CHAPTER 7

NORTHERN ARIZONA UNIVERSITY

College of Engineering and Technology
Department of Mechanical
Flagstaff Arizona 860114560

Principal Investigator:

David E. Hartman (602) 523-3450

Modified Parking Brake Release

Designer: John L. Dickmann
Supervising Professor: Dr. David Hartman, Ph.D., P.E.
College of Engineering & Technology
Northern Arizona University
Flags taff, Arizona 86011

INTRODUCTION

The client, a mature woman, suffers from severe rheumatoid arthritis. This disease attacks the individual's joints and eventually will render these joints deformed and useless. She has mainly been affected in the hands and feet. She is fortunate enough to have had several operations to implant artificial joints in the hands, feet and ankle. Although these implants are a miracle in themselves, they do not restore full use nor strength to the afflicted area. Furthermore, the client, with these obvious handicaps, still chooses to live an active life. Unfortunately, this active lifestyle is being threatened by problems arising during operation of a private automobile. She does not have the strength in her hands required to release the push-button mechanism on the emergency parking brake in her car.

The modified parking brake release is designed to allow any individual with limited hand strength to operate a manual push-button emergency parking brake release. This is accomplished through use of a curved arm that is attached to the existing brake are by a clamp. To make use of the client's strengths, the curved arm is positioned beneath the existing brake arm where the force will be applied. This force is them transmitted by the curved arm and used to push the button that disengages the brake.

SUMMARY OF IMPACT

Prior to the installation of this mechanical device, the client disengaged her parking brake release on her car with both hands. She was forced to put one hand on the button and lean over with the other hand to help push in the button.

The modified attachment now allows the client to continue operation of her private automobile, as well as living an active lifestyle. The ease with which she can now release the brake is very self-gratifying. She had the following to say:
"With this device being attached to my parking brake, I don't have to use two hands to release it anymore. In fact, I only need one finger because it works so easily! Not **only** is this a fantastic improvement for allowing me to release the brake, but it allows me to set the brake harder. I can set it harder because I know that I can release it now! You just have no idea how much this will aid me in my day to day life!"

TECHNICAL DESCRIPTION

This mechanical device was designed using the basic principles of leverage and moment. The device consists of four parts: 1) the curved lever arm, 2) the mounting piece, 3) the hardened steel pin, and 4) the clamp. The device was designed to fit in a space 6" long, and 4" wide, and 4" in depth.

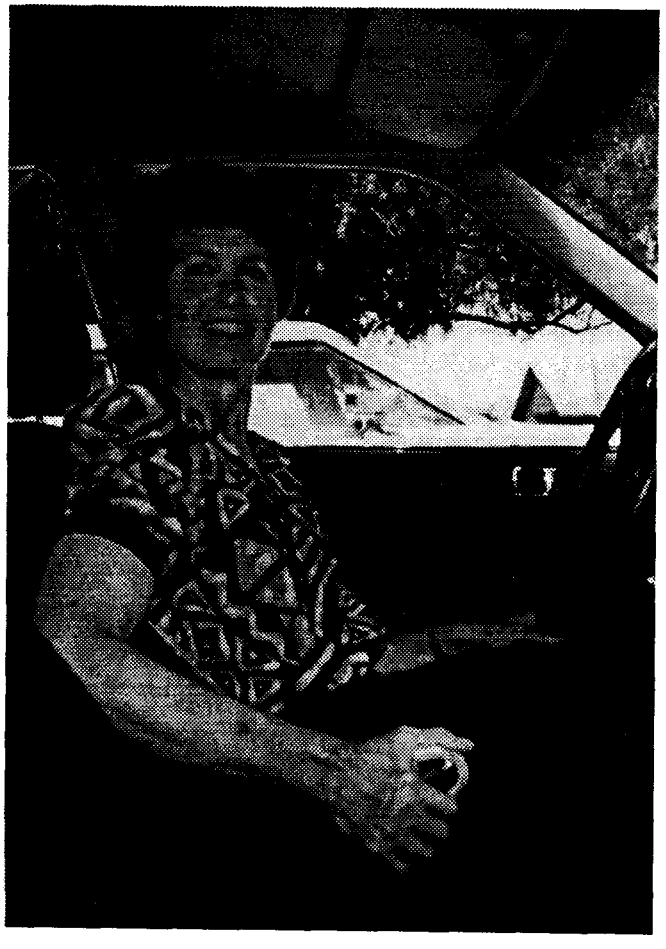
The material chosen to build both the curved lever arm and the mounting piece was 6061-T6 aluminum. This material was chosen due to its strength to weight ratio, machinability, and polished appearance. Both the curved lever arm and the mounting piece were machined in the engineering machine shop.

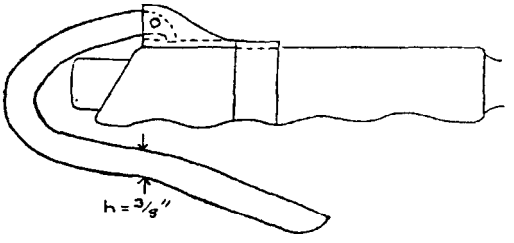
The shape of the curved member was determined from experiment. Due to spatial limitations around the existing brake handle, many shapes would not fit in both the engaged and disengaged positions. The final shape was determined using a flexible piece of wire as a model. This was bent and twisted until a desirable shape was found that both fit in the required space and disengaged the brake. The curved lever arm is 3/4" in depth and 3/8" thick.

The mounting piece was designed to attach to the top of the existing brake handle by a 4" diameter aluminum clamp (obtained at an aircraft maintenance shop). This mounting piece is connected to the curved lever arm by a 1/8" hardened steel pin (obtained at a nut and bolt supply house). The mounting piece is 7/8" in depth, 1" in length, and 1/2" in height. The middle of the top piece is milled out to allow the curved lever arm t be attached and pinned.

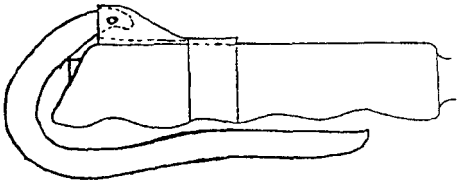
The cost to design and build the modified parking

brake release was $40.00. However, future individual production costs could be around $5.00 if the device were cast rather than machined. Due to some outside interest, production is currently being considered.





MECHANISM (REST)



MECHANISM (ENGAGED)

Work Desk For a Young Boy With Cerebral Palsy

Designer: R. Preston Feight
Handicapped Coordinator: Joen Hendricks,
Marshall Public School
Supervising Professor: Dr. David Hartman, Ph.D., P.E.
College of Engineering & Technology
Northern Arizona University
Flagstaff, AZ 86011

INTRODUCTION

This project involves the design and fabrication of a work desk for a student enrolled in the class for the multiply handicapped at Marshall Elementary School in Flagstaff, AZ. The work desk is used by a student who has been diagnosed with cerebral palsy limits control of his limbs, and because of the visual impairment he has difficulty identifying objects. Prior to the introduction of the desk, the student had no means of performing activities that stimulated the use of his limbs. The desk has to meet several specifications: it should provide the student with easy access to an assortment of communicative and work tools (i.e., tape recorder or communications touch pad), it needs to be easy to transport from home to school daily, it must be durable, lightweight, and must be within the $500 budget. After studying the problem, a desk was designed that met these needs.

SUMMARY OF IMPACT

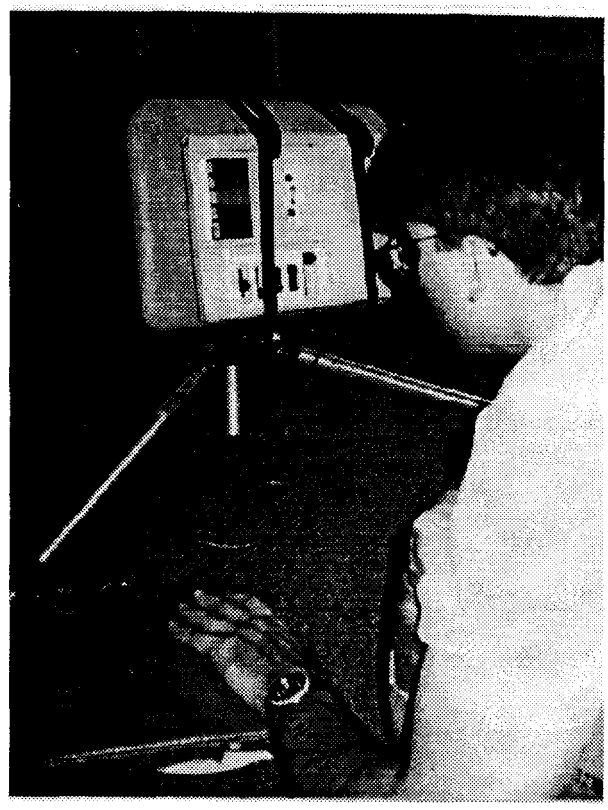
The new work desk allows the student to be more productive, and increases the amount of time that he can work on therapeutic activities. It can be used with the student lying in various positions.

TECHNICAL DESCRIPTION

The design is divided into two portions; the desk mount and the desk top. The desk mount is a Bogen 3021 tripod and 3047 tripod head. The tripod legs consist of three telescoping sections that are secured with tube clamps. The three section legs are hardened aluminum with outer diameters of 1.25, 1.00 and 0.75 inches. The tubing has a wall thickness of .05 inch. Each leg is individually adjustable that allows the desk to be placed on uneven surfaces. The telescoping legs allow the desk height to be adjusted from 14 to 74 inches. The 3047 head uses three annular friction clamps to allow for adjustment of the desk top in all three dimensions

The design of the desk top was determined by the specific needs of the student and the size and weight of the objects to be placed on it. The desk top is made of yellow pine, with dimensions of 0.75 inch thick, 12 inches high and 16 inches wide. The corners of the desk are rounded to eliminate sharp edges. Two 1 inch wide nylon cinch straps are used to attach the developmental aids to the desk surface. The desk is covered in vinyl to provide durability, aesthetics, and ease of maintenance.

The cost of the tripod and work desk is $185.00.



Magnetic Clipboard

Designer: Andrew Strebe
Therapist: Marcia Lamkin, P.T.
Supervising Professor: David Hartman, Ph.D.,P.E.
College of Engineering & Technology
Northern *Arizona* University
Flagstaff, Arizona 86022

INTRODUCTION

Many handicapped people have great difficulty writing because they do not have enough strength to hold paper with one hand and write with the other. Because of some disabilities, people cannot use conventional spring-force clipboards but they still need a device to hold their paper.

The magnetic clipboard was designed for a 7-year-old girl with spina bifida. As a result of this affliction she has limited strength and fine motor skills in her arms and hands. It is nearly impossible for her to hold down her paper and write at the same time. Her left arm is not strong enough to hold the paper, so her weakness forces her to write and hold the paper with her right hand. This method does not allow for a great enough force to hold the paper and it prevents her from writing dark and legibly.

The Magnetic Clipboard overcomes her strength and motor skill deficiencies. The device uses the concept of a conventional clipboard except magnets hold the paper instead of a spring loaded clamp.

SUMMARY OF IMPACT

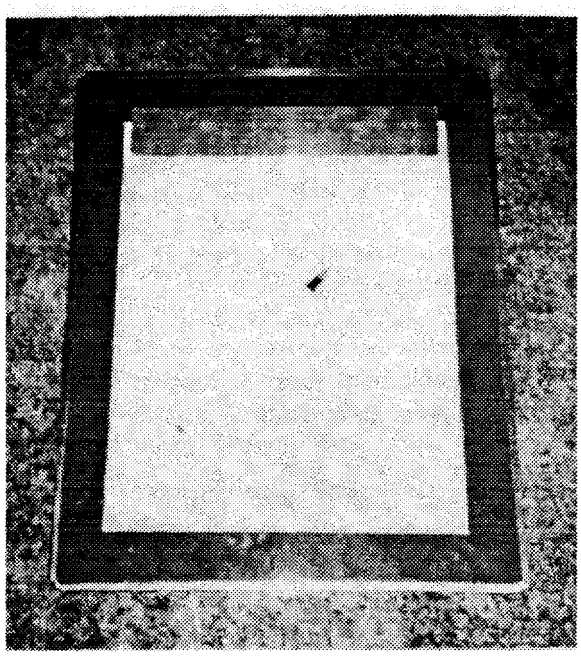
This Magnetic Clipboard is intended to be strong and simple. This device allows the girl to concentrate on writing instead of holding the paper. As a result of not having to hold the paper, she now can write darker and more legibly. More importantly, she becomes less frustrated with writing, which encourages her to write more often. She is delighted with the light weight clipboard and the easily removed magnetic clips.

TECHNICAL DESCRIPTION

The clipboard is made of two components: the board and the magnetic clips. The board is made of an 11" X 14" piece of 20-gauge, ready-to-paint sheet steel, for strength and magnetic purposes. Rubber washers are attached to the bottom of the board to prevent it from sliding on a smooth working surface. The surface of the board is painted with an epoxy paint. The painted surface tends to hold the paper with a clinging effect created by static electricity, and makes the board more aesthetically pleasing. The clipboard had to be less than 1 pound weight in order for the girl to be able to lift it.

The magnetic clamps are made using magnetic strip tape and aluminum sheet metal. The magnetic strip tape is 1" wide and attached to a 1 1/2" X 8" piece of aluminum sheet metal. The aluminum sheet metal is .04" thick. The magnetic tape spans the entire length of the aluminum strip. The magnets provide the clamping force that holds the paper to the board, yet are easily removed by the girl when she wants to adjust the paper.

The cost of each complete device is approximately $8.00. A complete device includes the board and two magnet clamps.



Computer Table For a Young Girl With Cerebral Palsy

Designer: Remo N. Neri
Disability Coordinator: Joen Hendricks,
Marshall School
Supervising Professor: Dr. David Hartman, Ph.D., P.E.
College of Engineering & Technology
Northern Arizona University
Flagstaff, Arizona 86011

INTRODUCTION

A 12-year-old fourth-grader suffers from cerebral palsy and uses a computer for all her written communication. She uses a bulky computer table that has many obstructions preventing close access to the computer with her wheelchair. She also is a growing girl and needs a new, larger wheelchair, which will make computer work even more uncomfortable. A table was needed to hold her computer and offer easy access with a wheelchair. A primary goal for the design was that the table needed to be height-adjustable to provide comfortable computer use even when she obtains larger wheelchairs as she grows. The table also needed to be portable in order to be used with her computer at home as well as with her computer, at school. Her disability gives her double vision when she reads from a horizontal surface. Consequently, all reading material must be positioned at least 60 degrees from horizontal.

SUMMARY OF IMPACT

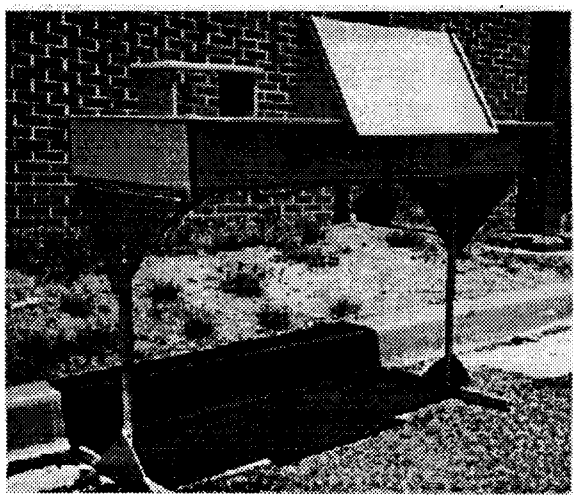
The new table has replaced the girl's existing computer table. According to her teacher Joen Hendricks, the new table is an improvement over the existing one, especially with its slantboard and height adjustability. Joen is pleased with the table's easy access for wheelchairs as well as its easy fold-up and set-up capabilities. Joen said the table's adjustability will allow it to be used by the girl throughout her life. It also can be used by other handicapped students to make computer learning more available and comfortable.

TECHNICAL DESCRIPTION

The table is height adjustable by use of telescoping legs that are locked into position at 1" increments. The adjusted height ranges from 27" to 38". 6061-T6 aluminum is used for the 1/8" sheet and the 1" and 1-1/4" tubing.

The horizontal surfaces of the table top are made of 1/2" mahogany plywood and the vertical surfaces are of 3/4" plywood. The drawers have inside dimensions of 4" high, 17" deep, and 20" wide. They offer ample room for the student's power pad, slantboard, floppy disks and other supplies. Portability is provided by connecting foldable legs to the table top with hinges, making the table compact. Also, wheels are mounted on the rear surface and a handle is cut into the top surface. These features make the table easy to transport in the folded position.

There is a monitor stand that can be folded down compactly, which is made of 1/2" plywood. This stand can be set up in seconds and holds the monitor securely. Her double vision was eliminated by providing a slantboard that attaches easily yet firmly to the tabletop surface. Reading material or computer interface devices can be rested on the slantboard and she can see them without getting double vision. The slantboard is stored in one of the drawers and fastens securely to the top surface. The bottom of the slantboard has dowels that insert into holes drilled into the table top. The table was built for about $580.



Bicycle Seat

Designer: Shane Hooton
Supervising Professor: Dr. David Hartman, Ph.D., P.E.
College of Engineering & Technology
Northern Arizona University
Flagstaff, Arizona 86011

INTRODUCTION

The bicycle seat was designed and fabricated to meet the needs of an individual with a unique physical limitation. A female client enjoys bicycle riding, but after having an operation for cancer in which part of her pelvic bone was removed, she is unable to use a normal bicycle seat and enjoy one of her favorite sports. The new bicycle seat was designed and built to alleviate her severe discomfort that she experiences after riding her mountain bike for a short time.

SUMMARY OF IMPACT

The client experienced discomfort caused by riding on a standard bicycle seat. She tried to find a special after-market seat, but was unable to locate one to solve her unique problem. This caused her to stop riding. The newly developed bicycle seat now allows her to ride her bike in comfort and safety.

TECHNICAL DESCRIPTION

To model the necessary seat contours, the client sat in a pliable modeling clay obtained from the art department. A plaster of Paris mold was made from the clay impression.

The bicycle seat is made out of 12-gauge steel that was hard forged into the desired shape. The steel plate was initially placed in an annealing oven and heated to 2000 degrees Fahrenheit. The final seat contours were forged by hand. The edges were rounded and ground using tools such as a rosebud torch, grinder, and belt sander. The right side of the seat is raised about 1.5 inches higher than the left side. This allows for the support needed on the right side where a portion of her pelvic bone had been removed. After the seat had the initial contours needed for proper support, a Plastazote Foam was used to cover the metal. Plastazote Foam was used because it can be heat formed. The Mastazote Foam was heated to a temperature hot enough to be formed to the client's lower posterior as she sat on it. The foam was then secured to the metal with a special adhesive. The foam was blended at the edges to give a desired rounded shape.

The seat utilizes a standard bicycle seat post. The seat supports from her old seat were welded to the fabricated steel seat using an arc welder. Additional material was needed to ensure that a hole would not be melted in the thin steel plate. Having the seat mounted on a standard seat post gives her the option of utilizing this seat on any bicycle she might use in the future.

A final product was obtained using an off-the-shelf seat cover to make the seat aesthetically pleasing. This also allows the seat to be versatile in that any type of cover can be used. The total cost of the seat was about $150.