VETERANS ADMINISTRATION PROSTHETICS CENTER REPORT

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I. DEVELOPMENT AND EVALUATION

A. Prosthetics

Lower Limb

Nylon Knee Joint. Nylon knee joints (BPR 10-29, page 80) are currently being evaluated by two below-knee amputees using conventional leather corsets. The nylon knee joints were shaped at room temperature with conventional bending tools; no breakage occurred. When incorporated with the leather corset, the knee-joint side bars seem to have the rigidity required to provide support and suspension for the average below-knee amputee.

After 6 months use, the knee joints are functioning very well with no signs of wear and tear. The evaluation process will continue to further test the durability of nylon knee joints.

B. Orthotics

Lower Limb

Plastic Knee Orthosis. This knee orthosis (Fig. 1) offers a unique

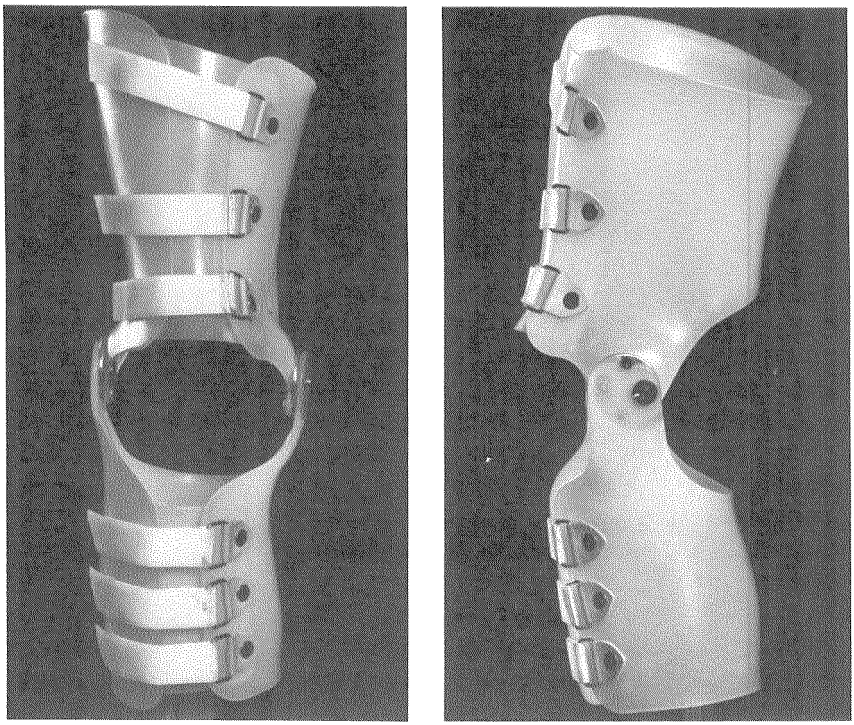

FIGURE 1.—Genucentric knee orthosis offers a unique polycentric joint.

polycentric (genucentric) joint as an alternative to single axis or conventional polycentric joints for mediolateral instability or genu recurvatum patients (BPR 10-29, page 81).

The genucentric[a] knee orthosis is lightweight, has improved cosmesis, and uses a supracondylar-suprapatellar suspension system. A unique knee-tracking capability, with its suspension mechanism, eliminates pistoning at the orthosis/limb interface. The most distinct feature of the genucentric joint is its ability to aproximate its instantaneous center of rotation with a structurally sound and/or pathologically deranged knee.

Clinical results indicate that this orthosis significantly improves comfort when compared to the more common knee orthoses. Pistoning and migration are reduced to the point of becoming undetectable. A full report of its clinical evaluation and fabrication technique has been prepared and is being submitted for publication.

[a]This term is used to distinguish the VAPC's unique polycentric knee joint from those now in common use.

C. Spinal-Cord-Injury Rehabilitation

1. *Environmental Control Systems*

a. *UCSB Commander Word Recognition System.* This eight-word environmental control system (Fig. 2) was designed and developed under VA contract by the Department of Mechanical and Environmental Engineering, University of California at Santa Barbara. A microprocessor and associated electronics recognize a vocabulary of eight voice command words: ON, OFF, CHANGE, LIGHT, NURSE, EMERGENCY, TV and BED; then control and operate the desired functions.

The system consists of a microphone, an acoustic word recognition module with display panel (for "training"), a display module, and an environmental device controller. The acoustic word recognition module accepts the voice command word from the microphone in analog signal form, converts this signal to a corresponding digital code word, and sends the digital code word to light the appropriate word on the display module, and to the environmental device controller. The environmental device controller accepts the digital code from the recognition module and provides the necessary power to operate the pertinent device or devices while providing a lighted display to indicate its operational status.

The system must be programmed to recognize the user's voice through a "training" procedure. This training procedure consists of placing the system in its training mode, then the user repeats each

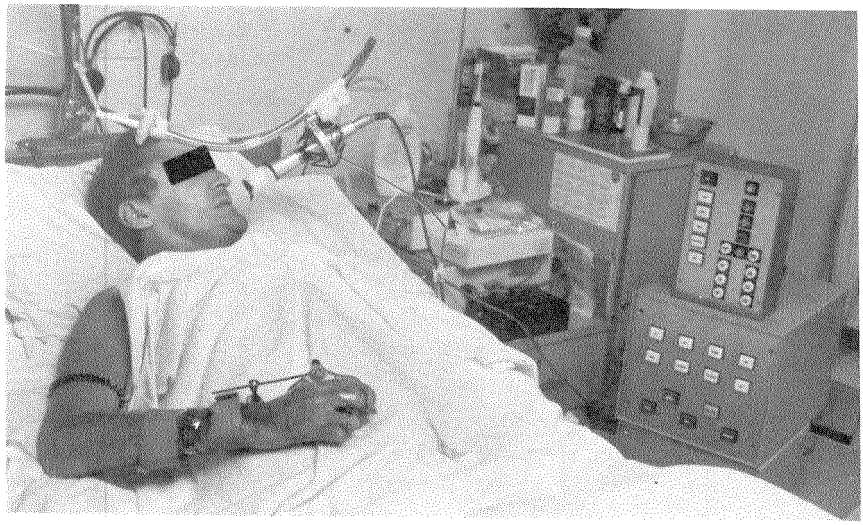

FIGURE 2.—UCSB Commander Word Recognition System recognizes a vocabulary of eight voice command words.

word in the system's vocabulary eight times, following the system's prompting. When the system requires additional training, it indicates the word or words that must be repeated. Upon completion of training, the Commander automatically shifts to its recognition mode. It is then ready to respond.

A typical command requires recognition by the device of a sequence of words. For example, to lower the head of his bed, the user voices the words "bed," (causing the BED and HEAD UP lights to come on) "change," (causing the HEAD UP light to go off and the HEAD DOWN light to come on) "on," (causing the head of the bed to begin going down) and "off" (causing the bed to stop and all lights to go off).

Laboratory tests indicate that the system correctly recognizes any given word in its vocabulary 86 percent of the time, and correctly rejects any given word that is not in its vocabulary 88 percent of the time. Clinical trials are currently being conducted at the VA Medical Center, Castle Point, New York.

b. *Speech Recognition and Control System.* This sophisticated system (Fig. 3), developed under VA contract by Dialog Systems, Inc., Belmont, Mass., is designed to recognize large numbers of words (up to 100) when spoken by different users without extensive training (BPR 10-23, page 248). The system primarily consists of two minicomputers, a floppy disc drive, and a special analog-to-digital converter, all in a single cabinet, and a microphone, display panel, teletype and color TV monitor outside the cabinet.

The user's commands appear on the display or monitor in word, letter or number form so that the user knows if his command has been recognized correctly. The monitor also indicates which words from the syntax tree are available next. The syntax tree (Fig. 4) is a hierarchy of the words that the system can recognize. This hierarchy reduces the available vocabulary at any given time, which results in an improved recognition rate.

The Speech Recognition and Control System interfaces with a complete VAPC home environmental control section; a teletype section that types all letters, numbers and punctuation; a calculator section that generates the four basic functions plus trigonometric and logarithmic functions; a telephone; and two games that allow the user to match wits with the computer. The system is programmed such that it can use implicit training, i.e., the computer improves its recognition of the user's voice as he talks; or it can use rote training, where the user trains the system directly by repeating each word in a subsection of the vocabulary three times.

The Speech Recognition and Control System has undergone

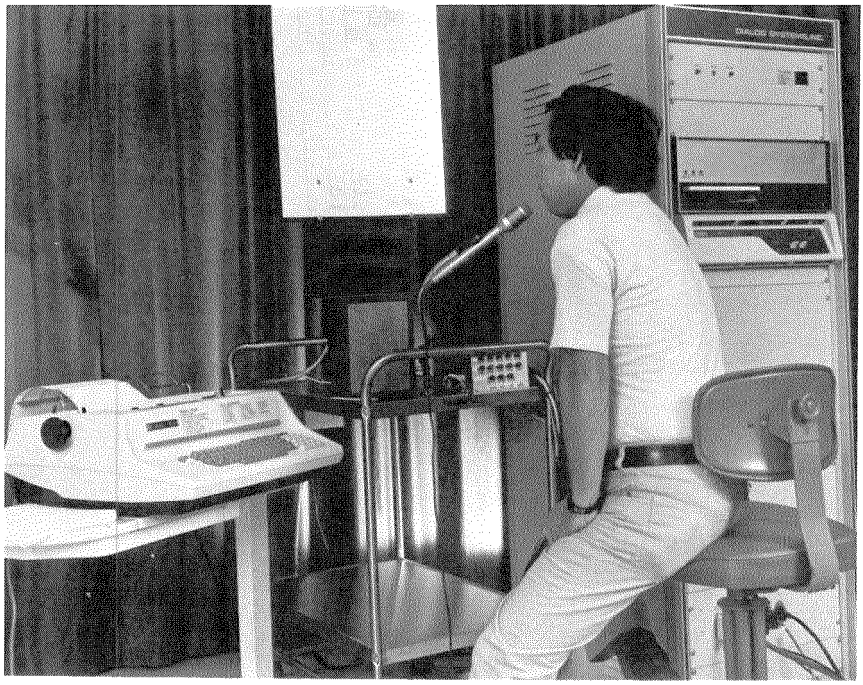

FIGURE 3.—Speech Recognition and Control System recognizes up to 100 words when spoken by different users without extensive training. "Syntax tree" (see Figure 4) is mounted in front of microphone.

laboratory testing and is currently undergoing clinical trials at the VAMC, Castle Point, New York.

c. *Power Access Door Opener, Model 4300.* The Model 4300 automatic Power Access Door Opener (Fig. 5) for interior doors in private homes and institutional buildings, manufactured by Power Access Corp., Eatontown, New Jersey, employs a 115 V a.c. electric motor that can be controlled via wall switches, floor-mat switches, electric eye or radio control. Its operation can be coordinated with an electric door lock. The unit is mounted above the doorway on the side from which the door is pushed open, and a standard hydraulic closer is used to close the door.

Two units will undergo tests for safety and reliability at the VA Medical Centers at Castle Point and St. Albans, New York. Clinical trials will begin after the units have been successfully tested.

2. *Communication Aids*

a. *CommunicAid.* This portable voice amplifier, developed for A. R. Mann of Decatur, Ill., its sole distributor, consists of an amplifier,

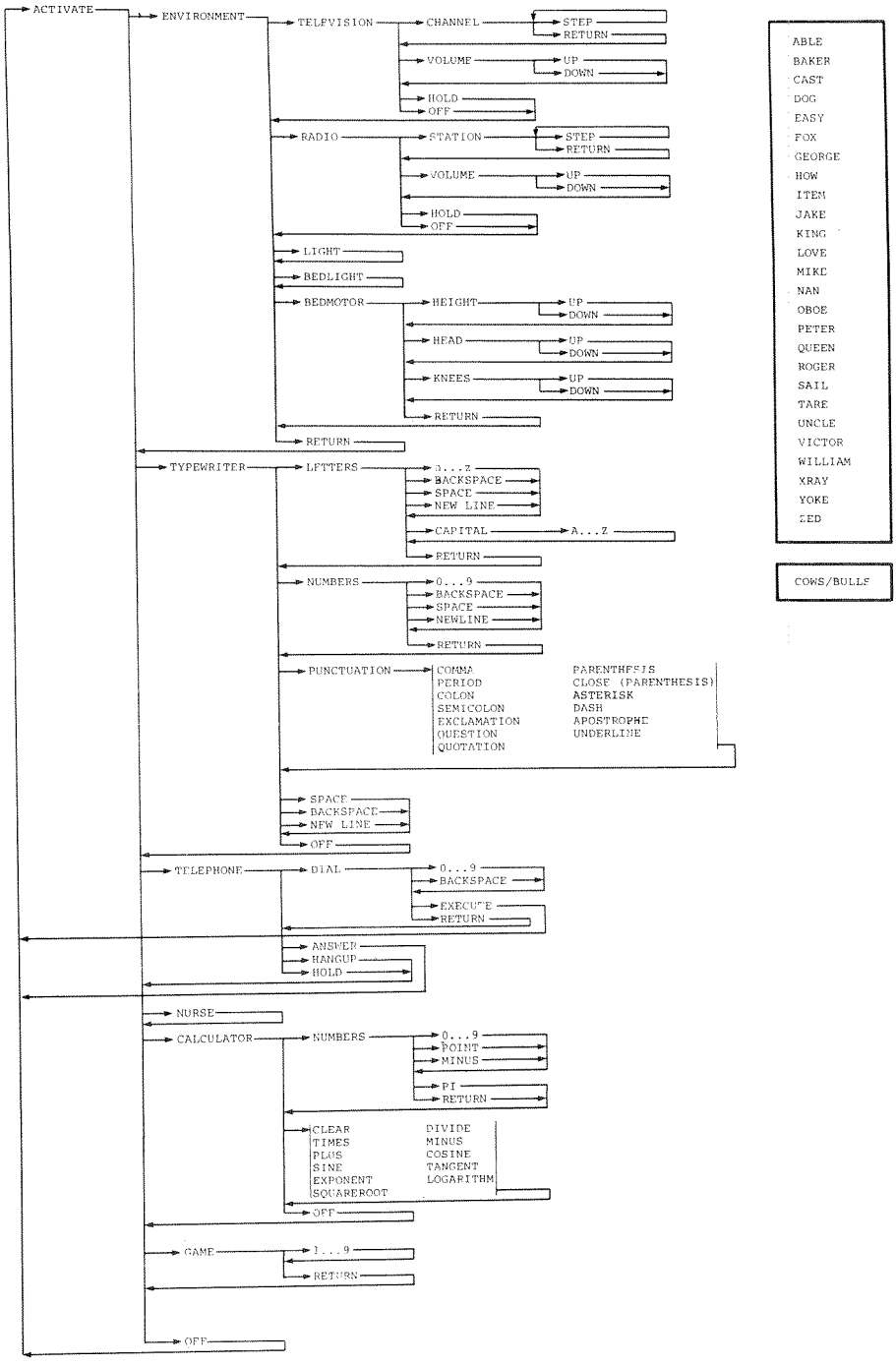

FIGURE 4.—The "Syntax Tree" is a hierarchy of the words recognizable by the system.

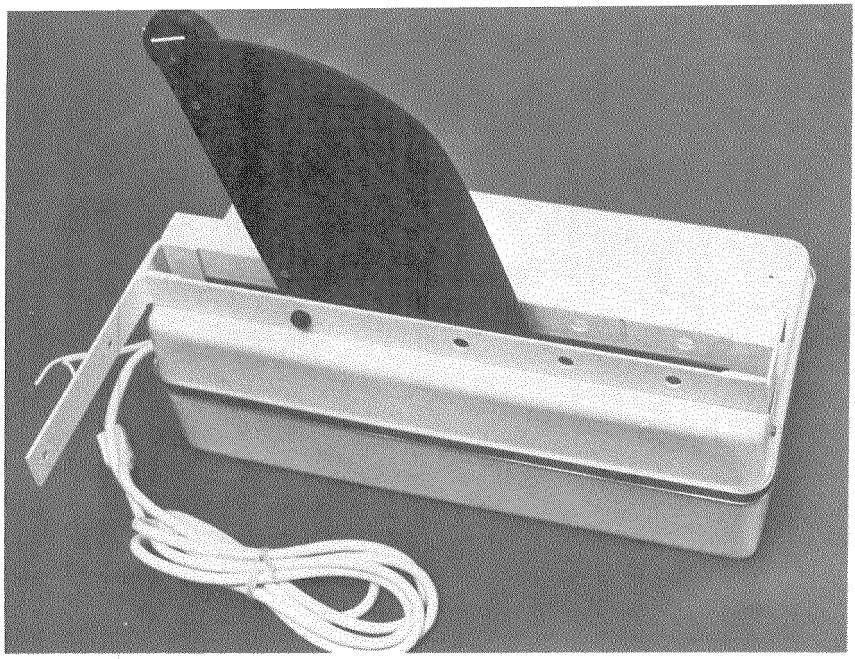

FIGURE 5.—Power Access Door Opener, Model 4300 for interior doors.

speaker and a 9-V battery housed in a formed 6-oz aluminum case that clips onto a belt or pocket, and a microphone. Two microphones are available: a small hand-held capacitive type and a very small one that clips onto eyeglass frames and has an acoustic tube that extends to the corner of the mouth (Fig. 6) for hands-free operation. The device is currently being evaluated.

b. *Easicorder Model REC-1.* Manufactured by Romich, Beery and Bayer, Inc., Shreve, Ohio, this cassette tape recorder (Fig. 7) is designed primarily for use by handicapped students. Once a cassette has been placed in the machine, a single switch controls all functions through a scanning arrangement. The functions include: on/off, play, record, fast reverse, fast forward, fast play, underline and channel selection.

Unlike standard cassette tape recorders, the Easicorder can reverse tape direction automatically when it reaches the end of the tape, thereby obviating the need to turn it over to record on both sides. The Easicorder uses each of four channels of a stereo recording head to record monaurally so that it can record for twice as long as the nominal duration of the tape. A special underlining feature makes it easy for the student to select important sections of the tape for review:

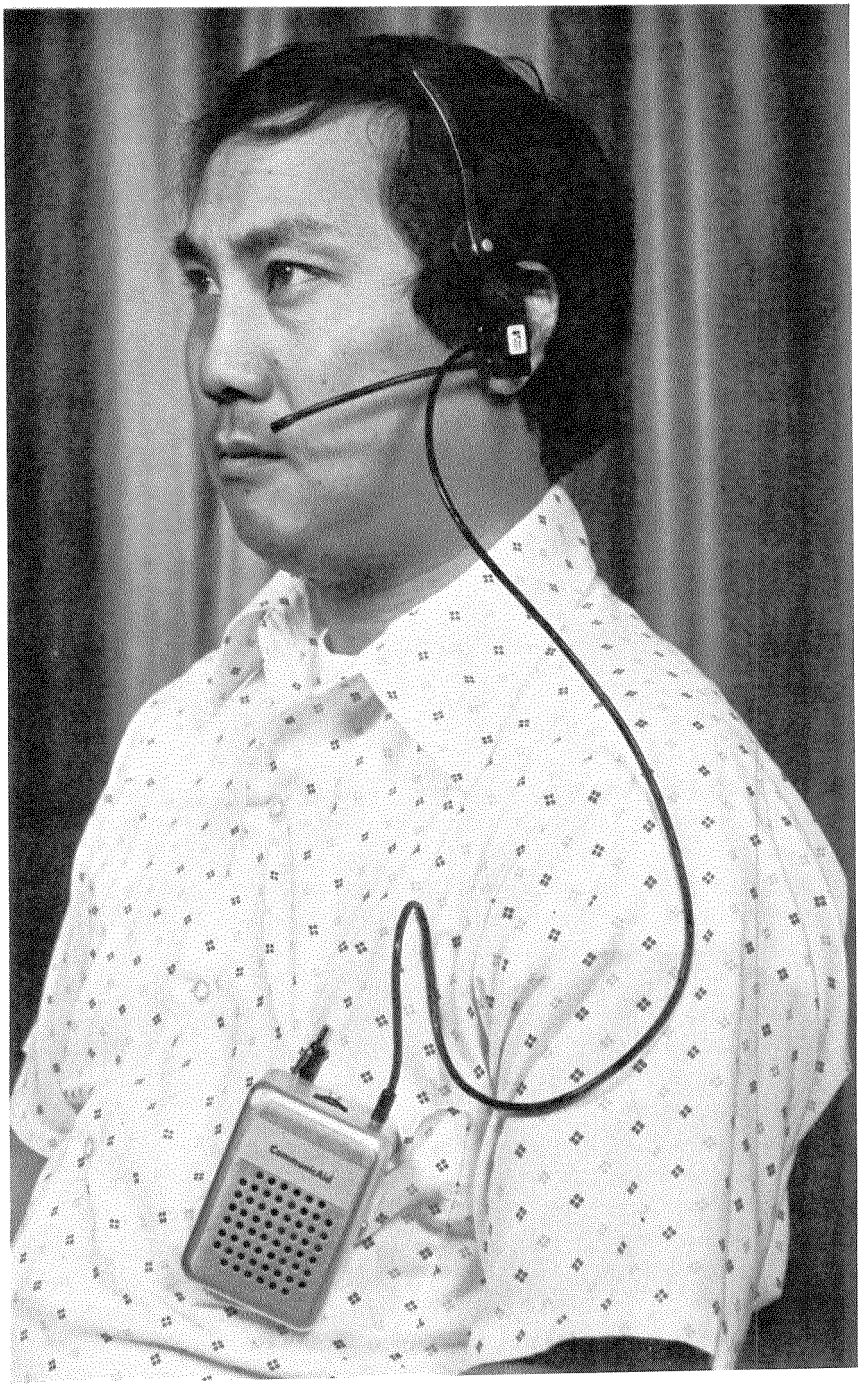

FIGURE 6. — CommunicAid portable voice amplifier

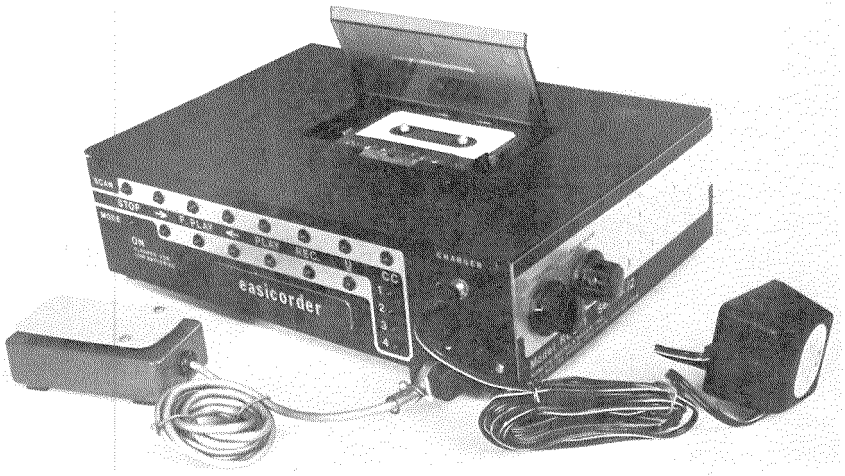

FIGURE 7. — Easicorder Model REC-1 cassette tape recorder.

four inaudible low-frequency beeps are placed on the tape while recording or playing back. When played back in fast play, the frequency of the beeps is increased and they become clearly audible. Because the user normally places these beeps on the tape after the start of an important section, the recorder automatically skips from fast play to fast reverse when the switch is depressed, then skips into normal play when the switch is released. This makes it easy for the user to "back up" to the beginning of the section marked by the beeps.

The Easicorder REC-1 comes in a self-contained desk-top model and a smaller lap-board model which requires the Prentke Romich Du-It controls for operation. The device is powered by rechargeable batteries that provide approximately four hours of operation. Standard cassettes must have the pressure pad removed before they can be used on the Easicorder. Clinical trials will be conducted with several students.

c. *Monitec Emergency Systems.* The Monitec emergency systems are manufactured by RMA Industries, Ltd., Rockville Centre, New York. Three basic systems include a local hookup within the house or between neighbors, a telephone-dialing system that dials directly to emergency personnel (police, fire, ambulance, etc.), and a telephone-dialing system to a central operator.

Monitec I comprises a transmitter and receiver combination with a built-in "sonalert" buzzer. The transmitter is a small battery-operated unit, about the size and weight of a cigarette pack, with a large recessed push button. Combined pulse coding and frequency modulation ensures interference-free operation. The receiver is housed in a black

plastic box that is connected to a standard 110 V a.c. wall outlet through a low-voltage transformer. An alarm sounds when the transmitter button is pressed within 200 ft of the receiver, and shuts off when the receiver is reset by a reset push button.

Monitec II (Fig. 8) employs the same transmitter used for Monitec I, but its receiver is coupled to automatic dialing equipment. A preprogramed tape is used to dial up to five emergency telephone numbers and play a prerecorded message after each number is dialed. The receiver is connected to a standard 110-V a.c. wall outlet through a low-voltage transformer. An emergency power source of rechargeable batteries is available in the event of main power failure.

Monitec III is similar to Monitec II except that a central operator who is on duty at all times is dialed during an emergency, and digital coded messages that identify the user and provide emergency or other pertinent information are sent. The operator then verifies the emergency and calls the appropriate emergency personnel. There is a monthly service charge.

Monitec IV is also similar to Monitec II except that two channels can be activated separately and two types of emergencies (e.g., fire and medical) can be handled simultaneously.

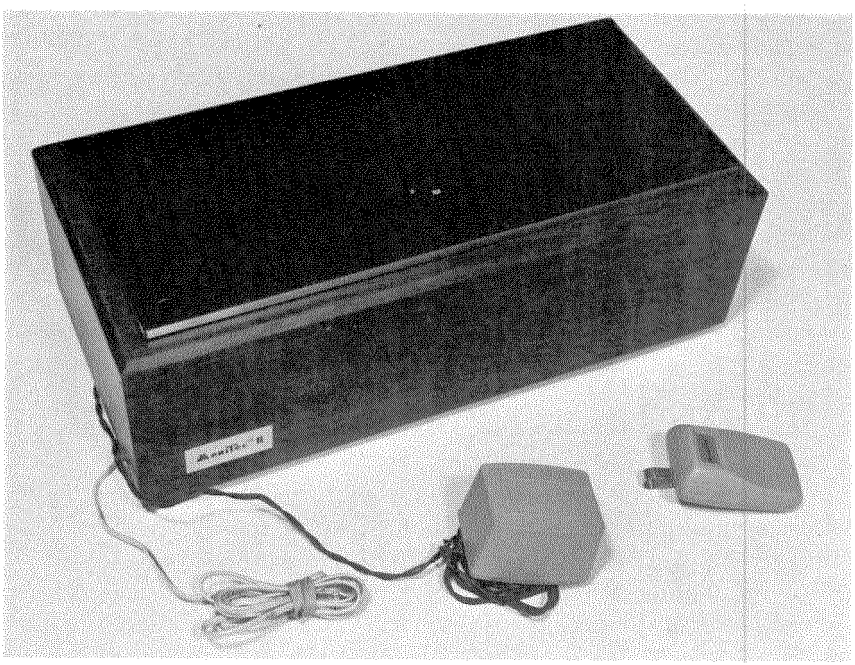

FIGURE 8.—Monitec II emergency system uses a preprogramed tape to automatically dial up to five emergency telephone numbers and play a prerecorded message after each dialing. (The transmitter is the small object at right.)

Laboratory tests on Monitec I and II for function and safety are currently being conducted, and clinical trials are scheduled to begin in early 1979. Testing of Monitec III and IV will begin in the near future.

3. *Mobility Aids*

a. *MED Quadriplegic Wheelchair System.* This powered wheelchair with powered recliner (Fig. 9) is available in many variations from the Medical Equipment Distributors (MED) network of dealers. It is designed to be as flexible as possible so that it can be adapted to suit various user requirements. It uses the Everest & Jennings series 33 powered wheelchair, which will be replaced by the E & J 3-P model in early 1979: the 3-P is similar to the 33. Available controls include a short-throw joystick, dual-axis rocker switch, four-switch slotted control, and single-tube breath control. Gradual acceleration is attained from a starting position; there are two forward speeds. Also included are a MED-i-Cliner powered recliner with head-operated microswitch tubes, troughed armrests that move back as the back reclines, and troughed leg rests that move up as the back reclines. The wheelchair

FIGURE 9.—MED Quadriplegic Wheelchair System is a powered wheelchair with a powered recliner.

system can be tailored to individual needs with both E & J and MED options.

The MED Quadriplegic Wheelchair System is currently being clinically evaluated. It is also being used as a prescription tool by the Clinical Evaluation Service, to allow patients to try various options and controls.

b. *Mobilpodium Mark III.* Designed and constructed under VA contract by the Center For Orthotic Design, Menlo Park, California, this mobile support system (Fig. 10 and 11) allows a paraplegic of up to 160 lb to move about and perform hands-free tasks in various bodily positions, ranging from a squatting position with hips approximately 14 in. above the ground to a fully standing or erect posture. The device can be locked anywhere between the squat and fully-standing positions.

The horizontal drive mechanism of the device is operable at any height and there is a choice of two speeds for horizontal motion. However, only slow speed is recommended for use in the fully standing position, while either fast or slow speed is recommended in the sitting or squatting positions.

The squatting position is designed to allow the occupant to pick up objects from the floor, and the standing position provides leverage so that such tasks as working on a work table, mopping a floor or utilizing standard-height cabinets can be accomplished.

One unit underwent laboratory evaluation at the VAMC, Castle Point, New York. Several recommendations for improvement were sent to the developer. These will be incorporated in the newer models currently being produced by a commercial source. When these are available, an expanded evaluation of the Mobilpodium Mark III will be conducted.

c. *Chin Control Powered Swing Away.* This device (Fig. 12 and 13) manufactured by General Teleoperators, Inc., Downey, Calif., is designed to move the chin control away from the wheelchair occupant when the wheelchair is stationary, or back into position for driving the wheelchair. The device uses a d.c. motor drive that is friction-coupled to a VAPC chin-control structure. It is controlled by a lever-operated, sequentially-actuated microswitch array attached to an adjustable-position bracket. Two units underwent evaluation by the Clinical Evaluation Service (BPR 10-28, pages 103–105). Both were installed on chin-controlled powered wheelchairs already in use at the VAMC, Castle Point, New York. The device was clinically acceptable and a convenience to the wheelchair user; however, recommendations for improvement were sent to the manufacturer before final acceptance.

FIGURE 10. — Mobilpodium Mark III; mobile support system in a fully standing configuration.

FIGURE 11.—Mobilpodium Mark III; mobile support system in a squatting configuration.

d. *Folding Rollator.* The Folding Rollator (Fig. 14), distributed by Rajowalt Fracture Equipment Company, Atwood, Indiana, is a rolling walking aid that can be folded for storage and transport. It is constructed of chrome-plated steel tubing and employs two 6 in. (15.24 cm) rubber front tires and two non-slip rear rubber tips. The handles are adjustable from 30 in. (76.20 cm) in height to 36 in. (91.44 cm) in height. Walking space within the base perimeter is 24 in. (60.96 cm) (length) by 21 in. (53.34 cm) (width) with a 4 in. (10.16 cm) clearance from the floor.

Lock pins on the side support bars are used to collapse and fold the Rollator. The Rollator is 24 in. (60.96 cm) by 24 in. (60.96 cm) by 8 in. (20.32 cm) when completely collapsed.

The device is designed such that the user must shift the rear legs up slightly to allow the front wheels to roll. When the user stops, his weight on the handle transfers to the two rubber tips at the rear; the rubber tips grip the floor and thereby prevent motion.

FIGURE 12.—Chin Control Powered Swing Away moves chin control away from wheelchair occupant when wheelchair is stationary.

The Folding Rollator is currently being evaluated by the Clinical Evaluation Service.

e. *Supermark Delta.* The Supermark Delta (Fig. 15), distributed by Fracture Equipment Company, Atwood, Indiana, is a folding walking aid with hand brakes and rubber balloon tires. It is constructed of chrome-plated steel tubing and has three 8-in. (20.32-cm) pneumatic tires, one on the front swivel post and two in the rear, in the shape of a

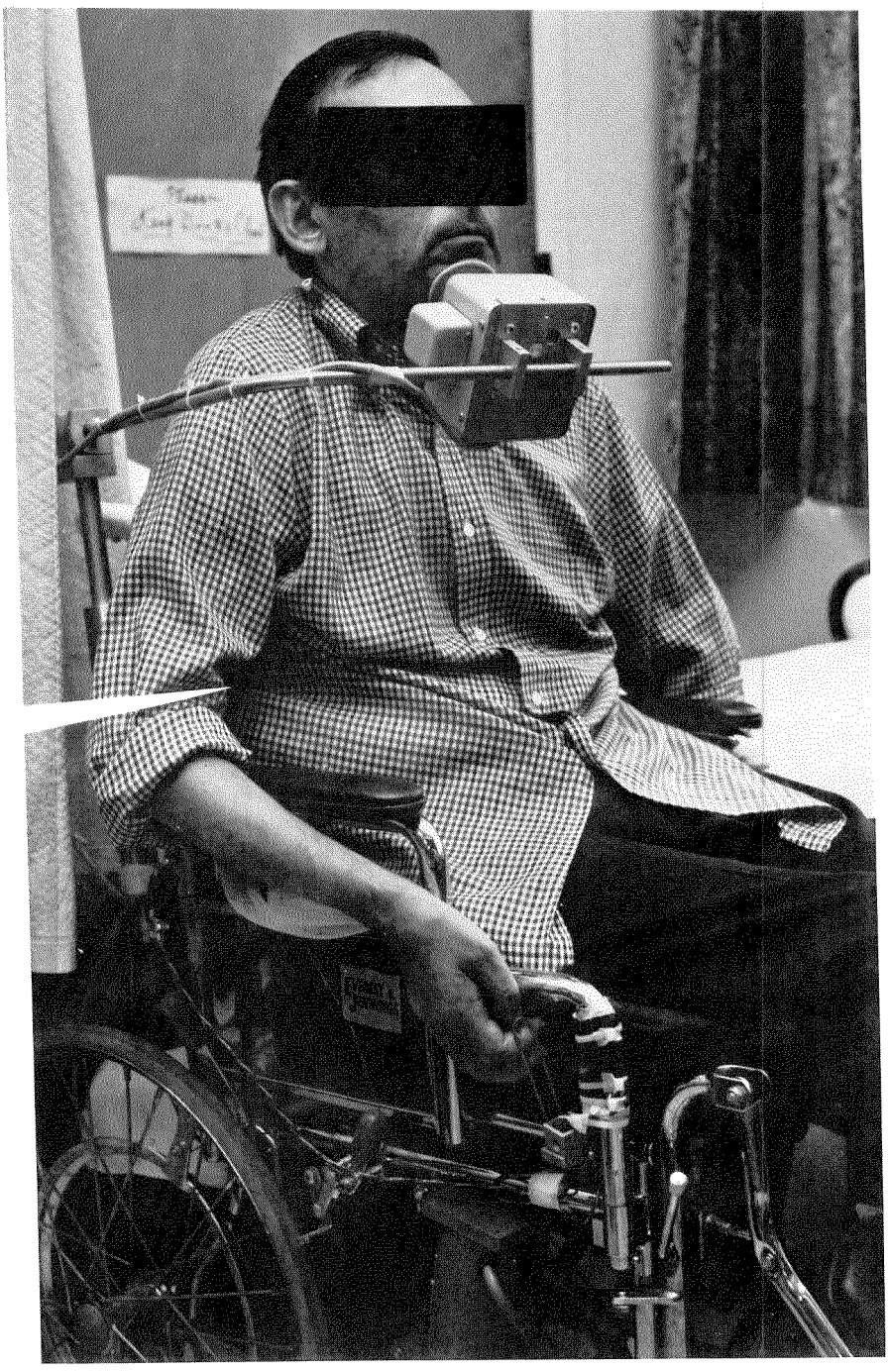

FIGURE 13.—Chin Control Powered Swing Away moves chin control back into position when wheelchair is being driven.

FIGURE 14.—Folding Rollator rolling walking aid. It may be folded for storage and transport.

triangle. Dual, spring-loaded, independently-operated hand brakes stop the device by applying pressure (friction) to the rear tires. The handles are adjustable from 29 in. (73.66 cm) in height to 36 in. (91.44 cm) in height. Walking space within the base perimeter is 19 in. (48.26 cm) from rear wheel to rear wheel. The user folds the device by pulling back on the lever mounted between the upper support bars. The Supermark Delta is 3 in. (7.62 cm) wide at the front frame and 10 in. (25.40 cm) wide across the rear when it is folded.

The Supermark Delta is currently being evaluated by the Clinical Evaluation Service at the VA Medical Center, Castle Point, New York.

f. *Safety Rolling Walker.* The Safety Rolling Walker (Fig. 16), manufactured by Polytechniques, Inc., Cleveland, Ohio, is a kit that converts most non-foldable or foldable walkers to rolling walkers with locking mechanisms. It consists of two adjustable front legs with 5-in. (12.70 cm) diameter rubber tires on plastic wheels mounted on fixed shafts, and two adjustable rear legs with swivel casters. Each wheel has a plastic gear attached on the inner side. The gear is normally en-

FIGURE 15.—Supermark Delta folding walking aid with hand brakes and rubber balloon tires.

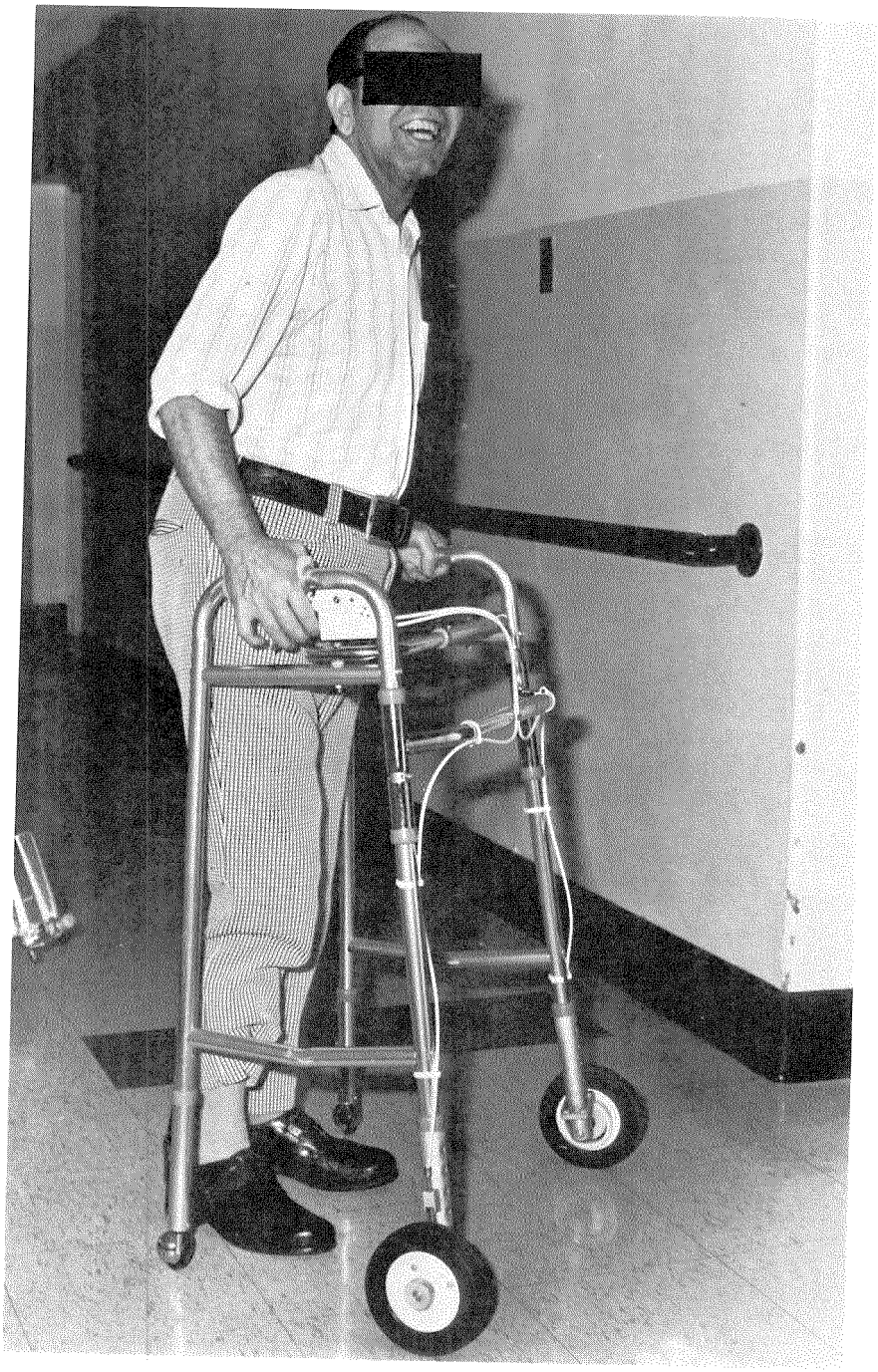

FIGURE 16.—Safety Rolling Walker kit converts most walkers to rolling walkers.

gaged by spring tension to a pivoted gear segment that keeps the wheels locked until pressure is applied to a hand lever on the right or left upper portion of the frame. The two cables attached to this lever are used to release the locking mechanism.

The user has the option of positioning the lever with or without the emergency grip. A large screw just above the hand lever regulates locking the system: adjusting the screw fully clockwise disengages the emergency grip while adjusting it fully counterclockwise engages the emergency grip. The device, when used without the emergency grip, will not lock, no matter how much pressure is applied to the lever. When using the emergency grip, locking is accomplished by overriding the resistance. Using the emergency grip provides a measure of safety if the user faints or is otherwise indisposed unexpectedly, if this would cause him to automatically tighten his grip.

The Safety Rolling Walker is currently being evaluated by the Clinical Evaluation Service, at the Castle Point, New York, VA Medical Center.

g. *Centauri Freewheeler.* This device (Fig. 17), manufactured by Tri-World Industries, Golden, Colorado, is a hand-propelled tricycle initially designed in 1974 for individuals with little or no use of the lower body.

All operating controls on the device are located at the head of the crank arm: these include brake levers, 5-speed gear shifter, parking

FIGURE 17.—Centauri Freewheeler hand propelled tricycle for individuals with little or no use of lower body.

brake attachment and body guard. The seat and leg rests are adjustable to achieve the proper crank location relative to the body. Four sets of Velcro safety straps secure the body in position: the two upper sets secure the chest and waist, the two lower sets the legs and feet.

Forward motion is attained by simultaneously pushing and pulling opposite handles. Shifting of gears is accomplished while the device is in motion. To reverse direction, the user pushes the rear wheels backwards by hand much like a manual wheelchair. Two side-pull caliper brakes are located on the front and right rear wheels. The manufacturer claims that the device will stop within 15 ft from a speed of 15 mi/h (which meets the standards of the Consumer Products Safety Commission) and recommends a top speed of 20 mi/h (32 km/h).

One Centauri Freewheeler is currently being evaluated at the VAMC, Castle Point, New York; another is being evaluated by a veteran outpatient on his farm.

h. *Independence Walker.* This 22 in. wide by 23 in. deep powered ambulator (Fig. 18), manufactured by Falcon R & D Corp., Denver, Colorado, is propelled by a single motor-chain assembly and powered by a 12-V battery, and employs an automatic battery-charger rated at 12 V, 6 A.

The user must enter from the front and turn himself around to operate the driving mechanism. He is supported by a waist-high locking belt and two padded cushions, one at knee level, the other at approximately the base of the spine.

Driving is accomplished by means of a forward-mounted tiller handle incorporating a toggle switch which directs power to the motor and a linkage to the rear wheels for steering control.

The Independence Walker was evaluated by the Clinical Evaluation Service at the VA Medical Center, Castle Point, New York, and the VA Extended Care Center at St. Albans, New York. It was reviewed at the Medical Center, New York, New York.

i. *Moto-Stand.* This powered ambulator (Fig. 19), developed by Ausmus Manufacturing Co., Independence, Missouri (BPR 10-28, page 114), offers a 3-wheel support base with the single rear wheel providing the power. Evaluation was conducted by the Clinical Evaluation Service at the VAMC, Castle Point, New York and the St. Albans, New York, Extended Care Center, and consistent clinical experiences were observed. The results and recommendations for improvement were sent to the manufacturer.

j. *VAPC Powered Ambulator.* The VAPC Powered Ambulator (Fig.

FIGURE 18. Independence Walker powered ambulator propelled by a single motor-chain assembly.

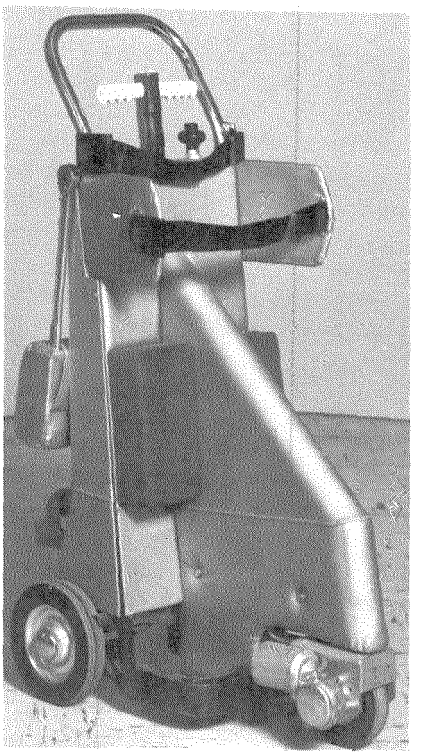

FIGURE 19. — Moto-Stand powered ambulator with 3-wheel support base.

20) is, primarily, an evaluation tool to determine the potential clinical benefits of powered mobile platforms that maintain their occupants in standing positions. (BPR 10-28, pages 113-114.)

The original model combines the basic chassis and support platform of the Jouk Ambulator, but it is powered by a pair of A-BEC powered wheelchair motors controlled by a 24-V Motorette proportional controller. Maximum speed is approximately 3 mi/h with a 180-lb occupant on level ground.

The device is used by residents and outpatients at the St. Albans, New York, Extended Care Center.

In general, the three or four subjects who routinely use the ambulator experience a reduction in lower-limb muscle spasticity. Multiple sclerosis patients who use this device do not require long leg braces. One outpatient finds that his urinary bladder retention has

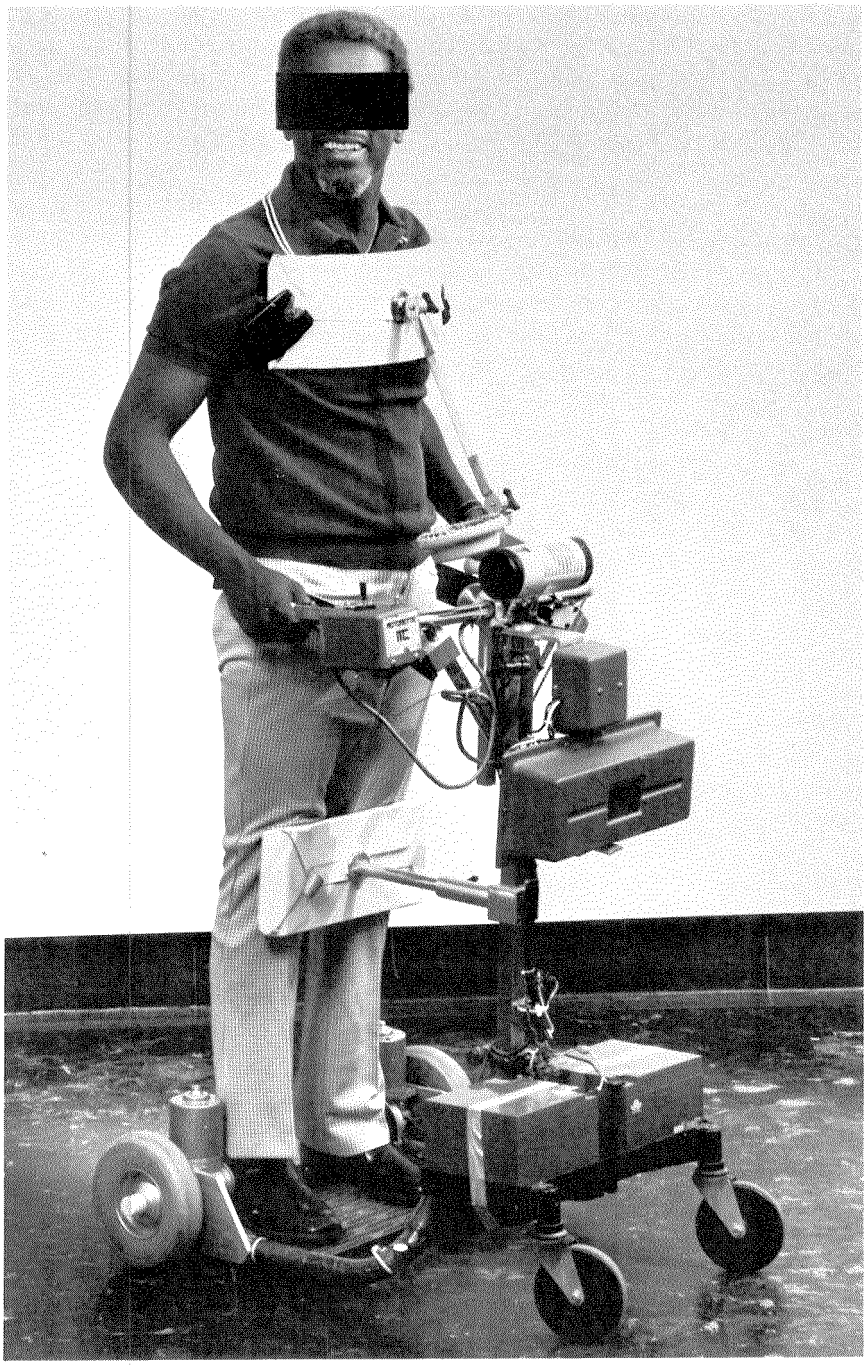

FIGURE 20. — VAPC powered ambulator evaluation tool.

improved; he also requires less physical therapy to stretch his lower-limb muscles. Initially, when entering onto the platform, this patient's pulse rate increases from 75 to 110 beats per minute, but quickly reduces to a normal level. This patient also believes that his general muscle tone has improved.

k. *Gad-A-Bout.* This mobility aid (Fig. 21) was originally intended by its manufacturer (Anik, Inc., San Rafael, Calif.) to provide some level of independence for in-hospital stroke patients, who would use it as a walking assist and item carrier. However, the manufacturer claims that its current configuration is to help patients manage their meals and to perform as a sturdy, adjustable-height walker.

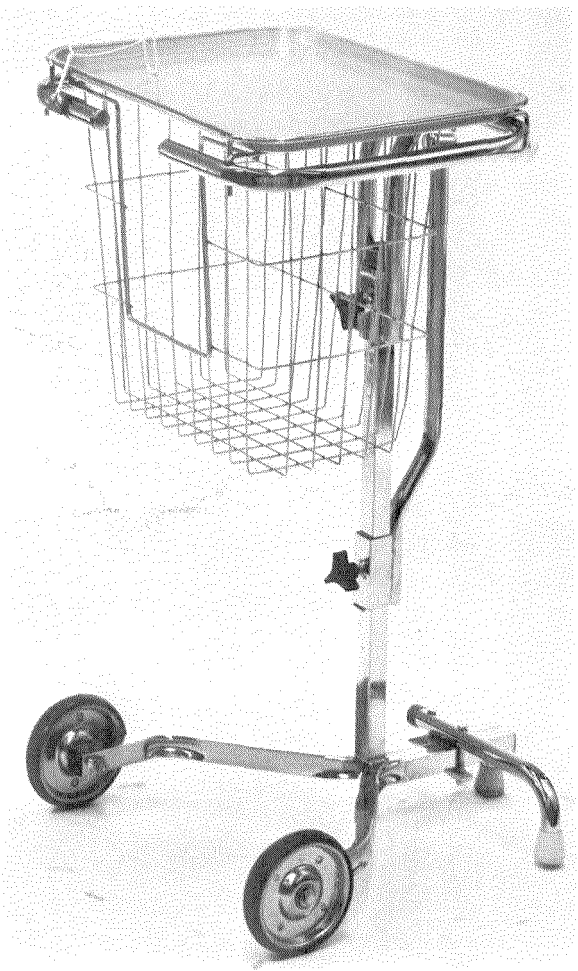

FIGURE 21. — Gad-A-Bout personal mobility aid.

The Gad-A-Bout offers a 3-point support; two points are small wheels and the third is a rubber tip. Overall weight is approximately 10 lb and hand-grip height is adjustable from 24 in. to 40 in. above the floor. The top surface of the tray and basket carrier is adjustable from 29 in. to 36 in. above the floor.

According to the manufacturer, the Gad-A-Bout should be used by independent ambulators, with or without an assistive device, but is contraindicated for those with ataxia. If the Gad-A-Bout is used for weightbearing and/or balance, the support force must be applied vertically to maximize stability. It is not intended to assist in climbing stairs.

The device will be clinically evaluated when a suitable number of patients, willing and able to use this device, are found.

4. *Body Supports*

a. *Nitto "No Sore" Cushion Pad.* This gel wheelchair cushion (Fig.22), developed by Nitto Company, Japan, and imported to this country by Nitto Dinko America, Inc., Lake Success, New York, weighs approximately 10 lb and is 15.5 in. long and 14.5 in. wide. The Nitto "No Sore" Cushion is lighter than some comparable gel cushions available in this country, but its dimensions are smaller and it does not completely cover the seat of an adult-size wheelchair. The cushion was tested by two subjects at the VA Medical Center, Castle Point, New York. While it was found to be comparable to gel cushions they had previously used, both subjects indicated that the Nitto pad was lighter to maneuver for transferring. Nitto anticipates marketing the cushion at a much lower price than its comparable gel cushion manufactured in the United States.

b. *RoHo Dry Flotation Cushion.* This cushion (Fig. 23), manufactured by Research and Development, Inc., East St. Louis, Illinois, uses air to support the patient's body uniformly and comfortably and thereby

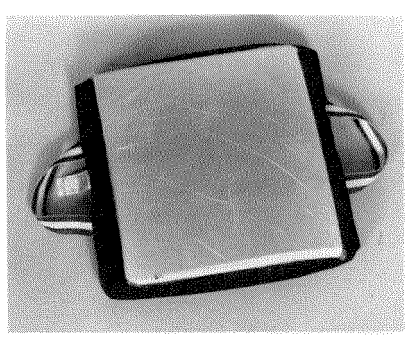

FIGURE 22. — Nitto "No Sore" Cushion Pad.

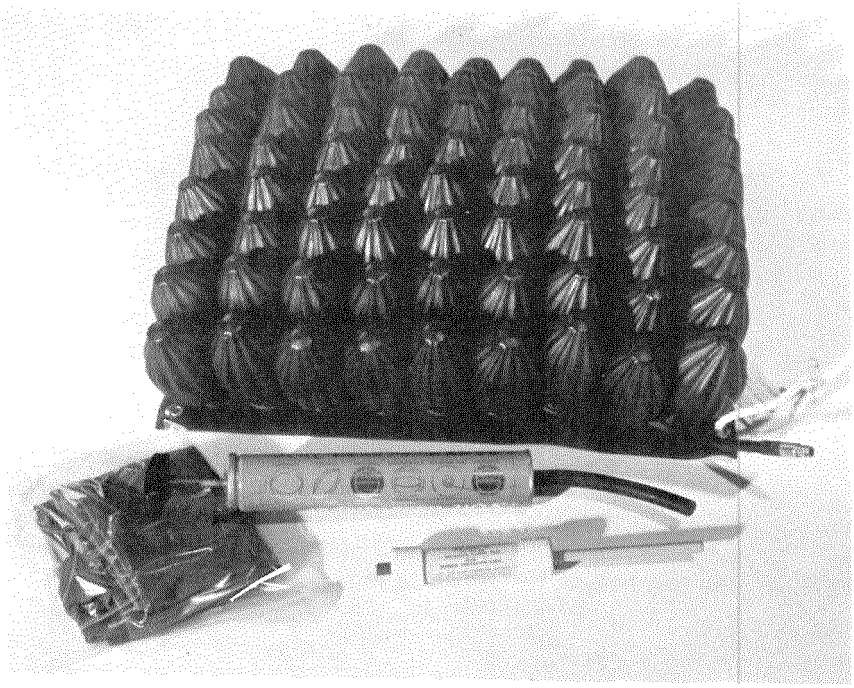

FIGURE 23.—RoHo Dry Flotation Cushion minimizes, prevents or heals pressure sores. Inflating device and pressure verification gage are shown in foreground.

minimize, prevent or assist in the healing of pressure sores (BPR 10-28, pages 117-118).

The *RoHo* was found to be useful for patients with hard-to-heal pressure sores, those with difficulties in sitting due to such conditions as hip disarticulation, perineal pressure, or those experiencing unsatisfactory results from other types of cushions. Clinical acceptance of this cushion is evidenced by the fact that over 50 cushions were used by patients at the VA Medical Center, Castle Point, New York, since the onset of the evaluation.

c. Pneumatic Lifter Seat. This portable vinyl-covered lifter (Fig. 24 and 25), distributed by the Rojowalt Company, Inc., Atwood, Indiana, helps raise the disabled individual from a sitting to a standing position. The device weighs 10.5 lb (4.76 kg) and measures 16.5 in. (41.91 cm) long by 16.5 in. (41.91 cm) wide by 3.5 in. (8.89 cm) high. Its foam-padded seat is attached to a chromium-plated steel tubing base with two pneumatic cylinders. The pneumatic cylinder brackets are adjustable (three positions) for patients of differing weights.

The device is currently being clinically evaluated by the Clinical Evaluation Service at the VA Medical Center, Castle Point, New York.

FIGURE 24. — Pneumatic Lifter Seat helps raise disabled individual from a sitting to a standing position.

FIGURE 25. — Pneumatic Lifter Seat

d. *Babette Bath.* The Babette Bath (Fig. 26 and 27), manufactured by Babette Industries, New York, N.Y., is a modular bathroom assembly that incorporates a sink, a foldaway bathtub, and a hand shower. The use of a soft bathliner adds to its safety. The device will be reviewed with patients having various physical handicaps, by the Clinical Evaluation Service, VA Medical Center, Castle Point, New York to determine indications for use. It will then be evaluated in the home of an outpatient.

5. *Lifts And Transfer Aids*

a. *Mann's E-Z Way Chair Lift.* This semi-automatic wheelchair loader (Fig. 28), manufactured by the M.E.W. Company, Tulsa, Oklahoma, is designed to maneuver and position a collapsed manual wheelchair easily into the trunk of a car or the cargo area of a station wagon or van, while decreasing the chances of the user incurring a back injury. The device consists of a boom assembly and electric winch, and a wheelchair holding bracket. The device underwent laboratory tests and clinical trials by the Clinical Evaluation Service at the VA Medical Center, Castle Point, New York (BPR 10-28 pages 124–125). It was found to be functionally useful and effective for wives and attendants of wheelchair users in storing wheelchairs in sedan trunks. Recommendations for improvement were sent to the manufacturer before final acceptance.

b. *Wilson Transporter.* Originally designed by Mr. Riley Wilson, Colorado Springs, Colorado, and later developed and marketed by Shyler

FIGURE 26. — Babette Bath modular bathroom assembly in foldaway configuration.

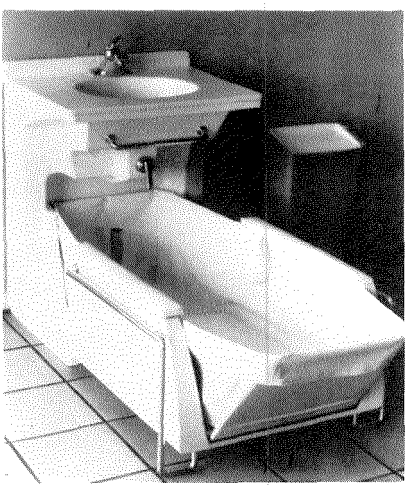

FIGURE 27. — Babette Bath modular bathroom assembly; soft bathliner adds safety.

FIGURE 28. — Mann's E-Z Way Chair Lift semi-automatic wheelchair loader.

Corp., Colorado Springs, this 65-lb (29.48 kg) device (Fig. 29) is used to help transfer and transport the disabled. The base of the transporter is 20 in. (50.8 cm) wide at the rear, 8 in. (20.32 cm) wide at the front, 36 in. (91.44 cm) long from front to rear, and 5 in. (12.70 cm) high from the floor. The two rear swivel casters are 3.5 in. (8.89 cm) in diameter and the front swivel caster is 5 in. (12.70 cm) in diameter. The front caster and one of the rear casters include a lock.

The patient's handle bars are 37 in. (93.98 cm) from the floor and the attendant's handle bars are 31 in. (78.74 cm) from the floor. The hydraulic lift, located 15 in. (38.10 cm) from the front of the base, has a lifting capacity of 300 lb (136.08 kg.). The seat, which is constructed of plastic fiber with a smooth top surface, is 16 in. (40.64 cm) long by 10 in. (25.40 cm) wide; it can be raised to a height of 32 in. (81.28 cm) from the floor and lowered to 16 in. (40.64 cm) from the floor. The seat can be easily replaced by an optional commode seat. Safety straps are included for patient safety.

The Wilson Transporter is currently being evaluated by the Clinical Evaluation Service at the VA Medical Center, Castle Point, New York to determine indications for use.

FIGURE 29.—Wilson Transporter helps to transfer and transport the disabled.

c. *Garaventa Wheelchair Elevator.* This device (Fig. 30), designed in Switzerland and currently available in the United States from Garaventa Limited, Langley, British Columbia, Canada, attempts to fill the gap left by wheelchair elevators presently on the market in the United States: the Garaventa Wheelchair Elevator can be adjusted to accomodate simple or complex bends and irregularities found in narrow staircases, spiral staircases, and staircases with sharp turns.

The wheelchair platform is supported on two parallel tubes attached to a steel haul cable that is accessible through a narrow slot cut along the underside of the upper tube. These tubes are bent in three dimensions to allow the path of the elevator to be tailored to a wide variety of

FIGURE 30. — Garaventa Wheelchair Elevator attempts to fill gap left by currently available wheelchair elevators.

variously shaped staircases of differing sizes.

This type of elevator system may be useful in a raised or high ranch home in that it may provide access to both upstairs and downstairs without interfering with the use of the door at mid-landing.

The Garaventa Wheelchair Elevator will be evaluated through our home-care program when a suitable candidate is found.

d. *Tuba-Chair.* This aid (Fig. 31 and 32), manufactured in Western Europe and distributed in the United States by Medical Equipment Distributors (MED), Inc., is claimed by the manufacturer to be a reasonably convenient way to transfer a severely physically disabled person from a bed to a sitting position. It employs a hydraulically operated mechanism, which raises or lowers the seat height of the Tuba-Chair between 19 in. and 24 in. from the floor. As the seat height is raised, the chair back is simultaneously lowered and the leg rest is elevated so that the device assumes a conventional stretcher-like configuration. The back and leg rest may be manually adjusted only when the seat is in its lowest position.

The hydraulic mechanism may be controlled by foot pedals located on both sides of the chair. A support adjustment rod on the back of the chair permits the back to be instantly lowered if the occupant begins to experience a blackout or other emergency. The front edge of the seat

FIGURE 31. — Tuba-Chair in geriatric wheelchair configuration.

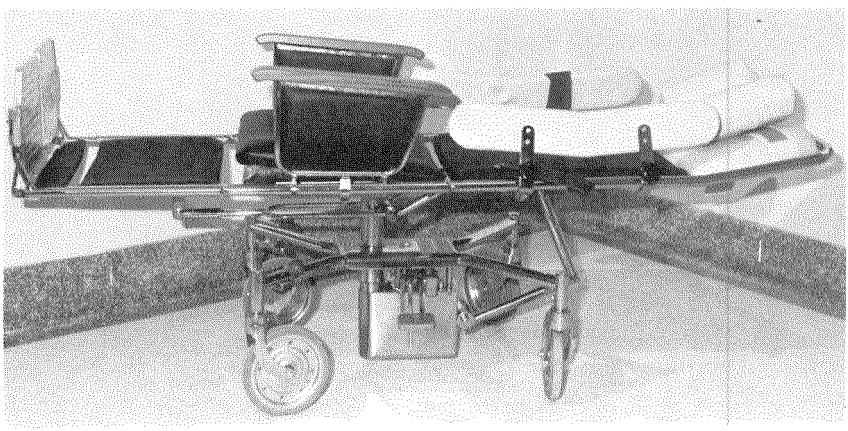

FIGURE 32. — Tuba-Chair in stretcher configuration.

may be tilted up, i.e., tilted down toward the rear of the chair, to prevent the occupant from sliding forward and to provide additional hip flexion.

The Tuba-Chair, if equipped with small wheels, assumes a geriatric chair configuration. However, 22 in. diameter pneumatic wheels may be installed in the front, as an option, to make the chair resemble a conventional wheelchair.

Offset, removable, reversible armrests are available with safety locking features which permit a limited adjustment (approximately 5 in.) in the mediolateral plane for different patient widths. These armrests may also be shifted toward the front or rear, depending upon patient requirements.

When equipped as a geriatric chair, the chair's four small wheels are free to swivel, but the front wheels may be locked to facilitate steering by an attendant. The front wheels are equipped with brakes.

The Tuba-Chair may be fitted with optional accessories such as an adjustable neck support to secure an occupant's head in a more comfortable position. Pads may be adjusted from side to side and for height. Side supports secure the occupant in an upright or prone position. A worktable attachment may be added for working or eating —or simply to maintain the occupant in a more secure position. The footrests are adjustable for different patient heights and do not require special tools for adjustment.

Clinical evaluation of the Tuba-Chair is nearing completion at the St. Albans, New York, VA Extended Care Center. Results thus far are satisfactory.

e. *Stretcher Chair.* This device (Fig. 33 and 34), similar to the Tuba-Chair already described, is manufactured by Everest & Jennings, Inc., Los Angeles, California. It is available only in a geriatric chair configuration. In contrast to the Tuba-Chair, the Stretcher Chair uses a mechanism to select different configurations.

Seat height is adjustable by a side-mounted crank to facilitate patient transfer between the patient's bed and the Stretcher Chair. Back and leg rests are independently controlled so that the occupant may be oriented in a seated position, a fully reclining position, or any combination thereof. The armrests may be folded down on the lateral aspects of the chair.

The four wheels are all approximately 5 in. in diameter and free to swivel. The rear swivel (caster) wheels incorporate independent, foot-operated locks to preclude motion. Both front caster wheel assemblies may also be locked into either a forward or turning configuration (0 or 90 deg) to attain a swivel action by pivoting the rear section about the front end, or to completely lock the entire unit when the rear wheel locks are employed.

FIGURE 33.—Stretcher Chair (E&J) in geriatric wheelchair configuration, upright position.

Back, seat and leg paddings have Velcro fasteners and may be readily removed for washing. The headrest can be relocated or repositioned by means of its Velcro fasteners.

This device is undergoing evaluation at the VA Extended Care Center St. Albans, New York. Thus far, clinical findings are satisfactory.

f. *Stretchair.* The Stretchair (Fig. 35 and 36), manufactured by Mobilizer Medical Products, Inc., Mt. Vernon, New York, is available in two models: one model assumes either a stretcher-like configuration or a typical geriatric-chair-like configuration; the other model assumes a stretcher-like configuration and a standard-wheelchair-like configuration. A "U"-shaped handle near the top, behind the high backrest,

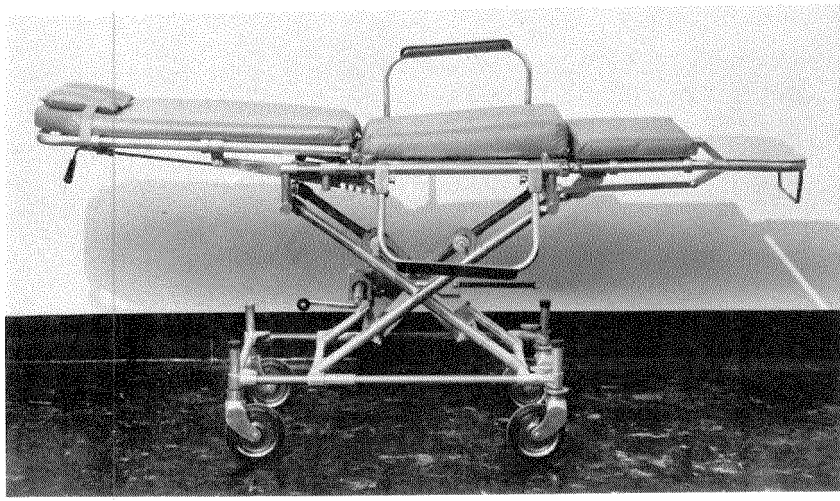

FIGURE 34.—Stretcher Chair (E&J) in stretcher configuration, reclining position.

is pulled to disengage the adjustment mechanism. Back and leg rests are not independently adjustable and the height of the seat and back in the stretcher configuration is not adjustable. The footrest can be pivoted about its end supports to be flat in the stretcher configuration or to provide a footrest in the chair configuration.

The front wheels are fixed but the rear wheels are free to swivel. The rear wheels are equipped with brakes that can effectively immobilize the Stretchair. Removable armrests are height-adjustable.

One unit has been successfully used to manage a 20-year-old veteran with a sub-dural hematoma at the VA Extended Care Center, New York.

Another unit is also being successfully used with a severe multiple sclerosis quadriplegic patient who has tight knee and hip musculature making him unable to sit in a regular wheelchair. The Stretchair is most effective for this patient in a partially folded configuration.

6. *Miscellaneous*

a. *Pulsemeter.* The Pulsemeter, Model 2D16 (Fig. 37), manufactured by San-Ei Instrument Co., Ltd., Tokyo, Japan, is a battery operated pulse-rate indicator that measures 6.5 in. by 3.5 in. by 2.0 in. and weighs approximately 19 oz. This instrument is the most portable of its kind evaluated to date.

Typically, a light incorporated in the finger sensor is diffused through the fingertip to illuminate a cadmium-sulphide photocell. The light is interrupted by the pulsatile blood flow, causing the electrical resistance of the photocell to vary with each pulsation. The signal is conditioned and amplified by transistor circuitry within the instrument

FIGURE 35.—Stretchair (Mobilizer Medical Products) in geriatric wheelchair configuration, upright position.

and displayed in three different fashions. A meter calibrated in beats-per-minute, with a working range of 30 bpm to 200 bpm, indicates a pulse rate that has been averaged typically over the most recent several beats. The remaining two displays are an audible tone "beeper" and a built-in "flash" indicator; these are triggered each time a pulse is sensed.

Reports received from the evaluation conducted by the Corrective

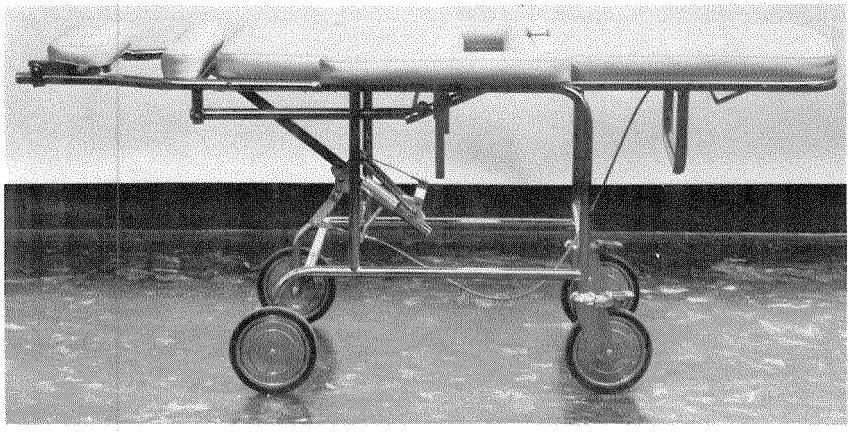

FIGURE 36. — Stretchair (Mobilizer Medical Products) in stretcher configuration, reclined position.

FIGURE 37.—Pulsemeter Model 2D16 showing finger sensor, optional ear lobe sensor, battery charger and mounting bracket.

Therapy department at the VA Extended Care Center, St. Albans, New York, resulted in a recommendation that this device be approved for use in VA health care installations.

b. *Pulse Watch.* The Pulse Watch, Model 420 (Fig. 38), manufactured by G & W Laboratories, Waltham, Massachusetts, is a portable battery-operated heart-rate monitor that is ideally suited for general health care in clinics, rehabilitation centers, etc. The device also lends itself for use in emergency situations, athletic fitness programs, and similar applications where direct pulse monitoring is required.

The Pulse Watch utilizes a photoelectric sensor that clips onto the finger. Pulse rate is displayed visually by means of a large meter on the face of the instrument, in addition to an LED (light emitter diode) that lights each time a heart beat is sensed. An audible signal from an internal speaker (a short tone per pulse) is available when desired.

Calibrated in beats-per-minute, the range displayed is 40 bpm to 200 bpm, with the reading indicating a pulse rate that has been averaged typically over the most recent five to seven beats.

The device was evaluated by the Corrective Therapy department at the VA Extended Care Center, St. Albans, New York. Ease of use along with accurate determination of pulse rate has led to a recommendation that approval be given to use this device in VA health care installations.

c. *Touch-Lite.* The Touch-Lite (Fig. 39) is designed for physically disabled housebound veterans who need special appliances that need

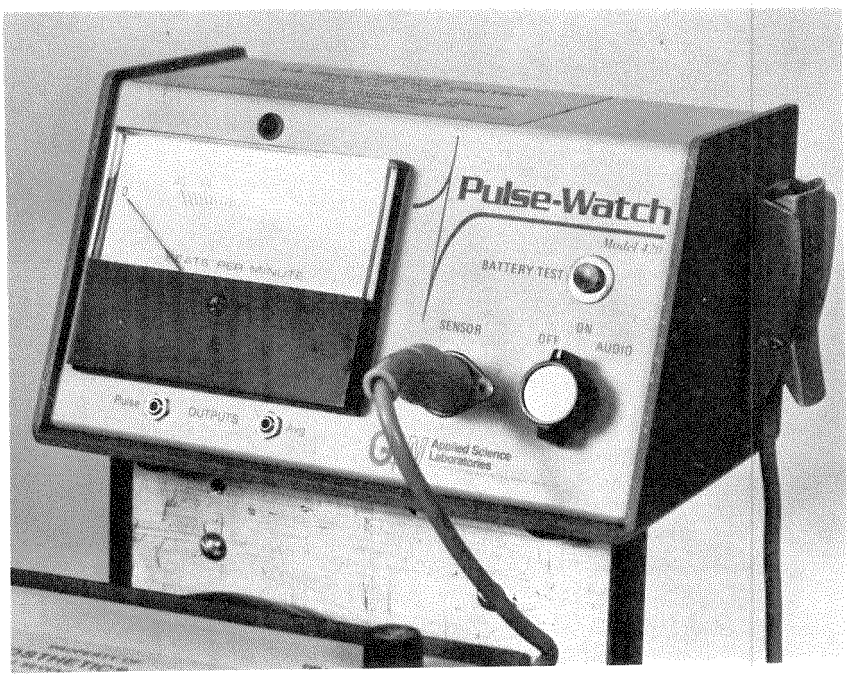

FIGURE 38. — Pulse Watch Model 420.

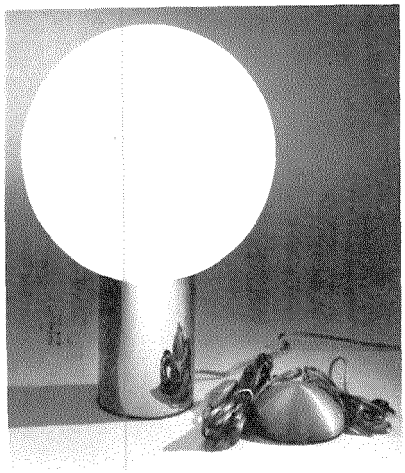

FIGURE 39. — Touch-Lite.

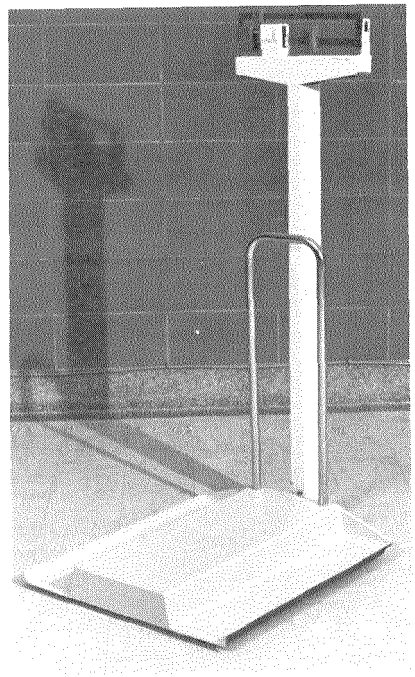

FIGURE 40. — Wheelchair Scale.

FIGURE 41. — Wheelchair Scale with platform removed.

not be operated by means of environmental controls. Manufactured by Sof-Touch, Inc., Boulder City, Nevada, the Touch-Lite is available in two models: a simple capacitance-sensitive lamp that can be turned on and off by simply touching the base of the lamp with any part of the anatomy, including the hand or fingers; the other (as illustrated) is a three-way unit. Successively touching the lamp base turns the unit on and raises it to higher levels of illumination. Standard three-way lamps are used.

The Touch-Lite is being evaluated in veterans' homes with excellent results. The only necessary modifications we foresee are a more stable base and a means of fastening the large globe. We have informed the manufacturer of our recommendations and expect to receive updated models within the next several months.

d. *Wheelchair Scales.* According to the Joint Commission on the Accreditation of Hospitals, monthly weights of in-patients must be obtrained and recorded. At the VA Extended Care Center, St. Albans, New York, with approximately 80 percent wheelchairbound residents, this problem is serious since no effective means of weighing patients in different wheelchairs, especially the newer powered types, is available. The Nursing Service requested that the VAPC Rehabilitation Engineering Service attempt to solve this problem.

A review of commercial wheelchair scales suggested that all were essentially similar. A conventional balance scale is modified to receive a custom fabricated platform (Fig. 40 and 41), which is intended to support a wheelchair and its occupant for weighing purposes.

We noted several serious problems. First, the platform is supported on the balance scale platform in such a way that the center of gravity of the wheelchair, occupant and wheelchair platform is significantly off-center, thereby producing weight readings that are often erroneous. Further problems are demonstrated when wheelchair leg rests or

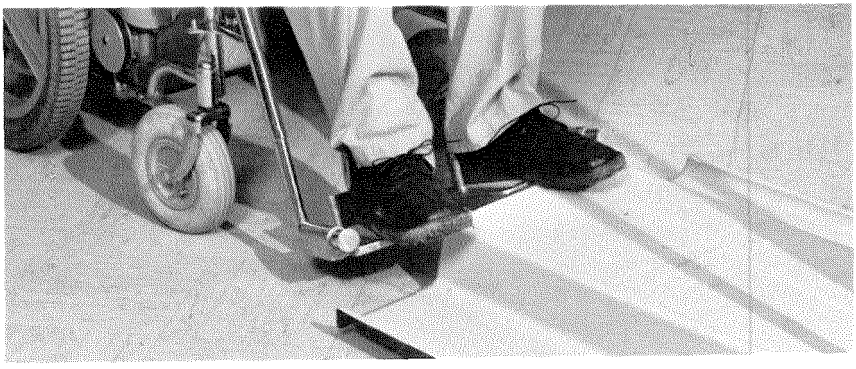

FIGURE 42. — Front approach to wheelchair scale showing interference with foot pedals of wheelchair.

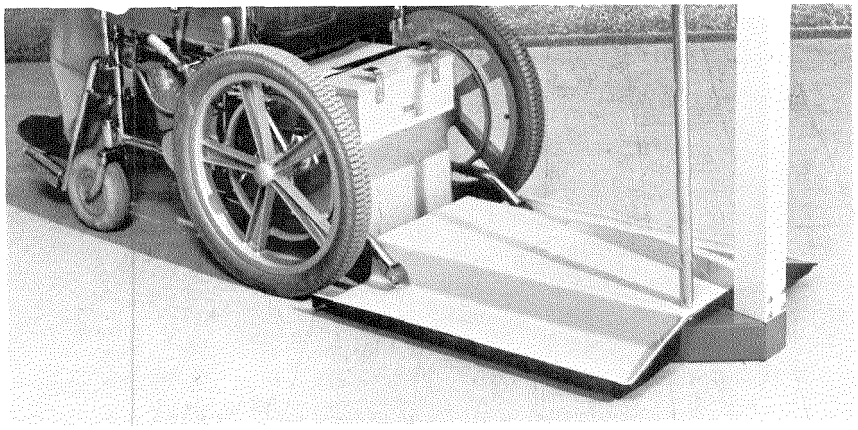

FIGURE 43.—Rear approach to wheelchair scale showing interference with battery case of powered wheelchair.

footplates have been adjusted to low positions for tall individuals.

With footplates in the low position, a mechanical interference occurs between the footplates and the center section of the wheelchair scale platform when the patient attempts to enter upon the platform in a forward direction (Fig. 42). Some of the newer powered wheelchairs are equipped with low battery trays; these present mechanical interference if the user attempts to enter upon the platform in reverse (Fig. 43).

After considering this problem as presented by several types of manual and powered wheelchairs, and discussing the matter with members of the Nursing Service at the VA Extended Care Center, St. Albans, New York, it was determined that a useful and practical wheelchair scale would require a relatively low support or weighing platform, mated to an inclined section to facilitate entry onto the platform. Furthermore, the support base, which would house the weight sensors, must be sufficiently wide so that even if a patient and his wheelchair are not physically located in the center, readings will be of sufficient accuracy to be useful.

Several manufacturers have been contacted concerning this problem. The initial development approach involves an electromechanical system with a sufficiently wide weight-support base to provide accurate readings. The weight read-out will be digital in both the english and metric systems. The initial prototype should be in clinical evaluation by March 1979.

II. COMPLIANCE TESTING

Shrinkage Tests

a. *Herringbone Corset Material.* Three samples of 50 percent cotton, 50

percent polyester fabric were submitted for testing by Meadtex Fabrics Co., Inc., New York, New York. All samples tested complied with current specification requirements.

b. *Coutil Corset Material.* Three specimens of each, 15 in all, of coutil fabrics were submitted for testing by the following manufacturers: Camp International, Jackson, Michigan; Kellogg Industries, Inc., Jackson, Michigan; Medipedic Surgical Supply Co., Warrior, Alabama; Atco Surgical Co., Cuyahoga Falls, Ohio; and Frederick Lee, Inc., Mayaguez, Puerto Rico. All items tested complied with current specification requirements.

c. *Stump Socks.* Special shrinkage tests were conducted on stump socks submitted by Knit-Rite, Inc., Kansas City, Missouri. All items tested complied with current specification requirements.

III. THE VAPC CLINIC TEAM

The statistical breakdown in Table 1 of veterans treated by the clinic team during the latter 6 months of 1978, is a typical case load that is similar to those presented in previous BPR reports. Of the total, 3 were World War I veterans, 427 were World War II veterans, 6 were Korean War veterans, and 142 were Vietnam War veterans. In addition, 28 Israelis, 1 Yugoslav, and 1 Costa Rican veterans were treated. Of the total, 479 were treated for service-connected injuries while 129 were treated for injuries that were non-service-connected.

TABLE 1.—*Breakdown of Patient Disabilities July 1, 1978 to December 31, 1978*

Amputation		
Area of involvement	Specific level of involvement	Number of patients
Lower-limb unilateral	Below-Knee	167
	Above-Knee	135
	Transmalleolar (Syme's)	23
	Hip (Disarticulation)	14
Lower-limb bilateral	Below-Knee	27
	Above-Knee/Below-Knee	4
	Above-Knee	13
	Transmalleolar (Syme's)	1
	Below-Knee/Transmalleolar (Syme's)	1
	Above Knee/Hip (Disarticulation)	1

Upper-limb unilateral	Below-Elbow	11
	Above-Elbow	6
Upper-limb bilateral	Above-Elbow	3
	Above-Elbow/Shoulder Disarticulation	1
Triple	Below-Knee/Below-Knee/ Below-Elbow	2
	Below-Knee/Above-Elbow/ Hip Disarticulation	1
		410 Total

Neuromuscular or Skeletal Impairment

Lower-limb unilateral	Ankle-Foot	85
	Knee-Ankle-Foot	29
	Knee	1
Lower-limb bilateral	Ankle-Foot	6
	Knee-Ankle-Foot	7
	Ankle-Foot/Knee-Ankle-Foot	2
Upper-limb unilateral	Arm-elbow-forearm; wrist-hand	4
Trunk	Lumbosacral spin	8
Miscellaneous	Varied (Wheelchairs, shoes, etc.)	55
		197 Total

Amputation and
Neuromuscular or Skeletal Impairment

Lower-limb bilateral	Above-Knee/Ankle-Foot	1 Total