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VETERANS ADMINISTRATION PROSTHETICS CENTER REPORT

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I. DEVELOPMENT AND EVALUATION

A. Prosthetics

Lower Limb

a. *Ortho Aid.* This prosthesis (Fig. 1) for unilateral below-knee and above-knee amputees, developed by Ivan Sabel, Ortho. Research, Inc., Bethesda, Maryland, consists of a socket made from PVC slats, an adjustable Lexan tube, a universal joint with miniature suction pads, plastic straps and a carrying case.

Originally intended for use in the shower, the device is also useful as an aid while shaving, getting to the bathroom during the night, and getting around the house. An evaluation is currently underway.

b. *Adjustable Polypropylene Above-Knee Socket.* This lightweight, adjustable, polypropylene socket (Fig. 2) for recent amputations or

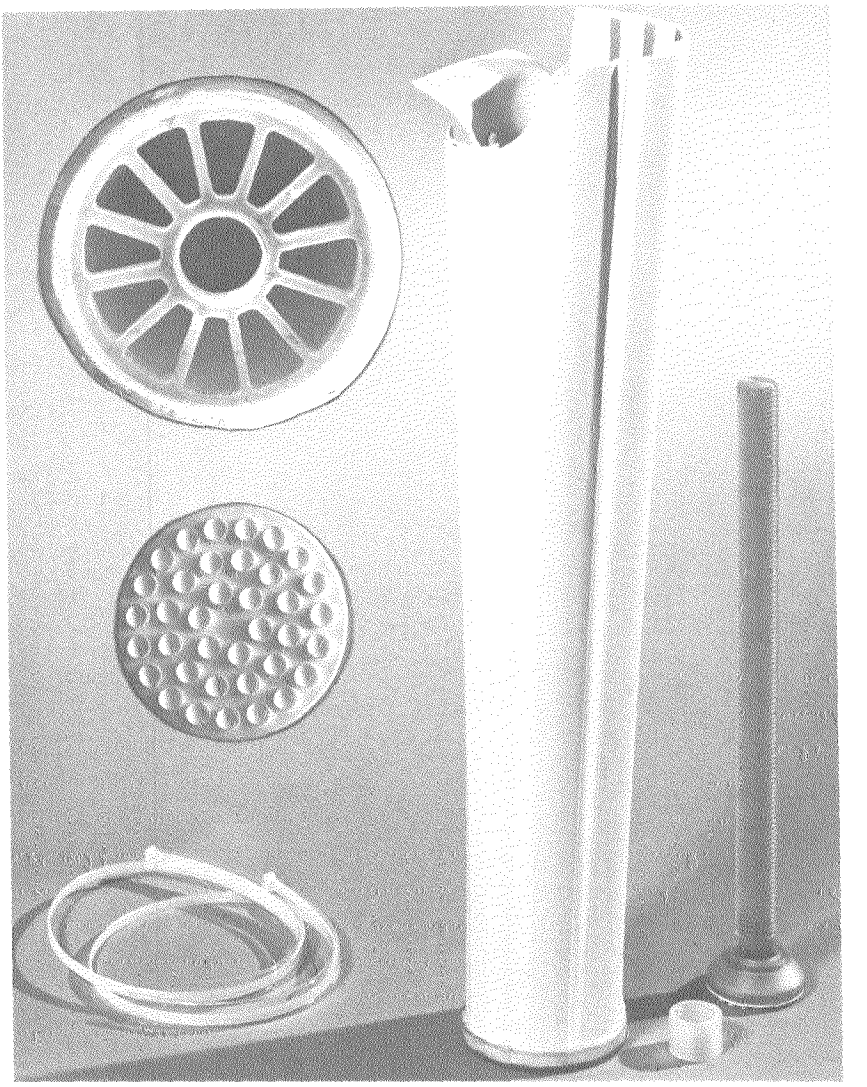

FIGURE 1. — Ortho Aid for unilateral BK and AK amputees.

geriatric amputees, is manufactured by the United States Manufacturing Company, Pasadena, Calif. Three Velcro straps control socket fit. The device allows earlier ambulation by the patient, controls residual limb volume changes, and reduces overall rehabilitation and training time. The sockets are available in four different sizes and two different lengths. The device is currently undergoing evaluation to determine its durability as a temporary prosthesis.

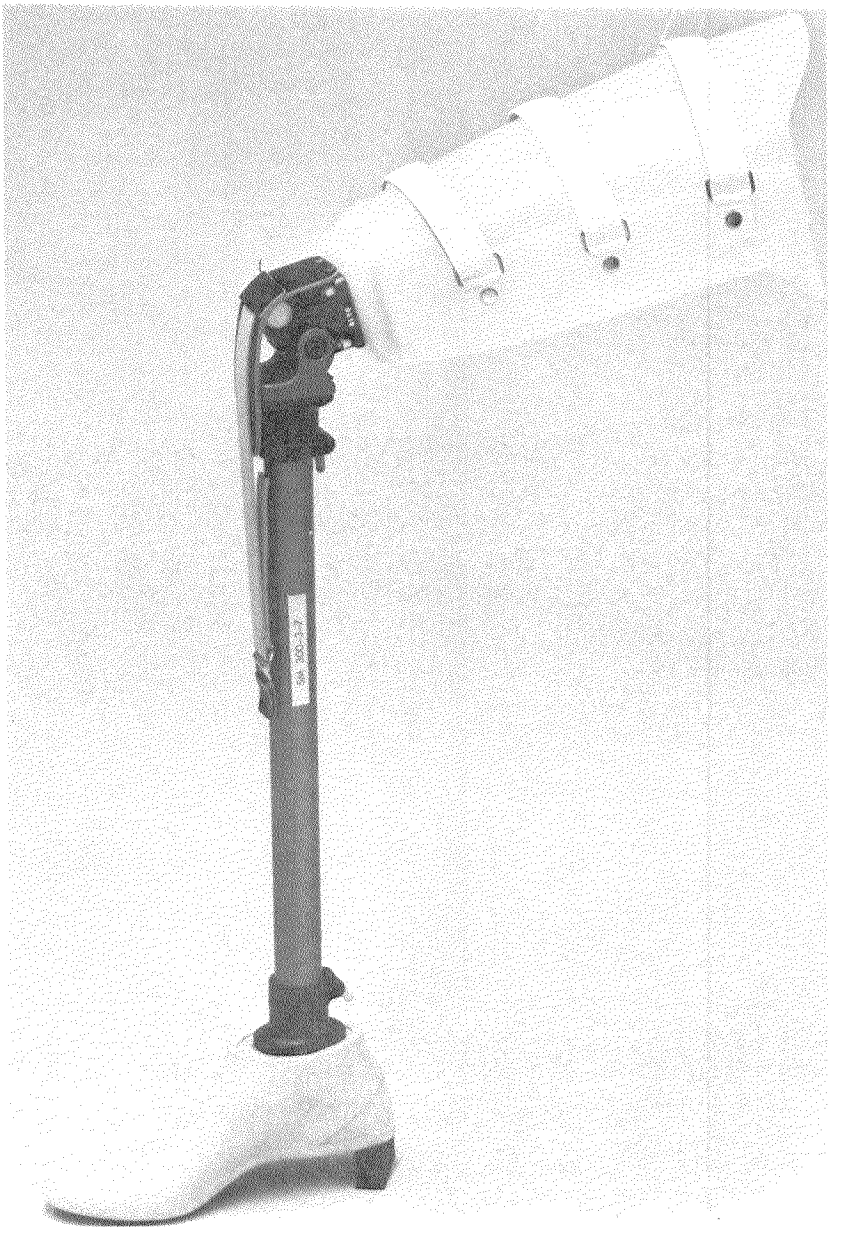

FIGURE 2.—Adjustable polypropylene above-knee socket.

c. *Swim/Walk Ankle.* It is not unusual for the VAPC to receive requests from veterans for some special type of prosthesis. A recent request was made by a BK amputee for a swimming prosthesis with a

two-position-lock ankle (Fig. 3 and 4). The first setting is at the normal walking position, while the second is at the plantar flexed position, which is the position assumed by the human ankle while swimming—the amputee is able to walk into water, change the prosthetic foot to the swimming position, and swim in a fairly normal manner while wearing a prosthesis. The ankle was developed by the Patient Care Service, and it has been in use for about one year. Constructed of polypropylene, the ankle unit is waterproof and will not corrode in salt water. The Kingsley Syme's foot, which is ideal for this setup, was fitted to the ankle joint. All other components, such as screws and tubes, are constructed of stainless steel.

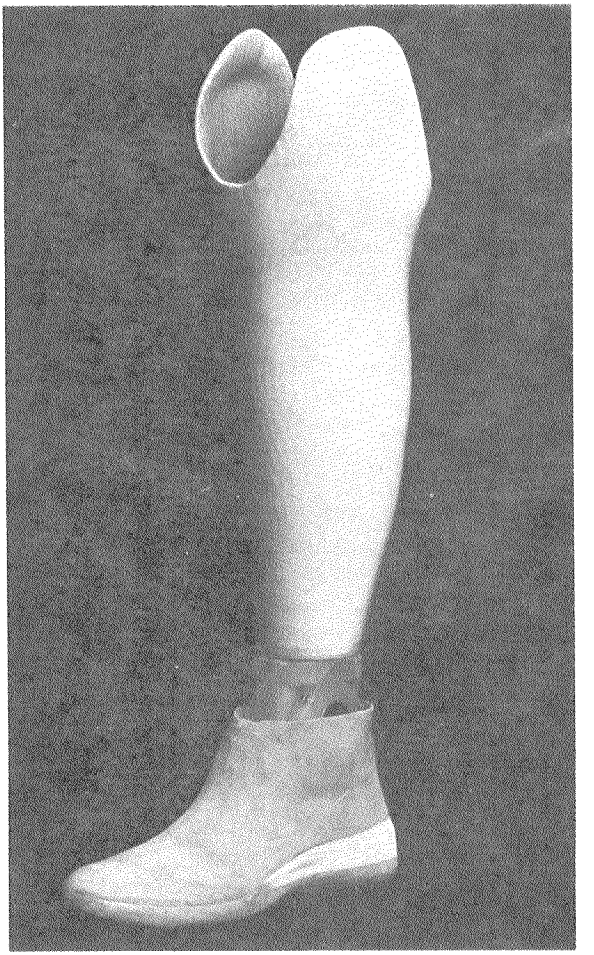

FIGURE 3.—Swimming prothesis has a two-position-lock ankle.

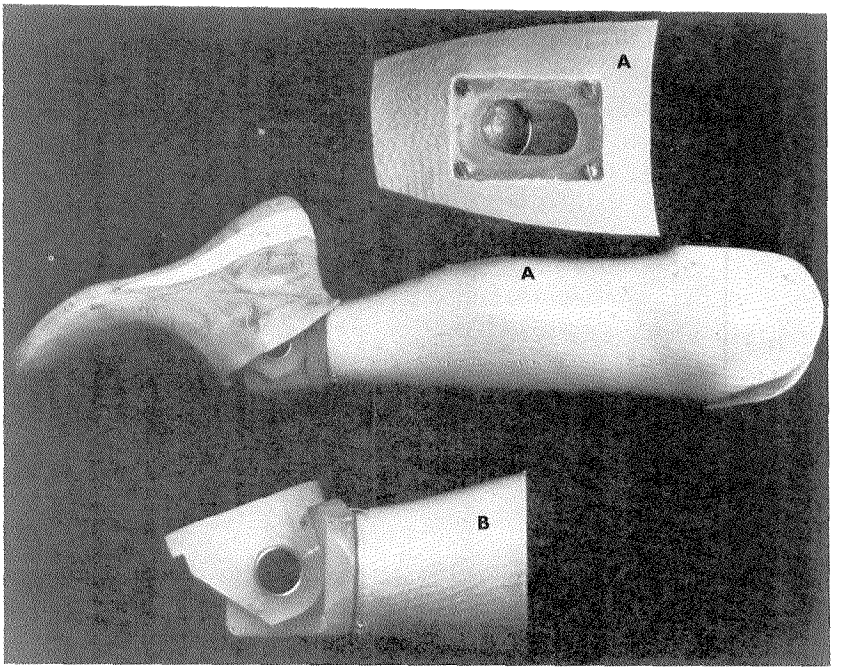

FIGURE 4. — Prosthesis with Swim/Walk Ankle has pull lever (A) to adjust ankle. Ankle is shown in swimming position without the foot (B).

The swim/walk ankle was constructed to lock at 90 deg for walking and 120 deg for swimming. The different positions are controlled by a spring-loaded pin that automatically locks into position. A ring is placed in the posterior portion of the calf area for the amputee to use in activating the lock.

So far, there have been no malfunctions. The veteran states that it has improved his swimming; it also allows him to shower while standing, and he can walk on the beach without difficulty. Two additional units are now being made for evaluation on other patients.

d. *The "Cushion Brim" AK Socket.* A common problem of above-knee amputees is irritation and discomfort at the proximal anterior and medial edge of the socket, for both suction and non-suction socket wearers. Several attempts were made in the past to correct the problem (including a part-flexible brim) but none has proved to be very successful.

The Patient Care Service, more recently, has developed a method called the "cushion brim". It is inexpensive and provides relief from irritation or discomfort in the most troublesome areas of an above-

knee stump, and it can be incorporated into any type of above-knee socket.

With the method used, only one additional step is added to the standard above-knee fabrication procedure. After cast modifications are completed, the cast is allowed to dry for about one day. Then a piece of ½-in. Evazote is heated and molded over the proximal anterior and medial portions of the model, extending down approximately 2 in. from the proximal border of the socket. The distal edge of the Evazote is feathered to blend into the contours of the model; then the cushion is glued in place and the model is laminated. After lamination, the cushion is removed from the model and glued to the plastic socket in the area outlined during lamination. After fitting and dynamic alignment have been completed, the cushion is removed before the final lamination. The cushion brim is then re-glued to the socket and covered with light horsehide. The horsehide overlaps the cushion by at least ½ in., both inside and outside the socket. Then two or three coats of liquid nylon lacquer are brushed on the horsehide to protect it from moisture.

Clinical results have shown that the cushion-brim socket provides the patient with more comfort and less irritation. Currently, six patients have been using the system for over a year with good success.

The benefits of the cushion brim are: more comfort, elimination of abrasions, less need for adjustments, and an inexpensive fabrication procedure.

e. *Nylon Hip and Knee Joints (BP10-30P).* VAPC continues to fit lower-limb amputees with hip and knee joints using Polypenco Nylon 101 as a material. This material has been used on hip joints and pelvic bands for about a year, with excellent results on a number of patients. Since Nylon 101 is more rigid than the previously used polypropylene, it can be fitted to patients with fairly short stumps. It can also be shaped cold with conventional tools. Commercial sources are in the process of fabricating a limited number of hip joints and bands for us.

The fitting of orthotic as well as prosthetic knee joints fabricated from Polypenco Nylon 101 is continuing with, thus far, encouraging results.

B. Spinal-Cord-Injury Rehabilitation

1. *Environmental Control Systems*

a. *VAPC Quadriplegic Manipulator.* This wheelchair-mounted manipulator (Fig. 5) employs a chin-controlled joystick, both to drive the wheelchair and to operate the manipulator. It utilizes a hook, which opens or closes and rotates in any direction for grasping objects,

mounted at the end of a boom that swings either left or right in any direction, or up or down through a 90 deg arc. The boom can telescope in or out approximately 3 feet, allowing it to reach down to floor level or up approximately 6 feet. A selector switch is used, in conjunction with a display, to select mode of operation. The joystick is a strain-gage joystick that responds to the force applied to it.

Clinical trials are currently underway to determine how much training is required to operate the device, what are its capabilities and usefulness for everyday tasks, and what if any improvements are required.

b. *Sears Home Control System.* Currently available from Sears Roebuck and Co., the Home Control System (Fig. 6) consists of a command console, cordless control, and modules for lamps, appliances and wall switches. Each can be purchased separately.

When the command console is plugged into any standard 115-V a.c. wall outlet in a house or apartment, it controls all modules plugged into other outlets throughout the house or apartment, so long as the console and module codes are set to agree with one another.

The cordless controller can control the command console from across a room, via an ultrasonic signal which is limited to line-of-

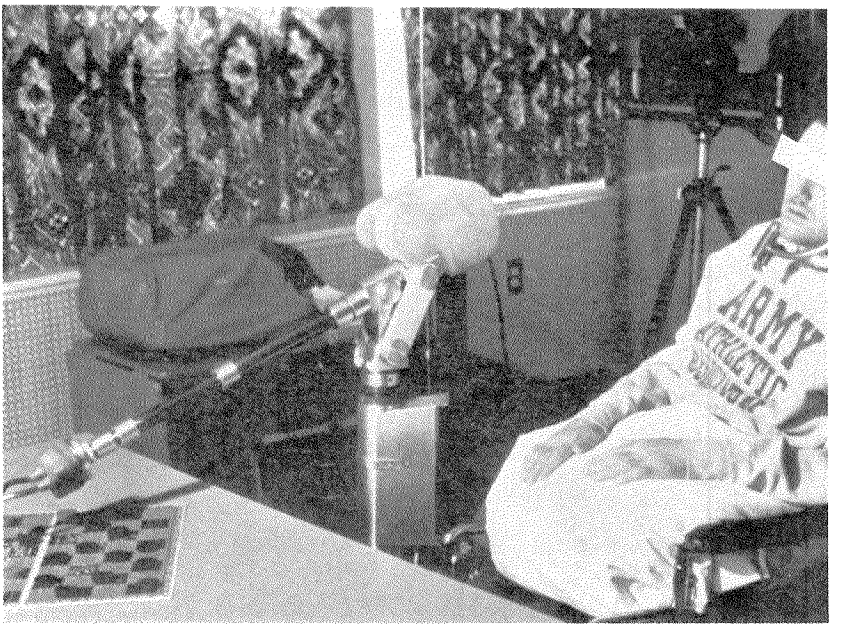

FIGURE 5.—The VAPC Quadriplegic Manipulator employs a chin-controlled joystick, both to drive the wheelchair and to operate the manipulator.

sight operation. Each console can operate up to 16 modules. Lights and appliances connected to modules can still be directly activated.

Sears is marketing the Home Control System as a convenience item for the general public. The system is currently being evaluated by the Clinical Evaluation Service, VA Medical Center, Castle Point, N.Y., for possible use by handicapped persons who do not need a complete environmental control system but can benefit from a remote control device.

c. *Turntable Desks.* This 76 in. by 44 in. twin turntable desk (Fig. 7) for high-level paralytics, designed by Mr. Arthur Heyer and manufactured by Extensions For Independence, Downey, California, enables its user to work or study by bringing equipment, books, and so forth within his immediate vicinity. The 36-in. diameter turntables, located

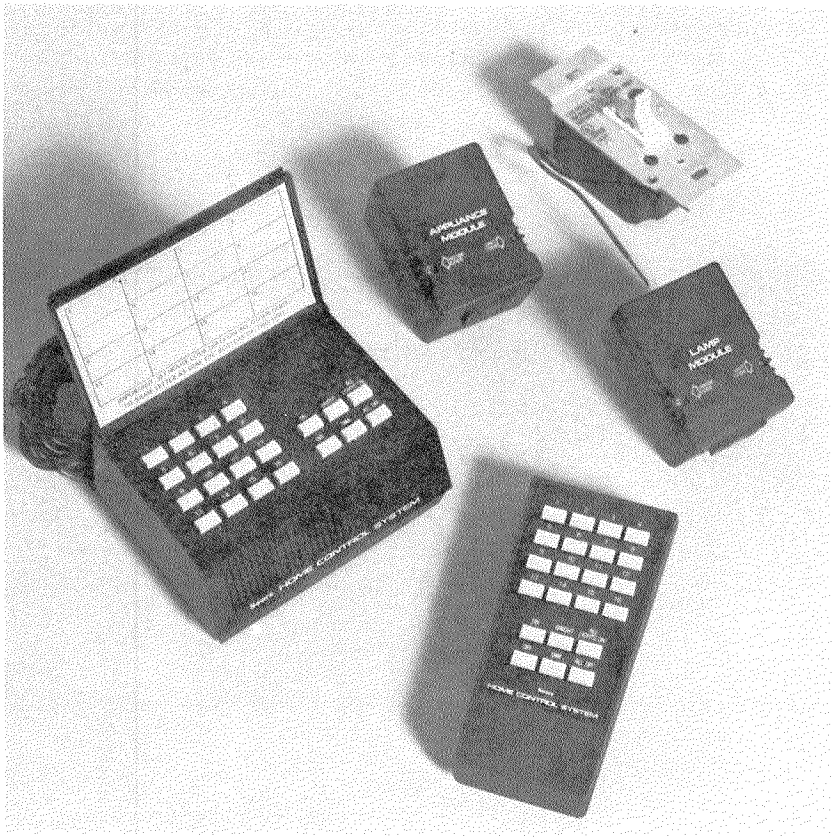

FIGURE 6. — The Sears Home Control System combines a command console with cordless control and operation modules.

at the outer edges of the desk, can either be rotated manually, by arm or a mouth stick, or automatically with a motor adaptation controlled by a toggle switch. There are center holes for electrical wires, and a 14-in. (1-in. increments) height adjustment capability. Two 25.5 in. by 17 in. extension tables are available: one forms a 90-deg angle with the desk, the other a 30-deg angle. Also available is a single 59 in. by 36.25 in. turntable model.

One desk (Fig. 7) was installed in the home of a New York State university student living on campus, who will be using it in his educational studies. Several models will soon undergo clinical evaluation through the Clinical Evaluation Service, VA Medical Center, Castle Point, New York.

d. *Magicall.* This sound-operated switch mechanism (Fig. 8), manufactured by Magicall, Ojai, California, is intended to replace the typical hospital nurse-call pushbutton. It consists of a microphone and an electronic control and power distribution unit. The microphone is placed near the user's mouth; two microphone lamps indicate its operational status. Sharp percussive sounds (i.e., clicking the teeth, clucking the tongue, grunting or coughing) activate the system.

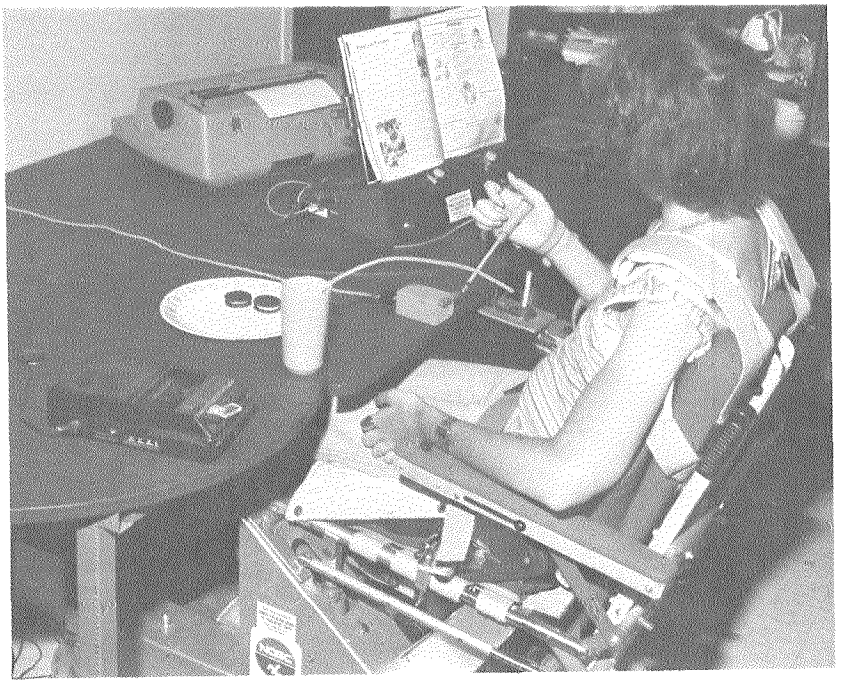

FIGURE 7. — Twin-turntable desk installed in student's home.

The electronic control and power distribution unit is housed in a box-like chassis mounted on the headboard of the bed. More recently, the manufacturer has modified this unit so that it should be possible to install it on the spring mattress of a bed. A 12-V contact socket connects the call cord to the particular nurse-call system used at the facility.

Magicall will shortly undergo clinical evaluation at the Extended Care Center, St. Albans, N.Y., and the VA Medical Center, Castle Point, N.Y.

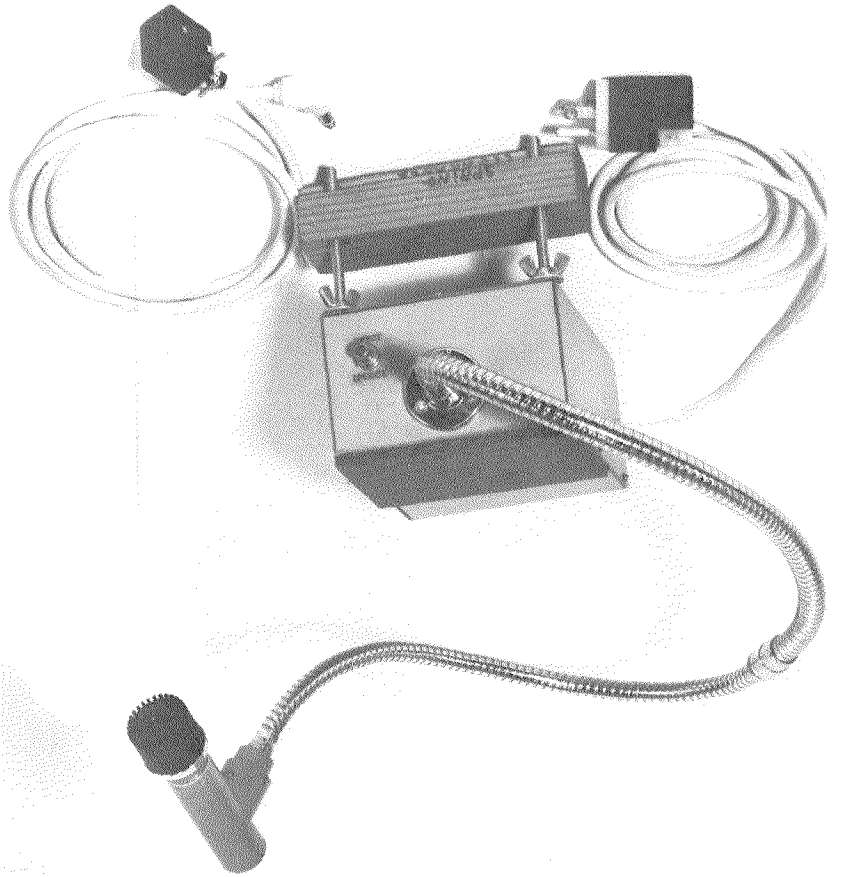

FIGURE 8.—The Magicall sound-operated switch for use as a nurse-call. Microphone on gooseneck is intended to be placed near user's mouth. Lamps on microphone housing indicate unit's operational status. One of the wire leads is power supply, the other carries a 12-V signal to hospital's nurse-call system. A "direct operate" switch can be seen on front of electronic control box.

e. *VAPC Remote Station Environmental Control.* This environmental control system (Fig. 9, BPR 10-25, pp. 59–61) facilitates operation of a variety of appliances by a high-level quadriplegic. Radiofrequency transmission is used so that the VAPC Remote Station Environmental Control, when mounted on a powered wheelchair, allows its user to select and operate appliances from his wheelchair—from any point in the home.[a]

The system consists primarily of a monitor and control unit (Fig. 10) and a receiver unit (Fig. 11). (Two types of receivers are available.) A pneumatic control unit may be included if required by the user. LED (light emitter diode) lamps on the monitor and control unit, when lighted, indicate which appliance (phone, TV, etc.) has been

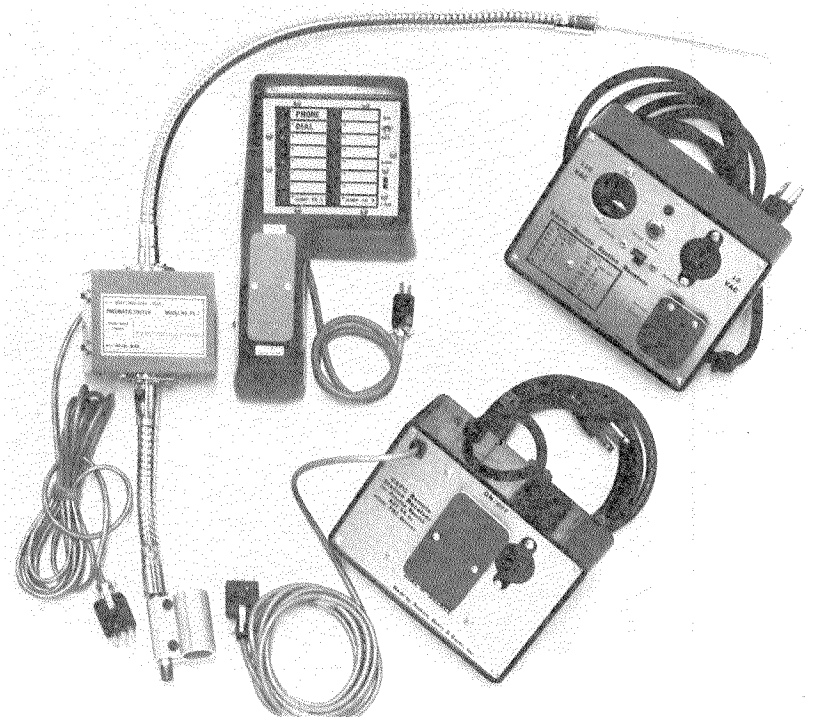

FIGURE 9.—The VAPC Remote Station Environmental Control facilitates operation of appliances by high-level quadriplegics. Wheelchair-mounted pneumatic switch and monitor/control unit are at left; a pair of remote station receivers are at right.

[a] All commercially available environmental controls evaluated to date have either required the user to operate appliances from a fixed location or, if he has remote control capability, to remain within viewing range of the monitor. The capabilities of newer systems (such as the Home Control System distributed by Sears Roebuck Co.) will be determined through evaluation.

selected by the user. The user makes his selection by depressing a rocking lever actuator control. This control operates two microswitches: one (at the bottom), to activate a selected appliance, the other (at the top) selects the desired appliance. Appliances are selected sequentially. The second switch, when depressed, also sets the selection sequence back to the top position (the 1 or 9 position) in the monitor column when the sequence has advanced to the JUMP TO 1 or 9 position.

One of the two types of receivers contains three outlets (at right in Figure 11): 110 V. a.c., 12 V a.c., and (SWITCH CLOSURE) shorting jacks. The first two are for 110-V a.c. and 12-V a.c. appliances, respectively, and the shorting jacks are used to turn a television channel selector switch through a stepping switch arrangement. (A paddle lever switch is an alternate actuator.) A selector switch provides a choice between momentary or latching modes: e.g., in the LATCHING mode, an appliance, such as a lamp, would activate when the paddle lever switch was depressed, and remain on until the switch was again depressed. In the MOMENTARY mode, the lamp would go off when the paddle lever switch was released.

The second type of receiver is used to operate a telephone. Two

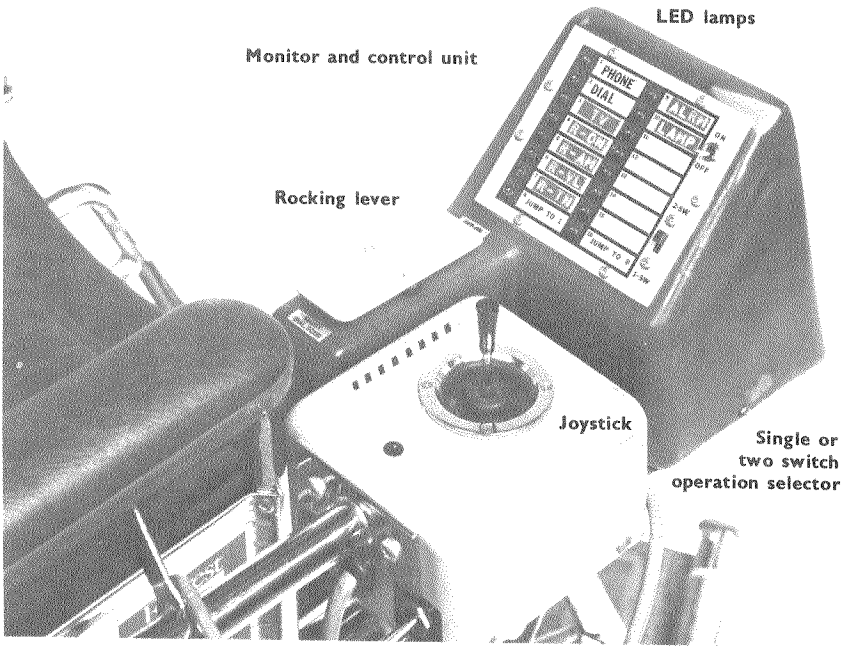

FIGURE 10. — Remote Station Environmental Control's monitor-and-control unit is seen mounted close to power wheelchair's joystick.

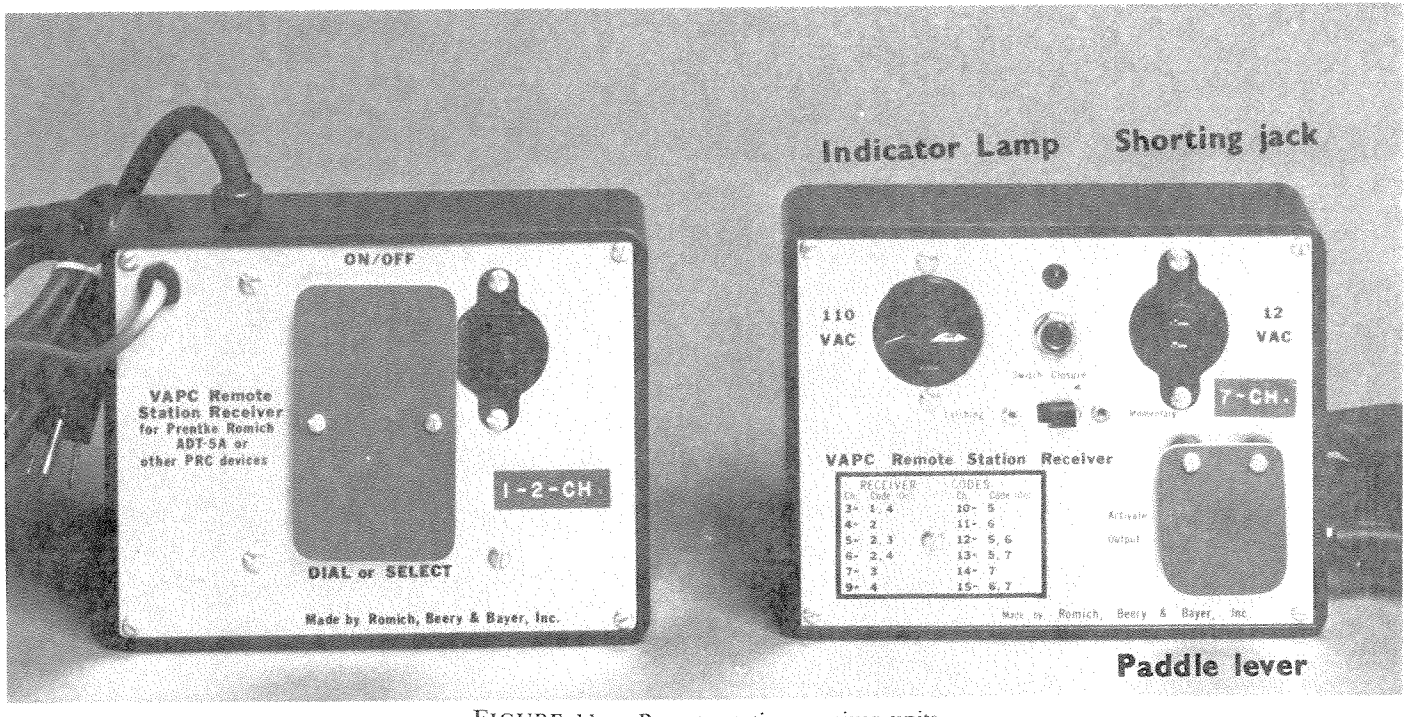

FIGURE 11. — Remote station receiver units.

microswitches are used to, first, activate or deactivate the telephone (ON/OFF), and, second, to dial the number (DIAL OR SELECT).

Up to 14 channels can be accessed by this system, and the operating mode can be either single-or-dual-switch: e.g., the user may utilize a sip and puff control arrangement (Fig. 12) or simply a puff control. A single 12-V battery is used to supply power.

The device will be evaluated by the VA Medical Center, Castle Point, New York, by the Extended Care Center, St. Albans, New York, and by the Institute of Rehabilitation Medicine, New York University Medical Center, New York.

2. *Communication Aids*

a. *ZYGO Eye Transfer Communication System.* This device (Fig. 13),

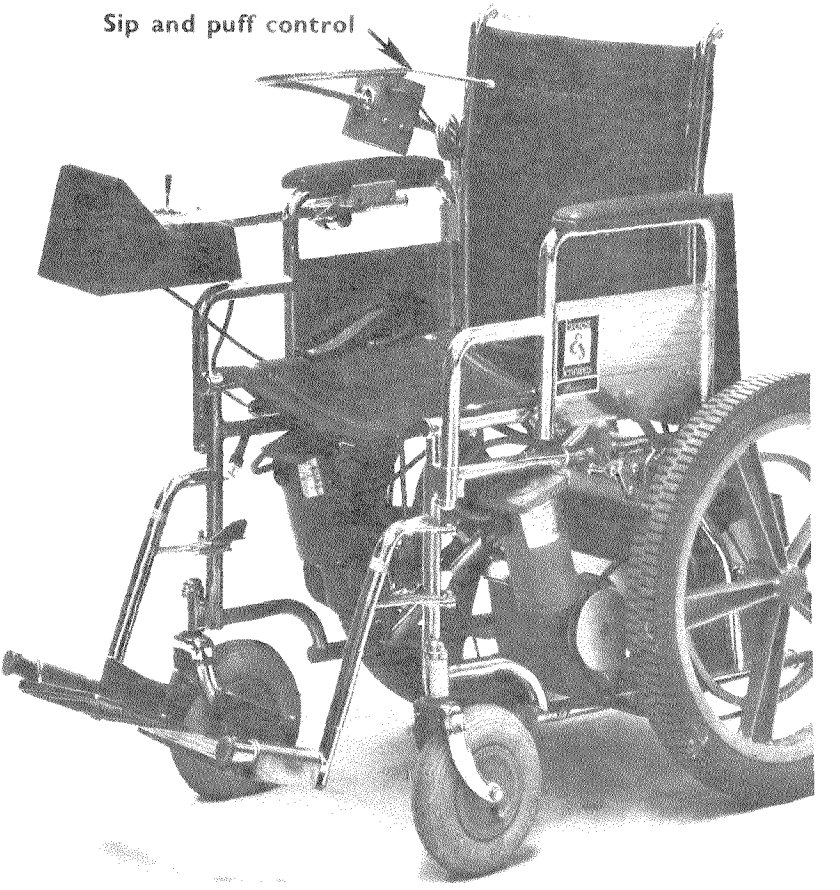

FIGURE 12. — Remote Station user may utilize a sip-and-puff control.

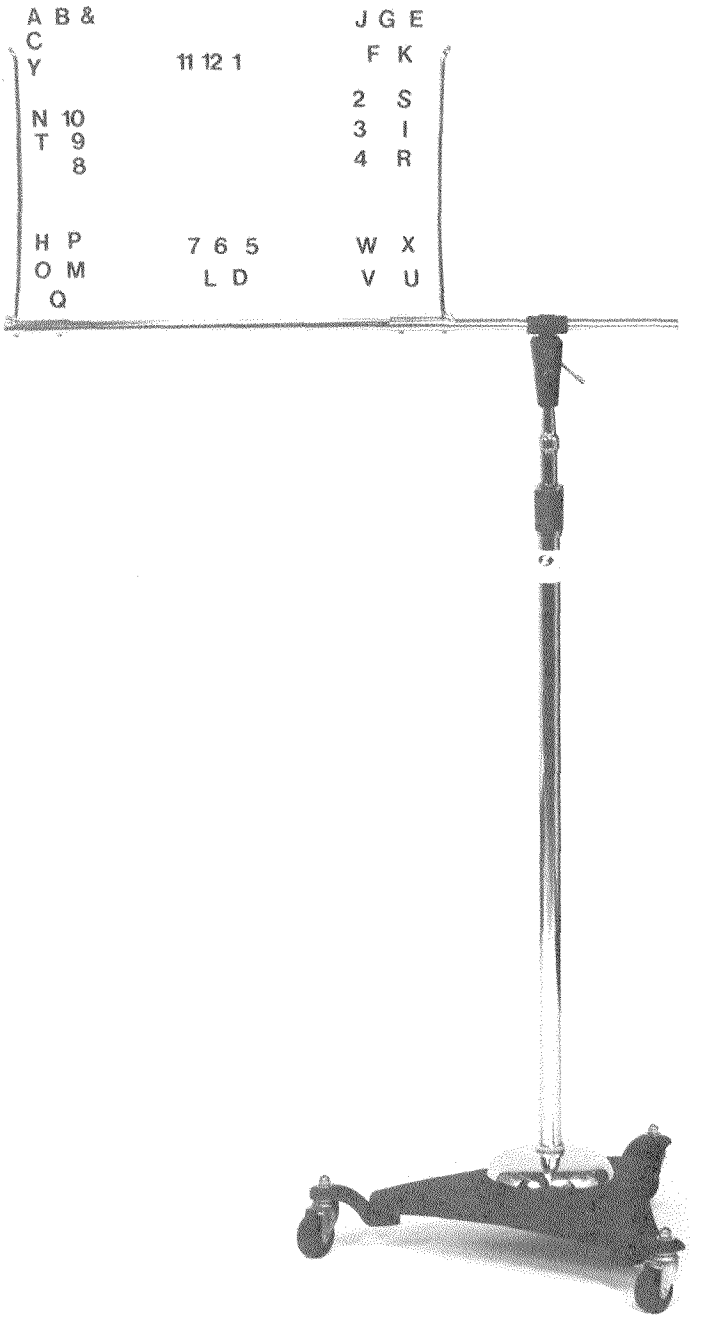

FIGURE 13.—The ZYGO Eye Transfer Communication System employs an eye gaze technique for communicating.

manufactured by Everest and Jennings, Inc., based on the ETRAN (Eye Transfer Chart), is designed to permit a paralyzed, nonverbal person to use an "eye gaze" technique to communicate with another person.

The lettered transparent plastic panel is held between the sender and receiver. (The center of the board is cut out to facilitate eye contact.) On the panel are eight groups of entries (letters, numbers, words, or other symbols) arranged in a rectangular manner: left top, top center, right top, left center, right center, left bottom, bottom center, and right bottom. Each group contains up to eight entries arranged as the group pattern on the board is arranged.

The aid is mounted on a weighted wheelbase above beds, mats, etc. It is adjustable in height. It can also be wheeled in front of a seating system. The clinical model allows for vertical and horizontal adjustments of the communication display, to facilitate the most direct sender/receiver eye contact.

The system comes with a blank Plexiglas display panel, a sheet of dry transfer letters and numbers. Letters and numbers were placed on the Plexiglas to facilitate the photography of this device. This letter arrangement is one of many formats that may be used for message display.

An entry is selected by two gazes. The first gaze selects the group; the second gaze then selects the entry within the group. The second gaze is directed to the group that occupies the same location on the display board selected by the first gaze.

In using the system, the sender should establish eye contact after each symbol selected; early in the learning experience, eye contact should be established after each gaze.

The system will soon undergo clinical evaluation.

b. *Canon Communicator.* This device (Fig. 14), distributed in the United States by Telesensory Systems, Inc., Palo Alto, California, is functionally equivalent to a small portable typewriter that provides printed matter on a paper strip. It is designed for persons who are unable to speak or write, but who have sufficient motor control to point at or depress keyboard characters. It can be hand-held, placed on a flat surface, or attached to a wheelchair. The arm belt allows it to be worn on the wrist or, with extension belts, on other parts of the body.

The keyboard consists of 26 keys, one for each letter of the alphabet (vowels and consonants are differentiated by color), and shift, correction and space keys. With the shift key depressed, a second series of characters, consisting of numbers 0 to 9, numerical notation, and

punctuation marks can be printed. The keys activate a printer that produces characters on a paper tape. Special keyguards have been designed to facilitate use by patients having muscular problems. The aid is powered by an external nickel-cadmium battery pack that can be placed in a pocket or on a belt.

The device is currently undergoing clinical evaluation at the Castle Point, New York; Northport, New York; and West Haven, Connecticut, VA Medical Centers. Thus far, it appears to be an effective speech and language prosthesis. Patient training for device operation has been minimal, requiring no more than one explanation of instructions, and little time was required for practice. Recommendations for improvement have included rearranging the keyboard into the United States accepted alphabet, and better provisions for stabilizing the device when it is not attached to the body.

c. *ZYGO Model 100.* This portable scanning communication device (Fig. 15), manufactured by Zygo Industries, Portland, Oregon, and distributed by Everest & Jennings, Inc., Los Angeles, California, is designed to enhance the communication skills of the severely disabled who cannot express themselves due to motor impairment. The device employs a microswitch control and a message board that consists of 100 message squares in a 10-square by 10-square matrix, with a light-emitting diode (LED) in each square. Operating power comes from a built-in rechargeable battery.

The LED's illuminate, sequentially from top to bottom in each row, after the control switch is depressed; this action continues until the

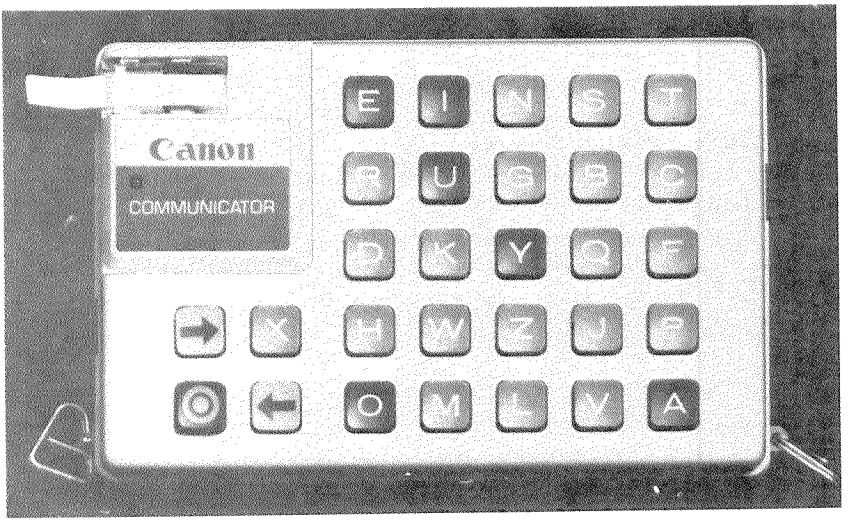

FIGURE 14.—The Canon Communicator produces printed matter on a paper strip.

control switch is again depressed, which the user does when the desired horizontal row is reached. The selected row will then be continuously scanned until the switch is again depressed—at the desired square. At that square, the selected message LED will flash on and off for a brief time. If the actuator switch is operated within that time, the message will be "erased"—if not, the message will be stored in the device's memory circuits. Sufficient space is available in each individual square to indicate, in pictorial or written form, preselected messages. The memory circuits are able to recall any 16 items (words, pictures or preselected messages) in the order of entry.

An audible alarm is available to attract attention and thereby call for assistance. Rate of scanning and selection delay time are adjustable.

The device is currently undergoing laboratory analysis. It will be clinically evaluated in the near future.

d. *VOTRAX Handi-Voice System, Models HC 110 and HC 120.* These improved versions of an earlier design (BPR 10-28, pp. 101-102), commercially available from Vocal Interface Division, Federal Screw Works, Troy, Michigan, are portable, battery operated, electronically-synthesized-speech aids for nonverbal/nonvocal populations.

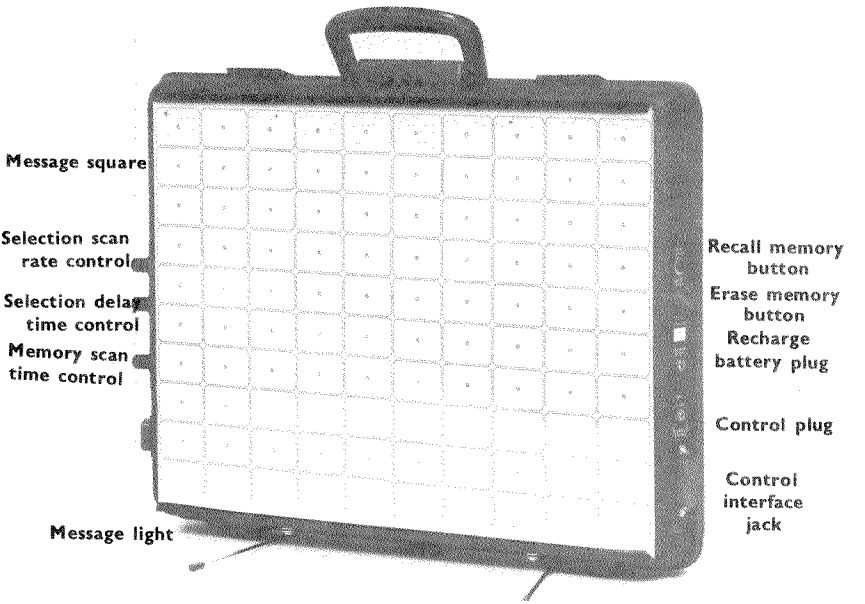

FIGURE 15.—The Zygo Model 100 portable communication scanner for the severely disabled with motor impairments.

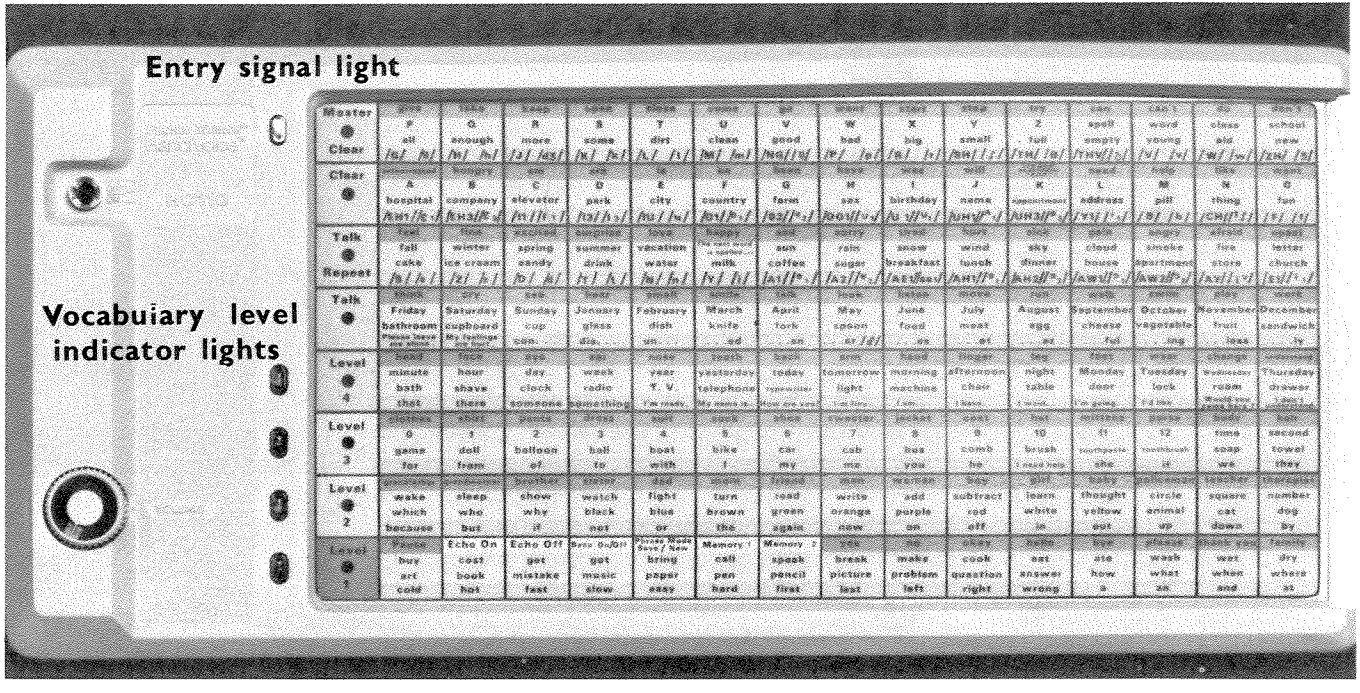

FIGURE 16.—The Votrax Handi-Voice System, Model HC 110, presents words, symbols, phonemes and control functions on a matrix.

The devices simulate the human voice and are capable of producing complete sentences.

Model HC 110 (Fig. 16) employs a direct-selection display board to present a self-contained vocabulary of words, symbols, phonemes, and control functions on a 128-position matrix. Each selection that occupies a position on the key pad is activated by light pressure. Four color changeable overlays differentiate four instrument features that include selectable functions, memory, and repeat modes. The pitch and rate of speech output may be varied by an adjustable control. Each vocabulary square has four different options, one for each of the four storage levels. Levels may be accessed sequentially to compose a message. To communicate, the user scans all four levels for the desired selection, noting level and square location of each. The user presses the numbered level square desired for the first selection. Its adjacent indicator light glows. The user then presses the corresponding chosen vocabulary squares sequentially. Each selection may be echoed (auditorily confirmed) and entered into memory. An entry indicator light flashes to show that each entry is complete. The process would continue until the message is complete. Pressing the "TALK" square allows the entered message to be played in sequence. Touching the "MASTER CLEAR" square cancels the message.

The Model HC 120 (Fig. 17) utilizes a numeric keyboard and a liquid crystal display. Available controls adjust the volume, scroll rate, sensitivity level, and the rate and pitch of the speech output.

The unit has a language base consisting of a self-contained vocabulary of words, phrases, alphabet, and phonemes. The language base is accessed by the user, either manually or through a scrolling technique, through selection of a three-digit code. Vocabulary selections are represented as three-digit codes; they are accessed by pressing the keys on the calculator-like keyboard. (Auxiliary switches, either microswitch or sound-sensitive, may be used by patients with limited motor skills to enter the vocabulary in the scroll mode.) Activation of the switch begins scrolling; a second activation is used to select each digit. The numerals 0 through 9 are rotated in each of the digit positions in the liquid crystal display (LCD) window from left to right. The speed of digit rotation may be adjusted by the scroll rate control knob.

Early results indicate that much memorization and practice is necessary to use both the random access HC 110 and the encode mode of the HC 120. The sound quality of the synthesized speech output is considered to be undesirable but understandable. Additionally, the phonetic concept appears to be too complex for subsequent patient learning. Final results should be available in the near future.

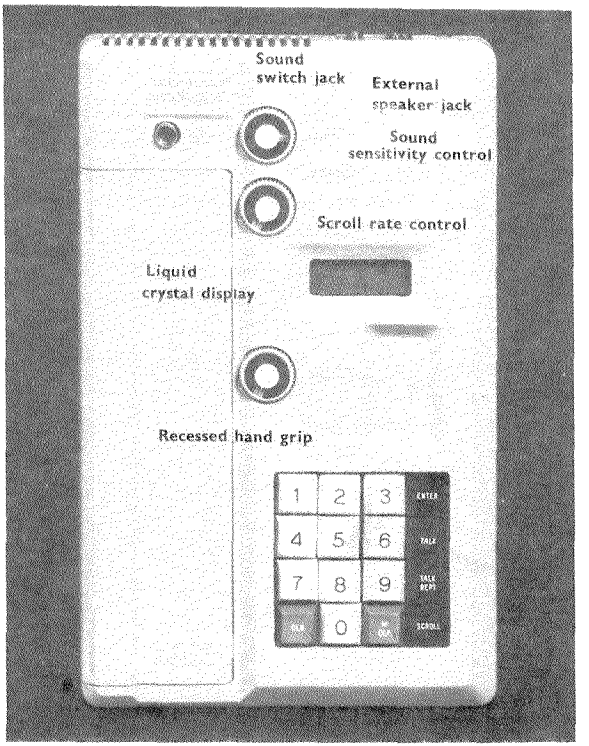

FIGURE 17. — The Votrax Handi-Voice System, Model HC 120, presents words, phrases, phonemes and alphabet on a liquid crystal display.

The communication aid is being clinically evaluated at the Asheville, North Carolina; Tampa, Florida; Durham, North Carolina; and Castle Point, New York, VA Medical Centers, and at Goldwater Memorial Hospital, Roosevelt Island, New York.

e. *Form-A-Phrase.* This voice output device (Fig. 18), manufactured by Scitronics, Inc., Bethlehem, Pennsylvania, consists of a main unit and either a keyboard control, numberboard, touchswitch, or wordboard. The user selects words to be spoken by one of two basic methods: one, by manually moving a marker to the desired printed word(s) on a large board, the other, by entering an encoded three-digit number to select any specific utterance.

The numeric keyboard control is similar to a hand-held pocket calculator. The user presses the keys sequentially for the three-digit number corresponding to the desired word or phrase. After the third digit has been entered, the main unit vocalizes the selection. All digits

are immediately displayed on the main unit. An erroneous entry can be eliminated by pressing a clear key.

The numberboard is operated exactly the same as the keyboard. The user sequentially enters a three-digit number, which is labeled inside large circles imprinted on top of the numberboard surface. Instead of depressing keys, the user enters a digit by manually positioning a movable marker (containing a magnet) over the desired circle.

The method of entering digits with the touchswitch differs from that of the keyboard or numberboard. Touching and maintaining

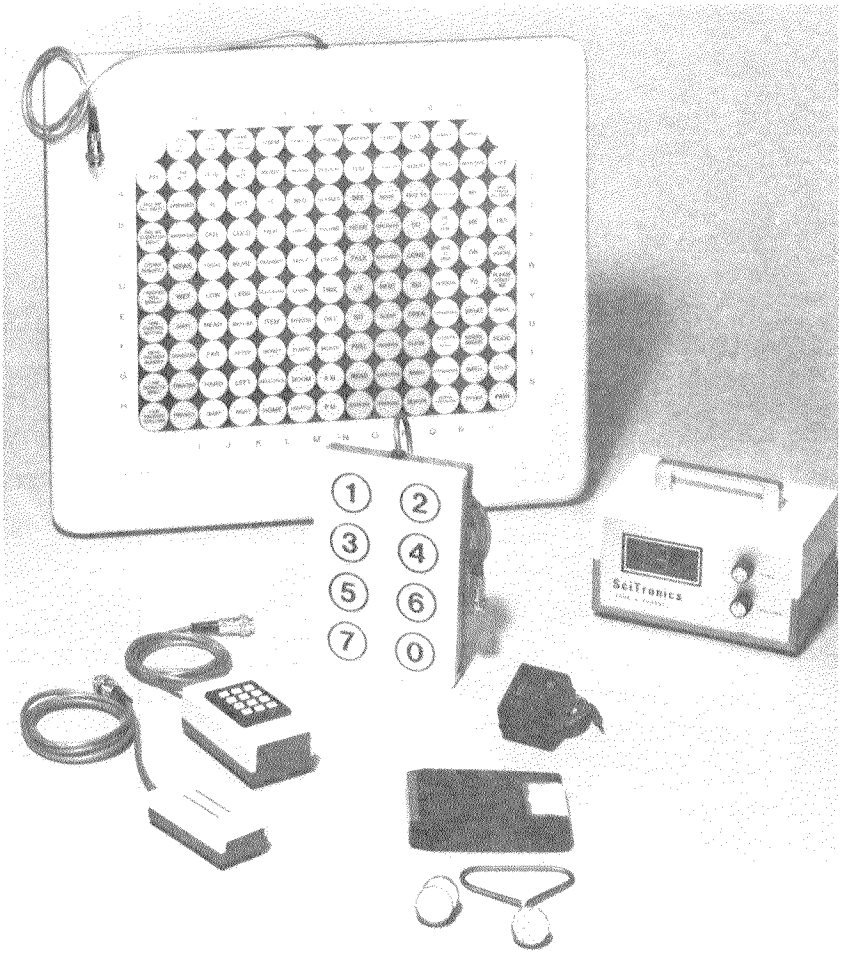

FIGURE 18.—The Form-A-Phrase voice-output device provides a manual marker or a three-digit code to select utterances.

contact across two parallel rods on the top surface of the numberboard causes the sequence of digits to begin to scroll upwards from zero. Releasing the rods when the appropriate digit appears stops the scrolling sequence and enters the first selected digit. This sequence is repeated for the second and third digits to enter the three-digit number and thus complete the utterance selection.

The time-control knob on the main unit can be adjusted to allow up to 8 seconds between counts, to accommodate different user reaction times for the keyboard, numberboard or touchswitch.

The wordboard is best suited for those who prefer "pointing" to a printed word or phrase and having that selection automatically vocalized. The user must have the motor capability to manually move a magnetic marker around a smooth plastic lap tray imprinted with the vocabulary. The duration of time that the marker must be over any word or phrase before the main unit "speaks" is adjustable up to 12 seconds.

The standard vocabulary cartridge supplied with the system contains 128 utterances, each consisting of one to five words. By combining these utterances, sentences can be formed. The vocabulary cartridge is available in adult male and female and children's voices. Specially ordered custom vocabulary cartridges can be substituted for the standard one. The system will soon undergo clinical evaluation.

3. *Mobility Aids*

a. *Cushion Lift Wheelchair Model 4000.* This manual wheelchair with electrically powered seat (Fig. 19 and 20), manufactured by Ortho-Kinetics, Inc., Waukesha, Wisconsin, and distributed by Handi Lift, Inc., Mahwah, New Jersey, is designed for those handicapped who require both wheelchair mobility and help in rising from a wheelchair seat or extending reaching height. The chair weighs 80 lb; lifting capacity is 500 lb. The lifting mechanism is powered by standard 115-V a.c. house current or a built-in 12 V battery. The seat can be adjusted to tilt approximately 45 deg maximum at maximum lift. It is currently undergoing clinical testing through the Clinical Evaluation Service, VA Medical Center, Castle Point, New York.

b. *Freedom Chair.* This manual, lightweight, portable and foldable wheelchair (Fig. 21 and 22) for handicapped travelers is imported from England by Invacar of America, Inc., Binghamton, New York. Folded, the device is under 20 in. high, 33 in. long, 10.5 in. wide, and weighs 37 lb. It can be carried in a nylon carrying bag. Push rims are 16 in. in diameter, and tires are 19 in. in diameter. The device is currently undergoing clinical evaluation through the Clinical Evaluation Service, VA Medical Center, Castle Point, New York.

FIGURE 19.—Cushion Lift Wheelchair Model 4000 manual wheelchair with electrically powered seat.

c. *Stand Aid Powered Wheelchair.* This powered wheelchair with powered stand-up feature for paraplegics and low level quadriplegics (Fig. 23) was developed by the Naval Oceans System Center (formerly Naval Electronics Laboratory Center), San Diego, California, under a VA contract. This is the second model of this device. The initial model (BPR 10-23, p. 241; BPR 10-24, pp. 185-186; and BPR 10-25, pp. 151-153) underwent clinical tests in 1975; most of our recommendations for improvement were incorporated into this second model.

Four units underwent controlled clinical testing. Paraplegics were able to utilize the device and were adequately supported, but none of the subject paraplegics were willing to continue its use. One quadriplegic, who had sustained an incomplete C-7 lesion, was able to use the device by locking his knees. However, the majority (who were unable to lock their knees) require a modified support system (Fig.

FIGURE 20. — Cushion Lift Wheelchair in tilted configuration.

24) developed by the Clinical Evaluation Service, VA Medical Center, Castle Point, New York. One individual, who lives in his own apartment, used one of the wheelchairs with an audio alarm to remind him to change positions at given times. For example, the alarm sounds when a preset time period has elapsed, perhaps a half hour; the times are set independently for standing and sitting. (Standing position is defined as approximately 30 deg forward of the sitting position.)

Modifications (mentioned above) included a shoulder-thoracic-waist

FIGURE 21. — The Freedom Chair is a manual, lightweight, portable and foldable wheelchair that can be carried in a nylon bag.

harness, commercial thoracic supports with a Velcro belt tieing two side supports together, a modified knee support with a relatively much larger area of contact, and angulation of the foot plates. For one individual, an adaptation was made to raise his armrest by several inches. The original lifting belt beneath the buttocks, approximately 6 in. wide, was replaced by a standard hammock wheelchair seat adapted to the frame. This has actually worked out well for two individuals, since it allows them to use standard wheelchair cushions and spreads the lifting force over a much broader area. By using the full hammock seat and wheelchair cushion, the hips are moved slightly

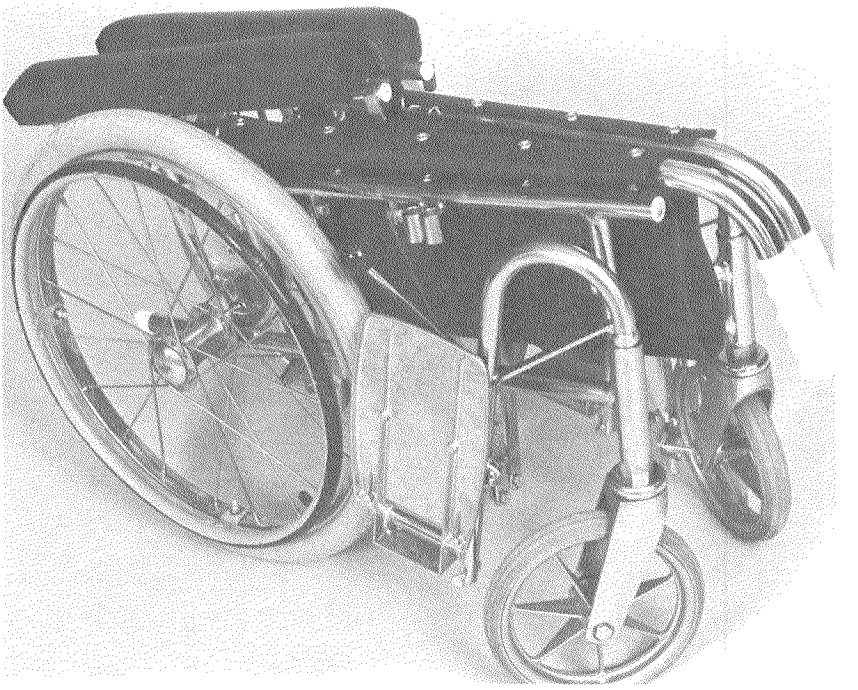

FIGURE 22. — The Freedom Chair in folded configuration.

forward to help lock the knees and provide good skeletal weightbearing and body-angle position.

For one individual, the seat back was tilted forward at the top for a more comfortable standing position.

Clinical tests through the Clinical Evaluation Service and laboratory tests by the Mobility Aids Laboratory, VAPC, New York City, are being continued, to determine the functional usefulness of the device, and to obtain performance specifications.

d. *Convertible Armrest Wheelchair/Walker or Parallel Bars.* This essentially conventional manual wheelchair (Fig 25) with detachable armrests, submitted by Camp International, Inc., Jackson, Michigan, can be converted into a walker (Fig. 26) or parallel bar device (Fig. 27). It is designed to assist persons with various physical disabilities (e.g., hemiplegia, amputations, fractures, arthritis, low-level spinal cord injuries) and geriatric patients, to stand upright or transfer. It can also function as a pick-up or wheeled walker (the crutch tips would have to be interchanged with wheels). Similar devices include the Edwards Walker (BPR 10-14, p. 225) and the Stand-O-Matic (BPR 10-4, p. 184). A prototype unit is currently being evaluated for use and prac-

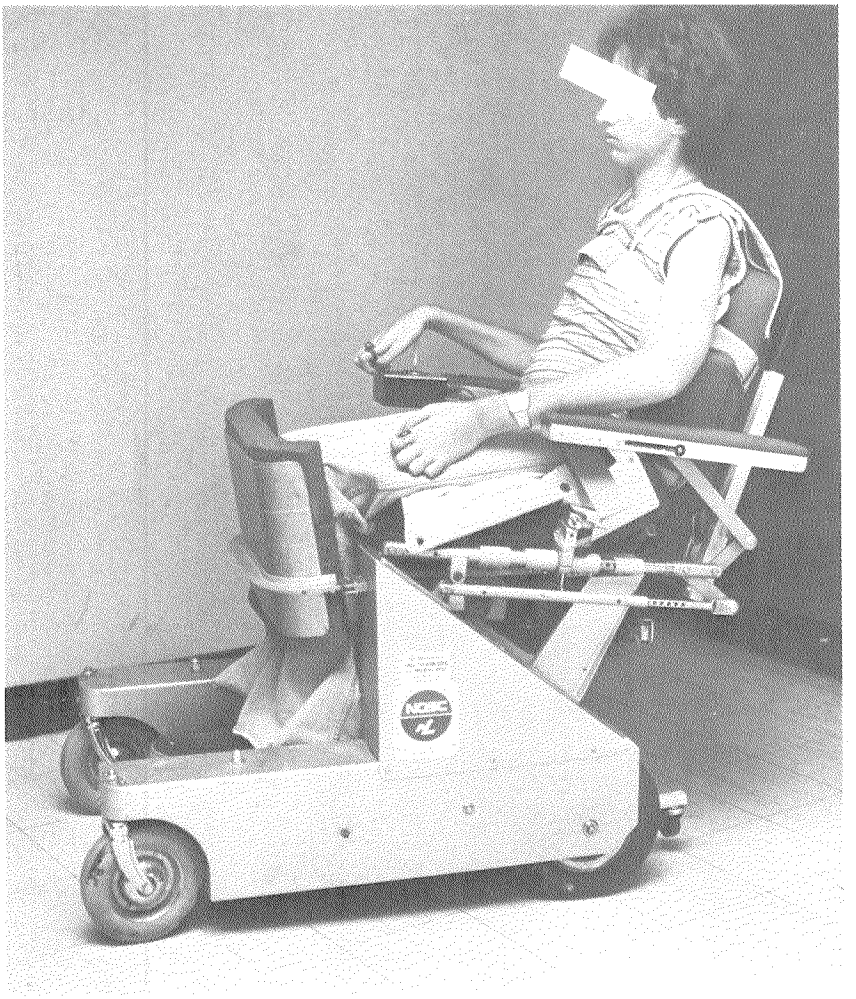

FIGURE 23.—Stand Aid Powered Wheelchair with power stand-up feature for paraplegics and low-level quadriplegics.

ticability through the Clinical Evaluation Service, VA Medical Center, Castle Point, New York.

e. *Powered Wheelchairs (For Dental Care).* For the past several years, the VAPC's Clinical Evaluation Service, VA Medical Center, Castle Point, New York, in cooperation with the Dental Service, has been striving to alleviate positioning problems in dental care for the wheelchair-confined, particularly quadriplegics. The Automatic Wheelchair Lift (BPR 10-17, pp. 227–228) was inadequate for use

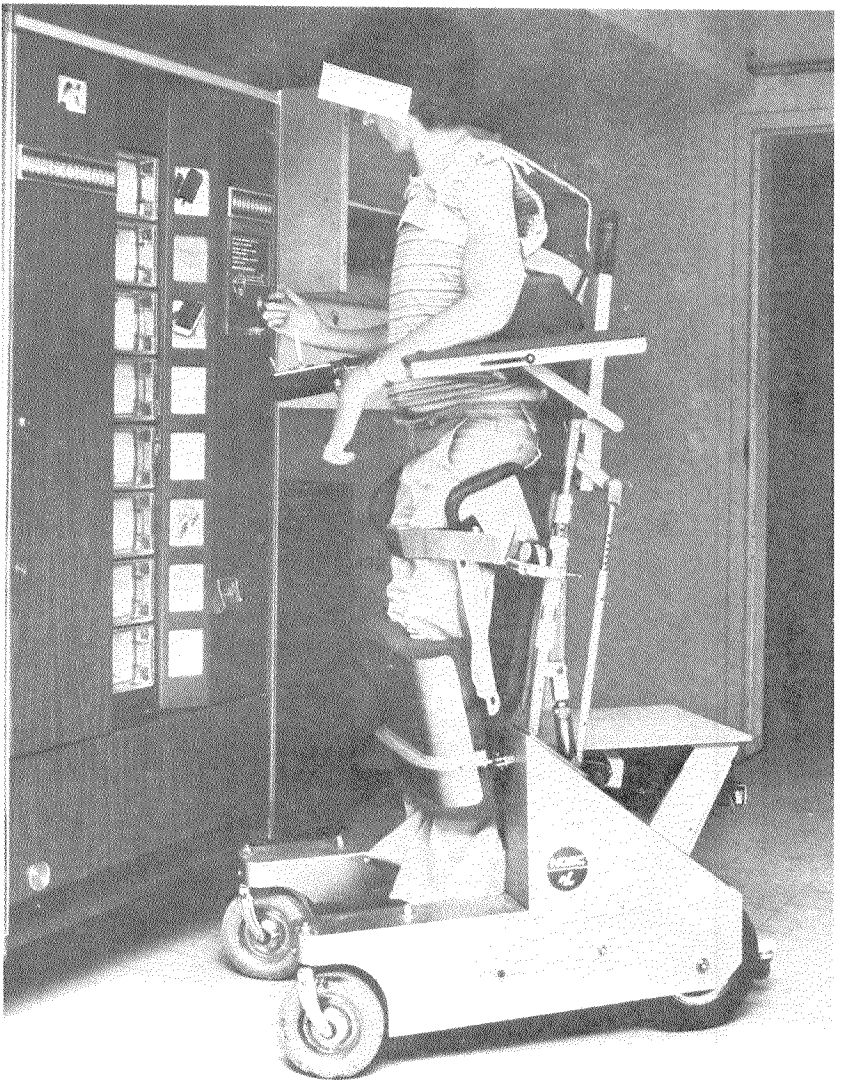

FIGURE 24. — Stand Aid Powered Wheelchair with modified support system

with electric wheelchairs due to acid spillage and subject discomfort during dental procedures. Dentists themselves experienced discomfort during treatment of patients in conventional wheelchairs due to the size and shape of the chairs.

Upon inquiry, it became apparent that no special modification of specific equipment had been developed for the spinal-cord-injured

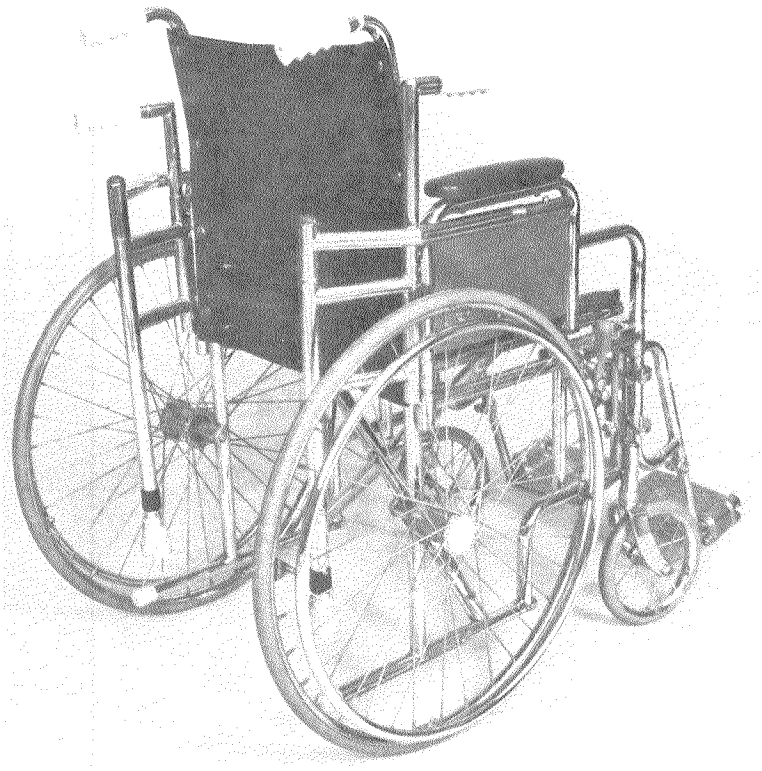

FIGURE 25. — Convertible armrest wheelchair/walker or parallel bars device.

person requiring dentistry, resulting in minimal and difficult dental care.

The program to develop an adequate wheelchair for this purpose began with the use of a UC-BL PRAHN wheelchair (BPR 10-26, pp. 234—236). The Chief of the Dental Service was able to complete his treatment 2 weeks ahead of schedule on the first patient to use the reclining feature of the PRAHN chair during dentistry. The PRAHN's armrests and footrests were subsequently modified, and a neck support was added, to enhance both comfort and positioning.

Several commercial wheelchairs have also been tried, in an effort to identify those characteristics of commercially available wheelchairs that would be helpful in dentistry.

FIGURE 26. — Convertible armrest wheelchair/walker or parallel bars device in walker configuration.

Due to its reclining and lowering characteristics and narrow shape, the PRAHN wheelchair was an excellent unit with which to initiate the program. The Everest and Jennings Postura with a General Teleoperators powered back recliner (Fig. 28) proved to be comfortable, but the back recliner was found to be inadequate because it only raised and lowered the back, without coordinating the feet. And be-

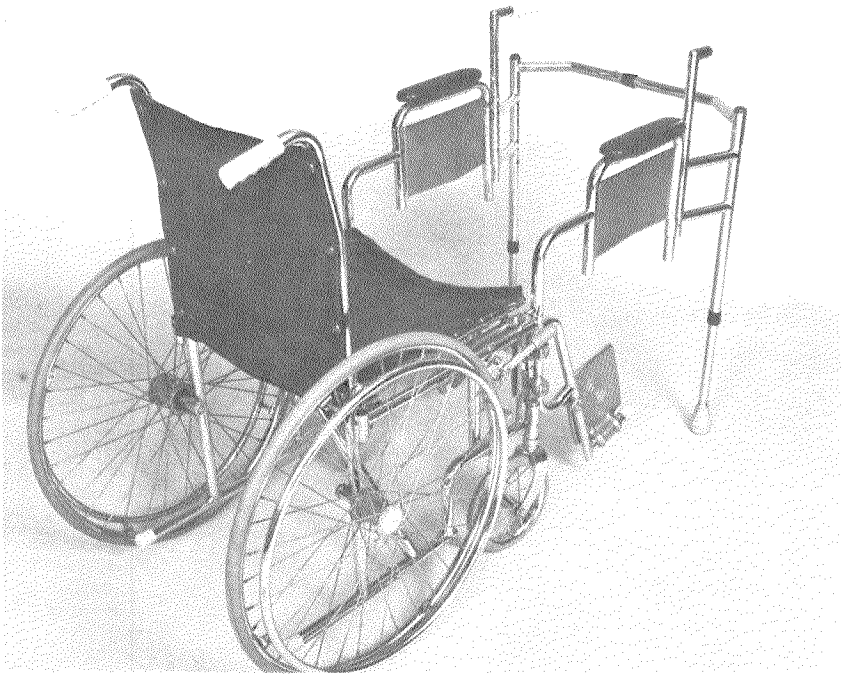

FIGURE 27. — Convertible Armrest Wheelchair/Walker or Parallel Bars device in parallel bars configuration.

cause the device projected in the rear, the dentist and his assistants were unable to get close to the patient. Several models of Independent Powered Reclining kits, manufactured by Falcon Research and Development, were evaluated. One kit, which articulated the back and legs, lowering and raising them, was installed on the Postura (Fig. 29, 30, and 31) and is being used successfully. The Japanese Imasen powered wheelchair (Fig. 32) and the Medical Equipment Distributors powered wheelchair (Fig. 33) are also being used in the Dental Service.

Several hundred wheelchair-confined patients have been treated by the Dental Service since the start of the program. The level of efficiency of treatments is now far greater than had been previously attained — many dental procedures that would not have been even considered in the past, procedures that were very uncomfortable for the patients (i.e., frequent changes of the patient's position to help relieve pressure and control spasms, etc.) or that required numerous visits for short periods of time, are now nearly routine.

The immediate goal of the program is to specify several wheelchair packages with the proper characteristics, which can be procured from

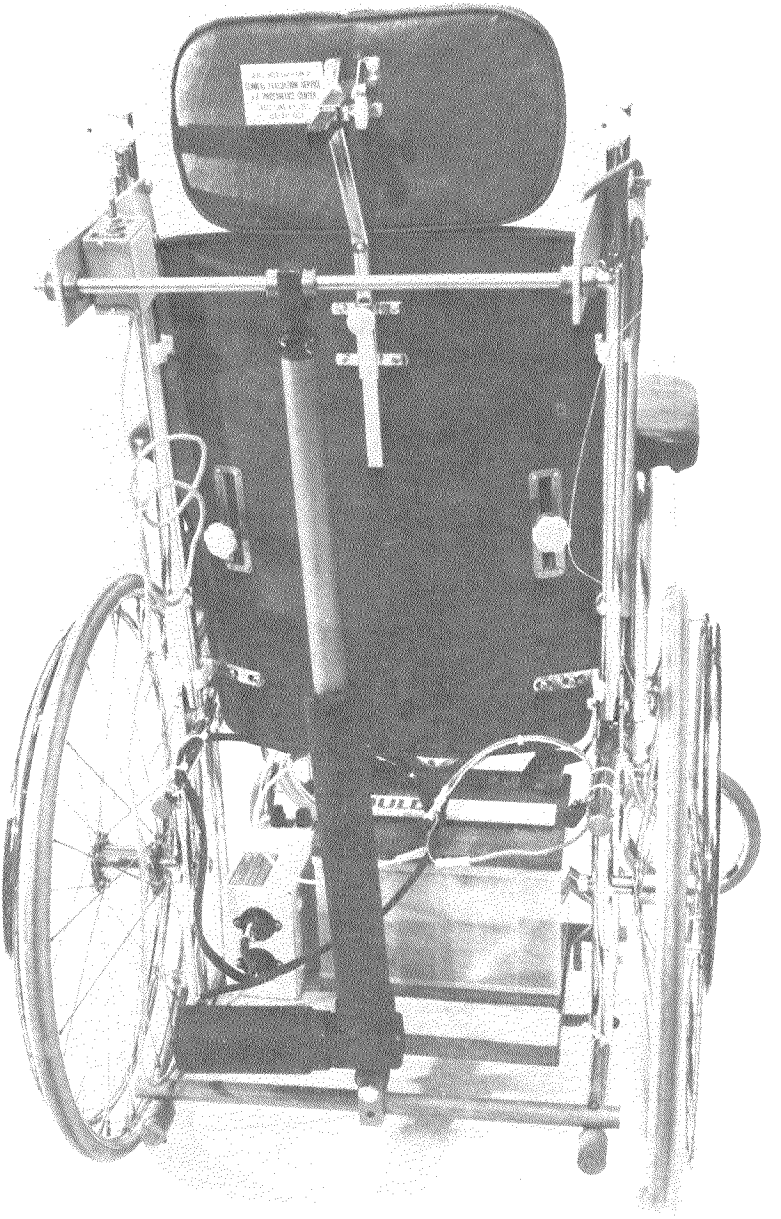

FIGURE 28. — E&J Postura with General Teleoperators powered back recliner.

commercial vendors and used by rehabilitation centers with dental services.

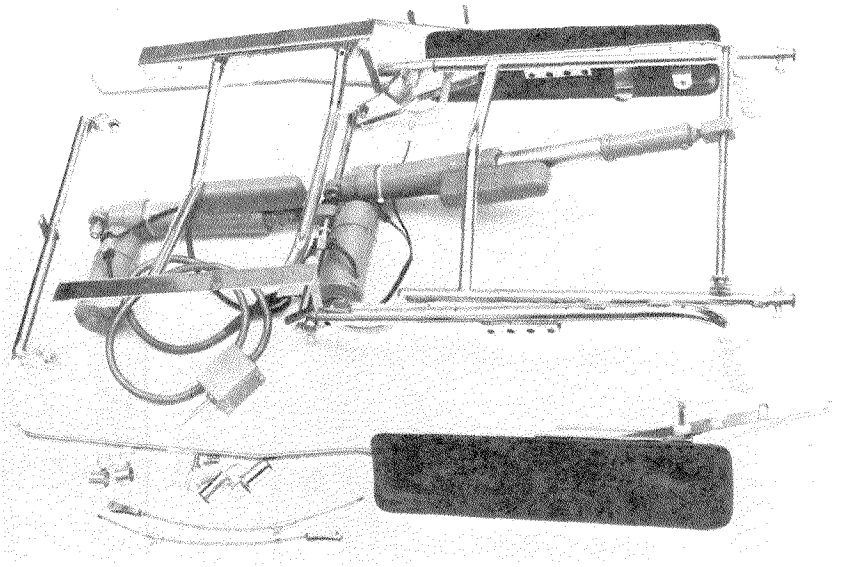

FIGURE 29. — An Independent Powered Reclining kit of the type installed on the Postura wheelchair.

Articles on this program have appeared in the following publications:

1. American Dental Association News: Dec. 25, 1978, p. 10.
2. Eastern Paralyzed Veterans Association Monthly Report: March 1979, pp. 11 and 13.
3. Veterans Administration Vanguard: May 15, 1979, XXV (17), p. 2.

f. *E&J Independence Recliner.* The Independence Recliner (Fig. 34 and 35), manufactured by Everest & Jennings, Los Angeles, California, is a joystick-operated powered wheelchair with proportional electronic control. Power is supplied by a single 12-V battery and charging is accomplished by means of an automatic battery charger rated at 6 amperes.

The drive mechanism, similar in design to that of other commercial powered wheelchairs, utilizes two motors connected to the rear drive wheels by means of a clutch and belt assembly. When this assembly is disengaged, the chair may be pushed about as a manual wheelchair. The four tires are solid and are mounted on spoked metal wheels. Anti-tipping devices, projecting rearward from the bottom of the battery holder, are provided.

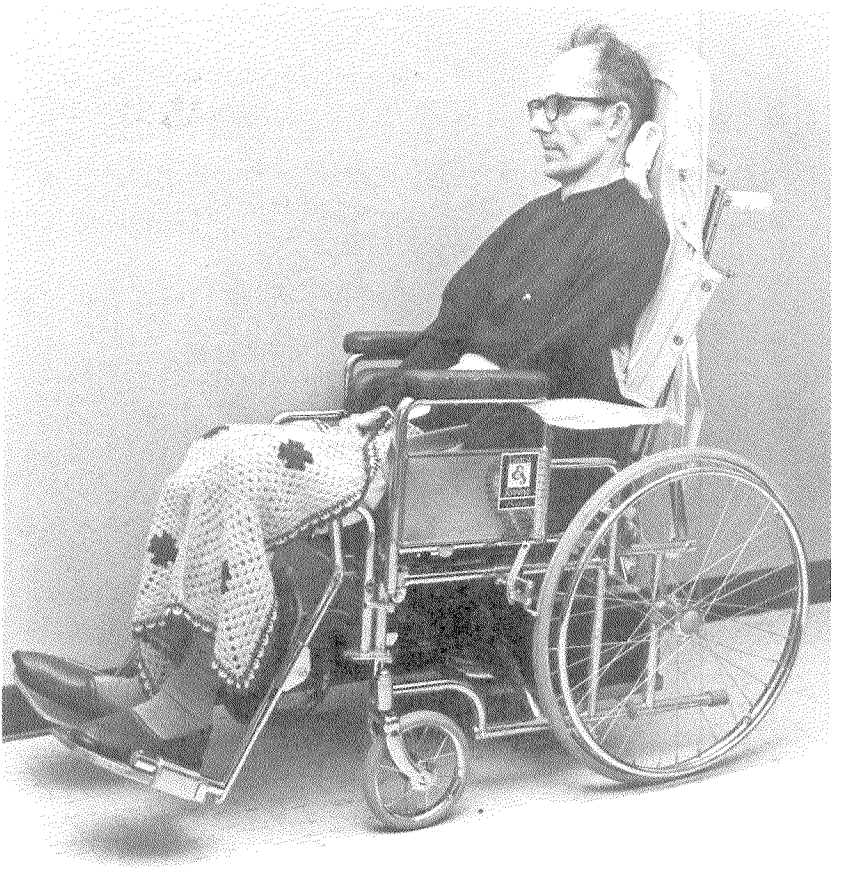

FIGURE 30. — Postura wheelchair, with kit installed, in nearly upright seating configuration.

The prominent feature of this wheelchair is the powered recliner, operated by a toggle switch control adjacent to the drive joystick. The operator may recline in an infinitely variable number of positions from a full 90 deg upright to a nearly 0 deg position parallel to the floor surface. In the upright position, the back support forms a 90 deg angle with the seat, the head support is fully retracted, the leg supports are at a slightly raised angle, and the arm supports are at a pre-selected position. Once reclining is initiated, the first component to move is the head support, which locks-in flush with the back support. Next, as the back reclines, the leg and arm supports move in a coordinated manner so as to support the limbs as the body descends into a prone position.

A linear actuator, located behind the back support and above the

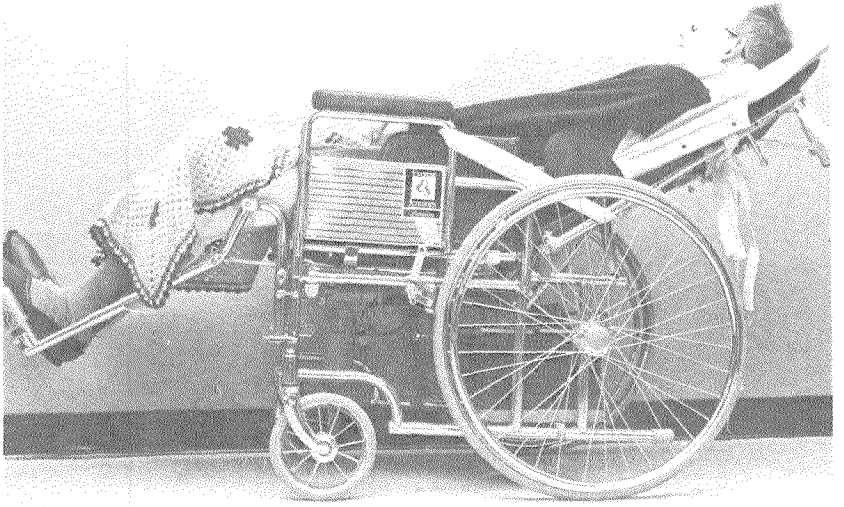

FIGURE 31. — Postura wheelchair, with kit installed, in 70 percent reclining configuration.

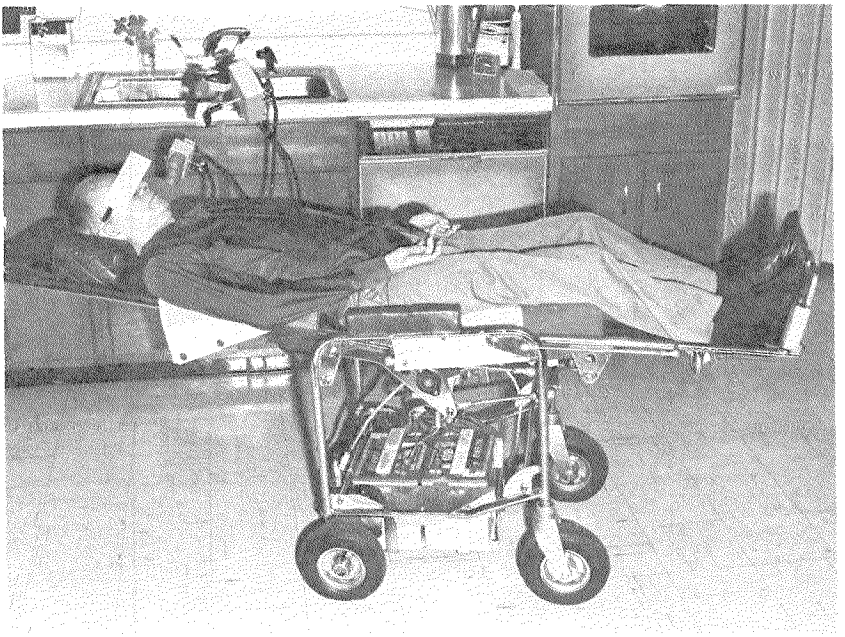

FIGURE 32. — Imasen wheelchair in reclining configuration.

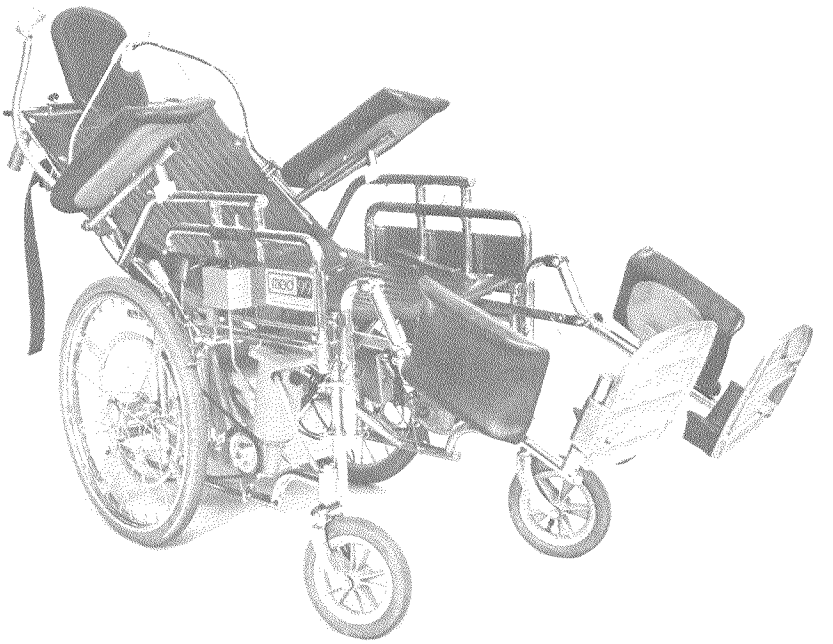

FIGURE 33.—Medical Equipment Distributors wheelchair in reclining configuration.

battery, provides the reclining action. It is attached directly to the back and head supports, and through mechanical linkages, it coordinates the movement of the leg and arm supports with the backrest. The Independence Recliner is ideally suited to those individuals who cannot remain in an upright or reclining position for long periods of time.

Evaluation is being conducted, by the VAPC Technology Applications Division, at the VA Extended Care Center, St. Albans, New York.

g. *Imasen Recliner.* This powered wheelchair (Fig. 36), manufactured by Imasen Electrical Industrial Company, Ltd., Japan, uses a proportional electronic control operated by a hand manipulated joystick. The wheelchair is powered by two 12-V batteries. Low and high speed modes are available, and are selected by the operator.

A linear actuator beneath the seat controls the reclining or elevating action. Mechanical linkages to the backrest and foot supports are used to produce a stretcher configuration in a coordinated manner. Initiation of reclining or elevation is achieved by depressing one of

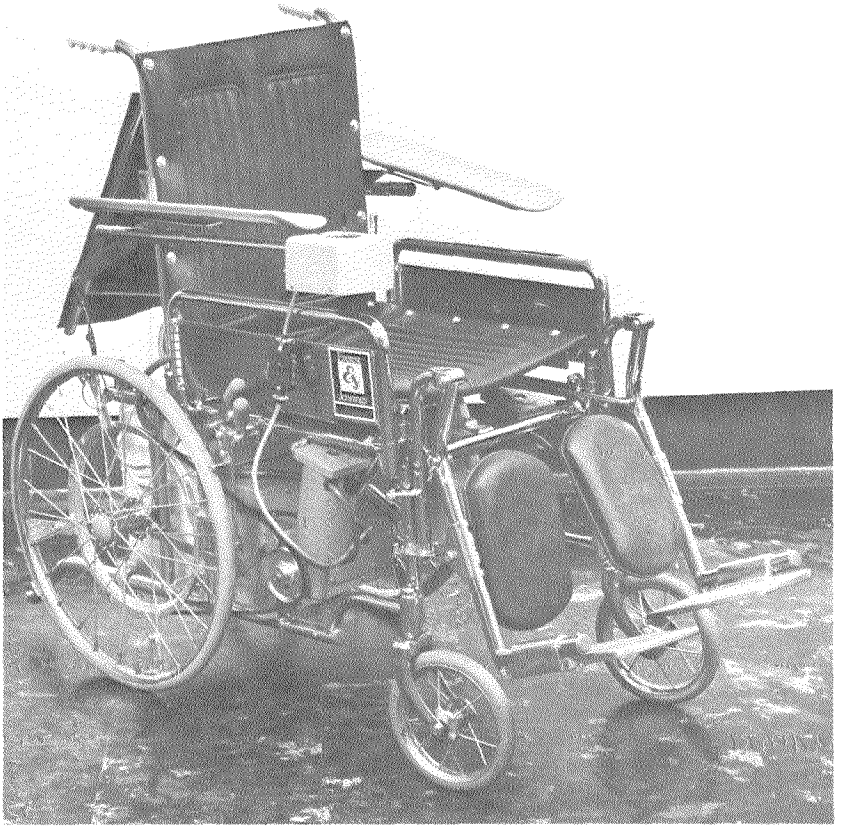

FIGURE 34. — Independence Recliner in fully upright position with head support retracted.

two buttons located in a separate control box mounted behind the joystick control box. The operator may choose any of an infinite number of positions, from a fully upright, seated position, to a horizontal (nearly flat) lying position.

The Imasen Recliner is currently undergoing clinical evaluation by the VAPC Technology Applications Division at the VA Extended Care Center, St. Albans, New York.

h. *Talley Ripple Alternating Pressure Pad For Wheelchairs.* This wheelchair aid (Fig. 38), manufactured by Talley Surgical Instruments, Ltd., Borehamwood, England, and distributed in the United States by Haag Brothers, Inc., Arlington Heights, Illinois, is designed to help prevent pressure sores and discomfort for the wheelchair bound. It

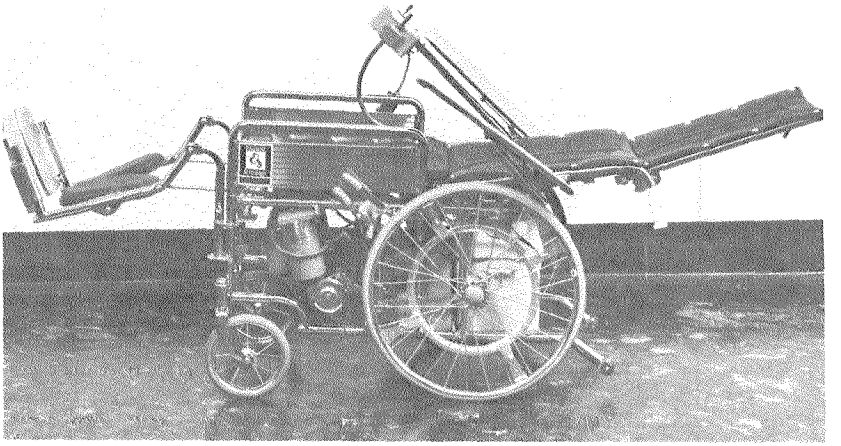

FIGURE 35. — Independence Recliner in fully reclining position.

consists primarily of a wheelchair cushion, power pump, battery charger, and rechargeable NiCad battery pack. An optional 12-V adapter is available to allow the device to operate from a powered wheelchair battery.

The cushion consists of two four-cell rows (eight cells in all) of cells that are 2 in. in diameter when fully inflated. Air is pumped from the power unit through a cycle-control valve that distributes air alternately to two tubing outlet nozzles on the end panel of the power unit. Each outlet is connected through tubing to the corresponding set of air cells. Both sets of air cells inflate fully when power is turned on, but after approximately 7 minutes the first set deflates, leaving the occupant supported on the second set for approximately 3 minutes. The first set then slowly inflates and the second set deflates to leave the occupant supported on the first set. This sequence is automatically repeated every 12 minutes.

Evaluation by the VAPC Technical Applications Division at the VA Extended Care Center, St. Albans, New York, has thus far produced positive results. Healing of decubitus ulcers of wheelchair-bound individuals has been reported.

i. *Pneumatic Water Dispenser.* This device, which can be mounted on a powered wheelchair (Fig. 38), is a VAPC development item currently undergoing evaluation by the VAPC Technology Applications Division at the VA Extended Care Center, St. Albans, New York. It is designed to supply the daily requirement of fluid intake by the severely physically handicapped.

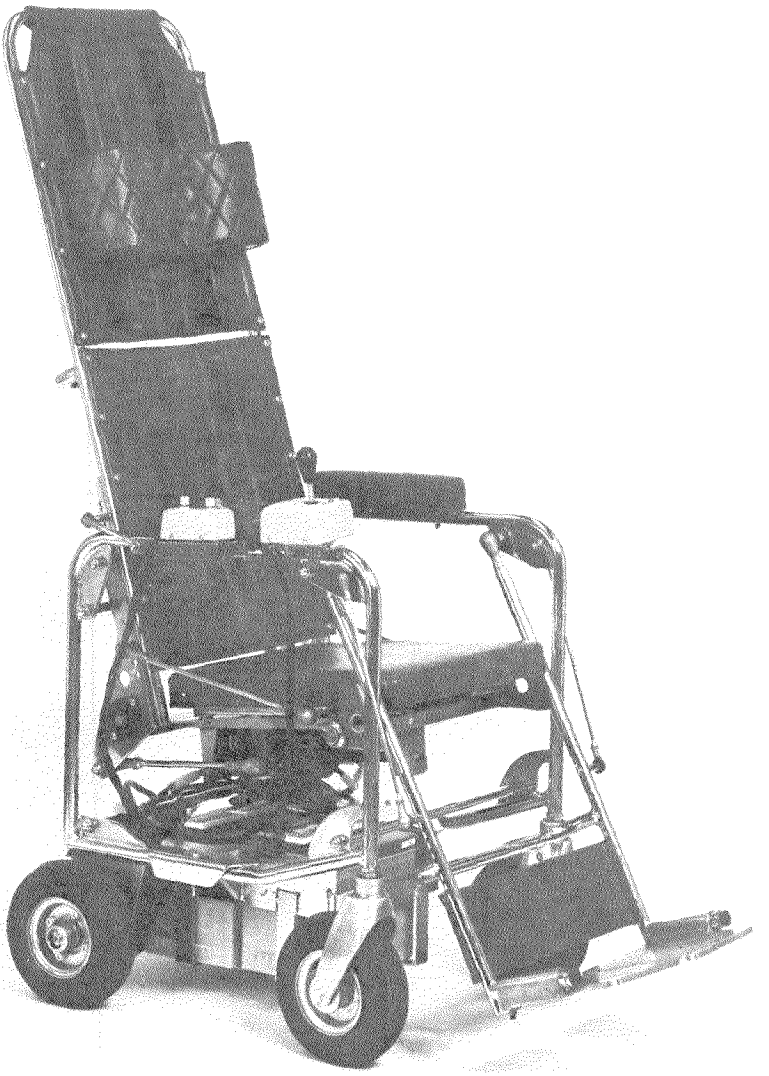

FIGURE 36. — The Imasen Recliner utilizes proportional electronic control.

Applying negative pressure to a small plastic drinking tube located near the user's mouth initiates a sequence of events that results in the injection of a bolus of water into the user's mouth. The system is designed so that the volume of the bolus, as well as the flow rate, may be predetermined. The pump and water container are located below the user's head, to preclude a siphoning action. After water is deliv-

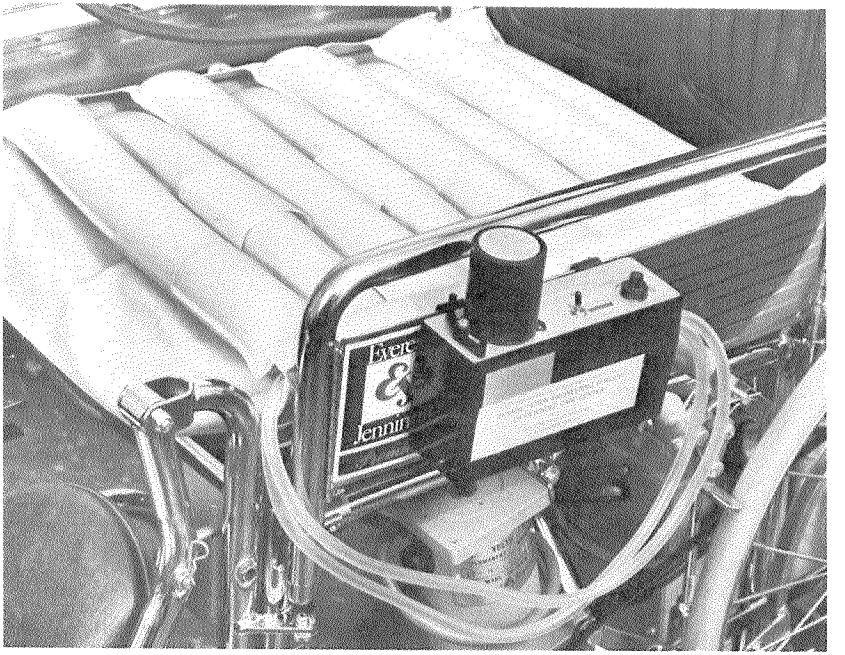

FIGURE 37. — The Talley Ripple Alternating Pressure Pad for wheelchairs is designed to help prevent pressure sores and discomfort.

ered, the system shuts off, thereby eliminating the possible "drowning" of the patient.

The Pneumatic Water Dispenser consists of three sections. The electronic section, powered by a 12-V d.c. source, incorporates an air switch that can be adjusted for various sensitivities to accommodate different individuals. The second section, a water reservoir and motor, has been adapted from an automotive windshield washer. The final section consists of tubing and plumbing hardware incorporating a one-way valve safety feature that prevents water back-flow.

A prototype model has been in service for a short time with an M.S. quadriplegic; it has functioned on a daily basis without problems. The patient commented that having water when desired relieves not only thirst, but mental agitation as well. An additional benefit is improved speaking ability, a result of receiving the proper amounts of water.

j. *Powered Wheelchair Battery Monitor.* Powered wheelchairs are recognized as valuable aids in the rehabilitation of physically disabled persons, especially those unable to ambulate independently. Although these wheelchairs have become more sophisticated during the

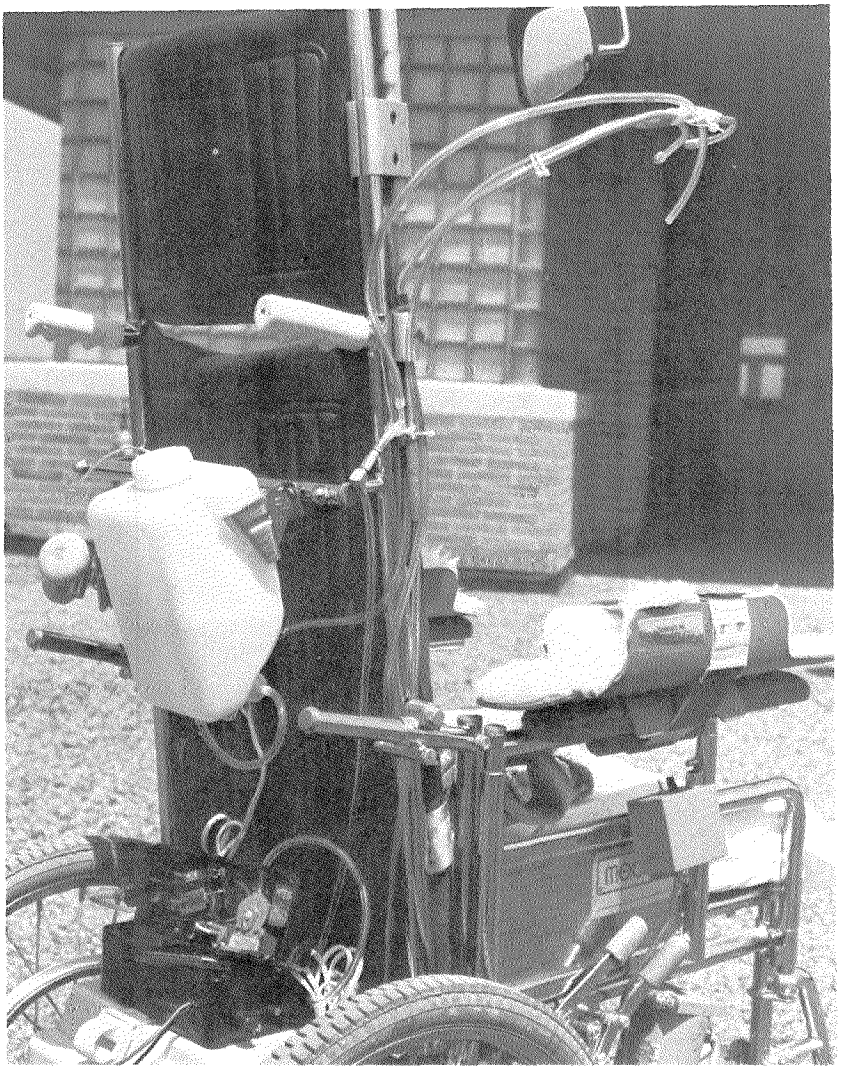

FIGURE 38. — Pneumatic water dispenser with small plastic drinking tube mounted on a powered wheelchair.

past several years, and are increasingly used for vocational, educational and recreational purposes, the batteries commonly used to power these chairs have not kept technological pace — although the technology exists.

BPR 10-21, page 86, describes and illustrates an early VAPC effort in the development of an inexpensive, useful "fuel gage" for powered wheelchair batteries. Now, as then, the most common powered-

wheelchair batteries are the automotive types, which are not intended for relatively low electrical current drains and deep discharge associated with wheelchairs. Recent experience, while dealing with active residents of VA Medical Centers and Nursing Home Care Units and an increasing number of homebound veterans who use powered wheelchairs, confirms the need for a powered-wheelchair battery monitor. (Even in limited cases where electric vehicle type batteries are used, a battery monitor would be beneficial.)

Initial clinical results of the battery monitors, described in the above-referenced BPR report, suggested that the meter type indicator is more desirable than the low-voltage indicator. The meter indicator crudely indicates gross battery voltage changes whereas the low voltage indicator simply alerts the wheelchair occupant if the battery voltage falls below a predetermined level.

The manufacturer of the meter instrument, EMICO (the name is an acronym for Electromechanical Instrument Corp.) was consulted by VAPC in connection with the need to develop an expanded-range voltmeter to monitor the critical voltage ranges of 12 V and 24 V. EMICO met the initial requirements and two ranges of voltage indicators (Fig. 39) were acquired. Each shows a three-color face: red, yellow, and green, to indicate voltage state to the user. The green colored section indicates high voltage levels such as those that might occur shortly after charge, or during charge. The yellow range indicates normal operational voltage levels. The red portion indicates the onset of deep discharge—or failure to achieve battery recharge. The low end of the red zone starts at approximately 9 volts for a 12-V system, and approximately 18 volts for a 24-V system. The low end of the normal operating range, the yellow zone, starts at approximately

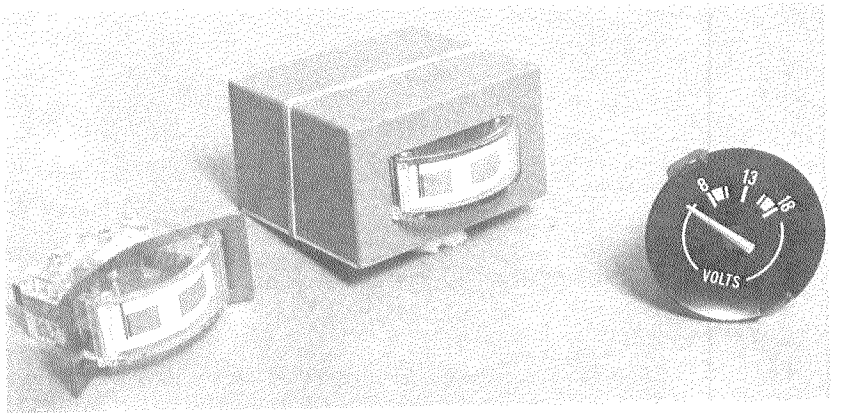

FIGURE 39. — Battery Monitors.

11.5 volts for a 12-V system and approximately 23.0 volts for a 24-V system.

Several units of each voltage type have been fitted to powered wheelchairs at the VA Extended Care Center, St. Albans, N.Y. Initial feedback shows that early battery failures have been detected and occasional failures of VA staff members to recharge the wheelchair batteries overnight have been discerned. Extensive uses, with the resultant voltage drops, have also been noted.

Several powered wheelchairs used by homebound residents will be fitted with these indicators for an expanded evaluation.

k. *Voyager IV.* This three-wheel, golf-cart-like vehicle (Fig. 40) manufactured by Voyager, Inc., South Bend, Indiana, is intended primarily for outdoor use to provide recreational activity for the handicapped. The vehicle is powered by two 12-V batteries and controlled with a hand-operated throttle adjacent to the right side of the seat. The throttle plus choice of either a high or low speed mode set with a speed control lever to the left of the seat, gives the occupant a choice of four forward speeds. A third control lever next to the throttle operates the reverse gear, so that tight maneuvering is possible. Steering is accomplished by means of a tilting tiller connected to the free-spinning, front wheel.

Because of its relatively small dimensions (25 in. wide by 41 in. long) the Voyager IV lends itself to tight-quarters maneuvering indoors. The body is constructed of glass reinforced plastic material with steel bumpers front and rear. A padded vinyl seat, with removable armrests and a swivel base, is standard equipment; however, no seatbelts are provided.

The Voyager IV has two motors, each connected to a rear wheel via a chain and sprocket mechanism. It can obtain a top speed of approximately 13.4 km/h (8.3 mi/h). Braking is accomplished by pushing forward on the throttle control, which engages the mechanical rear drum mechanism.

Obtained for evaluation at the VA Extended Care Center, St. Albans, New York, the Voyager IV will be used in a home care program, affording mobility to a handicapped individual in the community. Optional equipment, including head and tail lights and a wire basket, has been obtained. Further modifications have been made by the VAPC Technology Applications Division at St. Albans to enhance the safety of the unit; among them are the installation of seat belt, rear view mirror, custom foot restraints, and battery voltage indicators. A small battery operated radio has also been added.

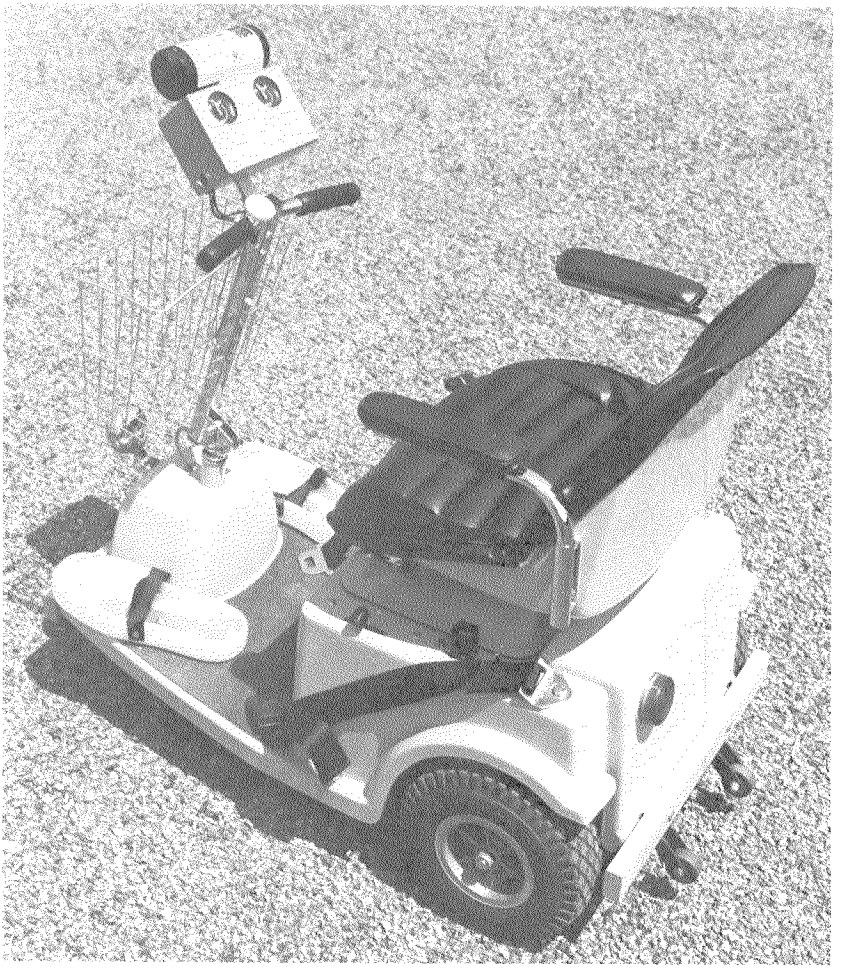

FIGURE 40. — The Voyager IV is intended primarily for indoor use to provide recreation for the handicapped.

1. *Han-Dee-Lite.* This device (Fig. 41), manufactured by Han-Dee-Lite, Deerfield Beach, Florida, is designed to help prevent falls and other accidents caused by poor visibility. It can be attached to wheelchair frames, crutches, canes and various other walking aids, indoors and outdoors, to illuminate stairs, floor, or ground directly in front of the user.

The device consists of a bulb, two batteries in a metal casing, an on-off switch, a friction type clamp and an adjustable holder.

It has been submitted for evaluation.

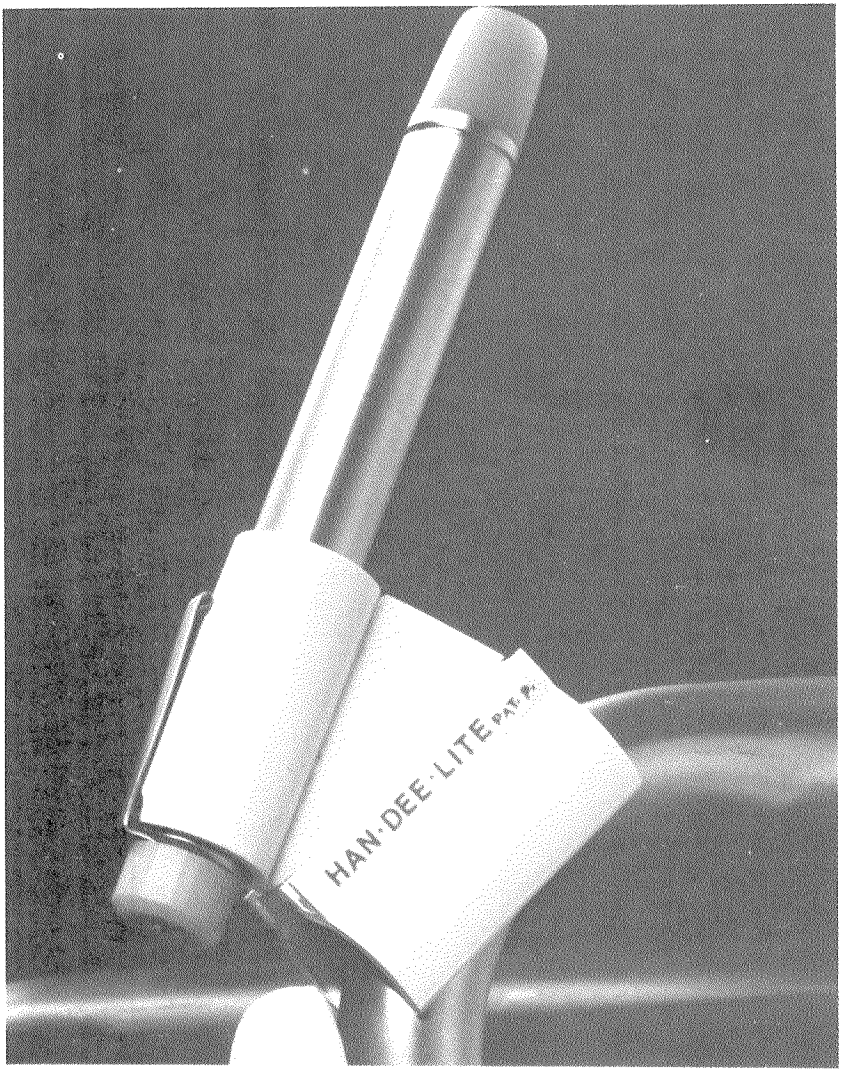

FIGURE 41. — Han-Dee-Lite.

4. *Body Supports*

a. *Aquarius Flotation System Mark IV.* This waterbed (Fig. 42), manufactured by Flotation Therapy, Inc., Houston, Texas, is designed to relieve pressure points by distributing the user's body weight over as wide an area as possible. It is said to be especially useful in preventing or healing decubitus ulcers or other skin problems.

The bed frame is constructed of rectangular steel tubing. Overall,

the device is 90.75 in. long, 41.75 in. wide, and 28.75 in. high, with large rubber buffers at the four corners. It is supported by 5.5-in. casters and employs two independent brakes, diagonally located for stabilization. The triangulated body of the bed ensures a substantial reduction in overall weight since water is concentrated only in required areas. The water mattress is constructed of 20-gauge polyvinyl chloride. Unfilled, the bed weighs 170 lb.; filled, it weights 670 lb. A low voltage heating system controls water temperature. The device is currently undergoing evaluation through the Clinical Evaluation Service, VA Medical Center, Castle Point, New York.

b. *Burke Long-Term Care Bed Model 77-32-2.* This electrically operated bed (Fig. 43 and 44), manufactured by Burke, Inc., Mission, Kansas, offers the benefits of a standard hospital bed as well as several additional bed contours necessary for long-term bedridden patient care. A large knob enables the patient to independently select 11 different therapeutic bed positions.

The Burke bed is currently undergoing clinical trials in the VA Medical Center, Castle Point, New York, Spinal Cord Injury Service.

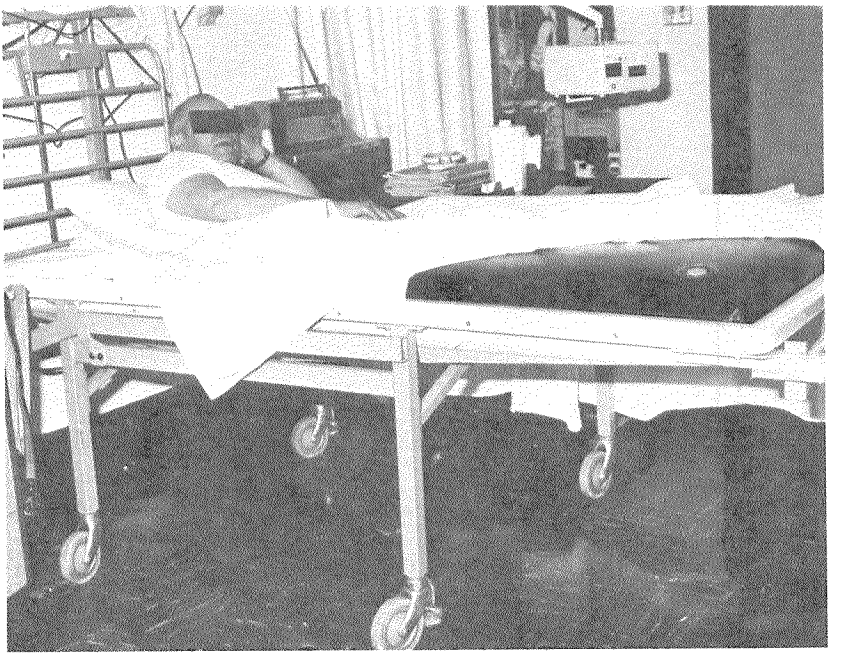

FIGURE 42. — The Aquarius Flotation System Mark IV water bed is designed to relieve pressure points by distributing the user's body weight over as wide an area as possible.

It has thus far been found to be practical for long-term care; it has also helped facilitate transfer of a recent SCI patient from bed to wheelchair during the intermediate treatment phase, just prior to the patient's being placed in an active rehabilitation program, when elevation activities are important.

FIGURE 43.—The Burke Long-Term-Care Bed Model 77-32-2 offers the benefits of a standard hospital bed as well as several additional bed contours necessary for long-term bedridden patient care.

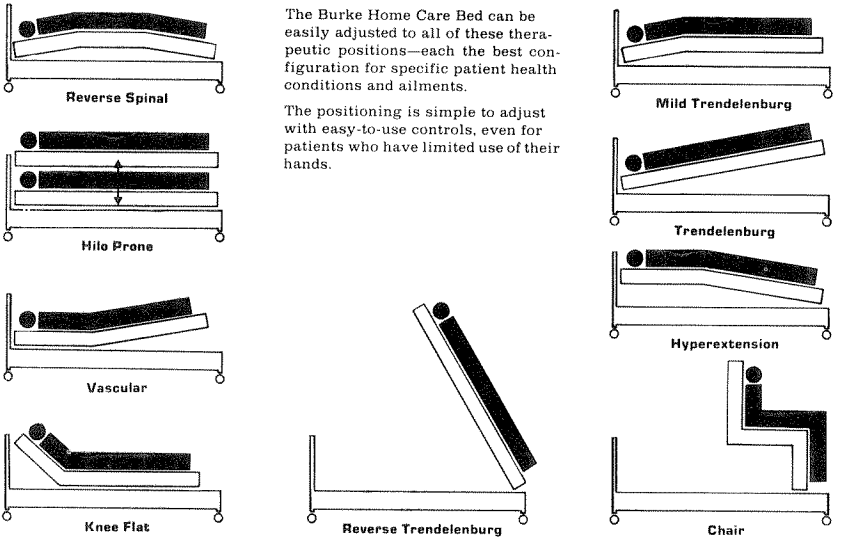

FIGURE 44.—Burke Long-Term-Care Bed: therapeutic positions.

c. *Talley Ripple Alternating Pressure Pad For Beds.* This device (Fig. 45), manufactured by Talley Surgical Instruments Ltd., Boreham-wood, England, distributed in the United States by Haag Brothers, Inc., Arlington Heights, Illinois, is designed to provide relief from pressure sores and discomfort for the bedridden. It consists of an air mattress and a power unit which uses a 110-V a.c. source.

The air mattress is constructed of a heavy duty PVC material; it consists of 14 cells divided into two separate sets. The entire mattress measures 34 in. wide by 5 ft., 6 in. long and weighs 11 lb.

The power unit, enclosed within a plastic housing for safety reasons, is virtually silent in operation. An adjustment knob on the front panel can be set for the weight of the patient. Display lights indicate whether or not the system is operating properly. A one-half-ampere fuse is incorporated into the rear of the housing. The power unit cycles approximately every 10 minutes, first inflating one set of air cells while deflating the other, then reversing the procedure.

An evaluation currently being conducted at the VA Extended Care Center, St. Albans, New York, has thus far revealed instances in which this device has assisted nursing personnel in healing already existing decubitus ulcers on residents.

5. *Lifts and Transfer Aids*

a. *Manhandler.* This modified hand truck (Fig. 46), manufactured by Escalara, Inc., Yuba City, California, is designed for use by airlines to

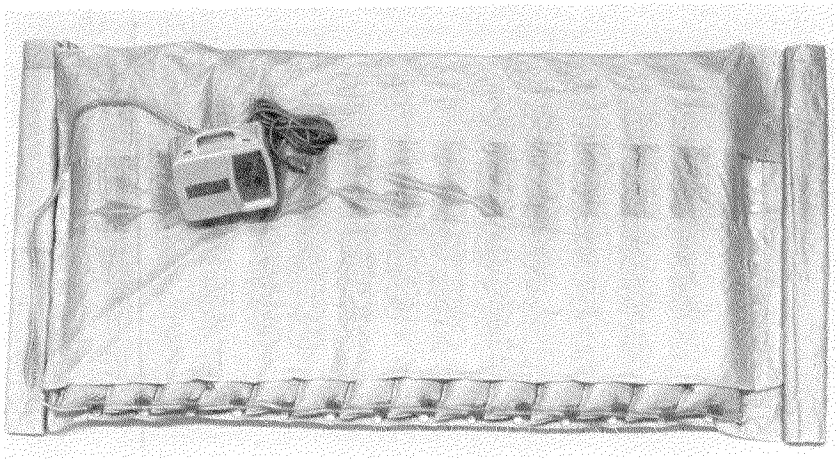

FIGURE 45. — The Talley Ripple Alternating Pressure Pad for beds is designed to provide relief from pressure sores and discomfort for the bedridden.

board handicapped passengers when ramps are unavailable. A 12-V battery operated motor powers a chain-driven lift that ascends or descends a flight of steps step-by-step. Two attendants are required; one to grasp the handles on the backrest and operate the direction switch, the other to hold the handles on the extended footrest. The device is being considered by the Clinical Evaluation Service, VA Medical Center, Castle Point, New York, for possible use in situations where wheelchair lifts are impractical or unavailable.

6. *Miscellaneous*

a. *Winsford Feeder Model 2.* This modified version (Fig. 47) of the original Winsford Feeder (BPR 10-28, pp. 126-127), manufactured by Winsford Products, Inc., Pennington, New Jersey, unlike the original, is controlled by a two-position chin or rocker switch and powered by a 6-V rechargeable battery. When the switch is set to one position, a mechanical pusher travels across the user's plate to slide its contents onto a spoon. This action then activates a motor to lift the spoon up to the user's mouth. The spoon then returns to the plate. The plate rotates when the switch is set at the second position. A knob situated on the motor cover is used to adjust the height of the spoon. The device is currently undergoing clinical evaluation through the Clinical Evaluation Service, VA Medical Center, Castle Point, New York.

b. *Touch-Lite.* The initial evaluation of two Touch-Lite lamp appliances, under development by Sof-Touch, Inc., Boulder City, Nevada, is described in BPR 10-31, pp. 202-204. The first is a

FIGURE 46.—The Manhandler is designed for use by airlines to board handicapped passengers when ramps are unavailable.

capacitance-sensitive lamp that is turned on and off by simply touching the metal base of the lamp with any part of the anatomy, usually the hand or fingers. The other is a 3-way unit capable of achieving three levels of illumination. Evaluation of both units continues with most favorable results.

Since the initial report, two additional types have been submitted for evaluation. One unit is a simple on/off type actuated by an "antenna" switch (Fig. 48). The device is intended for remote lamp locations and

FIGURE 47.—The Winsford Feeder Model 2 utilizes a two-position chin or rocker switch and a 6-V rechargeable battery.

is operated by simply touching the proximally located "antenna" switch. A simple conductive wire connects the antenna switch to the metal base of the capacitance-sensitive lamp.

As for the other unit (Fig. 49), when someone continuously touches the lamp, it provides an infinitely variable intensity of illumination—the lamp increases in illumination from full off to full illumination and then continues back to the off state. The cycle is maintained as long as

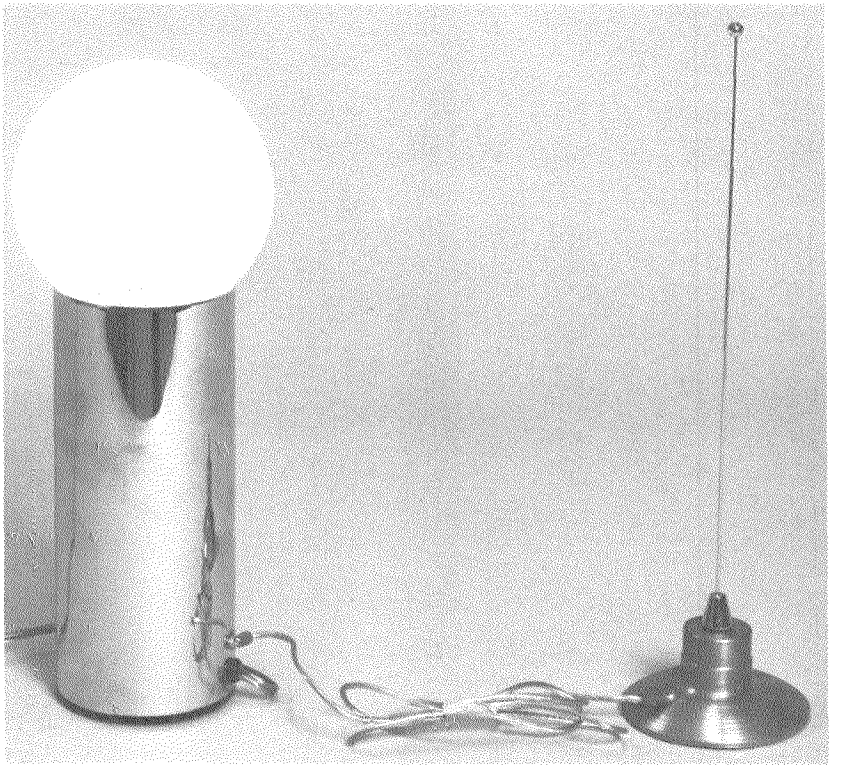

FIGURE 48.—Touch-Lite with "antenna" switch.

the lamp is being touched. Removing the fingers or hand from the lamp base fixes the lamp in the existing illumination level or off state. Simply touching the lamp for an instant then turns the lamp off (or on) at the preselected level of illumination.

Both new lamps will be clinically evaluated in the home care program conducted by the VAPC Technology Applications Division at the St. Albans, N.Y., Medical Center.

c. *Dynavit.* This computerized bicycle ergometer exercise machine (Fig. 50), manufactured in West Germany by Keiper, Inc., and distributed in the United States through various medical supply houses, is designed primarily to provide a level of cardio-respiratory exercise for individuals with various medical backgrounds. It is ideally suited to a rehabilitation program for it provides dynamic exercise. It is also useful in relieving the nervous tension that may result from being confined to a health care institution for extended periods of time.

The Dynavit is 29 in. long by 14 in. wide; its height is adjustable from

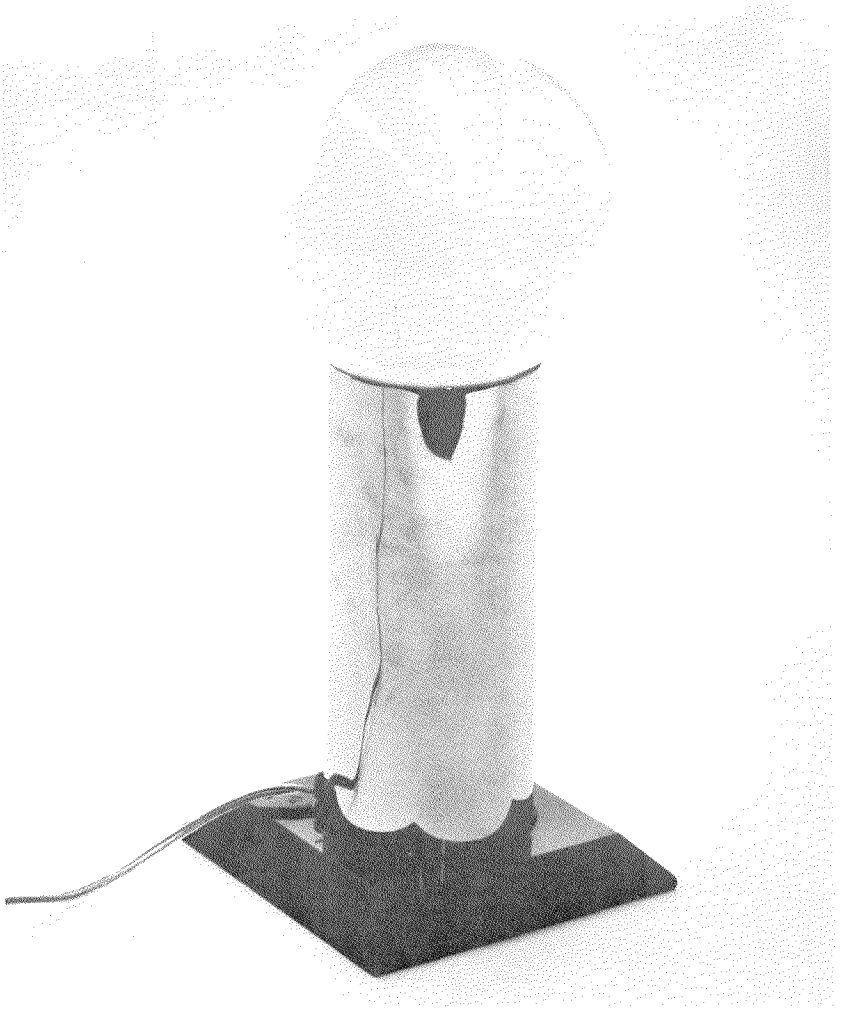

FIGURE 49.—Touch-Lite with variable intensity.

38 in. to 50 in., depending on the position of the seat, which is infinitely variable within the prescribed limits. It weighs approximately 90 pounds, which contributes to stability on a level surface. The handlebars are adjustable in a pivotal plane.

A microcomputer, keyboard, and digital display are built into the frame, and a rechargeable gel cell power supply for this is contained within the base. Recharging is accomplished as the bicycle is pedaled and therefore a connection to a.c. power is not required during operation.

FIGURE 50.—The Dynavit computerized bicycle ergometer exercise machine is designed to provide cardiorespiratory exercise.

Accessories supplied include ear clip and finger clip sensors, both of which monitor the user's pulse rate. A three-lead electrocardiogram connection is supplied to monitor heart rate directly.

The exercise device may be programed to accommodate individuals whose age range is 22 to 70 yr and whose weight range is 92 to 310 pounds. Once an individual reaches 70 to 80 percent of his or her

maximum heart rate, the computer flashes a warning light. At any time during operation, the user may request (and the Dynavit will visually display) calories expended, elapsed exercise time, actual heart rate, target heart rate, work load (in watts), and exercise units (an arbitrary parameter defined by the manufacturer).

The Dynavit is under evaluation with the Rehabilitation Medicine Service at the VA Extended Care Center, St. Albans, New York. The unit has thus far performed satisfactorily with only minor malfunctions. The unit is used regularly 7 to 10 times a day. In addition to its intended purpose in the program, it has been successfully employed to help reduce obesity.

II. COMPLIANCE TESTING

Vibration and Cyclic Tests

a. *Adaptive Automotive Hand Controls.* The following list, compiled in April of 1979, represents the manufacturers who have complied with VA requirements for adaptive automotive hand controls. Each manufacturer submitted one set of hand controls. Each set of hand controls underwent vibration and cyclic testing over a 7 mo period. The cyclic testing consisted of 250,000 cycles of braking, and 250,000 cycles of acceleration.

1. **Blatnik Precision Controls, Inc.**
   1523 Cota Avenue
   Long Beach, California 90813
   (213) 436-3275

2. **Drive-Master Corp.**
   16 Andrews Drive
   West Paterson, N.J. 07424
   (201) 785-2204

3. **Ferguson Auto Service**
   1112 North Sheppard Street
   Richmond, Virginia 23230
   (804) 358-0800

4. **Gresham Driving Aids**
   P.O. Box 405
   Wixom, Michigan 48096
   (313) 624-1533

5. **Handicaps, Inc.**
   4335 South Santa Fe Drive
   Englewood, Colorado 80110
   (303) 781-2062

6. **Hughes Hand Driving Controls, Inc.**
   P.O. Box 275
   Lexington, Missouri 64067
   (816) 259-3681

7. **Kroepke Kontrols, Inc.**
   104 Hawkins Street
   Bronx, New York 10464
   (212) 885-1547

8. **Manufacturing & Production Services**
   4664 Mercury Street
   San Diego, California 92111
   (714) 292-1423

9. **Mobility Products and Design, Inc.**
   709 Kentucky Street
   Vallejo, California 94590
   (707) 642-8967

10. **Nelson Medical Products**
    5690 Sarah Avenue
    Sarasota, Florida 33583
    (813) 924-2058

11. **Smith's Hand Control**
    1420 Brookhaven Drive
    Southaven, Mississippi 38671
    (601) 393-0540

12. **Trujillo Industries**
    5040 Firestone Blvd.
    South Gate, California 90280
    (213) 564-7943
    (Manufacturers steering assists only.)

13. **Wells-Engberg Co.**
    P.O. Box 6388
    Rockford, Illinois 61125
    (815) 874-6400

14. **Wright-Way Inc.**
    P.O. Box 40907
    Garland, Texas 75040
    (214) 278-2676

III. THE VAPC CLINIC TEAM

The statistical breakdown in Table 1 of veterans treated by the clinic team during the first half of 1979, is a typical case load that is similar to those presented in previous BPR reports. Of the total, 5 were World War I veterans, 480 were World War II veterans, 15 were Korean War veterans, and 152 were Vietnam War veterans. In addition, 9 Israeli veterans were treated. Of the total, 464 were treated for service-connected injuries, while 195 were treated for injuries that were non-service-connected.

See Table on following page.

TABLE 1. — *Breakdown of Patient Disabilities January 1, 1979 to June 30, 1979*

Area of involvement	Specific level of involvement	Number of patients
Amputation		
Lower-limb unilateral	Below-Knee	193
	Above-Knee	132
	Transmalleolar (Syme's)	14
	Hip (Disarticulation)	3
Lower-limb bilateral	Below-Knee	19
	Above-Knee/Below-Knee	8
	Above-Knee	11
	Below-Knee/Transmalleolar (Syme's)	1
	Above-Knee/Hip (Disarticulation)	2
	Below-Knee/Hip (Disarticulation)	1
	Knee Bearing	1
Upper-limb unilateral	Below-Elbow	9
	Above-Elbow	7
	Hand	1
Upper-limb bilateral	Below-Elbow	1
	Above-Elbow	4
Triple	Above-Knee/Below-Knee/ Below-Elbow	1
	Above-Knee/Below-Knee/ Above-Elbow	1
	Total	409
Neuromuscular or Skeletal Impairment		
Lower-limb unilateral	Ankle-Foot	92
	Knee-Ankle-Foot	32
	Knee	2
	Foot	1
Lower-limb bilateral	Ankle-Foot	12
	Knee-Ankle-Foot	2
Upper-limb unilateral	Arm-elbow-Forearm; Wrist-Hand	15
Trunk	Lumbosacral	6
	Cervical	2
Miscellaneous	Shoes	65
	Specialized footwear (clogs)	19
	Wheelchair	1
	Total	249
Amputation and Neuromuscular or Skeletal Impairment		
Lower-limb bilateral	Below-Knee/Knee-Ankle-Foot	2
	Transmalleolar (Syme's)/Ankle-Foot	1
	Total	3