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The CAPP Electric Cart: Recent Developments[1]

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SINCE the development of the first Child Amputee Prosthetics Project (CAPP) electric cart *(1-5),* the device has been completely redesigned. A limited number were produced in 1968-69, and a field test was conducted by New York University. This article describes the mechanical changes that have been made in the cart. The report of the field test is presented elsewhere in this issue.

The changes in no way altered the basic concept of the cart, and the design is still consistent with the original criteria: (1) the cart should be a powered vehicle which provides mobility to severely limited, limb-deficient children; (2) the controls should be simple to operate; (3) the cart should be compact, highly maneuverable, yet very stable and transportable; and (4) it should require minimal maintenance, and be attractive in appearance without resembling a wheelchair.

Earlier models of the cart are shown in figures 1, 2, and 3. These prototypes were built between 1962 and 1966. The changes made since prototype III have made the production of the 14 carts needed for the field test less costly. Figures 4 and 5 show the cart produced in 1968-69 for the field test. The differences between this model and the 1966 prototype are described below.

STRUCTURAL CHANGES

The chassis, redesigned to simplify construction, is built of 1-in.-square mechanical tubing. The seat frame is made of 3/4-in.-square, chromed mechanical tubing. The front axle was redesigned to allow torsional or vertical movement by means of a central pivot stud that is located at the center of the

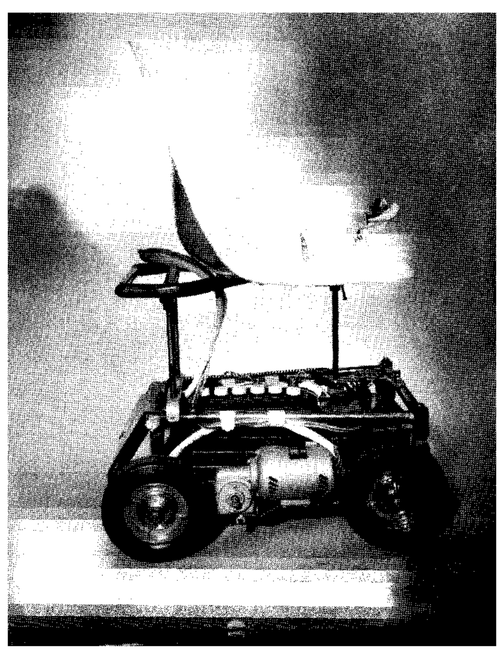

Fig. 1. Prototype I, CAPP electric cart.

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Fig. 2. Prototype II, CAPP electric cart.

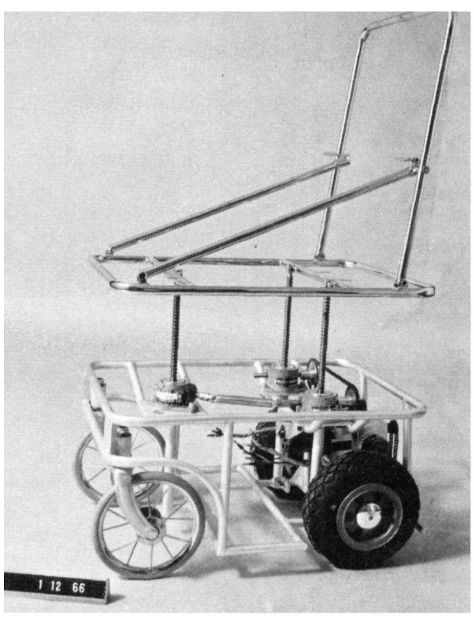


Fig. 3. Prototype III, CAPP electric cart.

axle, which allows the chassis to travel over an uneven surface and still maintain four-wheel contact and stability.

A new folding-seat arrangement makes the cart more compact for transport and adds lateral support from the side arms. The arms are set back far enough to allow the cart to be placed close to a table, desk, or washbasin. The frame for the backrest can be folded flat by lifting it slightly out of its locking notch and allowing it to fold forward onto the seat cushion.

A shell made of metallic-green fiber glass covers the chassis and power equipment. The upholstery for the seat cushion and

Fig. 4. Field-test cart.

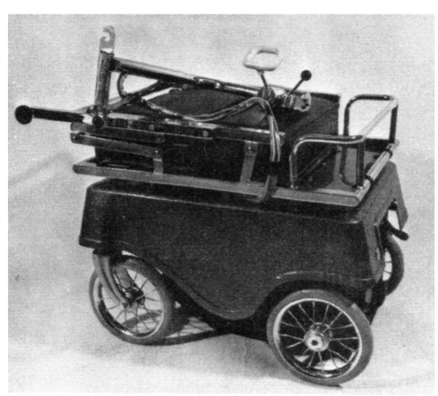


Fig. 5. Field-test cart folded.

backrest is black Leatherette (TM). The seat frame is slightly larger than the seat cushion, thus leaving a small space for storage behind the cushion. Eight-inch, spoked casters with one-inch, solid-rubber tires (wheelchair type) are used on all four wheels.

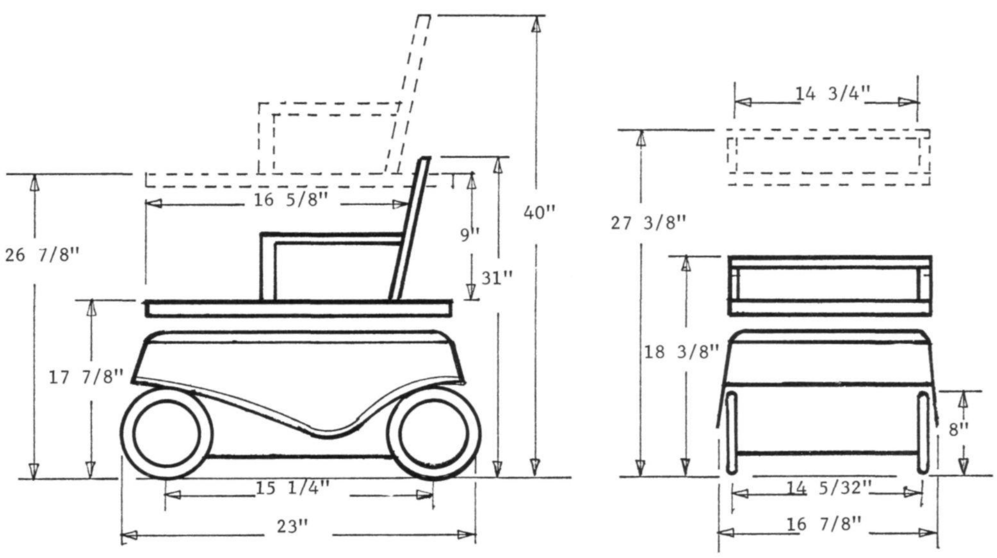
POWER-SYSTEM CHANGES

The two drive motors are positioned independently on each side of the chassis. Each motor drives a specially designed worm-gear reduction box. The rear wheels are mounted directly on the output shaft of the gearbox, which is bolted to the frame. Power is fed into the gearbox through a Browning gear belt.

A third motor powers seat raising and lowering. This motor is mounted adjacent to the right drive motor and is connected to the two rear screw jacks by a Browning gear belt and to a single front screw jack by a flexible shaft. These screw jacks raise the seat platform nine inches.

The battery is positioned between the rear wheels and is easily accessible from the rear of the cart. This arrangement is more convenient than the side opening in the previous model, but it necessitated repositioning the motors and gear boxes, which had been a single package at the rear of the cart in prototype III.

The control box is a specially designed unit developed at CAPP. It has toggle switches for directional control and a separate switch to raise and lower the seat. A circuit breaker was added to prevent an overload of the drive system. The switch



Power Source	
Drive motors	Redman, 12 v, dc, permanent magnet
Speed	$1\frac{1}{2}$ mph (approx.)
Range	One day use with overnight charging
Battery	Sears Roebuck, G8-2, 6 v, 135 amp for 20 hr, or equiv.
Control unit	Motorette solid-state, proportional control (Motorette Corp., 6000 Reseda Blvd., Tarzana, Calif.)
Chassis	
Body	Fiber-glass shell
Ground clearance	$1\frac{1}{2}$ in.
Cart weight	Approx. 95 lb with battery
Turning radius	$15\frac{1}{4}$ in.
Wheels (front)	8:00 x 1 in. spoked casters
Tires	Solid rubber, 8:00 x 1 in., wheelchair type

Fig. 6. Dimensions and specifications of CAPP electric cart.

Fig. 7. Cart with solid rear wheels and new control unit.

controls are housed in a compact cylindrical unit that is mounted at the end of an re-shaped control arm, which is attached to the left side of the seat frame and extends to the child's chin. The control arm can be adjusted for height and distance from the seat back. The chin receptacle is positioned next to the seat-elevation-control lever and is foam-padded (see figures 4 and 5). The control arm is held in position in front of the child by a ramp lock. When lifted slightly, the control arm swings out for seat folding, the child's use of the table top, or transfer.

The specifications for the cart's power equipment, size, turning radius, etc., are shown in figure 6.

CHANGES SINCE FIELD TEST

In November 1970, two additional changes were made. (The modified cart, with the new wheels and control unit, is shown in figure 7.)

1. A new solid-state proportional control unit, now available commercially, was selected to replace the previous control unit. This new unit (manufactured by the Motorette Corporation of Reseda, California) provides proportional (variable-speed) control and an on-off master switch. The manufacturer provided a control for raising and lowering the seat so that the unit could be used with the electric cart. The control box can be positioned for control by the chin or an extremity. The circuitry unit fits on the storage rack behind the seat.

2. The rear drive wheels were changed from spoke casters to specially designed cast-aluminum wheels to eliminate the possibility of breakage due to high torques, but they have the same solid-rubber tires as the front casters. Although the use of pneumatic tires is being considered, solid-rubber tires have been retained for the present because they provide less rolling resistance and thus prolong the life of the battery. Also, solid-rubber tires are more reliable for a testing program because no problems arise from variations in air pressure.

PRODUCTION

The gear box, control box, chassis, body, and seat-lifting mechanisms for the carts used in the field test were specially de-

Fig. 8. Assembly of field-test carts.

signed by Mr. Carl Sumida at the Child Amputee Prosthetics Project at UCLA. These items were manufactured by subcontractors, and other components were purchased from commercial sources. The fourteen carts were assembled for the field test at the CAPP (fig. 8).

During the field test, all mechanical repairs were made at CAPP. At the end of the test, all the carts were rechecked, new control boxes were installed, and new wheels were applied. The carts have been returned to the children who participated in the field test, who will continue to use them as long as necessary.

Attempts are now being made to find a commercial manufacturer for the electric cart because it has proven to be an extremely valuable aid to the mobility of the severely limb-deficient child.

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