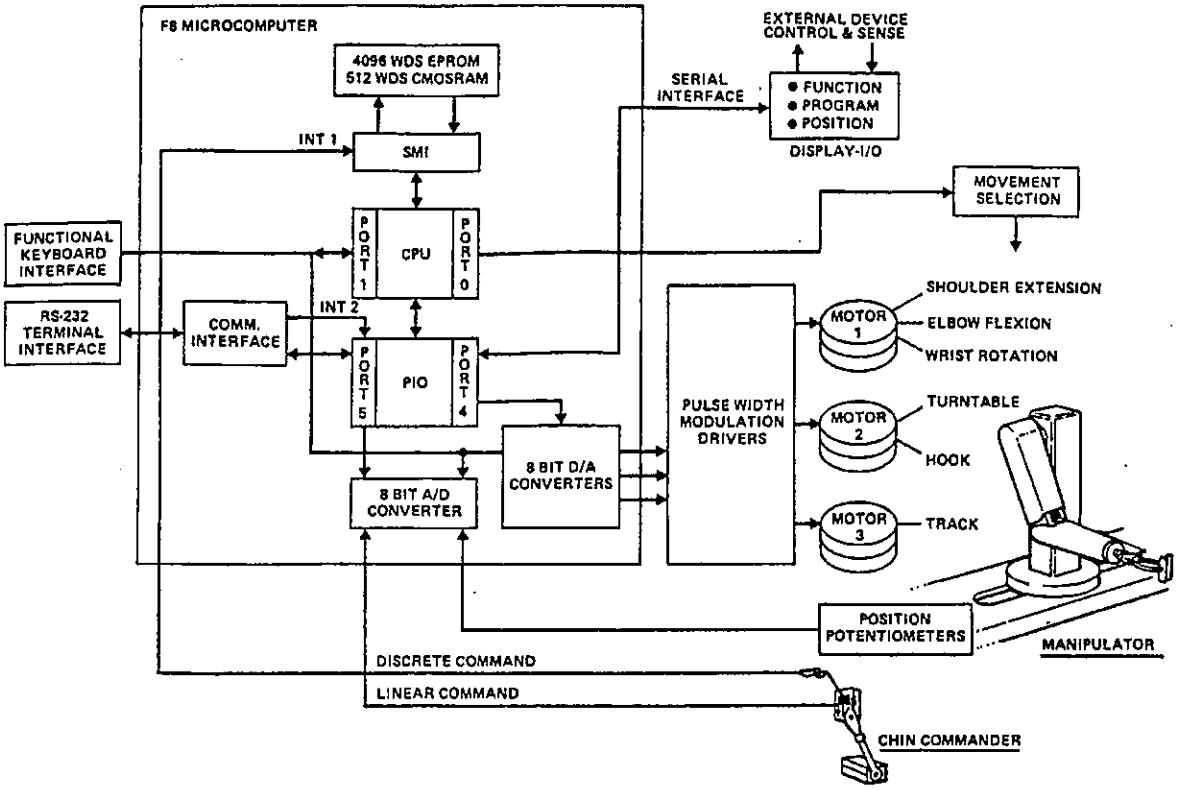


FIGURE 1

MICRO COMPUTER CONTROLLED MANIPULATOR

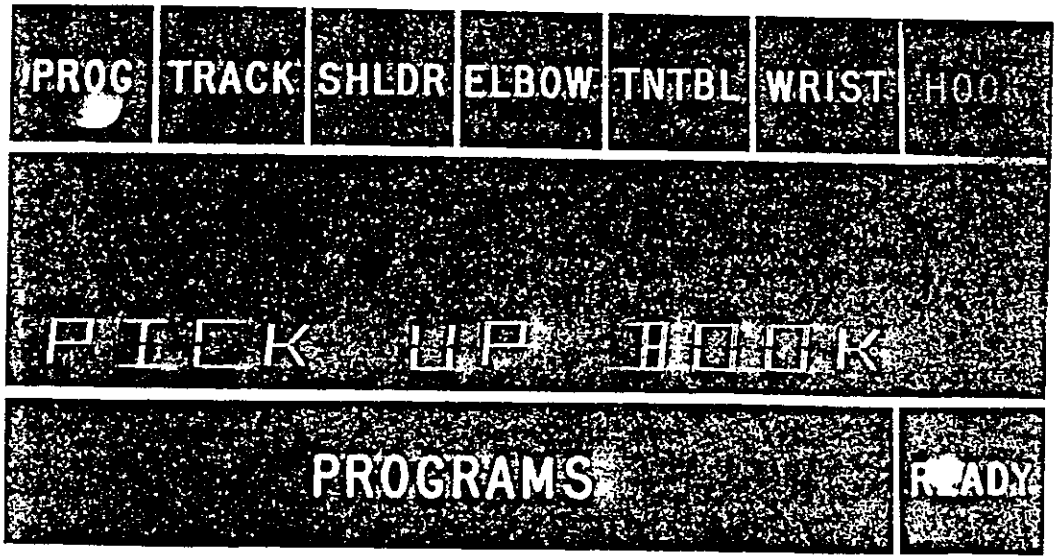
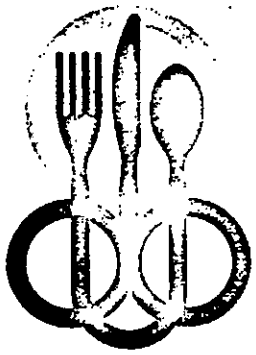


Figure 2: Light Emitting Diode Display

A prototype system shows how small, intelligent devices may offer the handicapped a new degree of independence.



Microcomputer-Aided Eating for the Severely Handicapped

R.L. Ramey, J.H. Aylor, R.D. Williams
University of Virginia

Computer control of manipulators and machine tools is a highly developed technology; however, where space, cost, and power are limited, there is a continuing demand for simple but effective digital control systems capable of modest accuracy. We have developed a versatile system which permits severely handicapped individuals to eat independently, using a microcomputer-controlled manipulator. We did not select the method of trajectory computing using coordinate transformations because of the computational load, and resulting reduced sampling rate, imposed on the computer. We instead used a "learning phase" to establish the point-to-point coordinates of the motion, regardless of the coordinate system in which the manipulator resides.

The system described here permits quadriplegics to direct the movements of a four-degree-of-freedom manipulator. A compact microcomputer, designed around the Intel 8080, controls the system.

System design philosophy

The term "high quadriplegic" refers to an individual with no upper limb response but who is capable of limited shoulder movement. Neck and head movement is usually present, but the response rate may be relatively slow. Thus, for a high quadriplegic, point-to-point control of a powered manipulator can be very difficult and frustrating. Also consider that when one eats one pays attention to the fork or spoon only when selecting a morsel at the plate—the movement from plate to mouth is under subconscious control. Thus eating is not a task which requires concentration by a non-handicapped person. If the handicapped person is to have similar facility in eating, the movement of the utensil from rest position to plate, from plate to mouth, and from mouth back to rest position, must be executed "subconsciously" by computer.

Extensive work has been done in industrial manipulator control, and some work has been done in manipulator control for quadriplegics. Most digital systems developed for the control of industrial manipulators have required minicomputers. Systems using microcomputers have often required multiple processor arrangements. General-purpose microcomputer controllers have been developed, but these are not intended to be multiplexed while maintaining a rapid sampling rate.[1] Some manipulators for quadriplegics have been developed to provide general motions under the operator's control. The one developed by Johns Hopkins University for the Veterans Administration[2] is an example of a widely used strategy. Their approach allows the operator to move the terminal device to any position in its range by operating one joint at a time. With practice, the operator can accomplish many different tasks independently, but the process is tedious. A similar device utilizing voice command control has been developed by the Jet Propulsion Laboratory, under the joint sponsorship of the National Aeronautics and Space Administration and the Veterans Administration.[3] This system requires a minicomputer. Another strategy for a general manipulator involves a computer as a coordinate transforming device. The operator moves a joystick in Cartesian coordinates, and the computer develops signals to move the manipulator in the indicated direction in its general coordinate system. This is the approach used by the Spartacus Project.[4] Preliminary project information indicates plans for use of a microcomputer, but all of their work has thus far required a minicomputer.

0018-9162/79/0100-0054$00.75 © 1979 IEEE

By using a method of motion storage and reproduction, however, the limited capabilities inherent in the typical microprocessor are sufficient to control a simple feeding device. The motion of any feeding manipulator which may be used in a public restaurant must be unobtrusive: the manipulator must move in smooth arcs, without jerking, in a way similar to the human arm. Further, anyone sitting near the person using the manipulator should be able to help him instruct the computer in "learning" a new motion, should the user wish to vary his eating pattern, such as eating from the table instead of from a wheelchair-mounted tray. We can easily meet all these requirements by programming the microcomputer so it can be placed in a "learning" mode. Then it can memorize the desired manipulator movement as some friend or attendant moves the manipulator-held utensil through the desired pattern. In this manner a smooth movement is obtained under computer control. Basic feeding movements will be stored in PROM so that the manipulator is always ready for use, while special movements for unique situations will be learned and temporarily stored in RAM, until no longer needed.

A typical feeding cycle is shown in Figure 1. The powered manipulator holds the feeding utensil in the rest position (P1) until the control computer receives a signal from a switch tripped by a shoulder, neck, or head movement. The manipulator then executes a preprogrammed path from the rest position to the plate (P2), at which point the utensil is moved in a "search" pattern. The user interrupts the search when the position of the utensil coincides with the morsel selected. The manipulator then executes a preprogrammed scooping motion to pick up the food. Next, another preprogrammed path is followed from the plate up to the mouth (P3), where the utensil is halted. Once the user has removed the food from the utensil, he signals the computer and the manipulator moves the utensil back to the rest position.

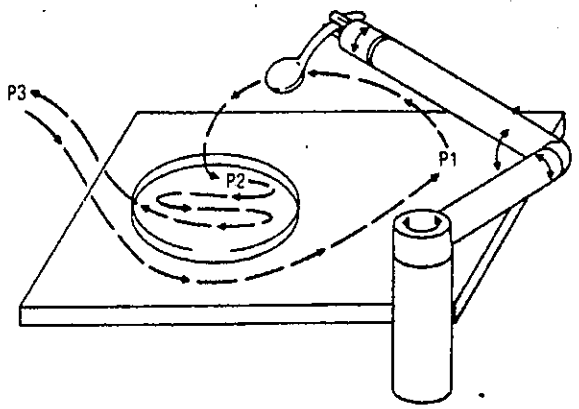


Figure 1. Feeding by microcomputer-controlled manipulator.

Specifications and initial design

Based upon the preceding discussion of the problem and our approach to its resolution, let us identify the following system specifications:

(1) The control computer must be portable and able to fit on a wheelchair, using the wheelchair battery as a power supply. Care must be taken to ensure that static electric discharges, generated by wheelchair operation on synthetic fiber rugs, will not affect the computer.
(2) The microcomputer and supporting hardware must operate from single power sources and be simple to install, such as the Intel MCS-48 Series.
(3) The software must enable the computer to operate in a "learning" mode, memorizing any new movement pattern. The pattern need not be a feeding cycle; it could be some task such as turning a door knob. Each pattern learned should include as much user interaction as possible, so that the pattern might be adapted to other tasks.
(4) The computer system must be expandable.

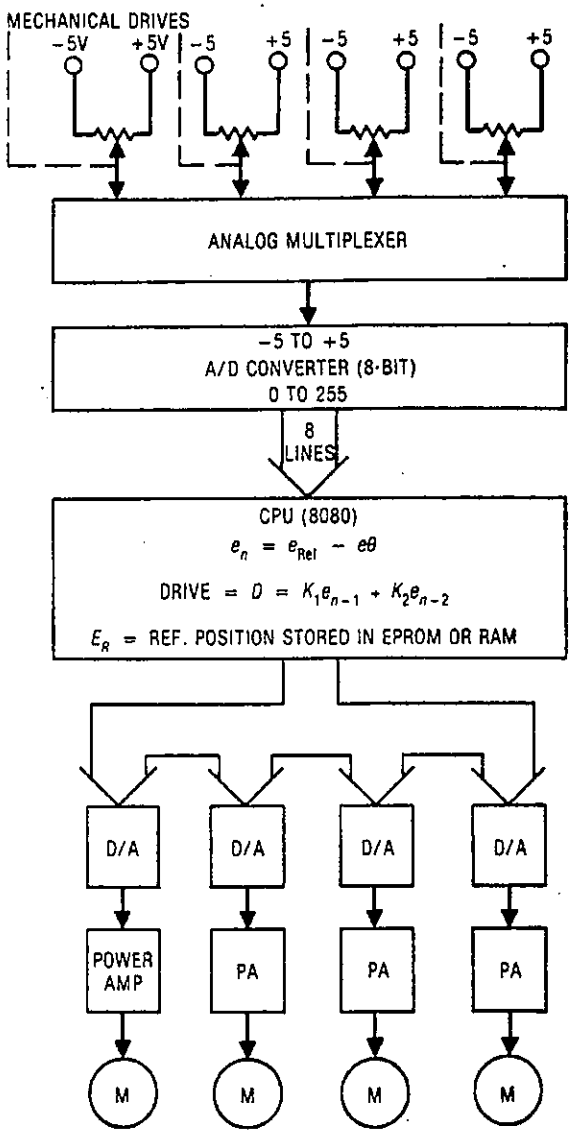


Figure 2. Block diagram of the feeder system.

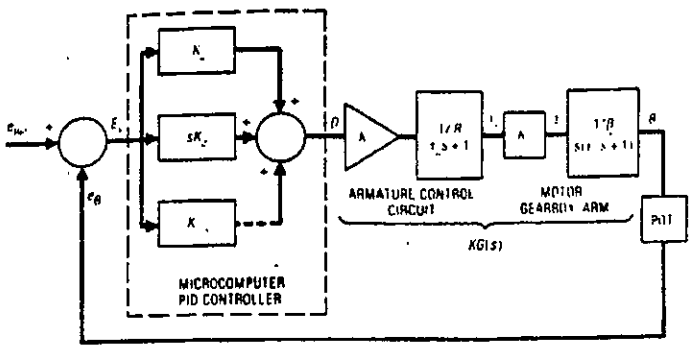


Figure 3. The PID control system. The armature control circuit time constant $\tau_a = L_a/R$ (ratio of the armature inductance to total control circuit resistance); the motor time constant $\tau_m = J/\beta$ (ratio of the armature plus arm inertia to the bearing and gearbox damping); the ratio of armature current to motor torque (measured out of gearbox) = K_T.

In order to obtain the desired response rates, and still use a microcomputer with limited supporting hardware, we had to devise a very simple software system. Most microcomputers are 8-bit systems, so the motion resolvers for each degree of freedom of the manipulator should be quantized into no more than 256 increments. Many of the rotary joints must be limited to a maximum movement of 120 degrees, or 0.47 degrees per increment if a linear scale is used. For feeding and simple household tasks, this is ample resolution.

The conversion of rotary or linear motion to an 8-bit word is more of a problem in production economics than it is a technical one. Ideally, 8-bit coded disk resolvers should be used for simple and direct conversion of rotary motion into an 8-bit word; but the small lot cost of these devices is high for the application at hand. Although with production quantities the use of digital resolvers may become economical, it is now far cheaper to use wirewound potentiometers, an analog multiplexer, and an 8-bit A/D converter.

One A/D conversion scheme transforms the analog voltage range of −5 to 0 to +5 volts to the decimal count of 0, 128, and 255, respectively. Each motion transducer potentiometer is excited with −5 / 0 / +5 volts unless only a fraction of the potentiometer movement is to be used (Figure 2). If only a fraction is used, the excitation voltages are increased so that −5 / 0 / +5 volts appear across the portion of the potentiometer in use. The 8-bit output of the A/D converter is connected to the microprocessor through an I/O port.

When another person moves the manipulator through a desired pattern during a learning cycle, the computer stores the pattern in memory. During subsequent executions of the pattern the incoming information from the four motion resolvers must be sequentially compared to the stored pattern data and the appropriate error signals developed. After signal processing, the output of the CPU sequentially strobes the four D/A converters. Each D/A converter controls one of the four drive motors through a simple operational power amplifier.

Control system

Each of the four components of the manipulator's motion has its own control system residing in the microcomputer software. By multiplexing at 400 Hz, each control system checks its error status every 0.01 seconds—a small amount compared to the time constants of the drive systems. Each control system is of the proportional-integral-derivative type (Figure 3), operating on the error signal

$$e_n = e_{\text{Ref}} - e_\theta \tag{1}$$

where e_{Ref} is the stored position information and e_θ is the actual position fed back through the potentiometer. The reference position information is stored every 0.1 seconds. Thus, a 4K x 8-bit RAM or ROM could store up to 100 seconds of instructions for each of the four motors.

The motor armature control circuit time constant is $\tau_a = L_a/R$ and the motor/gearbox/arm mechanical time constant is $\tau_m = J/\beta$ (Figure 3). Because of the natural integration provided in the drive system, we did not have to use the controller's integral control feature. Integral control would have required extended precision arithmetic. (Should this ever prove desirable, we would need to change the system software.)

At any instant the manipulator coordinate θ would be predicted to be

$$\begin{aligned}\theta &= DKG(s) \\ &= [K_p e_n + K_d(e_n - e_{n-1})/T]KG(s)\end{aligned} \tag{2}$$

where the step function D is the drive signal output by the controller and T is the sampling period. When the controller runs at maximum speed, the calculation time between the input of the error signal and the output of the calculated drive signal is not negligible with respect to the sampling rate. Hence, the new drive signal to input to controller is not calculated for the present error, but computed for the predicted value of the next error signal. If the present measured error is e_{n-1} and the preceding error is e_{n-2}, then by use of first-order approximation the predicted next error is

$$\begin{aligned}e_n &= e_{n-1} + (e_{n-1} - e_{n-2}) \\ &= 2e_{n-1} - e_{n-2}\end{aligned} \tag{3}$$

Upon substitution into the drive expression,

$$D = (2K_p + \frac{K_d}{T})e_{n-1} - (K_p + \frac{K_d}{T})e_{n-2} \tag{4}$$

Notice that the predicted value of the error signal, e_n, is never actually computed. As K_p, K_d, and T are all system constants, Equation 4 may be written

$$D = K_1 e_{n-1} + K_2 e_{n-2} \tag{5}$$

System adjustments are made in software by changing the coefficients K_1 and K_2, related to K_p and K_d by

$$K_1 = 2K_p + K_d/T \quad (6)$$

$$K_2 = -K_p - K_d/T \quad (7)$$

Microcomputer software

The microcomputer must perform two main tasks. One is control and monitoring of the motors, directing each to seek a position and seeing when each reaches the position. The other is directing the overall performance of the system—selecting the motion to be executed, responding to user inputs, and guiding the manipulator through complete motions. As usual, the hardware configuration dictated the software we used.

Motor control. The selection of digital control for the motors increased the microcomputer's task. Using the system of Equation 5, we did several things to reduce the time required to calculate a new drive signal. Because the coefficients K_1 and K_2 are not functions of time, they are calculated during an initialization phase. Note that the sampling time T is included in K_1 and K_2, thus requiring no division operation. Even though it reduces computational precision, we used fixed point arithmetic since it increases microcomputer throughput, permitting a much higher sampling rate. Equation 5 is implemented using 8-bit multiplication and adding the resultant 16-bit products. The computed drive value is obtained by limiting the absolute value of D to 127. Further software limiting of the drive signal is available through the coefficient D_M.

Figure 4 shows the flow chart for the motor control task. The subroutine is entered via an interrupt generated by a clock running at 400 Hz. During each subroutine call, the subroutine samples the position and calculates a drive signal for a single motor. The four motors are controlled by sequential multiplexing. Upon entering, the routine outputs to the selected motor(s) the drive signal calculated during its previous interrupt. It then samples the position of the joint, and calculates a new error signal. Next the routine calculates and stores a new drive signal, to be output at the beginning of the next interrupt using the present and previous error signals. It stores the present error value for the next drive calculation, and incorporates a zero-order-hold in the signal output, permitting quasi-continuous operation. The microcomputer then returns to the location in the program where the interrupt occurred.

Using a four-motor test device, we obtained a sampling rate of 100 Hz per motor. This rate allowed us to use a single computer for both the executive and motor control tasks. Using a multiple microprocessor system for even faster sampling rates and/or more motors is worth considering. The various tasks could then be delegated to different processors. For example, we could assign motor control to a single microprocessor.

Executive program. The general operation of the entire system is controlled by an executive program, described in the flow chart in Figure 5. We designed the system hardware so that execution of the executive routine begins as soon as the operator turns on the power. As in most computer programs, the first operation is initialization of various variables

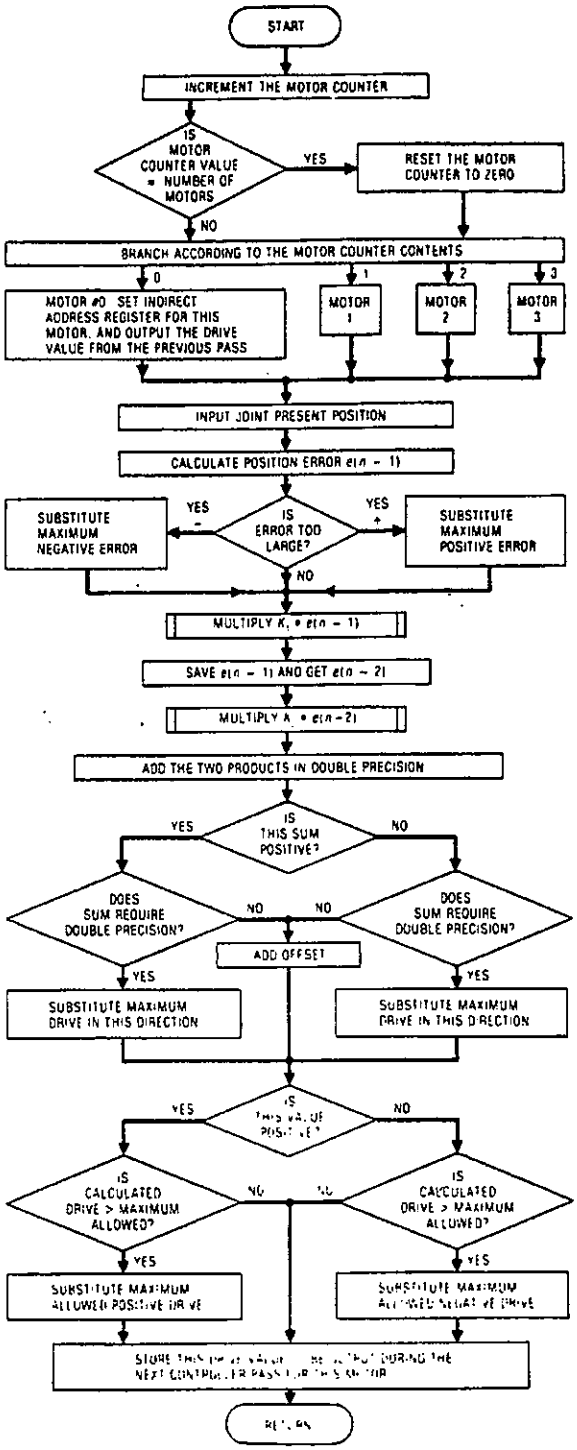


Figure 4. Multiplexed proportional-derivative controller.

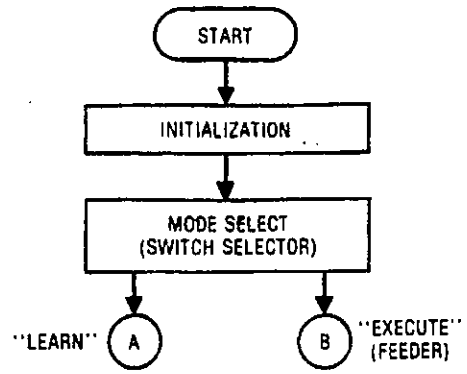


Figure 5. Executive program.

used in the program. This is an especially important part of a microcomputer program because much of the memory is usually volatile. After initialization, the operator can select either the learning (pattern storage) program or the motion reproduction program by use of a thumbwheel switch. The executive then proceeds directly to the selected main program. The executive is never reentered unless the operator presses an initialize or reset button.

Pattern storage program. The pattern storage program (Figure 6) is a sequence of five calls to the subroutine STORE, after the executive sets a pointer to the pattern storage area in memory. Figure 7 shows a flowchart for STORE. STORE starts with a delay loop establishing the joint position sampling rate. At the end of the delay, it inputs a complete set of joint positions through A/D converters. The program stores the negatives of the sampled values in the pattern storage area, and increments the pattern storage pointer appropriately. It uses the negatives of the values because of the requirements of the controller routine. As the samples are stored, it tests the pattern storage pointer to prevent the program from trying to store values beyond the limit of memory. The program activates a warning light and halts the machine if it detects this condition. It continues to take samples at the established rate until the operator signals; it suspends operations until he stops signaling. At that time the routine places a pattern termination flag in memory and returns the program flow to the calling routine.

Motion reproduction program. The motion routines retrieve the joint position values (saved by the pattern storage program) at a regular rate from the pattern storage area in memory. The flowchart of this program, shown in Figure 8, is a sequence of subroutine calls. There are four basic movements. The first subroutine REACH (Figure 9) makes the manipulator move from a starting point through a pattern to a stopping point. REACH then returns the program flow to the calling program. A second subroutine SCAN (Figure 10) moves the manipulator through a pattern, repeating the cycle continuously until signaled to return the program to the calling routine. Because SCAN leaves the utensil in an indefinite position relative to the stored pattern, a third subroutine, VARY (Figure 11), reproduces the stored pattern with joint position modifications. This allows

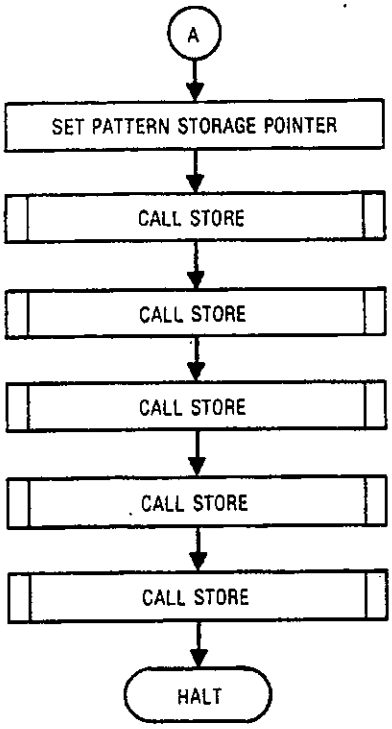


Figure 6. Pattern storage program.

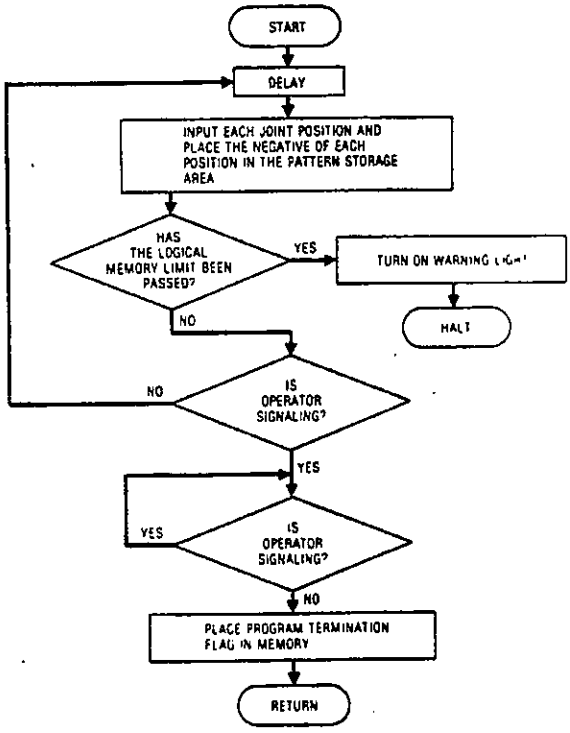


Figure 7. STORE—point storage.

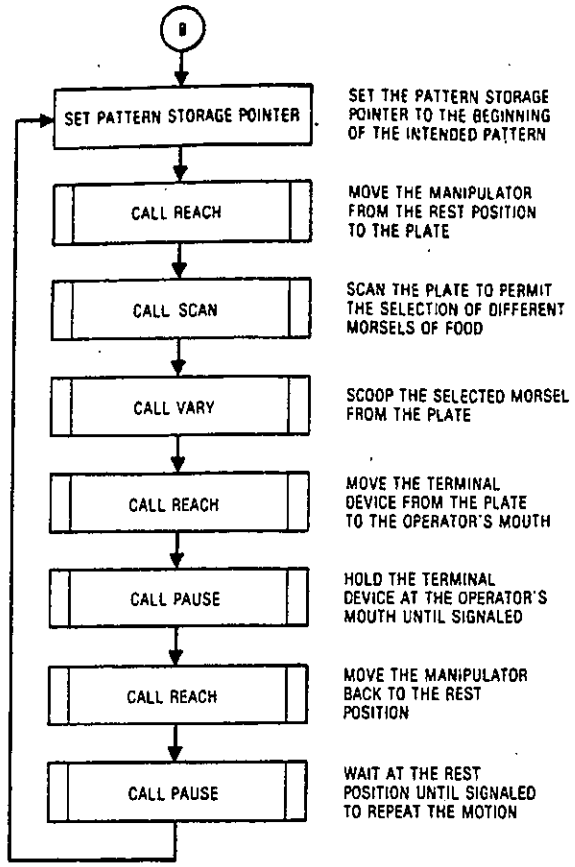


Figure 8. Motion (pattern) reproduction program.

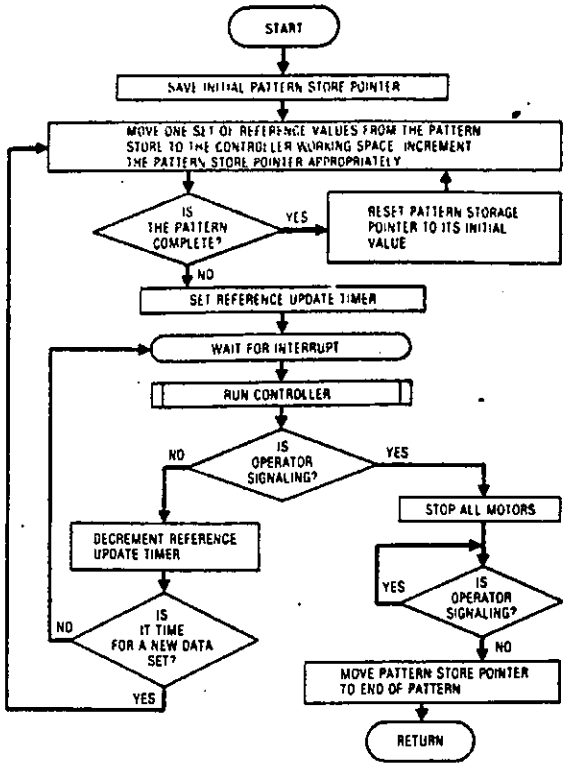


Figure 10. SCAN—cyclic motion.

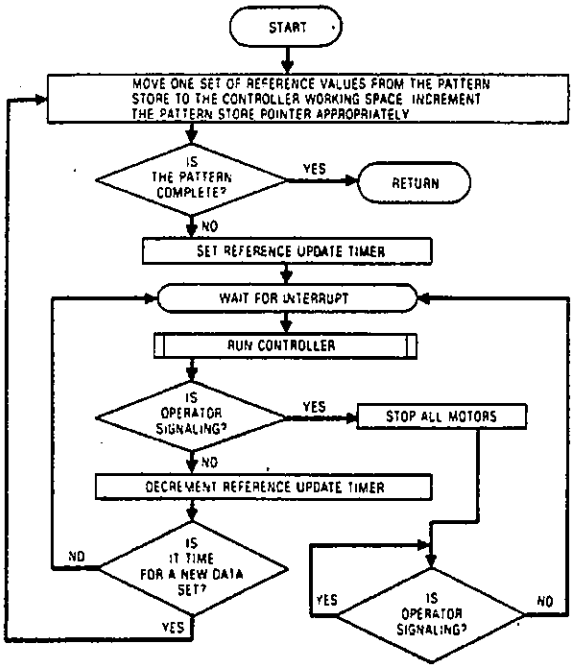


Figure 9. REACH—point-to-point motion routine.

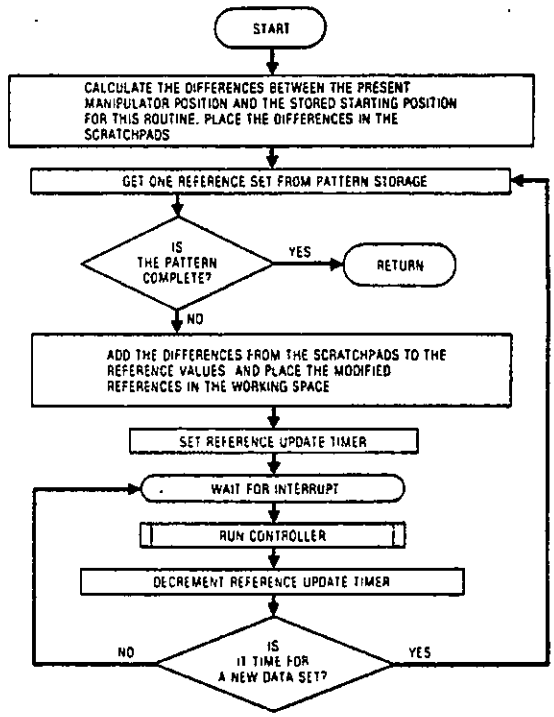


Figure 11. VARY—point-to-point motion modified by starting position.

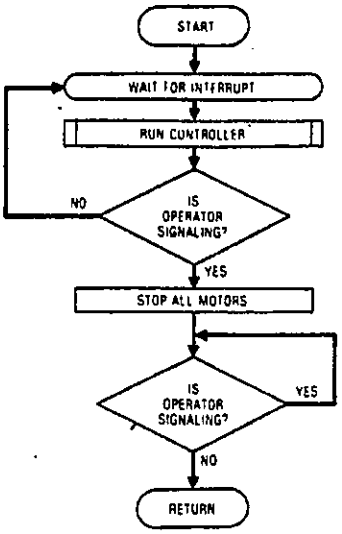


Figure 12. PAUSE—manipulator holding routine.

for the differences between the stored starting position and the actual starting position. The required modifications are determined at the beginning of the routine, and they are applied to every set of reference values thereafter. The final subroutine PAUSE (Figure 12) holds the manipulator at a stored position. PAUSE holds this position until signaled to return.

Conclusion

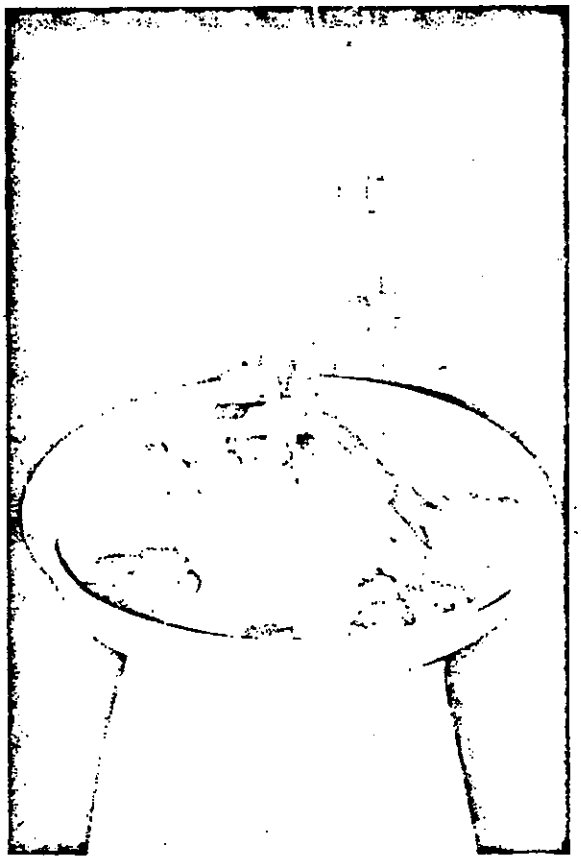
A prototype manipulator was designed by Ray Fulford, Rehabilitation Engineering Center, University of Virginia, to be used with our microcomputer system. Figure 13 is a sequence of pictures of this device. By removing various linkages, the operator can move the prototype through a feeding cycle while the computer samples the joint positions. The microcomputer also controls the rotation of the plate to accomplish the scan motion. It loads the utensil—here a spoon—by moving it radially from the center of the plate. By moving against the vertical lip of the specially-designed plate, the manipulator forces the food onto the spoon.

Preliminary tests indicate that the handicapped user can easily eat conventional meals provided the food is precut in bite-size pieces. He can even scoop up peas without difficulty. Occasional dropping of food occurs, but additional experimentation with the spoon design will hopefully eliminate this problem. Our microcomputer-based manipulator is sophisticated enough to replace conventional hand feeding by an orderly. Because this system offers such independence of action, the quadriplegic finds it highly desirable. ■

References

1. Reed, M. and H. W. Mergler, "A Microprocessor-Based Control System," *IEEE Trans. Industrial Electronics and Control Instrumentation*, Vol. IECI-24, No. 3, Aug. 1977, pp. 253-257.

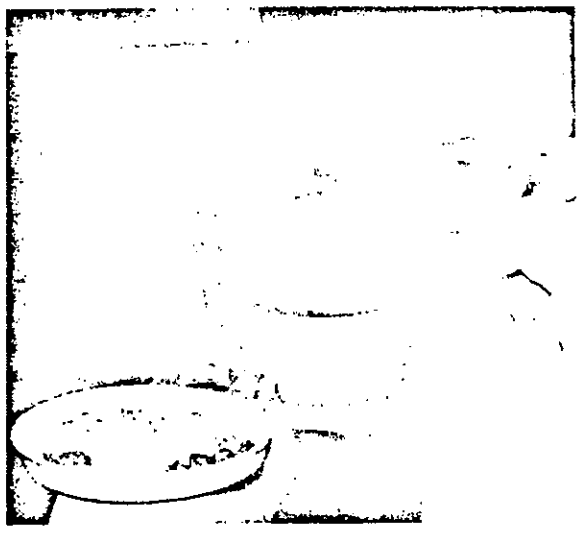
(a)



(b)

(c)

Figure 13. Spoon in position at center of plate prior to scooping several pieces of meat is shown in (a). As the spoon moves radially toward the vertical lip of the plate the meat is forced on the spoon (b). The spoon lifts the food toward the mouth position (c). The spoon has halted and waits for the user to accept the food (d). Meat, potatoes, and carrots comprise this meal.

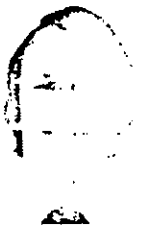


(d)

2. Seamone, W. and G. Schmeisser, "Interdisciplinary Development and Evaluation of Externally Powered Upper-Limb Prosthesis and Orthoses," *Veterans Administration Bulletin of Prosthetics Research*, Spring 1975, pp. 300-310.
3. Haggerty, J. J., *Spinoff 1977—An Annual Report*, NASA, Washington, D.C., Jan. 1977, p. 65.
4. Guittet, J., "The Spartacus Project: Aids for the Physically Handicapped," paper submitted to the Second International Congress on the Technology for Prosthetics and Functional Rehabilitation, Cannes, France, Mar. 1976.
5. Freedy, A., Lyman, J., and M. Salomonow, "A Microcomputer-Aided Prosthesis Control System," *Interface*, Vol. 2, No. 7, June 1977, pp. 16-23.
6. Klig, V., "Biomedical Applications of Microprocessors," *Proc. IEEE*, Vol. 66, No. 2, Feb. 1978, pp. 151-161.
7. Freedy, A. and J. Lyman, "A Microcomputer-Based Myoelectric Pattern Controlled Arm Prosthesis," *Proc. 5th Symposium on External Cont. of Human Extremities*, Dubrovnik, Yugoslavia, 1975.
8. Kirkpatrick, M., et al., "Electric Motorized Feeder Unit for the Severely Involved Patient," *Journal of Orthopedic and Prosthetic Appliances*, Mar. 1966.
9. Morewood, W. H., "Spoon Lifter Self-Feeding Device," *Proc. Conf. Systems and Devices for the Disabled*, Boston, Mass., 1976.

Robert L. Ramey, a professor of electrical engineering, joined the University of Virginia faculty in 1956. Before that he was with Sperry-Rand Corporation. He is the author of the texts *Physical Electronics, Electronics and Instrumentation*, and *Matrices and Computers in Electronic Circuit Analysis*, and is currently doing research at the university's Rehabilitation Engineering Center.

A member of IEEE, and Sigma Xi, Ramey attended Duke University and the University of Cincinnati and received his PhD from North Carolina State University in 1954.



James H. Aylor is an assistant professor in the Department of Electrical Engineering of the University of Virginia. His research interests are in the areas of digital systems, computer applications, and image processing. For the past two years, he has been involved in the design of various electronic devices for use by the handicapped. This work is being conducted at the university's Rehabilitation Engineering Center.

A member of IEEE, Sigma Xi, Tau Beta Pi, and the IEEE Computer Society, Aylor received the BS, MS and PhD degrees in electrical engineering from the University of Virginia in 1968, 1971, and 1977, respectively.

Ronald D. Williams is currently working toward his PhD at the Massachusetts Institute of Technology. During the past two years, he has done research in rehabilitation engineering in the area of microcomputer controlled manipulators.

Williams is a member of IEEE, Tau Beta Pi, and Eta Kappa Nu; he obtained the BS and MS degrees at the University of Virginia, specializing in the area of digital controls.

FEEDING/FEEDER REFERENCE LIST

Gentry, Dale and Haring, NG. B - Essentials of Performance Measurement. Page 209-236.

Suggested References (beginning page 36).

Alexander, R. Pre-Speech and Feeding Bibliography.

Independent Eating. Self-Care - Chapter 11. Page 291-294.

Self-Feeding. Page 62-65.

Banerdt, Barbara and Bricker, Diane. A training program for selected self-feeding skills for the motorically impaired. AAESPH Review, Dec. 1978, Page 222-229.

Lewis, C, Foshage, K, and Greeden, D. Occupational Therapy Clinical Affiliation Requirement.

Morris, SE. A glossary of terms describing the feeding process.

Campbell, PH. Assessing oral-motor skills in severely handicapped persons: an anlysis of normal and abnormal patterns of movement. Teaching the Severely Handicapped (Vol IV), 1979.

Robinault, IP. Functional Aids for the Handicapped. 1973.

Lowman, EW and Klinger, JL. Aids to Independent Living, Self help for the handicapped, 1969.

Barnitt, R. Aids for the multi-handicapped child. Physiotherapy, 57, Sept. 10, 1971, Page 418-424.

Jones, AM. Overcoming the feeding problems of the mentally and the physically handicapped. Journal of Human Nutrition 32, 1978, Page 359-367.

Azrin, NH and Armstrong, PM. The "mini-meal"-a method for teaching eating skills to the profoundly retarded. Mental Retardation, Feb. 1973, Page 9-13.

Colwell, CN, Richards, E, et al. Evaluation of self-help training of the profoundly retarded. Mental Retardation, June 1973, Page 14-18.

Christian, WP, Hollomon, SW, et al. An attendant operated feeding program for severely and profoundly retarded females. Mental Retardation, October 1973, Page 35-37.

Gertenrich, RL. A simple, adaptable drinking device for mental retardates lacking arm-hand control. Mental Retardation, June 1970, Page 51-52.

Green, EM and McIntosh, E. Food and nutrition skills of mentally retarded adults: assessment and needs. Journal of the American Dietetic Association, May 1985, Page 611-613.

Stratton, M. Behaviorial assessment scale of oral functions in feeding. American Journal of Occupational Therapy, Nov. 1981, Page 719-721.

Danford, DE, Huber, AM. Eating dysfunctions in an institutionalized mentally retarded population. Journal for Intake Research, 1981, Page 281-292.

Matson, JL., Ollendick, TH, et al. A comprehensive dining program for mentally retarded adults. Behavioral Research and Therapy, 18, 1980, Page 107-112.

Umaoka, K. A human ethological study in eating behavior. NISE Bulletin, Feb. 1986, Page 42-49.

Felix, CRM and Acevedo, JR. Brief or new: the thigh feeder. American Journal of Occupational Therapy, Sept. 1985, Page 600-601.

Wiener, MM. Brief or new: feeding device for finger foods. American Journal of Occupational Therapy, Nov. 1985, Page 746-747.

Takai, VL. Case report: the development of a feeding harness for an ALS patient. American Journal of Occupational Therapy, May 1986, Page 359-361.

Bagci, C. A motorized solid and liquid food feeding mechanism for the independent feeding of the handicapped. Proceedings of the International Conference on Rehabilitation Engineering, 1980, Page 256-260.

Ramey, RL, Aylor, JH, et al. Microcomputer-aided eating for the severely handicapped. Computer-IEEE Publication, Jan. 1979, Page 54-61.

Wyckoff, E and Mitani, M. The spoon-plate: a self-feeding device. American Journal of Occupational Therapy, May 1982, Page 333-335.

Fleming, SM and Weaver, AW. Feeding device for glossectomy patients. Archives of Physical Medicine and Rehabilitation, Apr. 1983, Page 183-185.

Gmitter, NW and Richards, LH. Pulley feeding system. Physical Therapy, Sept. 1973, Page 973.

Shaw, G and Wright, C. A two-handle spoon: an aid for independent eating. American Journal of Occupational Therapy, Jan. 1982, Page 45-46.

Mills, M. A gooseneck feeding device. American Journal of Occupational Therapy, Feb. 1983, Page 112.

Schneider, W and Seamone, W. A micro-processor-controlled robotic arm allows self-feeding for a quadriplegic. Proceedings IEEE-1980, Page 31-35.

Shinnar, SE. Use of adaptive equipment in feeding the elderly. (source ?), Sept. 1983, Page 321-322.

Kreckman, JE and Sheredos, SJ. Winsford feeder. VAREC Review, May 1981, Page 39-44.

VAPC Research Notes, Bulletin of Prosthetics Research, (BPR 10-34), Fall 1980, Page 140-143.

Gallender, D. Eating Handicaps, 1979.

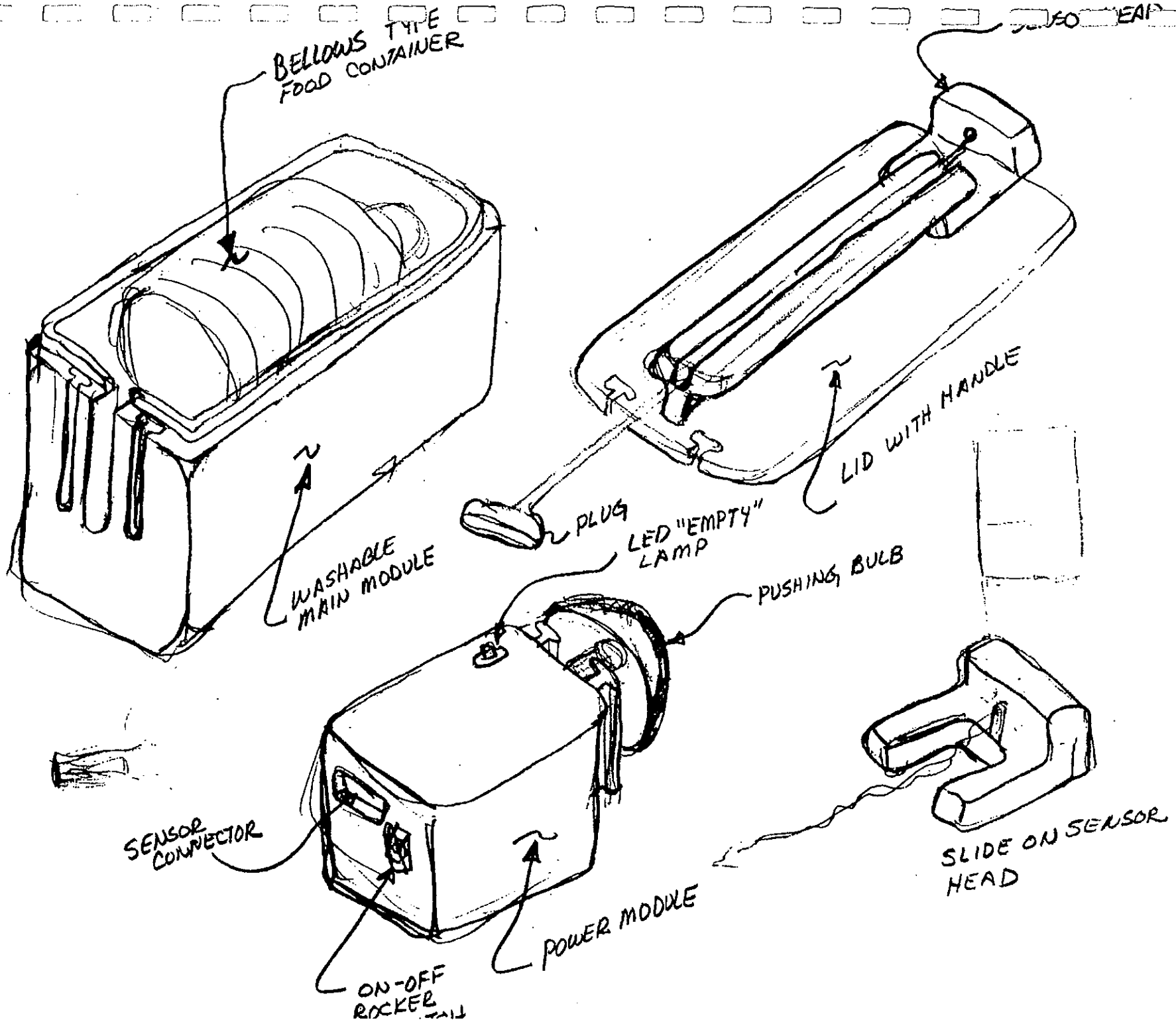
Perske, R, Clifton, A, et al. Mealtimes for Persons with Severe Handicaps, 1986.

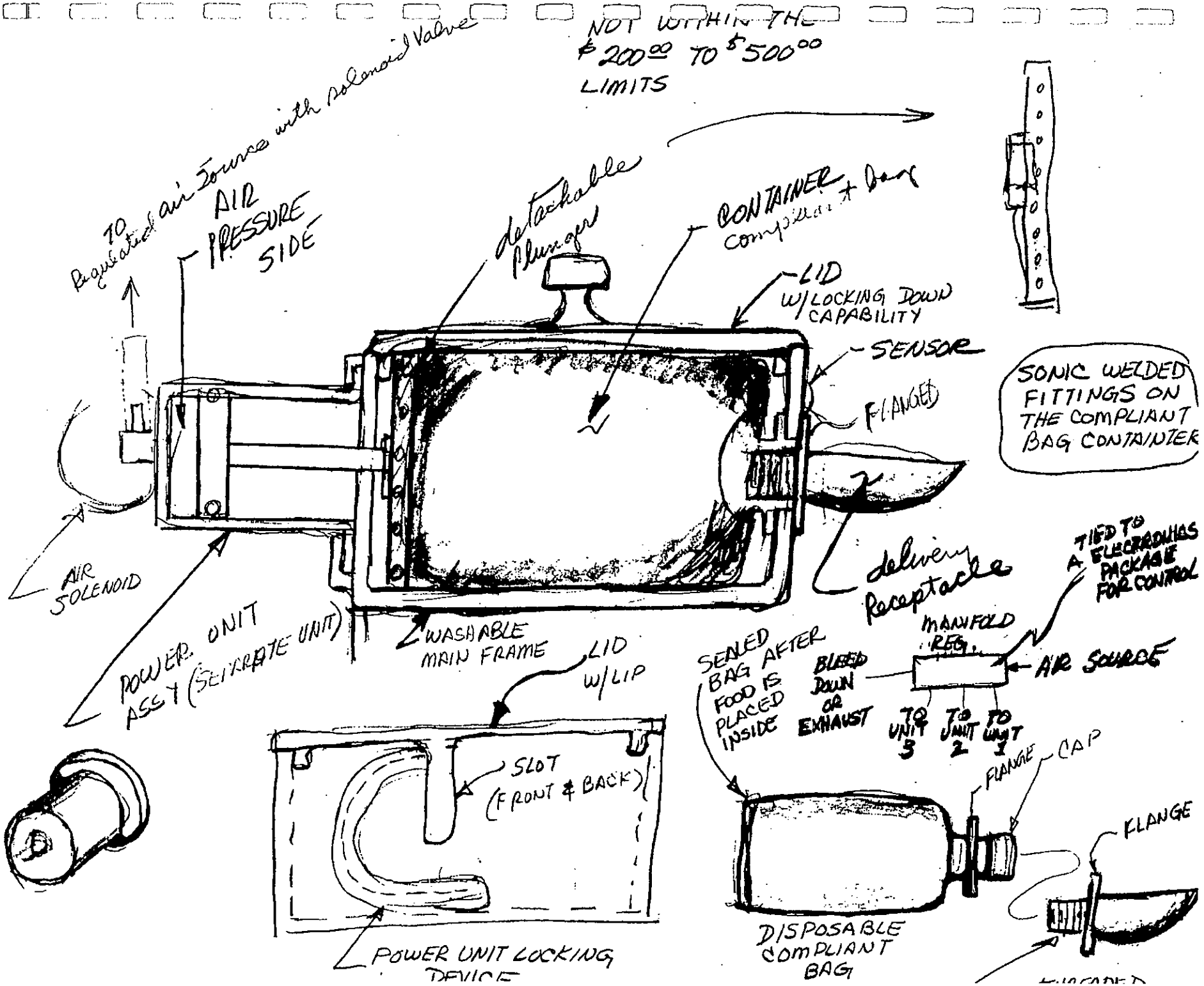
Patents

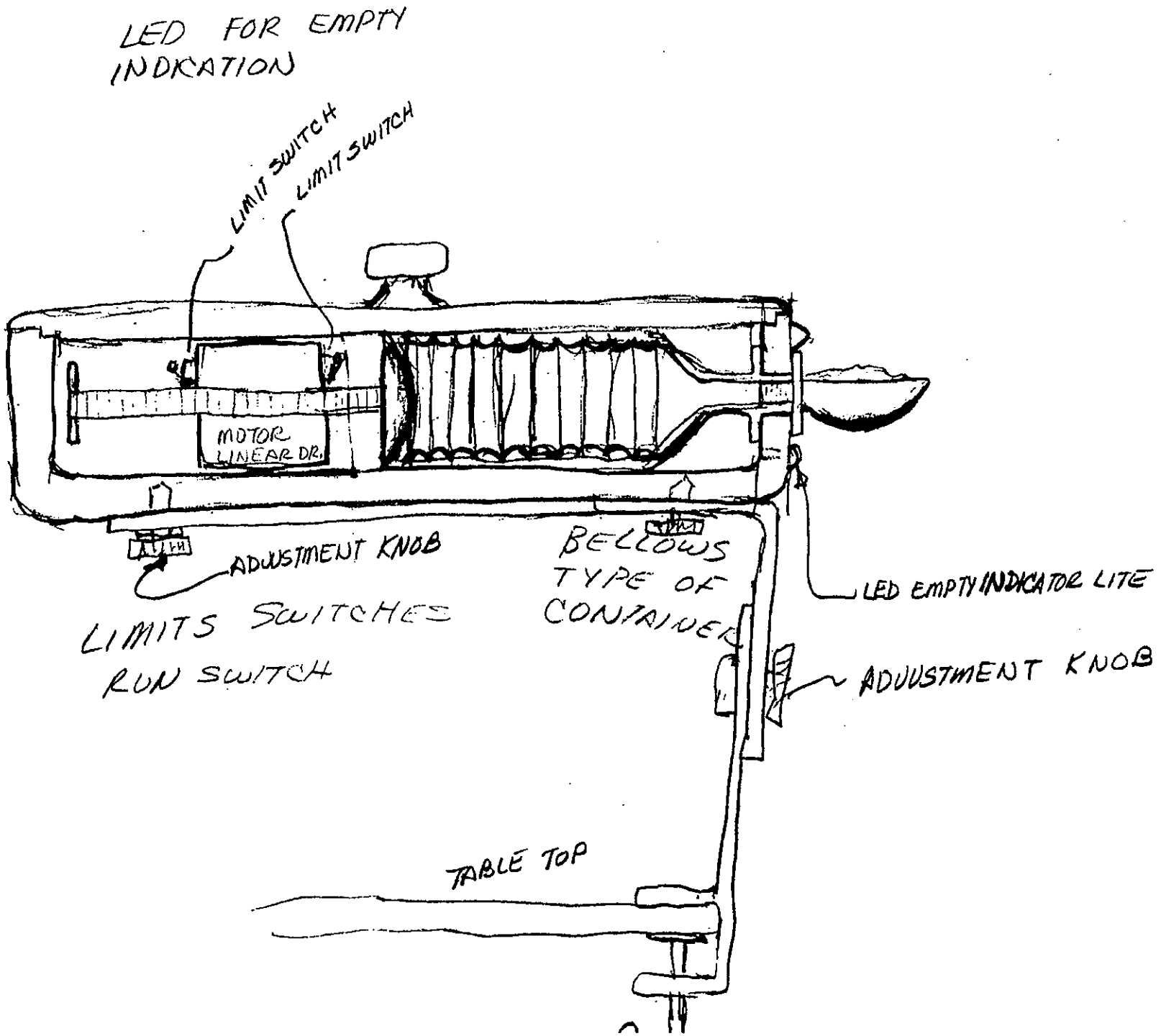
4,364,699 - Wheelchair table and food tray for handicapped persons
3,734,306 - Self-feeding device for handicapped persons
3,727,802 - Hand held food holder and dispenser
4,162,868 - Invalid feeding device

Appendix H

Related Considerations and Concepts

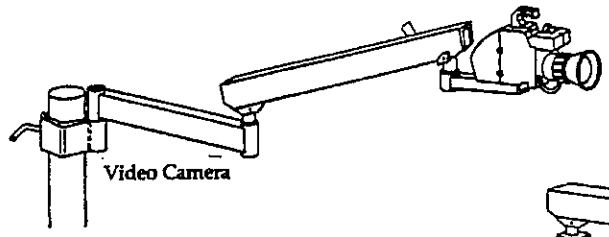

BELLOWS TYPE
FOOD CONTAINER
LID WITH HANDLE
PLUG
LED "EMPTY"
LAMP
WASHABLE
MAIN MODULE
PUSHING BULB
SENSOR
CONNECTOR
ON-OFF
ROCKER
POWER MODULE
SLIDE ON SENSOR
HEAD


NOT WITHIN THE $200.00 TO $500.00 LIMITS
To Regulated air Source with Solenoid Valve
AIR PRESSURE SIDE
detachable Plunger
CONTAINER compliant + Deep
LID W/LOCKING DOWN CAPABILITY
SENSOR
FLANGED
SONIC WELDED FITTINGS ON THE COMPLIANT BAG CONTAINTER
AIR SOLENOID
POWER UNIT ASSY (SEPARATE UNIT)
WASHABLE MAIN FRAME
delivery Receptacle
TIED TO A ELECTRONICS PACKAGE FOR CONTROL
MANFOLD REG.
AIR SOURCE
SEALED BAG AFTER FOOD IS PLACED INSIDE
BLEED DOWN OR EXHAUST
TO UNIT 3
TO UNIT 2
TO UNIT 1
LID W/LIP
SLOT (FRONT & BACK)
FLANGE
CAP
FLANGE
POWER UNIT LOCKING DEVICE
DISPOSABLE COMPLIANT BAG

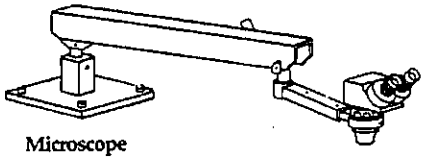

LED FOR EMPTY INDICATION
LIMIT SWITCH
LIMIT SWITCH
MOTOR LINEAR DR.
ADJUSTMENT KNOB
LIMITS SWITCHES
RUN SWITCH
BELLOWS TYPE OF CONTAINER
LED EMPTY INDICATOR LITE
ADJUSTMENT KNOB
TABLE TOP

We're a solution waiting for your problem.

The following are just a few examples of how the DecTron Heavy Duty Arm System is used to meet specific application challenges.

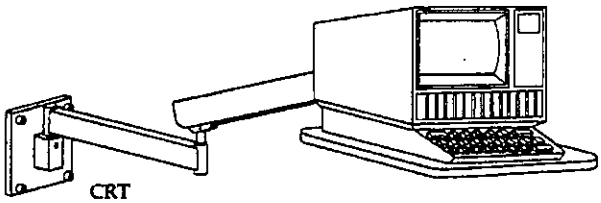


Video Camera

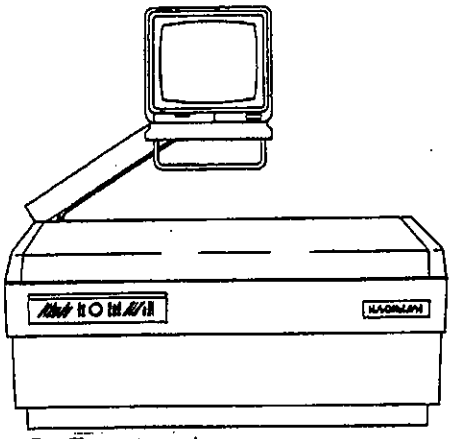


Microscope

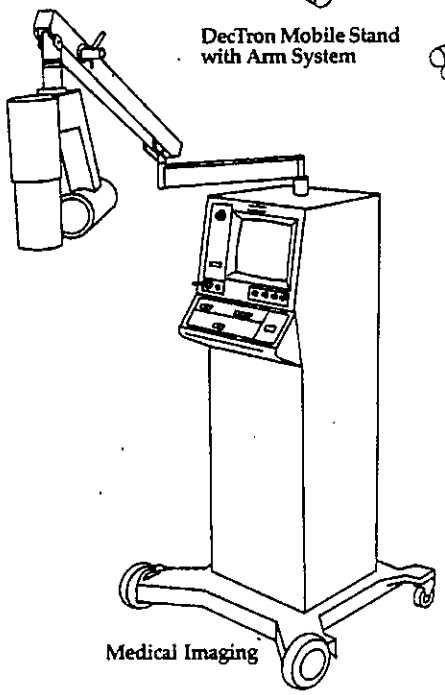
DecTron Mobile Stand with Arm System



CRT



Gas Chromatograph



Medical Imaging

DecTron products are manufactured by A-dec, Inc., since 1968 the world's leading supplier of components and systems designed for the dental profession. A logical extension of that engineering and manufacturing expertise, DecTron now offers a family of support systems built to give you a hand, whatever the job.

DECTRON®
PRODUCTS BY A-DEC

2601 Crestview Drive
P.O. Box 111
Newberg, OR 97132
(503) 538-7450
Telex: (ITT) 4970448 ADEC

WARRANTY

A-dec warrants its products against defects in material or workmanship for one year from the time of delivery. A-dec's sole obligation under the warranty is to repair, or at its option, to replace the product. The buyer shall have no other remedy. (All special, incidental, and coincidental damages are excluded.) Written notice of breach of warranty must be given to A-dec within the warranty period. The warranty does not cover damage resulting from improper installation or maintenance, accident or misuse. NO OTHER WARRANTIES AS TO MERCHANTABILITY OR OTHERWISE ARE MADE.

Arms built to give you a hand.

MGR ELECTRONICS, INC.

FT. WORTH, TX
817-338-1493

AUSTIN, TX
512-250-0926

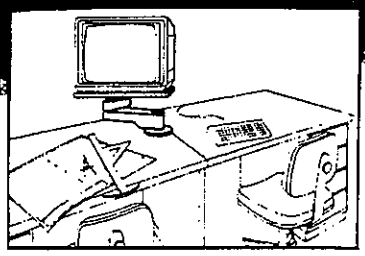
13610 Floyd Circle
Dallas, TX 75243
214-238-5246

TWX 910-867-4780

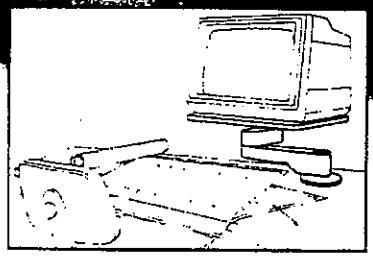
HOUSTON, TX
713-759-0187

OKLAHOMA
918-369-5186

ANTHROARM™ GT.



With the AnthroArm, you can share terminals between stations.



The AnthroArm keeps your workspace uncluttered.

THE ONLY ARM THAT HOLDS 200 LBS.

Your 19" terminal is big. It takes up a lot of your workspace. And it's heavy. It's no easy job moving it around on your desk.

That's where the AnthroArm GT comes in. The AnthroArm is designed to hold substantial loads—up to 200 lbs. It lifts your terminal up so it floats above your worksurface.

With your terminal raised above your desk, you can spread out with plenty of room to work underneath the AnthroArm. And you can easily move your monitor around. Pull it closer to you, or push it back to store it out of the way. Or swivel your terminal 360° to see it better, and to share it with others.

The AnthroArm GT. The only arm strong enough to give you back your workspace.

Call us: 800-325-3841

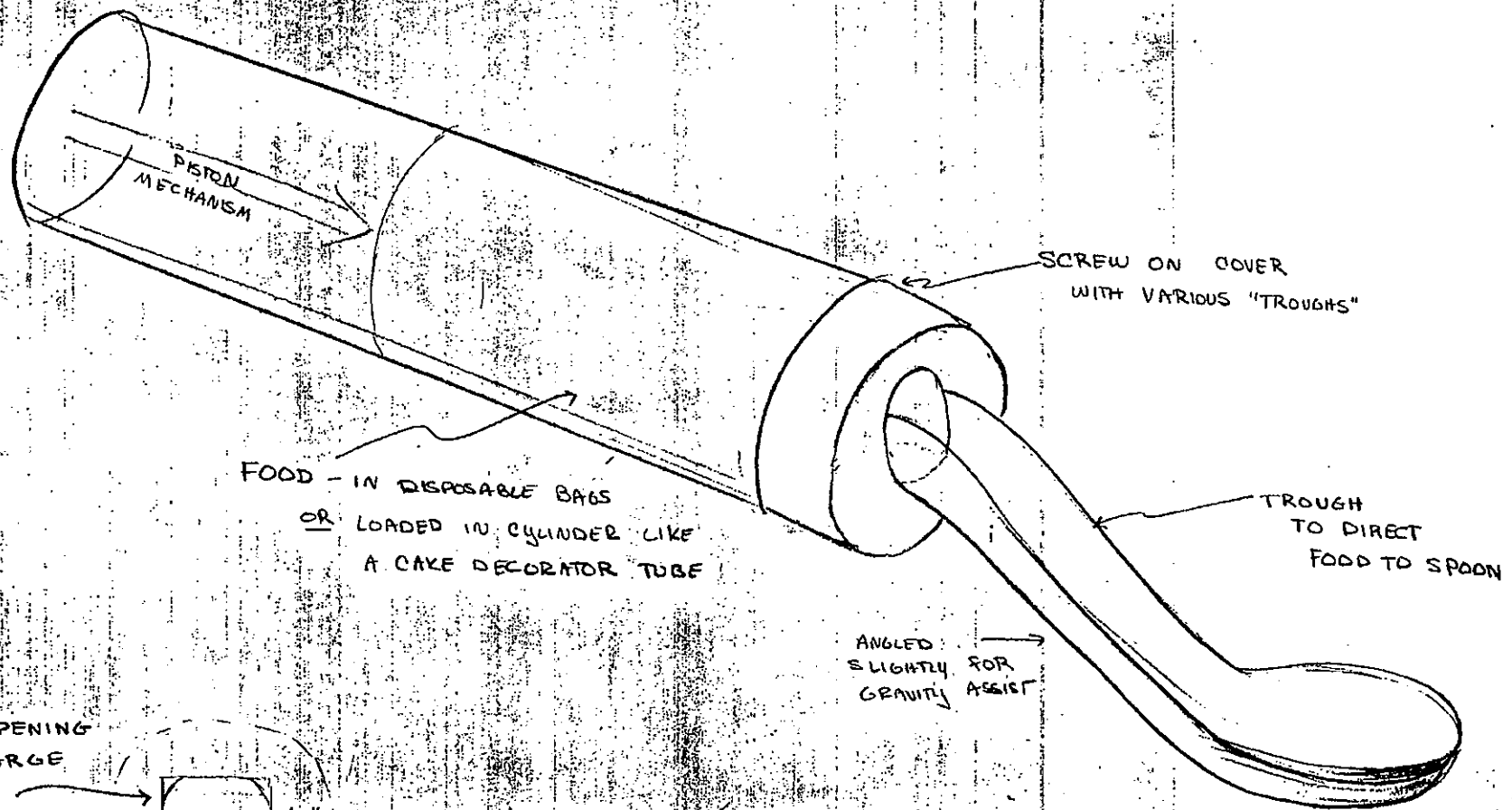
ANTHRO

Anthro Corporation
Technology Furniture
3221 NW Yeon St
Portland, OR 97210
503-241-7113

Anthro Corporation is a wholly owned subsidiary of Tennant Company. AnthroArm is a registered trademark of Anthro Corporation.

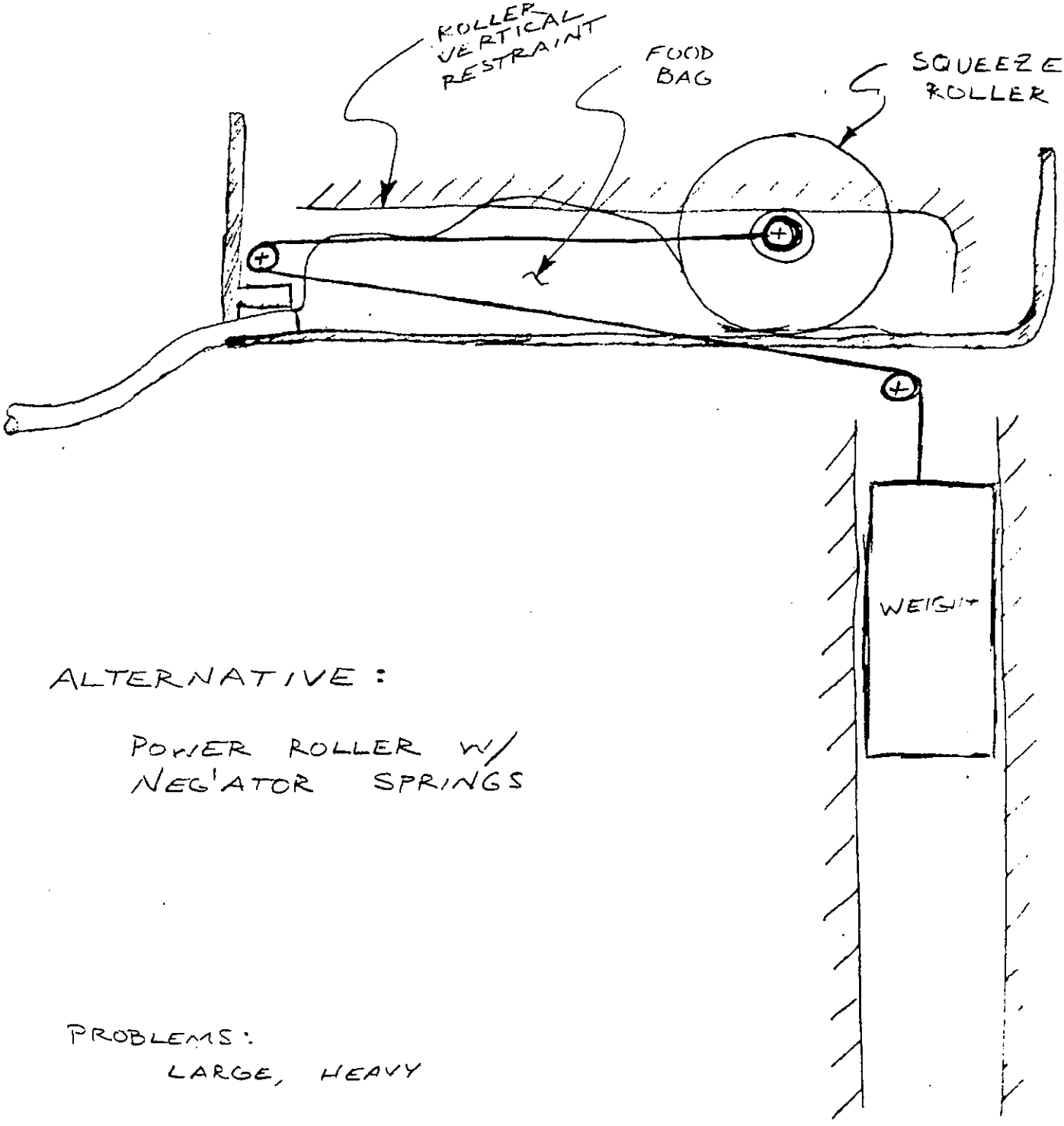
DELIVERY COMPONENT OF AUTOMATED FEEDER

USE LONG NARROW CYLINDER FOR FOOD - SAUSAGE SHAPED



? COULD OPENING BE AS LARGE AS THIS → NICE SIZE FOR "REGULAR" BITES

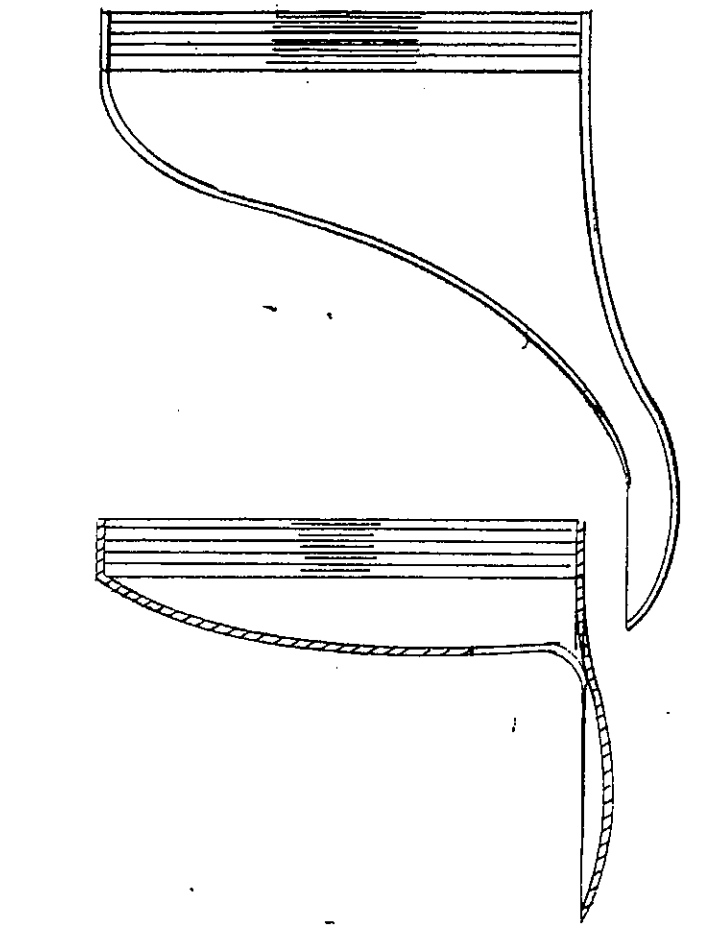
THE PACKAGED FOOD BAG DISPENSING: POWER DUCE

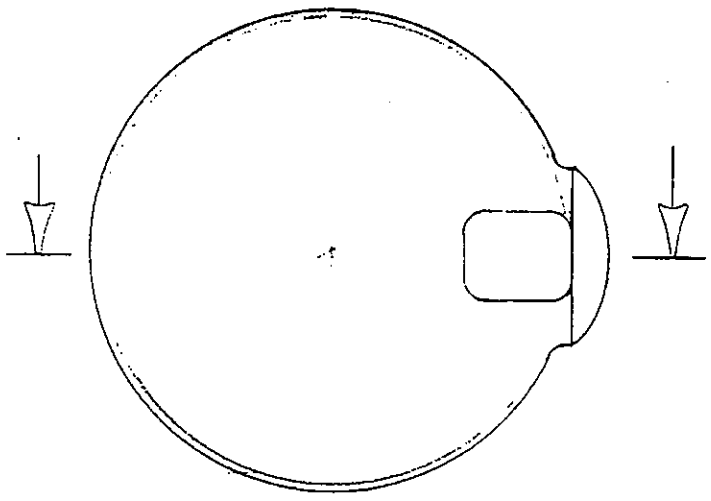


ALTERNATIVE:

POWER ROLLER W/
NEG'ATOR SPRINGS

PROBLEMS:
LARGE, HEAVY

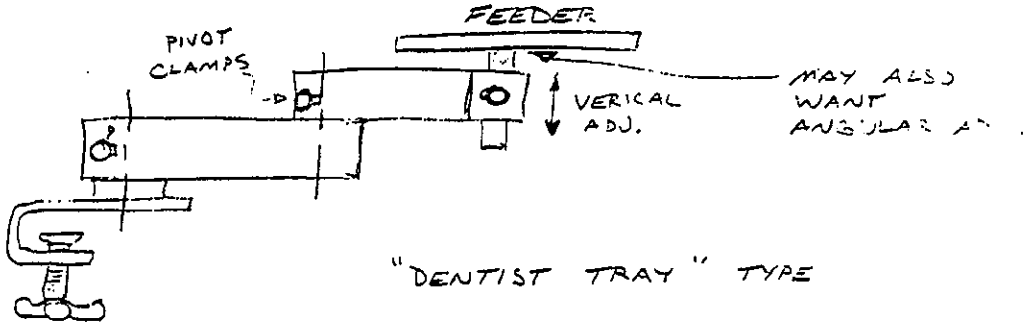




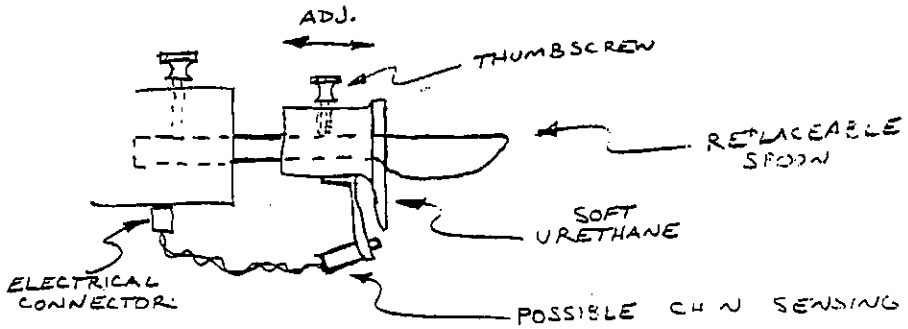
DISPENSER DESIGN

GENERAL COMMENTS & ALTERNATIVE IDEAS:

① A PIVOTED ARM SUPPORT MAY BE MORE EASILY ADJUSTED AND VISUALLY LESS "INSTITUTIONALIZED". THE TRADE-OFF WOULD BE REDUCED RIGIDITY AND A SLIGHTY GREATER WEIGHT. SEE PRODUCT LITERATURE EXAMPLES.



② THE LIP/CHIN GUARD MIGHT BE MADE MORE LIKE THEIR BICYCLE HANDLEBAR GRIP DESIGN:



③ MIGHT INDICATE INSULATION FOR FOOD HOPPERS. HOT/COLD