CHAPTER 13

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Designing Instructional Machinery for Handicapped Persons

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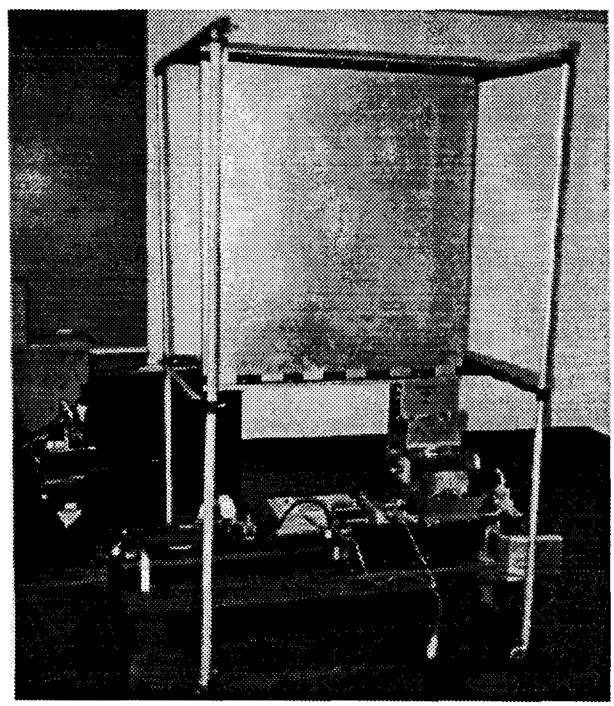
INTRODUCTION

The purpose for custom designing instructional machinery for handicapped persons is to allow them to advance their self-worth by performing socially and economically useful activities while learning to work. Profoundly and severely handicapped persons often times have the need for custom designed machinery or for machines modified in a manner that allows them to perform a job with the same efficiency as the non-handicapped person.

In 1988, a group of engineering and education professors at Texas Tech University initiated a strategy for developing assistive devices for handicapped children. During the first years of operation, orthotic devices were designed that enabled severely handicapped school children to communicate and move; more freely in their home and school environments. Synthetic speech communications systems, innovative wheelchairs for children with severe cerebral palsy, a variety of assistive devices for deformed hands, and therapeutic crawlers were designed to fit the individual needs of school children in the South Plains Region. This improvement in communications and mobility lead to older students seeing more of the world and raising their aspirations to be more integrated into regular work, school and social activities. Improved aspiration lead to the need for the older children to have custom designed machinery that would allow them to learn to work in a sheltered work environment or in the regular work places. More importantly, a few hours of employment in a sheltered work environment have the handicapped adolescent and young adult a sense of social contribution that greatly enhanced their self-esteem.

SUMMARY OF IMPACT

The demand for part-time employment by handicapped young adults created the need for the manufacturing and recycling of materials in the residence and public schools. Most existing machinery for manufacturing is designed for people without handicaps. If our young adults were indeed to learn to work, to manufacture, and to sell their own products, machinery had to be designed especially for them. Next, the custom designed machinery had to be fabricated, and later tested with the handicapped students using the machine and their special adaptive devices. The Senior Projects Team recognized this emergent need and custom designed several pieces of instructional machinery for the Lubbock State School's Vocational Workshop and the Lubbock Independent School District's Ballenger School.



The Can Crusher Project was designed for several older students at the Ballenger School to aid them in their aluminum can recycling enterprise. Dr. D. Reavis, Principal; Mr. George Campbell, Vocational Adjustment Coordinator; Ms. Anita Atkins, Senior Projects Cooperating Teacher; and several of the Ballenger School staff developed the idea of the instructional machinery and the recycling enterprise to train their older students. The established the plan for collecting and sacking cans by children with both higher and lower aptitudes to perform can crushing activities. At first this process was done by stomping and beating cans with a mallet. This manual recycling enterprise allowed young adults to work in and manage a cooperative enterprise. The enterprise allowed all handicapped students who wanted to contribute, to work in a enterprise of their own making and to earn modest amounts of money from the sale of the aluminum salvage.

The Ballenger Vocational Adjustment Group in November of 1989 asked for a team of Tech engineering students to design for them a can crusher that would accommodate to the limited mobility and motor skills of specific Ballenger students. The design team talked with students and staff at the Ballenger School to determine how they could design and construct a aluminum can crusher so children could not get a hand or a finger in the machine and so students in wheelchairs could get close enough to insert and operate the machine. Moreover, several of the Ballenger students had specific handicaps that called for special delivery of cans a remote activation of the crusher. After several designs were drafted and evaluated, a pneumatic design was selected as the best choice. The can Crusher Project was built in the Spring of 1990 with a cost of less than $900 and with more than two hundred hours of the Senior Projects Team's time. In May of 1990, Ballenger School students gave up their mallet for pounding cans and started crushing cans with the Texas Tech Can Crusher. The Ballenger students are very proud that they have automated their operations and that they were involved in the design of this specialized machinery. The Can Crusher has directly added to the quality of life for at the Ballenger School. More importantly, it has proven that machinery can be custom designed for handicapped persons who may then learn a job skill and management techniques that can further their efforts to make economically vaiuable contributions to their society.

TECHNICAL DESCRIPTION

The majority of the design criteria was driven by the characteristics of the people for whom the device

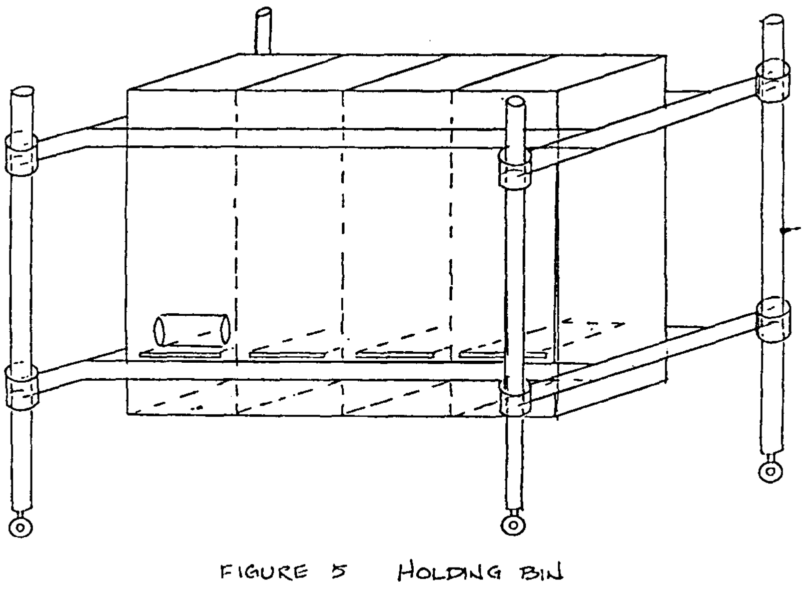


FIGURE 5 HOLDING BIN

was made. Some children may have as little mobility as only being capable of moving an elbow back and forth. The lack of mobility requires that the machine be operated by activating a single button. The machine should also be able to run for several cycles without the aid of a teacher or Supervisor. The objectives associated with the can crusher were basically that the machine be effective, safe, and economical. In order to be effective, the device needed to be capable of performing the following steps:

1. Load the can automatically.
2. Crush the can upon command.
3. Dispense the crushed can.
4. Stop the cycle in order to be reactivated.

The remainder of the design criteria depended on the force required to crush a single aluminum can.
In order for the machine to be safe, it had to be constructed so children could not get a hand or finger in the machine and it needed to be structurally sound. Finally, in order to be economical, the TTU can crusher had to be inexpensive to build and maintain.

When used by the students, a repetitive cycle is created that is very conducive to their learning process. The air cylinder will extend, driving the crushing plate toward the back wall while crushing the aluminum can. At the end of the stroke the trip plate will hit a limit switch that tells the air cylinder to retract. As the cylinder approaches its starting position, a second limit switch is contacted that causes the small air cylinder to extend, pushing the crushed can out though an opening in the box. The small air cylinder then retracts, and the large air cylinder will be at the starting position. Also, before the large air cylinder reaches the starting position, the movement of **a** trip plate causes the hollow cylinder to rotate allowing a can to fall into the press.

Crushing **Box**
The box that houses the press is 24” x 5” constructed of Cl010 hot-rolled steel welded together at the four corners. In order to alleviate the possibility of corrosion, an aluminum plate was used as the bottom of the box. The outer shell of the box and the aluminum bottom were flanged together. This construction provided a very solid structure that will not corrode when liquid from the cans remains in the bottom of the press.

A cutting torch was used to cut two openings opposing one another on the longer sides of the box. (See Figure 3) One opening of 3.5” x 3.5” was used to mount the small ejection air cylinder. The second opening was cut 3.75” x 4.75” in order to allow sufficient space when the ejection cylinder pushes the crushed can out of the box.

Crushing Plate
The crushing plate consists of two aluminum pieces assembled together with four 0.375” socket bolts staggered and counter sunk. (See Figure 4a) One piece houses the bearing and the other piece connects to the air cylinder. Linear ball bushings with an outside diameter of 1.125” and an inside diameter of 0.625” were pressed into the 1.120” holes in the crushing plate. Two bearings were used in each hole to prevent skidding of the crushing plate as it moves along the shafts. The lower portion of the crushing plate required special treatment when attached to the air cylinder. (See Figure 4b) A steel insert permanently sealed to the aluminum plate was used to strengthen the attachment. This was achieved by boring and threading a 2” hole into the plate. The steel insert with a 2" outer diameter and a 0.75” inner diameter was threaded and attached to the plate. This adaption provided a union of two like materials which insure a greater strength and a longer life of the threads.

Trip Plate
The trip plate has the important function of rotating the cylinder at the appropriate time. The trip plate was constructed of aluminum and has the dimensions of 4.875” x 2" x 3.875”. Two linear ball bushings were used for smooth movement. A 1/2" slot machined into the top the plate holds a bar that extends beyond the edge of the box. A cable connected to this bar controls the rotation of the cylinder that deposits the cans into the box.

Holding Bin
The holding bin is a 36” x 42” x 3” aluminum sheeting shell with separate columns within the shell. (See Figure 5) Each column is 6” wide and is capable of storing 15 cans, giving the bin a 90 can capacity. Each column has a “stop” at the base to stop the flow of cans from that particular column unless that column is in use.