MODIFIED AGRICULTURAL EQUIPMENT

Agricultural Equipment Manlifts for Farmers and Ranchers with Physical Handicaps

Funded By: Department of Education/National
Institute of Handicapped Research

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BREAKING NEW GROUND

Lifting Barriers for Farmers with Physical Handicaps
Department of Agricultural Engineering
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FOREWORD

In 1979, the Department of Agricultural Engineering at Purdue University initiated activities directed toward assisting agricultural workers with physical handicaps who desired to remain active in agricultural production. The resulting project became known as Breaking New Ground.

During the past few years, the project has had contact with thousands of farmers and rural rehabilitation professionals seeking information on modifications and techniques which would enable a farmer to continue performing tasks made difficult by a wide variety of physical handicaps. An extensive review of research literature reveals that little of this type of information exists.

One of the most frequently requested types of information has dealt with access to agricultural machinery by farmers with restricted mobility from spinal cord injury or amputations. Even in a day of capital and management intensive agriculture, it appears that the need or desire to continue operating agricultural production equipment remains important to the success of a farm operation. It has been concluded that the operation of this equipment is one of the most serious vocational barriers perceived by agricultural workers.

In many cases, the farmer has solved the problem of accessibility using personal and local resources. Consequently, a wide variety of homemade and semi-commercially available manlifts and controls have been designed, fabricated and put in use.

Some have been successful, others have not. However, designers and builders of modified agricultural equipment have seldom documented their work. Presently there are few plans available to complete necessary modifications on agricultural machinery. New modifications are often constructed without the benefits of prior experience. Consequently, in some cases farmers are using lifts and control modifications that appear to be well constructed. In other cases, farmers are using unconventional and possibly hazardous methods to gain access to the seat of their equipment and to operate machine controls.

Breaking New Ground recognized the need for technically oriented information pertaining to accessibility techniques and control modifications on self-propelled agricultural machines for farmers with serious mobility impairments. This manual is the result of an effort to fulfill that need. The research was conducted by Terry Wilkinson, Graduate Research Assistant in the Agricultural Engineering Department at Purdue University. The National Institute for Handicapped Research sponsored the work, which is greatly appreciated.

PREFACE

This resource manual contains twenty-eight descriptions which provide a comprehensive cross-section of the techniques being employed to transfer mobility-impaired farmers from the ground to the operator's station of modern agricultural tractors and combines.

The evaluations of the lifts were conducted both at Purdue University and during 17 farm visits with farmers presently using modified equipment. Each description in the manual gives background information on the farmer who uses the lift, provides an overview of the modified machine, describes the adaptability and compatibility of each lift as well as service and maintenance requirements, and accessibility information. The evaluations also cover a description of lift construction, description of operation, safety considerations, control modifications, accessories and estimated cost.

The information contained in this resource is intended to improve the understanding of concepts used in existing lift and control modification designs. However, the descriptions are solely intended to improve comprehension and are not intended to be used as a set of plans or as a substitute for plans. The farmer or the designer of the lift should be contacted for additional information. Prior to actual design or fabrication of a complex modification, it is recommended that a professional engineer be consulted.

DISCLAIMER

Breaking New Ground and Purdue University do not endorse, recommend, or certify any of these modifications as being safe or as being effective in solving a particular problem. Nor are the commercial products shown endorsed, recommended, or certified as being safe or functional, by Breaking New Ground or Purdue University. These products and prices quoted represent information available to Breaking New Ground, and the information is subject to change. There may be other companies which provide similar products or services of which Breaking New Ground is not aware. There is no intention to exclude anyone from being included in this manual.

ACKNOWLEDGEMENTS

Evaluating the modified agricultural machines described in this manual was a major task that required input from a wide variety of people who freely shared their time and expertise. Their efforts are greatly appreciated.

Special recognition goes to the many farmers who allowed us to visit their farms, and who freely shared their experiences with removing barriers from operating self-propelled agricultural machines. We would like to thank them for their patience during the evaluations.

Much time was spent writing the descriptions of the modified agricultural machines for this manual. Many text and format changes were made in order to present understandable descriptions. Making a publication understandable requires special talent and patience. The talent of Marguerite Casper, editor, who spent numerous hours proof-reading the descriptions, is certainly appreciated.

Writing a manual of this nature also requires the assistance of technical editors. We wish to acknowledge the technical editing of Mark Purschwitz and John Hancock of the Breaking New Ground staff.

Denise Evans, Deb Felix, Kay Stichter, and Kathy Brewer spent endless hours typing and retyping. Their skill and patience throughout all the text changes is greatly appreciated.

Publications require artistic talent to make the appearance, design, and layout appealing. The talents of Quan Vu, who designed the cover and layout, and the actual layout of the manual completed by Quan, Steve Pounders and Marguerite Casper, are shown in this manual. Giovanni Soto's artistic talent is also displayed in the manual through the drawings that are used to better illustrate specific concepts.

The technical assistance of Clarence Richey, Professor Emeritus of Agricultural Engineering, for the explanation of certain engineering concepts is greatly appreciated.

Finally, the assistance of the many students who helped with the various activities of the project, including modifications of equipment, is appreciated. The skills of Dean Kerstetter, Larry Wettschurack, Eric Williams and Jennifer Rusk are especially appreciated.

DESCRIPTION OF TERMS

Accessibility and Ease of Use: Brief summary of how the lift can be reached and utilized to raise an operator from the ground to the operator's station.

Accessories: Description of devices that farmers are using to improve the operation of their tractor or combine, or to improve access to the operator's station.

Adaptability: Brief summary of the changes that would be needed to mount the lift on other self-propelled agricultural machines.

Articulated: Type of steering where the tractor steers by pivoting at a center hinge. Each pair of wheels are always parallel to the tractor frame.

ATV: An abbreviation for all-terrain vehicles. In this manual ATV's refer to three and four-wheel all-terrain vehicles.

Angle iron: A piece of steel rolled to form an L-shape section.

Cab Entry Platform: A structure mounted outside the cab door to provide the operator a place to move from a lift to the operator's station.

Channel: A piece of steel rolled to form a U-shaped section.

Compatibility: Brief summary of the capability of a farmer with a physical handicap and other operators to use a tractor or combine and any obstructions a lift may cause.

Construction Description: Description of construction of the lift to provide a better understanding of the lift design. The description is not intended to be a set of plans.

Contact: Name of company or person producing a commercial product to be contacted for more information or for purchasing a product. References to Breaking New Ground as a contact is for information inquiries.

Control Modifications: Descriptions of brake, clutch, or steering devices that are being used on a particular tractor or combine which a farmer uses.

DC: An abbreviation for direct current which refers to the electrical system which runs off a battery.

Description of Operation: A summary of the procedures required to mount and dismount a tractor or combine, using a lift and accessories.

Estimated Cost: An estimate of the cost of building a lift and controls is included with most lift descriptions. The labor cost was not available in many cases because much of the labor was donated. The material cost listed, in some cases, is lower than what one can expect to pay if buying new materials. Many of the lifts were built with materials that were already on the farm. In the case of commercial products, the cost or price is listed. Please note, however, that this information is not always accurate, as the price listing received may be dated. Contact the company directly for an accurate cost quotation.

Expanded Steel: Sheet metal cut and expanded into crossed strips or lattice.

Farmer: Name of the farmer who owns the lift described. A brief description of the farmer is also provided.

Front-wheel Assist: Tractors that have the capability of the front wheels being driven by the tractor engine to provide extra traction.

HP: An abbreviation for the horsepower of a machine.

Hydrostatic: Refers to a transmission that uses hydraulic fluid to transmit power from the engine to the drive wheels. This type of transmission provides a variable range of speeds that is controlled by a single hand lever. The hydrostatic machines can be operated without the use of foot controls.

Lift Actuation: Description of how the lift is powered.

Lift Controls: Description of switches, levers and devices used to operate the lift.

Lift Guide: Description of the structure that directs the motion of the lift.

L-shape: Refers to materials bent or formed into a shape that resembles an "L".

Modified By: Name of person that made changes to the original design.

Modified Machine: The tractor or combine that a lift is mounted on.

Moving Frame: A description of the frame that moves during lift operation.

Operator's Station: The seat and control area of a tractor or combine.

PSI: An abbreviation for pounds per square inch.

PTO: An abbreviation for power-take-off which is used to operate other machines using the power from the tractor engine.

ROPS: An abbreviation for Rollover Protective Structure. A protective frame or cab designed to limit most tractor upsets to 90 degrees, and to protect the operator during upsets. The protective frame is designed in a two or four post structure with or without an overhead canopy. A ROPS cab is a four post structure completely enclosed with many comfort features. However, it should be noted, not all cabs are designed as rollover protective structures. There are aftermarket cabs that provide protection from the weather but not rollovers.

Safety Considerations: Key areas of safety that operators of the modified equipment should be aware of and improvements to correct safety problems.

Seat and Swing Arm: A pivoting metal structure that supports the seat and allows the operator to move the seat in position to transfer.

Service and Maintenance: Brief summary of the maintenance requirements to keep the lift in proper working condition.

Stationary Frame: A description of the frame that supports other parts of the lift.

U-shape: Refers to materials bent or formed into a shape that resembles a "U".

TABLE OF CONTENTS

I. CHAIRLIFTS

BREAKING NEW GROUND'S MARK II CHAIRLIFT

CONTACT: Round Grove Machine
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West Lafayette, IN 47906

DESIGNED BY: Clarence B. Richey
Agricultural Engineering Department
Breaking New Ground
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West Lafayette, IN 47907

SUMMARY

Function:

The Mark II chairlift is an improved version of the Mark I which uses a vertical electric screw to raise and lower the chair. The electric screw has been replaced with an electric screw-type linear actuator mounted diagonally in a parallelogram linkage. The first prototype of this design was mounted on a Case 1290 tractor, which is shown in Figure 1.

Figure 1. First Prototype of Mark II Chairlift mounted on Case 1290 Tractor

A second prototype is shown mounted on a John Deere 4440 tractor in Figure 2. The improved mounting bracket provides easy adaptation for John Deere 4000 series tractors. This prototype was developed by Round Grove Machine Corp., and this version of the Mark II is available through the company. A Mark II has also been modified to mount on a Ford four-wheel drive tractor. (See Breaking New Ground's Modified Mark II Chairlift).

Figure 2. Second Prototype of the Mark II Chairlift mounted on John Deere 4440 Tractor

Modified Machines:

Tractor:	Case 1290	Tractor:	John Deere 4440
Features:	ROPS Cab	Features:	ROPS Cab
Rear Tire Size:	16.9-30	Rear Tire Size:	18.4-38
Front Tire Size:	7.50-16	Front Tire Size:	11.0-16
PTO HP:	60	PTO HP:	130
Year:	1983	Year:	1983
Door on both sides of the cab		Door on one side of cab	
Adjustable seat		Steps on one side	
Syncromesh transmission		Grip bar on side of tractor	

The Case 1290 tractor was donated by JI Case to enable the Purdue University Agricultural Engineering Department to research modifications for farmers with physical handicaps.

Adaptability:

The Breaking New Ground Mark II chairlift is adaptable to other self-propelled agricultural machines by changing the mounting bracket to fit a particular tractor or machine. The parallelogram linkage has universal applications on various tractors that are similar in operator station height. Round Grove Machine designed a mounting bracket that would allow the lift to be mounted on 4000 series John Deere tractors regardless of operator station height.

For tractors or combines which require more lift, a larger parallelogram linkage and linear actuator would be used. Regardless of the linkage used, the mounting bracket must be designed to fit the particular machine on which the lift will be mounted.

Compatibility:

1. The lift obstructs the use of the tractor's steps when it is in the raised position. If it is in the lowered position an able-bodied operator can access the tractor by using the steps and then raising the lift using the control switch in the cab.
2. There were no permanent alterations made to the tractor during lift installation.

Service and Maintenance:

1. The lift is easy to service because there are few moving parts.
2. Grease fittings have been installed on the moving parts and are easily accessible.

Accessibility and Ease of Use:

1. The lift is easily accessible from a wheelchair, ATV, or by a farmer who uses leg braces and/or crutches.
2. The lift is designed for ease of transfer and operation. However, it may require some practice to successfully transfer to the tractor seat.
3. The lift is quiet during operation.
4. It takes approximately 25 seconds to raise a 200 lb. person from the ground to tractor seat transfer height.

CONSTRUCTION DESCRIPTION

Because the Round Grove version of the Mark II is the latest design, its construction is provided below. The construction is as designed for the John Deere 4000 series tractors, and is described in the following subsections: Mounting Frame, Moving Frame, Lift Seat, Lift Actuation and Lift Controls.

Mounting Frame:

The Mark II chairlift is uniquely adaptable to other self-propelled agricultural machines. The parallelogram linkage described in the "Moving Frame" subsection is a standard design and the mounting frame is designed for the particular tractor or machine.

The mounting frame is constructed from 3" square, 1/4" wall steel tubing. A 3" square tube passes over the top of the weight bracket on the front of the tractor with two 3/4" x 2 1/2" rectangular steel bars welded to the tube. They are bent to allow them to be mounted between the tractor and the tractor weights by bolts (Figures 2 and 3). A second 3" square tube is clamped perpendicular to the first tube so that it passes underneath it. The tubes are clamped together by three square steel plates and four long bolts so that the second tube extends horizontally along the side of the engine compartment (Figure 3). The clamp connection allows the lift frame to be adjusted forward and backward, and in and out along the front mounting tube, as required for mounting the lift to a particular tractor model.

A hole is drilled vertically through the outer end of the horizontal tube to serve as the lower bearing support of the pivoting member of the parallelogram linkage. The end of the horizontal tube is supported by contact with a brace attached to the tractor frame.

A vertical 3" square tube is welded 6-8" from the cab end of the horizontal tube that extends along the engine compartment. This vertical tube is reinforced by rectangular steel gussets. It serves as a mounting post for the upper bearing support for the pivoting member of the parallelogram linkage (Figure 4). A rectangular flat steel bar is bent into an "L"-shape and is fastened at the top of the vertical tube by two bolts. A hole is drilled through the horizontal section of the "L"-shaped bracket to allow for passage of a pivot rod.

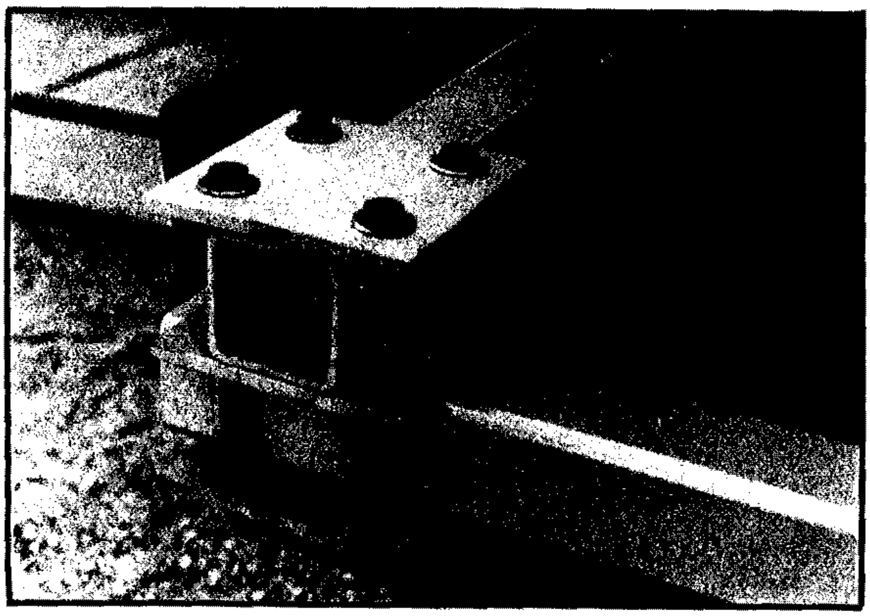

Figure 3. Frame Clamps allow Lift to be mounted on various models of Tractors

Moving Frame:

The movable part of the frame assembly is a parallelogram linkage which pivots on the vertical post of the mounting frame. The lift pivots on a vertical linkage member which is made of 1" diameter rod welded to a 3/4" x 2" reinforcing bar. A clevis is constructed from a rectangular flat steel bar bent into a "U"-shape and welded at the lower end of the reinforcement bar above the lower bearing support (Figure 4). The pivot rod extends through the 3" square horizontal tube at the lower end of the shaft and through the 1/2" x 2" "L"-shaped steel bar bearing support mounted on the vertical steel post of the frame (Figure 4).

The lower parallelogram link is made of 2" square, 3/16" wall steel tubing to provide stability and strength. At each end of the lower link, a 1 1/2" diameter, 1/4" wall, 4" long tube is welded to the link and serves as the housing for needle bearings. A 3/4" drill rod pin with a small rectangular bolting plate is welded on one end and passes through the clevis on the pivoting shaft. The pin holds the lower link bearing tube between the clevis ends. A hole is drilled through the bolting plate and the clevis to allow for placement of a bolt to secure the drill rod pin.

The upper parallelogram link is made from a pair of 1/4" x 1 1/2" steel bars welded together. The ends of the bars are spread, forming a clevis at each end which attaches by 1/2" diameter pins to the vertical pivot member and to the L-shaped seat tube. The upper link is loaded in tension caused by the operator's weight.

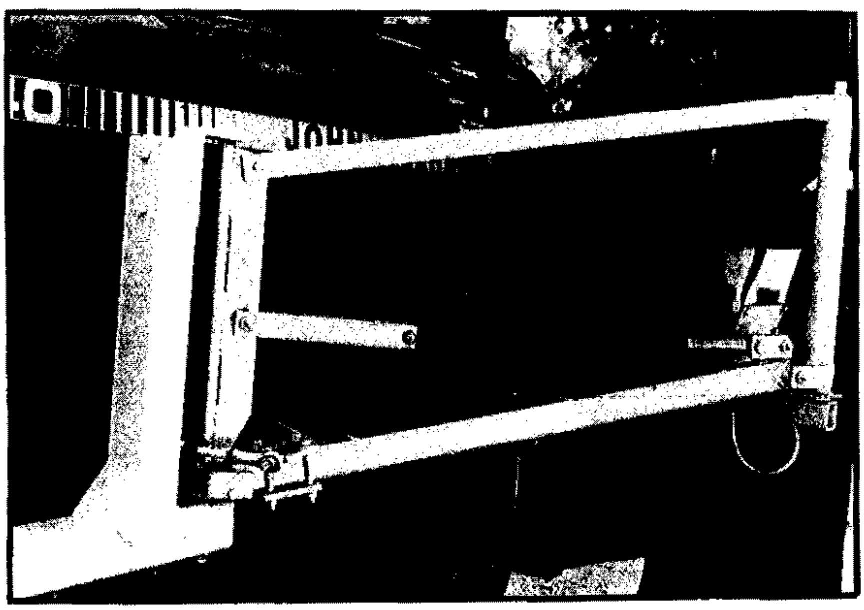

Figure 4. Parallelogram Linkage

Lift Seat:

The lift utilizes a stationary seat welded to the outer end of a 2" square, 3/16" wall horizontal steel square tube which is welded to a 1 9/16" O.D., 1/4" round pivoting pipe. The pivot pipe extends up into the outer vertical parallelogram linkage tube which is a 2" square, 3/16" wall steel tube. The outer tube attaches to the lower parallelogram link by a clevis constructed from a rectangular steel bar bent into a "U"-shape. It connects to the lower link by a round pin (Figure 5). The upper end of the vertical square tube is supported by an "ear." The ear is constructed from rectangular, flat, steel bar stock welded to the tube so that a length extends out horizontally from the tube. A hole is drilled through the steel bar to allow for passage of 1/2" diameter pins. The pins attach the upper parallelogram link to the vertical tube (Figure 4). This feature allows the seat to be pivoted as desired. This adds to the adaptability of the chairlift.

The seat is latched from pivoting until the latch is released by a handle or by a hand-held control switch. The swivel feature of the seat allows access to the tractor cab, access from a truck, and pivots to allow the operator to access the fuel tank.

The seat is a padded bucket seat similar to the seat used on Ford tractors. The seat is mounted to the horizontal length of the seat tube by a 12 gauge steel plate bent into an "L"-shape and bolted to the seat (Figure 5). The plate is welded to the horizontal tube. A "U"-shaped bracket constructed from a flat steel bar is welded to the outer end of the horizontal seat tube and to a rectangular steel plate attached to the bottom of the seat.

Figure 5. Mounting of Lift Seat and Control Switch

Lift Actuation:

The lift is powered by a Warner Electric ball-screw type linear actuator with a 12″ stroke (Figure 4). The lift offers a 51″ lift with a 300 lb. capacity. The actuator is rated at 1500 lb. force. A 12 volt DC motor, drawing up to 16 amperes, drives a screw in a sealed, permanently-lubricated gear train. The screw passes through a recirculating ball nut attached to a stainless steel tube, which extends through a grease and dust seal to apply the lifting force. The actuator contains an automatic load holding brake and a ball-detent overload clutch.

The actuator rod is mounted to a pair of 1/4″ x 1 1/2″ rectangular flat steel bars which straddle a bearing ear mounted on the outer end of the lower link (Figures 4 and 5). The steel bars are attached to the ear by a needle bearing and a 1/2″ diameter pin. The stationary end of the actuator is attached in the same manner, by a 1/2″ diameter pin, to the pivoting reinforcing bar of the parallelogram linkage (Figure 4).

The actuator mounting lifts the operator off the ground. In order to automatically swing the seat to the operator station, a "swing rod" is used. The swing rod consists of a threaded, 1/2″ diameter rod with female ball joint ends threaded on each end. These ball joints slip over 1/2″ diameter bolts welded to the vertical mounting tube and to a steel plate clamped over the lower link. The link is clamped by four bolts, the entire assembly acting as a crank arm, as shown in Figure 6. The crank arm swings the linkage assembly about 45 degrees as the linkage lifts through approximately 80 degrees. The swing rod length can be adjusted to obtain the desired horizontal stopping position at the top of the lift. Figures 7 and 8 show diagrams of lift operation for the Case 1290 tractor which illustrates the principles of the design.

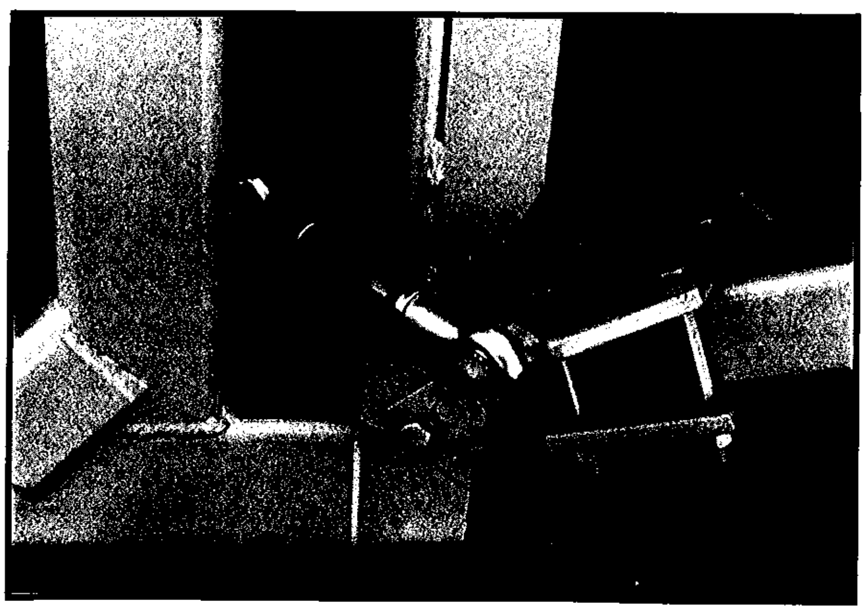

Figure 6. Swing Rod and Crank Arm

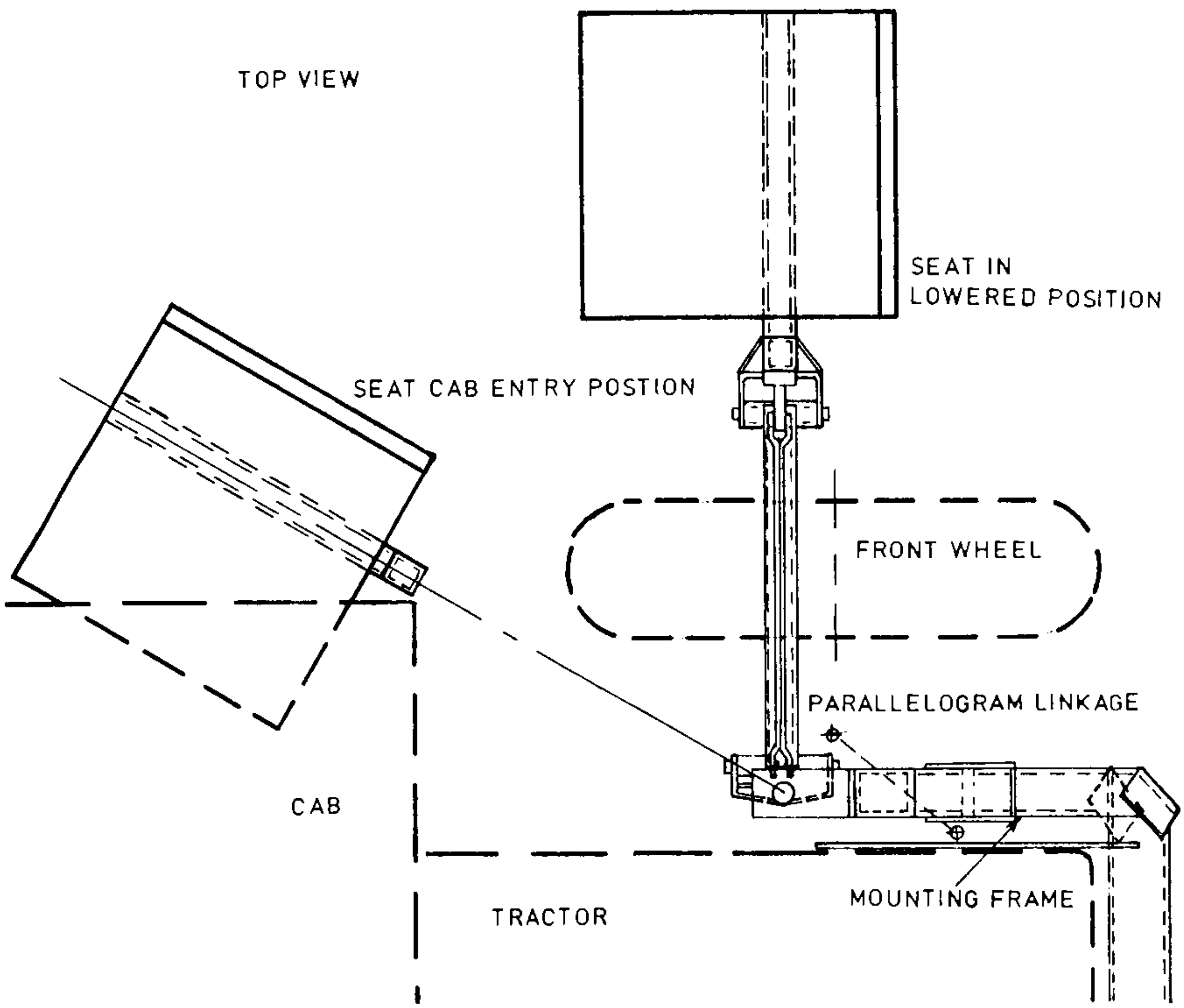

Figure 7. Diagram of Lift Operation

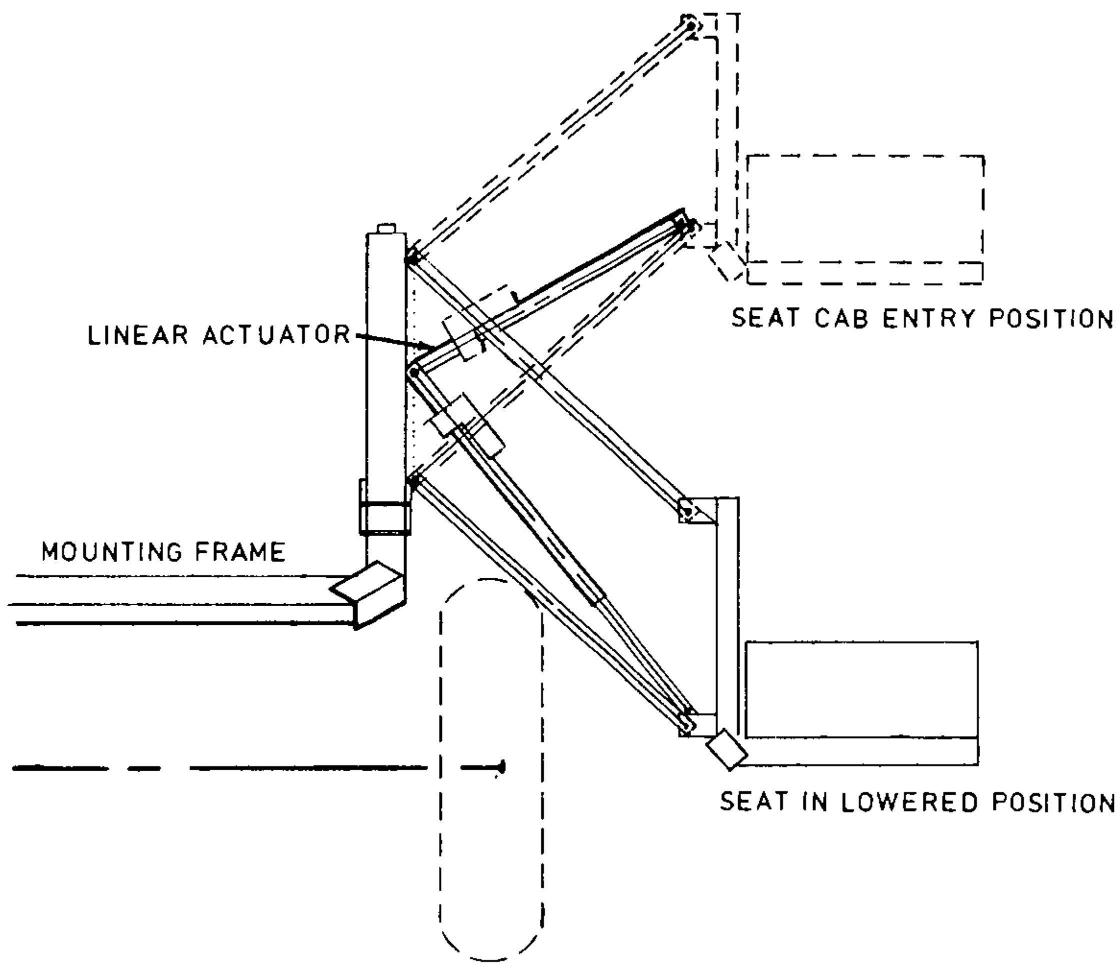

Figure 8. Diagram of Lift Operation

Lift Controls:

A self-centering, reversible toggle switch is located underneath the lift seat as shown in Figure 5. It allows for access and control by the operator to raise and lower the lift. A similar switch is placed in the tractor cab for control of the lift from the tractor seat. Round Grove Machine has also combined a hand-held remote switch to operate the lift, and a push-button switch to release the seat pivot latch, into one control unit which can be taken into the tractor cab.

Self-centering switches are used to prevent both switches being on at once, thus blowing the protective fuse. Figure 9 shows a wiring diagram for the lift mounted on the Case 1290 tractor.

SAFETY CONSIDERATIONS

The tractor engine should be shut off when the lift is in operation, to eliminate the danger of the operator being run over or thrown from the tractor while mounting or dismounting.

This lift provides the safety feature of not requiring the engine to be running. The use of self-centering switches protects both switches from being on at once and blowing a protective fuse.

The linear actuator with the screw drive prevents the lift from falling, should the unit or the electrical system fail.

The lift seat could use a footrest. It could prevent the operator from sliding out of the seat or catching his feet under the cab floor. Some operators might desire a seat belt to give them added security.

A lift control switch should be provided at wheelchair height on the tractor, so the operator can gain access to the tractor if the lift is in the raised position.

There are two additional safety precautions on the first prototype, as mounted on the Case 1290 tractor.

There is a pinch point when the lift is raised to the Case 1290 cab. It is possible for the operator to pinch his hand between the seat arm and the latch for the door, or the corner post of the cab if the seat is brought up to contact the cab, as shown in Figure 10.

A possible safety problem is the lift's inability to go all the way into the Case 1290 cab; thus there is enough room to the right of the lift seat for the operator to fall if he should slip. There is a small amount of play in this version of the lift, which is noticed when the operator attempts to climb from the lift to the tractor seat. This could be corrected with a few adjustments.

DESCRIPTION OF OPERATION

To mount the tractor, the operator positions his wheelchair beside the lowered lift seat and transfers into it (Figure 11). The operator raises the lift using the switch mounted underneath the seat until he can reach the door and open it. He may need to lower the lift to clear the door (Figure 12). Once the lift reaches the cab (Figure 2), he releases the switch and transfers to the seat. He then lowers the lift using a switch located in the cab and closes the door. Next he raises the lift where it will rest during field operation (Figure 13).

To dismount the tractor, the operator lowers the lift and opens the cab door. He raises the lift until it reaches the cab and transfers himself to the lift seat. The operator lowers the lift using the switch underneath the seat, closing the door on the way down. He descends to the ground, where his wheelchair is within reach.

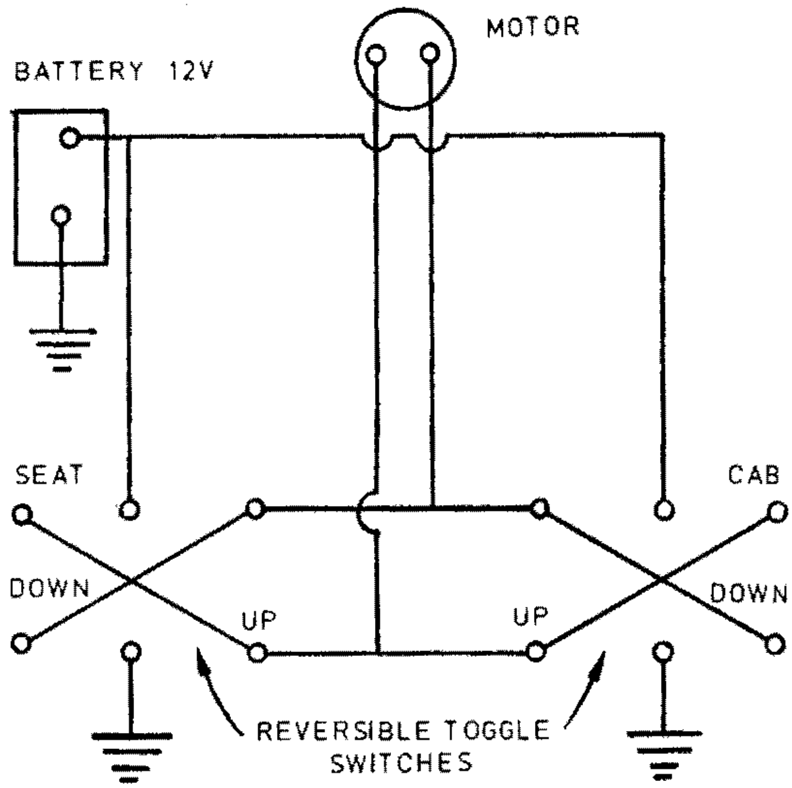

Figure 9. Wiring Diagram for lift on Case 1290 Tractor

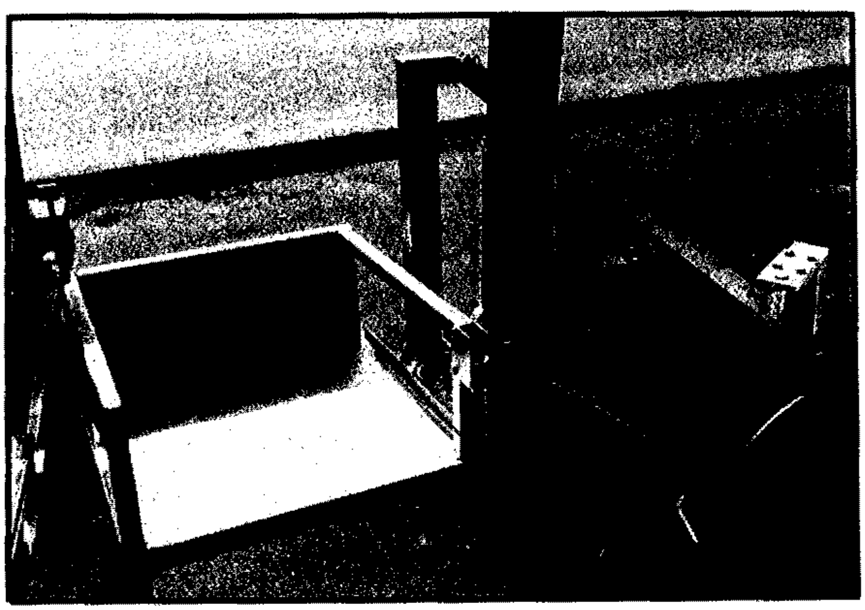

Figure 10. Lift Seat on Case 1290 Tractor. Note closeness of Left Arm Rest to ROPS Post

Figure 11. Operator transferring to Lift Seat

Figure 12. Lift in Operation

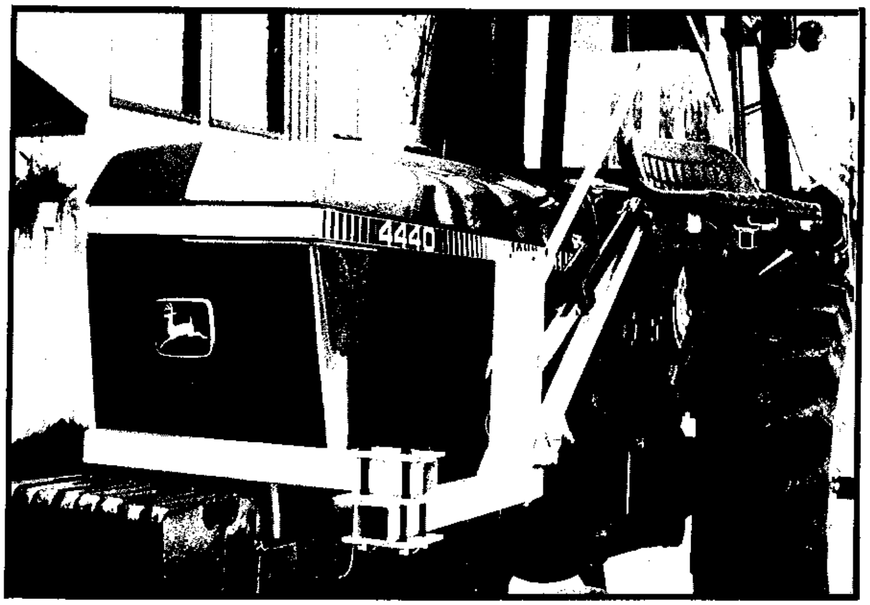

Figure 13. Lift Position For Tractor Use

CONTROL MODIFICATIONS

Brakes:

Separate hand levers are designed for the two brake pedals to allow individual operation. The brake levers are constructed from round steel tubing bent into shape for ease of operation. The upper ends of the tubes bend outward, away from each other, to serve as handles. The lower ends of the tubes bend horizontally and rest on top of the brake pedal shanks. Two rectangular steel plates are welded on each side of each hand lever and pass along each side of the pedal shank. Holes are drilled through the plates to allow for placement of bolts to securely fasten the levers (Figures 14 and 15).

The brake pedals can be locked together using the original brake lock. It is important that the brake levers can be locked together if so desired. To engage the brakes, the operator pushes down on the desired control lever. An able bodied operator can use the brake pedals with the levers in place.

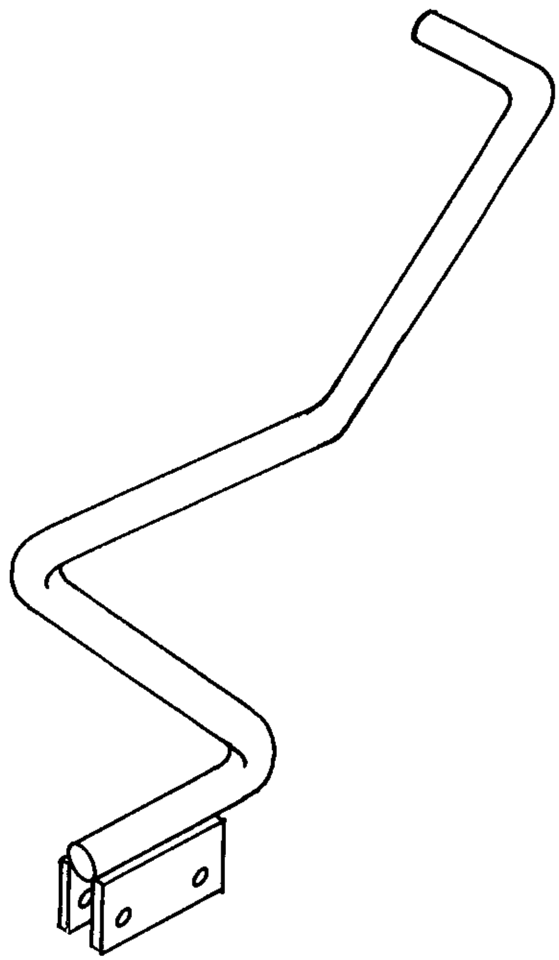

Figure 14. Right Brake Hand Lever

Clutch:

The clutch hand lever is constructed from round steel tubing bent into shape contour conducive to easy operation. The upper end of the tubing is bent horizontally to serve as a handle. A rectangular steel plate is bent into a "U"-shape and welded to the lower end of the control lever (Figure 16). The steel plate has a notch cut in the center of it to allow the plate to slip over the pedal shank. The lever is designed for easy removal to allow for operator access to the seat.

To disengage the clutch, the operator pushes down on the handle of the control lever.

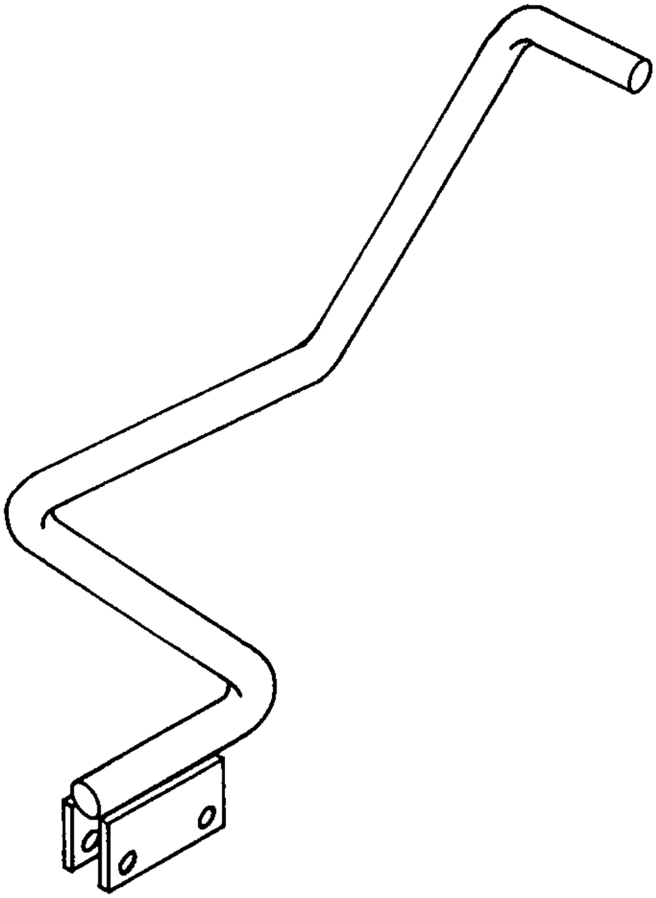

Figure 15. Left Brake Hand Lever

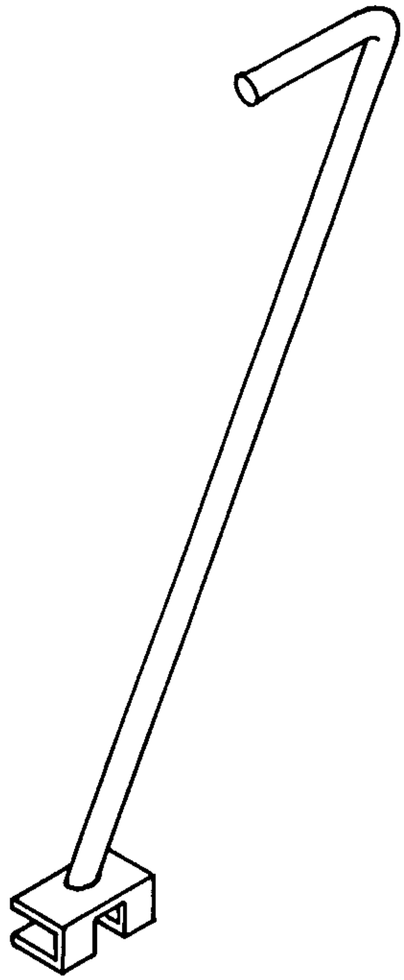

Figure 16. Detachable Clutch Hand Lever

ESTIMATED COST*

Current Selling Price of Lift and Controls of Round Grove version:	$2500.00

*At time of printing

BREAKING NEW GROUND'S MODIFIED MARK II CHAIRLIFT

CONTACT: Breaking New Ground
Agricultural Engineering Department
Purdue University
West Lafayette, IN 47907

DESIGNED BY: Clarence B. Richey
Agricultural Engineering
Purdue University
West Lafayette, IN 47907

SUMMARY

Function:

This lift is a modified version of the Breaking New Ground Mark II chairlift. The lift uses the same type of actuator and parallelogram linkage but is attached to the Ford 4610 tractor (Figure 1) with a different mounting frame. It is designed to provide access to the operator's station in a sitting position. The tractor also has been modified for hand control operation.

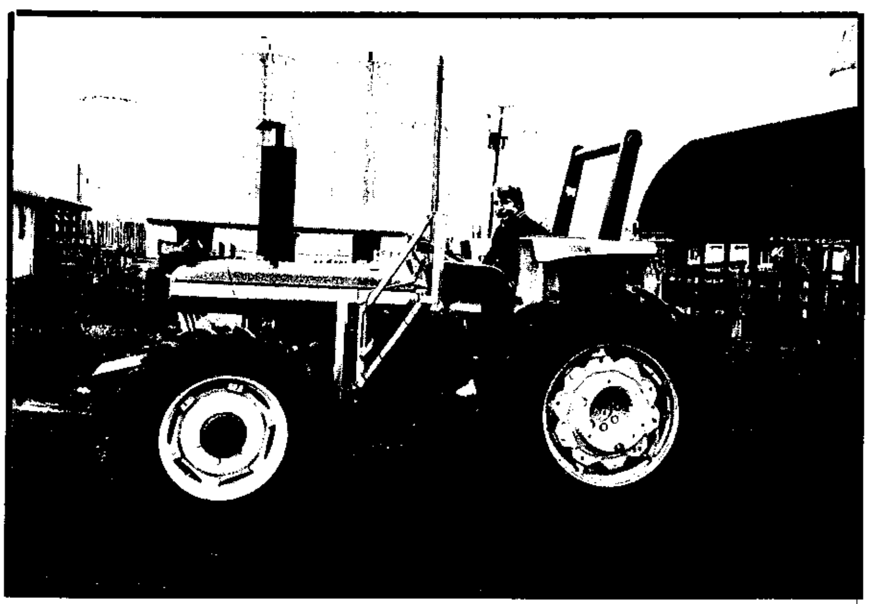

Figure 1. Modified Mark II Chairlift

Modified Machine:

Tractor:	Ford 4610-26
Features:	ROPS without a cab
Rear Tire Size:	16.9-30
Front Tire Size:	12.4-24
PTO HP:	52
Year:	1984

Syncromesh Transmission
Shift Levers Under Steering Column

Adaptability:

The modified Mark II Chairlift could be modified for attachment to other self-propelled agricultural machines by changing the mounting bracket. The parallelogram linkage has universal applications on various tractors that are similar in operator station height. Similar configurations have been devised for Case 1290 and John Deere 4440 tractors (see Breaking New Ground's Mark II Chairlift). For tractors or combines which require more lift, a larger parallelogram linkage and linear actuator would be used.

Compatibility:

1. Even though the lift partially blocks one side of the tractor, the lift does not significantly interfere with this use of the tractor by an able-bodied operator since he can mount the tractor on the opposite side.
2. There were no permanent alterations made to the tractor to install the lift.
3. The lift actuator is operated directly off the battery.

Service and Maintenance:

1. The lift is easy to service because there are few moving parts.
2. Easily accessible grease fittings have been installed at key points to reduce wear and load on the actuator.
3. An electrical harness has been installed to keep the wires secure and protected from damage.

Accessibility and Ease of Use:

1. The lift is easily accessible from a wheelchair, ATV, or by a farmer who uses leg braces and/or crutches.
2. The lift is designed for ease of transfer and operation. However, it might require some practice to successfully transfer to the tractor seat.
3. The lift is quiet during operation.
4. It takes approximately 25 seconds to raise a 200 lb. person from the ground to the necessary height for transfer to the tractor seat.

CONSTRUCTION DESCRIPTION

The construction of Breaking New Ground's Modified Mark II Chairlift is described in the following subsections: Stationary Frame, Moving Frame, Lift Seat, Lift Actuation and Lift Controls.

Stationary Frame:

This lift is uniquely adaptable to other self-propelled agricultural machines because the parallelogram linkage described in the "Moving Frame" subsection is a standard design. The mounting frame is designed for the particular tractor or machine.

A 2 1/2" square, 1/4" wall steel tube is mounted vertically along the side of the tractor engine by two 2" x 10 7/8", 1/2" thick, steel plates. The steel plates are welded to the lower end of the tube 11-13" apart which are bent to allow for clearance of the post along the engine compartment. The steel plates are fastened to the tractor side by two bolts passing through each rectangular steel plate (Figure 2).

Two 1/4" thick rectangular steel plates are welded horizontally 3" apart on the lower end of the mounting post to form a bearing support. A hole is drilled through the plate to allow for placement of the needle bearing housing and the pin of the pivot assembly (described under the reference to "Moving Frame"). The steel plates are shown in Figure 2.

A 2" x 9" steel plate bent into an "L"-shape is mounted on the upper end of the mounting post to form the upper bearing support for the pivot assembly of the parallelogram linkage.

A drawing of lift construction is shown in Figure 3.

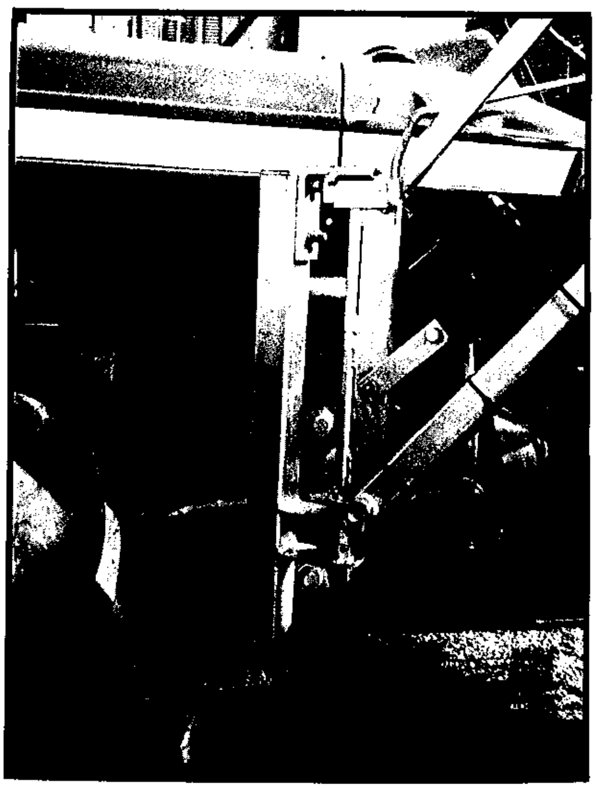

Figure 2. Vertical Mounting Post

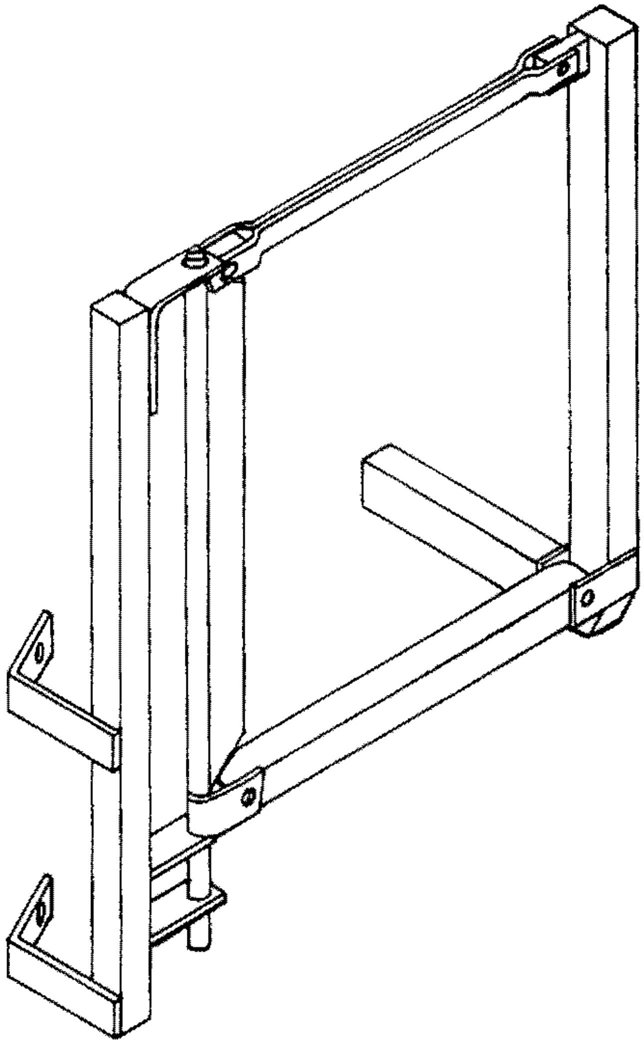

Figure 3. Drawing of Lift Frame

Moving Frame:

The movable part of the frame assembly is a parallelogram linkage. The lift pivots on a 1″ diameter shaft welded to a 3/4″ x 2″ steel reinforcing bar containing the inner linkage bearings and pivots in the bearing supports described previously. A clevis pivot constructed from a rectangular flat steel bar bent into a "U"-shape and mounted at the lower end of the reinforcement bar, above the lower bearing support, serves as the connection point for the lower parallelogram linkage. A 2″ x 3/4″ bar bearing passes through the clevis and lower link to securely anchor the link (Figures 2 and 3).

The lower parallelogram link is constructed from 2″ square, 3/16″ wall steel tubing to provide stability and strength for the lift. At each end of the lower link, a 1 1/2″ diameter, 1/4″ wall tube is welded to the link to serve as a housing for 3/4″ I.D. needle bearings. A steel "ear" with a hole drilled through it is welded on the outer end of the lower link, to serve as the mounting point of the linear actuator.

The upper parallelogram link is made from a pair of 1/4″ x 1 1/2″ flat steel bars welded together. The ends of the bars are spread, forming a clevis at each end which attaches by 1/2″ diameter pins to the vertical pivoting reinforcing bar and the outer clevis attaches to the seat tube (described under the reference to "Lift Seat").

A latch for the pivoting reinforcing bar is constructed from a rectangular flat steel bar welded to the end of the 1/2" diameter pin that secures the upper link. A round steel rod is welded to the steel bar and travels upward at an angle over the upper link and out toward the lift seat. A slot is cut in the steel bar to form a latch plate. The latch plate locks around a round steel pin welded under the upper bearing support on the vertical mounting post (Figure 4).

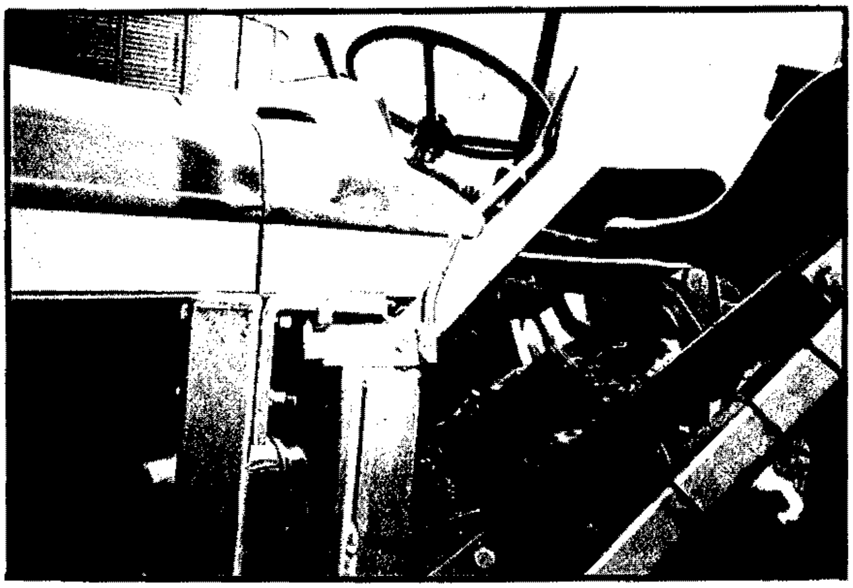

Figure 4. Lift Latch

Lift Seat:

The lift utilizes a stationary seat welded to the lower end of a 2" square, 3/16" wall "L"-shaped steel tube for attachment to the lower link. A clevis is mounted at the intersection of the horizontal and vertical lengths of the "L"-shaped tube. An "ear" constructed from 1/2" x 1 1/2" flat bar steel is welded to the upper end of the vertical length of the "L"-shape tube. A hole is drilled through the "ear" to allow for attachment of the upper parallelogram link by a 1/2" diameter pin (Figure 5).

The seat for the lift is a padded bucket seat which is used on Ford tractors. The seat is mounted to the horizontal section of the seat tube by a 12 gauge steel plate bent into an "L"-shape and bolted to the seat. The plate is welded to the horizontal tube. A flat steel bar is welded at an angle between the steel plate and the horizontal tube to support the lift seat (Figure 5). A steel bracket is also mounted underneath the front of the lift seat and attaches to the horizontal tube.

Lift Actuation:

The lift is powered by a Warner Electric linear actuator with an 8" stroke (Figure 4). The actuator is rated at 1500 lb. force. A 12 volt DC motor, drawing up to 18 amperes, drives a screw in a sealed, permanently-lubricated gear train. The screw passes through a recirculating ball nut attached to a stainless steel tube, which extends through a grease and dust seal to apply the lifting force. The actuator contains an automatic load holding brake and a ball-detent overload clutch.

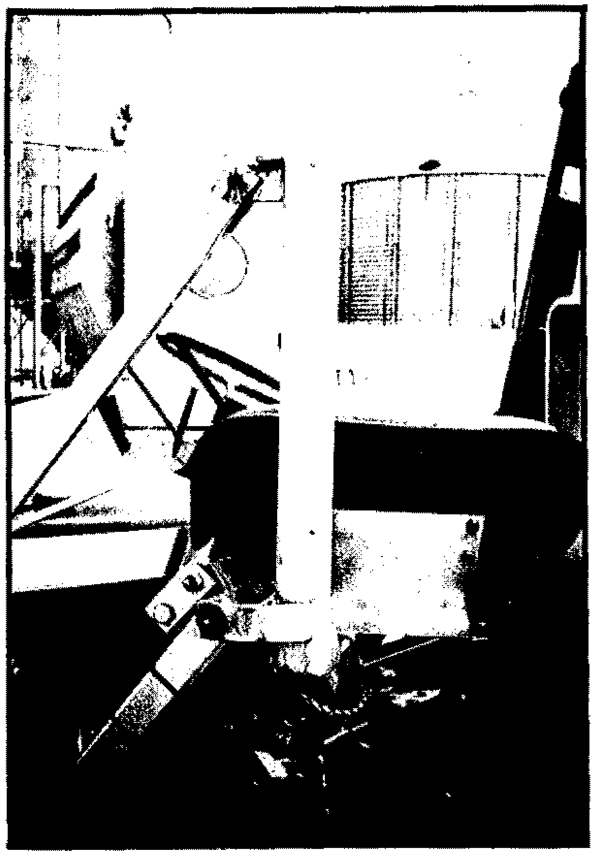

Figure 5. Lift Seat Tube and mounting to Linkages

The actuator rod is connected to an "ear" welded to the outer bearing tube on the lower parallelogram link. The ear contains a needle bearing, so that the actuator force is carried by a bearing. The stationary end of the actuator is attached in the same manner to the pivoting reinforcing bar by a 1/2" diameter pin (Figure 2).

The actuator provides the lift but the operator must grab hold of the fender to swing the seat around to transfer to the tractor seat. On some versions of this lift, an automatic swivel feature has been installed.

Lift Controls:

A self-centering, reversible toggle switch is located underneath the seat on a steel bracket (Figure 6). It allows control by the operator to raise and lower the lift. The wiring is 16 gauge and is protected by a plastic sheath.

A self-centering switch is used to cause the lift to stop upon release of the switch to protect the operator and the electrical system.

SAFETY CONSIDERATIONS

The tractor engine should always be shut off during the transfer process to eliminate the danger of the operator being run over or thrown from the tractor while mounting or dismounting. This lift provides this safety feature by not requiring the engine to be operating during lift operation.

The linear actuator with the screw drive prevents the lift from falling, should the unit or the electrical system fail.

There is a pinch point when the lift is raised next to the rear wheel fender. It is possible for the operator to pinch his right hand between the seat and the fender (Figure 6).

Figure 6. *Self-Centering Toggle Switch*

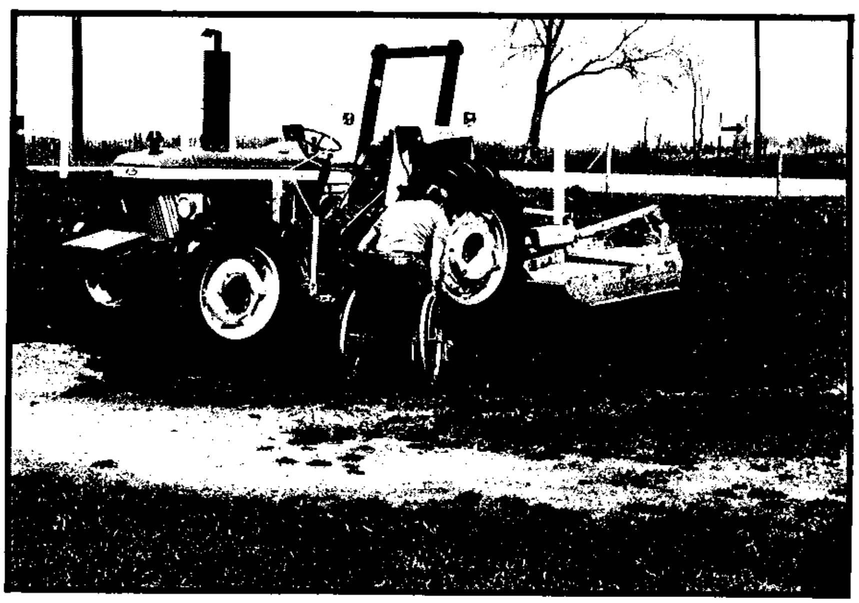

Figure 7. *Operator transferring to Lift Seat*

There is a small amount of play in the lift when the operator attempts to climb from the lift to the tractor seat. This is because the latch does not securely hold the pivoting member of the lift. It could be corrected with a few modifications.

The lift seat could use a footrest for the operator. It would offer leg support and keep him from sliding out of the seat. Some operators might desire a seat belt while sitting in the seat.

A switch should be provided on the tractor close to the ground, so the operator can gain access to the lift if it is raised.

DESCRIPTION OF OPERATION

To mount the tractor, the operator moves up to the lowered lift seat and sits down in the bucket seat (Figure 7). He then toggles the switch underneath the lift seat to raise the lift to the height to transfer to the tractor seat. When the operator can reach the tractor fender, he grabs hold of it and swings the lift in toward the tractor seat. He then locks the lift into position by using the lock provided to keep the lift from pivoting (Figure 4). He then transfers into the tractor seat (Figure 8). The seat is shown in the raised position for operator transfer in Figures 9 and 10.

To dismount the tractor, he slides over into the lift seat while using the steering wheel and fender for support. He releases the lock that keeps the lift from pivoting. The operator pushes against the tractor to swing the lift seat away from it, then toggles the switch mounted under the lift seat to lower it to the ground. He grabs his crutches and raises himself out of the seat and moves away from the tractor.

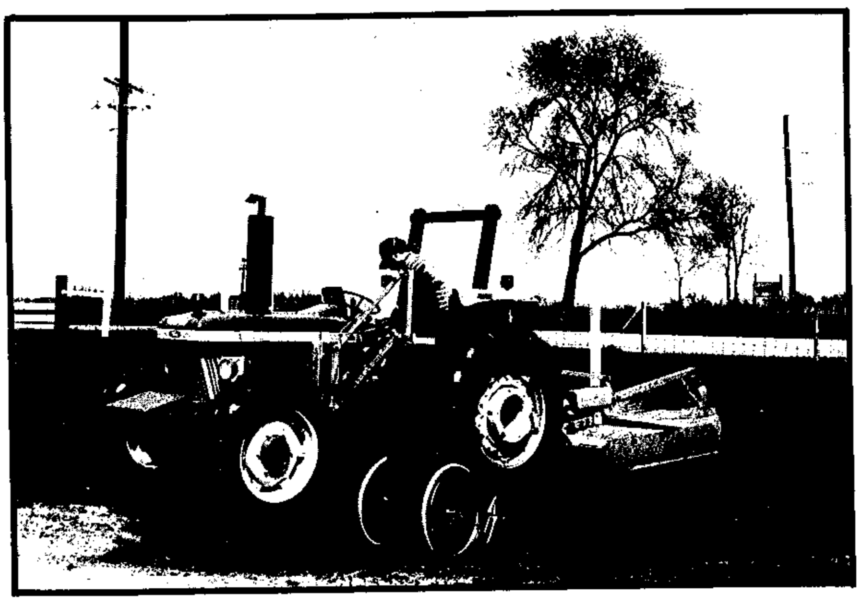

Figure 8. Operator transferring to Tractor Seat

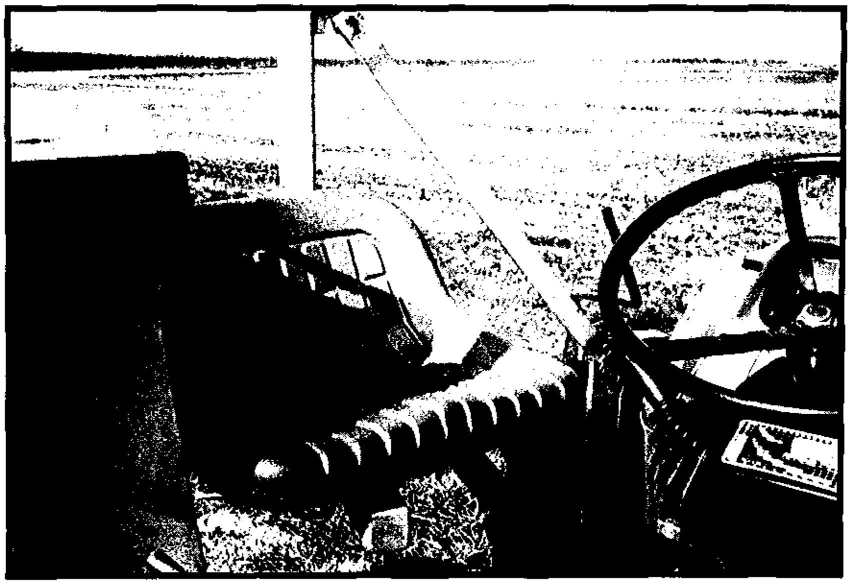

Figure 9. Seat in transfer Position

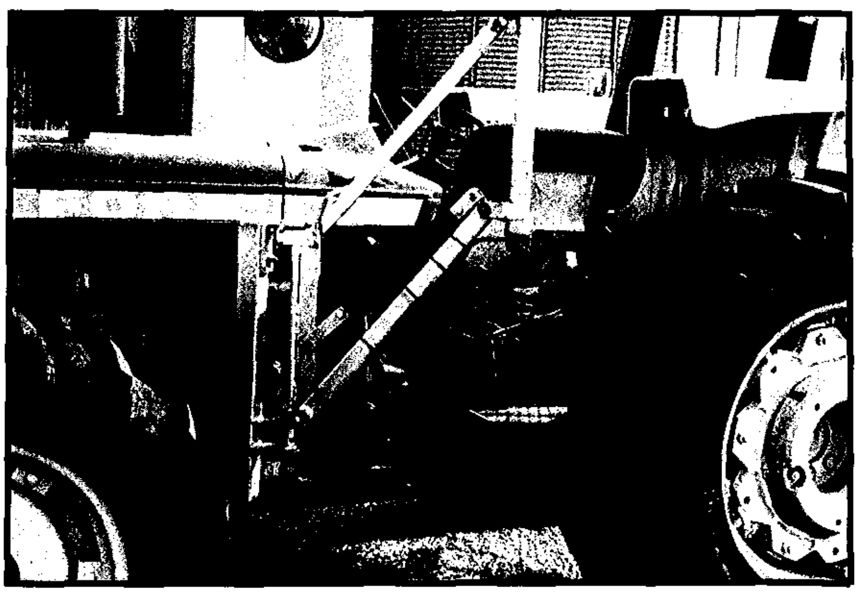

Figure 10. Lift in raised Position

CONTROL MODIFICATIONS

Brake:

The brake control modifications on the Ford 4610 tractor are designed for ease of operation. The modifications are constructed of square steel tubing, flat bar stock and round steel rod. A key feature of the controls is a pivot assembly (Figure 11) which allows the brakes to be locked in the engaged position by pushing the hand levers down until they are over center (Figure 12). Figure 13 shows the operator engaging the brake.

Clutch:

The clutch hand lever was constructed from a round steel rod bent into shape to travel from the pedal shank, along the transmission and up vertically along the side of the tractor seat. There it bends outward horizontally to form a handle. The upper portion of the lever is shown in Figure 14, along the side of the tractor seat.

A rectangular steel plate is bent around the lower end of the rod and welded to it. Holes are drilled through the steel plate to allow for placement of bolts to securely fasten the lever to the pedal shank (Figure 15).

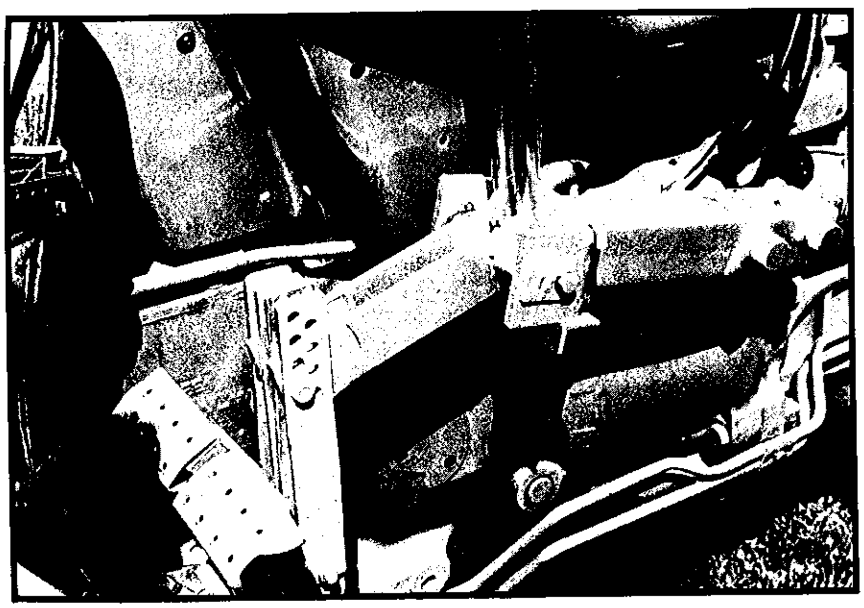

Figure 11. Pivot Assembly and mounting of Brake Levers to Pedal Shanks

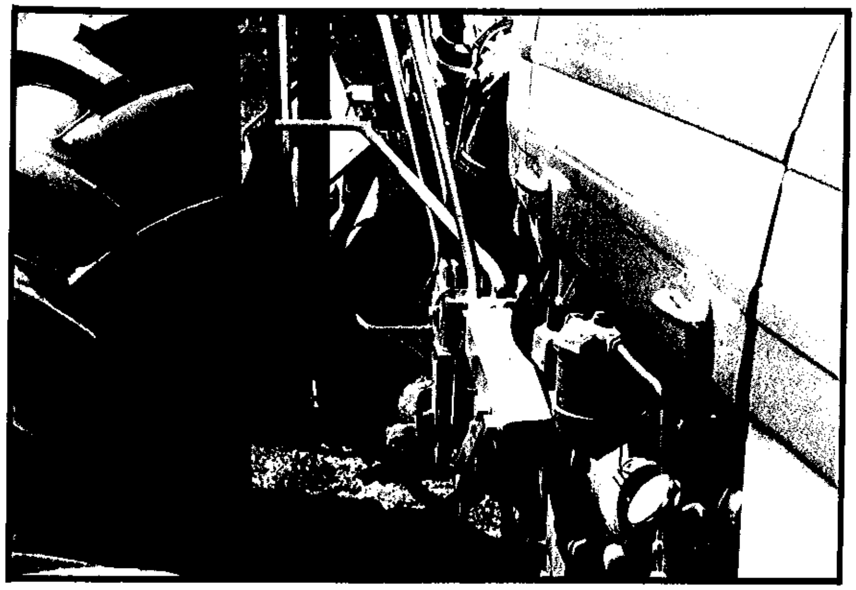

Figure 12. Lever in disengaged position

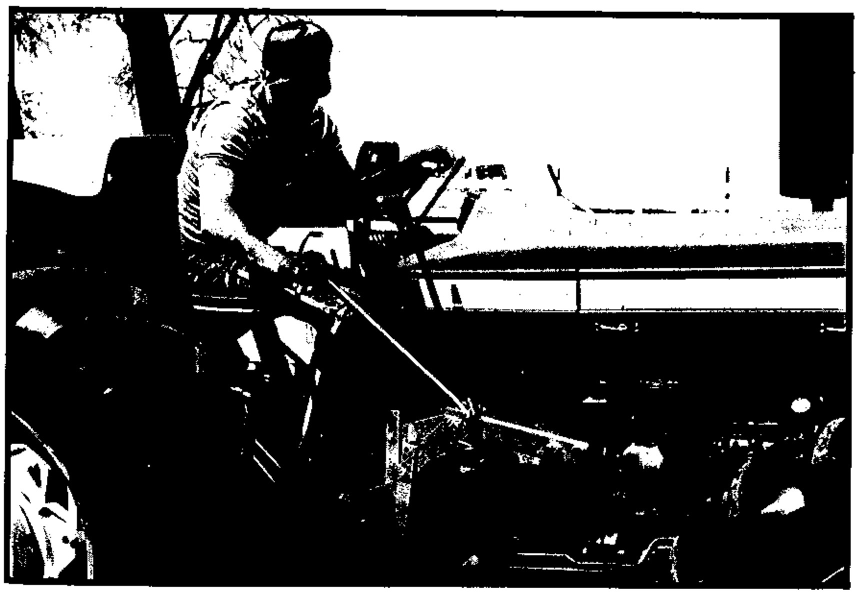

Figure 13. Operator engaging Brake

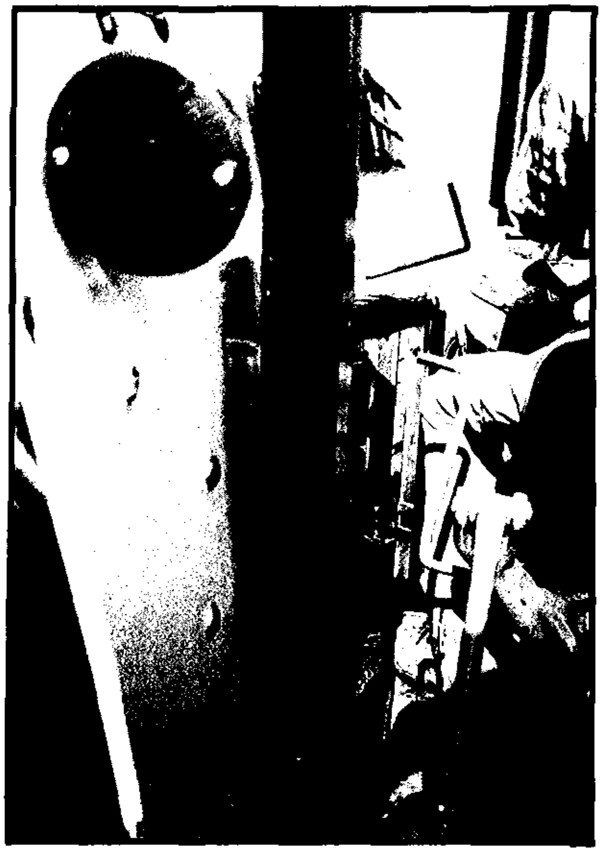

Figure 14. Clutch Lever next to Tractor Seat

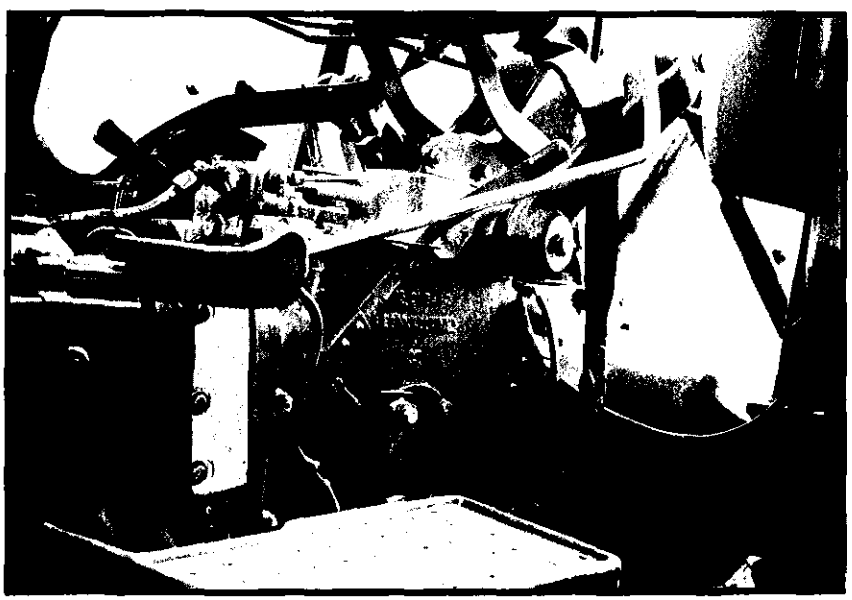

Figure 15. Clutch Lever mounted to Pedal Shank

ESTIMATED COST

All modifications: $ 1,200

DON SKINNER'S TRACTOR CHAIRLIFTS

FARMER: **Don Skinner**
R.R. #2, Box 169
Pawnee, IL 62558

SUMMARY

Function:

Don Skinner's tractor chairlifts enable him to access his tractors without climbing. The chairlifts are shown mounted on International Harvester 3488 and 1486 tractors in Figures 1 and 2. Control modifications for the tractors are described later in this section.

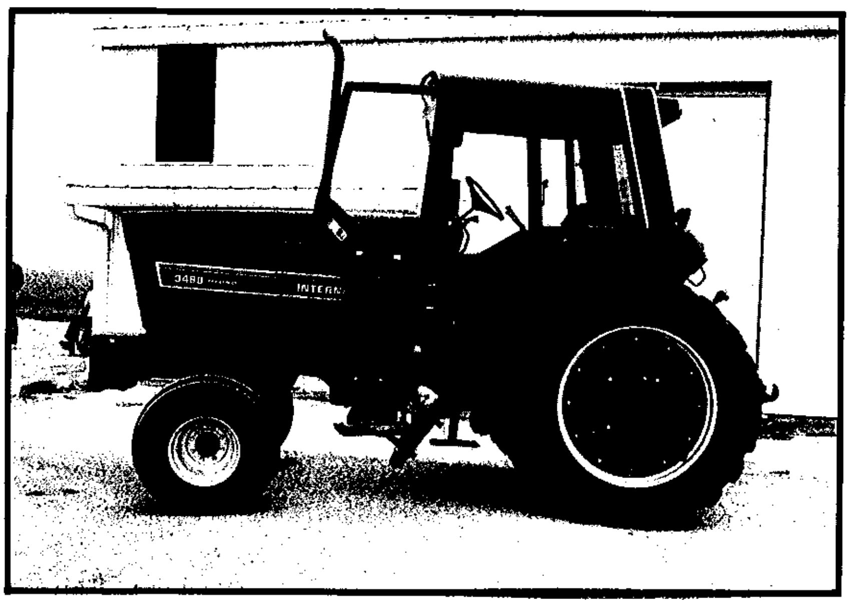

Figure 1. Chairlift on International 3488 Tractor

Figure 2. Chairlift on International 1486 Tractor

Farmer:

Don Skinner had farmed 960 acres of grain crops in Southern Illinois before an accident left him paralyzed. Following rehabilitation, Mr. Skinner continued to farm. Mr. Skinner is assisted on the farm by his wife Lynda, his son David, and a hired man.

Three chairlifts were built to allow Mr. Skinner to access his tractors. He used the same basic chairlift design on two International Harvestor 1486 tractors and an International Harvestor 3488 tractor. A lift was also built for his combine (see Don Skinner's Combine Chairlift). These lifts and control modifications have allowed Mr. Skinner to maintain an active role in his farming operation.

Don Skinner has assisted many other Illinois farmers with physical handicaps by suggesting ideas for constructing lifts and hand controls. He also offers them encouragement to return to agriculture.

Modified Machines:

Tractor:	International 3488
Features:	ROPS Cab
Rear Tire Size:	16.8-38
Front Tire Size:	11.0-16
PTO HP:	120
Year:	1982

Doors on both sides of cab
Hydrostatic Transmission
CB Radio

Tractor:	International 1486
Features:	ROPS Cab
Rear Tire Size:	18.4-38
Front Tire Size:	11.0-16
PTO HP:	160
Year:	1979

Doors on both sides of cab
CB Radio

Adaptability:

Don Skinner's lift was originally designed to be mounted on International Harvester 1486 tractors. The same lift design was placed on an International Harvestor 3488 tractor.

This lift concept is suitable for mounting on other tractors of similar design with changes in the mounting bracket and possibly modification to the cab door.

Compatibility:

1. The lift does not interfere with other operators using the tractor because there are doors on both sides of the cab. There is some inconvenience because the lift obstructs the side of the tractor on which the lift is mounted.
2. The door stop was removed to allow for easier operator transfer.
3. There were no major permanent tractor modifications required to install the lift.

Service and Maintenance:

1. The cable should be checked regularly for damage, corrosion or wear and replaced if necessary. Failure of the cable could cause a serious injury, especially if the failure were to occur while the lift were in the raised position.
2. The components of the lift are generally wheelchair accessible.

Accessibility and Ease of Use:

1. The lift is accessible from a wheelchair, ATV or by a farmer who has limited use of his legs and/or uses leg braces with or without crutches.
2. The lift is designed for ease of transfer from a wheelchair to the lift seat and lift seat to the tractor seat. The arm rest folds down to form a slide board.
3. The winch is noisy during operation.

Safety Concern:

Most cable and winch manufacturers warn against the use of their products for lifting human beings. This is a major concern of the evaluators. If, however, a farmer proceeds with a winch-type lift, it is strongly recommended that a high quality unit be selected that is self-locking when not activated. Experience has also shown that the electric switches included with some winches do not withstand frequent use. Heavy duty switches or solenoids, which allow for lower current flows, are recommended.

CONSTRUCTION DESCRIPTION

The construction of Don Skinner's tractor chairlifts are described in the following subsections: Mounting Frame (for both tractors), Main Frame, Moving Frame, Lift Seat, Lift Actuation, and Lift Controls.

Mounting Frame:

International 3488 Tractor:

The mounting frame is constructed from steel tubing and flat bar stock which attaches to the cab step on the left side of the tractor. A short length of 2″ square steel tubing is bolted horizontally around the tractor step mounting tube, which angles out and down from the tractor (Figure 3). A short length of 2″ square steel tubing is welded vertically to the opposite end of the horizontal tube to form an "L"-shape structure. The upper end of this vertical tube is cut at an angle for mounting to the main frame.

A length of flat steel bar is welded underneath the vertical square steel tube and extends down at an angle to the top of the tractor step. A second length of flat bar steel is welded horizontally between the main frame and the vertical length of square tubing (Figure 4).

A drawing of the lift is shown in Figure 5.

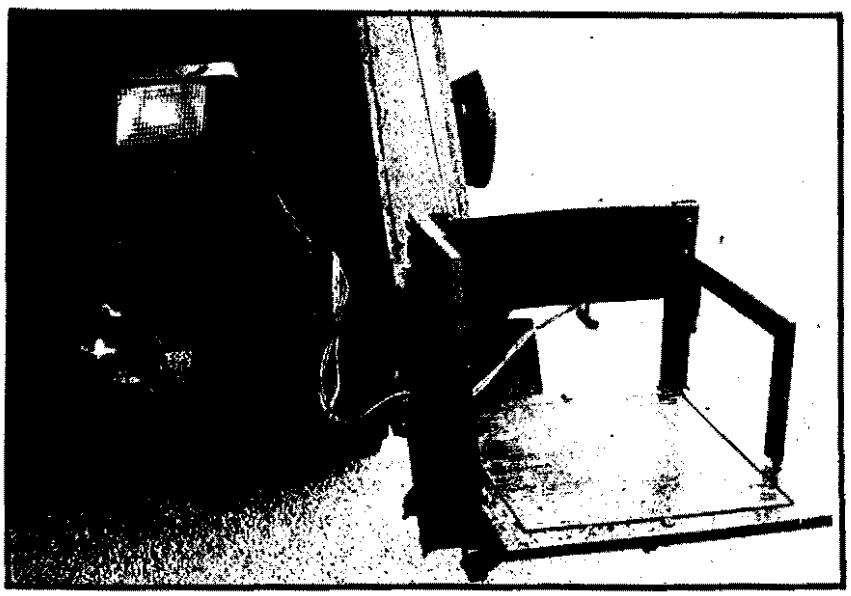

Figure 3. Mounting of Lift to Tractor Step and View of Lift Seat

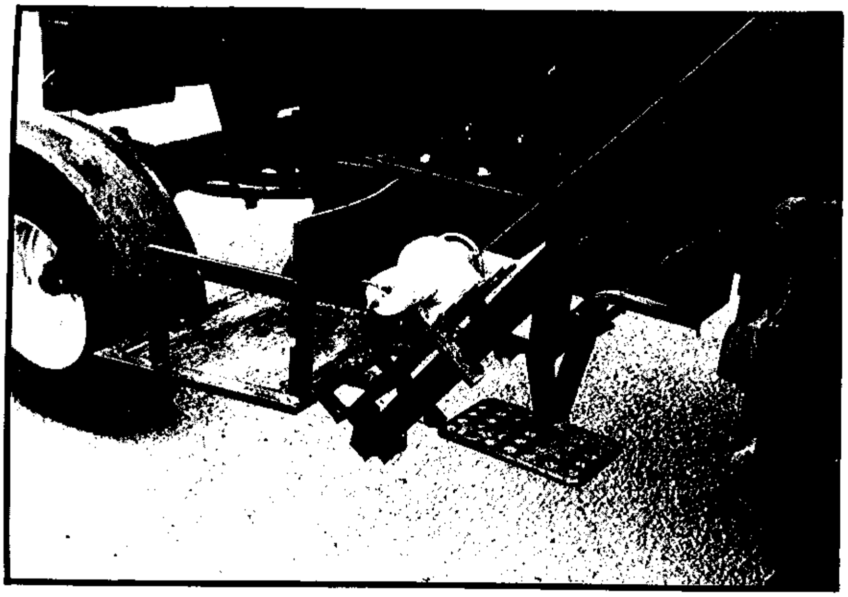

Figure 4. Side View of Lift Mounting Frame

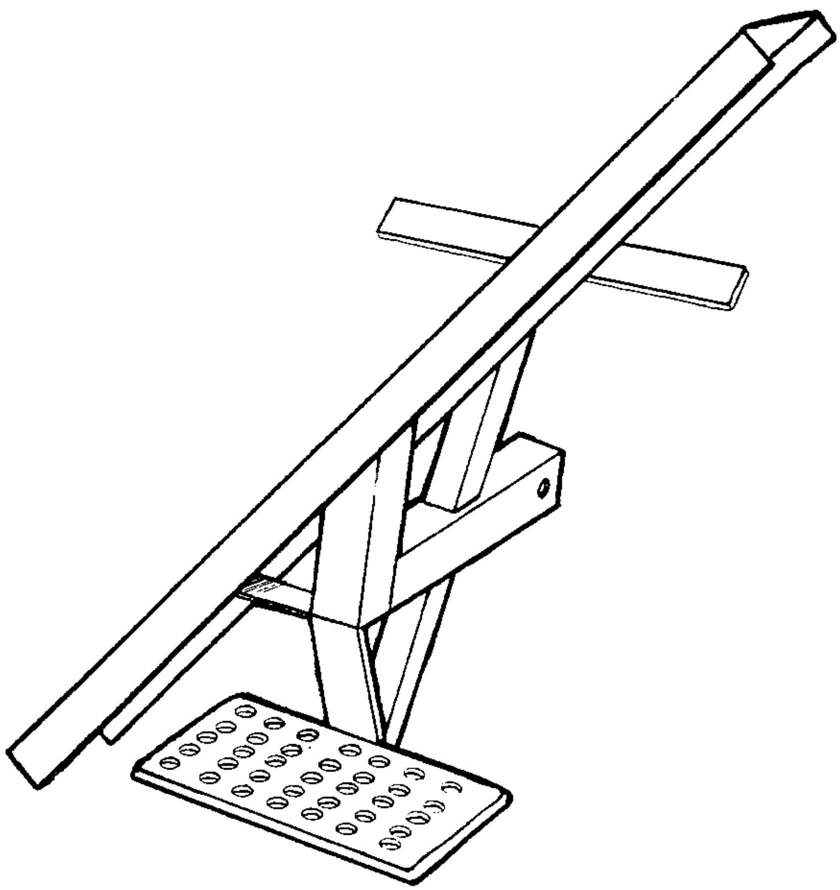

Figure 5. Drawing of Lift Mounting on International 3488 Tractor

International 1486 Tractor:

The tractor steps were removed for mounting the lift on the tractor's right side.

The mounting frame is constructed of square steel tubing and turnbuckles. A horizontal length of 3" square steel tubing is fastened underneath the tractor battery (Figure 6). A turnbuckle is fastened to the tractor frame along the tractor engine and travels at an angle back to the horizontal square tube, where it is bolted to the tube. A steel rod is fastened to a small "L"-shaped bracket of flat bar steel welded to the horizontal tube (Figure 6). The rod extends back underneath the cab where it is attached to the tractor frame.

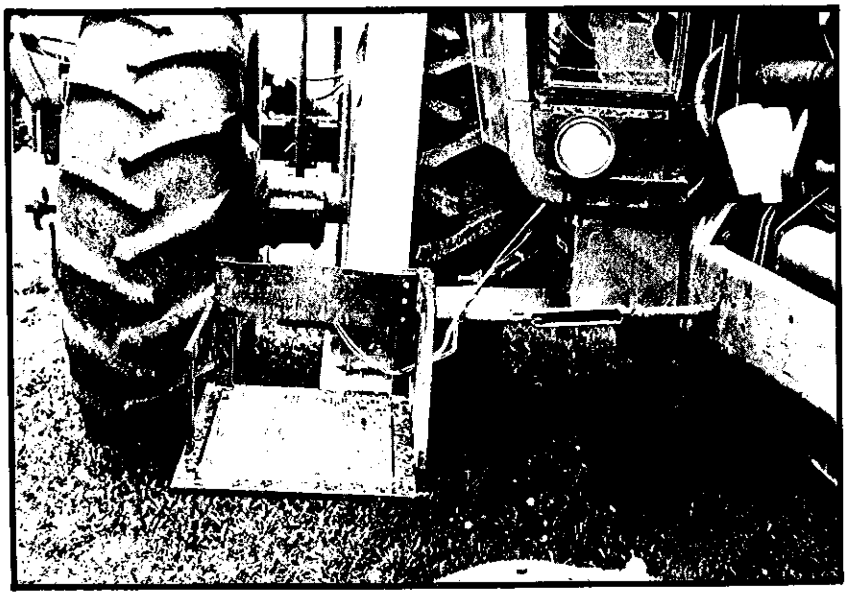

Figure 6. Mounting Frame on International 1486 Tractor

A length of square steel tubing is welded to the outer length of the horizontal tube, and is welded to the bottom side of the main frame (Figure 7). A frame of square steel tubing is welded between the horizontal tube and the main frame for added support.

Main Frame:

The main frame is a length of 6" inverted channel that forms an inclined track and extends from a point below the tractor step up to the tractor fender (Figures 1 and 2). The channel is bent slightly near the top to clear the tractor tire.

Figure 7. Mounting Frame attached to Main Frame

The channel is fastened to the mounting frame. The mounting of the main frame is shown in Figures 4 and 7.

The channel also functions to guide the lift seat, which is mounted on rollers, up the track.

Moving Frame:

The moving frame consists of a bearing plate to support the lift seat. The bearing plate is constructed of angle iron and rectangular steel plates. A steel plate 15″ - 17″ long and 9″ wide rests several inches above the steel channel. Short lengths of small angle iron are welded vertically below the steel plate at each corner, so that a flat side travels parallel to, yet not touching, the side of the channel. Rollers from a grain bin stirring machine were bolted to each angle iron post underneath the channel edge (Figure 4). This bearing plate serves as the mounting bracket for the lift seat.

Lift Seat:

The seat is constructed of rectangular steel tubing welded into a square frame. Two lengths of rectangular steel are welded vertically to the rear of the frame at each corner. A flexible backing is bolted across these vertical tubes to form a back rest (Figure 6).

The seat is attached to the bearing plate by a length of horizontal flat steel bar welded underneath the seat frame and to the bearing plate. Short lengths of angle iron are welded to each corner of the bearing plate and extend up at an angle and attach to the frame of the lift seat (Figure 4). Arm rests are located on both sides of the seat. The armrest on the side where the operator transfers from his wheelchair is constructed of rectangular steel tubing in an "L"-shape frame. The horizontal part of the armrest has a pin welded vertically on the end. The pin slips down inside a round tube welded to the vertical backrest tube and forms a hinge (Figure 4). The vertical part of the armrest has a pin welded inside it so that a short length extends out of the bottom. The pin slips inside a hole drilled through the seat frame (Figure 4). When the operator wishes to transfer to or from the lift seat, he lifts the arm up to pull the pin out of the seat frame and swings the arm back on its hinge out of the way. He replaces it after transferring.

A combination arm rest and slide board is mounted on the opposite side of the seat. The slide board is hinged on the seat frame. It has a frame of rectangular steel tubing with a wood panel fastened in the middle. The slide board is locked in the upright position by a short length of channel bolted to the back of the lift seat's vertical post. This allows it to pivot up and down (Figure 3). When the operator wishes to transfer to the tractor seat, he raises the pivoting channel iron lock and lowers the hinged slide panel down. He then slides over into the tractor seat (Figure 8).

Figure 8. Slide Board - Arm Rest

Lift Actuation:

The lift is powered by a 12 volt DC electric winch that operates off the tractor battery. The winch is mounted to the top of the seat bearing plate and travels up and down with the seat. The winch is shown in Figure 4.

The cable is wrapped around the winch spool in two directions. One end of the cable is attached to a hook at the top of the channel frame (Figure 9) and the other end is attached to the lower channel end. The cable attached to the lower end of the channel travels around a pulley and then attaches to a spring underneath the channel. The tension spring keeps the cable tight to ensure smooth operation of the lift.

A piece of rubber is also wrapped around the winch spool to reduce slippage.

Lift Controls:

The lift is operated by a solenoid remote switch which the operator holds in his hand while operating the lift.

SAFETY CONSIDERATIONS

As a safety precaution, the tractor engine should be turned off during lift operation. This lift offers the safety feature of not requiring the tractor engine to be running during operation.

The seat's arm rests help hold the operator in the lift seat. The slide board assists the operator in safely transferring from the lift seat to the tractor seat.

Most cable and winch manufacturers warn against the use of their equipment for

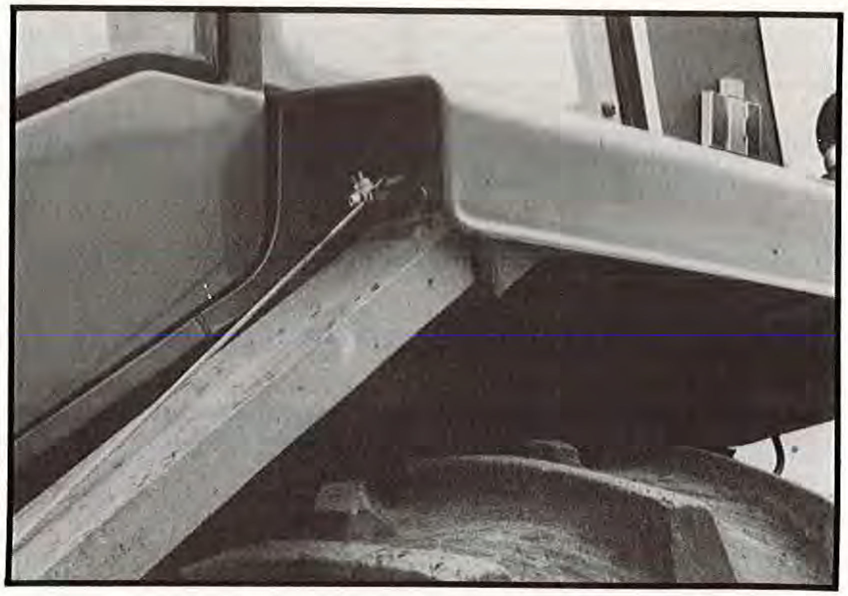

Figure 9. Cable attached to Steel Channel

lifting people. If the cable above the seat were to break, the operator would fall down the track because there is no braking device on the lift. The seat would come to an abrupt stop at the bottom of the lift track, possibly causing serious injury. In addition, if the cable were to break at any point, the operator might be struck by the cable and injured.

A footrest mounted under the lift seat might increase the operator's stability and security. Some operators might also desire a seat belt to hold them in the seat during lift operation.

DESCRIPTION OF OPERATION

To mount the tractor, Mr. Skinner positions his wheelchair beside the lowered lift seat (Figures 1 and 2). The wheelchair's arm is removed and the armrest on the lift seat is swung back. He then slides from the wheelchair to the lift seat and positions the armrest back in place. He holds onto the remote switch and moves the switch to raise the lift seat up the channel frame (Figure 10). When the seat reaches the proper transfer height, he releases the switch and places it out of the way. Mr. Skinner then raises the channel lock holding the armrest-slide board in the vertical position. He lowers the slide board to the horizontal position and slides over into the tractor seat. He then locks the slide board back in the vertical position. Using the switch to move the lift seat out of the way, he closes the cab door, using a grab bar located in the cab. He then places the lift seat where it will stay during tractor use.

To dismount, Mr. Skinner opens the door and swings it out of the way. He positions the lift seat at the proper transfer height. Mr. Skinner then lowers the slide board and transfers from the tractor seat to the lift seat. He locks the slide board in the vertical position by using the channel lock mounted on the backrest. He lowers the lift to the ground where his wheelchair is within reach.

CONTROL MODIFICATIONS

International 3488 Tractor

Clutch:

The hydrostatic tractor contains a clutch that is only needed when changing the transmission from high to low range.

A round steel rod serves as the lever for the clutch and is bent to follow the contour of the instrument panel. The lower end of the rod is fastened to the pedal shank with a U-bolt (Figure 11). The upper end of the lever is covered by a rubber grip to assure proper grip of the lever, and for operator protection.

To disengage the clutch, Mr. Skinner pulls back on the upper end of the rod, which forces the pedal shank down. An able bodied operator can use the pedal with the lever in place.

Figure 10. Mr. Skinner operating Lift

Figure 11. Clutch and Brake Levers for International 3488 Tractor

Brake:

Two steel rods, one for each brake, are bent to follow the contour of the instrument panel. They are located between the steering wheel and the throttle lever. The lower end of the rods are clamped to their corresponding pedal shanks with U-bolts (Figure 11).

To engage the brakes, Mr. Skinner pulls back on the lever of the brake he wishes to activate, forcing the pedal shank down. The brakes can be locked together if desired, using the regular lock. An able-bodied operator can use the brake pedals with the levers in place.

CONTROL MODIFICATIONS

International 1486 Tractor

Clutch:

The clutch control is constructed of a length of round steel rod that is bent in a "U"-shape to form two levers, one for each side of the steering console. The ends extend up along both sides of the instrument panel and the horizontal section passes along the front of the panel. The horizontal rod passes through a "U"-shaped mounting bracket constructed of flat bar stock. The rod passes through holes drilled through the raised sides (Figure 12). The horizontal length of the flat steel bar is fastened to the instrument panel.

Figure 12. Clutch and Brake Levers for International 1486 Tractor

An "ear" made of flat steel bar is welded to the horizontal rod directly over the clutch pedal. A steel rod connects the ear and the pedal shank. At the shank it connects to a "U"-shaped bracket constructed of flat steel bar stock that wraps around the pedal shank. The bracket is fastened around the pedal shank with two bolts (Figure 13).

The operator can disengage the clutch by pulling the lever on either side of the control panel, causing the horizontal shaft to rotate, and forcing down on the vertical rod, which pushes the pedal down. The clutch can be locked in the disengaged position by pulling the levers back toward the operator in a position approximately horizontal, forcing the vertical rod to be locked over-center. Other operators can use the pedal with the levers in place.

Brake:

The brake levers on the International 1486 tractor are similar to those on the International 3488 tractor (Figure 12).

ACCESSORIES

Door Grab Bar:

Mr. Skinner used a length of round steel tubing with a handle on the end to grab the door and close it.

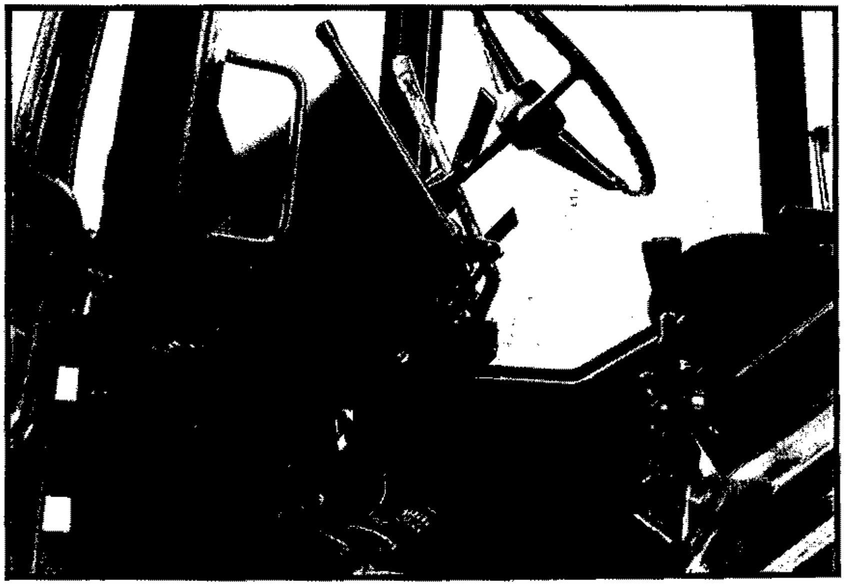

Figure 13. Mounting of steel rod to Clutch Pedal Shank

ESTIMATED COST*

Cost of Materials for one tractor $250.00

*At time of construction, 1982.

TOM AUMANN'S CHAIRLIFT

FARMER: **Tom Aumann**
R.R. #1
Decatur, IN 46733

SUMMARY

Function:

Tom Aumann's chairlift is designed to be mounted on an International Harvester 986 tractor (Figure 1). The lift serves the purpose of allowing a farmer with a handicap access the operator's station of his equipment.

Figure 1. Tom Aumann's Chairlift

Farmer:

Tom Aumann, who is a paraplegic, has a full-time job as a machinist and also farms part-time with his father. He raises 130 acres of corn, wheat and soybeans. Mr. Aumann has an interest in helping other handicapped farmers.

Mr. Aumann does field work on the farm by using a modified International Harvester 986 tractor with a chairlift and hand controls. He also has an International Harvester 656 tractor with hand controls used for cultivating crops and for mowing.

Modified Machine:

Tractor: International 986

Features: ROPS Cab

Rear Tire Size:	18.4-38 Duals
Front Tire Size:	11L-15
PTO HP:	105
Year:	1981

Doors on both sides of the cab
CB Radio

Adaptability:

This lift concept is suitable to be used on other self-propelled agricultural machines. Several lifts of this type have been fabricated and are being used successfully.

Compatibility:

1. The lift does not interfere with other operators using the tractor because there are doors on both sides of the cab.
2. There is some inconvenience because the lift prevents easy access to one side of the tractor and also causes some obstruction of the operator's view.
3. There were minor alterations made to the original equipment that could affect the tractor's resale value. The fender was partially cut off to allow the lift to be mounted so the door would clear the lift track. The door stop was removed to allow the door to swing out of the way so the operator could use the lift.

Service and Maintenance:

1. Regular maintenance should be considered to keep the lift in proper working condition.
2. The cable should be checked regularly for damage, corrosion and wear and replaced if damaged to prevent an accident.

Accessibility and Ease of Use:

1. The lift is accessible from a wheelchair, ATV, or by a farmer who uses leg braces and/or crutches.
2. The lift is designed for ease of transfer.

Safety Concern:

1. Most cable and winch manufacturers warn against the use of their products for lifting humans.
2. The lower mounting bracket of the lift was attached toward the inside of the cab. This type of lift mounting can introduce unwanted noise and vibration into the cab.

CONSTRUCTION DESCRIPTION

The construction of Tom Aumann's chairlift is discussed in the following subsections: Stationary Frame, Moving Frame, Seat and Swing Arm, Lift Actuation and Lift Controls.

Stationary Frame:

Lower Bracket:

The lower bracket is attached to the tractor by a piece of angle iron positioned inside the ROPS tube on the right front of the tractor cab and bolted into place. This piece is welded to another length of angle iron that extends away from the tractor to form the lower support for the lift (Figure 2). A triangular brace is welded between these two lengths of angle iron for added strength. Two small "L"-shape brackets are bolted to the horizontal angle iron support for mounting of the lift track. A third length of angle iron is mounted to the front section of the angle iron extending away from the tractor, and travels at an angle where it is bolted to the tractor for added support (Figures 2 and 3).

Upper Bracket:

The upper bracket is constructed of angle iron mounted inside and over the rear tire on the tractor. The bracket is mounted vertically and bolted to the inside of the rear tire well. A second piece of angle iron is welded to the vertical section of steel and extends horizontally over the rear tire for the upper support of the lift (Figure 4). A triangular metal brace is welded between the two pieces for added support.

A section of the fender was removed to allow for the placement of the bracket. This

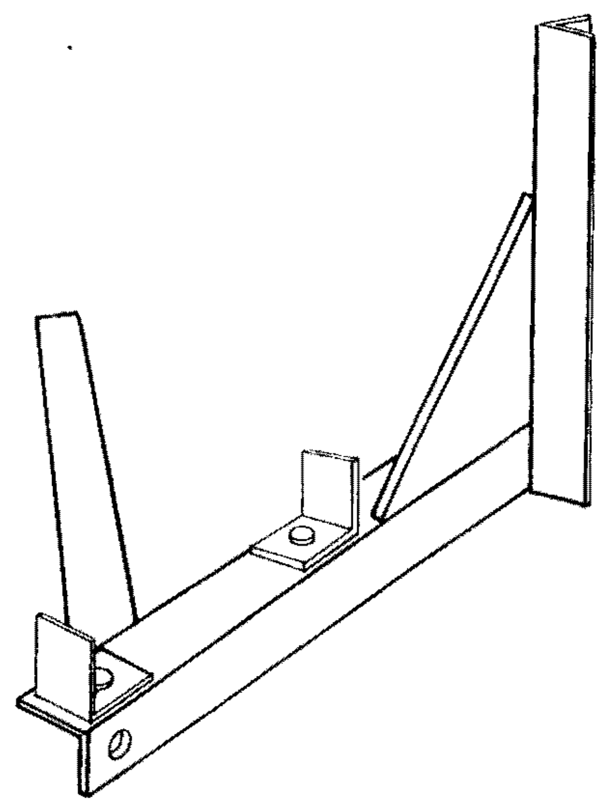

Figure 2. Lower Mounting Bracket

Figure 3. Lower Mounting Bracket and Uni-strut Track

enabled the track to clear the door. This left little clearance between the lift and the rear tires, which might pose a problem in muddy conditions.

Lift Guide:

The guide mechanism for the lift consists of two 9' sections of Uni-strut track welded to the upper and lower support brackets, with a spacing of 9" between them. The Uni-strut track is mounted with the channels facing each other. At each end of the Uni-strut track, a 12" length of angle iron is welded to it to add strength and support. This also provides a stop for the lift seat. A 4' plate of 1/16" steel is welded underneath the Uni-strut track, providing a mud guard for the lift.

Moving Frame:

The movable part of the chairlift consists of a bearing plate with four Uni-strut bearings that guide the lift seat assembly smoothly up the Uni-strut track. The bearing plate is constructed of steel to form a rectangle that fits between the two Uni-strut tracks and allows for placement of the lift seat mechanism. The cable was attached to the top of the bearing plate.

Near the top of the bearing plate an 11" steel plate is welded so that it extends horizontally away from the bearing plate. Near the bottom of the bearing plate a 6" steel plate is welded so that it extends horizontally away from the bearing plate. These two plates are approximately 7" apart vertically. A hole is drilled through the two brackets to allow for placement of a pivot pin for the seat and swing arm assembly. This assembly provides the mounting bracket for the seat and swing arm.

Seat and Swing Arm:

The seat and swing arm assembly is attached to the bearing plate by a steel pin that passes through two holes in the brackets as described under the reference to "Moving Frame". A flat steel bar is attached to the pivot pin underneath the lower bracket and extends horizontally out from the bracket to allow placement of the

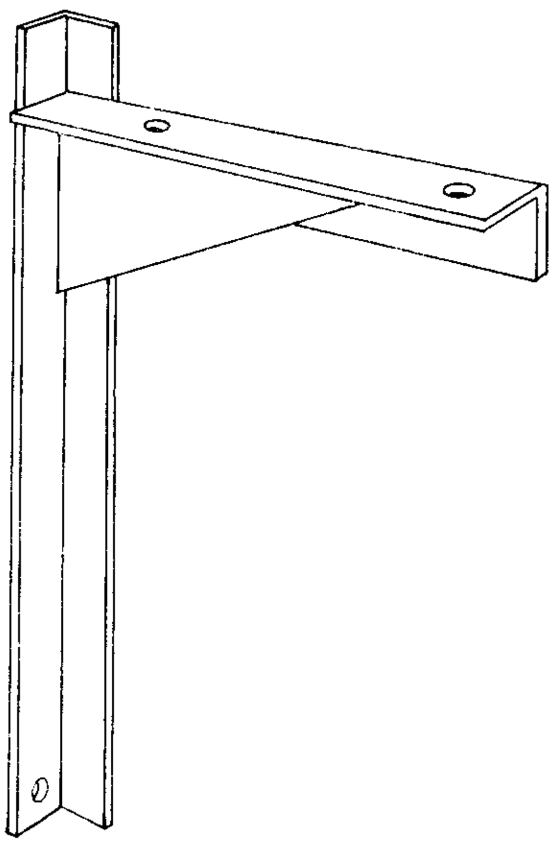

Figure 4. Upper Mounting Bracket

lift seat. A steel bar is attached to the pivot pin above the upper bracket, bends down at an angle and is welded to the lower section of steel that supports the lift seat (Figure 5).

A spring lock assembly is shown in Figure 5, which is constructed of steel bar formed into a "U"-shape and bolted to the upper swing arm support. Inside the bracket is a heavy duty spring attached to a steel rod. The rod passes through holes in the upper support arm and in the horizontal mounting bracket to lock the seat in place. A steel plate mounted underneath the spring is attached to a steel rod mounted in a "U"-shaped bracket behind the seat. A hole is drilled in each end of the bracket to allow for the placement of a rod which extends around the back and along the side of the seat. This enables the operator to release the spring lock assembly to swing the seat around. Mounted on the swing arm is a Wheelhorse lawnmower seat. An armrest was added on the right side to allow the operator to feel secure in the lift seat. There is no seat belt to help secure the operator in the seat.

Lift Actuation:

The lift is powered by a 12 volt DC winch that operates off of the tractor battery. The winch is bolted to the bottom side of a rectangular piece of steel that is bolted to the top of the Uni-strut track (Figure 6). The cable is attached to the top of the bearing plate which holds the seat.

Lift Controls:

The lift is operated by a remote switching device which the operator holds in his hand while operating the lift. The switch is mounted inside an oilcan to provide a hand-held control.

A series of solenoids were mounted inside the cab to provide the necessary reversing capabilities. The remote switching device is shown in Figure 7.

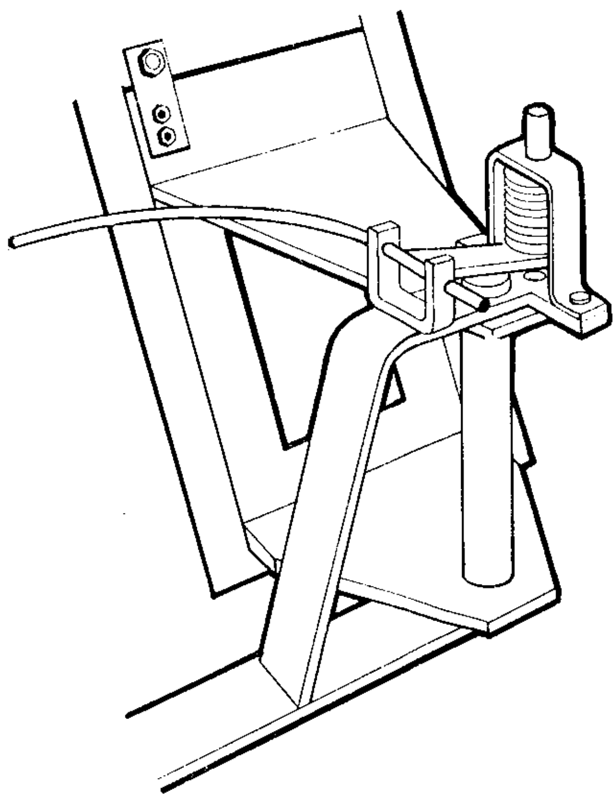

Figure 5. Bearing Plate and Seat Swing Arm Assembly

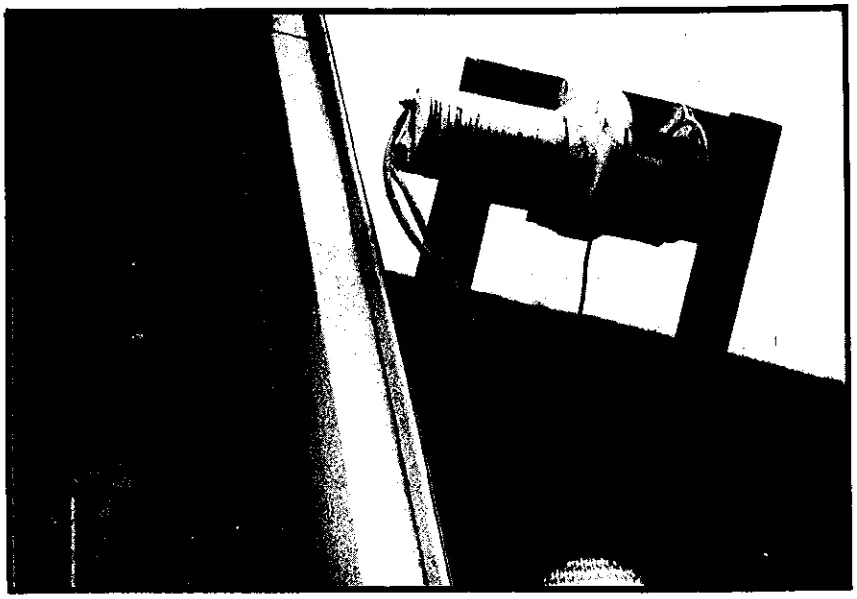

Figure 6. Mounting of Cable and Winch

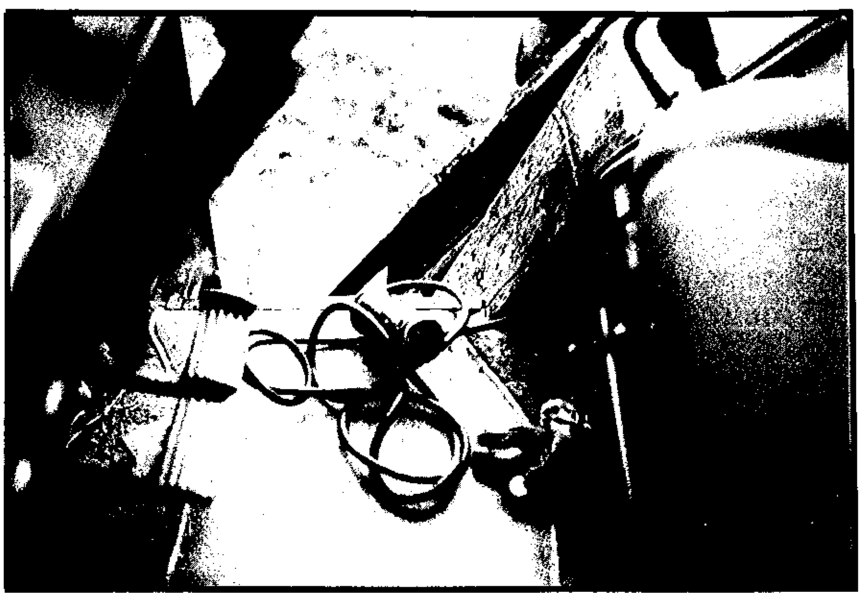

Figure 7. Remote Switching Device

SAFETY CONSIDERATIONS

It is very important for safe operation of the lift that the tractor be turned off. The lift contains a contoured seat, allowing the operator to feel comfortable. The seat also has an armrest on one side for the operator to hold during lift operation.

Cable and winch manufacturers warn against the usage of their equipment for lifting humans. If the cable should break, the operator would fall down the track, because there are no brake devices on the lift. The seat would come to an abrupt stop at the bottom of the lift track and could possibly cause serious injury. Also, if the cable should break the operator might be struck by the cable and injured.

A footrest mounted under the lift seat might increase the operator's stability and security. A seatbelt might also be desirable to hold the operator on the seat.

DESCRIPTION OF OPERATION

To mount the tractor, the operator positions his wheelchair beside the lowered lift seat (Figure 8). He removes the left arm of the wheelchair and slides over into the lift seat. He opens the door of the cab and swings it out of the way, and then picks up the remote switching device lying on the cab floor. He flips the switch and raises the lift till he reaches the proper transfer height. (The operator is shown moving up the lift track in Figure 9.) The operator pushes down on the spring lock release arm, which extends around the outside of the seat's right side, then grabs onto the side of the tractor and swings the lift seat into the tractor cab (Figures 10 and 11). He then slides over into the tractor seat. The operator moves the lift seat out of the cab and raises it out of the way of the door. He reaches out and closes the door.

To dismount, the operator opens the door and swings it out of the way. He lowers the lift seat and stops it at the proper transfer height and transfers to the lift seat. He lowers himself until he reaches the position to transfer to his wheelchair. He places the remote switching device into the cab and closes the door. He then slides over into his wheelchair.

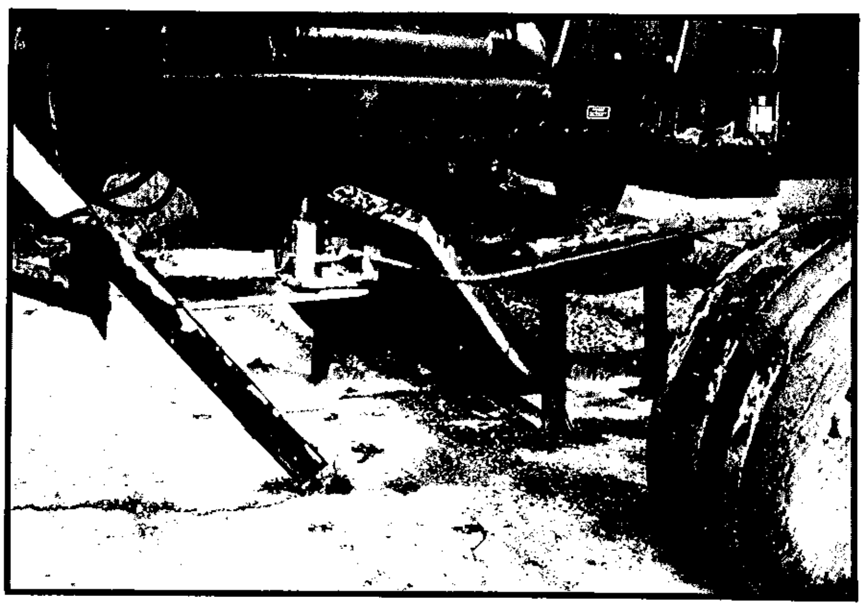

Figure 8. Lowered Lift Seat

Figure 9. Tom Aumann Operating Lift

Figure 10. Tom Aumann Transferring to Tractor Seat

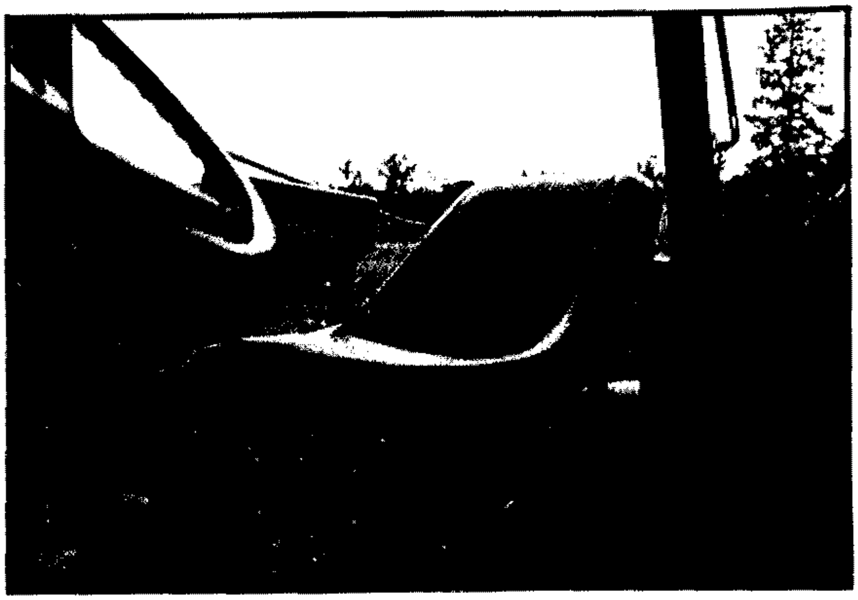

Figure 11. Lift Seat Inside Cab for Transfer

CONTROL MODIFICATIONS

The brake and clutch levers on Tom's tractor are mounted so they are operable with the right hand. The levers are made out of flat bar steel and are shaped to follow the contour of the instrument panel.

Clutch:

A round steel rod is mounted horizontally above the pedals so it can rotate. The clutch control lever is securely fastened to the right end of the rod, which rotates when the control lever is pulled. On the left end of the rod a short length of flat bar steel is attached to the rod by means of a collar. A roller is attached to the other end of the steel bar which rests on the pedal shank. Pulling on the clutch lever rotates the rod and thus disengages the clutch (Figure 12).

Brake:

The two brake levers are constructed out of flat bar steel. Each lever has a collar welded to the lower end so that it can rotate around the horizontal rod used for the clutch control. Attached to the collar on each brake lever is a short length of flat bar steel with a roller on the lower end that rests on the shank of the brake pedal. When the brake levers are pulled toward the operator, they pivot around the horizontal rod and engage the brakes (Figure 12).

Figure 12. Clutch and Brake Control Modifications

ESTIMATED COST

The Aumann's had not estimated the cost of the lift since nearly all the items used were already available on the farm. They also provided their own labor. An estimate of material costs is as follows:

Uni-strut Track	$ 60.00
Cable and Winch	150.00
Steel Frame	40.00
Wiring and switches	30.00
Seat	120.00
Accessories	25.00
Parts:	$ 425.00

MATT REYNOLDS' CHAIRLIFT

CONTACT: Agricultural Engineering Department
Breaking New Ground
Purdue University
West Lafayette, IN 47907

DESIGNED BY: Matt Reynolds
Agricultural Engineering Department
Purdue University

MODIFIED BY: Dean Kerstetter
Breaking New Ground
Agricultural Engineering Department
Purdue University

SUMMARY

Function:

Matt Reynolds' chairlift is designed to be mounted on various farm tractors to help a farmer with a handicap gain access to the operator's station.

The lift was designed as a prototype by Matt Reynolds, a student in Agricultural Engineering at Purdue University and is shown mounted on a Ford 8000 tractor in Figure 1.

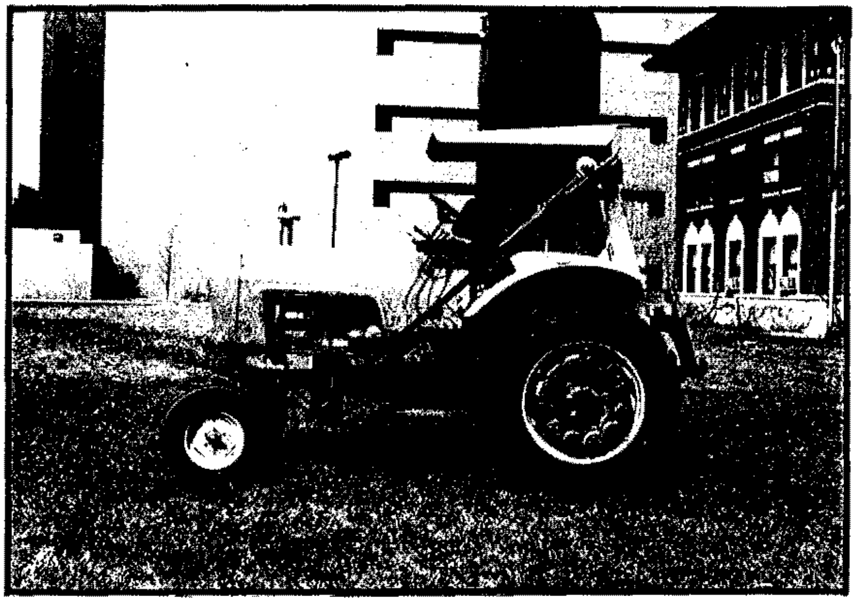

Figure 1. Matt Reynolds' Chairlift

Modified Machine:

Tractor:	Ford 8000	
Features:	ROPS Canopy	Steps on both sides of tractor Tilt Steering Wheel allows for easier access
Rear Tire Size:	16.9-34	Grip Bars on both sides of tractor
Front Tire Size:	7.50-16	
PTO HP:	105	
Year:	1968	

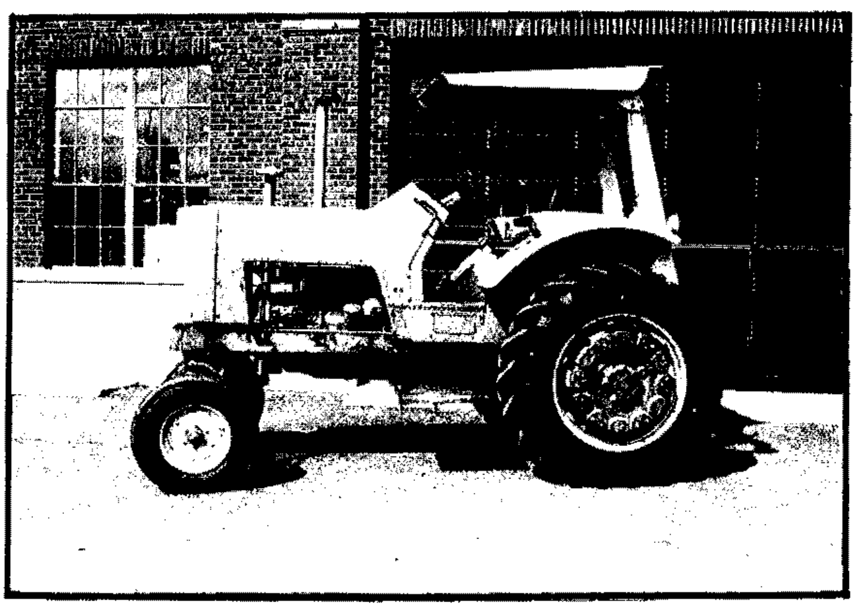

Figure 2. Ford 8000 Tractor

Adaptability:

This lift concept is suitable to be used on other self-propelled agricultural machines. Several lifts of this type have been fabricated and are being used successfully.

Compatibility:

1. The lift does not interfere with an able bodied farmer mounting the tractor because there are accessible steps on the other side.
2. The lift partially obstructs the operator's view to the left.
3. There are no major alterations required to mount the lift to the tractor.

Service and Maintenance:

1. There is minimal maintenance required to keep the lift in good working condition.
2. The cable should be checked regularly for damage, corrosion, or wear, and if necessary, replaced to prevent an accident. Failure of the cable could cause a serious fall, especially if the failure were to occur while the lift was in the raised position.

Accessibility and Ease of Use:

1. The lift is accessible from a wheelchair, ATV, or by a farmer using leg braces and/or crutches.
2. The lift is designed for ease of transfer from a wheelchair, however the operator has to swing his legs over the steering wheel to transfer to the tractor seat.
3. The cable and winch are noisy during operation.

Safety Concern:

Most cable and winch manufacturers warn against the use of their products for lifting humans.

CONSTRUCTION DESCRIPTION

The construction of the Matt Reynolds' chairlift is discussed in the following subsections: Stationary Frame, Moving Frame, Seat and Swing Arm, Lift Actuation and Lift Controls.

Stationary Frame:

Lower Bracket:

The lower mounting bracket 's constructed from a 5/16" thick rectangular steel plate with a 2 3/4" x 21" piece of steel bar welded to each side to form a "U"-shape bracket. Two 1/2" holes were drilled 1 1/2" from the top edge of the steel plate to allow for bolts to pass to mount the lift.

A two foot length of angle iron is welded horizontally to the steel mounting plate to form the lower support for the Uni-strut track. A triangular steel plate welded between the angle iron support and the steel mounting plate adds strength to the support arm. The bracket and support arm are shown in Figures 3 and 4.

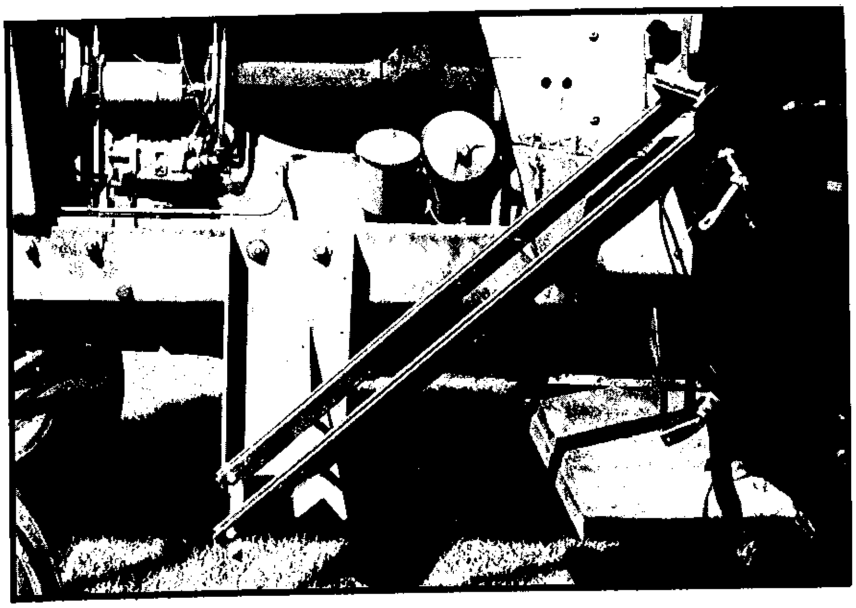

Figure 3. Lower Mounting Bracket on Ford 8000

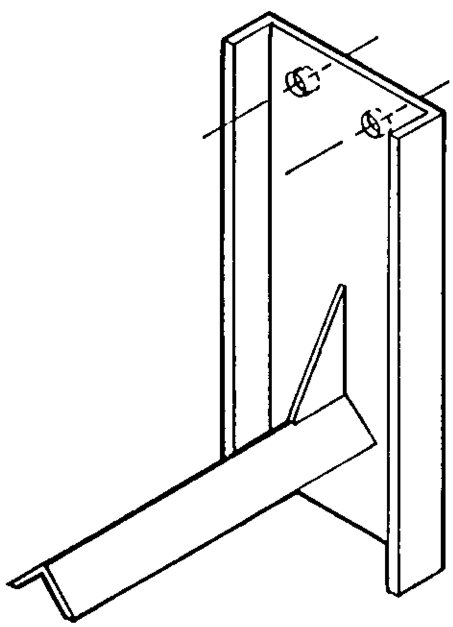

Figure 4. Lower Mounting Bracket and Support Arm

Upper Bracket:

The upper support arm for the chairlift is constructed from a length of angle iron and welded to a 5/16″ rectangular steel plate with four holes drilled in it, as shown in Figure 5. A second steel plate is placed on the inside of the left side ROPS post and the two plates are fastened securely together with four bolts, two on each side of the post.

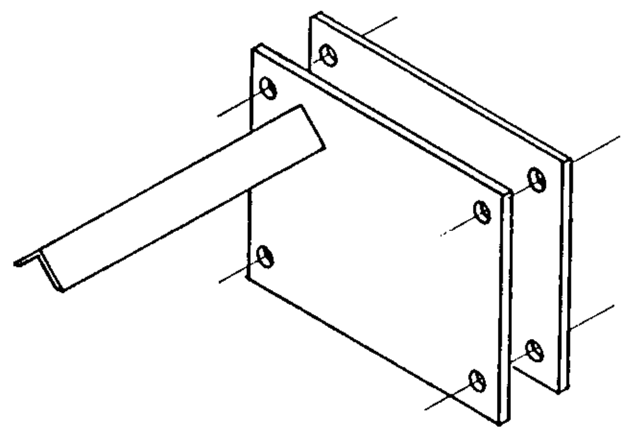

Figure 5. Upper Mounting Bracket

Lift Guide:

The guide mechanism for the lift consists of two 10' sections of Uni-strut track welded to the upper and lower support arm, 9 1/4″ apart. At each end of the Uni-strut track, a 13 1/2″ length of angle iron is welded to it to add strength and support. Two 1/4″ x 1 1/2″ bolts are placed through the lower end of both lengths of the Uni-strut track to provide a stop for the lift.

A 1' x 3' steel plate is welded to the underside of the Uni-strut track to provide a mud guard for the lift. The mud guard is placed approximately 3' from the top of the Uni-strut track.

Moving Frame:

A bearing plate with four press-fitted bearings guide the lift seat assembly along the Uni-strut track. The bearing plate is constructed from a 1/8″ thick steel channel. A hole is drilled in the middle of the upper portion of the bearing plate to allow the fastening of a cable to raise and lower the lift.

Two 3 1/2″ x 3 1/2″ x 1/4″ steel plates are welded into an "L"-shape and welded to the lower portion of the bearing plate, forming a base for the seat and swing arm. A 3 1/4″ length of 1 1/4″ diameter steel pipe is welded vertically to the base to form a pivot for the swing arm. The inside diameter of the pipe is 7/8″. The bearing plate is shown in Figure 6.

Seat and Swing Arm:

The seat and swing arm is attached to the "L"-shape mounting base on the bearing plate by a pin welded into a horizontal length of 3" square steel tubing. The pin slips down in the steel pipe welded to the base, providing the pivot for the swing arm. The outer end of the steel tubing is welded to a 7 1/4" x 9 1/2" steel plate, with four holes drilled in the plate to form a mounting bracket for the lift seat. A triangular steel plate is welded between the swing arm and mounting plate to give the lift seat added support. A square steel cap is welded to the other end of the square steel tubing to keep it from buckling.

The seat for the lift is original equipment from a Case 1290 tractor. The seat is attached to the swing arm mounting plate by four bolts. The lift seat provides a comfortable seat. The seat and swing arm assembly are shown in Figures 6, 7 and 8.

A rope and hook fixture is attached to the right side of the seat to keep the seat and swing arm stationary during field operation by attaching the hook to the hand grip bar on the side of the tractor.

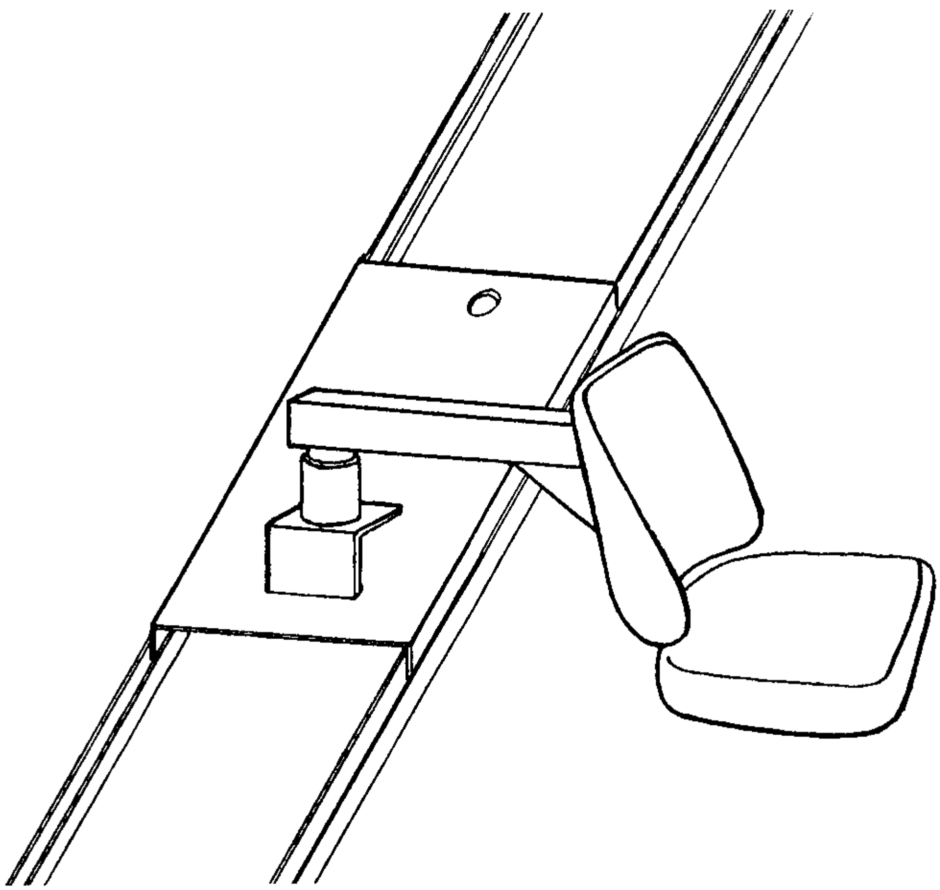

Figure 6. Bearing Plate, and Seat and Swing Arm Assembly

Figure 7. Lift Seat in lowered Position

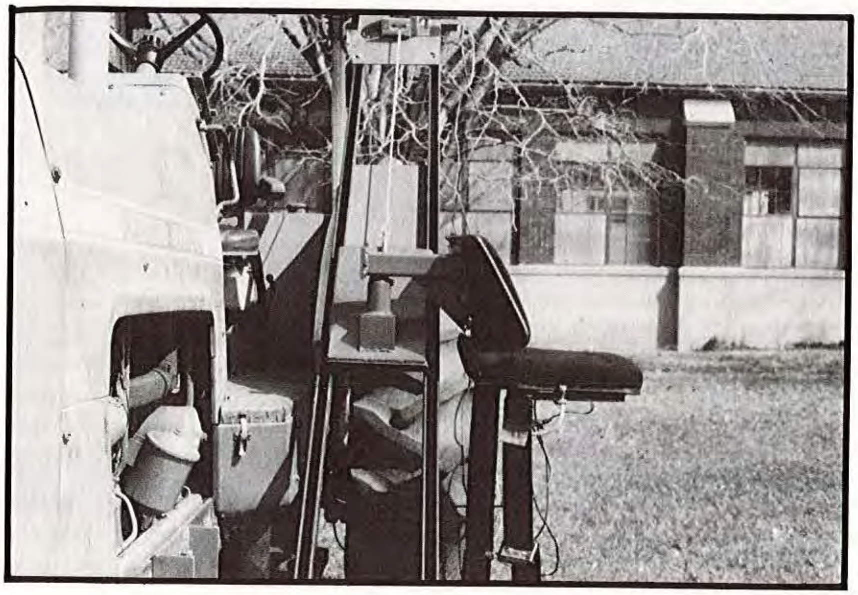

Figure 8. Side view of Swing Arm Assembly

Lift Actuation:

The lift is powered by a 12 volt DC winch. The winch is rated at 2500 lbs. pulling capacity with a speed of five feet per minute. The current draw is 25 amps. The winch is fastened to a rectangular steel plate attached to the Uni-strut track with four bolts which pass through the steel plate and into a spring nut locking device. This device holds the steel plate securely to the track, as shown in Figure 9. The cable hook attaches to a hole drilled through the bearing plate.

Figure 9. Winch Mounting Position

Lift Controls:

The lift is operated by a remote switch mounted on the lift seat. The remote switch has two 10' lengths of wire connecting the winch motor and the switch. Another wire is attached to the positive side of the battery and also contains a protective circuit breaker. A ground wire travels from the switch and attaches to the tractor frame above the tool box on the left side of the tractor. The switch is self-centering to allow the operator to raise and lower the lift as he desires.

This wire and switch assembly is not a fixed location and can be moved by the operator. The wires should be moved inside of the tractor fender before the operator uses the tractor or they may be damaged by the rear tire.

SAFETY CONSIDERATIONS

It is important for safe operation of the lift that the tractor be shut off during lift use.

The chairlift seat contains a seat belt to hold the operator in the seat during lift operation, and prevents falling which could cause serious injury.

Most cable and winch manufacturers warn against the use of their equipment to lift humans. If the cable were to break, the seat and operator would slide down the track because there is no braking device on the lift. The lift would come to an abrupt stop at the bottom of the lift track and could cause serious injury. Also, if the cable were to break, the operator might be injured if struck by the cable.

The lift seat hits the side of the tractor and does not turn around far enough to allow the operator to swing his legs onto the tractor platform and slide over into the tractor seat. In order to gain access to the tractor seat, the operator has to swing his legs over the steering wheel as shown in Figure 10. This could cause the operator to lose his balance and fall.

It is possible for the operator to pinch himself underneath the canopy of the tractor when the lift is being raised. Limit switches could be installed to prevent this problem.

The lift could use a footrest to provide balance and stability for the operator. The lift also should have a switch located on the tractor where the operator could lower the lift from ground level, if left in the raised position.

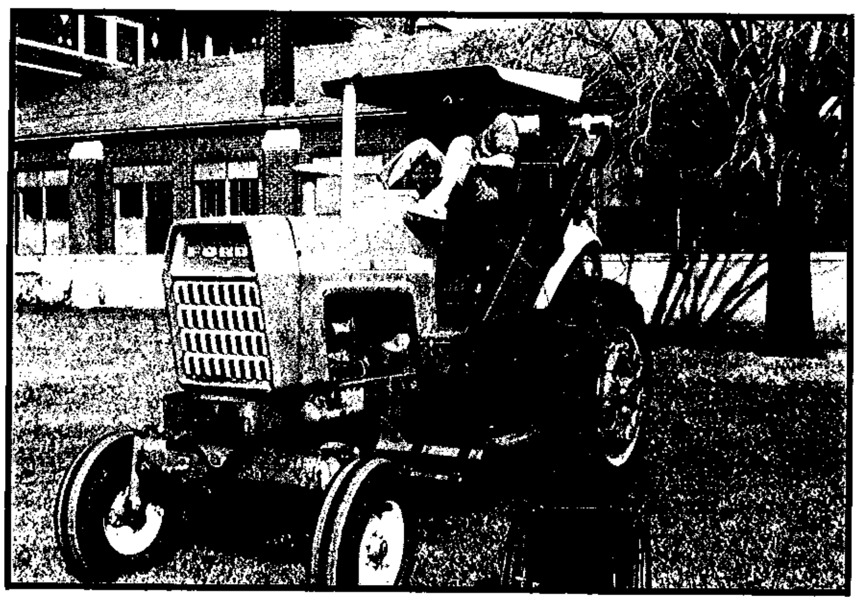

Figure 10. Operator moving from Lift to Tractor Seat

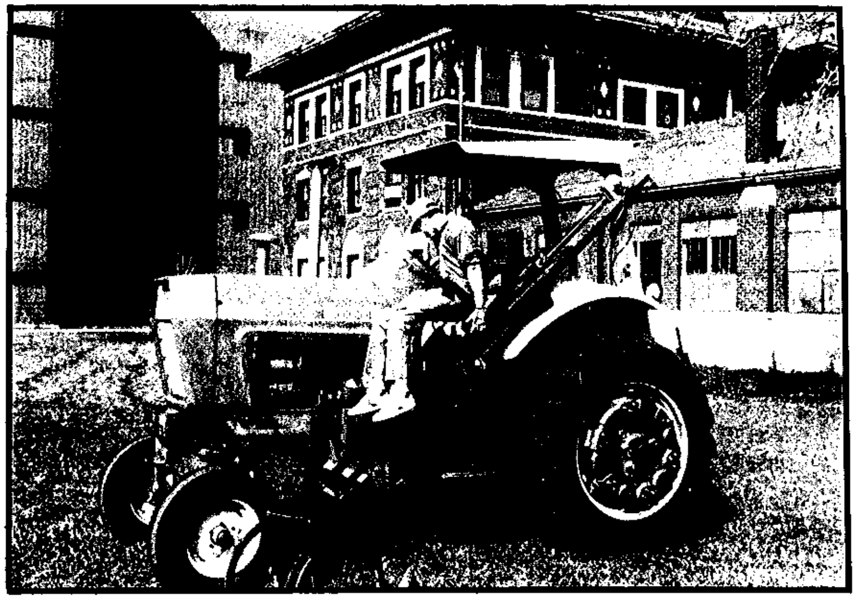

Figure 11. Lift in Operation

DESCRIPTION OF OPERATION

To mount the tractor, the operator positions his wheelchair beside the lowered lift seat. He removes the left arm of the wheelchair and slides over into the lift seat. He fastens the seat belt on the lift seat and raises the lift, using the remote switch mounted on the side of the lift seat. As the operator reaches a point half way up, he stops momentarily and grabs the grip bar or the side of the tractor to swing the lift seat around (Figure 11). He then continues raising the lift until he reaches a position where he feels comfortable transferring to the lift seat.

The operator has to swing his legs over the steering wheel to transfer to the tractor seat (Figure 10). Once in the tractor seat, the operator reaches under the lift seat and operates the switch to lower the lift out of the way. A rope and hook mounted on the side of the lift seat is used to fasten the seat and swing arm assembly to the hand grip bar on the side of the tractor.

To dismount, the operator unhooks the lift seat from the grip bar and raises the lift seat to a transfer position. He must raise his legs over the steering wheel to be in position to transfer to the seat. He lowers the lift until he reaches a point half way down. He releases the switch and pushes on the side of the tractor to position himself to transfer into his wheelchair. He continues lowering himself until he reaches the ground. He unbuckles his seat belt, slides over into his wheelchair, and places the left arm back onto his wheelchair.

ESTIMATED COST*

Description	Est. Cost
Uni-strut Track	$ 63.00
Lower Support	22.00
Upper Support	5.00
Bearing Plate and Swing Arm	55.00
Bearings	10.00
Cable and Winch	150.00
Remote Switch and Wiring	12.00
Seat	321.00
PARTS	$ 638.00

Labor Cost Not Available

*At time of construction, 1983

ED BELL'S CHAIRLIFT

FARMER: **Ed Bell**
S.R. 38 West
Hagerstown, IN 47346

SUMMARY

Function:

Ed Bell's chairlift is designed to be mounted on an agricultural utility tractor. The lift enables Mr. Bell, a paraplegic, to gain access to the operator's station.

The chairlift is shown mounted on a Hesston 666 DT tractor in Figure 1. Control modifications and accessories on Mr. Bell's tractor are reviewed later in this section.

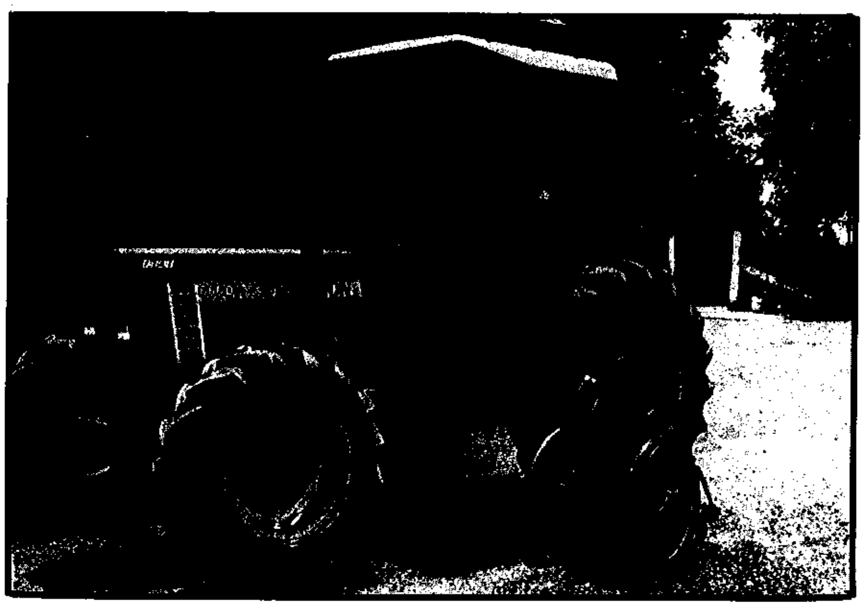

Figure 1. Ed Bell's Chairlift

Farmer:

Ed Bell is a farmer in East-Central Indiana. He farms 72 acres, including 60 acres of tillable ground. Mr. Bell plants all the acreage in vegetables and sells them retail at the farm.

To enable him to be active in the farm operation, a Hesston 660 DT tractor was modified with the addition of a chairlift and control modifications. Mr. Bell also has a small 18 horsepower Allis-Chalmers tractor with modifications made to the controls. In 1986, Mr. Bell was selected as the Outstanding Handicapped Person of the Year for the state of Indiana.

Modified Machine:

Tractor: Hesston 660 DT

Features: ROPS 4-pt Canopy

Year: 1983
PTO HP: 62

Accessible from both sides of tractor
Front-Wheel Assist

Adaptability:

This lift was designed to be mounted specifically on the Hesston 666 DT tractor. With modifications in the design, the lift could possibly be mounted on another tractor of similar size and design.

Compatibility:

1. The lift does not interfere with an able-bodied individual's mounting of this tractor, because the tractor is accessible on both sides.
2. The chairlift seat folds up against the fender to allow for accessibility by other operators, operation of the clutch, and to reduce mud build-up on lift platform seat.
3. The tractor fender was cut back on the operator's left side to allow for lift operation. This could lower the tractor's resale value.

Service and Maintenance:

1. The cable should be checked regularly for damage, corrosion or wear, and be replaced if necessary.
2. The chairlift platform should be cleaned periodically due to the closeness of the platform to the rear tire, which results in mud and dirt accumulation.

Accessibility and Ease of Use:

1. The lift is accessible from a wheelchair, ATV, or by a farmer who uses leg braces and/or crutches.
2. The cable and winch are noisy during operation.

Safety Concern:

Most cable and winch manufacturers warn against the use of their products for lifting human beings. This is a major concern of the evaluators. If, however, a farmer proceeds with a winch-type lift, it is strongly recommended that a high quality unit be selected that is self-locking when not activated. Experience has also shown that the electric switches included with some winches to not withstand frequent use. Heavy duty switches or relay solenoids which allow for lower current flows are recommended.

CONSTRUCTION DESCRIPTION

The construction of Ed Bell's chairlift is discussed in the following subsections: Transfer Platform, Lift Arm and Seat, Lift Actuation, and Lift Controls.

Transfer Platform:

A rectangular piece of plywood fastened to an angle iron frame and mounted horizontally on the left side of the tractor serves as a transfer platform. The operator uses

Figure 2. Pivot Assembly and Lift Arm

the platform to transfer from the wheelchair to the lift seat (Figure 1).

Lift Arm and Seat:

Mr. Bell's lift consists of a platform that is attached to a pivot arm that is raised and lowered by a winch. Bolted to the inside of the left fender is a 3" x 6" flat steel bar with a short pin welded onto it. The pin extends inward perpendicular to the fender and acts as the pivot point for the lift arm (Figure 2).

The lift arm consists of a length of steel pipe with a short piece of steel pipe welded perpendicular at one end. This short piece of pipe slips over the pivot pin on the fender (Figure 3).

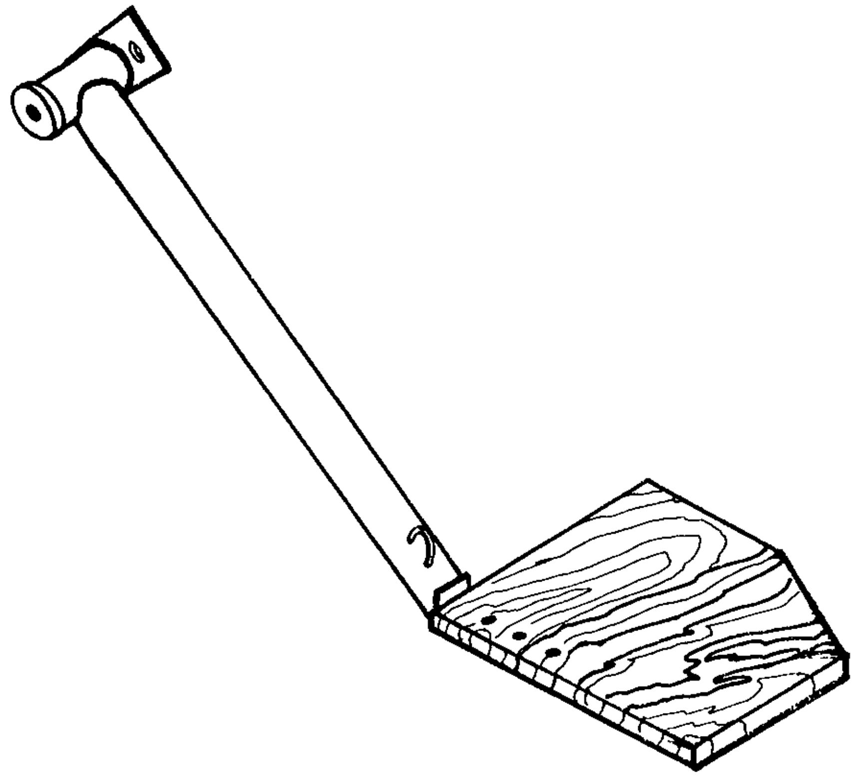

Figure 3. Drawing of Lift Arm and Seat

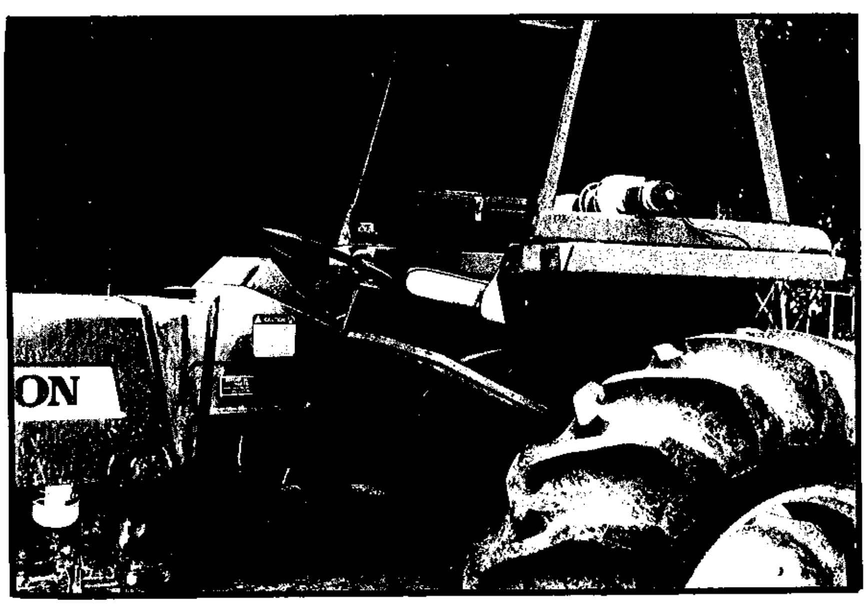

Figure 4. Lift Seat in raised Position

At the other end of the lift arm, a seat constructed of steel rods is welded to the lift arm and covered with plywood. The shape of the seat was designed so that it would clear the fender and not injure the operator (Figure 3). The seat is hinged and can be folded up against the fender when not in use. Figure 4 shows the lift seat in the raised position.

Lift Actuation:

The lift is powered by a 12 volt DC electric cable and winch. The winch is bolted to a steel plate welded to the angle iron frame on the tractor fender located between the posts of the roll-over protective structure (Figure 5).

The cable extends from the winch to the lower end of the lift arm, where it travels around a pulley attached to the lift arm by a hook. The cable then travels up vertically and attaches to the winch mounting with a hook (Figure 5).

Figure 5. Cable and Winch with Pulley Arrangement

Lift Controls:

A rotary switching device is mounted on the end of the winch facing out from the tractor (Figure 3).

To operate the control, Mr. Bell sits on the plywood lift seat, reaches behind him with one hand and operates the switch (Figure 6). The switch is self-centering, thus when the switch is released, the lift stops.

Figure 6. Ed Bell operating Lift

SAFETY CONSIDERATIONS

For safety, the tractor engine should be turned off during lift operation. This is important if the operator loses his balance or some other problem occurs. This lift does not require the engine to be running during operation.

Most cable and winch manufacturers warn against using their equipment for lifting human beings. If the cable were to break, the operator would fall rapidly, which could result in serious injury. This is due to the absence of a braking device on the lift. The operator might also be injured if struck by the cable.

There is danger of the operator's clothing becoming entangled in the cable as he reaches over it to operate the winch. A switch located near the lift platform would reduce this hazard and allow easier operation of the lift.

DESCRIPTION OF OPERATION

To mount the tractor, Mr. Bell positions his wheelchair facing the transfer platform. The wheelchair's left arm is removed and he slides onto the transfer platform (Figure 7). He then positions his legs on the transfer platform so they face the front of the tractor and proceeds to slide onto the lift platform seat. Mr. Bell holds onto the tractor's hand control clutch lever with one hand for support while he reaches behind him with the other to operate the winch (Figure 6). As the lift seat raises it tilts to the rear but does not cause a transfer or balance problem. This also helps hold him onto the seat (Figure 4). Once the lift seat is raised, he releases the switch and slides backwards onto the tractor seat (Figure 8). Mr. Bell has to pick up his right leg and raise it over the steering wheel to get properly seated on the tractor. Mr. Bell uses two seat belts to securely fasten himself into the tractor seat (Figure 1). One seat belt holds him down to the seat while the other seat belt holds him against the seat's backrest.

To dismount the tractor, Mr. Bell positions the lift platform seat at the proper

Figure 7. Moving onto Transfer Platform

Figure 8. Moving from Lift to Tractor Seat

Figure 9. Hand Brake Levers

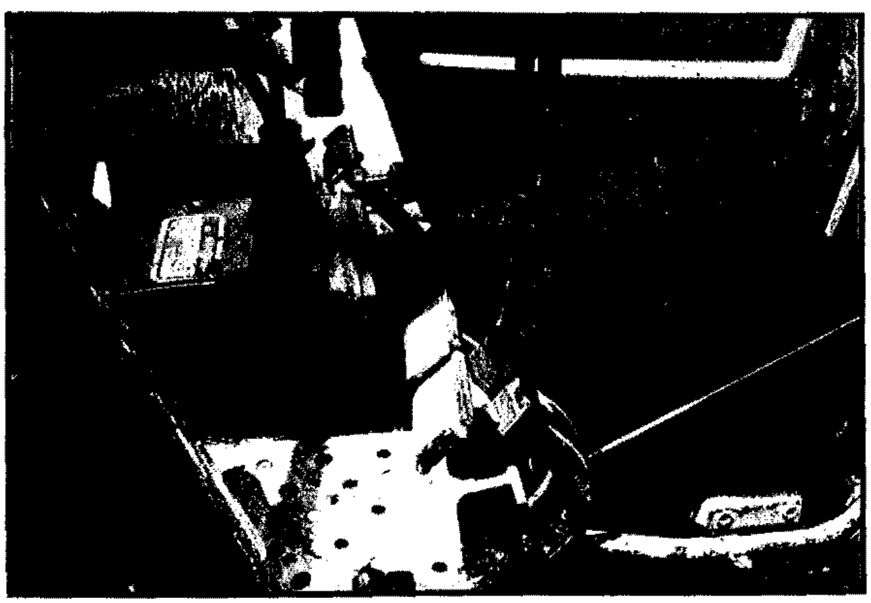

Figure 10. Levers attached to Brake Pedal Shank

transfer height. He unfastens his seat belts and raises his right leg over the steering wheel and slides onto the lift seat. He operates the winch to lower the lift platform, and then slides onto the transfer platform. There he reaches out for his wheelchair to position it next to the tractor. He then slides from the transfer platform onto the wheelchair seat.

CONTROL MODIFICATIONS

Brake:

Separate hand levers were designed for the two brake pedals. Each hand lever is constructed of a steel rod and welded to a "U"-shaped steel block, allowing the block to slip over and clamp to the brake pedal shank (Figure 9). A hole is drilled through the open end of this "U"-shaped clamp and a bolt placed through it underneath the brake pedal (Figure 10). This type of mounting securely fastens the levers to each brake pedal shank and allows for easy removal of the levers when desired.

The design of the brake hand lever controls will not interfere with normal brake pedal usage, by an able-bodied operator.

Clutch:

The hand lever for the clutch is constructed from a length of steel rod mounted on a pivot in front of the clutch pedal. It extends underneath the foot platform, where it attaches to the linkage mechanism of the clutch (Figure 11).

The design of the clutch hand lever control will not interfere with normal clutch pedal usage by an able-bodied operator.

Figure 11. Hand Control Clutch Lever

ESTIMATED COST*

Cable and Winch $130.00

Other material costs not available

*At time of construction, 1983

BOB SHENDEL'S CHAIRLIFT

FARMER: **Bob Shendel**
R.R. #1
Wilton, WI 54670

DESIGNED BY: **Berry Blomquist**
Midcity Steel Fabricating
LaCrosse, WI 54601

SUMMARY

Function:

Bob Shendel's chairlift is designed to fit specifically on an International 186 Hydro tractor (Figure 1). The chairlift is designed to enable Mr. Shendel, a paraplegic, to gain access to the operator's station.

The tractor also contains control modifications and accessories which are reviewed in this section.

Figure 1. Bob Shendel's Chairlift

Farmer:

Bob Shendel is a Wisconsin dairy farmer operating 320 acres with 90 head of dairy cows.

To enable Mr. Shendel to remain active in the farm operation, an International 186 Hydro tractor was purchased, and a lift was designed and mounted on the tractor by Berry Blomquist of Midcity Steel Fabricating, LaCrosse, Wisconsin. Controls were mounted on the brakes to allow him to operate the brakes by hand. He also has hand controls mounted on John Deere 2020 and 2640 tractors, which he uses for utility work. Neither of these tractors are equipped with man-lifts.

Mr. Shendel milks his dairy cows in a double 5 herringbone arrangement, with the parlor and milk room at ground level for easy access. Both are wheelchair accessible. He also has a hired hand to help with many of the farm tasks.

Modified Machine:

Tractor: International 186 Hydro

Features: ROPS Cab

Rear Tire Size:	18.4-38
Front Tire Size:	11L-15
PTO HP:	105
Year:	1981

Doors on both sides of cab
Hydrostatic Transmission

Adaptability:

Bob Shendel's chairlift was designed specifically for the IH 186 tractor. Adapting the lift to other tractors of similar size and design would require changes in the mounting of the lift and the tractor door configuration.

Compatibility:

1. The lift does not interfere with access of the tractor by other operators, since there is a door on each side of the tractor cab. This design could cause a problem for a farmer who has a one-door tractor, because he would have to utilize the lift to gain access to the tractor.
2. There were several alterations made to the original equipment that might make resale of the tractor difficult. The door on the lift side was removed from its hinges and rehinged at the top of the cab so it would swing up. Also, a steel box was welded on the fender inside the cab to provide a surface over which Mr. Shendel could transfer from the lift seat to the cab.

Accessibility and Ease of Use:

1. The lift is easily accessible from a wheelchair, ATV, or by a farmer who uses leg braces and/or crutches.
2. The lift is designed for ease of transfer and operation.
3. The lift is quiet during operation.

Service and Maintenance:

1. Grease fittings to grease moving parts are accessible.
2. The switches in the switch box on the lift have required periodic replacement because they have not withstood the weather and have malfunctioned.
3. The hydraulic circuit should be checked periodically for leaks.

CONSTRUCTION DESCRIPTION

The construction of Bob Shendel's chair-lift is described in the following subsections: Stationary Frame, Moving Frame, Lift Seat, Lift Actuation and Lift Controls.

Stationary Frame:

Bolted to the tractor frame is a stationary steel plate which supports a pivot assembly.

Moving Frame:

The pivot assembly is attached to a square plate which attaches to the moving frame. A pair of angle irons are mounted vertically, side-by-side, with a space between them. This space allows for placement of a double-acting hydraulic cylinder that raises and lowers the lift. The hydraulic cylinder is mounted between the angle irons by a pin passing through holes drilled in them. A steel brace is welded to the top of the angle irons to provide bracing. Another steel plate is welded to the lower end of the angle irons and attaches to the pivot assembly so the complete assembly can rotate (Figure 2).

Welded vertically on each side of the angle iron assembly are two flat steel bars. A space between them forms mounting points for the parallelogram linkage arrangement (described below). Holes are drilled through each end of the steel plates for the pins that attach the linkage arms (Figure 2).

The parallelogram linkage consists of four arms constructed of square steel tubing. Welded to each arm is a small length of steel bar stock, which slides inbetween the vertical flat steel bars on the side of the angle iron assembly (Figure 3). Holes are drilled through each of these vertical plates, and pins pass through them to form pivot points for the lift arms (Figure 3).

Lengths of square steel tubing are welded between the two upper linkage arms at the midpoint and at the lower end to increase the rigidity of the frame. On the lower linkage arms, lengths of square steel tubing are welded on the upper and lower ends of the arms. Welded between these lengths of steel tubing and inside the confines of the linkage arms are two lengths of flat steel bar stock. A space between these forms a mounting point for the vertical double-acting hydraulic cylinder.

Figure 2. Vertical Angle Iron Assembly and Linkage Arms

Mounted on the outer ends of the linkage arms is a rectangular framework made of square steel tubing. Another length of square steel tubing is welded vertically in the middle of this frame to increase the strength of the assembly. Gusset plates are welded in the four corners to reinforce the frame. Small steel plates are welded on the top and the bottom of the frame facing the tractor. These plates provide attachment points for the linkage arms, the ends of which have small lengths of flat steel bar stock welded to them. Holes are drilled through these plates and a pin is placed through them so the linkage arm assembly can pivot and keep the rectangular frame vertical (Figure 2).

The lower member of the rectangular frame described above extends out horizontally then bends upward at an angle to form a structural support for the lift seat (Figure 2).

A second double-acting hydraulic cylinder is attached to the front of the tractor and extends out horizontally where it attaches to the angle iron assembly (Figure 1). This cylinder causes the entire assembly to pivot toward the front or back.

Lift Seat:

The lift uses a tractor seat mounted on a steel plate welded to the square steel tubing seat support (Figure 2). An armrest is mounted on the left side of the lift seat. A piece of sheet metal is attached underneath the lift seat support member, providing a "fender" to keep mud from being thrown on the lift. A square section of steel plating is

Figure 3. Linkage Arms and Angle Iron Assembly

attached to the lower member in front of the lift seat to provide a footrest for the lift.

A hand rail is formed from round steel tubing and is welded to the rectangular linkage arms in front of the lift seat. The switch control box is mounted on the top of this handrail (Figures 2 and 3).

Lift Actuation:

The lift is powered by its own electric hydraulic system, powered by a battery-operated starter motor. The vertical two-way cylinder lifts the seat to the height of the tractor seat. The horizontal hydraulic cylinder moves the chair horizontally over to the cab door.

Lift Controls:

The switch box, located on the handrail in front of the lift seat, contains two push button switches: one to raise the lift and another to lower the lift. A second switch box is located inside the tractor cab, so the operator can move the lift out of the way and close the door, and then position the lift against the cab door during tractor use.

Limit switches are mounted on the lift to limit the travel of the linkage assembly. Electric solenoid valves control the hydraulic system and thus the direction of the chairlift.

SAFETY CONSIDERATIONS

As a safety precaution, the tractor should be shut off during lift operation. This eliminates the danger of the operator being run over or thrown from the tractor while mounting or dismounting. The separate electric hydraulic system provided by this lift offers the safety feature of having the tractor shut off during lift operation.

The lift will move only as long as the operator's finger is on the control button.

The footrest and armrest on the lift adds stability for the operator and security during lift operation.

DESCRIPTION OF OPERATION

To mount the tractor, Mr. Shendel positions his wheelchair beside the lowered lift seat (Figure 4). The right arm of the wheelchair is removed, he swings the armrest on the lift seat back, slides over onto the lift seat and repositions the armrest on the lift seat. He unlatches the cab door and pushes the door up slightly as air cylinders raise the door out of the way. He then pushes the switch to raise the lift. The lift raises vertically until it reaches the height of the tractor seat. The horizontal hydraulic cylinder automatically pushes the lift assembly against the tractor cab so Mr. Shendel can transfer (Figure 5). He releases the switch and slides over into the tractor seat, aided by the steel box (with a smooth surface) mounted on the fender inside the tractor cab (Figure 6). He then uses the switch mounted inside the cab to move the lift out of the way so he can close the door (Figure 6). The lift moves horizontally to a predetermined position before it will travel vertically. He then raises the lift up against the tractor cab, and is ready for field work (Figure 7).

To dismount the tractor, Mr. Shendel lowers the lift and opens the cab door. He raises the lift until it reaches the cab and transfers over into the lift seat, across the steel box (Figure 6). He pushes the switch that lowers the lift. The lift first moves horizontally away from the tractor cab, and then down vertically until he reaches the ground, where his wheelchair is within reach. On the way down to the ground, Mr. Shendel grabs a leather strap attached to the cab door and pulls on it to lower the door so he can close it.

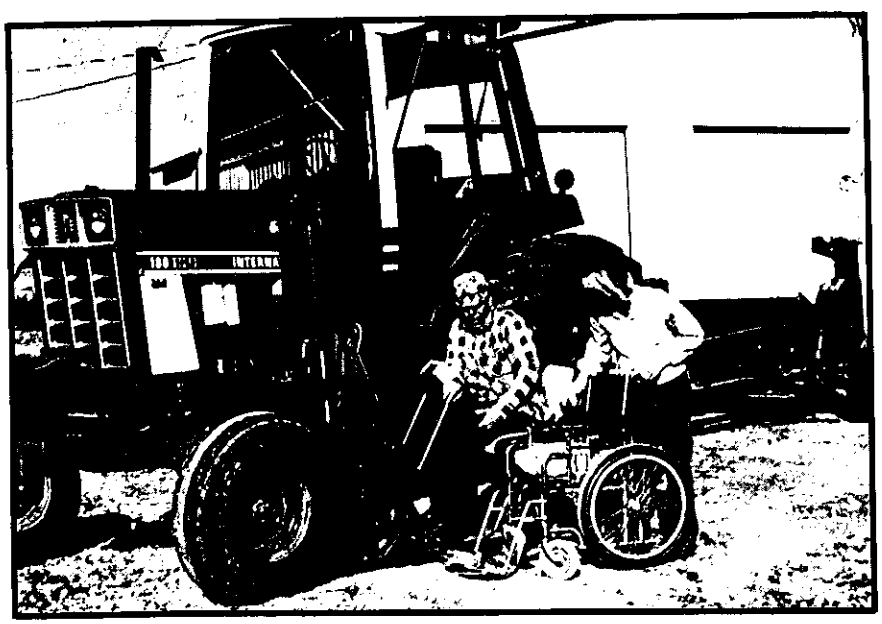

Figure 4. Mr. Shendel transferring to Lift

Figure 5. *Mr. Shendel transferring from Lift to Tractor*

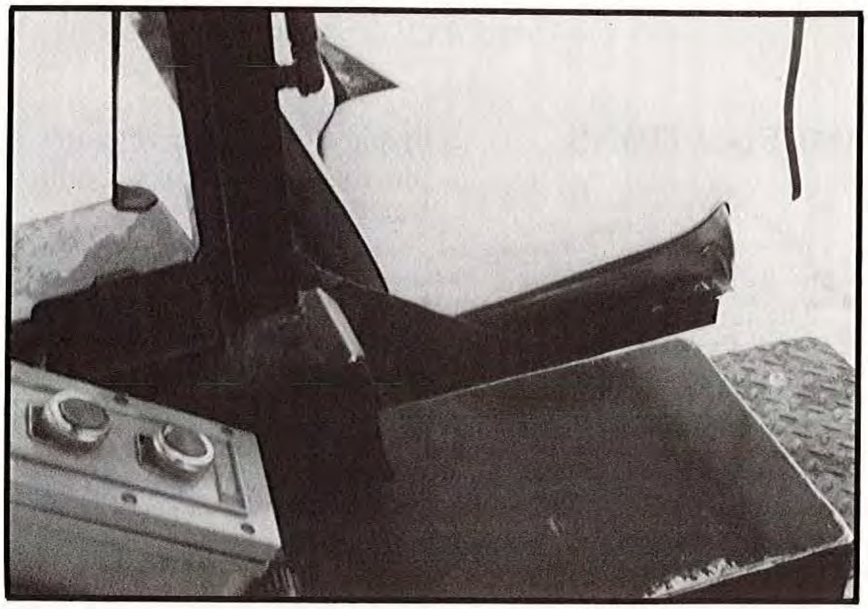

Figure 6. *Steel Glide Box and Lift Controls*

Figure 7. Lift Placement for Tractor Usage

CONTROL MODIFICATIONS

Brake:

Separate hand levers were designed for the two brake pedals. The hand levers were constructed of round steel bars shaped to the contour of the tractor control console. Each lever is welded to a short length of pipe such that it can pivot around a horizontal steel bar (Figures 8 and 9). The horizontal steel bar is supported on each end by a steel plate attached to the floor of the cab. This frame straddles both pedals.

Welded to each of the separate lengths of pipe is a short steel plate, mounted at approximately a 45 degree angle to the hand levers. Each of these short steel plates is straddled by a pair of steel plates attached by pins. Each pair of plates is attached by a pin to a metal bracket bolted to one of the tractor's brake pedals.

This type of mounting forces an able-bodied operator to use the hand brake levers when operating the brakes. To engage the brakes, Mr. Shendel pulls back on the desired hand lever.

OTHER MODIFICATIONS

Door:

The left door of the cab was removed from the hinges and remounted with hinges on the top of the door. This allows the door to swing up and out of the way of the lift. Small gas-pressurized telescoping cylinders were mounted to the door and the cab (Figure 10). A leather strap was attached to the door so Bob could pull down on it to close the door, as well as use a handle mounted to the door close to the cab (Figure 11). Mr. Shendel indicates that the door is very hard to open and close.

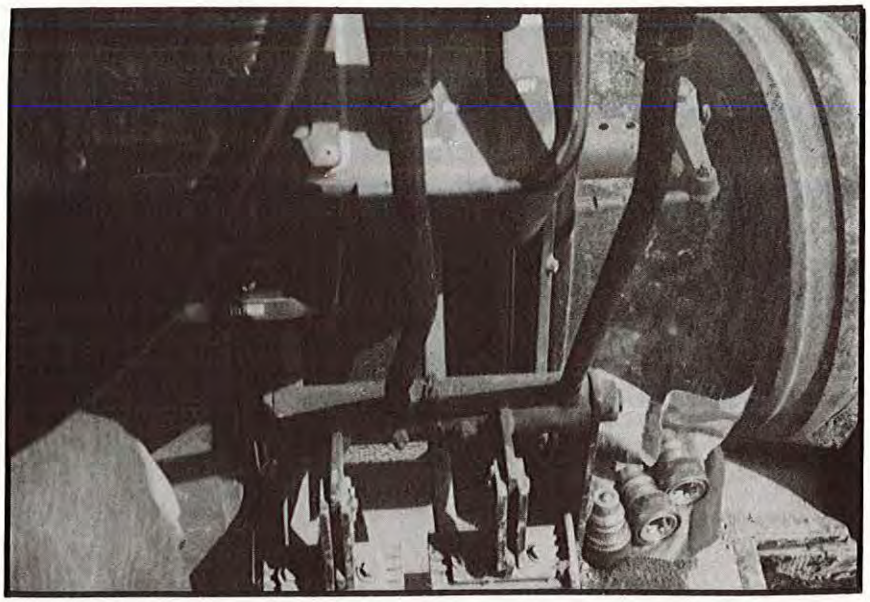

Figure 8. Mounting of Brake Levers

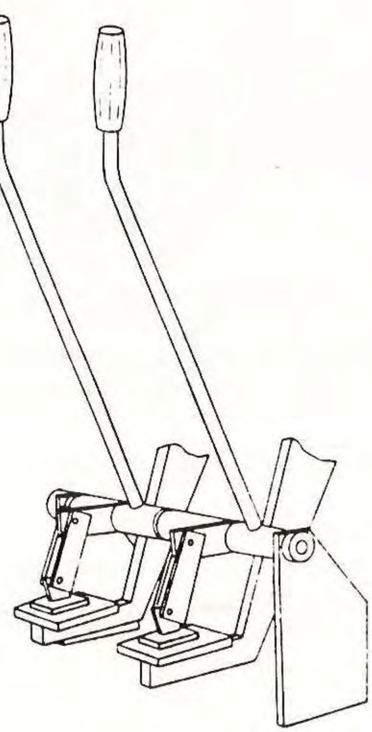

Figure 9. Drawing of Brake Levers

Figure 10. Modified Cab Door

Figure 11. Handle for Closing Door

ESTIMATED COST*

Estimated Price of Modifications $ 6,900.00

*At time of construction, 1981

DALE BRONK'S PORTABLE CHAIRLIFT

FARMER: **Dale Bronk**
R.R. #2
Plainfield, IL 60544

DESIGNED BY: **Emmpco**
East Moline, IL

MODIFIED BY: **R.J. Mobility**
715 South Fifth Street
Maywood, IL 60513

SUMMARY

Function:

Dale Bronk uses a commercially available Emmpco standing boom lift which was modified into a chairlift. The lift is similar to units operated by power companies. The lift was modified for Mr. Bronk, a quadriplegic, to enable him to gain access to two four-wheel drive tractors.

The modified lift is shown in Figure 1. Control modifications and accessories on the tractors Mr. Bronk operates are also reviewed in a later section.

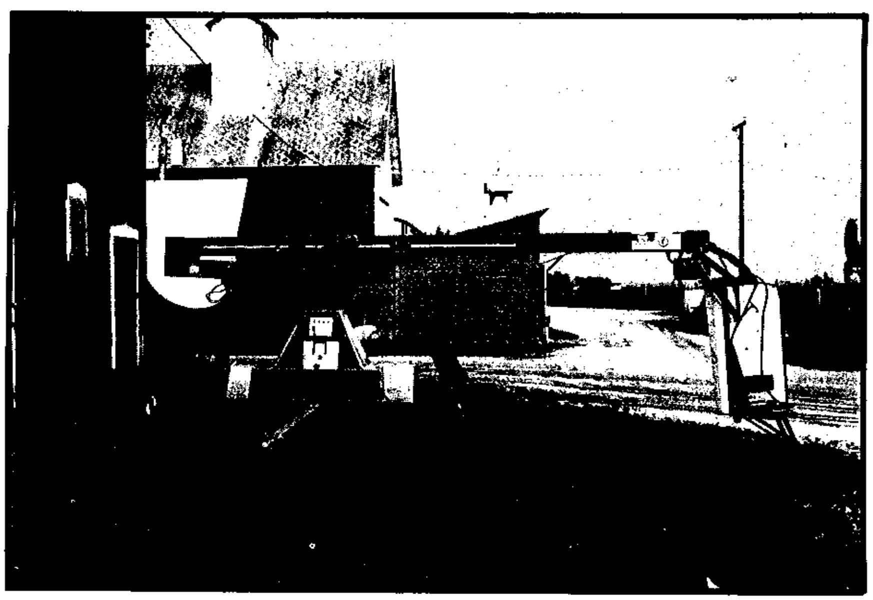

Figure 1. Dale Bronk's Portable Chairlift

Farmer:

Dale Bronk was injured in an accident at a young age. He wished to remain active in a 1000 acre grain farm operated by his father, Allyn.

To enable Mr. Bronk to have access to the four-wheel drive White 4-210 tractor that the Bronk's use on their farm, a Champ Uni-lift, manufactured by the Emmpco Company of East Moline, Illinois, was purchased. The lift bucket was modified by R.J. Mobility of Chicago, Illinois to transform the standing bucket into a chairlift. Control modifications and accessories were also placed on the White 4-210 tractor.

A White 4-270 tractor was later equipped with control modifications and accessories by Dale's brother, Dan. The newer tractor is easier for Mr. Bronk to operate, because the tractor is manufactured with a hydraulic clutch.

Modified Machine:

Emmpco Champ Uni-Lift Model 534

Features:	Portable lift with tow hitch Four outriggers on the corners Contains self-propelled power unit 12 volt DC battery operation Cherry picker bucket	
Dimensions:	Normal Working Height	32 feet
	Reach From Center of Trailer	21 feet
	Stowed Travel height	78 inches
	Stowed Travel Width	68 inches
Hydraulics:	Hydraulic System Pressure	2500 psi
	Normal Operating Pressure	500 psi
	Maximum Operating Pressure	1250 psi

Adaptability:

This lift can serve many purposes. The lift can transfer a farmer to a self-propelled machine, aid in machinery servicing, maintenance work on buildings and many other possibilities.

Compatibility:

1. The lift can be used by farmers with physical handicaps and able-bodied individuals for a variety of farm chores.
2. The lift can be towed by the trailer hitch to various locations for different uses.
3. The lift can be operated by a remote control switch which the operator holds while sitting in the bucket, or by a switch mounted on the trailer.

4. The lift can be utilized with a variety of self-propelled agricultural machines.

Service and Maintenance:

1. Electrical wiring and switches should be kept in good repair to prevent failure.
2. The hydraulic lines and components should be checked periodically for leaks.

Accessibility and Ease of Use:

1. The lift is accessible from a wheelchair, ATV, by a farmer who has limited use of his legs and is able to stand up; or by a farmer who uses leg braces and/or crutches.
2. The lift is simple to operate after receiving proper instruction for lift use.
3. Operation of the lift requires two people. The handicapped operator controls the lift from the lift seat and transfers to the tractor cab. A second operator then activates the controls on the trailer unit to move the lift away from the tractor.
4. The lift is quiet during operation.

CONSTRUCTION DESCRIPTION

The construction of Dale Bronk's Portable Chairlift is described in the following subsections: Boom, Trailer, Lift Seat, Lift Actuation, Lift Controls.

Boom:

A rotating round column extends from the top of the trailer base unit. A short horizontal support arm extends out from the column to a point several feet beyond the width of the trailer. A triangular gusset is welded between the column and the horizontal support arm. Square steel plates extend up vertically from the support arm to form a "U"-shape structure around the arm; the open side faces the trailer.

The lift boom mounts on a pin passing through the steel plates on the support arm, so the lift boom can raise, lower and pivot on the pin (Figure 2).

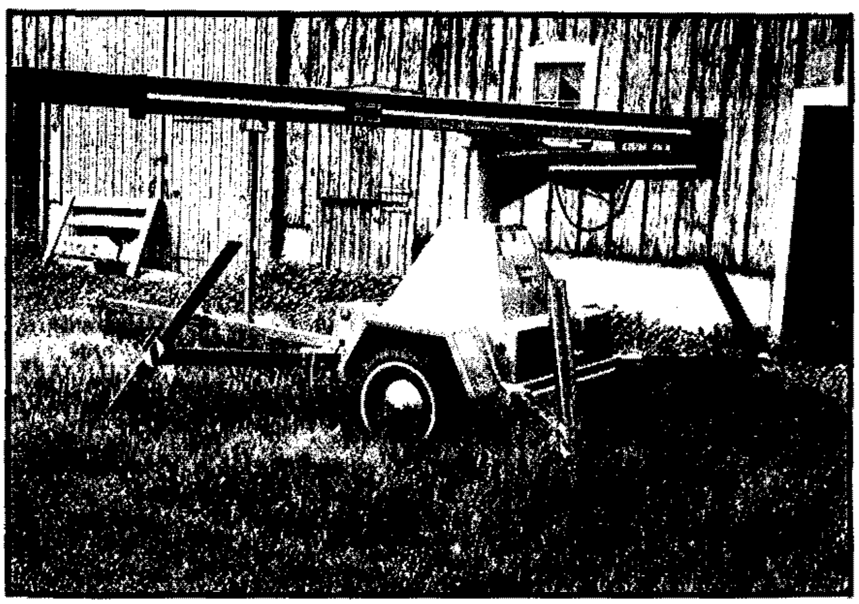

Figure 2. Outriggers to stabilize Lift

The lift boom consists of a horizontal square tube with a smaller tube that slips inside the outer tube to form telescoping tubes (Figure 1). A modified bucket is mounted on the end of the telescoping tube to form a chairlift.

Trailer:

The lift boom is mounted on a mobile trailer operated in the stationary mode. When the lift is positioned for use, four adjustable manual outriggers, one at each corner of the trailer, are lowered to provide stability during lift operation (Figure 2).

A vertical steel tube extends up from midpoint of the trailer hitch with a "U"-shaped bracket mounted on the end to form a rest for the boom when the lift is in tow (Figure 3).

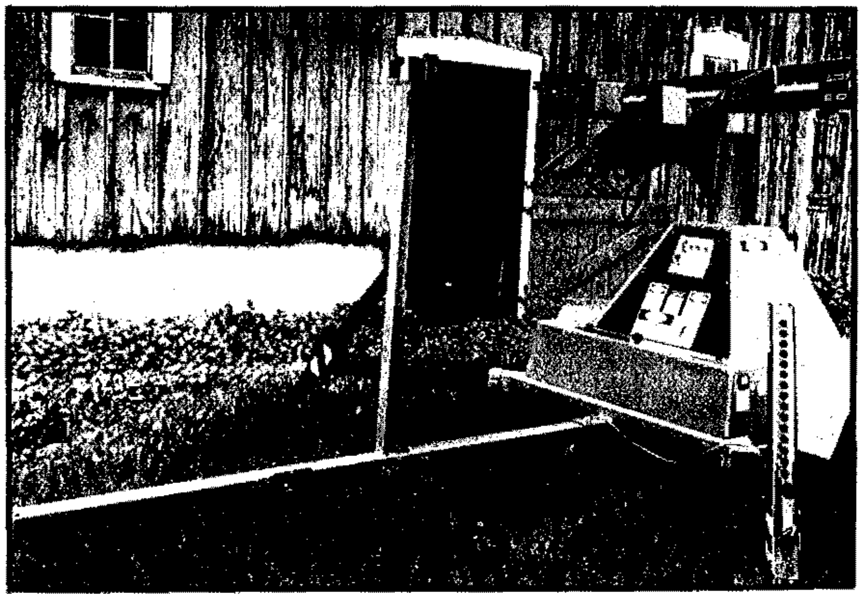

Figure 3. Boom Rest Bracket

Lift Seat:

The original bucket of the boom lift is designed to accommodate a standing operator. The bucket is modified to form a chair for Mr. Bronk to sit in while being lifted.

The front of the bucket and a section of the bucket's right side has been removed. A seat is mounted in the bottom of the bucket with an armrest mounted on the bucket's left side. A seat belt is provided in the bucket to securely fasten Mr. Bronk into the lift seat (Figure 4).

A footrest is mounted underneath the bucket to help provide stability and leg support while using the lift. Square steel tubing extends down at an angle from each side of the bucket to form the mounting bracket for the footrest. Two steel rods, one on each side, are welded to the bracket and attach to the rear of the lift bucket seat, bracing the bracket. A steel plate with raised edges is welded to the steel tubing to form a small foot platform for Mr. Bronk. Rectangular steel bars welded underneath the front of the platform help support the front edge of the footrest when the bucket is lowered to the ground for operator transfer (Figure 4).

The bucket is attached to the end of the telescoping tube. Square steel tubing and rectangular flat steel bars extend down at an angle from each side of the telescoping tube and fasten to each side of the bucket (Figure 4). Stabilizing cylinders are mounted on the bucket to keep the seat level.

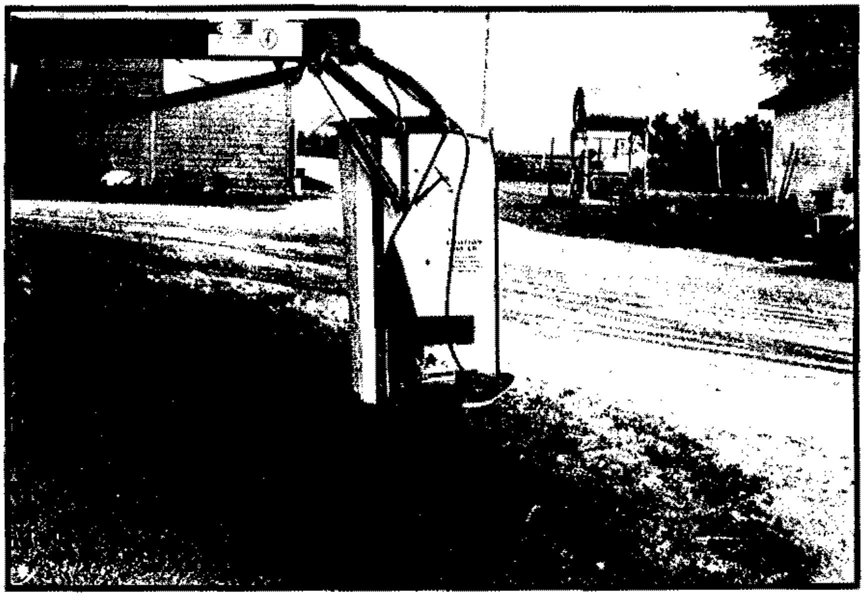

Figure 4. Lift Bucket modified to form a Chairlift

Lift Actuation:

The lift is powered by a 12 volt DC electrically operated hydraulic system. The hydraulic system has a maximum rated pressure of 2500 psi while the normal operating pressure is 500 psi.

A hydraulic cylinder is mounted at an angle between the horizontal support arm and the lift boom with the pump and reservoir mounted to the side of the cylinder in a protective bracket. The cylinder functions in lifting the boom up and down. A second hydraulic cylinder is mounted inside the lift boom to move the telescoping tube in and out (Figures 2 and 5).

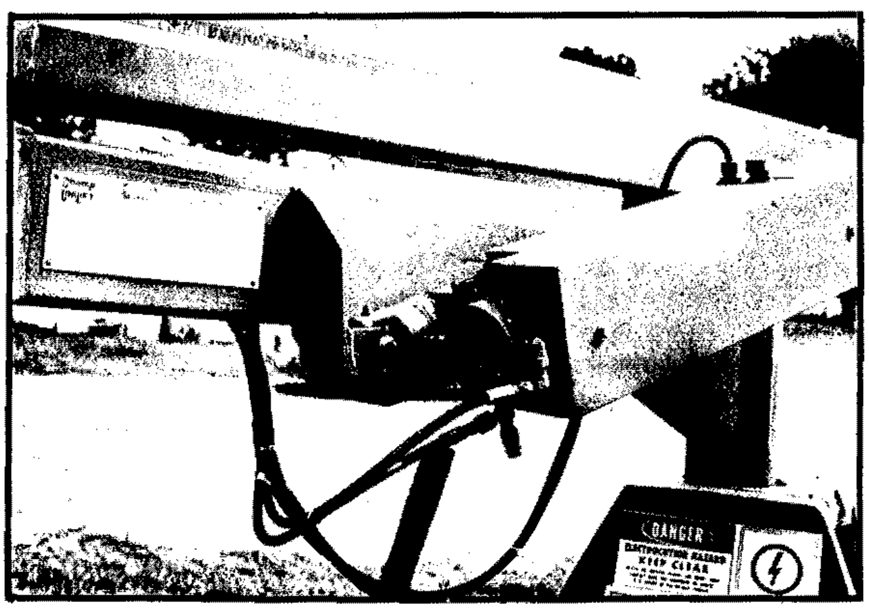

Figure 5. Hydraulic Cylinder and Pump

Lift Controls:

Two control units are provided for lift operation. A hand-held remote control switch box is used by the operator in the lift seat to operate the lift: up and down; in and out; clockwise and counterclockwise; and on and off (Figure 6). The second set of switch controls is mounted on the side of the trailer in a control panel with the same functions as the remote switch (Figure 7).

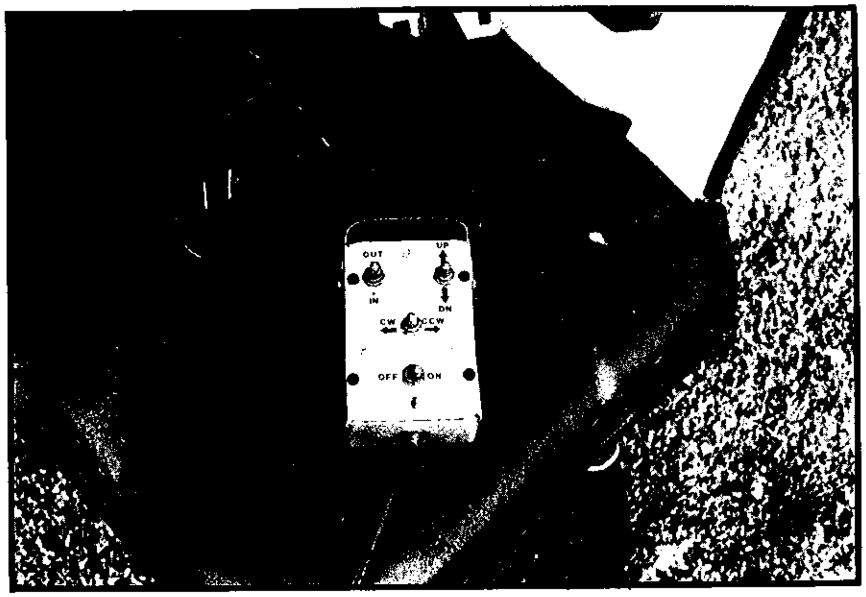

Figure 6. Remote Control Switch Box

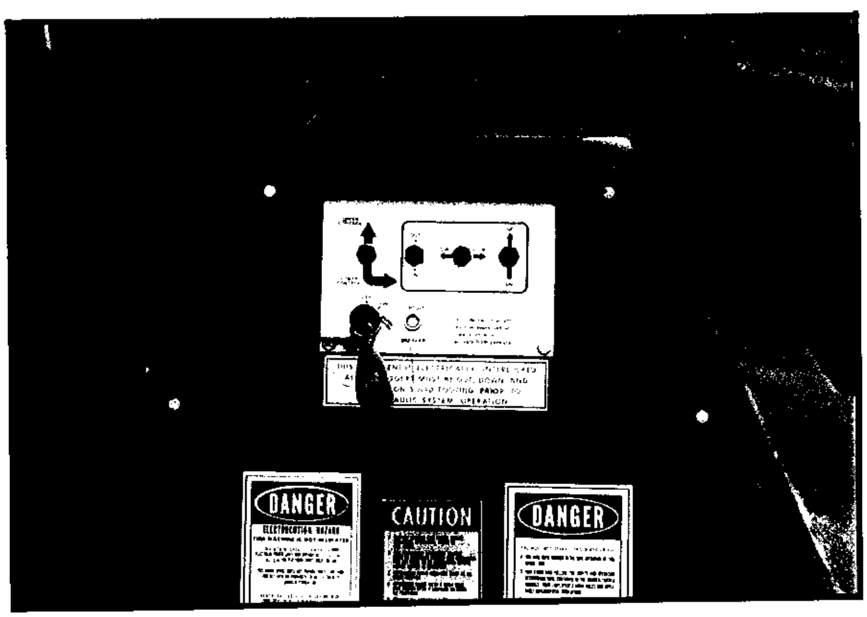

Figure 7. Switch Control Panel on Trailer

After Mr. Bronk has transferred onto the tractor, a second person uses the controls on the trailer to move the boom away from the tractor. The lift seat must be moved back to the tractor cab by a second operator when Mr. Bronk wishes to exit the cab.

SAFETY CONSIDERATIONS

As a safety precaution, the operator should operate the lift only when the engine of the tractor is turned off. The lift should be operated only by properly trained individuals.

Due to the lift cability, the lift should never be operated near overhead power lines. Contact with power lines could result in death. Other overhead structures such as low ceilings, could also pose serious problems.

The outriggers provide stability during lift operation to assure operator safety. The outriggers should be placed on solid footing before the lift is operated.

The chairlift is equipped with a seat belt to help hold the operator in the lift seat, thus guarding against falls. The footrest mounted underneath the lift bucket helps provide leg support and stability for the operator. It also helps keep the operator from slipping out of the lift seat.

DESCRIPTION OF OPERATION

An able-bodied operator must drive the tractor up next to the chairlift.

To mount the tractor, Mr. Bronk or a second individual moves the trailer to the tractor. The lift boom is then positioned for transfer from his wheelchair to the lift seat (Figure 1).

Mr. Bronk transfers from his wheelchair to the lift seat. Once he moves into the lift seat, he places his feet on the footrest mounted on the bucket. He then secures himself in the bucket with the seatbelt provided. Mr. Bronk uses the hand-held remote switch to move the lift bucket to the tractor cab (Figure 8). He moves the bucket inside the cab and transfers to the tractor seat (Figure 9). (*Note: The cab door stop was removed so the door would open farther). A second operator now uses the switches on the trailer control panel to move the lift boom and bucket away from the tractor.

Figure 8. Operator using Lift to access Tractor Cab

Figure 9. Operator transferring from Lift to Tractor Seat

To dismount, Mr. Bronk drives the tractor up near the lift. A second operator moves the bucket up to the cab. Mr. Bronk moves the electric operated tractor seat back to allow him more room for transferring (described in the "Accessories" section). He transfers from the tractor seat to the lift seat and securely fastens himself with the seat belt (Figure 10). Mr. Bronk then uses the hand-held remote switch to lower the lift to the ground.

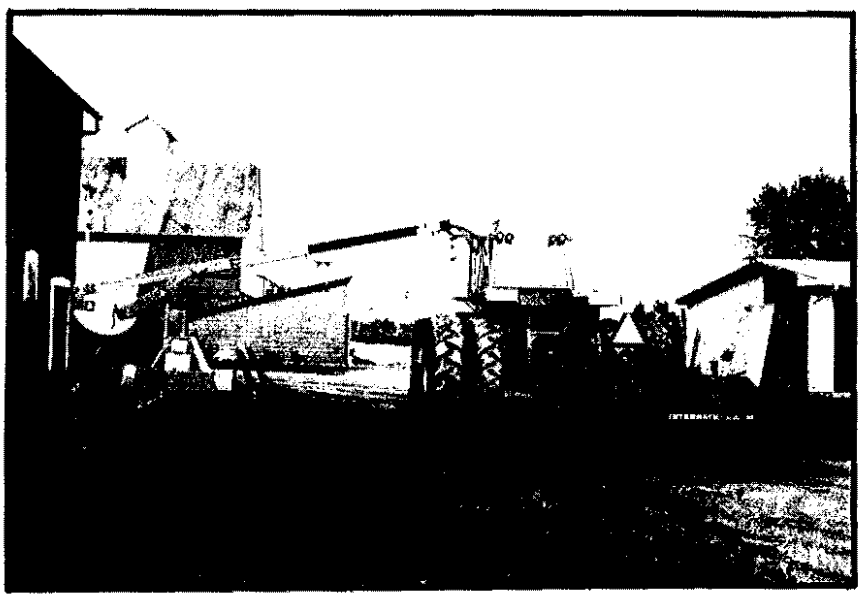

Figure 10. Lift raised to Tractor Cab

CONTROL MODIFICATIONS

White 4-210

Clutch:

A 12-volt DC electric linear actuator is installed on the White 4-210 tractor clutch that Mr. Bronk operates by using a dash mounted toggle switch. The actuator ram attaches to a 2″ pin protruding from the linkage between the foot pedal and the clutch assembly. The pin replaced the clevis that was installed on the linkage. The actuator is attached to the tractor frame in a protective steel cover (Figure 11).

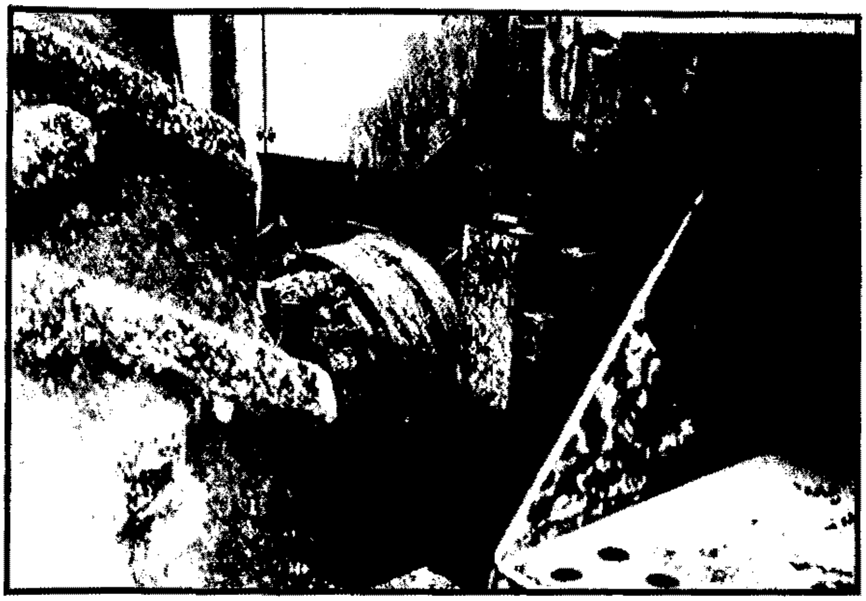

Figure 11. Linear Actuator Mounting (White 4-210 Tractor)

The toggle switch to control the clutch is mounted on the left side of the instrument panel. The switch is the lower toggle switch shown in Figure 12. Red and green lights are used to indicate whether the clutch is engaged or disengaged.

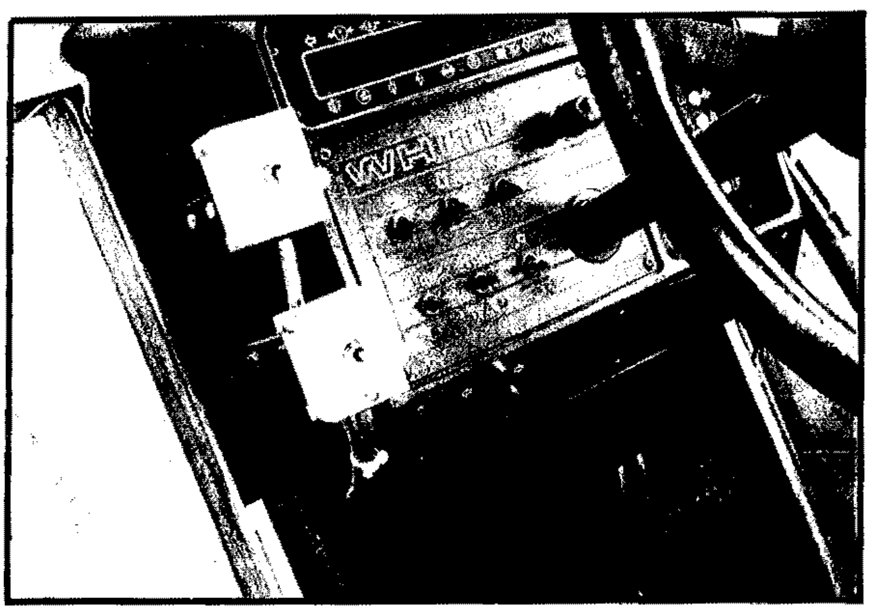

Figure 12. Toggle Switches for Clutch Control and Kill Switch (White 4-210 Tractor)

The actuator acts slowly, which could cause problems in attaching machinery, or making sudden stops to prevent an accident.

An able-bodied operator can use the foot pedals to operate the clutch.

Brake:

A driver education instructor's brake pedal, which consists of a pedal and a cable, is fastened to the right side of the cab frame post by two bolts (Figure 13). A flexible sheath encloses the cable, travels down the side of the cab and attaches to the floor underneath the tractor brake pedal shank. A pulley is mounted to the cab floor underneath the pedal shank. The cable extends out of the flexible sheath and travels around the pulley and up to the pedal shank. The cable is attached to rectangular flat steel bars fastened around the brake pedal shank by bolts (Figure 14).

To engage the brakes, the operator pushes on the pedal mounted to the cab frame. This pulls on the cable, thus pulling down on the pedal shank and engaging the brakes. An able-bodied operator can use the brake pedal with this device in place.

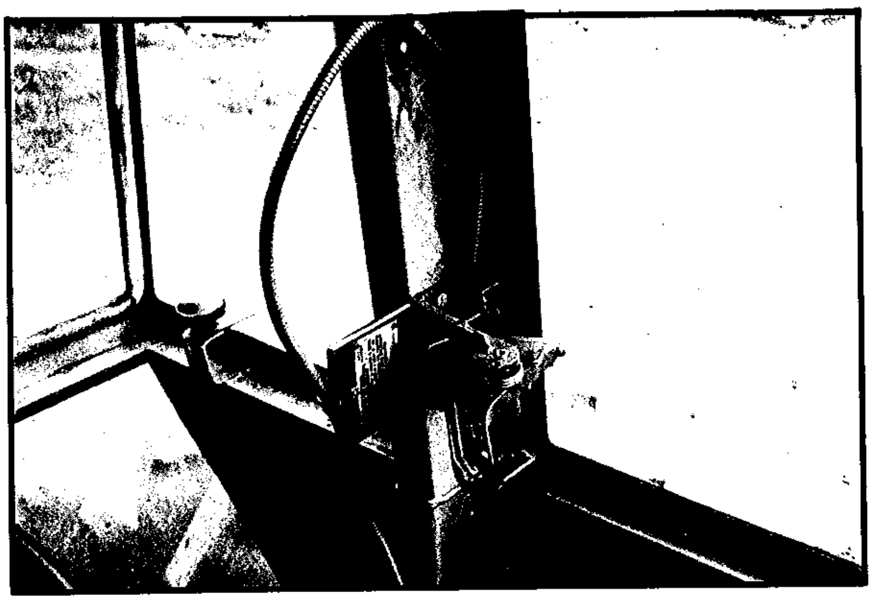

Figure 13. Pedal Assembly for Brake Control (White 4-210 Tractor)

ACCESSORIES

White 4-210

Kill Switch:

A toggle switch mounted above the clutch control switch functions as a kill switch (Figure 12). The switch is used in emergencies to shut off the fuel system.

Adjustable Tractor Seat:

To increase the space needed for transfer, the seat has been modified to allow for easy movement. The 12V motor driven seat is controlled with a toggle switch located on the left side of the cab.

Hydraulic Levers:

Small springs are attached to the hydraulic levers, allowing Mr. Bronk to operate the levers with less arm strength.

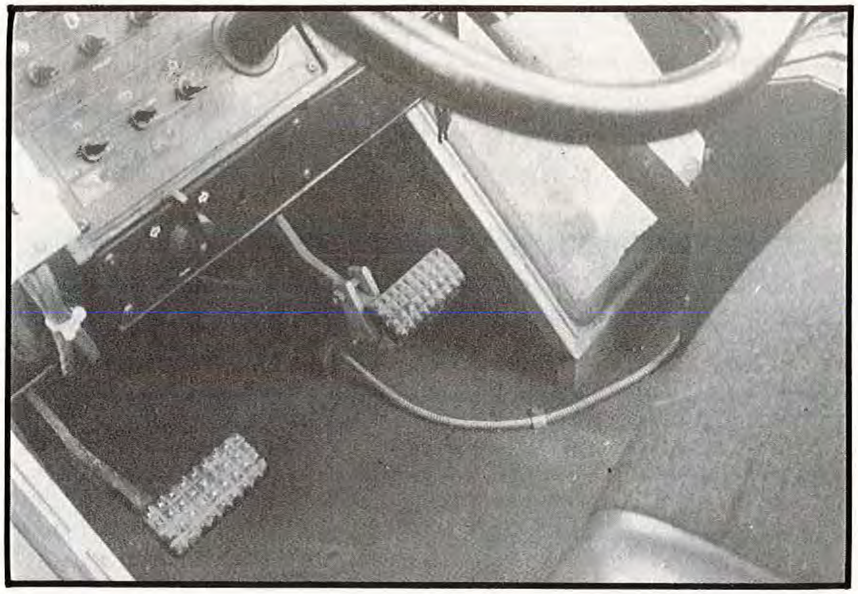

Figure 14. Cable attached to Brake Pedal Shank (White 4-210 Tractor)

Door Modification:

The door stop was removed to allow the door to swing open farther. This allows the lift to move farther into the tractor cab.

CONTROL MODIFICATIONS

White 4-270

Clutch and Brake:

The White 4-270 tractor is manufactured with a hydraulic clutch which Mr. Bronk indicates is easier to operate because it requires less force from the operator (Figure 15).

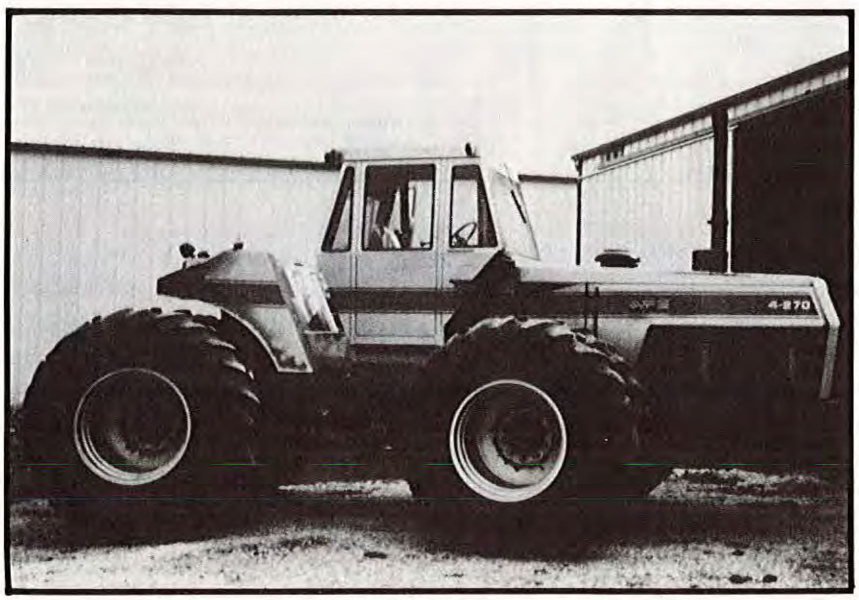

Figure 15. White 4-270 Tractor

Two master cylinders from an old car are mounted to the control panel to the right of the tractor seat. The master cylinders are mounted on a rectangular steel plate (Figure 16). Two round steel rods, one for the clutch and one for the brake, extend up from the cylinder and bend back toward the tractor seat. Protective knobs are placed on the end of each rod (Figure 17). The hydraulic line travels down from each

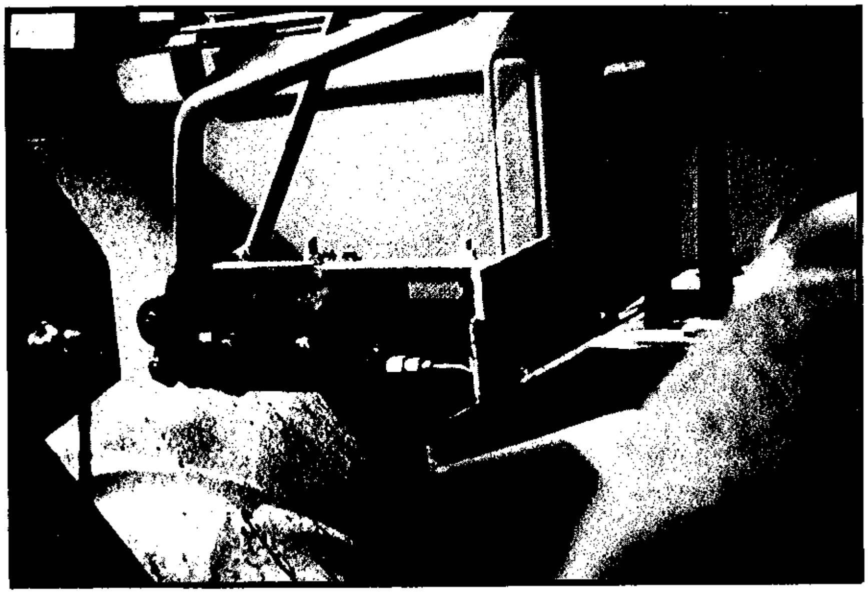

Figure 16. Mounting of Cylinders to control Clutch and Brake

Figure 17. Top view of Hand Levers

cylinder to a small cylinder mounted to the cab floor under the appropriate pedal. The cylinder rod is attached to one end of a formed steel bar that is mounted on a pivot pin underneath the instrument panel. The other end of the bar rests on top of the pedal shank.

Pushing forward on the left lever extends the cylinder rod attached to the clutch. This causes the steel bar to pivot and push down on the pedal shank.

The right hand lever, connected to the brake, functions in the same manner as the clutch lever. An able-bodied operator can use the clutch and brake pedals with the modifications in place.

ESTIMATED COST*

Emmpco Champ Uni-Lift $6,000.00

*Other modification costs not available.

DON SKINNER'S COMBINE CHAIRLIFT

FARMER: **Don Skinner**
R.R. #2, Box 169
Pawnee, IL 62558

SUMMARY

Function:

Don Skinnner's Electric Chain Drive Chairlift is designed to be mounted on International Harvester 1440 or 1460 combines. The lift enables Mr. Skinner, a paraplegic, to gain access to the combine cab.

The lift is shown mounted on an International Harvester 1460 combine in Figure 1.

Figure 1. Don Skinner's Combine Chairlift

Farmer:

Don Skinner had farmed 960 acres of grain crops in Southern Illinois before an accident left him paralyzed. Following rehabilitation, he continued to farm. Mr. Skinner is assisted on the farm by his wife Lynda, his son David, and a hired man.

After he successfully completed a chairlift for three of his tractors (see Don Skinner's Tractor Chairlifts), a lift was designed and built for his International Harvester 1440 combine. The same lift was later mounted on an International Harvester 1460 combine. These lifts and control modifications have allowed Mr. Skinner to maintain an active part in his farm operation.

Mr. Skinner has assisted many other Illinois farmers with physical handicaps by suggesting ideas for constructing lifts and hand controls. He also offers them support as they try to achieve goals they have to return to farming.

Modified Machine:

Combine: International Harvester 1460

Features: Cab

Year: 1983

Hydrostatic Drive
Axial Flow

Adaptability:

Don Skinner's combine chairlift was designed specifically for International 1440 or 1460 combines. With changes in the mounting and/or placement of the lift, it may be possible to mount it on other combines of similar design.

Compatibility:

1. The lift does not interfere with the mounting of the combine by other operators. The steps are accessible with the lift in place, because the seat swings out of the way of the combine steps.
2. There were no major permanent alterations of the combine required to place the lift on the machine.

Service and Maintenance:

1. The drive chain should be checked periodically to make sure the links are in good condition, and should be replaced if damaged.
2. The lift seat picks up excessive amounts of dust while the combine is in use. The dust is difficult to remove from the carpet on the seat.
3. The lift motor is generally unprotected from dirt and debris. It should be checked periodically to clean it of trash and to keep the motor and wiring in good condition.

Accessibility and Ease of Use:

1. The lift is accessible from a wheelchair, ATV or by a farmer who has limited use of his legs and/or uses leg braces with or without crutches.
2. The lift is designed for ease of transfer from a wheelchair to the lift seat and from the lift seat to the combine seat.
3. The lift is quiet during operation.
4. The lift cycle takes 10-15 seconds.

CONSTRUCTION DESCRIPTION

The construction of Don Skinnner's combine chairlift is described in the following subsections: Lift Track, Lift Seat, Seat Carriage, Lift Actuation, and Lift Controls.

Lift Track:

The lift track assembly consists of a seat guide and a seat leveling guide for the lift seat, which is located to the right of the combine steps and up over the cab platform.

Seat Guide:

The seat guide provides a track for the lift seat to follow from the ground to the cab.

A vertical length of 2 1/2" square steel tubing extends from a height even with the lower combine step, and up to the height of the cab platform. A second length of 2 1/2" square steel tubing is mounted horizontally 17-22" above the cab platform. It connects to the vertical section of the guide by lengths of flat bar stock, curved to allow for smooth transition from the vertical lift travel to the horizontal lift travel (Figure 2).

The vertical length of the square steel tubing is welded to a bracket constructed from rectangular steel tubing and a rectangular steel plate. The steel plate is welded to the vertical tube and is bolted to the cab entry platform, to the right of the combine steps. Welded over the top of the vertical and horizontal steel tubes is a flat steel plate which is several inches wider than the tubes. It forms a smooth track for the lift seat and bearing plate (Figure 2).

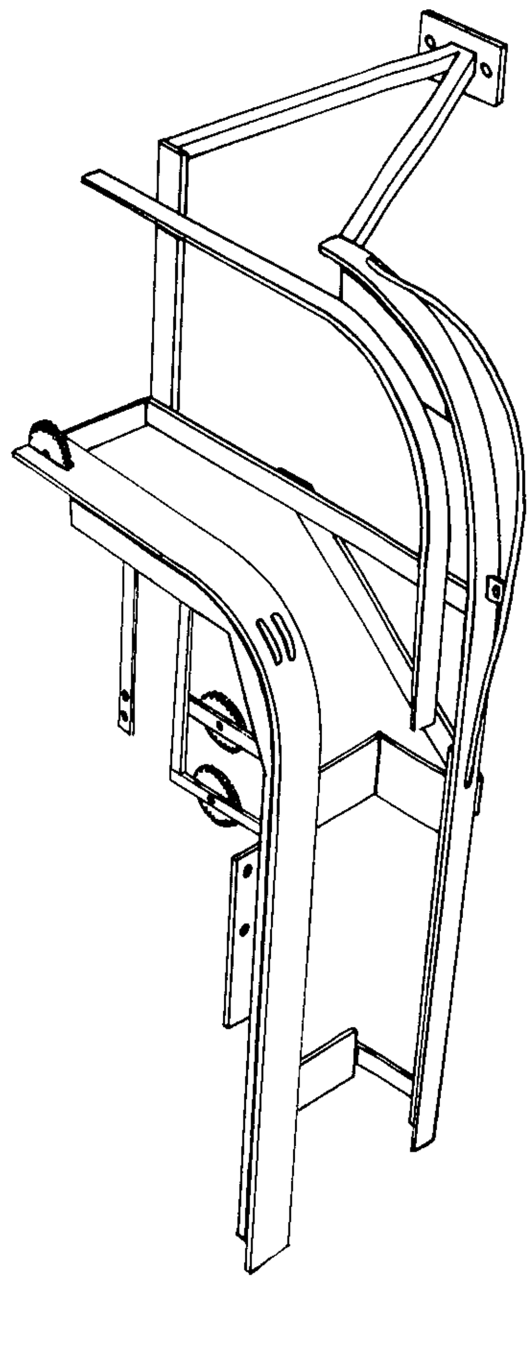

Figure 2. Drawing of Lift Construction

Seat Leveling Guide:

A seat leveling guide is located approximately 12-15" above the seat guide. The guide is constructed from lengths of angle iron, flat bar steel and steel plates.

A square steel plate extends out away from the mounting plate of the seat guide to form an "L"-shape structure. A length of angle iron is welded vertically to the steel plate (Figure 2). It extends down along the side of the combine to the right of the seat guide, and down to the height approximately equal to the combine's second step from the ground. The angle iron is fastened on the lower end to an "L"-shape rectangular steel plate structure. This is welded to the vertical steel plate behind the seat guide (Figure 2). A length of flat steel bar is welded to the upper edge of the angle iron and extends up over the top of the cab platform about 15" above the seat guide. This length of steel bar is fastened on the upper end by a length of rectangular steel tubing and is welded to a square steel plate bolted to the top of the grain tank (Figures 2 and 3). A second length of angle iron, with a flat steel bar welded to the upper edge, is mounted horizontally from the side of the cab. It travels to the edge of the cab platform where it bends down in a smooth curve. A steel plate is welded between the two lengths of flat steel bar to form a channel (Figure 2 and 5) where the leveling guide changes the lift seat direction from vertical travel to horizontal travel.

See Figure 2 for details of lift construction.

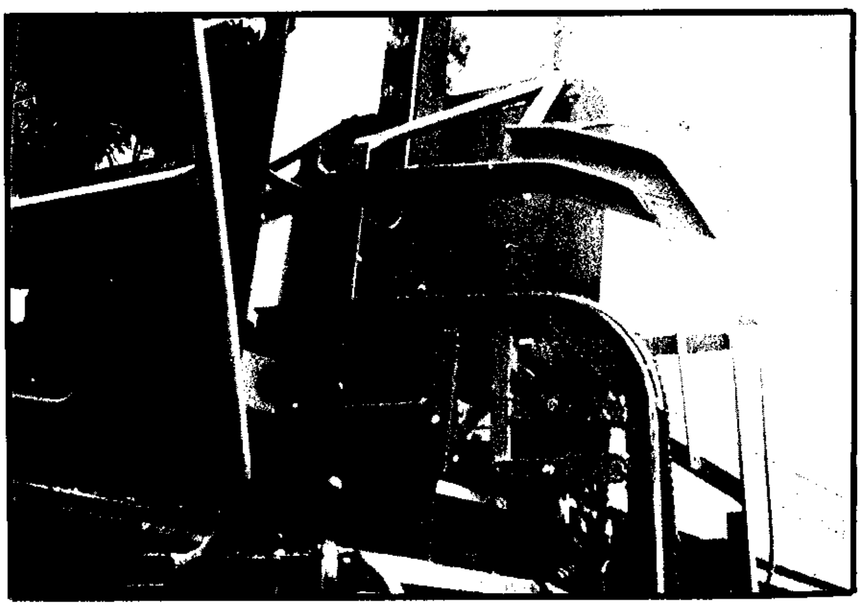

Figure 3. Close-up of Upper Length of Seat and Leveling Guide and Sprockets for Chain Movement

Lift Seat:

A square frame is constructed from lengths of rectangular steel tubing. Plywood fastened to the tubes serves as the seat. Indoor-outdoor carpet is fastened over the plywood to cushion the seat. Steel tubing is mounted vertically above the lift seat at both rear corners of the seat. A flexible material is bolted to these tubes to form a back rest for the seat. Arm rests constructed from round steel tubing extend out horizontally from the vertical posts and bend down vertically near the front of the lift seat where they attach to the seat frame (Figure 4). The outer arm rest pivots, so it can be swung out of the way for operator transfer.

Figure 4. Bottom View of Seat and Carriage

Seat Carriage:

A carriage is constructed of three rectangular steel plates mounted on each side and above the seat guide track with rollers mounted in front of and behind the track. An "L"-shaped rod passing through holes drilled through a "U"-shaped flat steel bar is used as a hinge. A horizontal rectangular steel plate is welded to the steel rod. A second rectangular steel plate bolted to the hinged plate can pivot horizontally (Figure 5). A spring loaded pin locks the pivoting plate to holes drilled in the hinged plate. This allows the operator to face one direction when traveling up the lift track vertically, and to swivel to face another when traveling horizontally into the combine cab. A roller attached to the vertical length of the hinged steel rod travels in the seat leveling guide. A wiring support is shown in Figure 6 to prevent the wiring from being damaged during lift operation.

Lift Actuation:

A No. 40 roller chain travels around the length of the seat track (Figure 2). A sprocket is mounted at the end of the horizontal end of the track (next to the cab) and a second sprocket is mounted on the lower end of the track. Starting at the bottom of the track, the chain travels up vertically from the sprocket, passing over the steel plate of the seat track until it reaches the cab entry platform. The chain travels horizontally over the cab entry platform, then passes over a sprocket next to the combine cab. The chain travels underneath the track where it passes over a series of sprockets mounted at the edge of the cab platform. One of the sprockets is connected to the drive motor. The chain then travels down vertically to the sprocket mounted on the lower end of the track. The carriage of the lift seat attaches directly to the chain (Figure 5).

Figure 5. Carriage and Lift Seat with Roller in Leveling Guide

The chain is powered by a modified electric motor off an early 1950's Massey Harris Combine and a starter motor reduction gear. The motor was converted from 6 to 12 volts DC. Solenoids were added on the lift to provide reversing capability.

Lift Controls:

Push-button switches are mounted on the right arm rest of the lift seat (Figure 6). A control switch is mounted inside the combine cab to allow Mr. Skinner to move the lift seat out of the cab so he can close the cab door.

SAFETY CONSIDERATIONS

The combine engine should be shut off during lift operation. This lift offers the safety feature of not requiring the combine engine for power supply.

The seat has arm rests which help hold the operator in the lift seat, thus offering the operator more security. A footrest mounted under the lift seat might increase the operator's stability. A seatbelt might also be desirable for some operators in order to securely fasten them in the seat. This is a greater concern with combine chairlifts because of the height involved. A textured seat assists in preventing the operator from sliding out of the seat.

The chain is the only support mechanism for the lift seat and should be inspected periodically for possible wear and/or

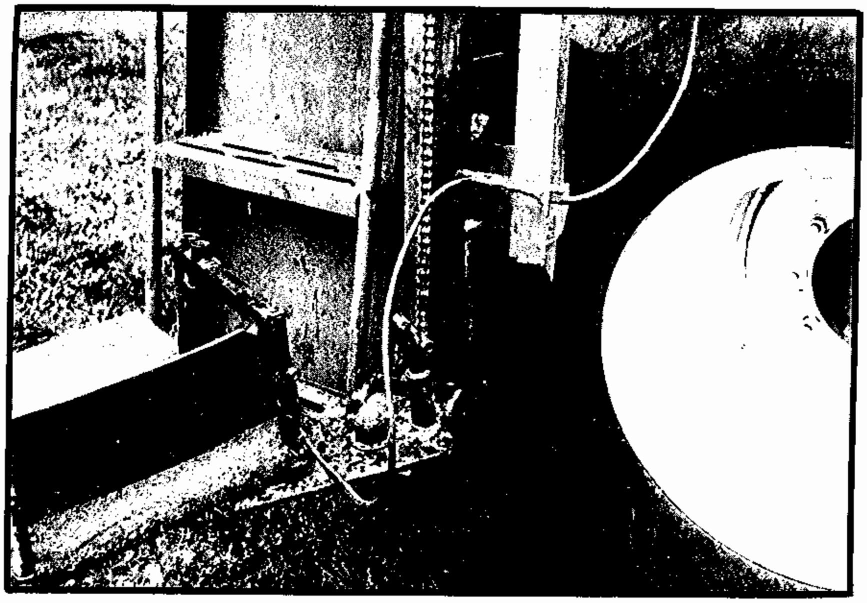

Figure 6. Extension to prevent Wiring from being damaged during Lift Operation

damage. If the chain were to break, the seat would fall and possibly cause serious injury to the operator. This is due to the absence of a braking device on the lift. An appropriate means of chain tension adjustment is needed to minimize wear.

A switch should be located close to the ground on the combine to allow the operator to access the lift if left in the raised position.

DESCRIPTION OF OPERATION

To access the combine, Mr. Skinner positions his wheelchair beside the lowered lift seat (Figure 7). He removes the right arm from his wheelchair and pivots the seat arm rest out of the way. He slides over into the lift seat and replaces the armrest. The seat is facing forward and he pushes the "up" button to raise the lift seat. Mr. Skinner continues raising the lift until it

Figure 7. Mr. Skinner on lowered Lift Seat

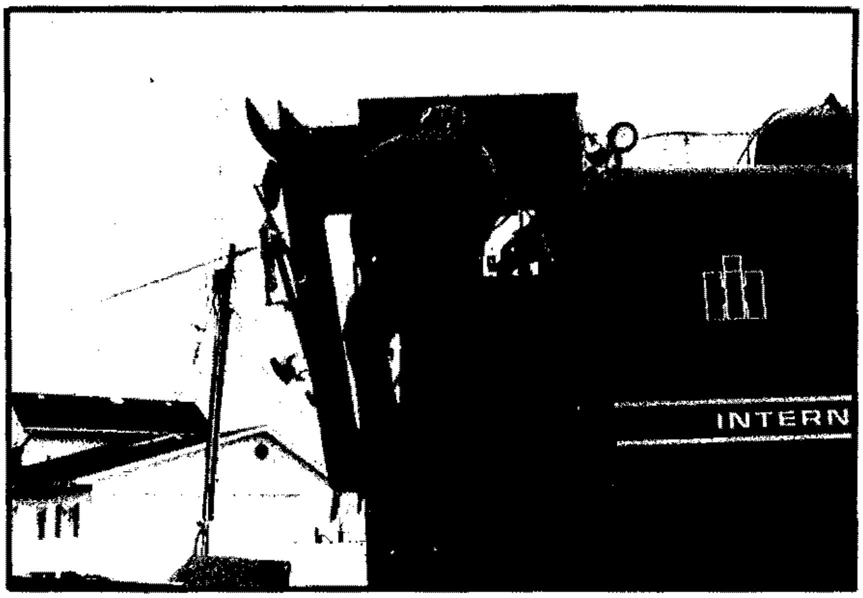

Figure 8. Mr. Skinner moving into Combine Cab

reaches the highest point of lift travel. Then he releases the switch. He reaches behind and pulls the pin that locks the swiveling seat in place. He swivels the seat 90 degrees to face the cab door (Figure 8), and places the pin in the hole to lock the seat in place. Mr. Skinner then pushes the "up" button to move the lift seat to the combine cab. When he reaches the cab, he releases the switch and transfers into the combine seat (Figure 9). Mr. Skinner uses a switch mounted inside the combine cab to move the lift seat out of the way. Then he can close the cab door using a rope attached to the door.

To dismount, Mr. Skinner opens the cab door and uses the switch mounted inside the cab to bring the lift seat into position. He then transfers into the lift seat. He pushes the "down" button and the seat moves out of the cab until it reaches the maximum horizontal distance of lift travel. At this time

Figure 9. Lift Seat in Cab Doorway

he releases the switch, pulls the pin locking the seat in place, and swivels the seat 90 degrees to face forward. He positions the pin back in place. He pushes the "down" button to lower the lift to the ground where his wheelchair is within reach.

ESTIMATED COST*

Material Cost Not Available
Labor Cost $200.00

*At time of construction, 1983

RALPH CHRISTENSON'S CHAIRLIFT

CONTACT: Ralph Christenson
Vari-Pol
1 Guantanamo St.
P.O. Box 56
Badger, South Dakota 57214

SUMMARY

Function:

Ralph Christenson's Chairlift is designed to be mounted on various self-propelled agricultural machines to help a handicapped farmer gain access to the operator's station. The lift is constructed in two standard designs and the mounting bracket is constructed by the farmer to fit a particular machine. The lift is shown mounted on a Ford 8000 tractor in Figure 1.

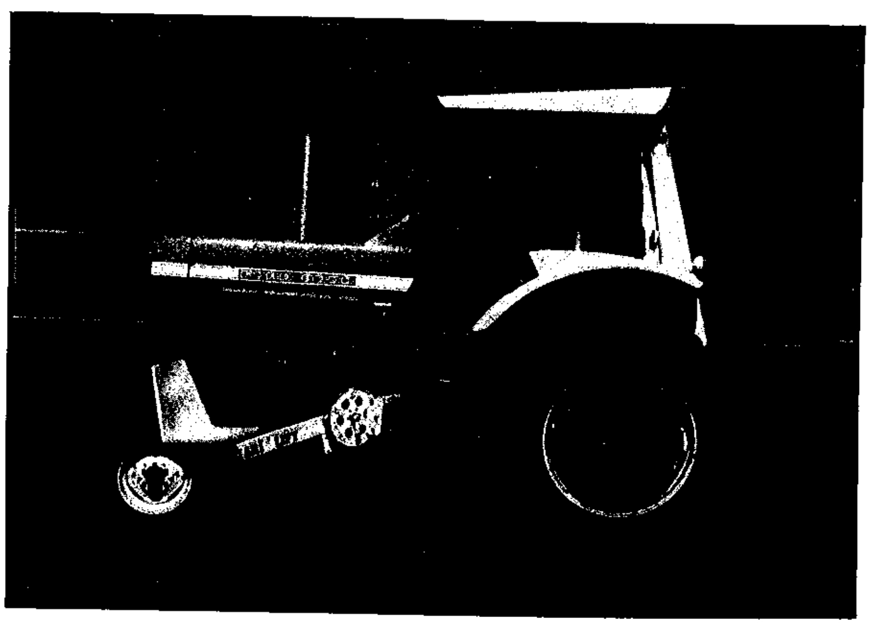

Figure 1. Ralph Christenson's Chairlift

Modified Machine:

Tractor:	Ford 8000
Features:	ROPS and Canopy
Rear Tire Size:	16.9-34
Front Tire Size:	7.50-16
PTO-HP:	105
Year:	1968

Steps on both sides of the tractor
Hand grip bars on both sides
Tilt steering wheel allows for easier access

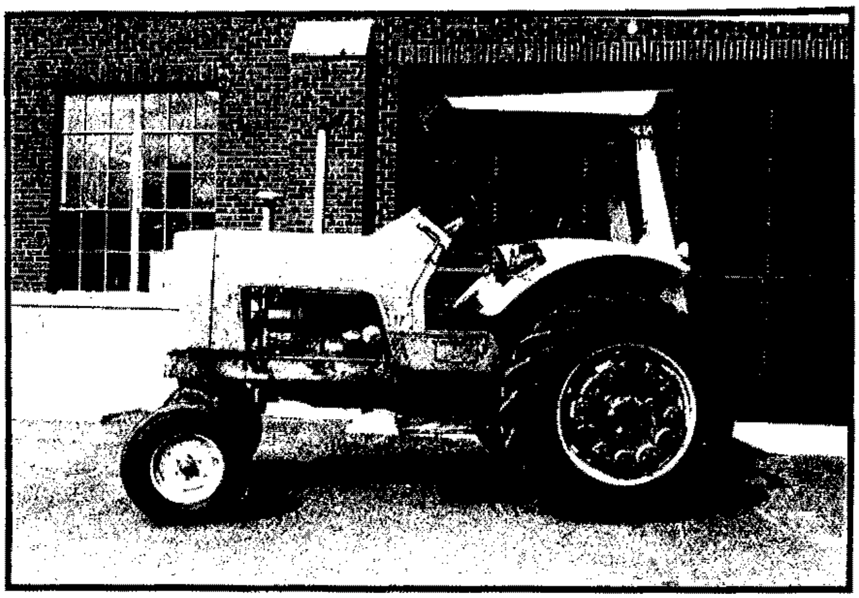

Figure 2. Ford 8000 Tractor

Adaptability:

This lift is suitable to be mounted on other self-propelled agricultural machines.

Compatibility:

1. The lift does not interfere with the use of the tractor by a non-handicapped individual, since there are steps on both sides of the tractor.
2. The lift was mounted on this particular tractor without major alterations to the original equipment.

Service and Maintenance:

1. Moving parts should be lubricated periodically and examined for wear.
2. The lift utilizes a chain to keep the seat level during lift operation; it must be checked periodically. However, this is a problem because there is no access door on the lift tube for examining the chain or removing a link when tightening the chain.

Accessibility and Ease of Use:

1. The lift is accessible from a wheelchair, ATV, or by a farmer using leg braces and/or crutches.
2. Some difficulty might occur when transferring to the lift seat because the seat rotates freely on a pivot pin.
3. The lift is fairly quiet during operation.
4. The lift tested could not lift a person off the ground because the motor lacked sufficient power. The lift was able to lift a person off the tractor and lower him to the ground.

Safety Concern:

During lift operation there is a point where the lift seat is 6' 5" off the ground. The seat wobbled due to the slack in the chain and presented a dangerous situation to the operator.

CONSTRUCTION DESCRIPTION

The construction of the Ralph Christenson's chairlift is described in the following subsections: Stationary Frame, Moving Frame, Lift Seat, Lift Actuation and Lift Controls.

Stationary Frame:

The mounting bracket is constructed of 2" tubular steel welded to a 1/4" piece of 2 1/2" x 2 1/2" angle iron. There are two holes drilled into the angle iron to mount the bracket to the tractor. The piece of 2" tubular steel extends 17 1/2" out from the tractor. Another piece of 2" steel tubing is welded at a 45 degree angle to the tubing arm extending out from the tractor. A piece of steel is welded on the top and underneath this joint for added support. The mounting bracket is shown in Figures 3 and 4. The bracket is attached to the tractor frame by two bolts.

Moving Frame:

The moving frame consists of a 44" piece of constructed tubing. This lift tube contains a series of sprockets and a chain that serves as a leveling device for the seat as the lift raises and lowers. The lift tube rotates on a horizontal shaft that goes through the center of a ring gear. A bearing is mounted on the tube so that the tube can rotate around the shaft fixed to the ring gear. A steel plate is attached to one end of the shaft and bolted to the ring gear to securely fasten the shaft (Figure 5). The other end of the shaft is supported by a brace made of steel tubing and is welded to a small collar of square tubing. The square tubing serves as the slip tube to mount the lift on the mounting bracket (Figure 6). A 9" x 4 1/2" steel plate is welded to the slip tube by 3 bolts. The slip tube is bolted to the mounting bracket to hold the lift onto the tractor.

A 12-volt starter motor with gear box is attached to a 4 3/4" x 5" bracket that is welded to the side of the lift tube opposite the ring gear. Tubing along the side of the lift tube protects the wiring from damage.

Figure 3. Mounting Bracket Front View

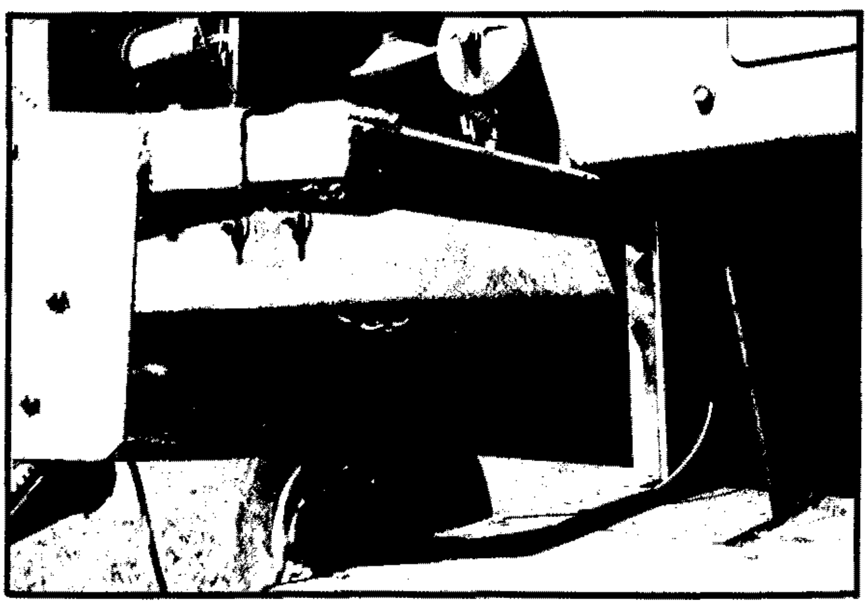

Figure 4. Mounting Bracket Rear View

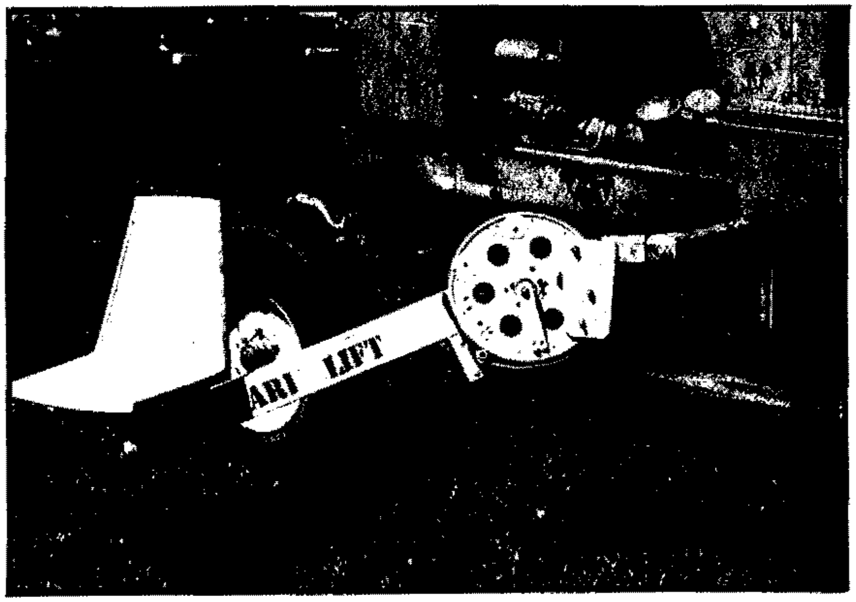

Figure 5. Side View of Ring Gear Assembly

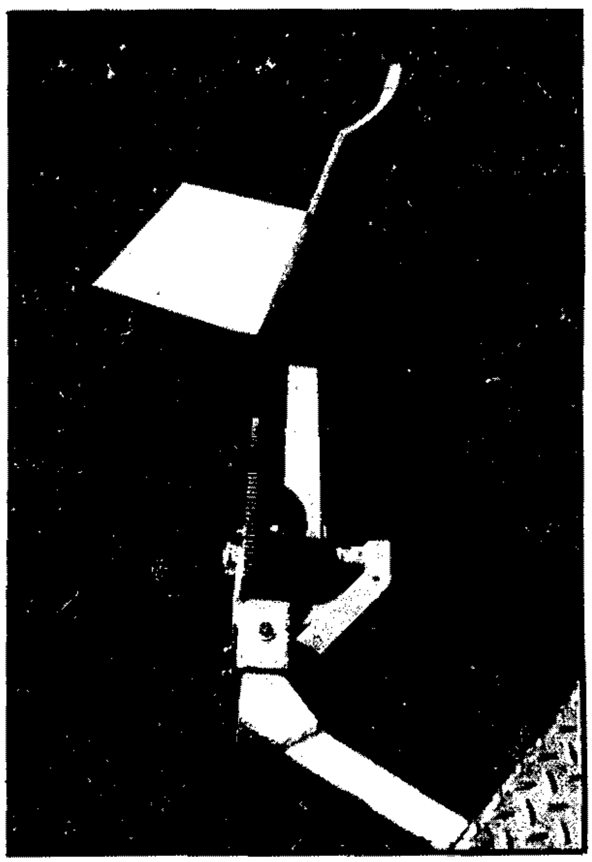

Figure 6. Top View of Bracing and Slip Tube

Lift Seat:

The lift uses a swivel seat that rotates on a pin attached to a shaft extending out from the ring gear assembly. The seat is constructed of molded plastic and has no arm rests or seatbelt.

The shaft onto which the seat is attached serves as a leveling device for the seat. The shaft which supports the seat is formed into an "L"-shape and passes through the square lift tube. A sprocket is attached to this shaft and a roller chain connects it with the sprocket on the lower end of the lift tube. The shaft is supported in the lift tube by bearings. This seat leveling assembly operates during the use of the lift; the sprockets rotate to keep the seat level so that the operator does not fall off.

Lift Actuation:

The lift is powered by a 12 volt DC motor and a small gear box. The motor is securely fastened to the lift tube, as described previously under the reference to "Moving Frame". A small pinion gear on the motor shaft engages the stationary ring gear. The pinion gear tracks around the ring gear, serving as the lifting mechanism to raise and lower the lift. The motor is shown in Figure 7.

Lift Controls:

A toggle switch is located underneath the lift seat. The switch is mounted on a steel bracket extending out from the seat leveling shaft. The wires travel from the switch down through the wiring tube to the starter motor. A single wire travels from the starter motor to the tractor battery. The switch bracket is shown in Figure 8.

Figure 7. Starter Motor for Lift Operation

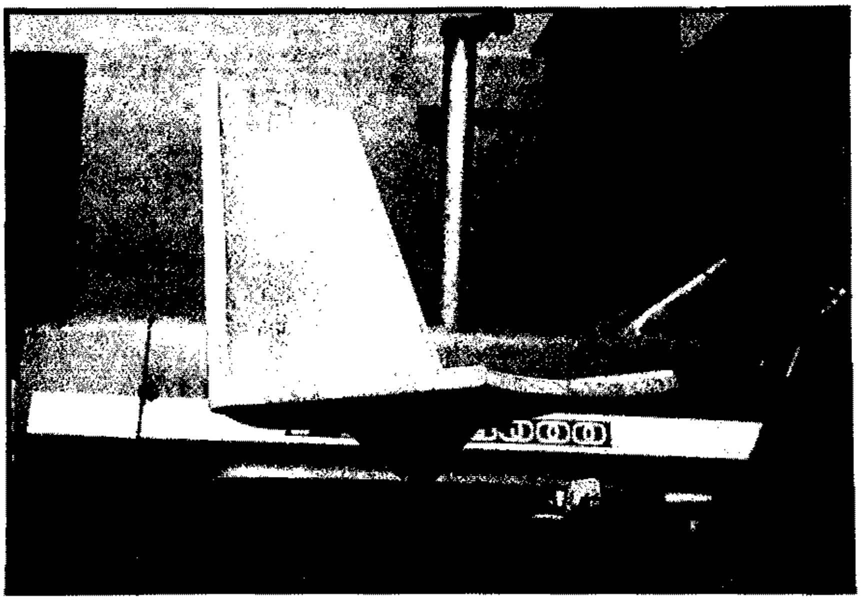

Figure 8. Switch Located Underneath the Seat

SAFETY CONSIDERATIONS

It is important to operate the lift with the tractor turned off to eliminate the danger of being thrown from the tractor and possibly run over while mounting or dismounting. This lift is operable without use of the tractor engine.

The switch to operate the lift is not self-centering. Thus, the operator must shut the switch off rather than just release it. This could be critical if the operator were to lose his balance. The lift also coasts after the operator shuts off the switch. To prevent coasting, the operator must push the switch in the opposite direction and then position the switch back in the neutral position.

The lift motion is erratic at times during operation, which could cause the operator to lose his balance.

The seat provides no armrests or seatbelt to securely fasten the operator into the seat and keep him from falling off the lift if he should lose his balance. This should be a major concern, because at one point the lift seat is extended 6' 5" above the ground (Figure 9). If the operator were to fall off the lift from this height he could be seriously injured. Danger is magnified in this situation when the seat wobbles because, although the chain is adjusted as tightly as possible, it still has slack. The seat pivot is loose and adds to this wobbly motion of the seat.

In addition, there is nothing for the operator to grab onto during lift operation, due to the distance between the operator and the tractor.

The lift seat could use a footrest to prevent the operator from sliding out of the seat.

A switch should be provided close to the ground on the tractor so the operator can gain access to the tractor if he falls off the lift or if the lift is left in the raised position.

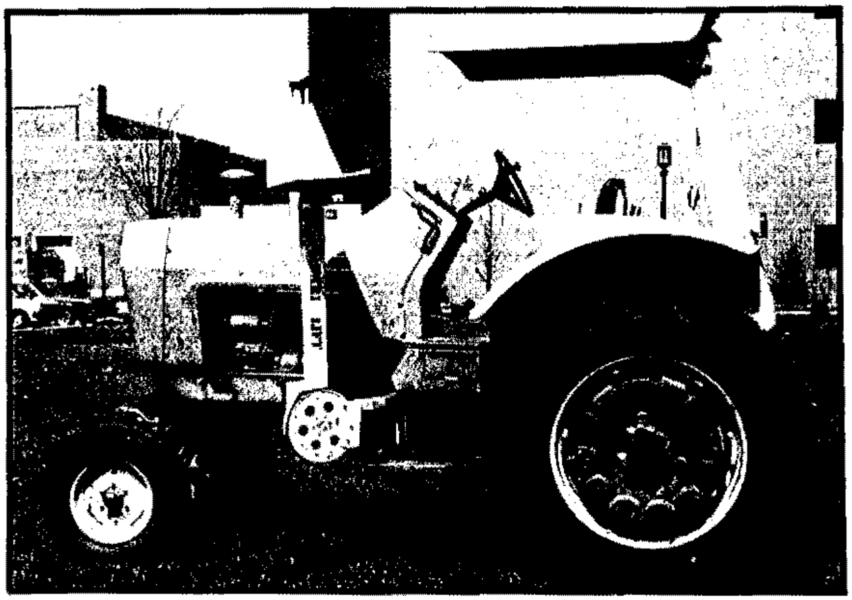

Figure 9. Lift Seat 6' 5" Off the Ground

DESCRIPTION OF OPERATION

To mount the tractor, the operator positions his wheelchair beside the lowered lift seat (Figure 1). The wheelchair left arm is removed and the operator slides over into the lift seat. The operator raises the lift using the switch mounted under the seat. The lift seat travels in an arc and the lift continues in the same direction both to raise the operator and to lower him to the platform. The operator places the switch in the neutral position and grabs the grip bar on the side of the tractor and swings the seat around to face the tractor seat when the lift is at the proper height. He then activates the switch, so that the lift lowers him to the tractor platform deck. He turns the switch to the off position when he reaches the desired transfer level (Figure 10). The operator then slides over into the tractor seat. The steering wheel on the tractor can tilt up, in case the operator has difficulty transferring into the tractor seat.

To dismount, the operator slides over into the lift seat and activates the switch located under the lift seat. This raises the seat until it clears the fender. The operator turns the switch to the "off" position, pushes on the side of the tractor or canopy, and swings the seat around so that he faces his wheelchair. He activates the switch to lower the seat to the ground. As he approaches ground level, he adjusts the lift seat level most suitable to enable him to transfer without difficulty into the wheelchair.

Figure 10. Lift in Raised Position

ESTIMATED COST*

Estimated cost of all modifications:	$ 255.68

* At Time of Construction

BREAKING NEW GROUND'S MARK I CHAIRLIFT

CONTACT: Breaking New Ground
Agricultural Engineering Department
Purdue University
West Lafayette, IN 47907

DESIGNED BY: Clarence B. Richey
Agricultural Engineering Department
Purdue University
West Lafayette, IN 47907

SUMMARY

Function:

Breaking New Ground's Mark I chairlift is designed to be mounted on a farm tractor to enable farmers with physical handicaps to gain access to the operator's station.

The lift shown, mounted on a Case 1290 tractor in Figure 1, was designed as a prototype in the Agricultural Engineering Department at Purdue University. The tractor also contains control modifications and accessories which are described in this section.

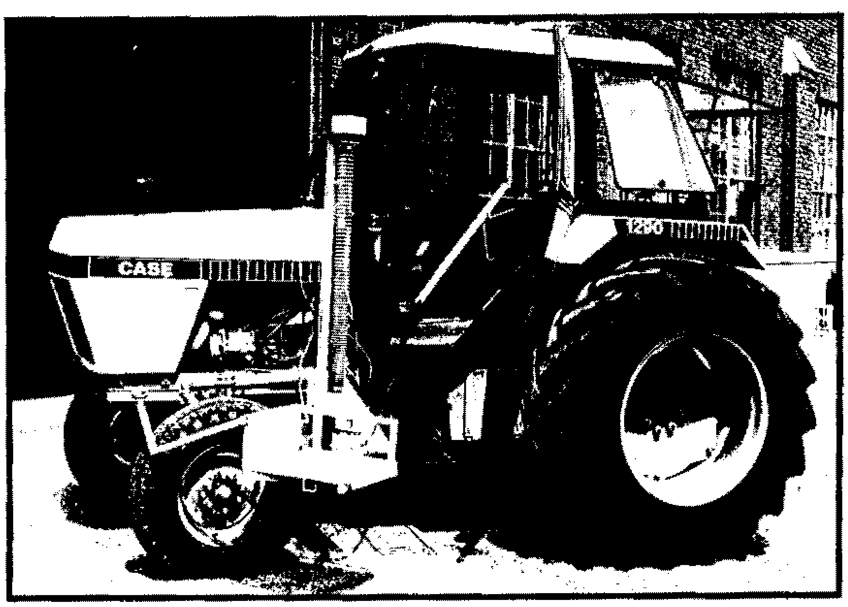

Figure 1. Breaking New Ground's Mark I Chairlift

Modified Machine:

The tractor, donated by J.I. Case, allows the Purdue University Agricultural Engineering Department to research modifications for farmers with physical handicaps.

Tractor: Case 1290

Features: ROPS Cab

Rear Tire Size: 16.9-30AS
Front Tire Size: 7.50-16AS
PTO HP: 60
Year: 1983

Door on both sides of the cab
Adjustable Seat
Syncromesh Transmission

Adaptability:

The Breaking New Ground Mark I Chairlift could be modified for other tractors of similar size by changing the mounting frame.

Compatibility:

1. The lift does not interfere with the use of the tractor by other operators since there is a door on each side of the tractor cab. The lift seat swings out of the way when not in use.
2. No permanent alterations to the tractor were required in order to mount the lift.

Service and Maintenance:

1. The lift is easy to service. Little maintenance is needed besides lubricating the screw and possibly the guide sleeve as needed.
2. Service and maintenance points on the lift are wheelchair accessible.
3. The motor and electrical system are simple and require little maintenance other than to keep connections tight.

Accessibility and Ease of Use:

1. The lift is easily accessible from a wheelchair, ATV, or by a farmer who uses leg braces and/or crutches.
2. The lift is designed for ease of transfer and operation. However, the transfer from the lift seat to the tractor seat may require some practice.
3. The lift is fairly quiet during operation.

CONSTRUCTION DESCRIPTION

The construction of Breaking New Ground's Mark I Chairlift is described in the following subsections: Stationary Frame, Guide Sleeve, Seat and Swing Arm, Lift Actuation and Lift Controls.

Stationary Frame:

The frame is a 3″ square, 1/4″ wall steel tube fabricated into an L-shape (Figure 2). The short leg passes under the tractor engine and is welded to 3/16″ thick steel mounting plates, which bolt to each side of the tractor frame. A stop bar and a lift screw bearing plate are welded to the base of the vertical leg. A mounting plate with four threaded holes is welded inside the top of the vertical tube to support the lift screw and motor bar (Figure 2).

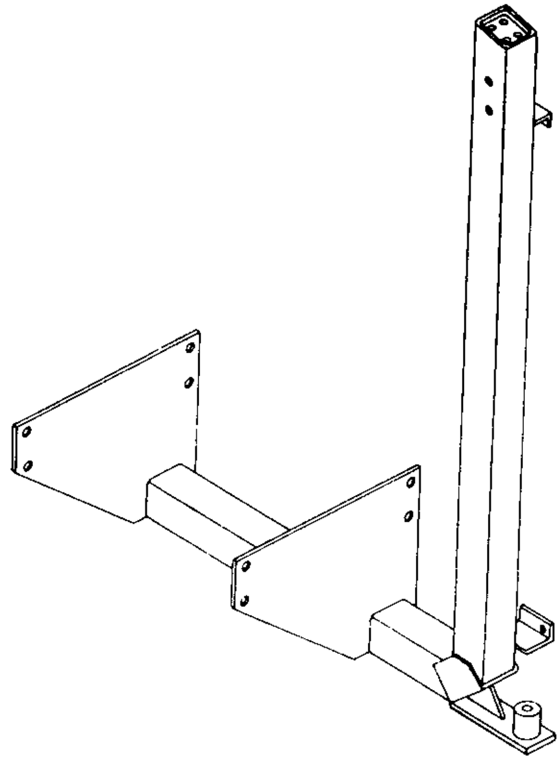

Figure 2. Stationary Frame

Guide Sleeve:

A guide sleeve constructed of 6″ standard pipe fits around the vertical tube. Square steel plates are welded inside the sleeve to carry eight straddle-mounted, 3/8″ bore, needle cam follower bearings, which guide the sleeve up and down the square tube and prevent rotation around the tube (Figure 3).

Welded to the guide sleeve is a short channel-shaped arm made from 3/16″ steel, as shown in Figure 3. The outer end of the channel supports the seat and swing arm. The channel also retains the nut attached to the lift screw, which passes through the channel at a point between the sleeve and the pivot hub, which functions in raising and lowering the guide sleeve when the screw is actuated.

Seat and Swing Arm:

This particular lift uses a seat and swing arm assembly. The seat is made of 16 gauge steel with an 8″ high back. The seat arms are made of 1″ square steel tubing. The right arm pivots at the top rear of the seat to allow it to be swung up and back. The operator can then slide over into the seat from his wheelchair.

A 2″ square, 3/16″ wall tube is welded perpendicularly to a 1 5/8″ diameter wheel spindle at the inner end of the swing arm and carries the welded-on seat and gussets as shown in Figure 4. The wheel spindle and hub comprise the swinging seat pivot.

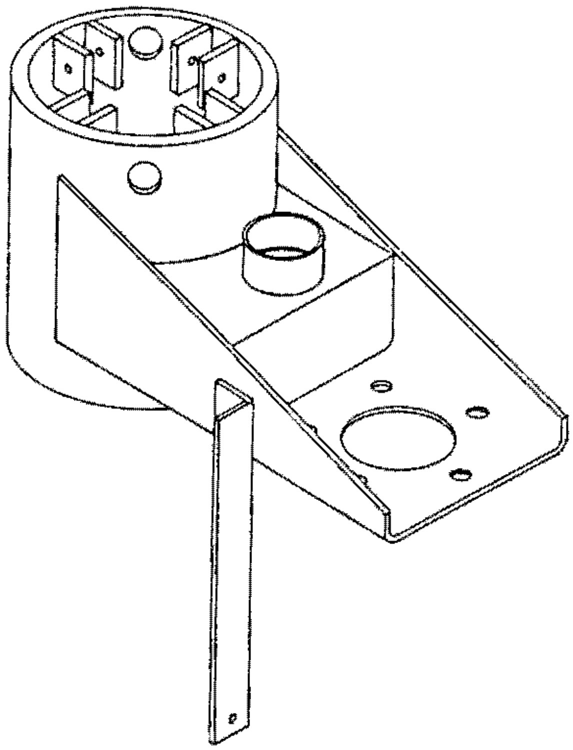

Figure 3. Guide Sleeve

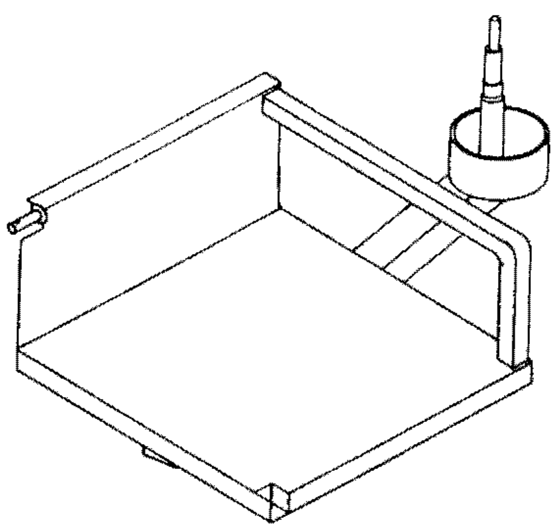

Figure 4. Seat and Swing Arm

A latch, webbed strap and springs are mounted on the swing arm. After the operator transfers to the tractor seat, he pulls on the control strap which releases the latch. Springs cause the seat to swing back against the engine compartment for storage (Figure 5).

Lift Actuation:

The lift is powered by a permanent magnet 12 volt DC electric motor, developing 1/6 horsepower at 1800 rpm. The power unit drives a 5/8″ diameter x 60″ (1524 mm) Acme thread lift screw at 500 rpm by means of a V-belt. A 3/8″ x 3 1/2″ support bar is bolted to the mounting plate inside the vertical frame tube and carries the motor on one side and the lift screw on the other. A sealed, self-aligning flange mounted ball bearing supports the lift screw. The lower end of the lift screw is stabilized by a bearing block welded to the lower frame. The lift screw nut is tapered to fit into a countersink with a fabric washer in order to inhibit vibration and allow self-alignment.

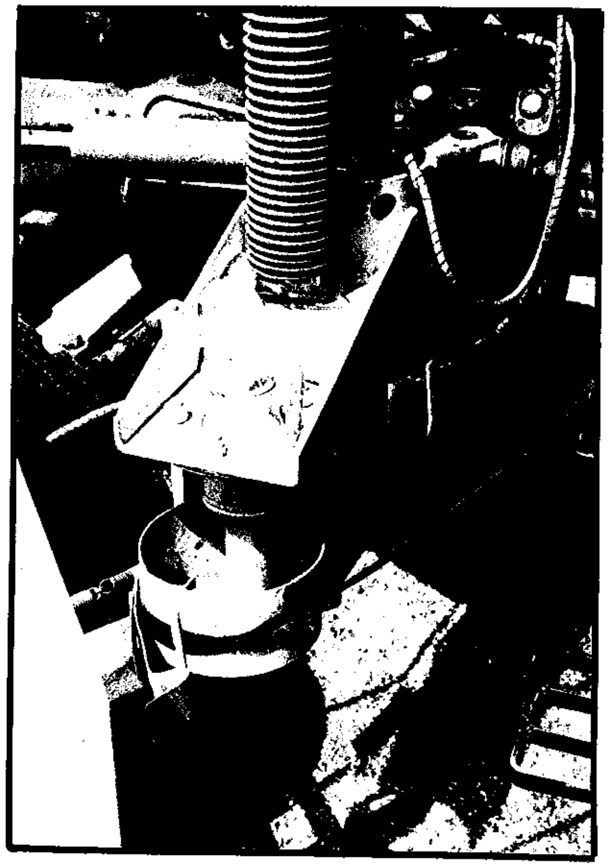

Figure 5. Webbed Control Strap mounting on Pivot

The lift screw is lubricated by high viscosity grease. Dust is kept off the lift screw by a pair of bellows which can retract down to 10% of their extended length. The 2″ inside diameter ends are clamped to mounting rings at the top on each side of the guide sleeve channel and to the bearing block at the bottom. The bellows are interconnected by drilled holes to allow air exchange during raising and lowering, thus avoiding contamination by outside air and dust.

Lift Controls:

One double throw, double pole, self-centering toggle switch is provided on the left rear side of the lift seat and another is located on the tractor dash. Either of these switches are necessary to prevent the possibility of both switches being on at once and blowing the protective fuse. Momentary toggle switches act as limit switches for upward travel, for downward travel, for operator access, and for downward travel to the stowed position above the front wheel. A wiring diagram is shown in Figure 6.

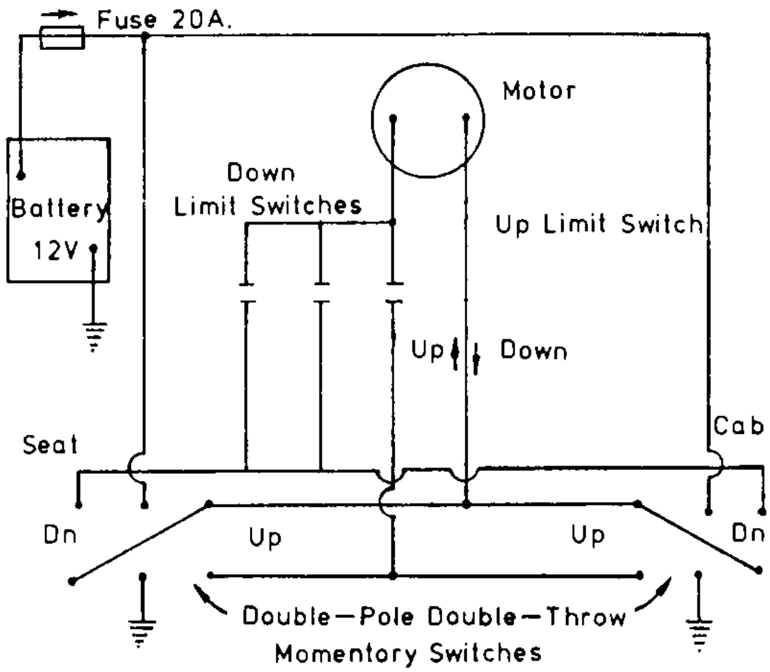

Figure 6. Wiring Diagram

SAFETY CONSIDERATIONS

As a safety precaution, the tractor engine should be shut off during operation of the lift.

The use of momentary toggle switches allows the operation of the lift as the operator wishes and the self-centering design of the toggle switches allows the lift to stop immediately upon their release.

The door hinges were modified to allow the door to swing open far enough to allow operator access and to eliminate a possible pinch-point underneath the door when the lift is being raised.

The lift screw thread design prevents the lift from falling if the motor should fail.

If a footrest were mounted on the lift, it would correct the operator's posture, eliminate the possibility of sliding out, and protect his feet. Some operators might desire a seatbelt to avoid falling off the lift.

An additional switch, positioned in a low place on the tractor or lift, would provide the operator access to the tractor if the lift were in the raised position.

DESCRIPTION OF OPERATION

To mount the tractor, the operator positions his wheelchair beside the lowered lift seat. The wheelchair arm is then removed and the right arm on the lift seat is lifted up and back (Figure 7). The operator slides

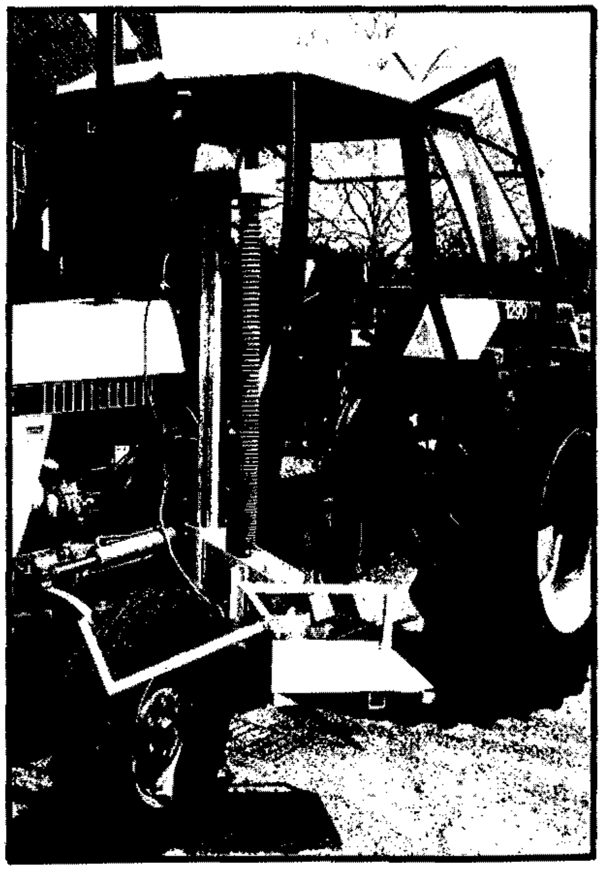

Figure 7. Seat with right arm swung back

into the lift seat and positions the right lift seat arm back in place. A switch on the seat is used to actuate the lift. The vertical lift screw smoothly lifts the operator. The swing position of the lift seat is manually controlled by the operator's arm position on the door. Once the lift has stopped, he pulls the seat to the latched position, partially through the door. The operator can then grasp the diagonal overhead hand-grip bar to transfer into the tractor seat (Figure 11). Once in the seat, the operator pulls on the webbed control strap attached to the seat arm assembly which releases the latch. A return spring swings the seat to its forward position (Figure 5). The operator uses the dash-mounted switch to lower the lift seat to a stowed position above the tractor front wheel and then shuts the cab door.

To leave the cab, the operator opens the cab door and raises the lift seat using the dash-mounted control switch. Once the lift seat is raised, he pulls on the control strap, which latches the lift seat into position. Using the overhead hand-grip bar he transfers into the lift seat and releases the latch using the control strap. Using the switch on the left seat arm, he lowers himself to the ground where his wheelchair is within reach.

CONTROL MODIFICATIONS

Brake:

Separate hand levers are designed for the two brake pedals to allow individual operation. The brake levers are constructed of 1" rectangular steel tubing shaped for ease of operation. Some operators may have difficulty using this style of brake lever because of the downward force required to engage the brakes. A 3" length of 3/4" pipe is welded to each lever to form a handle. Several pieces of rectangular steel plates are welded to the base of each lever in a configuration that allows the lever to be mounted to the brake pedal (Figure 8).

A 1/4" hole is drilled through each brake pedal and the plate attached to the corresponding lever. Each lever is then securely fastened by a 1/4" x 1 1/14" bolt. The brake levers can be easily removed by removing the bolt and nut. It is important that the brake controls be easily removable to allow for normal brake pedal usage and for emergency exit of the tractor on the right side.

The brake pedals can still be locked together using the original brake lock. The operator pushes down on the levers to engage the brakes.

Figure 8. Brake Hand Levers

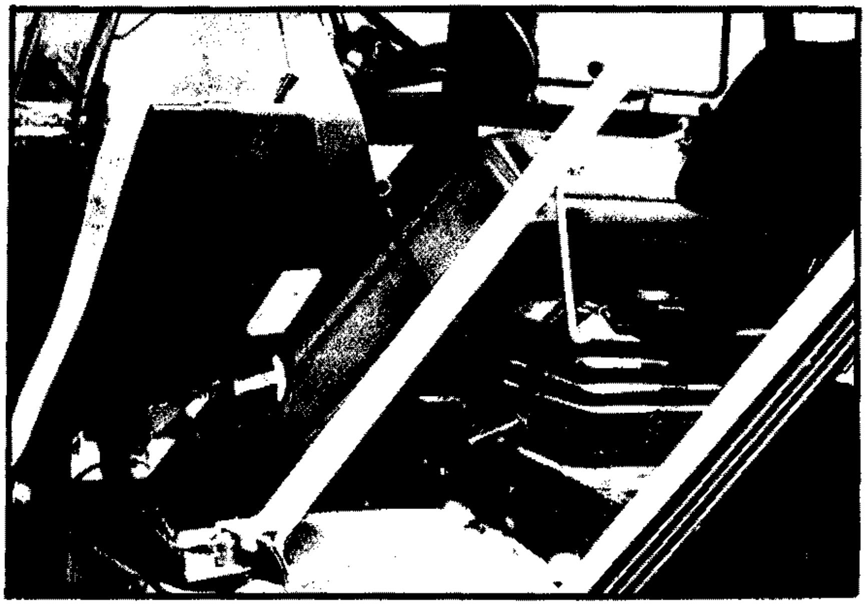

Figure 9. Detachable Clutch Hand Lever

Clutch:

The clutch hand lever is constructed of 1″ rectangular tubular steel shaped for easy operation. On the lower end of the lever several rectangular steel plates are welded into a bracket that allows the lever to be mounted on the clutch pedal. No bolts are used; the mounting bracket holds itself in place due to its configuration (Figure 9).

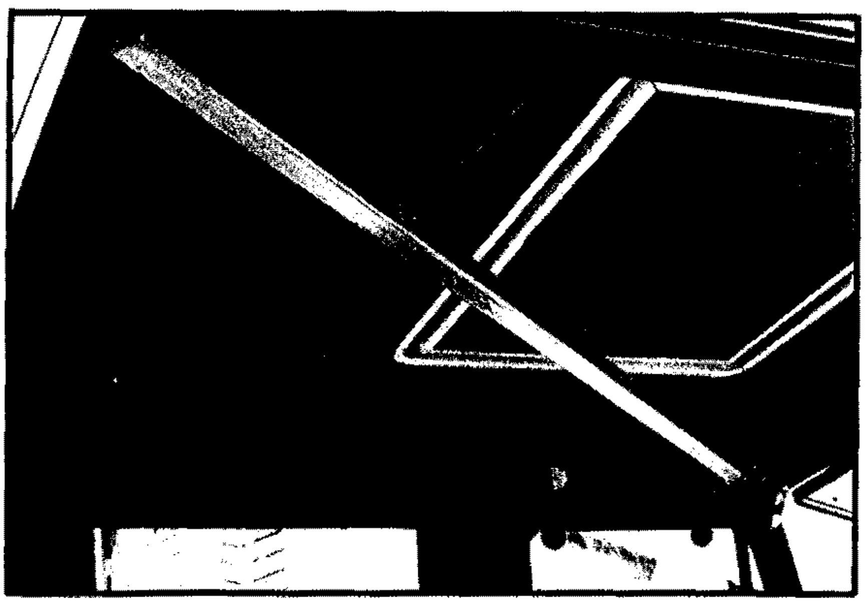

Figure 10. Overhead Handgrip Bar on Case 1290

This particular design allows for the clutch to be detached quickly and easily for operator entry and exit, and for pedal use by an able bodied operator. At the upper end of the clutch lever a "J"-shaped steel rod is mounted such that it pivots slightly. The lower end of the rod forms a hook that fits into a hole under the seat. This allows the operator to push the clutch lever down and lock the clutch in the disengaged position, freeing his left hand for other activities.

Overhead Grip Bar:

An overhead grip bar is designed and installed in the ROPS cab on the Case 1290 tractor to aid operator access to the tractor seat. The grip bar is made of 1" rectangular tubular steel tubing, 3/16" wall, with a 1" x 1 1/2 steel plate welded on each end. One end of the bar is welded to the upper front left hand post of the ROPS. The other end of the bar is bolted to a 1" x 1 1/2" steel plate welded to the right rear post of the cab. The steel plate has 2 bolts welded to it that match the holes in the steel plate on the end of the bar. The grip bar is shown in Figure 10.

Figure 11. PNEU-CON Wide Rear View Mirror

ACCESSORIES

Mirrors:

A full view tractor mirror is installed on the Case 1290. The mirror is manufactured by the PNEU-CON Corporation of Palatine, Illinois. The mirror provides an undistorted field of view directly behind the tractor. The mirror eliminates the need for the tractor operator to turn his head or upper torso when monitoring trailing implements. The mirror operates on a sliding mounting bracket which allows the operator to move the mirror as much as 10 inches horizontally and 10 inches vertically. If the mirror is not needed, it folds up out of the way (Figure 11).

The mirror is especially beneficial to farmers with back injuries. Other types of mirrors and locations can be used to aid in hitching and various types of field monitoring.

Hitching Mechanism:

A Sta-Fast hitch can be used to aid a farmer with restricted mobility to hitch and unhitch implements himself. Sta-Fast Hitches, Inc., is located in Milford, Indiana. The hitching mechanism bolts to the tractor drawbar (Figure 12). A spring attached to a steel plate is welded to the tongue of the implement. The other end of the spring is attached to a stationary part of the implement. This keeps the tongue of the implement off of the ground and enables easy hitching (Figure 13).

The assembly easily attaches to many different tractors and implements. Tongue assembly does not interfere with normal drawbar use. A spring-loaded pin allows hitching and unhitching from the cab by pulling on a rope.

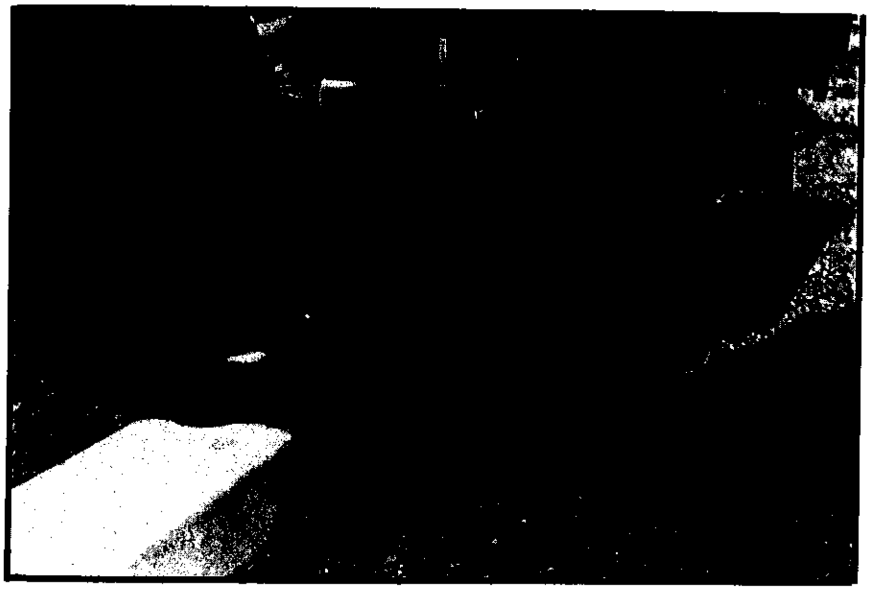

Figure 12. Sta-Fast Hitch mounted on Tractor

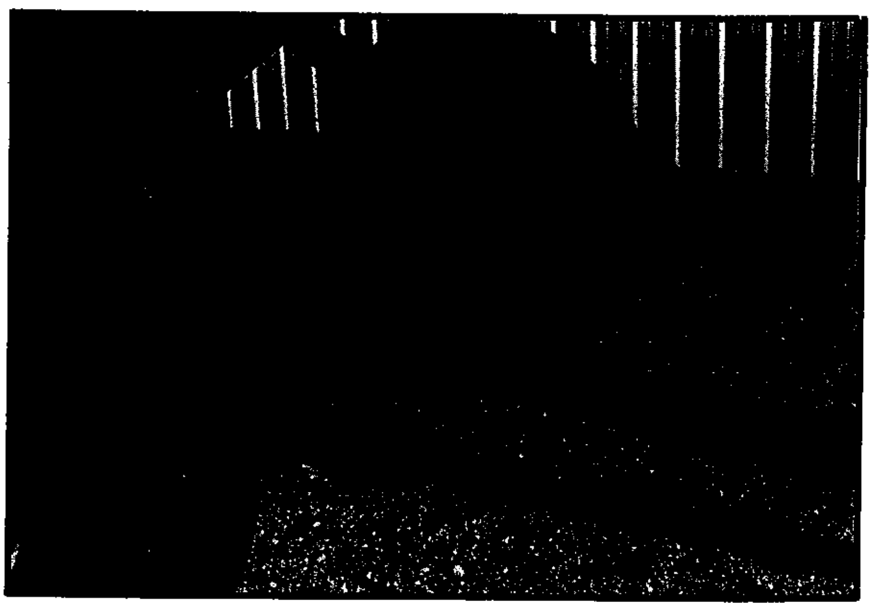

Figure 13. Spring Assembly mounted on Wagon Tongue

ESTIMATED COST*

LIFT

Hardware	79.32
2 Sheaves for 3L V-Belt	7.23
V-belt	2.28
Acme Screw (Lift Screw)	55.00
Electric Motor 12V DC 1/6 HP	41.31
Switches and Wiring	16.67
Pull Strap	4.20
Steel	90.00
Paint	12.00
	PARTS: $ 308.01
Labor Cost (Approximately 240 hours)	LABOR: $ 1440.00
	TOTAL: $ 1748.01

CONTROL MODIFICATIONS

Hardware	1.85
Steel	9.20
Labor	42.00
	TOTAL: 53.05

GRIP BAR

Hardware	2.05
Steel	10.00
Labor	24.00
	TOTAL: $ 36.00

*At time of construction, 1985

MIRROR

PNEU-CON Mirror
Wide View Mirror
P.O. Box 61
Palatine, IL 60067 — $ 44.95*

HITCHING

Sta-Fast Hitch	7/8″ pin size	195.00*
R.R. #2, Box 60	1 1/4″ pin size	295.00
Milford, IN 46542		

*Prices available at time of printing.

Price subject to change without notice.

II. PLATFORM LIFTS OPERATED IN A STANDING POSITION

SHIRLEY HOLLOPETER'S PLATFORM LIFT

FARMER: Shirley Hollopeter
R.R. #3
Albion, IN 46701

DESIGNED BY: Braun Corporation
1014 S. Monticello
Winamac, IN 46996

SUMMARY

Function:

Shirley Hollopeter's platform lift is designed to be mounted on a farm tractor to help her gain access to the operator's station.

The lift is shown mounted on a Ford TW-20 in Figure 1.

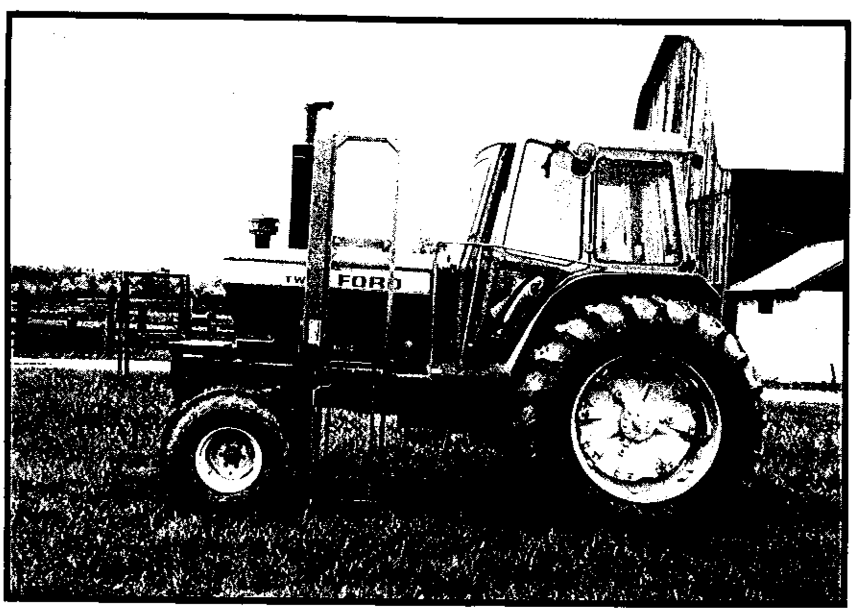

Figure 1. Shirley Hollopeter's Platform Lift

Farmer:

Shirley Hollopeter was active in a farm operation in northern Indiana until she suffered a stroke which left her with limited use of her left side. As she recovered, she still had a strong desire to return to farming.

Mrs. Hollopeter needed a way to access her tractor and to use the controls on the left side of the tractor. After purchasing a Ford TW-20 tractor, the Braun Corporation installed a lift on the tractor and modified the clutch so that it was operable from the right side of the tractor.

Mrs. Hollopeter once again is actively involved in field work on the farm and with other chores she can perform with the tractor.

Modified Machine:

Tractor: Ford TW-20

Features: ROPS Cab

Front Tire Size:	11.0-16
Rear Tire Size:	18.4-38
PTO HP:	130

Adaptability:

This lift was designed specifically to be mounted on a Ford TW-20 tractor. The same lift can possibly be mounted on other tractors with a few changes in the mounting frame. Similar lifts have been installed by the Braun Corporation on a John Deere 8430 and an International 186 Hydro tractor. The Braun Corporation has also installed a lift with wheelchair carrying capacity on an International 186 Hydro tractor.

Compatibility:

1. The lift does not interfere with the use of the tractor by an able bodied operator because there is a door and accessible steps on the other side of the cab.
2. There were no major alterations of the tractor required to install the lift.
3. The lift is designed so that it can be easily removed for service of the tractor or for resale.

Service and Maintenance:

1. The chain may need to be tightened and lubricated periodically.
2. The hydraulic circuit should be checked periodically for possible leaks.
3. Electrical switches and wiring need to be kept in good repair to prevent failure.
4. The components are accessible for ease of service and maintenance.

Accessibility and Ease of Use:

1. The lift is accessible for a farmer who has limited use of his legs and is able to stand up,

or by a farmer who uses leg braces and/or crutches.

2. The operator must stand on the lift platform to access the tractor.
3. The lift is quiet during operation and has a smooth ride.
4. Little training is required to operate the lift.

CONSTRUCTION DESCRIPTION

The construction of Shirley Hollopeter's platform lift is described in the following subsections: Stationary Frame, Lift Guide, Lift Platform, Lift Actuation, Lift Controls, and Cab Entry Platform.

Stationary Frame:

The stationary frame functions as a mounting frame and is constructed from steel tubing and welded steel bars. The frame attaches to both sides of the tractor and passes over the top of the engine compartment. The frame is bolted to the tractor frame for support. This type of design ensures adequate support and prevents twisting in rough terrain.

On the opposite side of the lift platform the mounting frame is constructed of two vertical steel tubes welded to a length of "L"-shape steel that is bolted to the tractor frame. The vertical steel tubes are bent slightly to fit tightly around the contour of the tractor's engine compartment. Two steel rods are welded between the two vertical tubes to increase the strength and rigidity of the frame (Figure 2). The same construction extends horizontally over the top of the engine compartment.

The horizontal frame section is bolted to a rectangular steel bar which is welded between two vertical steel tubes which form the guide mechanism for the lift (described under the reference to "Lift Guide") as shown in Figure 3. The other mounting frame attachment point is a steel compartment enclosing the hydraulic pump and components to power the lift. This compartment is bolted to the tractor frame. Two triangular steel plates extend up from each side of the compartment and are welded to the lower end of the vertical lift guide tubes (Figure 4).

The design of the mounting frame allows quick removal of the lift for tractor service or resale.

Lift Guide:

The lift guide is constructed from two rectangular steel tubes that are attached vertically to the mounting frame. Inside the vertical tubes, steel channels covered with a teflon-like coating are added to provide bearing surfaces which eliminates the need for grease. Vertical steel tubes attached to the lift platform slip inside the guide tubes.

Lift Platform:

The lift utilizes a platform to carry the operator. The platform is a rectangular steel frame with expanded steel welded over it. The platform has two short sides of steel welded on the edge closest to the tractor and on the edge next to the front wheel. This helps keep the operator's feet from sliding off the platform.

Round steel tubing is welded to the sides of the platform and extends up vertically to approximately waist high. Here the tubing bends to form a horizontal handgrip on the front and left side of the platform (Figure 5). A switch to operate the lift is mounted underneath the front horizontal handgrip tube. A mechanical latch is attached to the handgrip tube so the lift can be securely

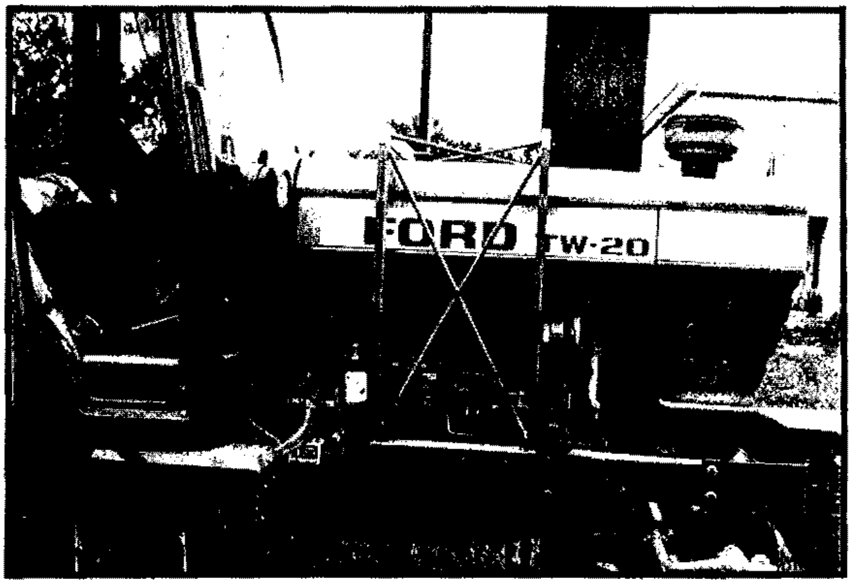

Figure 2. *Lift Mounting Bracket on Right Side of Tractor*

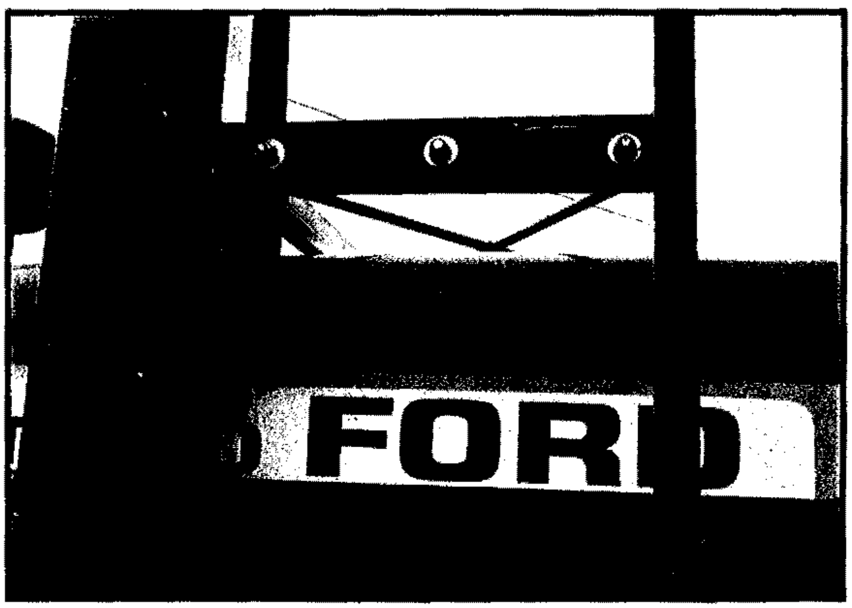

Figure 3. *Mounting Bracket Attachment to Lift Guide Tubes*

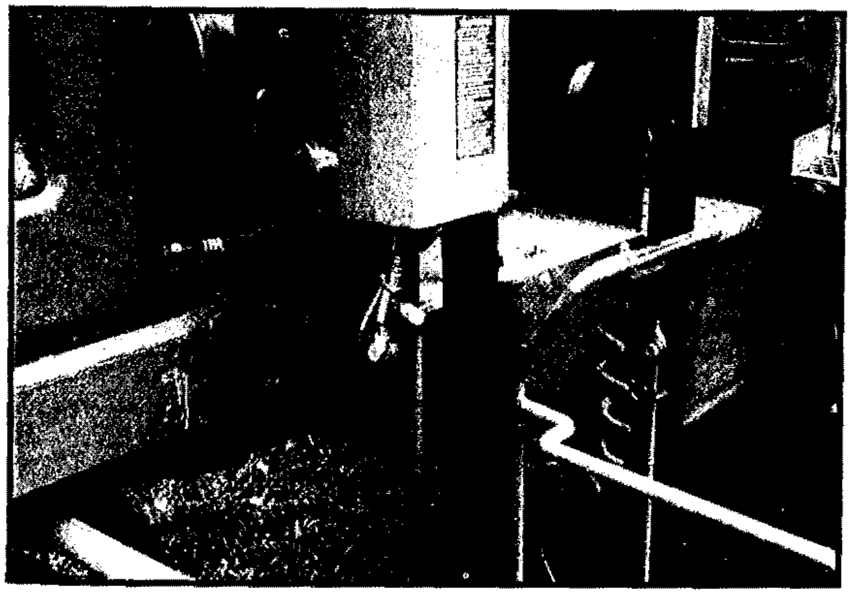

Figure 4. Hydraulic Component Box and Mounting to Tractor

Figure 5. Lift Platform

fastened in the raised position while operating the tractor.

Two rectangular steel tubes are welded to the lift platform and extend up vertically into the lift guide tubes. Sprockets are mounted on the upper end of each vertical tube to which a chain passes around to raise and lower the platform. Each chain travels from the sprocket up through the lift guide tube where it passes over another set of sprockets at the top of the guide tubes. The chain travels horizontally at this point in a protective steel covering then travels down along the outside of the left guide tube where both chains pass around sprockets mounted on the lift's hydraulic cylinder rod.

Lift Actuation:

The lift uses a 12-volt DC hydraulic system separate from the tractor hydraulic system. Figure 6 shows the components in the hydraulic system. The system is powered by a Monarch pump which has a capacity of 0.8 to 0.9 gallons per minute at 2000 psi. The pump is equipped with a bypass valve that functions when the lift is in the raised position to prevent damage to the pump if the switch is not released. A pressure compensated flow control valve is installed in the hydraulic system to control the rate of descent of the lift, based upon the weight the platform is carrying.

The lift uses one single-acting cylinder to raise and lower the lift. The cylinder allows gravity to lower the lift, reducing the battery drain and eliminating half of the cycle wear on the hydraulic pump. The hydraulic cylinder is attached to the roller chains which act on both telescoping lift tubes to raise and lower the lift.

Lift Controls:

Weatherproof switches are mounted underneath the handgrip bar on the lift platform, on the side of the cab entry platform, and inside the cab. The placement of the switches allows the operator to raise or lower the lift from the ground, operate the lift while standing on the platform, or operate the lift from the cab.

A "Circuit Sentry" manual-reset circuit breaker is mounted next to the battery on the right side of the tractor to protect the electrical system from overloads (Figure 7).

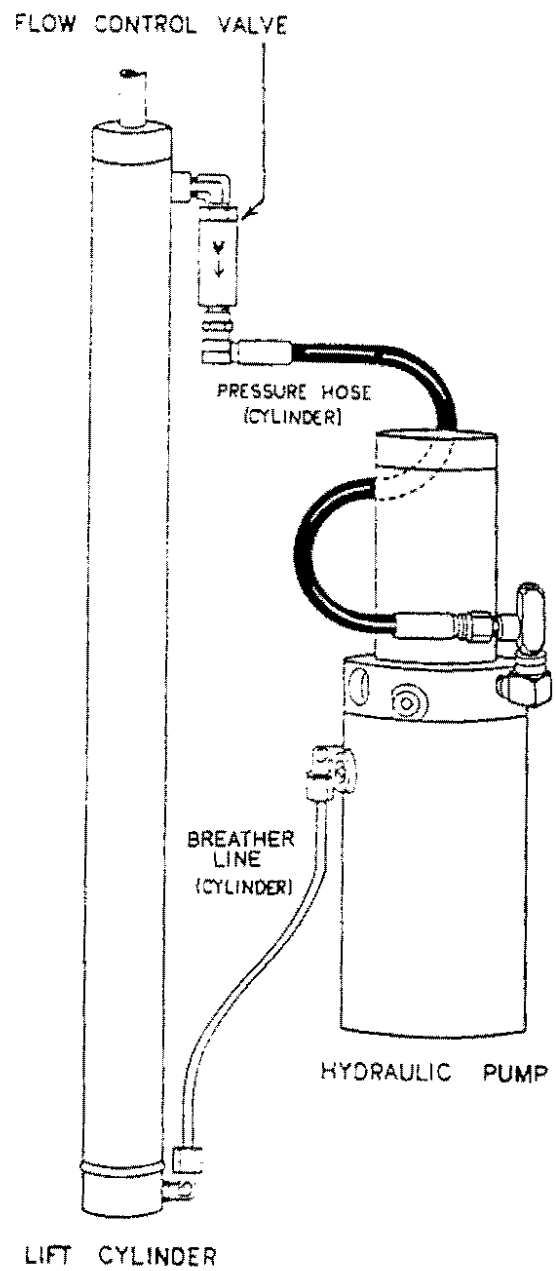

Figure 6. Hydraulic System Schematic

Cab Entry Platform:

A cab entry platform is mounted on the tractor to allow the operator to move from the lift platform to the tractor cab (Figure 8). A steel frame forms a platform outside of the tractor door. Expanded steel is welded over this frame to serve as a floor.

To keep mud off the platform, a metal fender is welded to the platform and attached to the tractor fender. Hand rails constructed from round steel tubing, are attached to the metal frame. The platform is attached to the tractor underneath the cab. A weatherproof switch is mounted on the outside of the platform to allow the operator to raise and lower the lift from the ground (Figure 8).

SAFETY CONSIDERATIONS

As a safety precaution, the tractor should always be shut off during lift operation.

Braun has chosen a separate 12-volt DC electrically-powered hydraulic system which offers the safety feature of not requiring the tractor to run during lift operation. This type of system also allows the placement of several switches wherever they are needed for accessibility.

The roller chains used in the lift mechanism allow for a smooth riding platform. The chains can be adjusted to increase tension and to keep the platform level. The chain is size 40 and has a tensile strength of 3700 pounds (Braun specifications).

A mechanical latch is added for safety, to prevent the lift from lowering if a leak in the hydraulic cylinder occurs.

The "Circuit Sentry" manual reset circuit breaker protects the electrical system from overloads. The unit is located close to the tractor battery for maximum protection.

The Hollopeter's are happy with their lift, but they see a few possible improvements that could be made one of

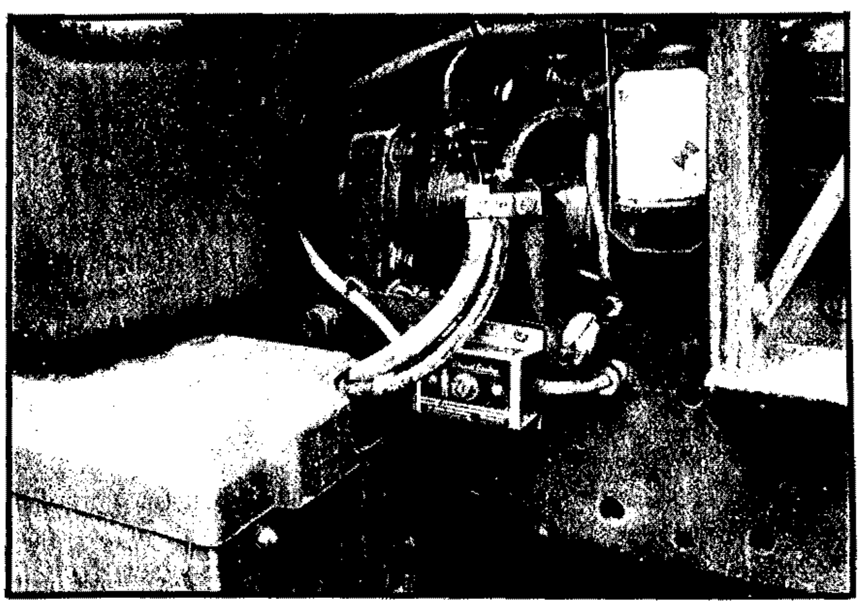

Figure 7. Circuit Sentry Manual Reset Breaker

which is described below.

The Hollopeter's are concerned with the possibility of someone operating the tractor while the lift is in the lowered position. They feel that an electrical time delayed device should be installed on the tractor which would automatically raise the lift 5 or 10 minutes after the tractor has been shut off. Their other idea was a device which would not let the tractor start until the lift is raised. This would reduce the problem of someone using the door on the opposite side of the tractor and driving off with the lift down and damaging it. The Hollopeter's feel that this should be a requirement for all lifts.

DESCRIPTION OF OPERATION

To mount the tractor, the operator moves up next to the tractor. If the lift is in the raised position, she pushes the switch mounted on the side of the cab entry platform to lower the lift (Figure 8). The operator climbs onto the lift platform and grabs hold of the grip bar on the front of the lift platform (Figure 9). The operator then uses the switch mounted under the horizontal hand grip bar to raise the lift. The operator locks the platform in the raised position, using the mechanical latch on the vertical handgrip tubing, and then moves onto the cab entry platform while holding onto the handrails. From there she proceeds into the tractor cab (Figure 10).

To dismount, the operator from the tractor cab onto the cab entry platform, holds onto the handrail and moves onto the lift platform. She then releases the mechanical latch and moves the switch to lower the lift, which lowers by gravity to the ground.

Figure 8. Cab Entry Platform

Figure 9. *Operator on Lowered Platform*

Figure 10. *Operator Moving Onto Cab Entry Platform*

CONTROL MODIFICATIONS

Clutch:

The clutch lever is designed to be operational from the right side of the tractor console. This allows Shirley to operate it with her right hand, due to limited mobility of her left side.

The clutch lever is constructed from steel bar stock. The lever is attached to a pivot point and linkage which connects to a horizontal shaft with a rack and pinion arrangement on the opposite end. The pinion gear is attached to the horizontal shaft (Figure 11). The rack is connected to the conventional foot pedal by an adjustable connecting rod.

A notched steel plate welded near the handle of the hand lever is used to lock the lever in the disengaged position. It is locked on the round tubing that encloses the gear shift levers on the tractor (Figure 12). It is important that the clutch be designed so that it can be locked in the disengaged position to free the operator's hand and for safety reasons.

To disengage the clutch, the operator pulls back on the lever which causes the horizontal shaft to rotate and actuates the rack and pinion, thus disengaging the clutch. An able bodied operator can use the clutch pedal with the modifications in place.

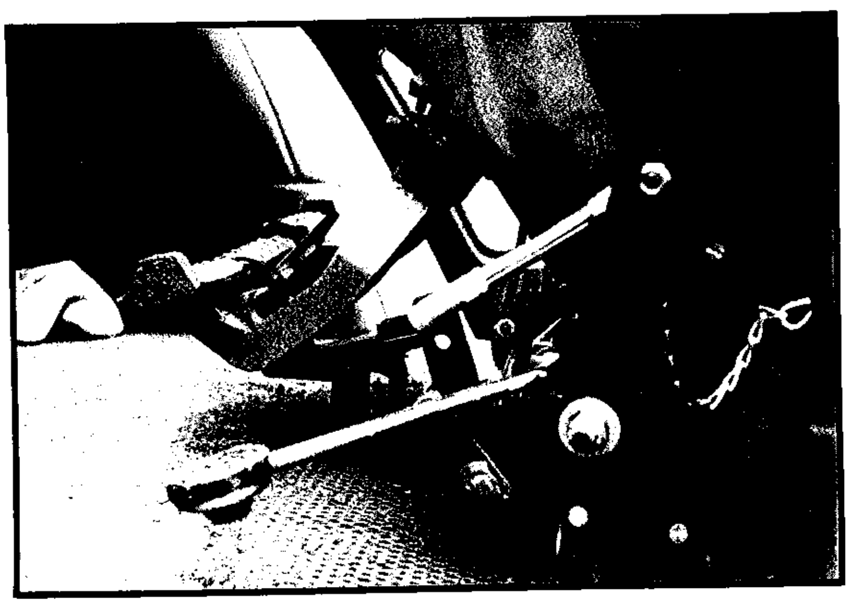

Figure 11. Hand Control Clutch Mechanism

Figure 12. Clutch Locked in Disengaged Position

ESTIMATED COST*

Estimated price of all modifications: $6200.00

*At time of construction

CHIP PETREA'S PLATFORM LIFT

FARMER: **Chip Petrea**
Iuka, IL 62847

DESIGNED BY: **Braun Corporation**
1014 S. Monticello
Winamac, IN 46996

SUMMARY

Function:

Chip Petrea's platform lift is designed to be mounted on an International Harvester 186 Hydrostatic tractor (Figure 1). The chairlift enables Mr. Petrea to gain access to the operator's station. The tractor contains control modifications and accessories which are described later in this section.

Figure 1. Braun Platform Lift

Farmer:

Chip Petrea lost both lower limbs above the knee in a farm accident. He is part owner/operator on a 500 acre dairy farm in Southern Illinois with his three brothers.

To enable Chip to continue to be active in actual field work, an International Harvester 186 Hydrostatic tractor was purchased. The tractor had to be modified to provide a way for Chip to access the tractor cab and also provide a means of operating the controls in the cab.

The lift and control modifications were completed in 1981 by the Braun Corporation of Winamac, Indiana and R.J. Mobility of Chicago, Illinois.

Modified Machine:

Tractor: International Harvester 186 Hydro

Features: ROPS Cab

Year: 1979

Hydrostatic Transmission
Door on Both Sides of cab
Steps on One Side of cab
Rear View Mirrors

Adaptability:

This lift was designed specifically to be mounted on an International Harvester 186 Hydrostatic Tractor. The same lift can be mounted on another tractor with changes in the mounting frame. Similar lifts have been installed by the Braun Corporation on a Ford TW-20 tractor (see Shirley Hollopeter's Platform Lift) and a John Deere 8430 tractor (see Bill Gundrum's Platform Lift). A second International Harvester 186 Hydro tractor was modified by the Braun Corporation with a lift design that provides wheelchair carrying capacity (see Paul Augsburger's Wheelchair Lift).

Compatibility:

1. The lift does not interfere with the use of the tractor by other operators because the cab is designed with door and steps on the side opposite the lift.
2. The main shifting lever was cut off and welded in a position where it would not interfere with Mr. Petrea accessing the tractor seat.
3. The lift is designed to be easily removed for service of the tractor or to trade-in the tractor.
4. The cab door was removed and hinges reversed so that the door would swing open toward the rear of the tractor.

Service and Maintenance:

1. The chain may need to be tightened and lubricated periodically.
2. The hydraulic circuit should be checked periodically for leaks.
3. Electrical switches and wiring need to be kept in good repair to prevent failure.
4. The components are accessible for ease of service and maintenance.

Accessibility and Ease of Use:

1. The lift is accessible to a farmer who has limited use of his legs and is able to stand up, or by a farmer who uses leg braces and/or crutches.
2. A bracket is provided on the lift for placement of crutches while the tractor is being used.
3. Use of the lift requires little training.

CONSTRUCTION DESCRIPTION

The construction of Chip Petrea's platform lift is discussed in the following subsections: Stationary Frame, Lift Guide, Lift Platform, Lift Actuation, Lift Controls, and Cab Entry Platform.

Stationary Frame:

The stationary frame functions as a mounting frame and is constructed of steel tubing and welded steel bars. The frame attaches to both sides of the tractor and passes over the top of the engine compartment. The frame is bolted to the tractor frame for support. This type of design ensures adequate support and prevents twisting in rough terrain.

On the opposite side of the lift platform the mounting frame is constructed of two vertical steel tubes welded to an "L"-shape steel plate that is bolted to the tractor frame. The vertical steel tubes are bent slightly to fit tightly around the contour of the tractor's engine compartment. Two steel rods are welded between the two vertical tubes to increase the strength and rigidity of the frame (Figure 2). The same construction extends horizontally over the top of the engine compartment.

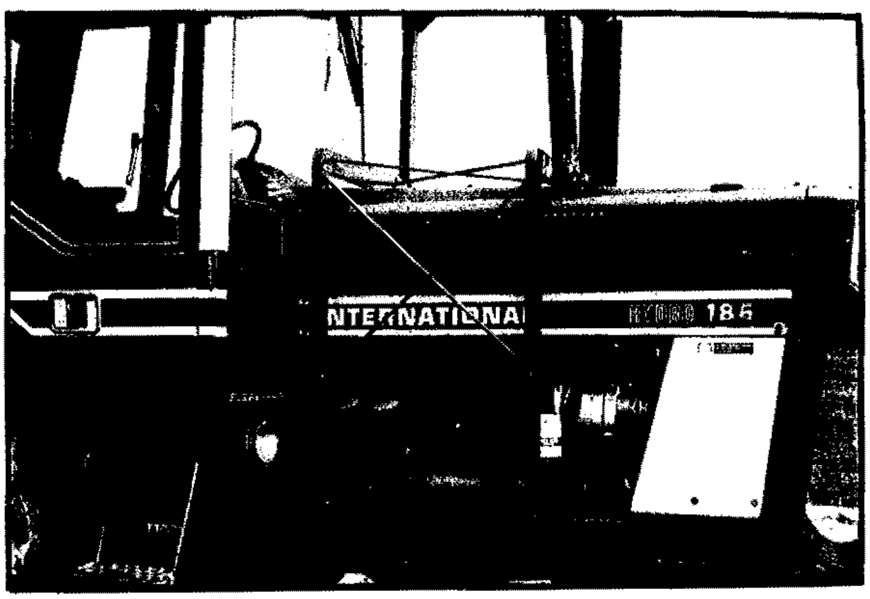

Figure 2. Lift Mounting Frame on right side of Tractor

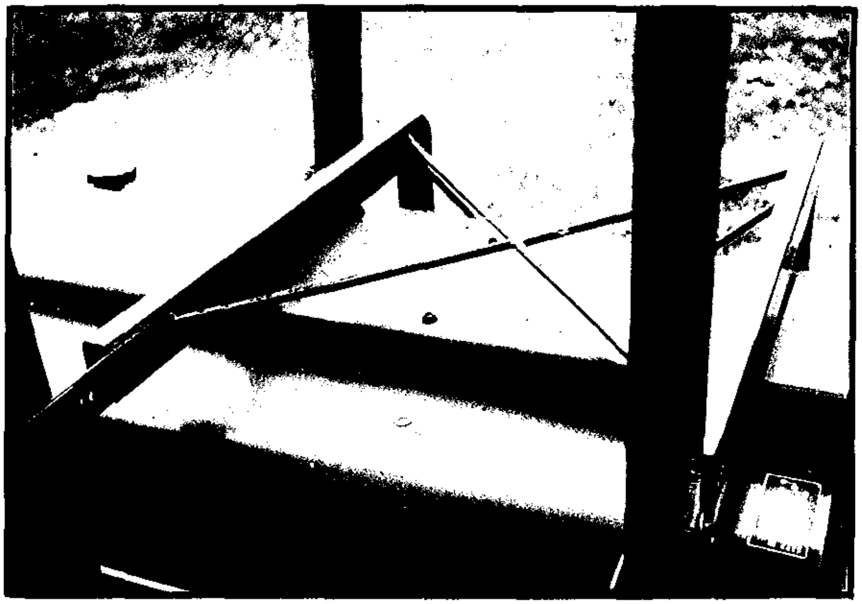

Figure 3. Mounting Frame attachment to Lift Guide Tubes

Figure 4. Lift Platform

The horizontal frame section is bolted to a rectangular steel bar which is welded between two vertical steel tubes forming the guide mechanism for the lift (described under the reference to "Lift Guide"), as shown in Figure 3. The other mounting frame attachment point is a steel compartment enclosing the electric motor and hydraulic pump and components to power the lift. This compartment is bolted to the tractor frame. Two triangular steel plates extend up from each side of the compartment and are welded to the lower end of the vertical lift guide tubes.

The design of the mounting frame allows for quick removal of the lift for tractor service or resale.

Lift Guide:

The lift guide is constructed of two vertical steel tubes that are attached to the mounting frame. Inside the vertical tubes, steel channels are added to provide bearing surfaces which are covered with a teflon-like coating that eliminates the need for grease. Steel tubes attached to the lift platform slip inside the guide tubes.

Lift Platform:

The lift utilizes a platform to carry the operator. The platform is a rectangular steel frame with expanded steel welded over it (Figure 4). The platform has two short steel plates welded on the side closest to the tractor and on the side next to the front wheel. This helps keep the operator's feet from sliding off the platform.

Round steel tubing is welded to the sides of the platform and extends up vertically to approximately waist height. Here the tubing bends to form a horizontal handgrip on the front and left side of the platform (Figure 5). A switch to operate the lift is mounted underneath the front horizontal handgrip tube. The location of the switch is shown on the center of the handgrip bar in Figure 6.

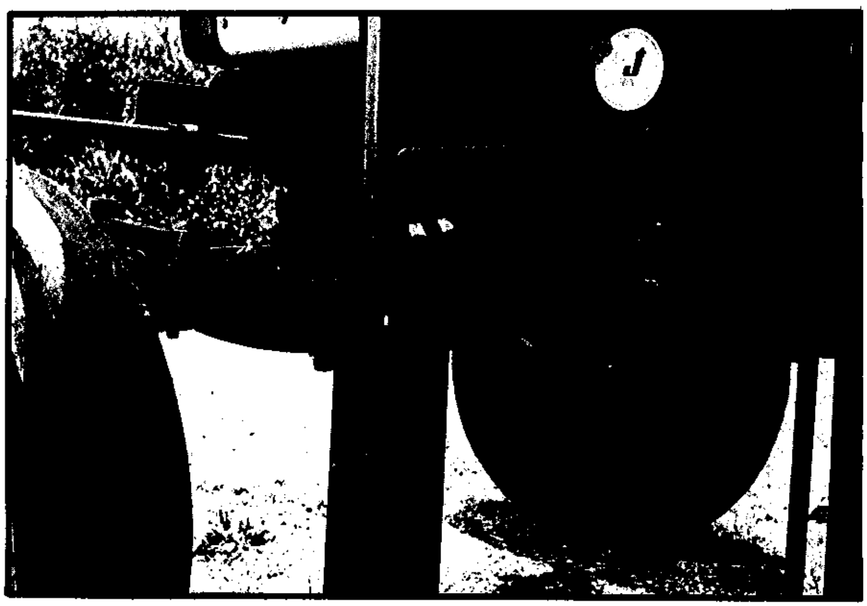

Figure 5. Handgrip Bars

A small square steel bracket is located in the left hand corner of the lift platform,

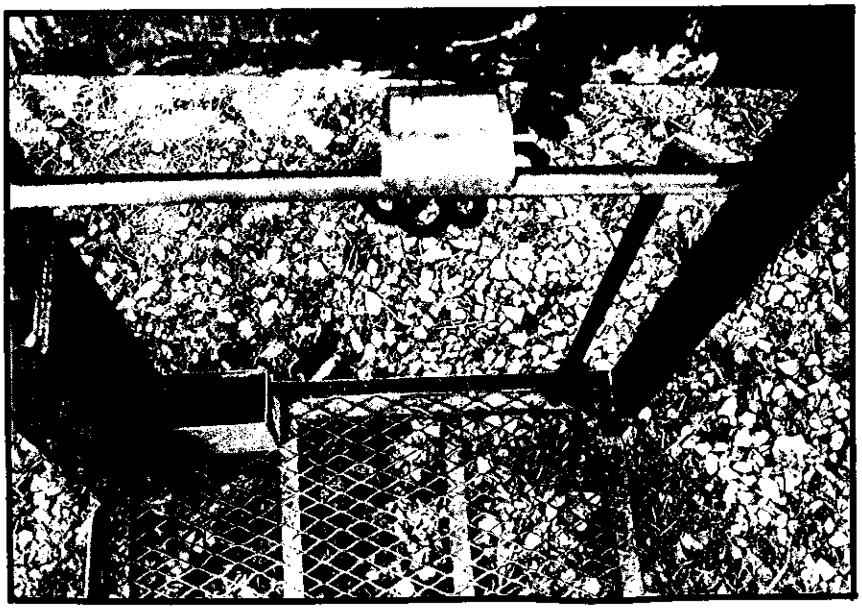

Figure 6. Switch, Grip Bar and Crutch Bracket

providing a place for Mr. Petrea to place his crutches while operating the tractor.

Two rectangular steel tubes are welded to the lift platform and extend up vertically into the lift guide tubes. Sprockets are mounted on the upper end of each vertical tube around which a chain passes to raise and lower the platform. Each chain travels from the sprocket up through the lift guide tube where it passes over another set of sprockets at the top of the guide tubes. The chain travels horizontally at this point in a protective steel covering. It travels down along the outside of the lift guide tube where both chains pass around sprockets mounted on the lift's hydraulic cylinder rod.

Lift Actuation:

The lift uses a 12-volt DC electric/hydraulic system separate from the tractor hydraulic system. Figure 7 shows the components in the hydraulic system. The system is powered by a Monarch pump with a capacity of 0.8 to 0.9 gallons per minute at 2000 psi. The pump is equipped with a bypass valve that functions when the lift is in the raised position to prevent damage to the pump if the switch is not released. A pressure compensated flow control valve is installed in the hydraulic system to control the rate of lift descent, based upon the weight the platform is carrying.

The lift uses one single-acting cylinder to raise and lower the lift. The cylinder allows for gravity to lower the lift, reducing the battery drain and eliminating half of the

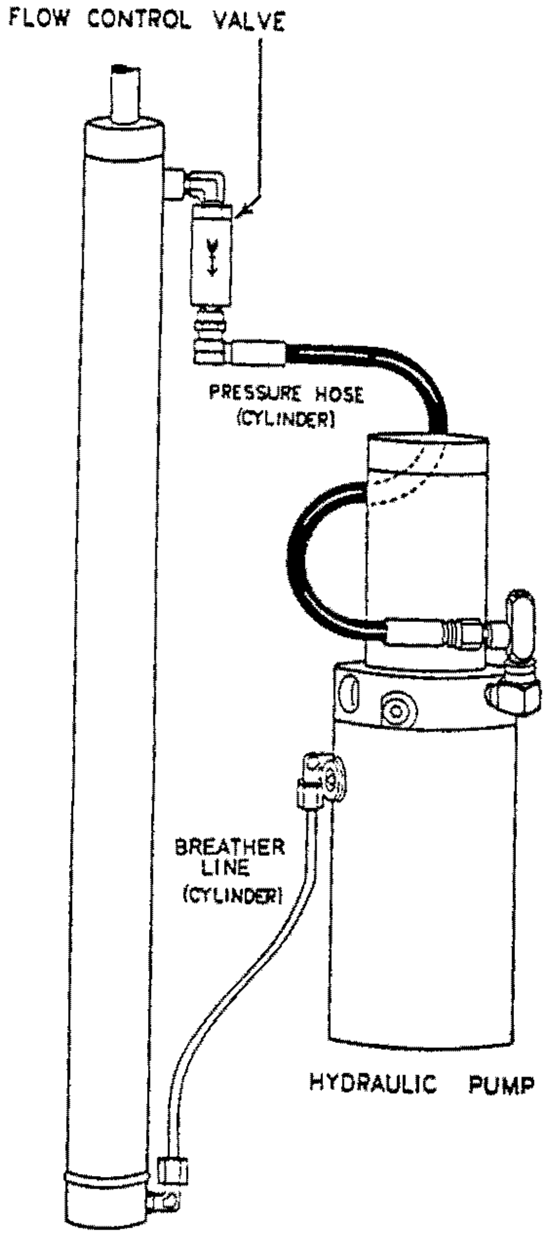

Figure 7. Hydraulic System Schematic

cycle wear on the hydraulic pump. The hydraulic cylinder is attached to the roller chains which act on both telescoping lift tubes to raise and lower the lift. The hydraulic cylinder is shown in Figure 8 with the protective metal covering removed.

Lift Controls:

Weatherproof switches are mounted underneath the handgrip bar on the lift platform, on the side of the cab entry platform, and inside the cab. The placement of the switches allows the operator to raise or lower the lift from the ground, operate the lift while standing on the platform, or operate the lift from the cab.

A "Circuit Sentry" manual reset breaker is mounted next to the battery on the right side of the tractor to protect the power system from overloads.

Cab Entry Platform:

A cab entry platform is mounted on the tractor to allow the operator to move from the lift platform to the tractor cab (Figure 9). A steel frame forms a platform outside the tractor door. Expanded steel is welded over this frame to serve as a floor.

To keep mud off of the platform, a metal fender is welded to the platform and attached to the tractor fender. Handrails constructed from round steel tubing are attached to the metal frame. The platform is attached to the tractor underneath the cab.

SAFETY CONSIDERATIONS

As a safety precaution, the tractor should always be shut off during lift operation.

Figure 8. Hydraulic Cylinder Mounting

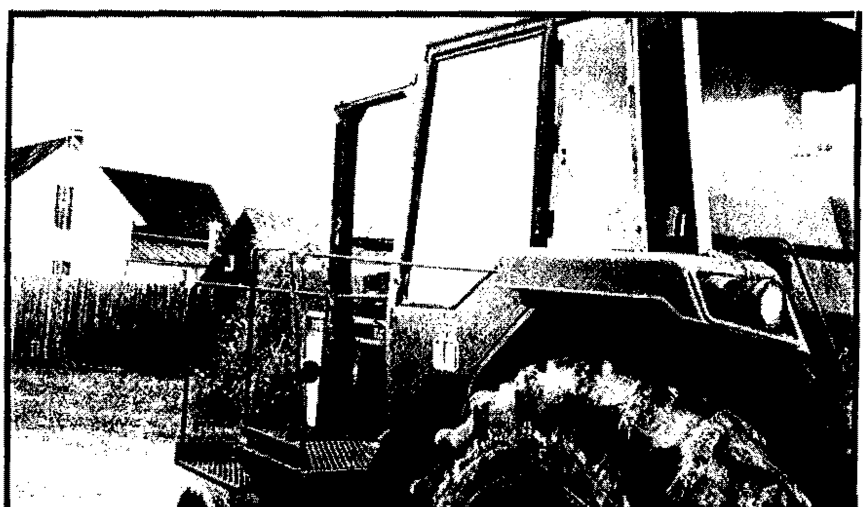

Figure 9. Cab Entry Platform

Braun chose a separate 12-volt DC electrically-powered hydraulic system which offers the safety feature of not requiring the tractor to be operated during lift operation. This type of system also allows the placement of several switches wherever they were needed for accessibility.

The roller chains used in the lift mechanism allow for a smooth riding platform. The chains can be adjusted to increase tension and to keep the platform level. The chain is a No. 40 roller chain and has a tensile strength of 3700 pounds (Braun Specifications).

The lift could use a device that would raise the lift platform after the engine has been shut off for a short length of time. This would help prevent the possibility of other operators mounting the tractor on the opposite side of the cab and driving off with the lift in the lowered position, thus damaging the lift.

Another potential hazard is that the lift platform extends beyond the rear tractor wheel if duals are not on the tractor, and the platform could be damaged by running into another object. To reduce this hazard, slip out the wheels on the axle. This happened to Mr. Petrea's lift and is the reason some of the pictures show damage to the lift. The lift struck a telephone pole during forage harvesting.

DESCRIPTION OF OPERATION

To mount the tractor, Mr. Petrea moves up next to the tractor. If the lift is in the raised position, he pushes the switch mounted on the side of the cab entry platform to lower the lift. Mr. Petrea steps onto the lift platform and grabs hold of the grip bar on the front of the lift platform (Figure 10). He places his crutches in the

Figure 10. Mr. Petrea on lowered Platform

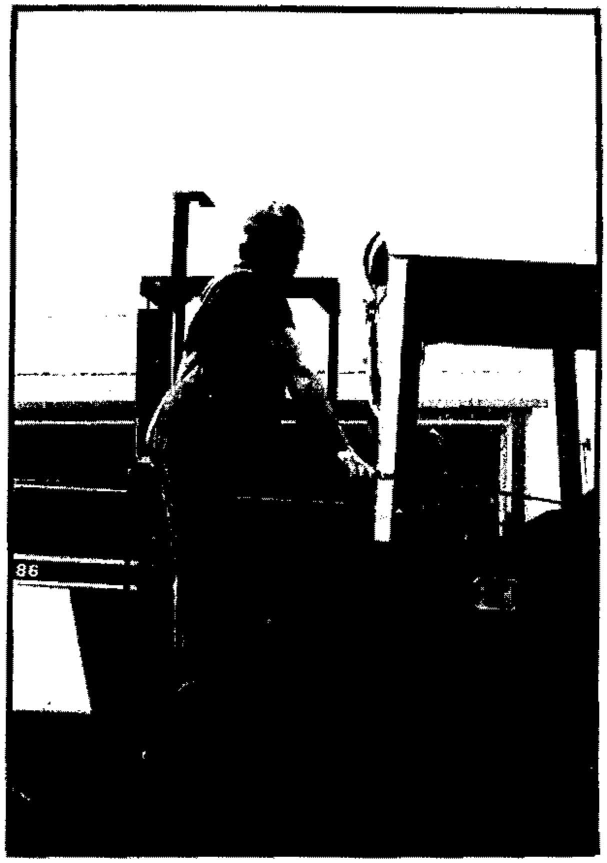

Figure 11. Mr. Petrea moving onto cab Entry Platform

Figure 12. Lift in raised Position

bracket to secure them during field work (Figure 6). Mr. Petrea then uses the switch mounted under the horizontal handgrip bar to raise the lift. He moves from the lift platform to the cab entry platform (Figure 11), and proceeds into the tractor cab (Figure 12).

To dismount, Mr. Petrea moves from the tractor cab onto the cab platform, holding the handrail and moving onto the lift platform. He then moves the switch to lower the lift, which lowers by gravity to the ground.

CONTROL MODIFICATIONS

Clutch:

The International Harvester 186 Hydrostatic contains a clutch that is only needed when changing the transmission from high to low range.

The clutch was modified for hand operation by using a steel lever that can be locked in an up (stowage) position. It is placed out of the way for moving in and out of the tractor cab.

Brake:

Mr. Petrea's hand brakes consist of two vertical steel round levers constructed of round bar stock mounted to a bracket on the cab floor, which allows them to pivot around a pin. These levers are connected by adjustable linkages to another pivot assembly in a bracket mounted to the cab floor underneath the brake pedals. From this second pivot assembly, another set of linkages connect to the brake pedal shanks (Figures 13, 14 and 15).

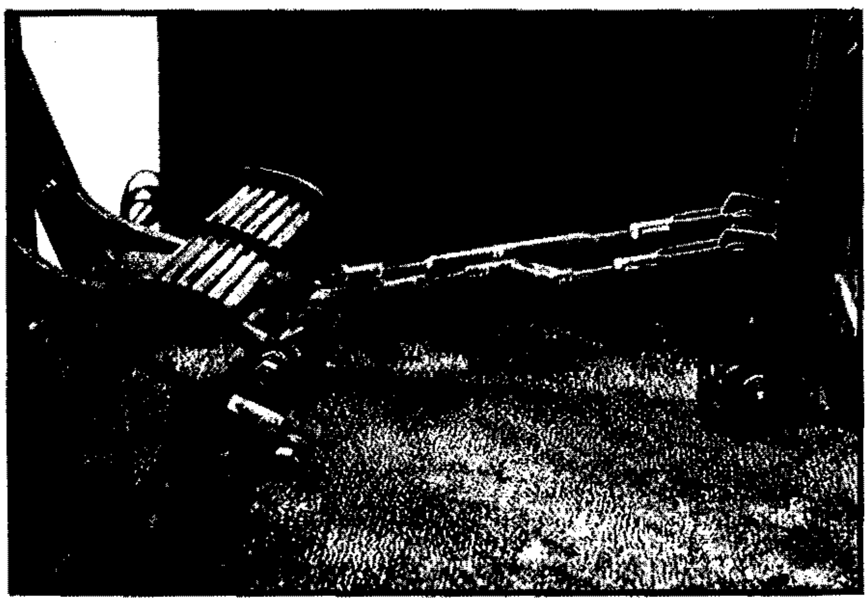

Figure 13. Hand Control Brake Mechanism

To engage the brakes, Mr. Petrea pushes forward on the hand levers. The extended length of the hand levers decreases the amount of strength required to operate the brakes. The hand levers feature rubber handgrips to reduce the chance of the operator's hand slipping off the lever.

Grease fittings were installed at each pivot point to help reduce wear and friction.

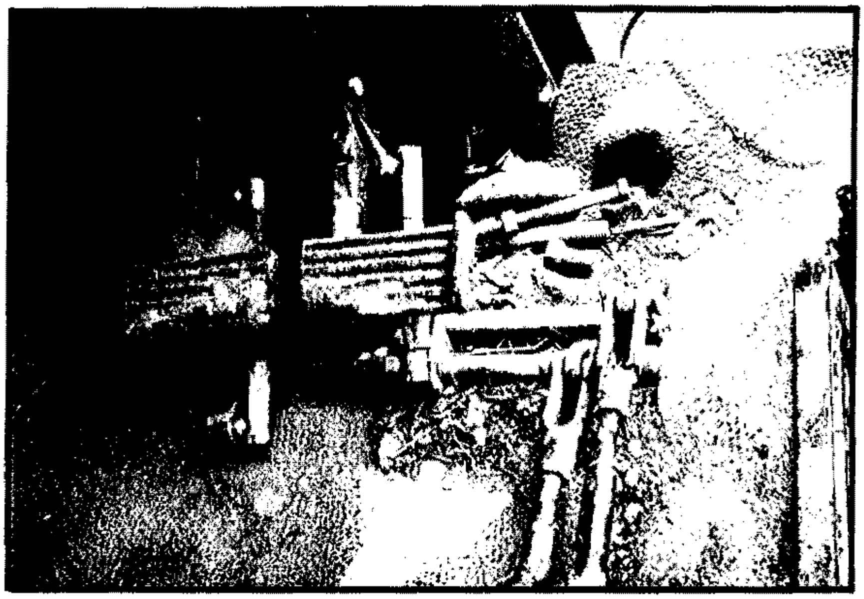

Figure 14. Pivot Assembly underneath Brake Pedals

Figure 15. Side view of Brake Hand Levers

ACCESSORIES

Grip Bar:

A grip bar was mounted inside the cab on both sides of the tractor seat to aid transfer in and out of the cab.

The grip bar was constructed of tubing molded into a "C"-shape and bolted inside the tractor cab (Figure 16).

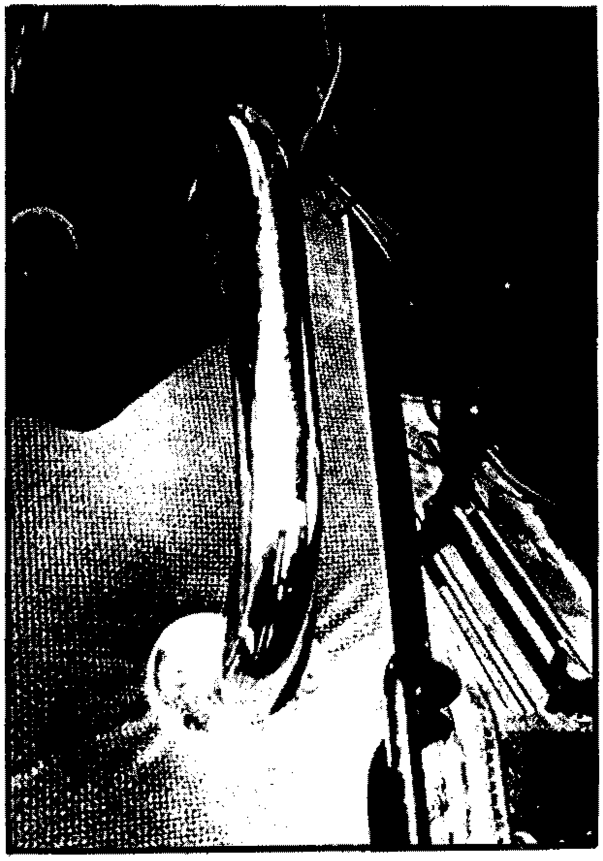

Figure 16. Grip Bar inside Tractor Cab

ESTIMATED COST*

Estimated price of all modifications: $ 18,500.00

*At time of construction, 1981

BILL BAME'S TRACTOR PLATFORM LIFT

FARMER: **Bill Bame**
14347 C.R. 179
Findlay, OH 45840

SUMMARY

Function:

Bill Bame's tractor platform lift was designed specifically to be mounted on a John Deere 4440 tractor (Figure 1). The platform lift enables Mr. Bame, a paraplegic, to gain access to the operator's station. The tractor contains control modifications and accessories which are reviewed later in this section.

Figure 1. Bill Bame's Platform Lift

Farmer:

Bill Bame farms 800 acres of corn and soybeans in Northern Ohio. He is also paraplegic.

To enable Mr. Bame to continue farming after his accident, his father-in-law built a platform lift for the John Deere 4440 tractor and International Harvester 1460 combine (see Bame's Combine Platform Lift). The two lifts are similar in operation. He also has an accessible shop where he can work from his wheelchair.

Modified Machine:

Tractor:	John Deere 4440
Features:	ROPS Cab
Rear Tire Size:	18.4-38
Front Tire Size:	11.0-16
PTO HP:	130
Year:	1980

Door on one side of cab
Steps on one side of cab
Grip bar on side of tractor
CB Radio

Adaptability:

This lift was designed specifically to be mounted on a John Deere 4440 tractor. The lift concept can possibly be used on other farm tractors of similar design. Several lifts of this type have been fabricated and are being used successfully.

Compatibility:

1. The lift interferes with an able-bodied farmer mounting the tractor, thus he also must employ the lift for tractor use.
2. The steps leading to the tractor's only door were removed for the installation of the lift.
3. No major permanent alterations were made to the tractor when installing the lift.
4. The clutch pedal has been separated from its shank and reattached offset to the right. This moved it farther away from the doorway to allow Mr. Bame to move more easily in and out of the cab.

Service and Maintenance:

1. The hydraulic circuit should be checked periodically for leaks.

2. The cable should be checked regularly for damage, wear or corrosion and be replaced if necessary. Failure of the cable could cause a serious fall, especially if the failure were to occur while the lift was in the raised position.

3. The components are accessible for ease of service and maintenance.

Accessibility and Ease of Use:

1. The lift is accessible for a farmer who has limited use of his legs and is able to stand up, or by a farmer who uses leg braces and/or crutches.

2. The operator must stand up on the lift platform to access the tractor.

CONSTRUCTION DESCRIPTION

The construction of Bill Bame's platform lift is discussed in the following subsections: Stationary Frame, Lift Guide, Moving Frame, Lift Platform, Lift Actuation, Lift Controls and Cab Entry Platform.

Stationary Frame:

A steel plate is bolted to the tractor frame along the left side of the engine. The plate extends down below the tractor frame where a short horizontal length of 3" square steel tubing is welded to it (Figure 2). A second length of 3" square steel tubing is welded vertically to the steel plate and to the end of the short horizontal tube. This vertical tube houses the hydraulic cylinder. A third length of 3" square steel tubing is welded horizontally to the vertical tube to form an "L"-shape structure. A pre-drilled rectangular steel plate is welded to the other end of the horizontal tube. This structure passes underneath the tractor engine and is bolted to the tractor frame. A drawing of the frame is shown in Figure 3.

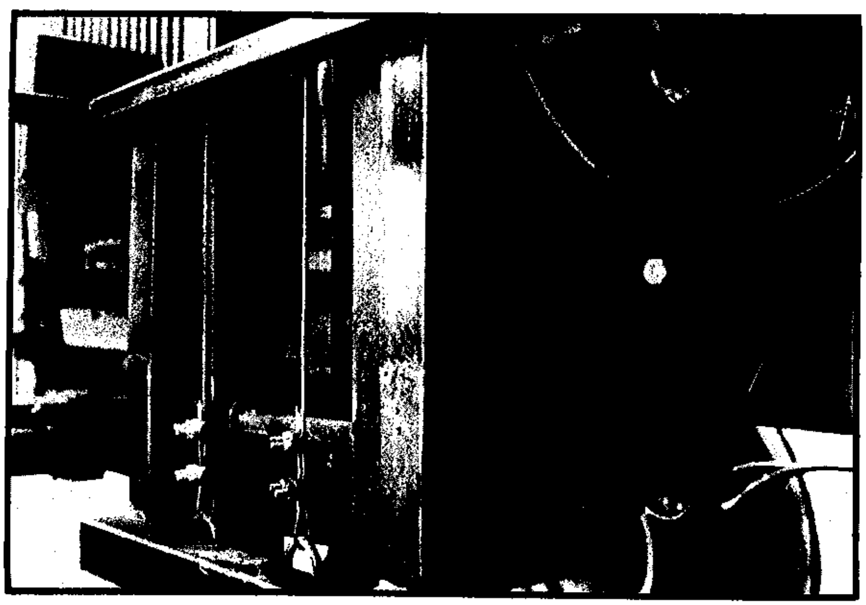

Figure 2. Mounting Plate and Horizontal Mounting Tube. Note Cable attached to Hooks on Horizontal Bar on Lift Platform.

Lift Guide:

Welded near the top and bottom of the front face of the vertical steel tube (which houses the hydraulic cylinder) are two horizontal steel rods with roller bearings on the ends. These rods function as a guide for the lift's moving frame (Figure 3).

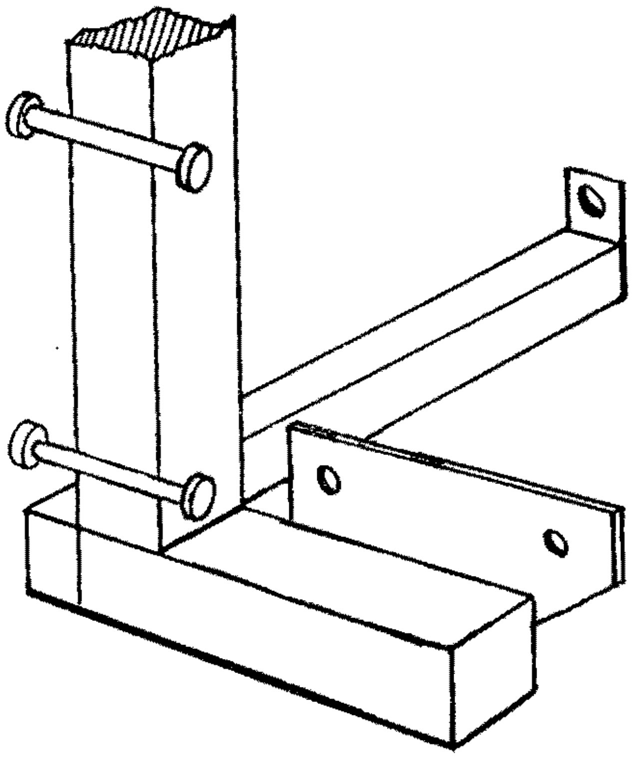

Figure 3. Mounting Frame and Lift Guide

Figure 4. I-beam Frame and Hydraulic Cylinder. Note: Mounted on Lift Platform Railing and Cab Entry Platform.

Moving Frame:

Two vertical steel I-beams, spaced 12-14" apart, are centered on each side of the vertical steel tube hydraulic cylinder housing. The two I-beams are fastened together at the top by square steel tubing welded to the front and back of the I-beams (Figures 4 and 5). A length of square steel tubing is centered between the I-beams and welded perpendicularly to the other tubes, and a steel rod attached to the cylinder ram rests in the tube. A horizontal steel rod fastens the I-beams at their base (Figure 5).

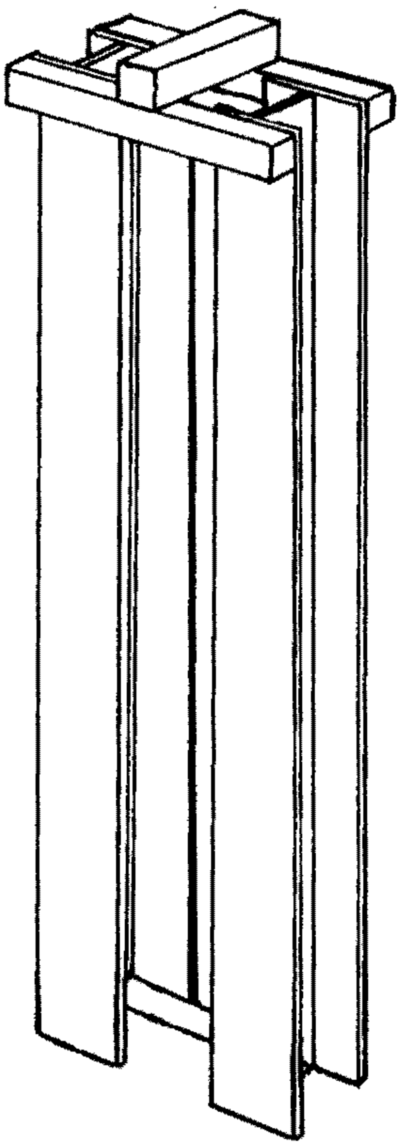

Figure 5. I-beams form the Moving Frame

This moving frame travels up and down on the lift guide rollers.

Lift Platform:

The platform is an "L"-shape framework constructed of square steel tubing and expanded steel (Figure 6). Two lengths of square steel tubing are evenly spaced in the middle of the framework for support (Figure 7).

Two 2" square steel tubes are welded to the rear of the platform so that they are parallel to the I-beams. Welded on each end of these two tubes are horizontal steel rods with roller bearings positioned to rest against the I-beams. The rollers guide the platform along the moving I-beam frame.

Welded to the left front of the platform is a length of 1 1/2" rectangular steel tubing that extends up vertically to a point above the waist of the operator. Two lengths of rectangular steel tubing are welded into an "L"-shape at the upper end of this vertical tube, and are welded to vertical steel tubes at the rear of the platform, forming a handrail (Figures 4, 6, and 7).

Lift Actuation:

The lift is powered by a 12 volt DC Prestolite Pump with a Monarch reservoir separate from the tractor's hydraulic system. The pump was taken from a snowplow. The pump is mounted to the right side of the tractor frame. Flat bar stock, formed into an "L"-shape is bolted to the tractor frame. The reservoir is bolted to the horizontal leg of the "L" (Figure 8). The pump only operates during the lifting cycle of the platform. Gravity lowers the platform to the ground at a rate determined by a flow control valve.

A hydraulic cylinder is mounted inside the vertical square tube shown in Figures 3 and 4. The hydraulic cylinder is attached to

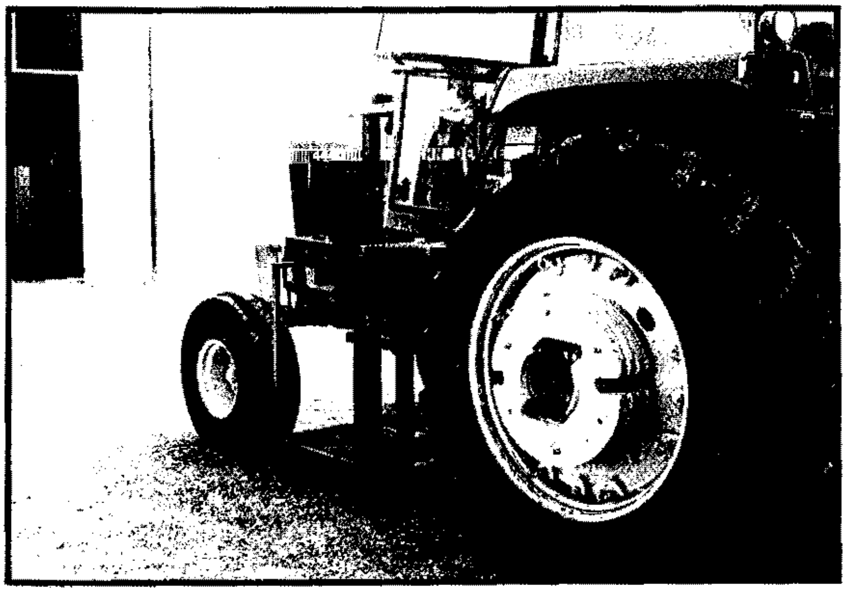

Figure 6. Lift Platform on Tractor

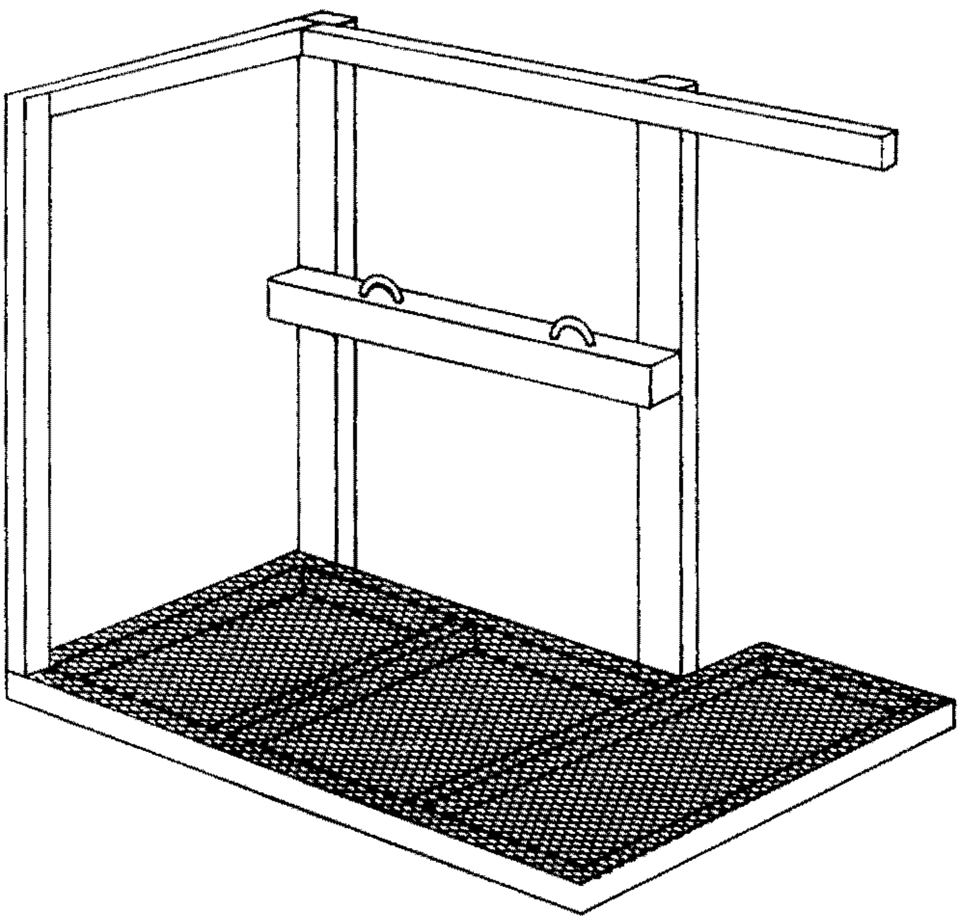

Figure 7. Lift Platform

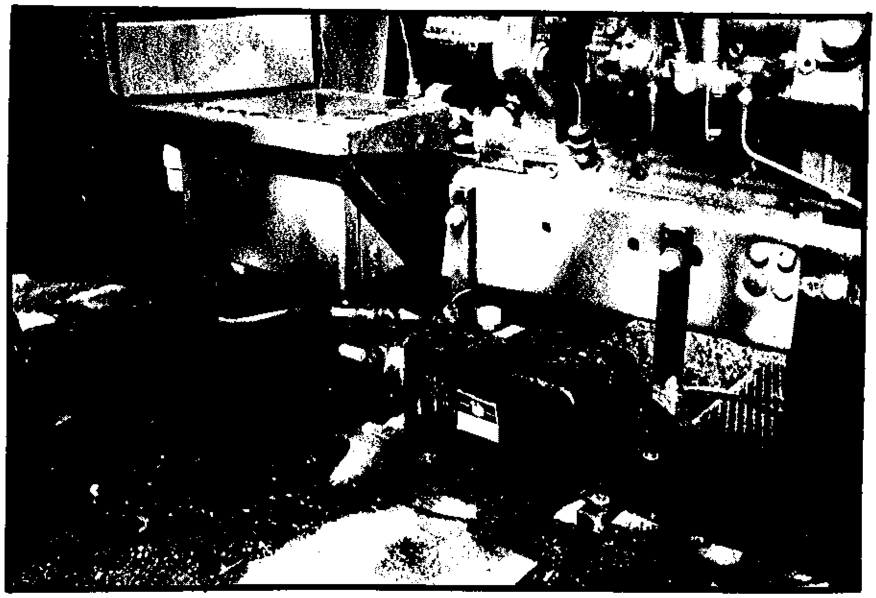

Figure 8. Hydraulic Pump for Lift Operation

steel mounting brackets which extend down from the vertical tube. The cylinder ram attaches to a rod that extends through the center horizontal square tube at the top of the moving I-beam framework (Figure 4).

Hooks are welded underneath the horizontal square tube which is mounted across the front of the I-beams. Cable pulleys are attached to each of these hooks. Two cables attached by clamps travel from the anchor point on the top steel rod of the lift guide (Figures 3 and 4), up and over the pulleys mounted on the moving I-beam frame, and down to the horizontal cross bar mounted on the lift platform, where cable clamps attach the cable to the hooks on the cross bar (Figure 2).

Lift Controls:

An all-weather switch control box is mounted on the lift platform's handrail, to the left of the moving I-beam frame, enabling the operator to raise and lower the lift (Figure 4).

Cab Entry Platform:

The original platform for entrance to the tractor cab was too small for Mr. Bame to safely maneuver, so it was replaced with a larger platform.

The new platform is constructed of a framework of square steel tubing with expanded steel welded over the top. A rectangular steel plate is bolted vertically to the tractor frame and welded to the square steel tubing on the back of the platform. A second square steel tube is welded at an angle between the steel mounting plate and the platform (Figure 4). A third length of square steel tubing extends down vertically at the front of the platform where it bolts to a steel bar located under the battery box (Figure 4).

A handrail is mounted on the rear of the platform. A length of square steel tubing is welded to the rear of the platform so that it extends 16" - 20" above the tractor hood. Two lengths of flat bar stock are welded horizontally to the vertical tube so that they point toward the front of the tractor. A length of rectangular steel tubing is welded at an angle on the opposite side of the vertical steel tube so that it points toward the tractor cab (Figure 4). The operator uses this railing when moving in and out of the cab and onto the lift platform.

SAFETY CONSIDERATIONS

For safety, the tractor engine should be shut off. This lift's 12 volt DC electrically operated hydraulic system provides this safety feature.

The platform lift could be improved by adding bracing or railing around the platform to form a "cage" around the operator, thus guarding against falls. The railing would have to be designed to allow the operator access to the platform. A pivoting railing that locks in place would serve this purpose.

A pinch point is present when the lift platform approaches the cab entry platform. If the operator's foot extends over the lift platform edge, it will be pinched between the two platforms. Increasing the distance between the two platforms and the placement of a hinged guard over the gap would protect the operator.

The cables should be checked periodically for possible damage, corrosion or wear. If the cable were to break, the platform would fall rapidly to the ground and could injure the operator. A braking device would prevent this type of accident.

A switch should be located close to the ground, enabling the handicapped operator to access the lift if it is in the raised or partially raised position.

DESCRIPTION OF OPERATION

To mount the tractor, the operator moves onto the lowered platform and grabs the railing on the front of the lift platform (Figure 9). He then pushes the "Up" button on the switch control box to raise the lift until it reaches the cab entry platform (Figure 1). Next he moves into the tractor cab using the hand railings mounted on the lift platform, cab entry platform (Figure 4), and cab door (Figure 15).

To dismount, he moves from the tractor cab onto the cab entry platform, using the railings (Figure 10). The operator then moves onto the lift platform and pushes the "down" button on the switch control box to lower the lift. He holds onto the platform railing with the other hand until he reaches the ground. He can now move off the lift platform.

CONTROL MODIFICATIONS

Clutch:

The clutch pedal has been cut from its shank and offset to the right to allow Mr. Bame room to move in and out of the cab.

A locking hand lever, originally the torque amplifier control on an early-model International tractor, is used as a clutch lever. The lever is mounted through a hole cut in the cab floor to the left of the tractor seat (Figure 11). A rubber collar was placed around the lever and over the hole. The lever attaches to a linkage connected to the clutch shaft. A collar placed over the clutch shank's existing pedal linkage allows the hand lever to be operated without affecting normal pedal usage (Figures 12 and 13).

Two springs are attached to the lower end of the hand lever to assist in returning the lever to its neutral position.

To disengage the clutch, Mr. Bame pulls back on the hand lever.

To help prevent noise and dust leakage into the cab, any holes cut in the cab floor should be sealed with flexible rubber collars.

Figure 9. Operator on lowered Platform

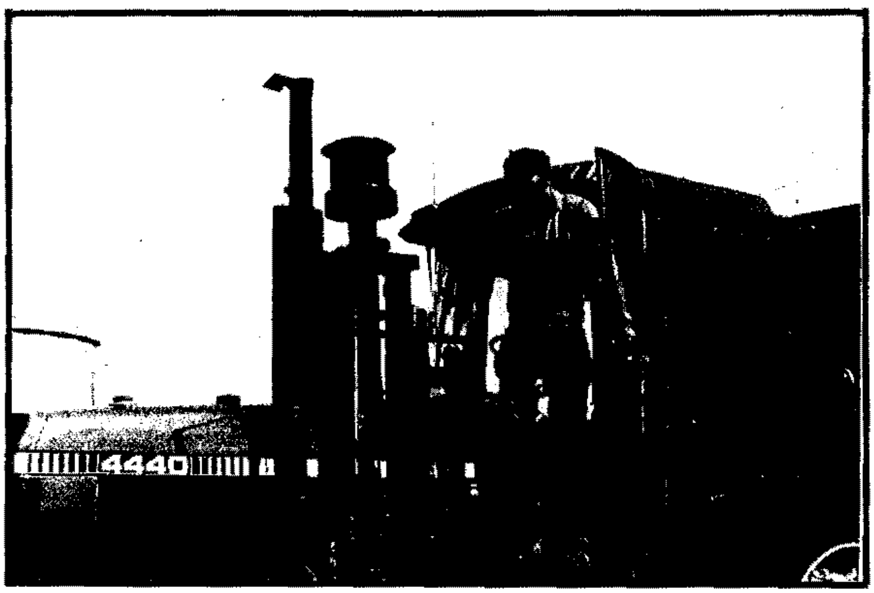

Figure 10. Operator moving out of Tractor Cab using Hand Railings

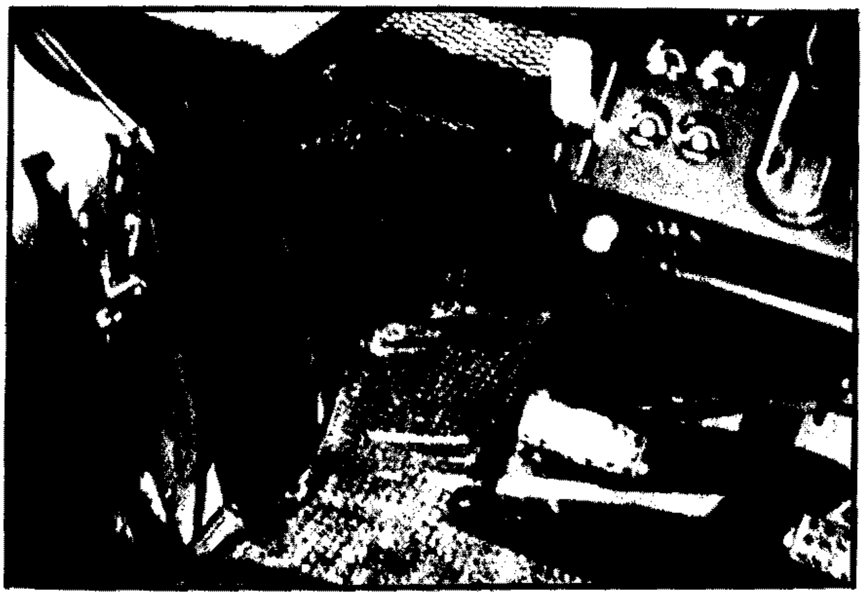

Figure 11. Clutch Hand Lever

Figure 12. Modified Linkage of Clutch

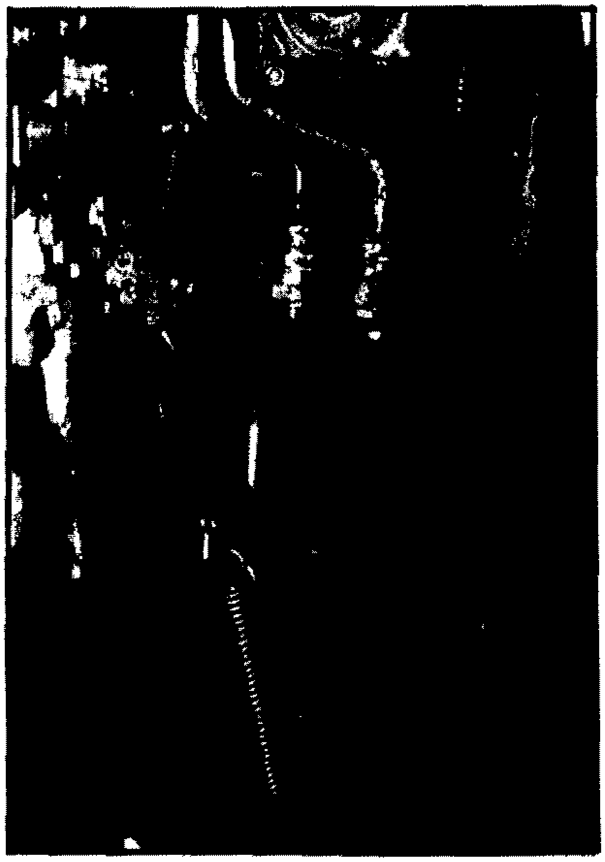

Figure 13. Return Spring and Adjustment Rod of Linkage

Brake:

Two hand levers are constructed from round steel rods. The steel rods extend up from the pedal shanks at an angle and bend up vertically along the instrument panel (Figure 14). Square steel tubing welded to the shanks serve as brackets for the hand controls. The steel rods slip down inside the square tubes. Hex nuts welded onto the steel tubes allow the use of set screws to tighten the levers securely in place.

The brakes are actuated by pulling back on the levers. The brakes can be locked together by using the normal pedal locking mechanism. An able bodied person can use the pedals to engage the brakes with the levers in place. The levers can also be easily detached.

While the mounting of the brakes allows the levers to be detached, the tubing welded to the shanks may damage the tractor's resale value. The cast steel shanks could also be weakened by welding to them.

ACCESSORIES

Hand Railing:

An "L"-shape hand railing constructed of rectangular steel tubing is welded to the framework inside the cab door (Figure 15). This aids the operator when moving in and out of the tractor cab, as does the railing mounted on the cab entry platform.

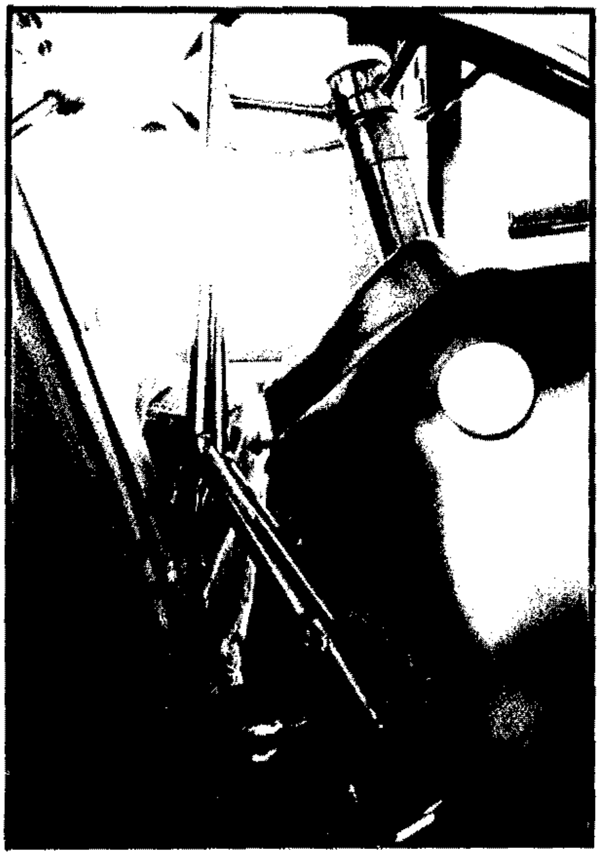

Figure 14. Brake Hand Levers with Tubing welded to Shanks

Figure 15. Hand Railing mounted on Cab Door

ESTIMATED COST*

Lift, Cab Entry Platform and Controls $1,200.00

*At time of construction, 1981.

BILL BAME'S COMBINE PLATFORM LIFT

FARMER: **Bill Bame**
14347 C.R. 179
Findlay, OH 45840

SUMMARY

Function:

Bill Bame's combine platform lift was designed specifically to be mounted on an International Harvester 1440 or 1460 combine. The lift enables Mr. Bame, a paraplegic, to gain access to the operator's station.

The lift is shown mounted on an International Harvester 1460 combine in Figure 1.

Figure 1. Bill Bame's Combine Platform Lift

Farmer:

Bill Bame farms 800 acres of corn and soybeans in Northern Ohio.

To enable Mr. Bame to harvest crops after his accident, his father-in-law built a platform lift for an International Harvester 1460 combine. He also has an accessible shop where he can work from his wheelchair.

Modified Machine:

Combine:	International Harvester 1460
Features:	ROPS Cab
Front Tire Size:	67-34.10
Rear Tire Size:	19.4-16.1
Year:	1979
Axial Flow Combine	
Hydrostatic Drive	

Adaptability:

This lift was designed specifically for an International Harvester 1460 combine. This lift could possibly be mounted on other combines of similar design with a few changes in the mounting of the lift and the lift platform.

Compatibility:

1. The steps leading to the combine door were removed for lift installation.
2. The lift interferes with an able-bodied operator mounting the combine, thus he also must employ the lift for use.
3. The hydrostatic drive allows the combine to be operated without the use of foot controls.

Service and Maintenance:

1. The hydraulic circuit should be checked periodically for leaks.
2. The cable should be checked regularly for damage, wear or corrosion and replaced if necessary to prevent an accident. Failure of the cable could cause a serious fall, especially if the failure were to occur while the lift was in the raised position.
3. A farmer with a physical handicap would have difficulty accessing most of the lift components for service and repair.

Accessibility and Ease of Use:

1. The lift is accessible for a farmer who has limited use of his legs and is able to stand up, or by a farmer who uses leg braces and/or crutches.

2. The operator must stand up on the lift platform to access the combine.
3. The lift is designed for simple operation. However, it may require some practice to successfully transfer to the cab.

CONSTRUCTION DESCRIPTION

The construction of Bill Bame's platform lift is discussed under the following subsections: Stationary Frame, Lift Guide, Lift Platform, Lift Actuation, and Lift Controls.

Stationary Frame:

Upper Mounting Frame:

The combine steps were removed in order to install the lift. A rectangular steel plate is fastened to the side of the cab entry platform by four bolts. A lip on the steel plate slips over the top edge of the platform where the plate is bolted (Figures 2 and 3).

A square steel tube is welded horizontally across the steel mounting plate and extends out from the front of the cab entry platform (Figure 3). A triangular gusset is welded between the tubing and the steel plate for support (Figure 2). A smaller length of square steel tubing formed into a "C"-shape is welded horizontally across the front of the larger horizontal square tube. Expanded steel is welded over the framework to extend the cab entry platform (Figure 2).

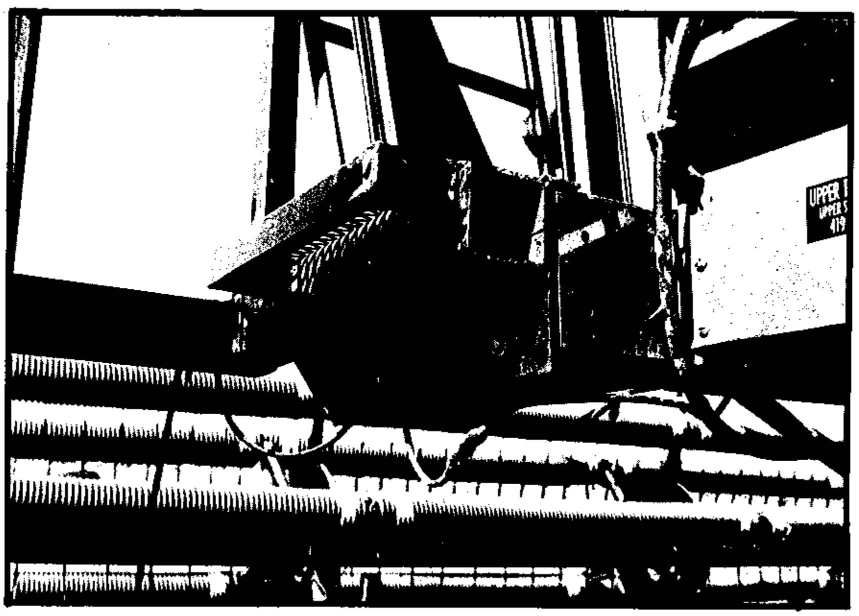

Figure 2. Lift Mounting Plate and Steel Tubing

Extending up vertically from the horizontal mounting tube in front of the cab entry platform is a length of square steel tubing. The tubing is supported by a triangular steel plate (Figure 3). A length of 2" flat bar stock is welded horizontally on its edge across the top of the vertical tube to form a railing (Figure 4). The railing is used as a grab bar when moving in and out of cab.

Figure 3. Top view of Tubing Construction

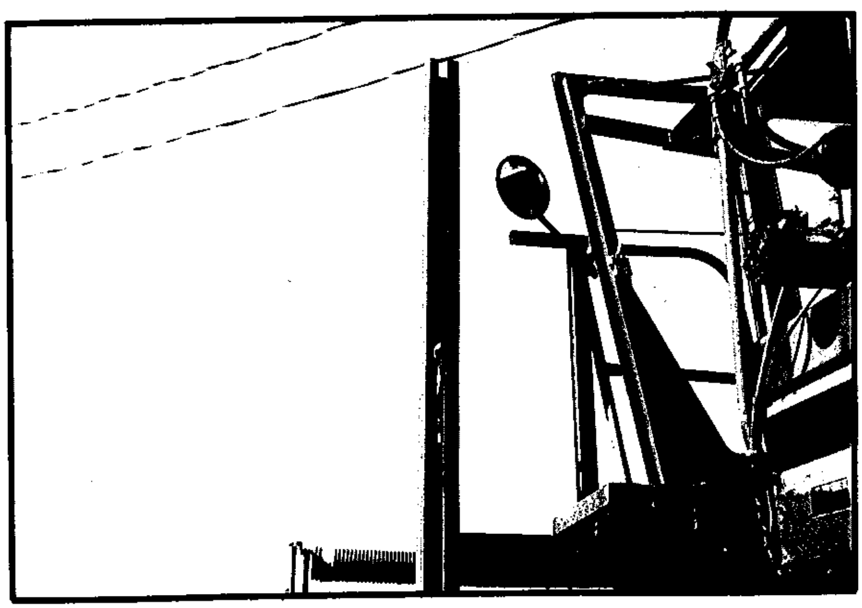

Figure 4. Hand Rail and top of Lift Guide Tube. Note Slot cut for Pulley and Cylinder Ram Travel.

A length of square steel tubing is welded to the horizontal square tube that extends out from the front of the cab entry platform where the two tubes form an "L"-shape structure. A steel plate welded over the end of the second tube supports the vertical tube which serves as the lift guide (Figures 5 and 6).

Figure 5. Mounting Plate attached to Lift Guide Tube

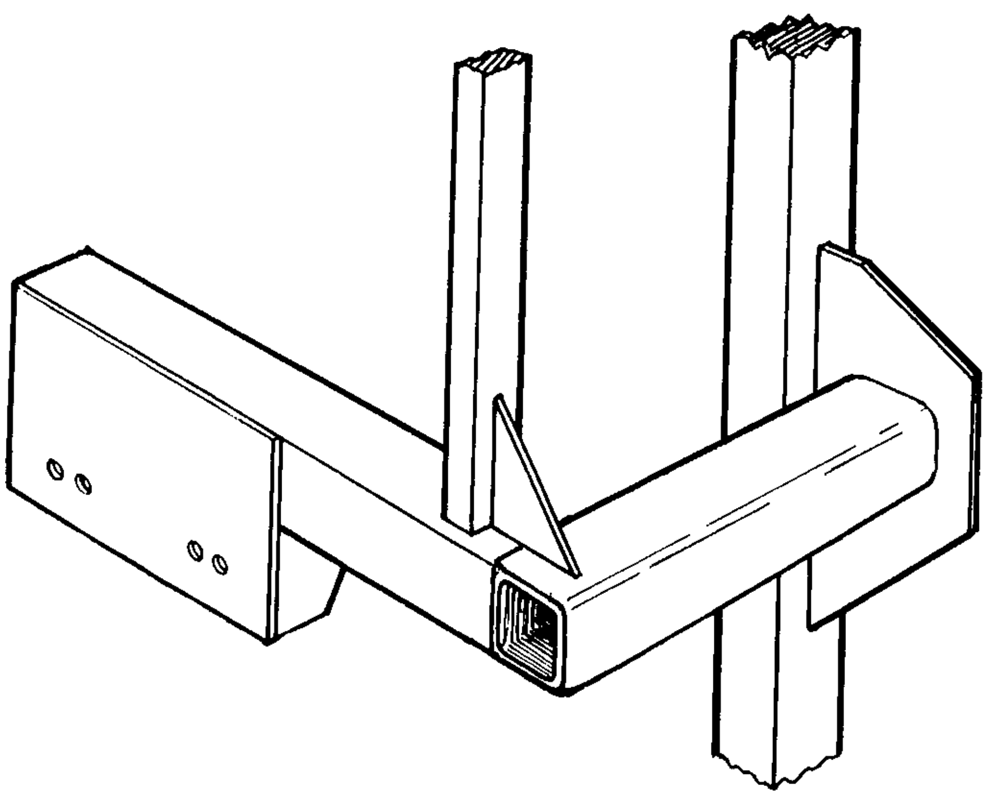

Figure 6. Upper Mounting Frame

Lower Mounting Frame:

A steel plate welded to the lower end of the vertical square lift guide tube serves as the attachment point for the lower mounting frame. A 2 1/2" square steel tube is fastened by a bolt to the front edge of the steel plate (Figure 7). The opposite end is bolted underneath the cab.

Lift Guide:

A 3" square steel tube serves as the lift guide. The tubing extends from about 12-16" off of the ground to a height equal to the top of the cab door (Figure 1). The lift guide is fastened to the upper and lower mounting frame (Figure 7).

A hydraulic cylinder is mounted at the bottom, and inside the vertical tube. A slot is cut in the tube on the side facing the rear of the combine. The slot extends down from the top of the square tube to a point 6 -12" above the cab entry platform (Figure 4).

Lift Platform:

The lift utilizes a platform to raise the operator to the combine cab entry platform. The platform is constructed from a rectangular frame of square steel tubing and expanded steel (Figure 8). Two lengths of square steel tubing are welded in the center of the rectangular frame for support.

A vertical length of 3 1/2" channel is welded to the back of the platform to form a slip plate. The channel wraps around the vertical lift guide tube. Short lengths of rectangular steel tubing are welded to the top edge of the channel on both sides of the lift guide tube. On the back side of the lift guide tube, cam follower rollers are bolted to the short horizontal lengths of steel tubing attached to the slip plate. The rollers are not connected, allowing them to pass the mounting plates during lift operation. A second set of rollers are mounted on short lengths of horizontal channel underneath the upper roller mount. The rollers are attached to the channel on the platform side of the lift guide tube (Figure 8).

A hook is welded to the top of the channel slip plate for attachment of a cable.

A vertical length of rectangular steel tubing is welded to the front edge of the lift platform at the approximate height of the operator's waist. Two lengths of rectangular steel tubing are formed into an "L"-shape

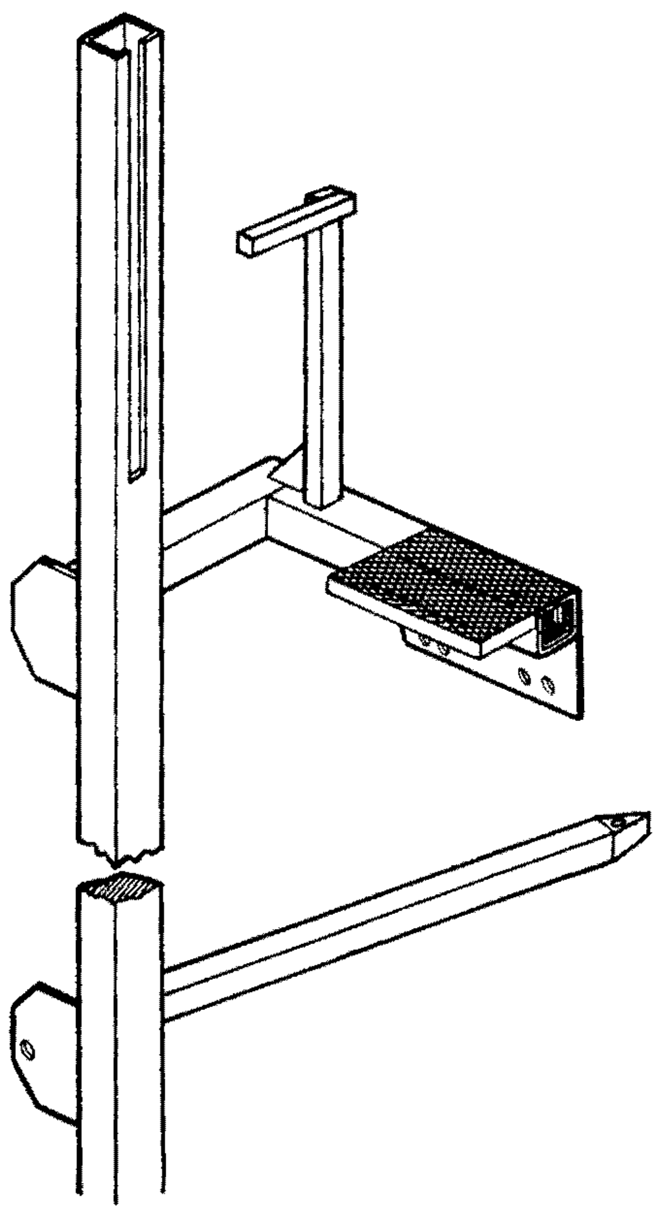

Figure 7. Drawing of Frame Construction

and welded to the vertical tube and the top of the steel channel slip plate to form a railing (Figure 8).

Lift Actuation:

The lift is powered by a 12 volt DC electrically operated Prestolite hydraulic pump with a Monarch reservoir that is separate from the combine's hydraulic system. The pump was taken from a snowplow. The pump and reservoir are mounted in front of the grain tank next to the combine cab (Figure 9). The pump functions during lifting while gravity lowers the platform. A flow control valve is mounted on the railing outside the combine cab to control the rate of lift operation (Figure 9).

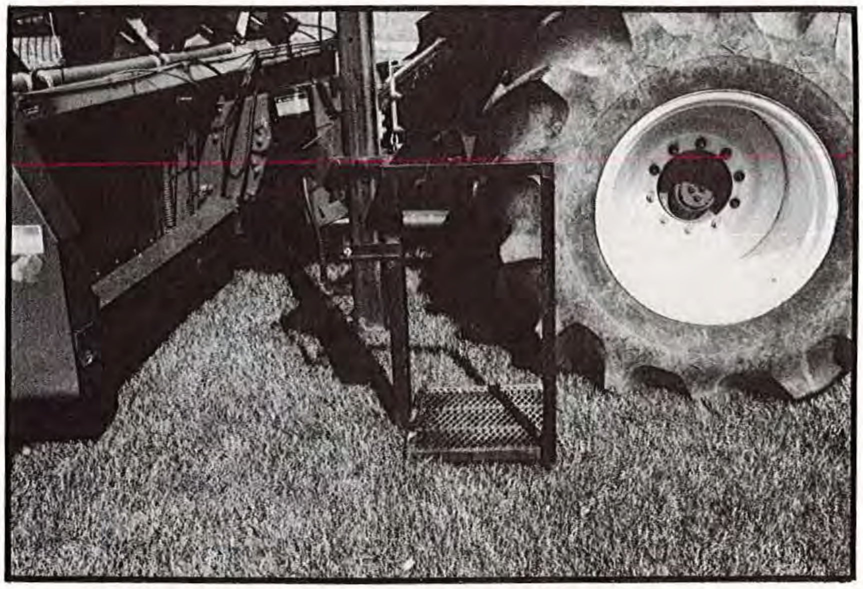

Figure 8. Lift Platform in lowered Position

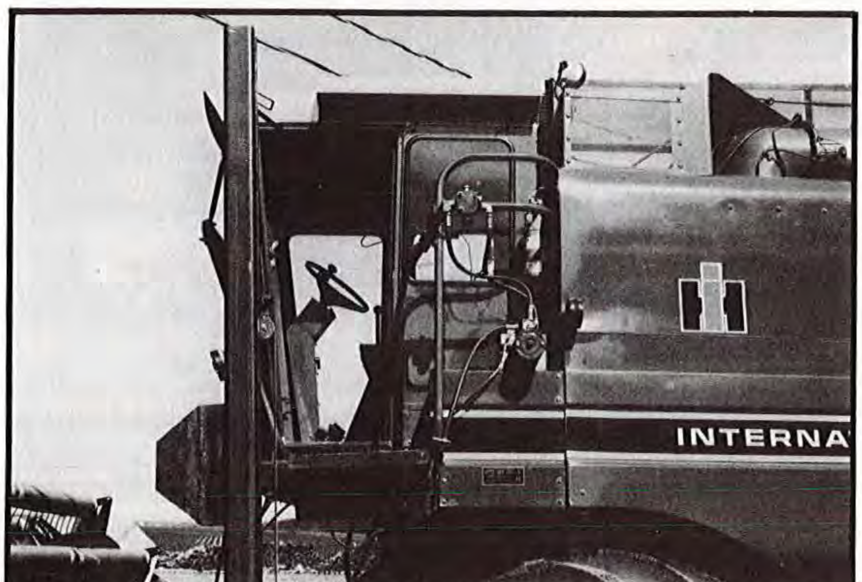

Figure 9. Hydraulic Pump and Flow Control Valve

A hydraulic cylinder is mounted inside the lower end of the vertical guide tube. The cylinder ram is attached to a steel block that slides up and down the lift guide tube. A steel bracket extends out through the lift guide tube slot and is attached to a pulley at the end of the bracket (Figures 4 and 9).

A cable is mounted inside the lift guide tube, near the base, and travels up and over the pulley. It then continues downward and attaches with cable clamps to the hook on the lift platform slip plate (Figure 8).

As the hydraulic cylinder extends, the lift platform rises. Due to the cable and pulley arrangement, the platform rises at twice the rate of cylinder extension.

Lift Controls:

A push-button switch control box is mounted on the handrail of the lift platform to the left of the guide tube, and enables the operator to raise and lower the platform (Figure 10). A second push-button switch control box is mounted inside the combine cab to allow the operator to lower the lift when inside the cab in the event that another person wishes to come up to the cab.

SAFETY CONSIDERATIONS

For safety, the combine engine should be turned off during lift operation. The separate 12 volt DC electrically operated hydraulic system of the lift offers this safety feature.

The platform lift could be improved by adding bracing or a railing around the platform to form a "cage" around the operator on the platform, thus guarding against falls. The danger of falling off the platform is magnified by the greater distance the platform must travel to lift the operator to the cab. The railing would have to be designed to allow for operator transfer. A pivoting or swinging railing that locks in place would serve this purpose.

A pinch point is present when the lift platform approaches the cab entry platform. If the operator's foot is hanging over the lift

Figure 10. Push-Button Switch on Lift Platform

platform edge, it may be pinched between the two platforms and cause serious injury. Increasing the distance between the two platforms and the placement of a hinged guard over the gap would protect the operator.

The cable should be checked periodically for possible damage, corrosion or wear and replaced if necessary. If the cable were to break, the operator would fall rapidly to the ground, resulting in a possibly serious injury. This is due to the absence of a braking device on the lift.

DESCRIPTION OF OPERATION

To gain access to the combine, the operator moves onto the lowered platform and grabs the railing with his left hand while operating the switch with his right (Figures 8 and 10). After the lift is in the raised position (Figure 11), he releases the switch and moves into the combine cab using the railings for assistance (Figures 4 and 12).

To dismount, he moves from the combine cab onto the lift platform using the railings for assistance. The operator then pushes the down button on the switch control box to lower the lift as he holds onto the railing.

ACCESSORIES

Hand Railing:

A steel plate is fastened with U-bolts to round tubing connected to the grain tank. The steel plate has a length of angle iron welded to its front to form a channel. Two lengths of rectangular steel tubing are bolted in this channel. The lengths of tubing face out in opposite directions to form a handrail (Figure 12).

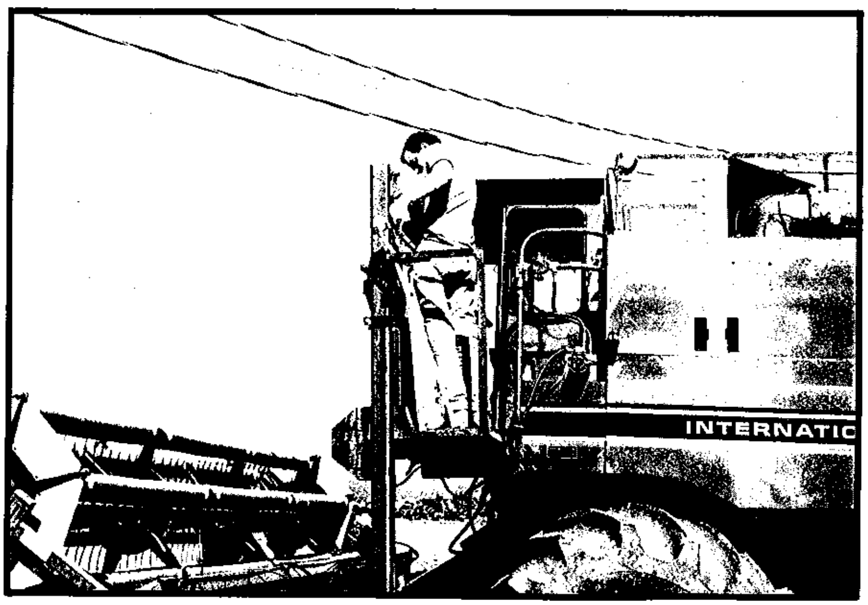

Figure 11. Operator on raised Platform

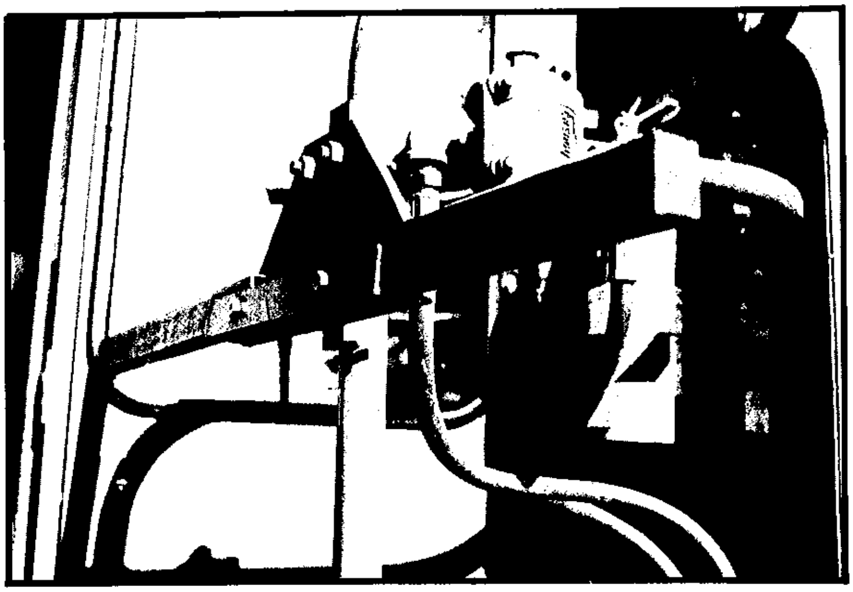

Figure 12. Railing mounted outside Cab Door

ESTIMATED COST*

Lift: $1,200.00

*At time of construction, 1981.

ANDY SULLENS' PLATFORM LIFT

FARMER: Andy Sullens
Rt. 2, Box 94-A
Iuka, IL 62849

DESIGNED BY: Ahnafield Corporation
3200-19 West Washington St.
Indianapolis, IN 46222

SUMMARY

Function:

Andy Sullens' platform lift is designed to be mounted on a farm tractor to help a handicapped farmer gain access to the operator's station.

The lift is shown mounted on a John Deere 4440 tractor in Figure 1. The tractor contains control modifications which are also reviewed in this document.

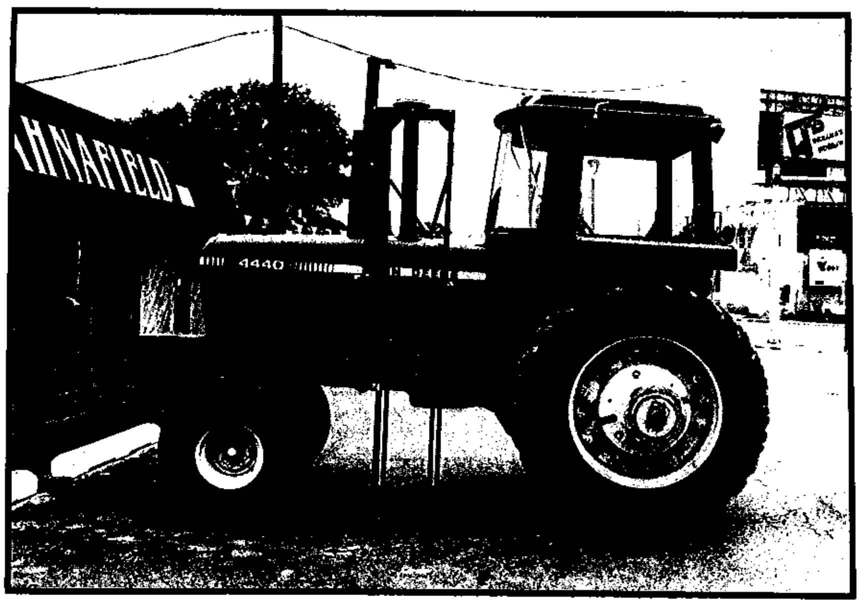

Figure 1. Andy Sullens' Platform Lift

Farmer:

Andy Sullens is a 21 year old farmer and is a paraplegic as a result of an accident. He farms 300 acres of soybeans, grain sorghum and wheat with his father in Southern Illinois.

To enable Mr. Sullens to remain active in the farm operation, a John Deere 4440 tractor was modified. A lift was developed by the Ahnafield Corporation of Indianapolis, Indiana, using the same basic lift design used in van lifts. Control modifications and accessories were installed to allow Mr. Sullens to operate the tractor.

Modified Machine:

Tractor:	John Deere 4440
Features:	ROPS Cab
Rear Tire Size:	18.4-38
Front Tire Size:	11L-15
PTO HP:	130

Adaptability:

This lift was designed specifically to be mounted on a John Deere 4440 tractor. The same lift can be mounted on another self-propelled agricultural machine with a few changes in the mounting bracket.

Compatibility:

1. The lift interferes with a non-handicapped farmer mounting the tractor, thus he also must employ the lift to use the tractor.
2. The lift is designed to be easily removed for service of the tractor or for resale.
3. The battery was rotated 90 degrees so the lift could be mounted.

Service and Maintenance:

1. The chain may require periodic tightening and lubrication.
2. The hydraulic circuit should be checked periodically for possible leaks.
3. The components are accessible for ease of service and maintenance.

Accessibility and Ease of Use:

1. The lift is accessible for a farmer who has limited use of his legs and is able to stand up, or by a farmer who uses leg braces and/or crutches.
2. The lift is quiet during operation.

CONSTRUCTION DESCRIPTION

The construction of the Andy Sullens' platform lift is discussed in the following subsections: Stationary Frame, Lift Guide, Lift Platform, Lift Actuation, Lift Controls, and Cab Entry Platform.

Stationary Frame:

The mounting bracket is constructed of steel tubing and steel plates. The bracket attaches to both sides of the tractor and passes over the top of the tractor. The frame is bolted to the tractor frame for support. This type of design ensures adequate support and prevents twisting in rough terrain.

On the opposite side of the lift platform, a steel plate is bolted to the tractor frame. Square steel tubing is welded to the bracket and extends upward vertically with a slight bend in the tubing to allow for clearance between the mounting bracket and the tractor (Figure 2). The steel tubing extends above the engine compartment by several inches (Figure 3). A rectangular steel compartment is welded to the vertical steel mounting tube and houses the hydraulic pump which operates the lift (Figure 3).

A steel bracket is welded to the steel tube facing toward the lift platform, allowing for attachment of steel tubes that secure the lift frame. Two bolts fasten the cross-members to the bracket (Figure 3). The steel cross-member tubes extend from the mounting bracket upward at an angle, and bolt to the lift guide tubes (described under the reference to "Lift Guide"). The tubes are bent as they extend from the mounting bracket to the lift guide tubes which are several feet apart (Figure 4).

The stationary frame is attached to the tractor on the platform side by a steel bracket bolted to the tractor frame. Steel tubing is welded on each end of the bracket and extends up vertically to approximately the same height as the tractor's exhaust manifold, where the vertical tubes are welded to the lift guide tubes (Figure 5).

The design of the mounting frame allows quick removal of the lift for tractor service or to trade-in the tractor.

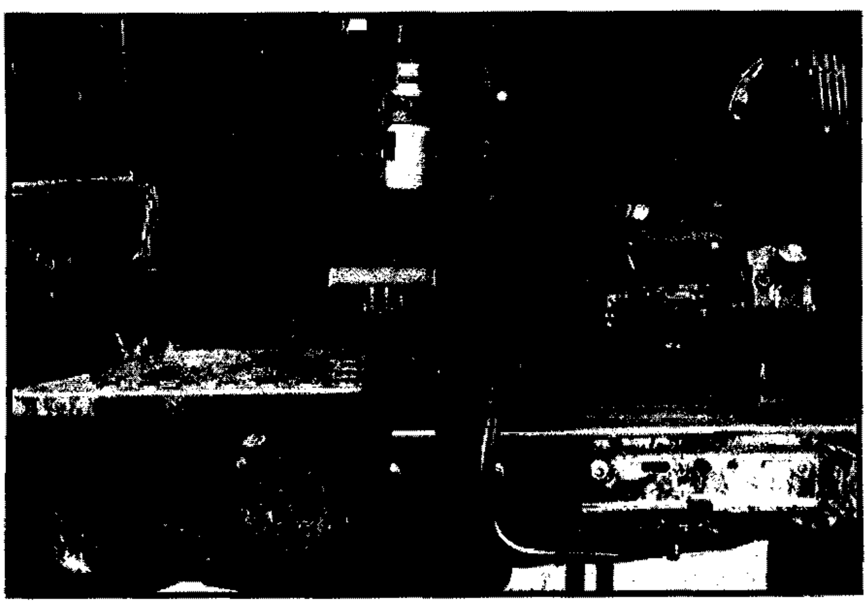

Figure 2. Lift Mounting Bracket on Right Side of Tractor

Figure 3. Mounting Frame and Hydraulic Component Box

Figure 4. Cross-members Attached to Lift Guide Tubes

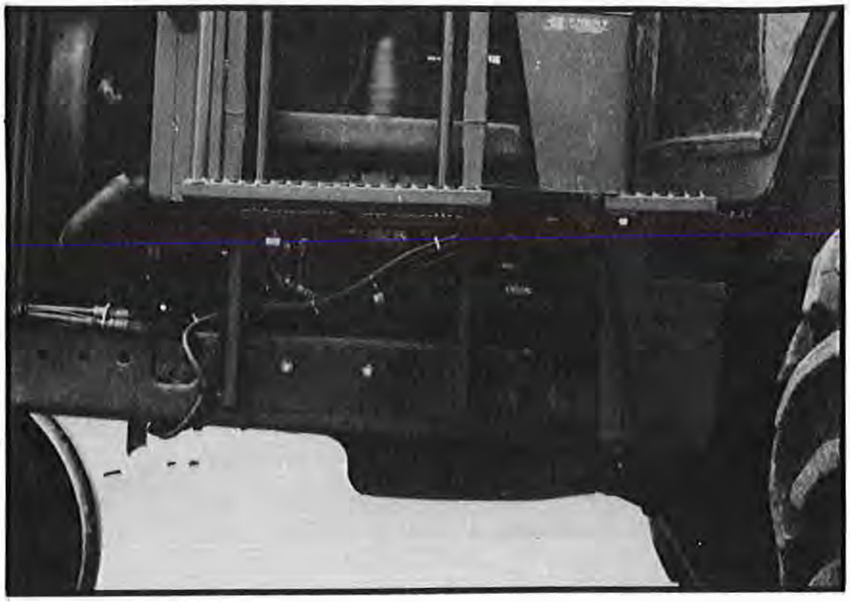

Figure 5. Mounting Bracket on Platform Side

Lift Guide:

The lift guide is constructed of two vertical steel tubes that are attached to the mounting frame, as described under the reference to "Stationary Frame". Inside the vertical tubes, metal plates were added with a teflon-like coating that acts as a bearing and eliminates the need for grease. A roller is mounted to the top of the two steel tubes attached to the lift platform that slip inside the guide tubes. A roller chain rotates over these rollers and extends vertically through the guide tubes. It passes over another set of rollers at the top of the guide tubes, enclosed in a protective steel covering, and travels down and attaches to a roller on the lift hydraulic cylinder. The hydraulic cylinder is mounted to the left of the vertical guide tubes and is protected by a steel covering (Figure 6).

Lift Platform:

The lift utilizes a platform to lift the operator. The platform is constructed of steel to form an 18" x 18" square frame. Expanded steel is welded over the frame where the operator stands.

Round steel tubing, 1" diameter, is welded to the platform and extends up vertically to a point above the waist of the operator. Here it bends to form a horizontal handgrip, and then bends back down vertically to attach to the lift platform. A handrail of round steel tubing is also constructed on the left side of the platform and attaches to the front of the platform. The handrail extends up vertically and bends to form a horizontal hand rail approximately waist high. It then attaches to the vertical steel tubing that forms the grip bar on the front of the platform (Figures 1 and 6).

Figure 6. Raised Platform Lift

Lift Actuation:

The lift is powered by an electrically-operated hydraulic system separate from the tractor hydraulic system. The system is powered by a 12-volt DC Monarch pump with a capacity of 1 1/2 gallons per minute at 1600 psi. The pump is equipped with a bypass valve that operates when the lift is in the raised position, to prevent damage to the pump if the switch is not released. A pressure compensated, flow control valve controls the rate of lift descent, based upon the weight on the platform. The maximum capacity of the lift is approximately 750 pounds.

The lift uses a 1 1/2″ single-acting cylinder to raise the lift. The single-acting cylinder allows gravity to lower the lift, reducing the battery drain and eliminating half of the cycle wear on the hydraulic pump. The hydraulic cylinder is attached to the roller chains which are attached to both telescoping lift tubes to raise and lower the lift, (described under the reference to "Lift Guide").

Lift Controls:

A switch is mounted underneath the handgrip bar on the lift platform. The placement of the switch allows the operator to operate the lift only while he is standing on the platform (Figure 7).

Cab Entry Platform:

An 18″ platform entry into the cab is constructed of steel tubing, as shown in Figure 8. Expanded steel is welded over the steel tubing to form the platform. The platform is attached to the side of the tractor and mounted with steel bars underneath the battery.

A special safety feature is built into the lift to prevent the possibility of the operator's feet being pinched as the lift platform approaches the cab entry platform. A steel plate with hinges is mounted horizontally across the edge of the cab entry platform and is spring loaded in the down position. The hinged plate covers a gap between the lift platform and the cab entry platform and prevents the operator's foot from being caught between the two platforms. If his foot is hanging over the edge of the lift platform, the hinged plate raises up when his

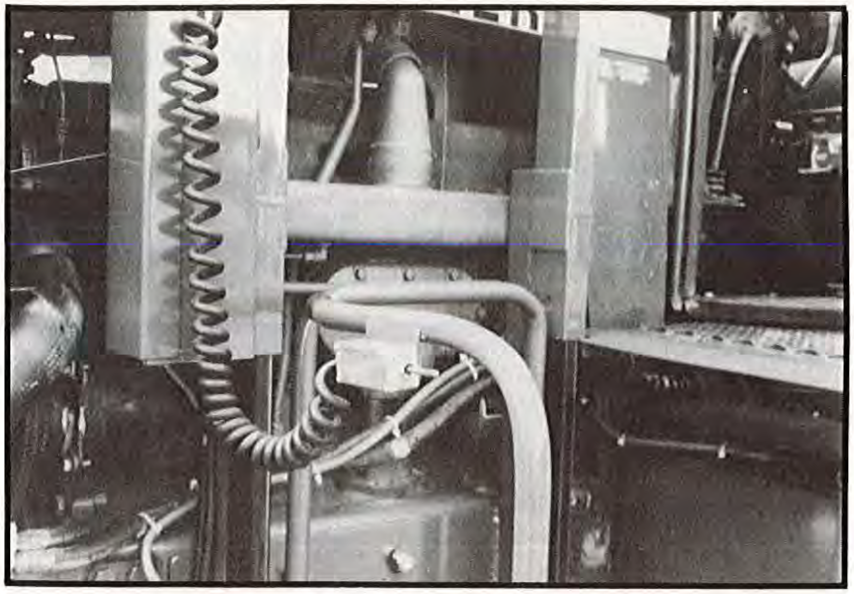

Figure 7. Control Switch and Hand Rails

foot contacts the underneath side of it. A strip of "non-skid" surface material placed on the smooth steel surface helps keep the operator from slipping (Figure 8).

SAFETY CONSIDERATIONS

For the sake of safety, the tractor should be turned off during lift operation.

Ahnafield chose a separate 12-volt DC hydraulic system which offered the safety feature of the tractor not running during lift operation.

The roller chains used in the lift mechanism allow for a smooth riding platform. The chains can be adjusted to increase tension and to keep the platform level.

Hand rails form a semi-cage to help keep the operator on the platform.

An extension of the handrails might be considered to extend around to the front of the platform, and designed so they are movable to allow for transfer. This would help prevent the operator from possibly falling off the lift.

A switch should be located close to the ground. This would allow the handicapped operator to access the lift if someone left it in the raised position.

DESCRIPTION OF OPERATION

To mount the tractor, Andy Sullens moves up next to the tractor. He climbs onto the lowered lift platform and grabs hold of the grip bar on the front of the lift platform (Figure 1). He then uses the switch mounted under the horizontal handgrip bar to raise the lift until it reaches the cab entry platform. He moves from the lift platform to the cab entry platform and proceeds into the tractor cab and onto the tractor seat.

To dismount, he moves from the tractor cab onto the cab entry platform and moves onto the lift platform. He then toggles the switch to lower the lift, which lowers by gravity to the ground.

CONTROL MODIFICATIONS

Clutch:

A clutch hand lever was constructed of a steel rod and shaped to follow the contour of the tractor control console. The lever

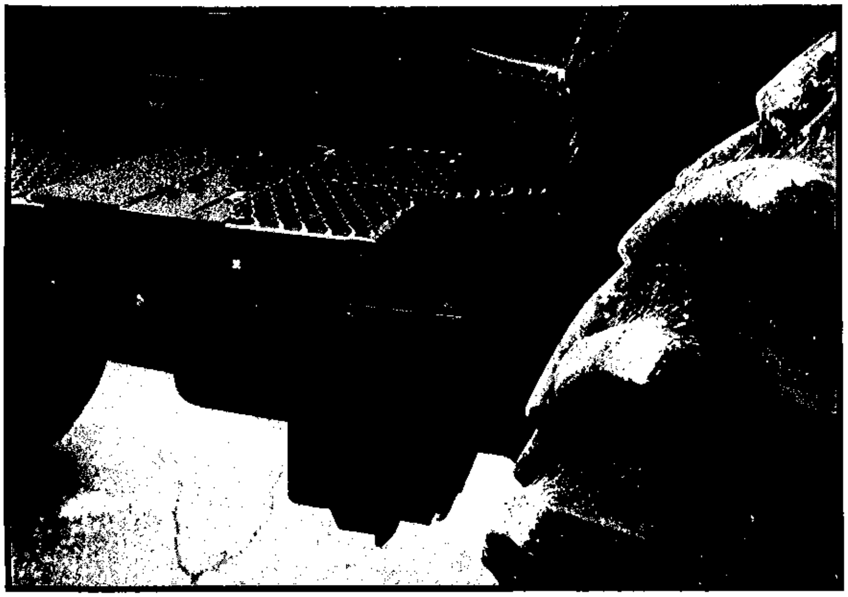

Figure 8. Cab Entry Platform

bends around the console and is attached to a pivot mechanism, and then extends down vertically where a roller is mounted on the end (Figure 9). The roller rests on the clutch pedal shank. The pivot assembly is constructed of a pin mounted through a steel bracket mounted behind the control console. On the upper end of the hand lever, a round steel tube with a rubber handgrip on the end slips over the rod to form a removable hand lever. This allows the hand lever to be removed so Mr. Sullens can move in and out of the tractor cab.

To disengage the clutch, Mr. Sullens pulls back on the hand lever. A non-handicapped person can use the pedal to operate the clutch with the hand lever in place.

There is no device on the clutch control that allows it to be locked in the disengaged position. It is important that the clutch be designed so that it can be locked in the disengaged position to free the operator's hand and for safety reasons.

Brakes:

The brake hand levers are constructed of two long steel rods. Each has a handgrip knob on one end and a roller attached on the lower end. The rollers rest on the brake pedal shanks. The rods are attached to a pivot assembly close to the brake pedal shank. The pivot assembly is constructed of a pin attached to a steel bracket which is mounted behind the control console (Figures 10 and 11).

To engage the brakes, Mr. Sullens pulls back on the hand lever for either brake. A non-handicapped person can use the pedals to engage the brakes with the levers in place.

Figure 9. Hand Control Clutch

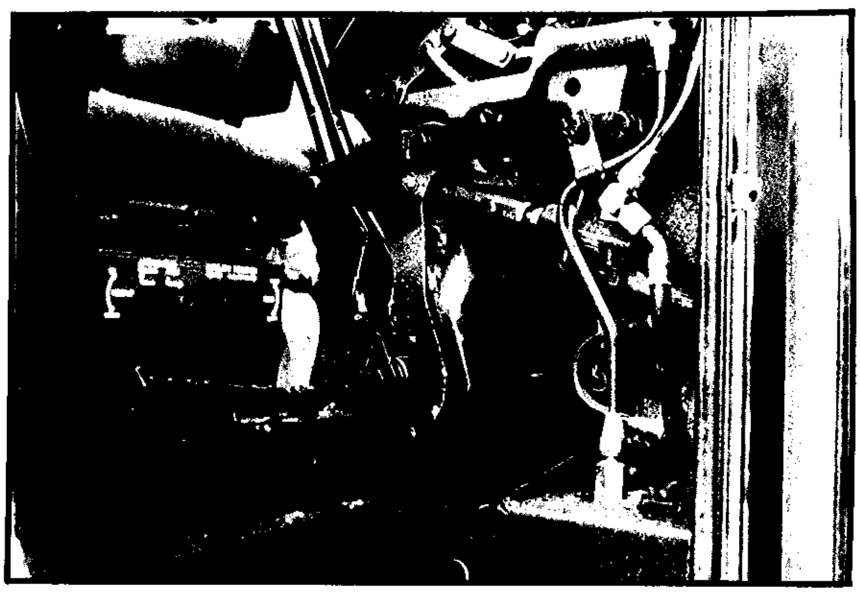

Figure 10. Pivot Assembly and Rollers on Pedal Shank

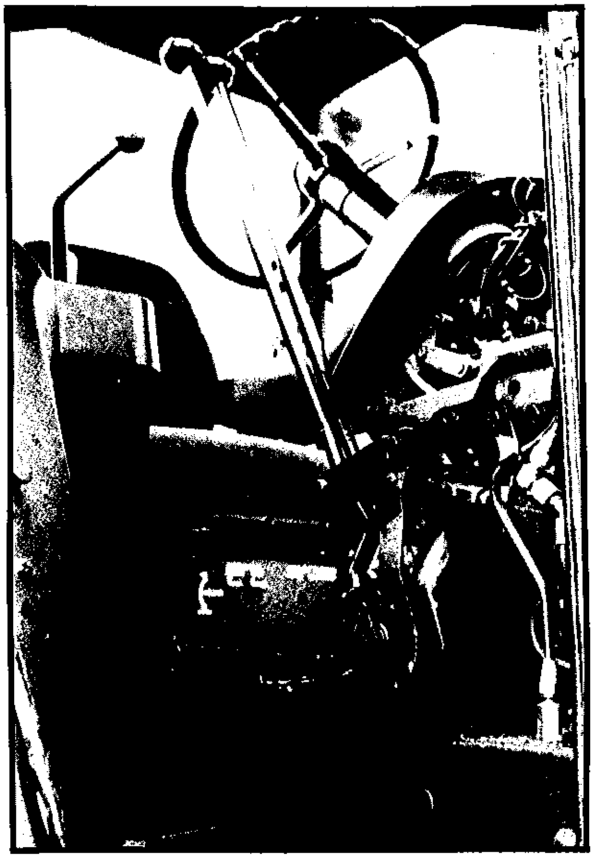

Figure 11. View of Brake Hand Levers

ESTIMATED COST*

Lift:	$ 5,500.00
Hand Controls:	2,500.00
Total:	$ 8,000.00

*At time of construction, 1986.

AL COPELAND'S PLATFORM LIFT

FARMER: **Alan Copeland**
R.R. #8
Greenfield, IN 46140

SUMMARY

Function:

Al Copeland's platform Lift is designed to be mounted on a John Deere 4440 tractor. The lift enables Mr. Copeland to gain access to the operator's station of his tractor (Figure 1).

Control modifications on Mr. Copeland's tractor are also reviewed later in this section.

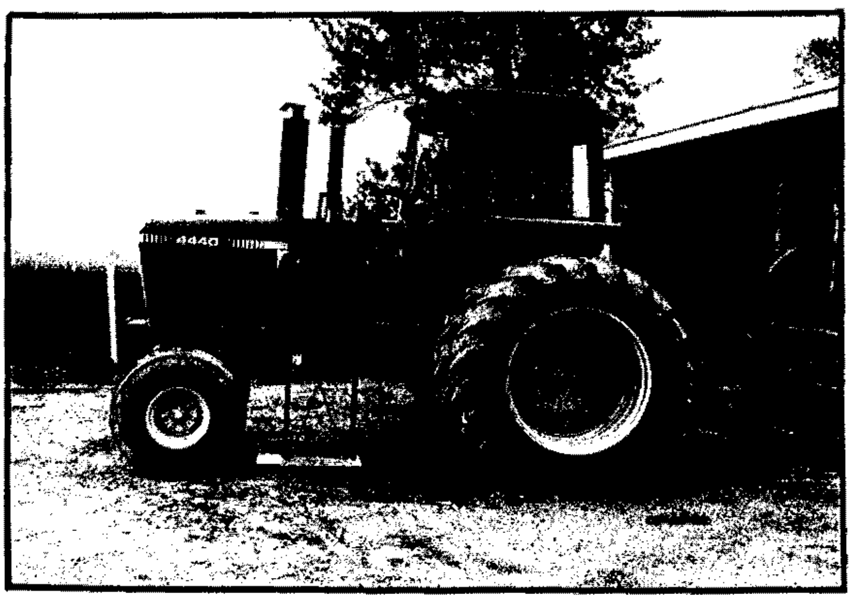

Figure 1. Al Copeland's Platform Lift

Farmer:

Al Copeland and his father farm 800 acres of corn, soybeans and wheat in Central Indiana. They also raise Angus cattle on their farm. Al Copeland is a paraplegic.

Mr. Copeland eventually plans to install a lift on their combine so he can do more work during the harvest season.

Modified Machine:

Tractor:	John Deere 4440
Features:	ROPS Cab
Rear Tire Size:	18.4-38
Front Tire Size:	11.0-16
PTO HP:	150
Year:	1978

Dual wheels on tractor
Door on one side of cab

Adaptability:

This lift was designed specifically to be mounted on a John Deere 4440 tractor. The same lift can possibly be mounted on other farm tractors.

Compatibility:

1. The steps leading to the tractor's only door were removed for the installation of the lift.
2. The lift interferes with an able-bodied farmer's mounting the tractor, thus he also must employ the lift.
3. The lift is powered by the tractor's hydraulic system, thus the tractor must be running in order to raise the lift.
4. The ignition key was relocated and placed on the lift.

Service and Maintenance:

1. The hydraulic circuit should be checked periodically for leaks.
2. The cable should be checked regularly for damage, corrosion, and wear and if necessary, be replaced to prevent an accident.

Accessibility and Ease of Use:

1. The lift is accessible for a farmer who has limited use of his legs and is able to stand up, or by a farmer who uses leg braces and/or crutches.
2. The operator must stand on the lift platform to access the tractor.

CONSTRUCTION DESCRIPTION

The construction of Al Copeland's platform lift is discussed in the following subsections: Stationary Frame, Lift Guide, Moving Frame, Lift Platform, Lift Actuation and Lift Controls.

Stationary Frame:

A 2 1/2" x 5" "U"-shaped channel and a length of square steel tubing behind the channel, form the lower mounting bracket for the platform lift (Figures 2 and 3). The mounting bracket is fastened to the tractor frame with two bolts.

Welded vertically to the steel channel are two square steel tubes mounted about 2' apart. They extend upward to a height above the exhaust manifold of the tractor engine, where a flat steel bar is welded to each vertical tube. The opposite end of each flat bar is bolted to the tractor engine to form the upper support for the lift (Figures 2 and 3). The vertical mounting tubes support the lift guide described in the following three paragraphs. Figure 3 shows the lower mounting bracket of the hydraulic cylinder on top of the steel channel.

Lift Guide:

The lift guide is constructed from two lengths of rectangular steel tubing, each with a machined slot facing outward to allow the grip bar and braces of the telescoping tubes (described below) to pass. The tubes are welded in front of the vertical mounting tubes described in the subsection "Stationary Frame," with an overlap of 12 inches. A flat steel brace is welded between the two lift guide tubes for support (Figure 3).

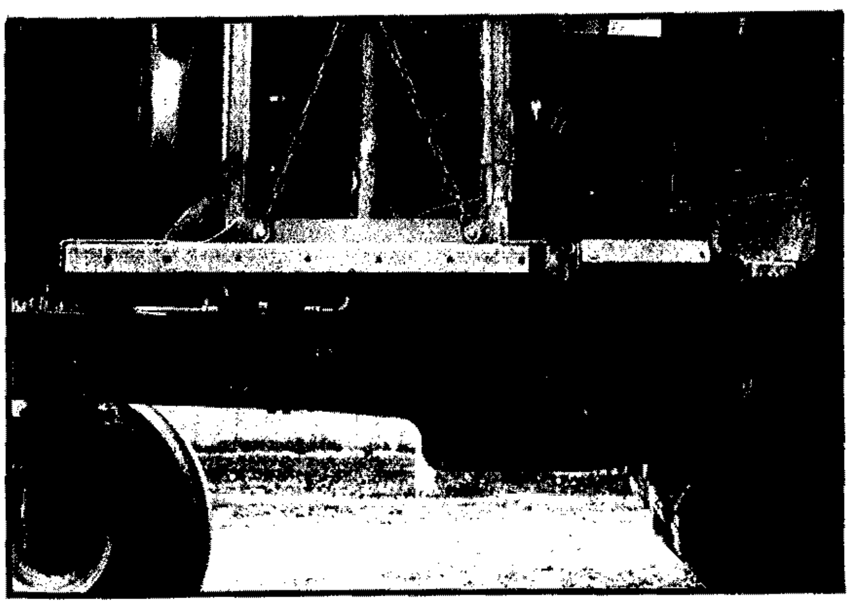

Figure 2. Lower and Upper Lift Mounting Bracket

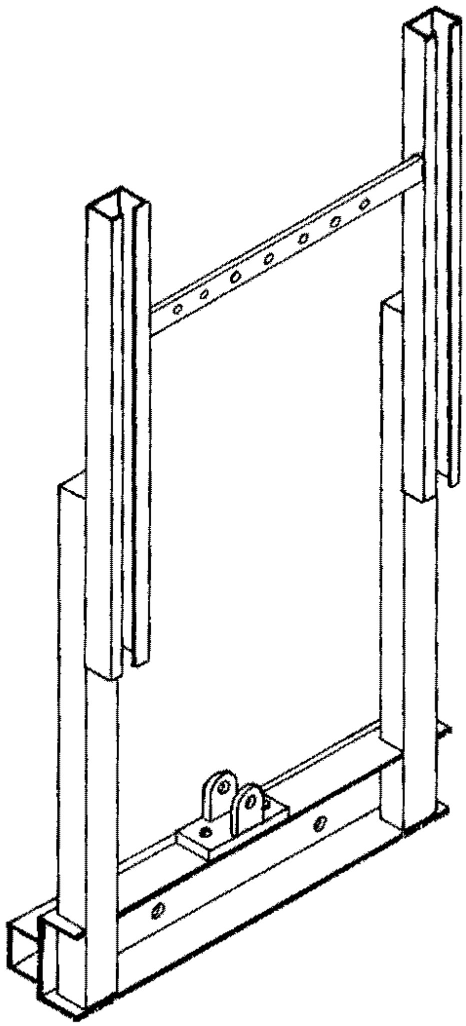

Figure 3. Mounting Bracket and Lift Guide Tubes

Moving Frame:

The moving frame consists of a telescoping tube frame. The telescoping tubes consist of three sections of square steel tubing with the outer stationary section being the lift guide and the other two sections telescoping inside of each other and moving when the lift is in operation.

A steel rod welded between the outer moving sections forms a handgrip bar for the operator to hold during lift operation (Figure 4). Below this grip bar, a steel bar with holes (Figure 4) was also welded to the outer moving sections. This steel bar is a mounting point for vertical flat steel bars that function in lifting the lift platform (described under "Lift Actuation"). Attached to the inner telescoping tube is the lift platform which is described in the following paragraph.

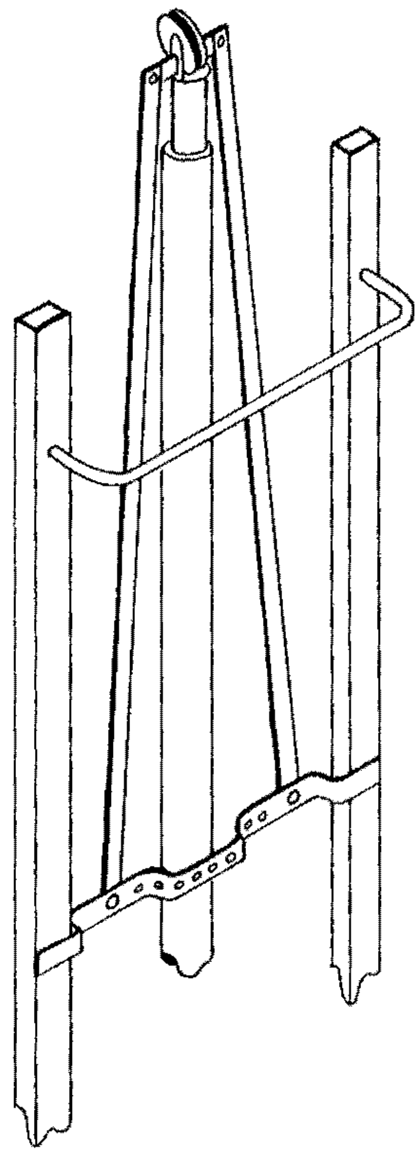

Figure 4. Telescoping Tube and Hydraulic Cylinder

Lift Platform:

The lift platform is welded to the inner telescoping tube. A 15" x 31" rectangular framework of steel plating and angle iron form the lift platform (Figure 5). Angle iron welded to the inner telescoping tube forms a raised edge at the rear of the platform to help keep the operator's feet on the platform. The steel plating of the platform was welded underneath the angle iron framework to complete the construction of the platform (Figure 5).

Lift Actuation:

The lift is operated by the tractor's hydraulic system, thus the tractor engine must be started to raise the lift.

The lift is operated by a single acting hydraulic cylinder mounted vertically between the two vertical lift guide tubes. The lower end of the hydraulic cylinder is attached to a bracket bolted to the lower mounting bracket of the stationary frame (Figure 3). A pulley is attached to the end of the cylinder ram and a short section of flat steel bar is welded to each side of the pulley housing to form two "ears". Attached to these ears and extending downward are two flat steel bars. These bars are bolted to the horizontal steel brace which connects the outer moving section of the telescoping tube (Figure 4). These steel bars assist in raising and lowering the lift by raising the outer telescoping tubes.

A cable is attached to the tractor frame behind the hydraulic cylinder. The cable travels over the pulley on the cylinder ram and down to attach to a clevis hooked onto the midpoint of a chain. Each end of the chain is bolted on each end to the angle iron support of the lift platform (Figure 5).

As the cylinder extends upward, the bars mounted to the cable pulley bracket lift the

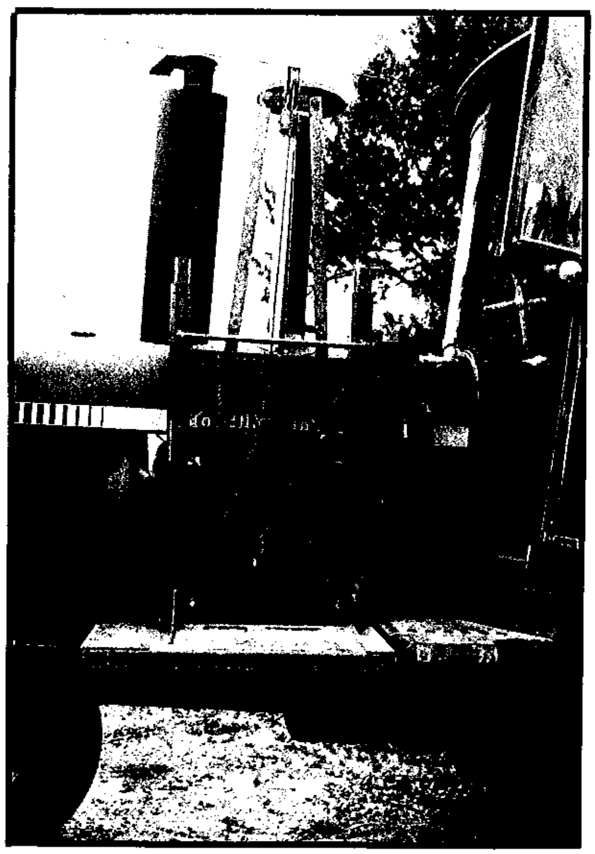

Figure 5. Lift Platform in raised Position

outer telescoping tubes while the cable pulls the lift platform up at the same time. Thus as the cylinder is extended, the cable lifts the platform at twice the rate of the cylinder extension. The lift platform lowers by gravity.

Lift Controls:

The tractor engine has to be running to raise the lift, so an ignition key is located to the right of the lift guide tubes (Figure 6). A hydraulic control valve, used to raise and lower the lift, is mounted to the right of the lift guide tubes (Figure 7).

SAFETY CONSIDERATIONS

In order to raise this lift, the tractor engine must be running which raises a safety concern. To prevent runover accidents, it is desirable that lifts can be operated with the tractor engine shut off.

The platform lift could be improved by adding bracing or railing around the platform to form a "cage" to hold the operator on the platform, thus guarding against falls.

A pinch point is present when the lift rises to the cab, between the lift platform and the platform deck on the tractor (Figure 2). This pinch point could be guarded by increasing the distance between the two platforms and placing a hinged guard over the gap. A second hazard exists on the telescoping tubes and could be corrected by placing a guard over the lift guide tubes to prevent an injury to someone's hand as the lift is operated.

The control valve is mounted high off the ground on the lift guide tube. A control should be mounted close to the ground to allow a handicapped operator to access the lift if the lift were in the raised or partially raised position.

The cable, chain and hydraulic lines should be checked periodically for possible damage, wear and corrosion to prevent cable, chain or hydraulic line breakage. Due to the absence of a braking device on the lift, failure of the cable, chain or hydraulic lines could result in serious injury.

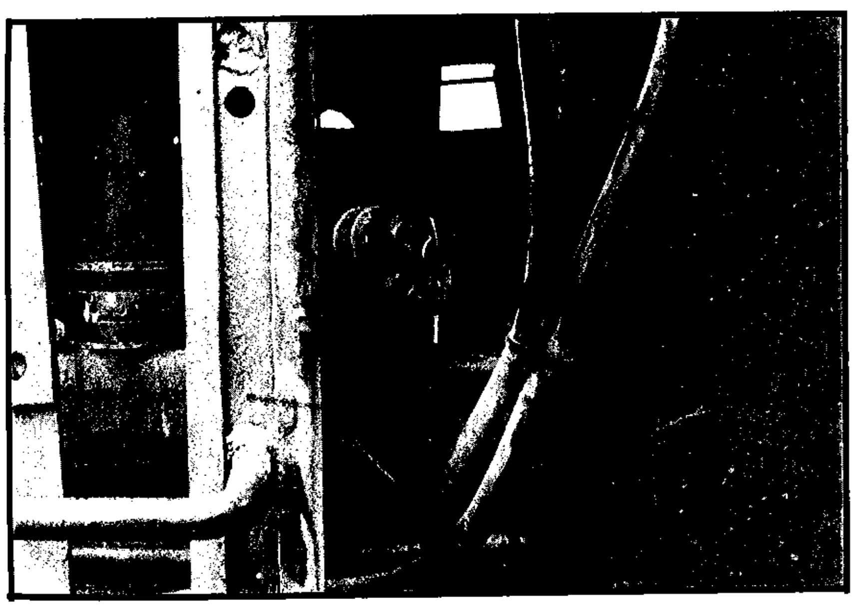

Figure 6. Ignition Key to start Tractor

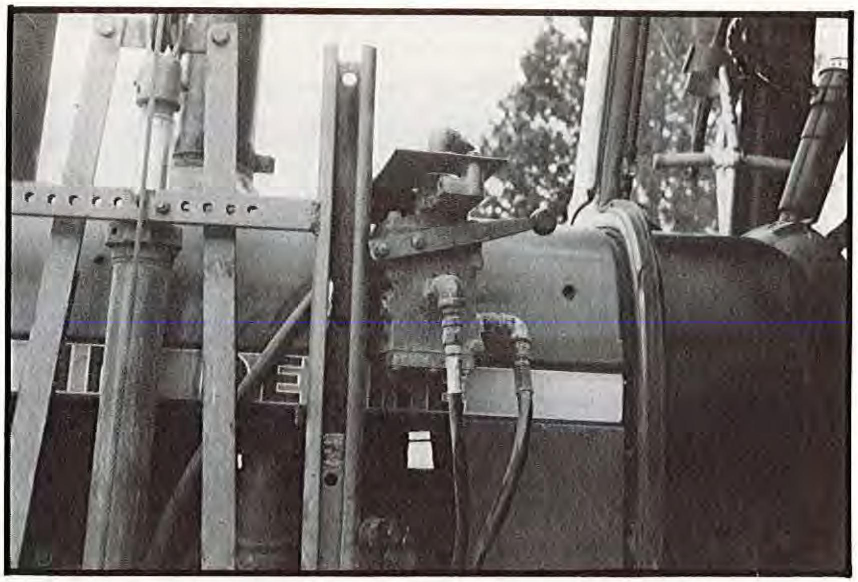

Figure 7. Hydraulic Control Valve for Lift Operation

DESCRIPTION OF OPERATION

To mount the tractor, the operator moves onto the lowered lift platform and grabs the grip bar on the lift with his left hand (Figures 1 and 4). He starts the tractor with the ignition key, mounted behind the right lift guide tube, with his right hand (Figure 6). He then moves the control valve lever (Figure 7) and raises the lift until it reaches the cab entry platform (Figure 5). Once the lift is in the raised position, he positions the hydraulic control valve lever in neutral and transfers into the cab by holding onto the grip bar and the cab door.

To dismount, he shuts the tractor engine off and transfers from the cab to the lift platform. He then moves the control valve lever and the lift lowers to the ground by gravity.

CONTROL MODIFICATIONS

Clutch:

The clutch hand lever was constructed from flat steel bar stock. The control lever is connected to the clutch linkage pedal underneath the instrument panel. The lever then travels through the control panel, with a rubber handgrip placed on the operator's end (Figure 8).

To disengage the clutch, the operator pulls the lever back. The clutch pedal can still be used by an able-bodied operator.

Brake:

The brake hand levers were constructed from a formed square steel bar. A bracket was bolted to the cab floor with a rod mounted horizontally through the bracket. Two sleeves, one for each brake, slip over the horizontal rod and are welded to the lower end of the hand control levers (Figure 9). The hand levers are shaped around the outside of the brake pedal shanks, and curve inward in front of the shanks, where a metal

Figure 8. Hand Control Lever for Clutch

"lip" is welded to each lever (Figure 9). The control levers continue upward with a slight curve to allow the operator sufficient leg room. Bicycle handgrips are placed on the end of the hand control levers for protection of the operator and for proper grip of the controls (Figure 10).

To operate the brakes, the operator pushes forward on either brake lever. The metal "lip" on the control lever pushes the brake pedal shank to engage the corresponding brake. The brake pedals can be used by an able-bodied operator with the controls in place.

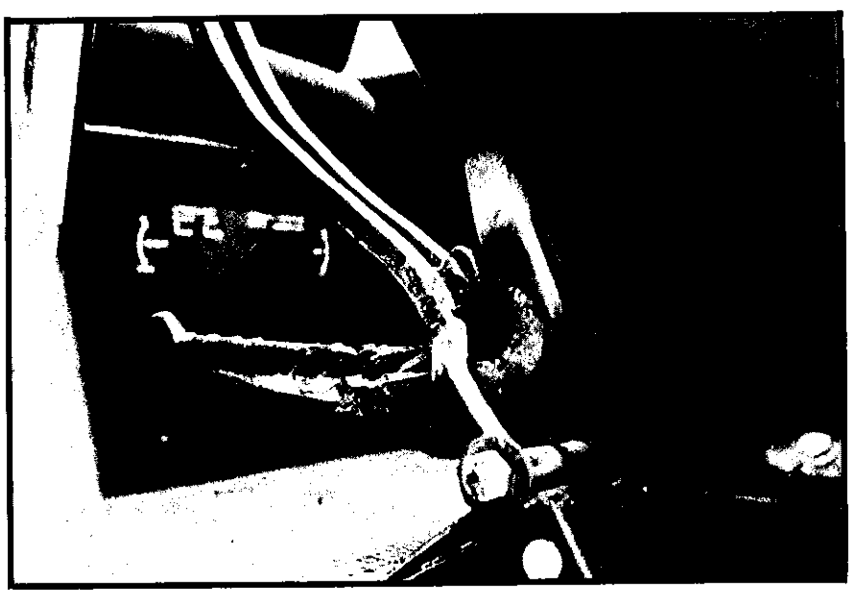

Figure 9. Mounting of Hand Brakes to Cab Floor

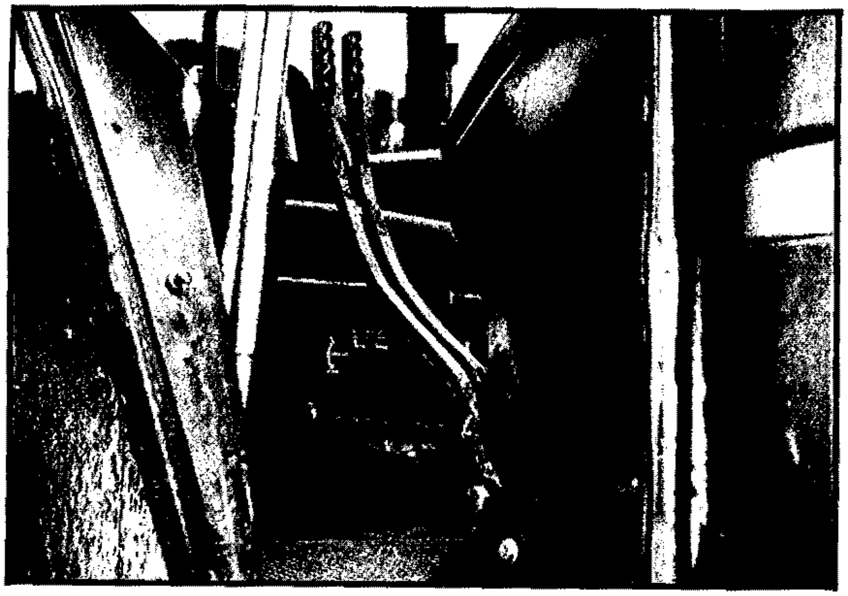

Figure 10. Control Levers for Brakes

ESTIMATED COST

Cost not available

ROGER BIDLINGMAIER'S PLATFORM LIFT

FARMER: **Roger Bidlingmaier**
P.O. Box 116
Winslow, IN 61089

SUMMARY

Function:

Roger Bidlingmaier's platform lift is designed to be mounted on a farm tractor to help a farmer gain access to the operator's station without the need to climb.

The lift is shown mounted on a John Deere 4450 tractor in Figure 1. Control modifications on Mr. Bidlingmaier's tractor are also reviewed in this section.

Figure 1. Roger Bidlingmaier's Platform Lift

Farmer:

Roger Bidlingmaier manages the family's farm with his stepfather. As the result of an accident, he is also paraplegic. He has three hired hands to help with milking and other chores. The farm consists of 600 acres devoted to pasture and cropland, a 120 head dairy cow operation and a 400 head beef steer operation.

Modified Machine:

Tractor: John Deere 4450

Features: ROPS Cab

Rear Tire Size:	18.4-38
Front Tire Size:	10.0-16
PTO HP:	150
Year:	1983

Door on one side of cab
Steps on one side of cab
CB Radio
Power-shift Transmission

Adaptability:

This lift is designed, with only minor changes, to be mounted a on John Deere 30, 40 or 50 series tractor. Changes in the mounting bracket and platform would also make this lift suitable to be mounted on other tractors of similar design. Several lifts of this type have been fabricated and are being used successfully.

Compatibility:

1. The lift interferes with an able bodied farmer mounting the tractor, thus he also must employ the lift.
2. The steps leading to the tractor's only door were removed for the installation of the lift.
3. The battery on the left side of the tractor was removed from its original location and placed on the right side of the tractor (see Figure 4).
4. The clutch pedal has been separated from its shank and reattached offset to the right. This moved it farther away from the doorway, to allow Mr. Bidlingmaier more foot room to move in and out of the cab.
5. The lift operates off the tractor's 12-volt electrical system, which is standard on most modern farm tractors.

Service and Maintenance:

1. The cable should be checked regularly for damage, corrosion and wear and replaced if necessary. Failure of the cable could cause a serious fall, especially if the failure were to

occur while the lift was in the raised position.

2. The guide for the lift platform should be lubricated periodically to assure smooth operation.

3. Electrical components should be checked regularly to ensure tight connections and identify potential shorts.

Accessibility and Ease of Use:

1. The lift is accessible by a farmer who has limited use of his legs and is able to stand-up, or by a farmer using leg braces and/or crutches.
2. The operator must stand on the lift platform to access the tractor.
3. The cable and winch are noisy during operation.

Safety Concern:

Most cable and winch manufacturers warn against the use of their products for lifting human beings. This is a major concern of the evaluators. If, however, a farmer proceeds with a winch-type lift it is strongly recommended that a high quality unit be selected that is self-locking when not activated. Experience has also shown that electric switches included with some winches do not stand up to frequent use. Heavy duty switches or solenoids which allow for lower current flows are recommended.

CONSTRUCTION DESCRIPTION

The construction of Roger Bidlingmaier's platform lift is described in the following subsections: Mounting Frame, Lift Guide, Lift Platform, Lift Actuation and Lift Controls.

Mounting Frame:

The mounting frame is a rectangular steel plate fastened to the tractor frame by two bolts (Figure 2). "Uni-strut" track welded vertically to the mounting frame forms the lift guide.

A metal skid plate welded vertically to the grip bar on the hood of the tractor and to a brace located underneath the tractor cab to the right of the lift guide track keeps the lift platform away from the tractor during lift operation (Figures 2 and 3). A length of flat steel bar is fastened vertically to the tractor frame, left of the lift guide track, to assist in keeping the lift platform away from the tractor (Figures 2 and 3).

Lift Guide:

The lift guide is a vertical Uni-strut track welded to the lift mounting frame (Figure 2). The track extends from a point below the tractor frame and up vertically to a height about 3' above the engine compartment (Figure 1).

Lift Platform:

The tractor battery on the left side was moved to the opposite side of the tractor in front of the other battery to allow for placement of the lift platform (Figure 4).

The lift platform is constructed from a welded frame of angle iron, with expanded steel welded over the top (Figures 5 and 6). The platform is designed so that it will rest next to the cab when in the raised position, to allow Mr. Bidlingmaier to move in and out of the cab easily.

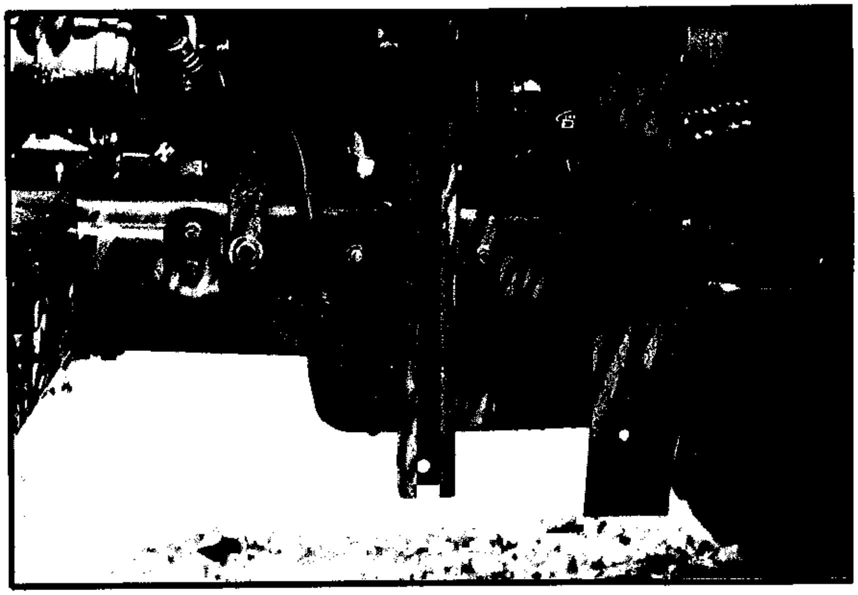

Figure 2. Lift Mounting Frame and Skid Plate

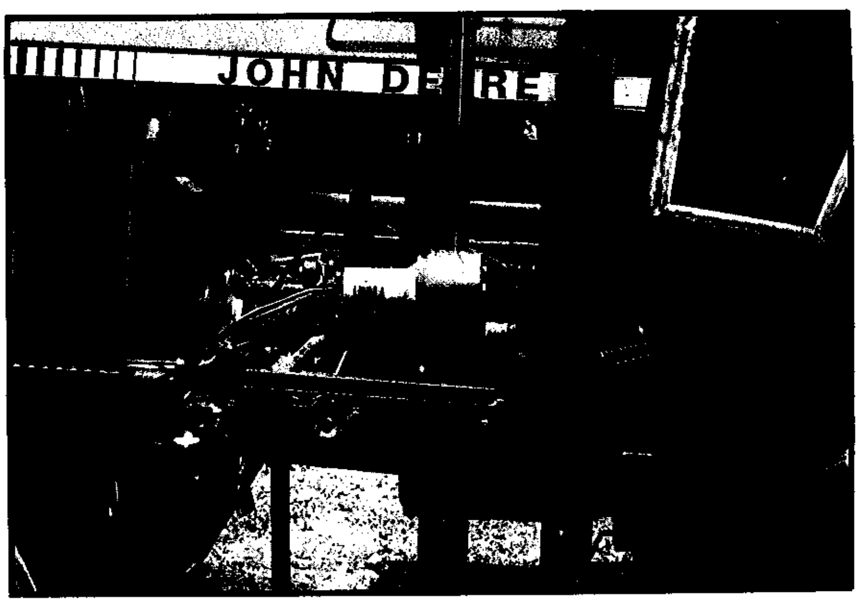

Figure 3. Skid Plates and Platform Handrails

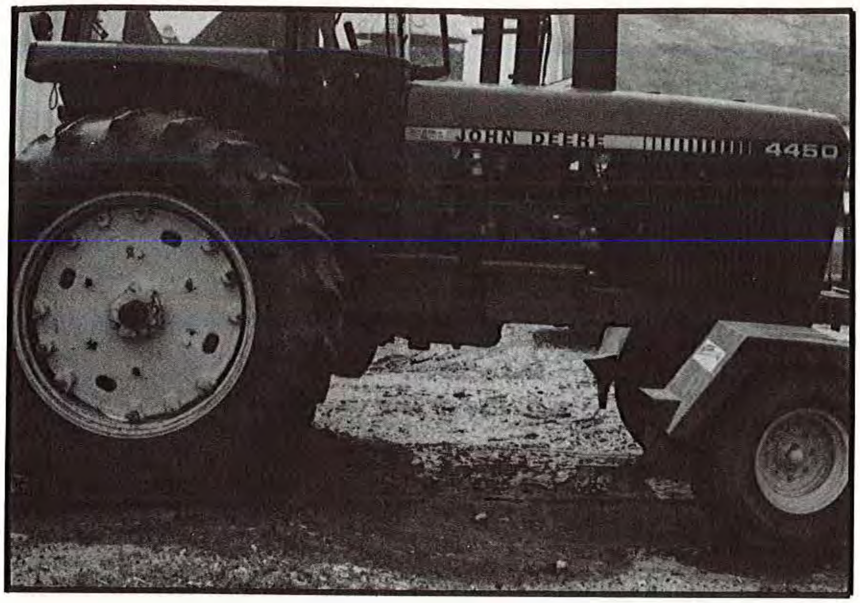

Figure 4. *Tractor Battery Location*

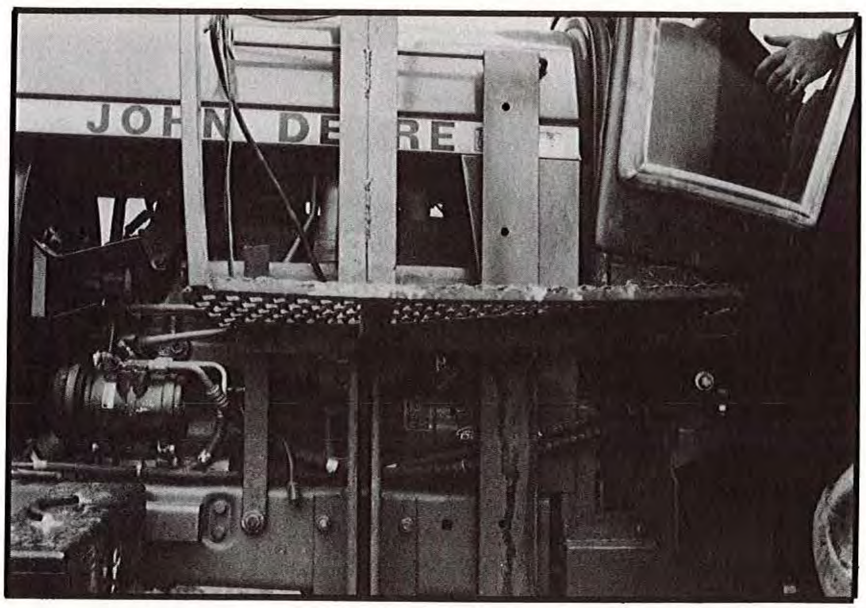

Figure 5. *Lift Platform Construction*

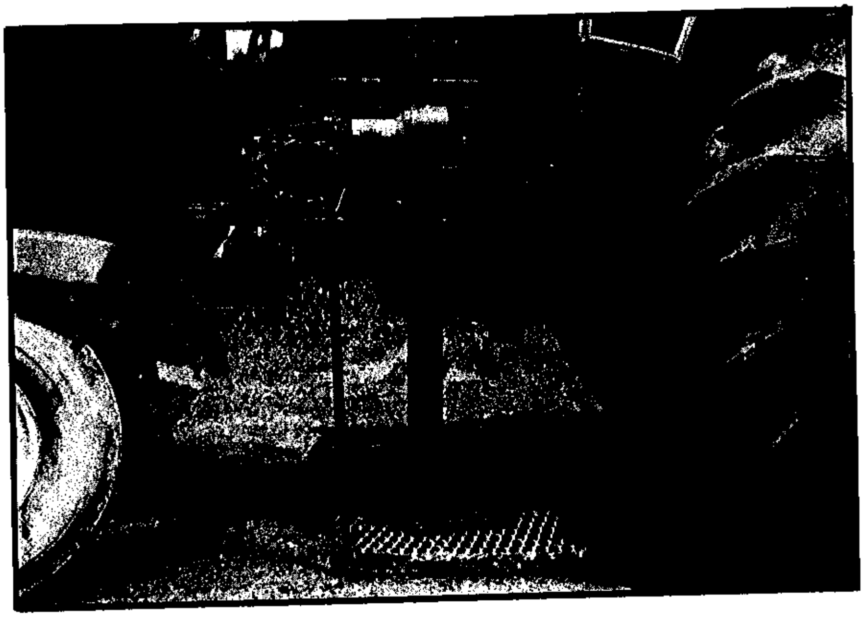

Figure 6. Lift Platform and Handrail

Two lengths of angle iron welded together form a channel. This channel is welded vertically to the lift platform, in a position that allows it to fit over the Unistrut track (Figure 6).

A "C"-shape handrail is constructed from steel channel and mounted above the lift platform at waist height. Steel tubing welded vertically to the front of the lift platform supports the handrail. The front section of the handrail pivots on a bolt, to allow access to the lift platform. The moving handrail locks into place when the lift is in use. Figure 6 shows the movable handrail unlocked for transferring and Figure 3 shows the handrail locked into place. A drawing of the lift platform is shown in Figure 7.

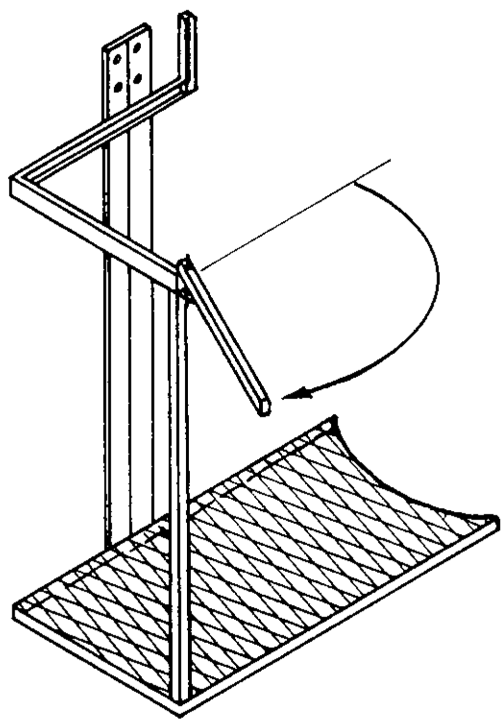

Figure 7. Lift Platform

Lift Actuation:

The lift is powered by a 12 volt DC electric winch. The winch is mounted on the vertical angle iron channel of the lift platform (Figure 3). The winch travels up and down with the platform. A guard is mounted over the winch spool to protect the operator from being caught in the cable while the lift is being operated (Figure 8).

The cable travels upward to the top of the Uni-strut track. It passes over a pulley (Figure 1) and then down through the Uni-strut track, and is anchored at the base of the track.

Lift Controls:

A rotary switch is mounted on a metal bracket welded to the handrail in front of the winch, for operating the lift from the platform (Figure 8). A self-centering toggle switch is mounted in the tractor cab to allow lift operation from the tractor seat (Figure 9).

To operate the control, the operator stands on the lift platform while holding onto the platform handrail, and rotates the switch to raise or lower the lift. When the switch is released, the lift stops.

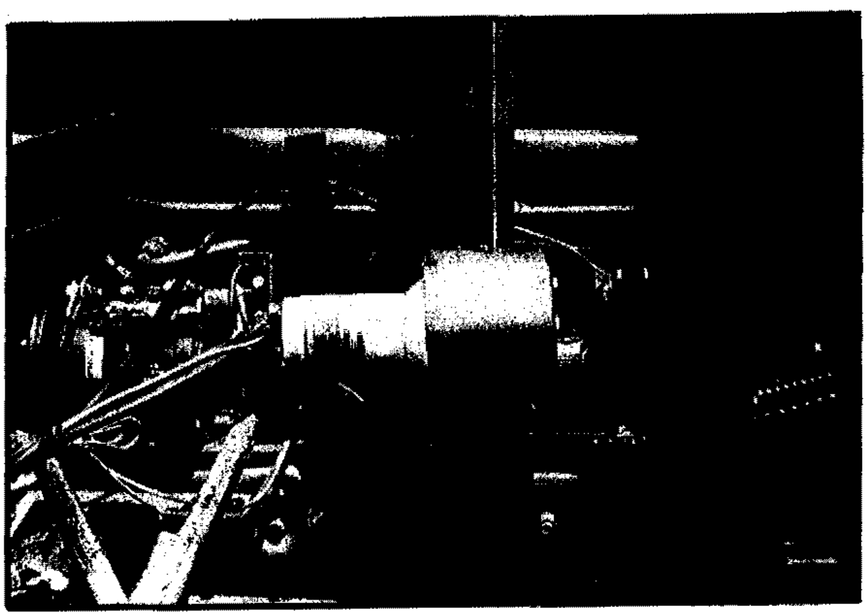

Figure 8. Winch Rotary Switch and Spool Guard

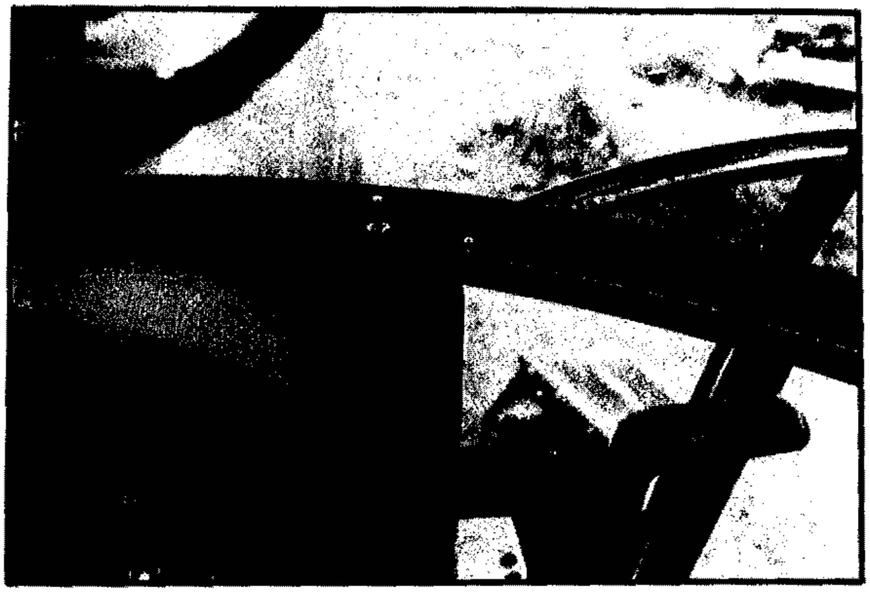

Figure 9. Lift Control Switch in Cab

SAFETY CONSIDERATIONS

For safety, the tractor engine should be turned off during lift operation. This lift does not require the tractor engine to be running during lift operation.

The self-centering switch stops the lift when released.

A guard placed over the winch spool protects the operator from possibly becoming entangled in the cable as the lift is operating (Figure 8).

The handrail on the lift platform forms a semi-"cage" that helps hold the operator on the lift platform, thus guarding against falls.

Most cable and winch manufacturers warn against using their equipment for lifting human beings. If the cable were to break, the operator would fall rapidly to the ground, which could result in serious injury. This is due to the absence of a braking device on the lift. The operator might also be injured if struck by the cable.

A switch should be located close to the ground, enabling the handicapped operator to access the lift if it is in the raised or partially raised position.

DESCRIPTION OF OPERATION

To mount the tractor, the operator moves onto the lowered lift platform and locks the handrail in place behind him (Figure 3). He turns the rotary switch mounted on the handrail to raise the lift (Figure 8). He continues raising the lift until it reaches the tractor cab (Figure 10). The operator then opens the door of the tractor cab and transfers into the cab using the handrail, cab door and grip bar inside the cab door.

Figure 10. Lift in raised Position

CONTROL MODIFICATIONS

Clutch:

The clutch pedal has been cut off the shank and offset to the right to allow Mr. Bidlingmaier additional space to more easily move in and out of the cab.

The clutch hand lever is constructed of 1 3/4″ flat steel bar cut and welded into three sections so that it follows the shape of the tractor instrument panel. A rubber handgrip is attached to the upper end to assure proper grip and for protection of the operator's hand (Figure 11). The lower end of the clutch lever has a "U"-shape bracket,

Figure 11. Clutch Hand Lever

constructed from a steel bar, that rests over the pedal shank. A bolt placed through the lower end of the bracket underneath the pedal shank securely fastens the lever to the shank.

To disengage the clutch, the operator pulls the hand lever toward himself. An able bodied person can use the clutch pedal with the lever in place. The clutch lever is designed for quick detachment if necessary.

Brake:

Two brake hand levers are constructed from 1 3/4" flat steel bars. Each lever extends up vertically, and then is bent 90° outward to form a horizontal handle. A rubber handgrip placed over the end of each lever assures proper grip and protects the operator from sharp edges. The lower end of each hand lever curves inward and has a "U"-shaped bracket welded on the end, which rests on the pedal shank. A bolt placed through the bracket underneath each pedal shank securely fastens the levers to the shanks of the pedals (Figure 12).

To engage the brakes, the operator pushes down on the lever. An able bodied person can use the pedals to engage the brakes with the levers in place. The brake levers can be easily removed if desired.

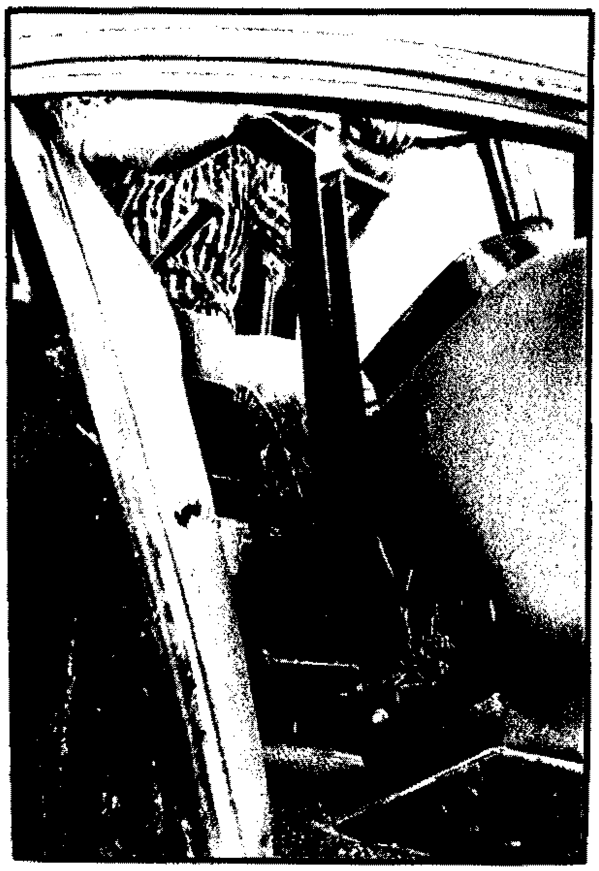

Figure 12. Brake Hand Levers

ESTIMATED COST*

Winch	$130.00
Material	600.00
Total	$730.00

*At time of construction, 1983

PHILIP BOGGS' PLATFORM LIFT

FARMER: **Philip Boggs**
Route 1, Box 30
Dunkirk, IN 47336

SUMMARY

Function:

Philip Boggs' platform lift is designed to be mounted on a Massey Ferguson 1805 four-wheel drive tractor as shown in Figure 1. The lift design helps a farmer with a physical handicap to gain access to the operator's station.

Accessories which Mr. Boggs uses with his Massey Ferguson tractor are described in a later section.

Figure 1. Philip Boggs' Platform Lift

Farmer:

Philip Boggs farms 800 acres in northern Indiana: 300 acres of corn, 120 acres of wheat and 380 acres of soybeans. He operates the farm himself, and his son helps on a part-time basis.

Mr. Boggs suffers from a muscle control nerve disease. He was not able to walk for a long period of time following the onset of the disease. His determination to overcome his disability has enabled him to regain enough strength not only to walk, but also to become active in farming again.

In addition to the lift on his four-wheel drive tractor, he has added steps on his combine and on a two-wheel drive tractor for improved access.

Modified Machine:

Tractor:	Massey Ferguson 1805 (4-WD)
Features:	ROPS CAB
Rear Tire Size:	18.4-38
PTO HP:	210
Year:	1978

Door on one side of cab

Adaptability:

This lift concept is suitable for use on other self-propelled agricultural machines. Several lifts of this type have been fabricated and are being used successfully.

Compatibility:

1. The steps leading to the tractor's only door were removed for installation of the lift, thus other operators must employ the lift for access.
2. The lift is located next to the corner ROPS post and does not obstruct the view of the operator.
3. No major alterations to the tractor other than the step removal were required to install the lift.

Service and Maintenance:

1. The cable should be checked regularly for damage, wear, or corrosion; and if necessary, replaced to prevent an accident. Failure of the cable could cause a serious fall, especially if the failure were to occur while the lift was in the raised position.

2. The guide for the lift platform should be lubricated periodically to assure smooth operation.
3. After five years of use, Mr. Boggs had to replace the cable and winch.

Accessibility and Ease of Use:

1. The lift is accessible for a farmer who has limited use of his legs and is able to stand-up; or by a farmer using leg braces and/or crutches.
2. The cable and winch are very noisy during operation.

Safety Concern:

Most cable and winch manufacturers warn against the use of their products for lifting humans.

CONSTRUCTION DESCRIPTION

The construction of Philip Boggs' platform lift is discussed in the following subsections: Stationary Frame, Lift Guide, Lift Platform, Lift Actuation, and Lift Controls.

Stationary Frame:

The mounting frame is constructed of two 3″ angle iron bars bolted to the tractor frame 13 1/2″ apart underneath the tractor cab. The two angle iron bars angle out away from the tractor at the rear of the cab to allow for attachment of the lift guide mechanism, and to allow for the articulating motion of the tractor (Figures 2 and 3).

Lift Guide:

The guide mechanism for the lift is a vertical framework constructed of steel. A 7' 10 1/2″ section of steel channel is welded to the mounting frame. A steel plate is welded between the raised edges of the channel to form a flat surface for attachment of the mounting frame (Figures 2 and 4). Two

Lift Platform:

A 2' section of 1 3/4″ x 4″ steel slips inside the guide tube which is formed by the two vertical angle iron bars. The slip tube

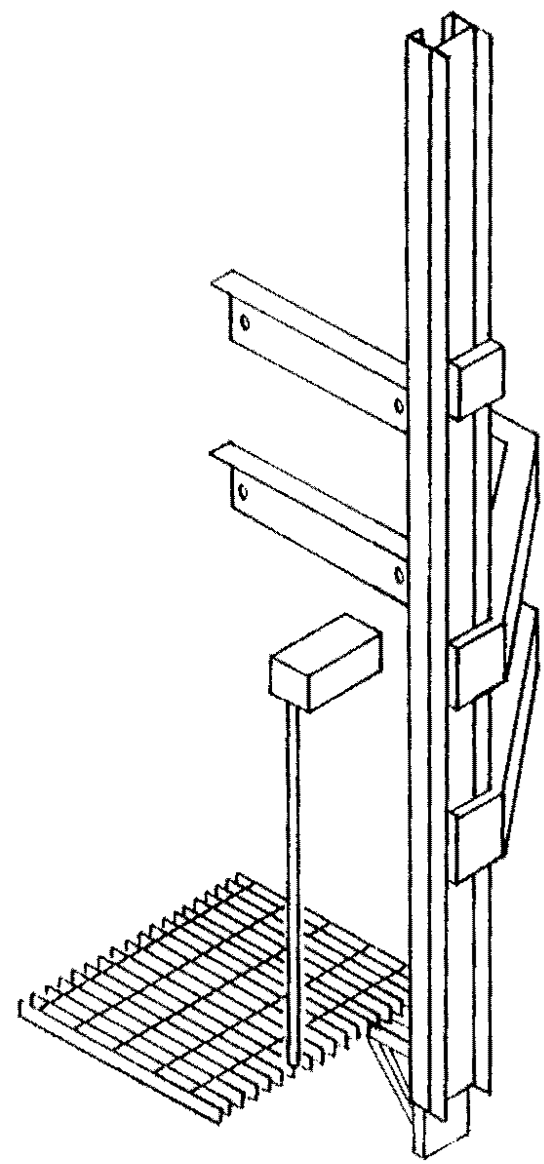

Figure 2. Drawing of Lift Construction

angle iron bars are welded along the length of the flat side of the channel. These two steel bars are sized to form a gap between them in the front where the lift platform mounting will pass (Figures 3 and 4). The two angle iron bars also form a guide tube for the lift platform's "slip tube".

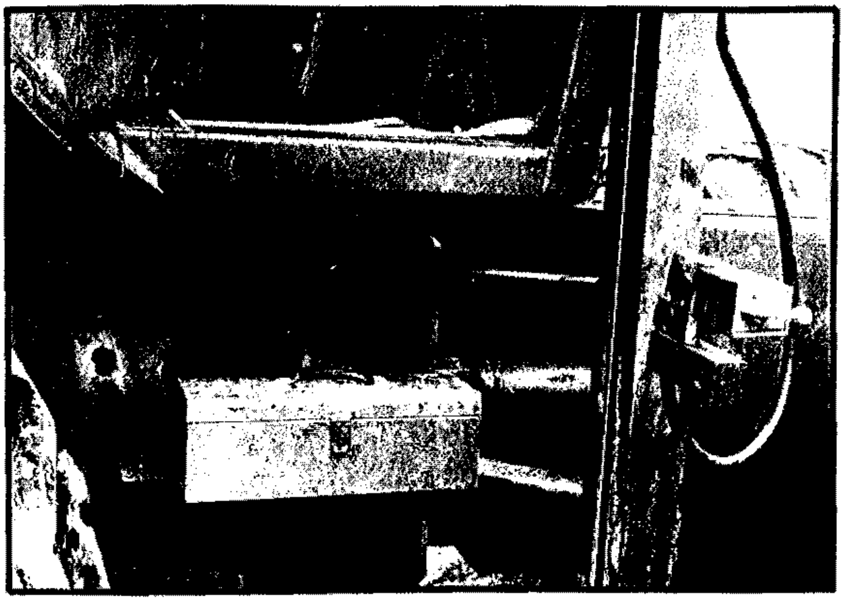

Figure 3. Mounting Bracket location on Tractor

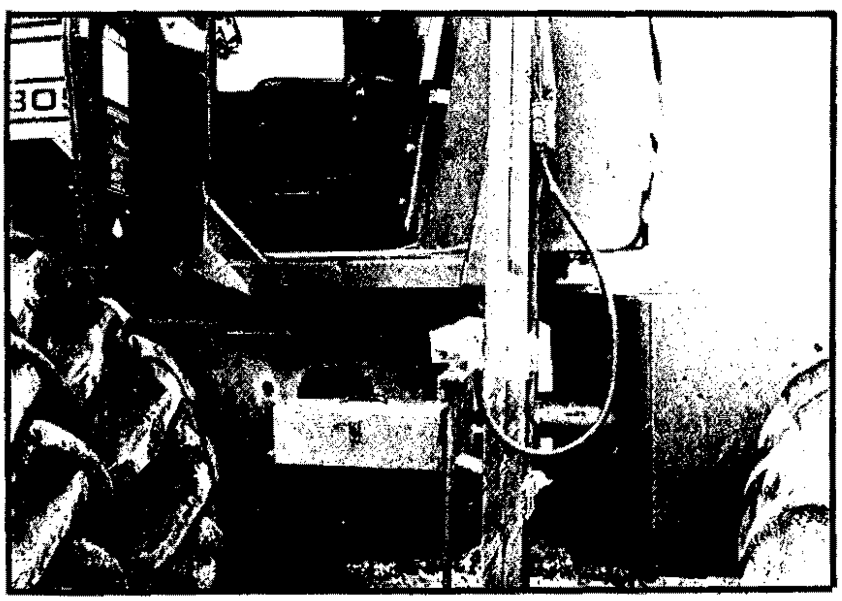

Figure 4. Mounting Bracket attachment to Lift Guide

provides the attachment point for the lift platform. A triangular bracket constructed of square steel tubing forms the base of the lift platform and attaches to the slip tube (Figures 2 and 5). A narrow steel plate is welded over the triangular bracket's horizontal length which supports the platform surface. The platform surface is a grate constructed of narrow steel bars mounted on their edge with steel rods passing through them (Figure 5).

A pulley is attached to the top of the slip tube to allow attachment of the winch cable (Figure 6).

A steel rod is welded to the lift platform and extends up vertically to approximately waist height. An "L"-shaped bracket is mounted on the steel rod for the attachment of the lift controls. A second steel rod is welded to the lift platform and mounted at an angle to support the vertical steel rod (Figures 3 and 6).

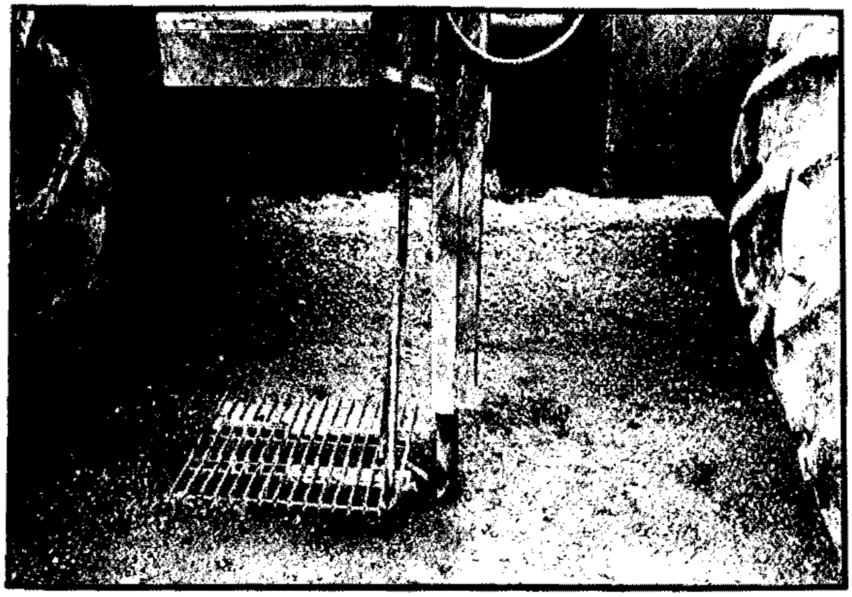

Figure 5. Lift Platform

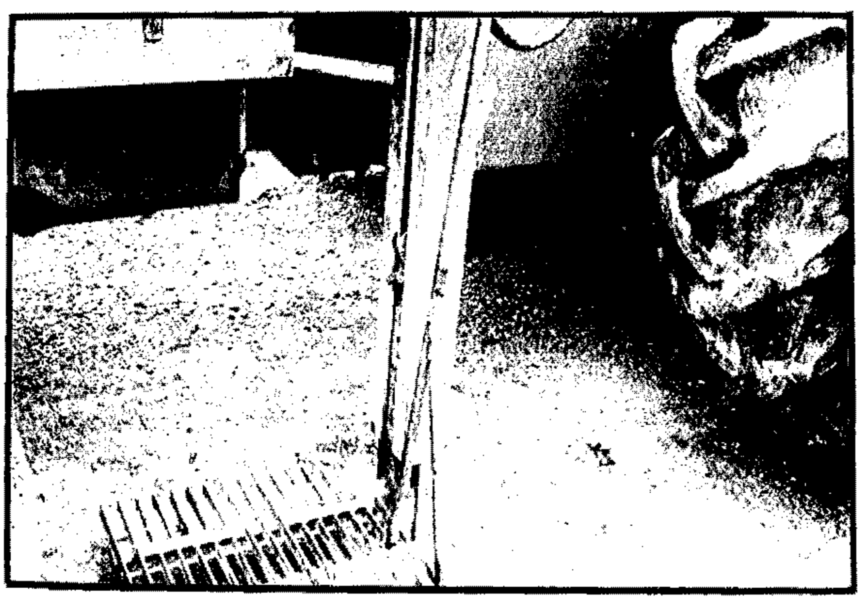

Figure 6. Lift Platform and Slip Tube with Pulley

Lift Actuation:

The lift is powered by a 12 volt DC electric winch. The winch is bolted to a steel plate that is welded to the top of the vertical steel channel. The cable and winch are shown in Figure 7.

The cable extends down to the slip tube, travels around the pulley attached to the slip tube, and extends back up vertically to the top of the lift guide, where it is attached to a steel rod (Figure 7).

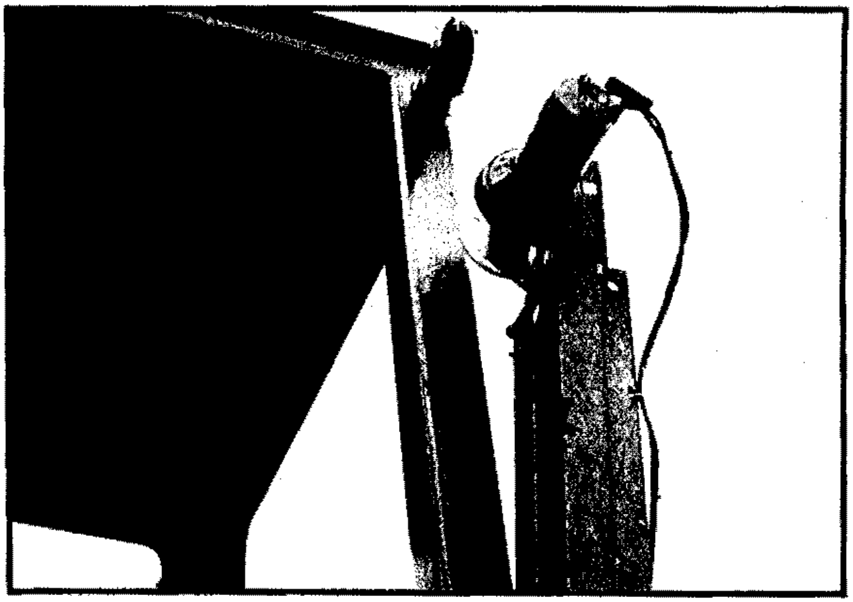

Figure 7. Cable and Winch (Note: Cable secured to steel rod underneath Winch)

Lift Controls:

A steel rod mounted to the lift platform, extending up vertically, provides the mounting point for the lift control switch. An electrical junction box is attached to an "L"-shaped steel bar mounted on the steel rod. Extending out from the junction box is a switch control box housing the self-centering switch used to raise and lower the lift (Figure 3).

The wiring travels out of the junction box on the lift platform to another junction box mounted on the back of the vertical channel (Figures 4 and 8). The wiring is protected by rubber tubing. The wiring then travels from the second junction box to the tractor battery, and another wire travels to the winch (Figure 8).

Figure 8. Lift Wiring and Controls

SAFETY CONSIDERATIONS

The tractor engine should be turned off during lift operation. This is an important safety feature of the lift.

The self-centering switch stops the lift when released.

Most cable and winch manufacturers warn against using their equipment for lifting humans. If the cable should break, the operator would fall rapidly to the ground, which could result in serious injury. This is due to the absence of a braking device on the lift. The operator might also be struck by the cable and injured.

The platform lift could be improved by adding bracing or railing around the platform to form a "cage" around the operator. This guards against accidental falls.

The operator should make sure the platform is in the raised position before operating the tractor, because the lift could be damaged when the tractor is articulated (Figures 9 and 10).

It might be desirable to have a switch located near the ground on the tractor, because if the lift is left partially raised the operator would not be able to access the tractor.

It should also be noted that the platform rests several inches off the ground, making accessibility of the platform difficult for some farmers with physical handicaps.

Figure 9. Lift Platform with Tractor Articulated

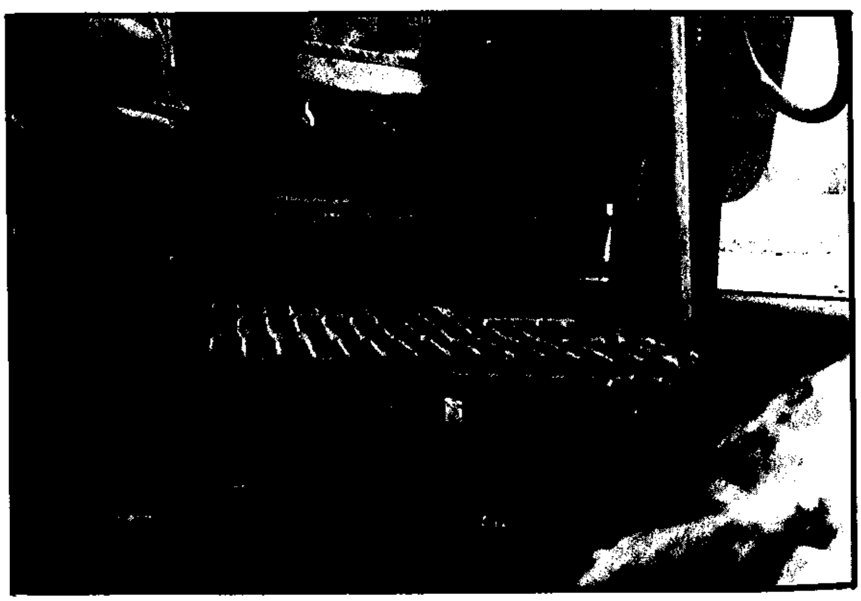

Figure 10. Lift Platform and the closeness to Tractor Tire

DESCRIPTION OF OPERATION

To mount the tractor, Mr. Boggs moves up to the lowered platform (Figure 5). He climbs onto the lift platform, which rests several inches off the ground, and with one hand holds onto the switch bracket while operating the switch with the other hand (Figure 3). He continues raising the lift until he reaches the door, at which time he releases the switch and opens the door (Figure 11). He then continues to raise the lift until it reaches the floor level of the tractor cab (Figure 12).

Figure 11. Mr. Boggs raising Lift

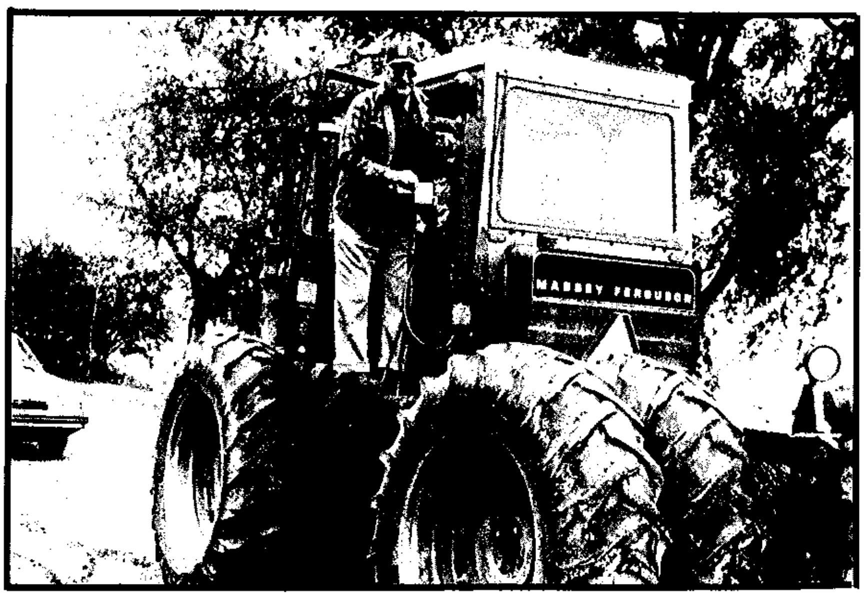

Figure 12. Lift in raised Position

To dismount, he steps from the tractor cab onto the lift platform. He then turns the switch with one hand and lowers the lift until he can close the cab door. Mr. Boggs continues to lower the lift until it reaches the ground, where he releases the switch and steps off the lift platform to the ground.

ACCESSORIES

Rear View Mirror:

Due to his limited mobility, Mr. Boggs mounted a mirror from a school bus inside his tractor cab to allow him to view trailing equipment without having to turn around (Figure 13).

Figure 13. Rear View Mirror

Stair Steps:

Mr. Boggs uses a movable set of wooden stairs to access the engine compartment of his tractor to perform service and maintenance work. He mounted railings along the side of the steps to provide assistance in climbing up and down the stairs.

To use the steps, Mr. Boggs drives his tractor along the side of the stairs with the front wheels of the tractor next to the top step (Figure 14).

Figure 14. Wooden Steps for Engine Access

ESTIMATED COST*

Materials and Winch: $ 300.00

*At time of construction, 1981

BREAKING NEW GROUND'S PLATFORM LIFT

CONTACT: **Breaking New Ground**
Purdue University
Agricultural Engineering Dept.
West Lafayette, IN 47907

DESIGNED BY: **Larry Linville (Deceased)**

SUMMARY

Function:

One of the early lifts investigated by the Breaking New Ground project was an electric winch operated platform lift built by Larry Linville of Shelbyville, Indiana (now deceased). The lift enabled his father, who was unable to climb, to access both his tractor and combine. Breaking New Ground fabricated a similar prototype to mount on a John Deere 4430 (Figure 1).

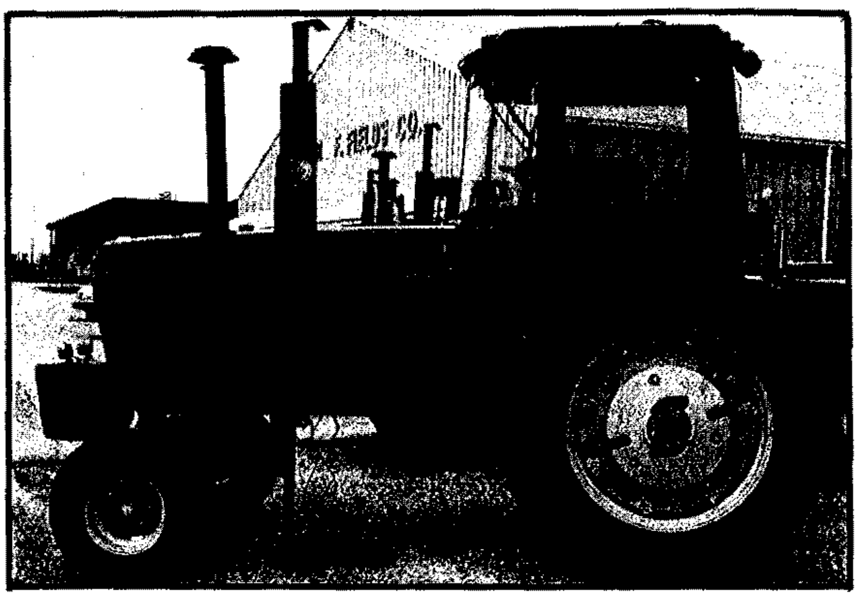

Figure 1. Breaking New Ground's Platform Lift

Modified Machine:

Tractor:	John Deere 4430
Features:	ROPS Cab
Rear Tire Size:	18.4-38
Front Tire Size:	11L-15SL
PTO HP:	125

Sound Guard Cab
Hydraulic suspension seat
Grip Bar on side of tractor
Door on one side

Adaptability:

This lift concept is suitable to be used on other self-propelled agricultural machines. Mr. Linville successfully used the lift on a John Deere 4440 tractor and a John Deere 4400 combine. Other farmers have fabricated similar lifts for use on other machines.

Compatibility:

1. The steps leading to the cab were removed to install the lift.
2. The lift interferes with the normal access to the tractor. Once installed, the lift must be used in order to gain access to the tractor cab.
3. Some inconvenience is caused by the lift's obstruction of the operator's view on the left side of the tractor.
4. The lift could cause some crop damage because its frame extends below the main framework of the tractor. The lift frame could also be damaged if it made contact with a secure object, such as a stump.
5. No permanent alterations were required in mounting the lift to the tractor.

Service and Maintenance:

1. The cable should be checked regularly for damage, corrosion and wear and replaced if necessary. Failure of the cable could cause a serious fall, especially if the failure were to occur with the lift in the raised position.
2. The guide for the lift platform should be lubricated periodically to assure smooth operation and to prevent wear.

Accessibility and Ease of Use:

1. The lift is accessible for a farmer who has limited use of his legs and is able to stand up, or by a farmer who uses leg braces and/or crutches.
2. The operator must stand on the lift platform to access the tractor.

3. The cable and winch are noisy during operation.
4. Little training is required to operate the lift. However, moving into the tractor cab might require some practice.

Safety Concern:

Most cable and winch manufacturers warn against the use of their products for lifting human beings. This is a major concern of the evaluators. If a farmer proceeds with a winch-type lift, it is strongly recommended that a high quality unit be selected that is self-locking when not activated. Experience has also shown that the electric switches included with some winches do not withstand frequent use. Heavy duty switches or solenoids which allow for lower current flows are recommended.

CONSTRUCTION DESCRIPTION

The construction of the Breaking New Ground Platform Lift is discussed in the following subsections: Stationary Frame, Lift Guide, Lift Platform, Lift Actuation and Lift Controls.

Stationary Frame:

The mounting frame is constructed from a 10″ x 6″ x 1/2″ steel plate with two bolt holes drilled for mounting the lift to the tractor. The steel plate is welded to a 6″ x 8 1/2″ length of horizontal steel channel which supports a 5' 6″ x 6″ vertical steel channel.

Lift Guide:

Two 5 foot lengths of Uni-strut track were welded to the vertical steel channel. The two lengths of Uni-strut are positioned parallel to one another, with their track openings facing each other. Together they serve as the guide mechanism for the lift. The lift unit is shown in Figure 2.

Lift Platform:

The lift platform is constructed from a rectangular framework of 1″ angle iron inverted so a flat side faces up, with expanded steel welded over it.

On one edge of the platform a 3″ x 14″ steel plate is mounted vertically. The steel plate has four bolt holes drilled in it for a rectangular steel bracket to hold a vertical 2″ square tube. It slips between the two vertical lengths of Uni-strut track (Figures 2 and 3).

Lift Actuation:

The lift is powered by a 12 volt DC electric winch. The winch is mounted on the top of the vertical steel channel by two bolts (Figure 2).

Figure 2. View of Lift from inside Tractor Cab

The winch has a pulling capacity of 2500 lbs. The winch also has an electrical load rating of 25 amps.

Lift Controls:

A remote control switch is mounted on the vertical square tube attached to the platform. The remote switch is wired to the winch with 10 feet of 10 gauge wire. The switch is shown in Figures 2 and 3.

To operate the control, the operator pushes the switch in one direction to raise the lift and the other to lower it. The switch is self-centering, thus when the switch is released, the lift stops. A wire travels from the winch to the tractor battery, while a ground wire travels from the remote switch to the side of the tractor. A wiring diagram is shown in Figure 4.

SAFETY CONSIDERATIONS

As a safety precaution, the tractor should be turned off during lift operation.

Most cable and winch manufacturers warn against using their equipment for lifting human beings. If the cable were to break, the operator would fall rapidly to the ground, resulting in possibly serious injuries. This is due to the absence of a braking device on the lift. Also, if the cable were to break, the operator might be struck by the cable and injured.

There is a pinch point on the side of the tractor between the lift platform and the small platform deck in front of the door (Figure 3). It occurs as the lift raises to the cab.

This type of platform lift could be improved by the addition of bracing around the lift platform. Forming a "cage" would prevent an accidental fall from the platform during operation.

The grip bar on the side of the tractor is positioned too low to provide stability for the operator as he moves from the platform to the tractor cab. An additional grip bar would provide additional security.

The switch is located too low for easy reach by the operator. It should be at least hip high so he will not have to bend over to reach it.

The lift causes some obstruction of view on the left side of the tractor (Figure 2). Care should be taken when designing a lift to prevent the lift from blocking the operator's view.

The platform on the tractor is too narrow for the operator to feel secure when moving from the lift platform to the tractor. In addition, the cab door does not provide a secure grab point when the operator pushes against it to step into the cab. The movement of the door could cause him to lose his balance and fall.

DESCRIPTION OF OPERATION

To mount the tractor, the operator moves up to the lowered platform (Figure 1). He steps onto the lift platform and grabs the grip bar on the side of the tractor. With his left hand, he turns the remote switch mounted on the side of the lift platform assembly to raise the lift (Figure 5). He continues raising the lift until it reaches the platform on the side of the tractor, releases the switch, and steps into the tractor cab (Figure 6).

To dismount, he first steps from the tractor cab onto the tractor platform. He then grabs the door and the grip bar to move onto the lift platform. The operator positions himself on the lift platform and holds onto the grip bar with one hand. At the same time, he operates the switch with the other hand. He then lowers himself to the ground.

Figure 3. Side View of Lift

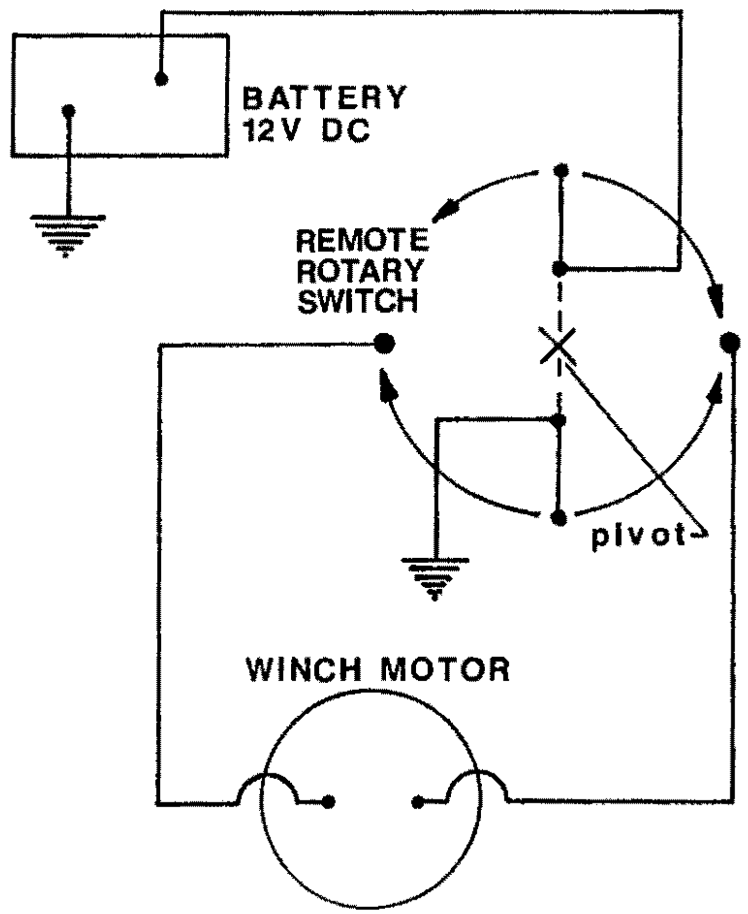

Figure 4. Wiring Diagram

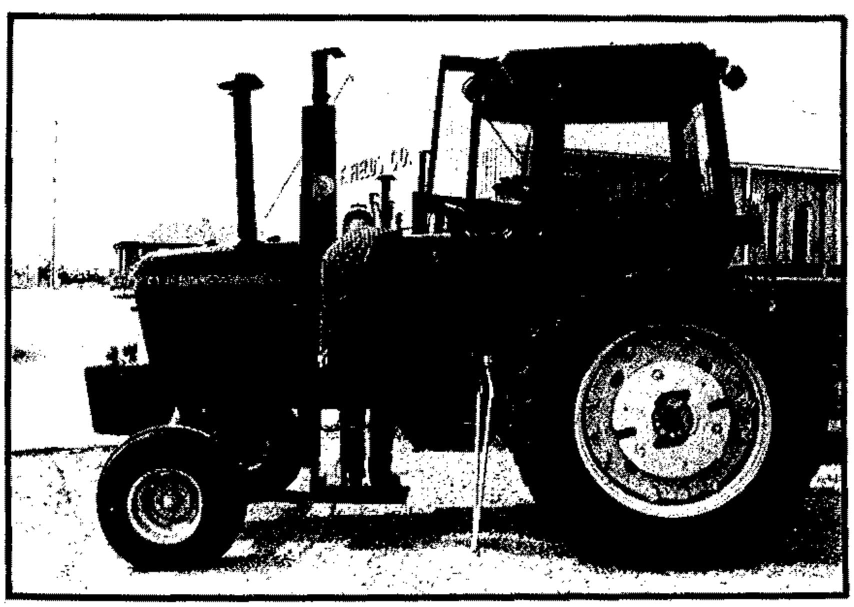

Figure 5. Operator using Lift

Figure 6. Moving from Lift to Tractor Cab

ESTIMATED COST*

Hardware	$ 15.00
Uni-Strut	32.00
Steel	46.00
Winch	150.00
Remote Switch	12.00
MATERIALS:	$ 255.00

Labor Cost Not Available

*At time of construction, 1981

DON GIBBS' PLATFORM LIFT

FARMER: Don Gibbs
R.R. #1, Box 49
Princeville, IL 61559

DESIGNED BY: Dave Gibbs (Don's Son)

SUMMARY

Function:

Don Gibbs' platform lift is designed to be mounted on an Allis-Chalmers 7060 tractor to enable him to gain access to the operator's station (Figure 1). The lift is operated with the user in a standing position. Control modifications on Mr. Gibbs' tractor are described in a later section.

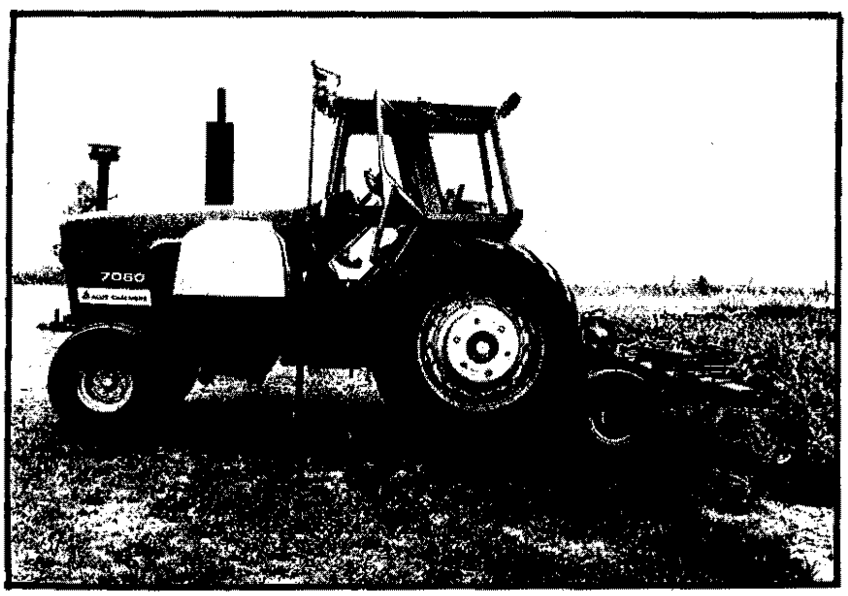

Figure 1. Don Gibb's Platform Lift

Farmer:

Even though Don Gibbs is semi-retired from farming, he still helps his son Dave who farms 1300 acres of corn and soybeans in Northern Illinois.

To allow Mr. Gibbs to help with field work, an Allis-Chalmers 185 tractor was modified with a lift and hand controls. Later, a second lift was built and mounted on the cab of their Allis-Chalmers 7060 tractor. The second lift uses a combination of a platform and a sling which is described in this section. Hand controls were installed to operate the clutch and brakes.

Modified Machine:

Tractor:	Allis-Chalmers 7060
Features:	ROPS Cab
Rear Tire Size:	18.4- 38
Front Tire Size:	11.0-16
PTO HP:	160
Year:	1981

Door on one side of cab
Saddle Tanks for Chemicals

Adaptability:

This specific lift is designed to be mounted on an Allis-Chalmers 7060 tractor. This lift concept is suitable for use on other self-propelled agricultural machines. Several lifts of this type have been fabricated and are being used successfully.

Compatibility:

1. The inclined steps leading to the tractor's only door were removed and redesigned to form a vertical ladder which can be used by operators who do not need to use the lift.
2. The lift does not interfere with an able-bodied farmer using the tractor because the lift platform folds up out of the way, allowing use of the modified steps.
3. The cab door was modified to swing open farther, allowing easier operator movement in and out of the cab.

Service and Maintenance:

1. The cable should be checked regularly for damage, corrosion and wear and replaced if damaged. Failure of the cable could cause a serious fall, especially if the failure were to occur while the lift was in the raised position.
2. Electrical switches and wiring need to be kept in good repair to prevent failure.

Accessibility and Ease of Use:

1. The lift is accessible for a farmer who has limited use of his legs and is able to stand up or by a farmer who uses leg braces and/or crutches.
2. The operator must stand on the lift platform to access the tractor.
3. The lift has a sling feature that assists a farmer moving from the lift platform to the tractor seat.
4. The cable and winch are noisy during operation.

Safety Concern:

Most cable and winch manufacturers warn against the use of their products for lifting human beings. This is a major concern of the evaluators. If a farmer proceeds with a winch type lift, we strongly recommended a high quality unit that is self-locking when not activated. Experience has also shown that the electric switches included with some winches do not withstand frequent use. Heavy duty switches or solenoids, which allow for lower current flows, are recommended.

CONSTRUCTION DESCRIPTION

The construction of Don Gibbs' platform lift is described in the following subsections: Stationary Frame, Lift Guide, Modified Steps, Lift Platform, Lift Actuation, and Lift Controls.

Stationary Frame:

Mounted over the tractor door is a length of horizontal rectangular steel tubing and a steel mounting bracket attached to the tractor cab (Figure 2). The horizontal tube extends out beyond the front ROPS post of the tractor cab. There it is bolted to the back of the lift guide tube (Figure 3).

A horizontal length of square steel tubing passes over the tractor cab. The end of the tube is bolted to a square steel bracket attached to the cab (Figure 4).

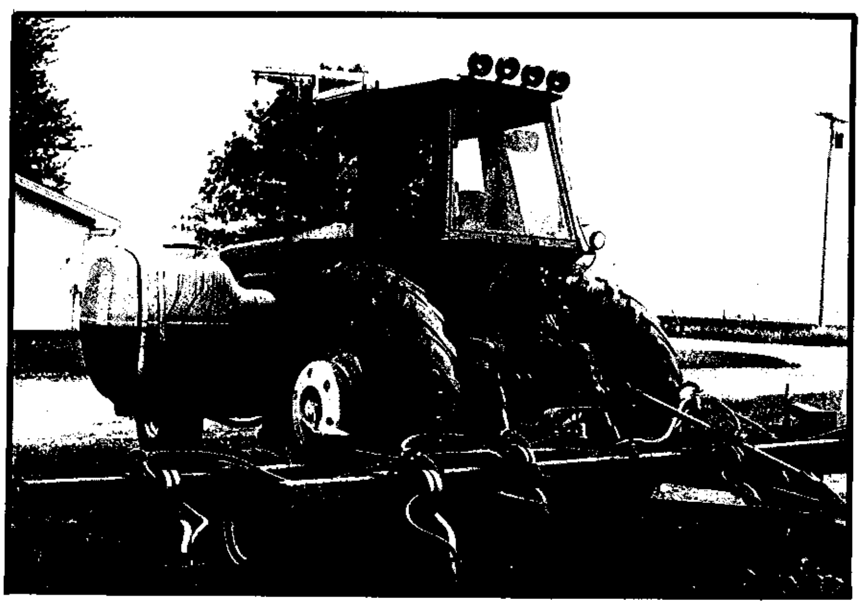

Figure 2. Horizontal Mounting Bracket

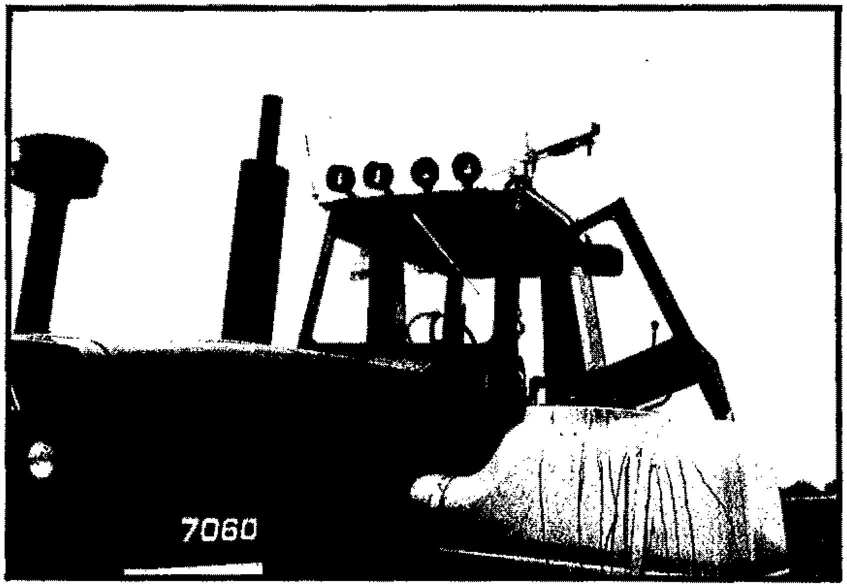

Figure 3. Mounting Bracket attached to Lift Guide

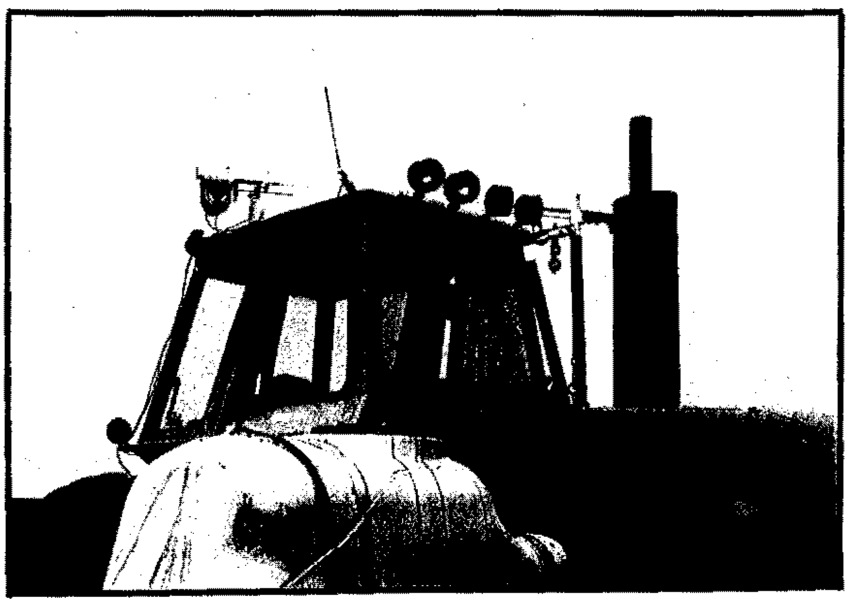

Figure 4. Winch Mounted over Tractor Cab

Lift Guide:

The lift guide is constructed from 1-1/2" x 8' square steel tubing. The lift guide is fastened to the tractor cab at two points besides the mounting described above. An "L"-shaped bracket is constructed from flat steel bar stock and fastened to the lift guide tube with a bolt at a height equal to the door handle (Figure 5). A second brace constructed from a flat steel bar is fastened to the "L"-shaped bracket (Figure 5) and extends down where it securely fastens to the lower end of the lift guide tube. A drawing of the lift frame and lift platform is shown in Figure 6.

Modified Steps:

The original steps on the Allis-Chalmers 7060 tractor were removed and reconstructed so the steps form a vertical ladder next to the tractor cab. Flat steel bars welded on the right side of the steps function as a skid plate for the lift platform (Figure 7). The skid plate prevents any interference between the lift platform and steps.

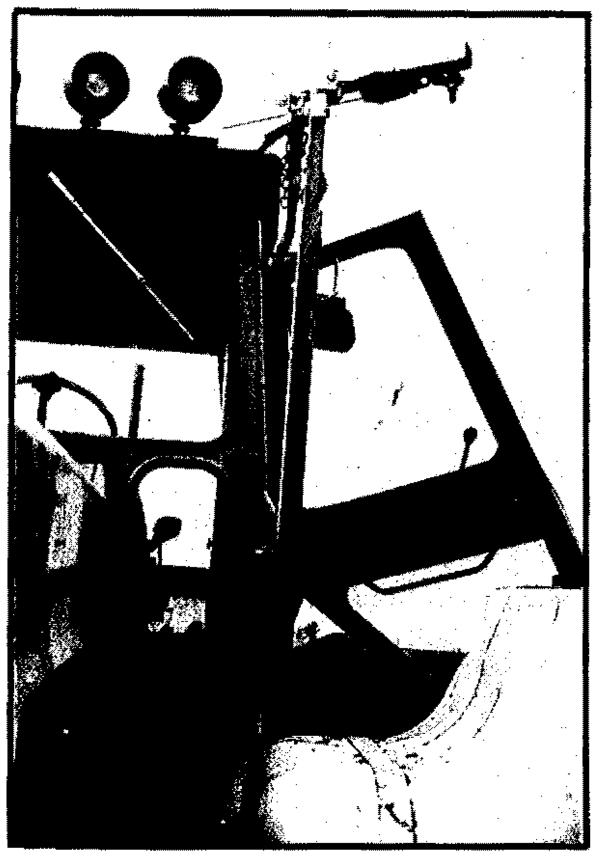

Figure 5. Lower Mounting Bracket for Lift Guide Tube

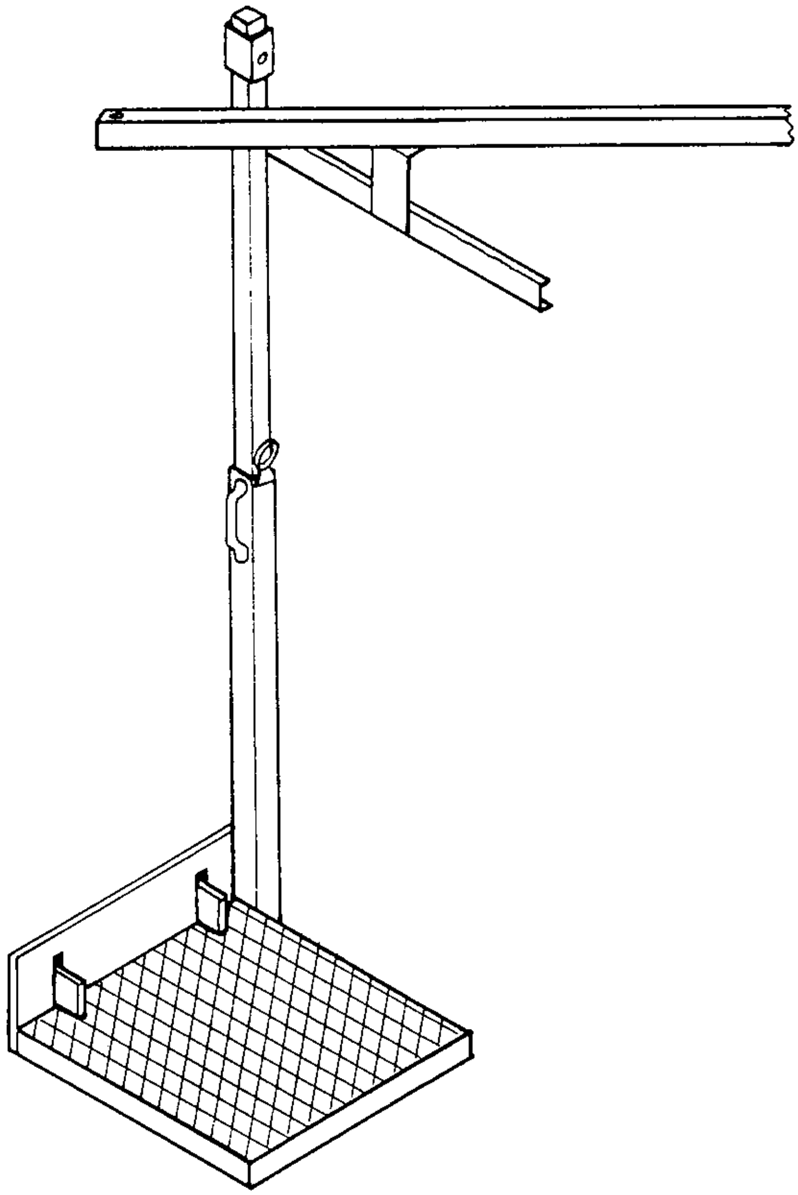

Figure 6.   Lift Frame and Platform

Lift Platform:

The lift platform is attached to a length of 2" square steel tubing which slips over the vertical lift guide tube. This "slip tube" has a slot machined along its entire length on the side that faces the engine compartment, to allow the slip tube to travel up and down and pass the mounting bolts of the lift guide tube.

The slip tube is welded to a rectangular steel plate. Two slots cut in the plate allow passage of steel hinges attached to the platform (Figures 6, 7 and 8). A rectangular framework of angle iron and expanded steel is welded to the steel hinges to form the platform (Figure 8).

The hinges allow an able-bodied operator to mount the tractor without using the lift by swinging the lift platform upward out of the way and then using the steps (Figure 7).

A handle welded to the top of the slip tube provides stability for the operator when the lift is in use (Figure 5).

Figure 7. Modified Steps

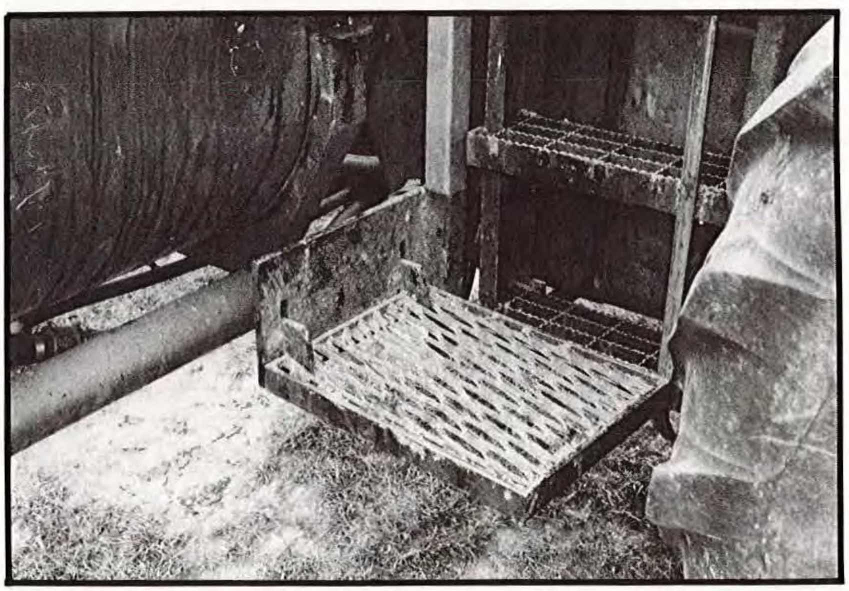

Figure 8. Lift Platform

Lift Actuation:

The lift is powered by a 12 volt DC electric winch. The winch is mounted underneath a length of horizontal steel tubing passing over the tractor cab on the side opposite the lift (Figure 4). The horizontal winch mounting tube extends out beyond the tractor cab to form a boom where a pulley is attached over the lift platform (Figure 5).

The cable travels horizontally from the winch to the pulley shown in Figure 5. The cable then travels over a small pulley mounted to the top of the lift guide tube. It continues downward where a hook attaches to a short length of chain welded to the lift platform slip tube (Figure 9).

A lock to hold the lift in the raised position is shown in Figure 4. The lock is a short length of chain with a hook on the end fastened around the horizontal mounting tube for the lift guide. Mr. Gibbs fastens the chain lock to the slip tube and transfers the cable hook to a sling that he wraps around himself for lowering himself into the tractor seat.

Figure 9. Cable Attached to Slip Tube

Lift Controls:

A hand held remote control switch is used to operate the winch. The remote switch is shown in Figure 10.

The electrical wiring travels from the remote switch to a control box containing solenoids, mounted behind the tractor seat. The wiring then travels outside the cab from the control box to the winch motor (Figure 4). A wiring diagram for the solenoid box is shown in Figure 11.

SAFETY CONSIDERATIONS

For safety, the tractor engine should be turned off during lift operation. This is an important safety feature of this lift.

Most cable and winch manufacturers warn against using their equipment for lifting human beings. If the cable were to break, the operator would fall rapidly to the ground, which could result in serious injury. This is due to the absence of a braking device on the lift. The operator might also be injured if struck by the broken cable.

The platform lift could be improved by adding bracing or railing around the platform, forming a "cage" to hold the operator on the platform.

There is a pinch point where the lift platform and the tractor steps come together. It is possible for the operator to get his feet caught underneath the steps if they are not fully on the platform. A hinged steel guard mounted on the platform edge would help eliminate this hazard. The guard would need to be designed so that it folded down when the lift reaches the raised position.

DESCRIPTION OF OPERATION

To mount the tractor, Mr. Gibbs moves up to the tractor and opens the cab door where a hand held remote switch is on the floor (Figure 10). If the platform is in the raised position (Figure 7), Mr. Gibbs swings the platform down, and then lowers the lift to the ground (Figure 1). He then moves onto the lift platform and grabs the handle on the slip tube (Figure 5) with one hand while he operates the lift with his other hand. When the lift reaches the cab entry height, he moves onto the top step, then fastens the lift lock to the chain on the slip tube. He unhooks the winch cable from the slip tube and fastens a sling around himself and attaches the end of the winch cable hook to the sling. He operates the remote switch to lower himself into the tractor seat, and then closes the cab door.

To dismount, Mr. Gibbs fastens the sling which is attached to the winch cable around himself, and opens the cab door. He toggles the remote switch to raise himself from the tractor seat to the steps of the tractor. Once he is outside the cab, he stands on the tractor steps. He then transfers the winch cable hook to the slip tube of the lift platform and attaches it to the short length of chain (Figure 9). He then unfastens the lift lock and moves over onto the lift platform. He toggles the remote switch to lower himself to the ground.

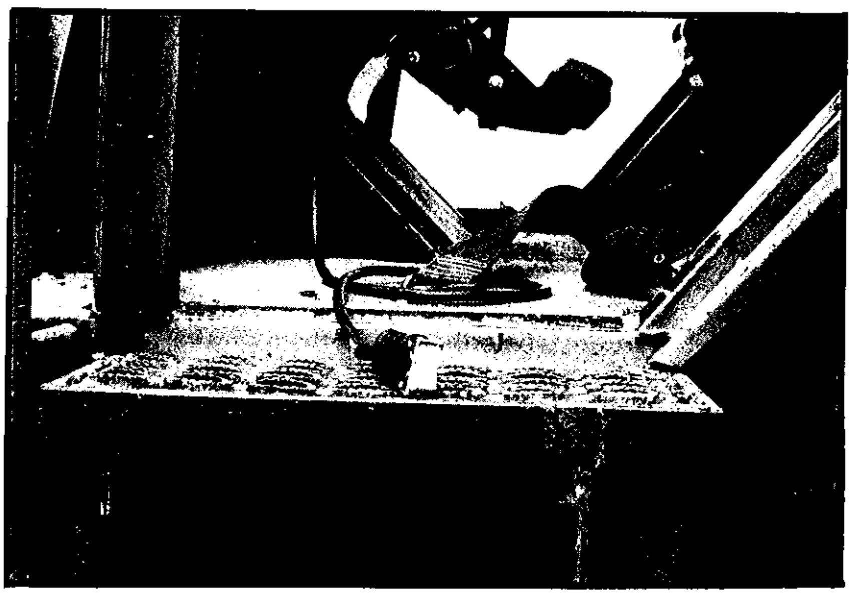

Figure 10. Remote Control Switch

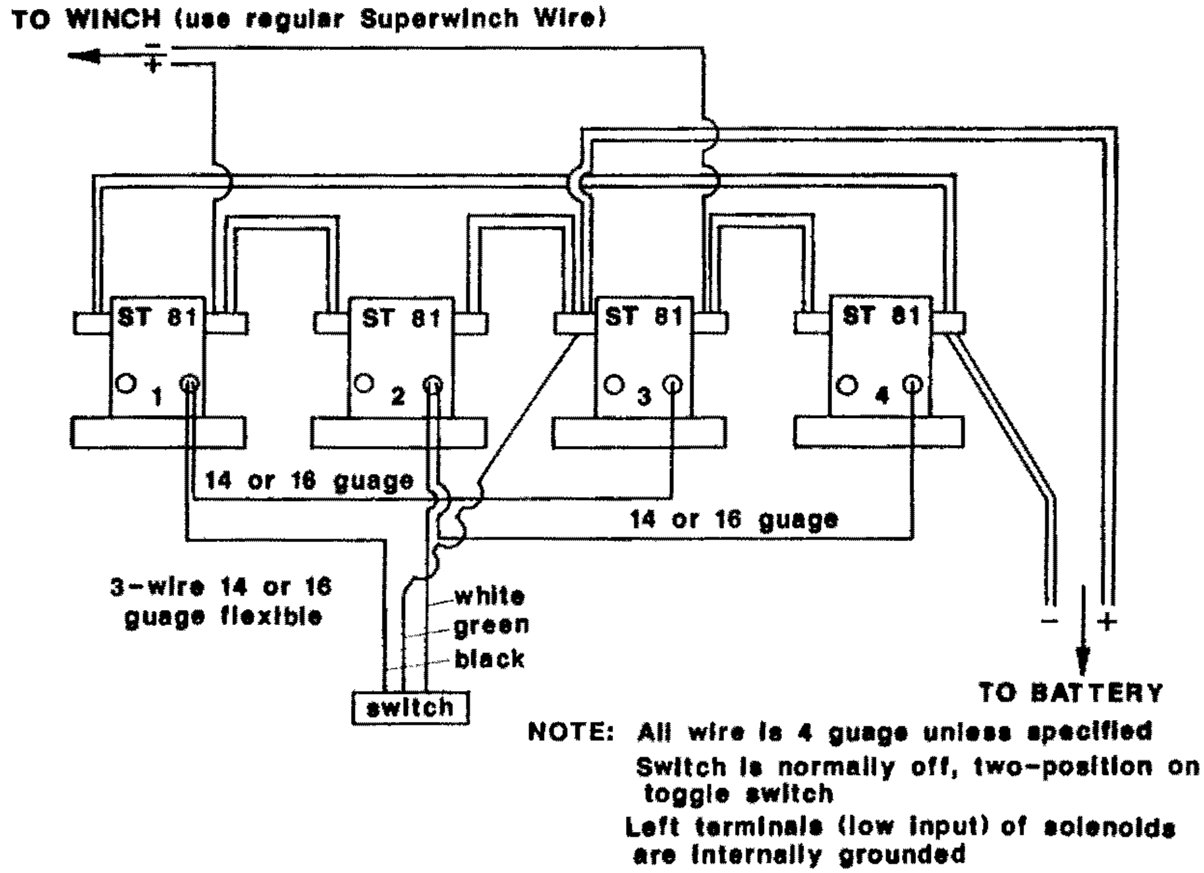

Figure 11. Solenoid Switching Box Wiring Diagram

CONTROL MODIFICATIONS

Clutch:

The clutch hand lever is constructed from a vertically mounted round steel bar (Figure 12). A short length of round steel bar is welded horizontally to the end of the clutch hand lever, which in turn is welded to a steel plate for mounting to the clutch pedal shank. The steel plate is fastened to the pedal shank by three bolts that pass over and under the pedal shank (Figure 13).

To disengage the clutch, Mr. Gibbs pulls back on the hand lever. An able-bodied operator can use the clutch pedal with the hand lever in place. The clutch lever can be easily detached from the pedal shank.

Brake:

Two brake levers were constructed from round steel pipe, one for each pedal. The pipe is shaped to follow the tractor instrument panel. The lower end of each hand lever is bent back horizontally and rests on top of the brake pedal shank. Each lever is securely fastened to the pedal shank by two clamps (Figure 14).

The brake levers can be easily removed by loosening the clamp bolts. An able-bodied operator can use the pedals to engage the brakes with the levers in place. To engage the brakes, the operator pulls back on the levers.

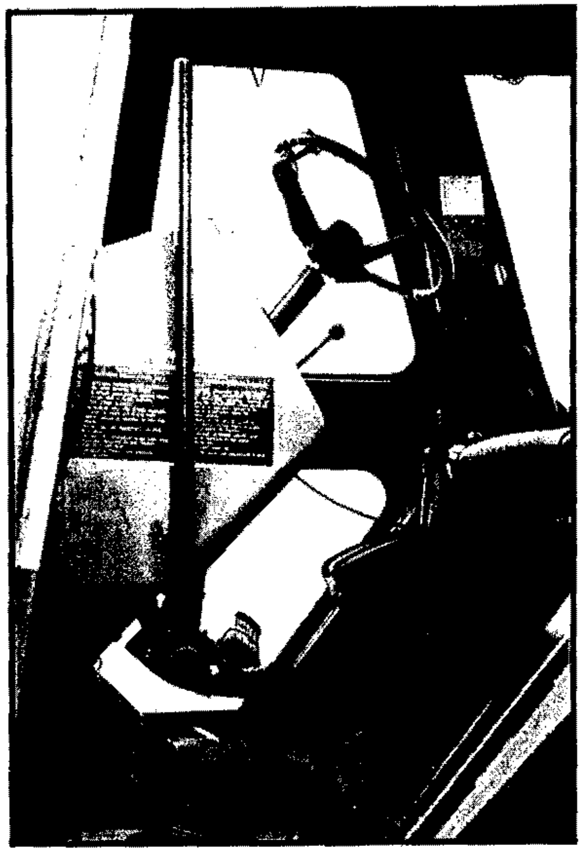

Figure 12. Clutch Hand Lever

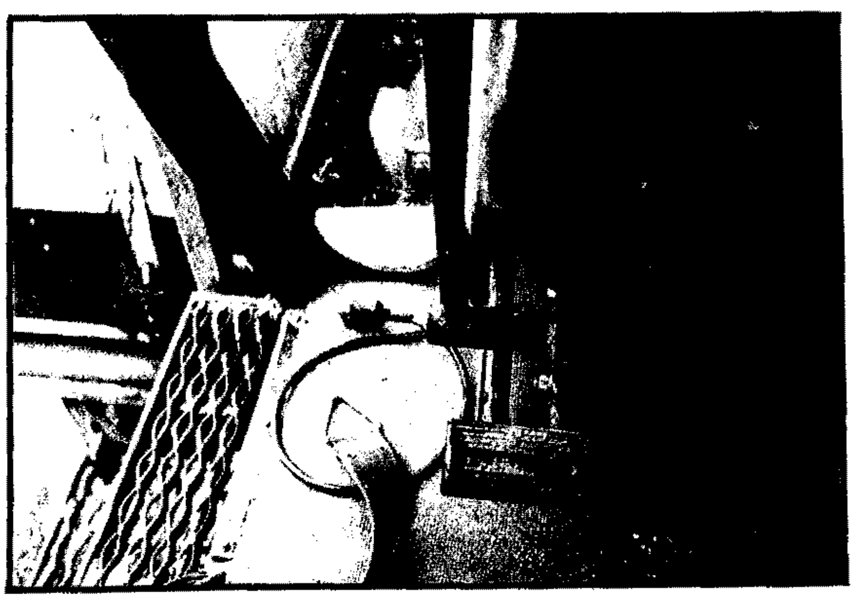

Figure 13. Clutch Hand Lever attached to Pedal Shank

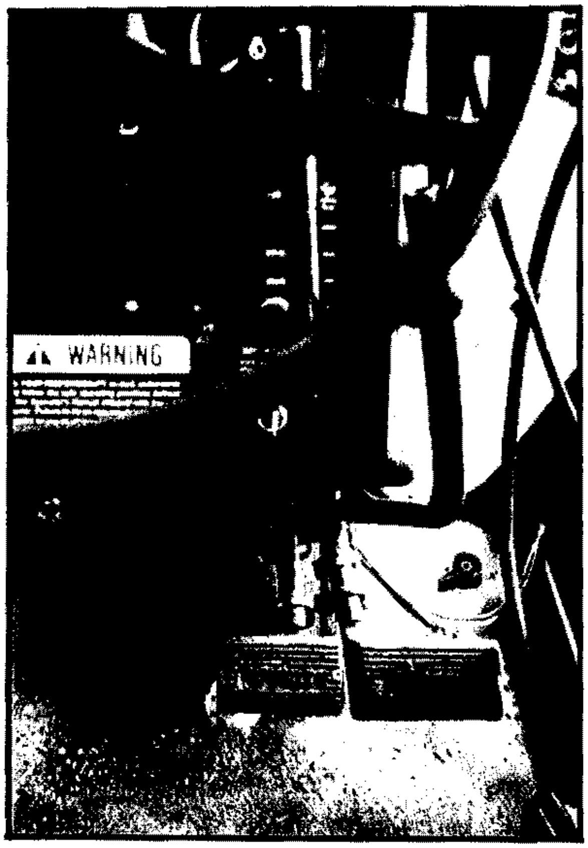

Figure 14. Hand Brake Levers

ESTIMATED COST*

Winch and Solenoid Control	$200
Steel	$150
Total Material Cost:	$350

Labor Cost Not Available

*At time of construction, 1981

III. PLATFORM LIFTS OPERATED IN A SITTING POSITION

BILL GUNDRUM'S PLATFORM LIFT

FARMER: Bill Gundrum
R.R. #2, Box 153B
Royal Center, IN 46978

DESIGNED BY: Braun Corporation
1014 S. Monticello
Winamac, IN 46996

SUMMARY

Function:

Bill Gundrum's platform lift is designed to be mounted on a four-wheel drive, articulated frame, John Deere 8430 tractor (Figure 1). It provides Mr. Gundrum, a high level paraplegic, with access to the cab by sitting on the platform.

The tractor contains control modifications and accessories which are described in a later section.

Figure 1. Bill Gundrum's Platform Lift

Farmer:

Bill Gundrum and his father farm 700 acres of cash grain crops. The primary crops they raise are corn and soybeans. Mr. Gundrum, who is a paraplegic as a result of an accident, has also suffered some nerve damage in his left arm, which further limits mobility and transfer activities.

To enable Mr. Gundrum to continue to be active in actual field work, a lift was developed by the Braun Corporation of Winamac, Indiana. The Braun Corporation incorporated the same basic design as their van lifts and installed the lift on a John Deere 8430 tractor.

Modified Machine:

Tractor: John Deere 8430 (4WD)

Features: ROPS Cab

PTO HP: 175

CB Radio
Rear View Mirrors
Door on one side of cab
Air Conditioner and tinted glass

Adaptability:

This lift was designed specifically to be mounted on a four-wheel drive John Deere 8430 tractor. The same style of lift can be mounted on other tractors with changes in the mounting frame. Similar lifts have been installed by the Braun Corporation on a Ford TW-20 tractor (see Hollopeter's Platform Lift) and an International 186 Hydro tractor (see Petrea's Platform Lift). The Braun Corporation has also installed a similar lift with wheelchair carrying capacity on an International 186 Hydro tractor (see Augsburger's Wheelchair Lift).

Compatibility:

1. The lift interferes with an able bodied farmer mounting the tractor, thus he also must use the lift to access the tractor.
2. The lift is designed to be removed for service of the tractor.

Service and Maintenance:

1. The lift contains few moving parts and is serviced similarly to the Braun van lifts.
2. The chains need periodic tightening and lubrication.
3. The hydraulic circuit should be checked periodically for leaks.
4. Electrical connections and switches need to be kept protected and in good repair.

Accessibility and Ease of Use:

1. Access is made to the lift by transferring from the wheelchair to the lift. The lift in the

lowered position is at wheelchair height.

2. Mr. Gundrum operates the lift while sitting on the platform.
3. Once in the raised position, Mr. Gundrum slides into the cab using a foam rubber cushion to prevent bruising. Once next to the tractor seat, he uses an overhead strap to pull himself up into the seat.
4. The lift can be secured in the raised position and operated from inside the cab.

CONSTRUCTION DESCRIPTION

The construction of Bill Gundrum's platform lift is discussed in the following subsections: Stationary Frame, Lift Guide, Lift Platform, Lift Actuation, Lift Controls, and Cab Entry Platform. An exploded view of the construction of the lift is shown in Figure 2.

Stationary Frame:

The stationary frame is constructed of steel plates and tubing which attaches to the side of the tractor next to the fuel tank directly underneath the tractor cab door. A steel plate with 3-5" of one edge bent upward at an angle extends outward horizontally behind the front wheels of the trac-

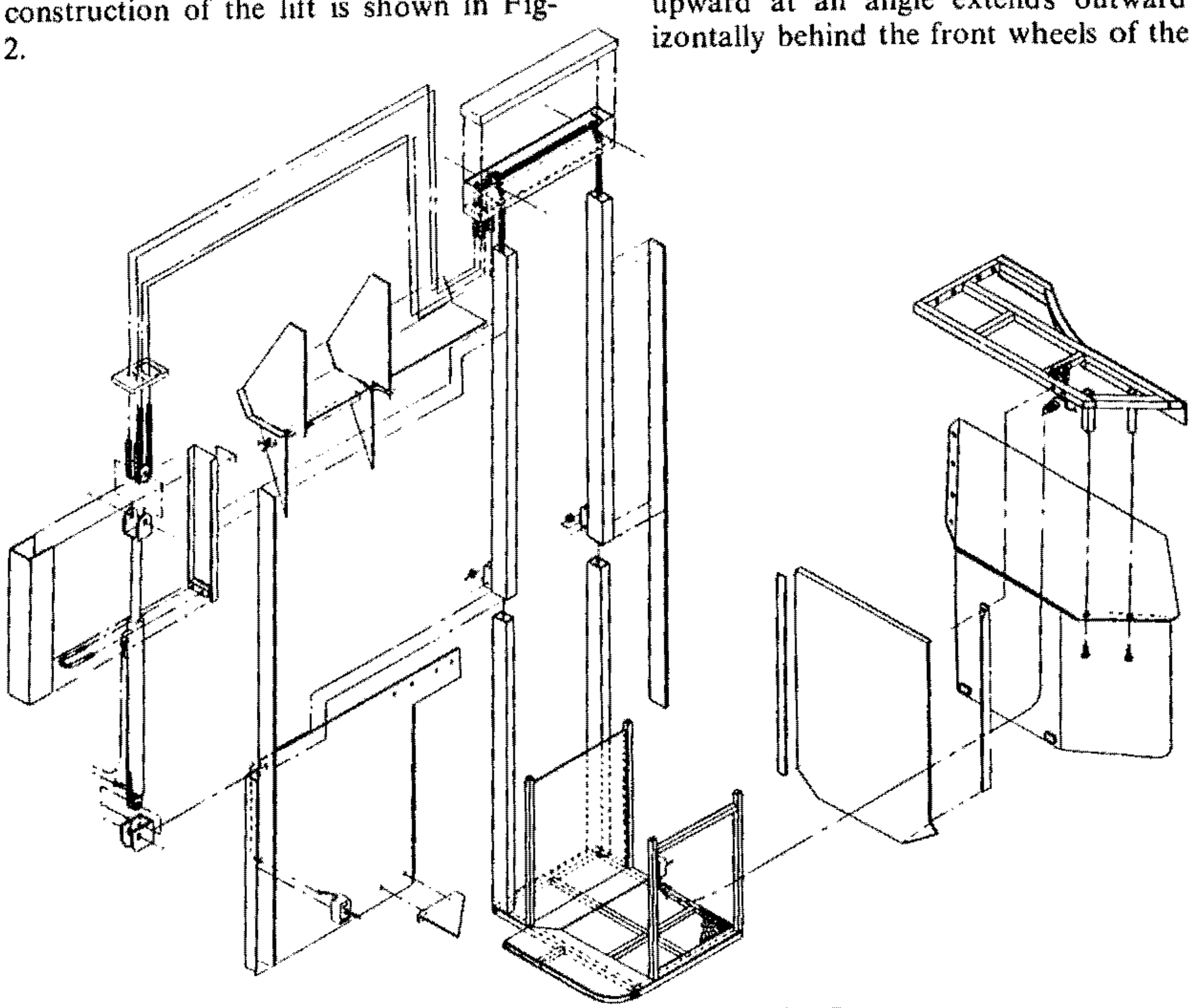

Figure 2. Exploded View of Lift Construction. The cab entry platform is shown to the right, lift platform and guide tubes in the center, and the triangular stationary frame on the left.

tor. Two triangular shaped steel plates are welded vertically on top and underneath this steel plate to support the lift guide tubes (Figures 2, 3 and 4).

A length of steel bar is mounted vertically on the outside of both triangular shaped steel plates to which a square steel plate is mounted to enclose the lower end of the lift (Figure 2). Figure 2 shows a square steel plate that attaches to the fuel tank under the cab entry platform to serve as a back when the lift is in the lowered position.

The design of the mounting frame allows for quick removal of the lift for tractor service or resale.

Lift Guide:

The lift guide is constructed of two vertical rectangular steel tubes that are attached to the mounting frame. Inside the vertical tubes, steel channels covered with a teflon-like coating are added to provide bearing surfaces. The coating eliminates the need for grease. Steel tubes attached to the lift platform slip inside the guide tubes Figure 5.

Lift Platform:

The lift platform is a rectangular frame with expanded steel welded over it (Figure 6). Rectangular steel tubes are mounted vertically at each corner of the platform. On one side of the platform a square steel plate is mounted between two of the vertical tubes as a guard. On the opposite side of the platform a horizontal length of rectangular steel tubing is mounted between two of the vertical tubes to act as a handrail and provide stiffness (Figure 7).

Two additional rectangular steel tubes are mounted vertically to the side of the platform where the vertical steel plate is located. These tubes slip inside the lift guide tubes. Sprockets are mounted on the upper end of each vertical tube over which chains pass to raise and lower the platform. Each chain travels from the sprocket up through the lift guide tube where it passes over another set of sprockets at the top of the guide tubes. The chain travels horizontally at this point in a protective steel enclosure. It travels down along the outside of the outer guide tube, where both chains pass around sprockets mounted on the lift's hydraulic cylinder rod.

Lift Actuation:

The lift is powered by a 12-volt DC electrically operated hydraulic system

Figure 3. Lift Mounting Frame

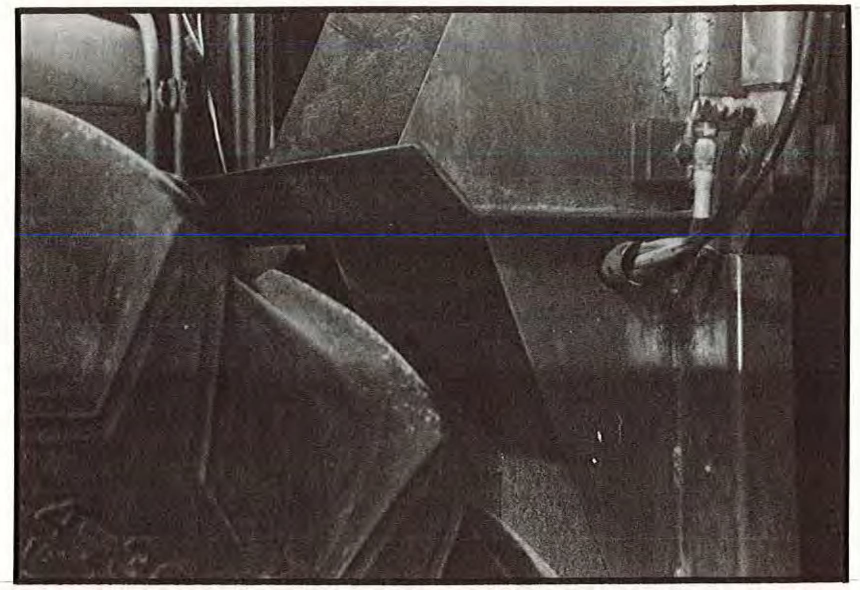

Figure 4. Lift Mounting Frame

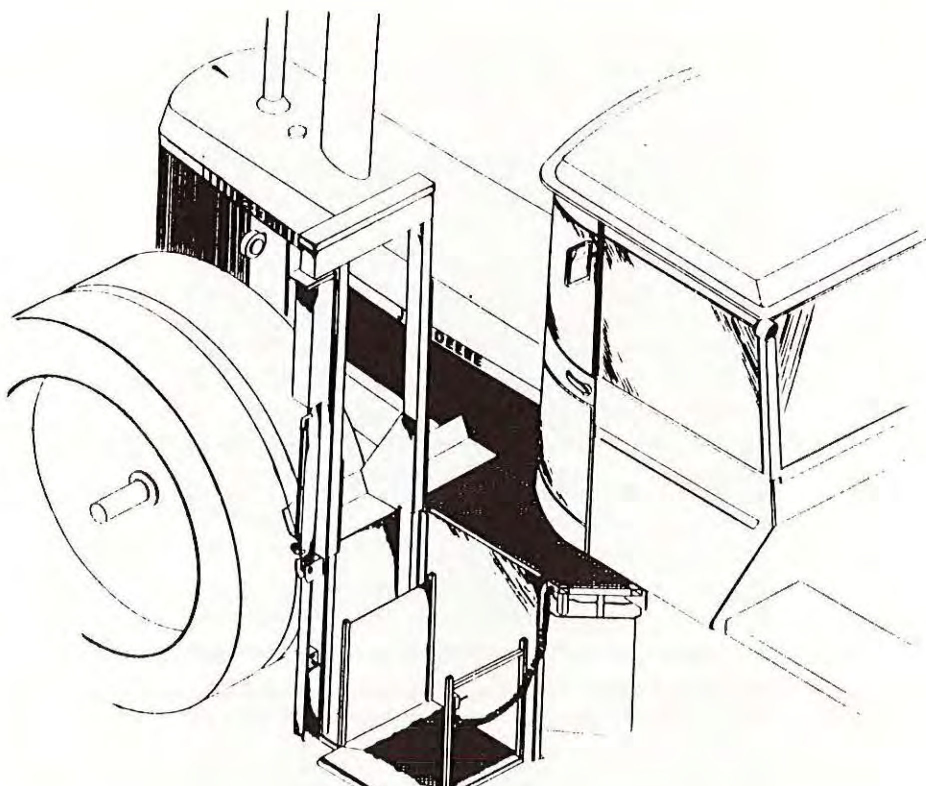

Figure 5. Drawing of Lift

Figure 6. Lift Platform

Figure 7. Handgrip Bars and Switch

separate from the tractor hydraulic system. Figure 8 shows the components of the hydraulic system. The system is powered by a Monarch pump which has a capacity of 0.8 to 0.9 gallons per minute at 2000 psi. The pump is equipped with a bypass valve that is functional when the lift is in the raised position. This prevents damage to the pump if the switch is not released. A pressure compensated flow control valve is installed in the hydraulic system to control the rate of lift descent.

The lift uses one single-acting cylinder to raise and lower the lift. The system allows for gravity to lower the lift, reducing the battery drain and eliminating half of the cycle wear on the hydraulic pump. The hydraulic cylinder is attached to the roller chains which are attached to both telescoping lift tubes to raise and lower the lift.

Lift Controls:

Toggle switches were mounted underneath the handgrip bar on the lift platform (Figure 7), low on the lift guide tube (Figure 9) and in the cab. The placement of the switches allows Mr. Gundrum to lower the lift from the raised position when he is on the ground, or to operate the lift while sitting on the platform.

Cab Entry Platform:

The cab entry platform, located outside the cab door and above the fuel tank, has been enlarged to allow room for Mr. Gundrum to transfer from the lift platform to the tractor cab.

The platform is constructed of a frame of steel tubing and steel plate shaped around the door area of the tractor cab, extending out horizontally to the mounting frame (Figures 2 and 3).

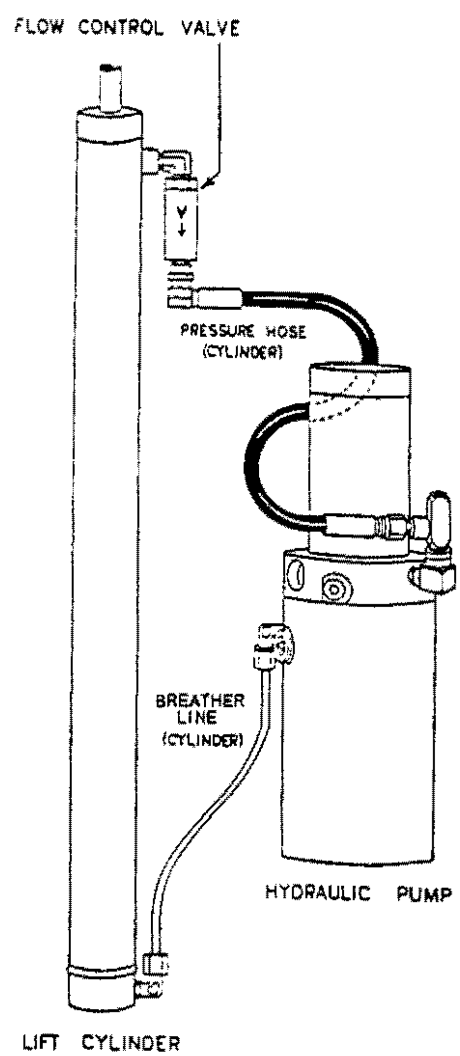

Figure 8. Hydraulic Schematic

SAFETY CONSIDERATIONS

Braun chose a separate 12-volt DC hydraulic system which offered the safety feature of the tractor not running during lift operation. This type of system also allowed the placement of several switches wherever they were needed for accessibility.

As a safety precaution, the tractor should be turned off during lift operation.

The roller chains used in the lift mechanism allow for a smooth riding platform. The chains can be adjusted to increase tension and to keep the platform level. The chain is size 40 and has a tensile strength of 3700 pounds (Braun Specifications).

A mechanical safety latch was added to prevent the lift from lowering during operation if a leak in the hydraulic system were to occur. It is important to note that if the lift is not in the fully raised position when the tractor is operated, the lift platform could be crushed during articulation. The lift must always be fully raised before even starting the tractor.

The lift was designed with a chain to be placed across the front of the platform to prevent the operator from falling off of the platform.

DESCRIPTION OF OPERATION

To mount the tractor, Mr. Gundrum moves next to the tractor in his wheelchair. If the lift is in the raised position, he activates the switch mounted on the side of the lift guide tube to lower the lift (Figure 9). He then removes the left arm of his wheelchair, places a foam rubber pad onto the lift platform, and slides over onto the platform (Figure 10). Using the switch mounted underneath the horizontal handrail, he raises the lift until it reaches the cab entry platform (Figure 11). Mr. Gundrum locks the platform in the raised position by using the mechanical safety latch located on the lift (Figure 12). He opens the cab door and places the foam rubber pad on the cab entry platform and then slides into the cab (Figure 13). Using an overhead strap attached to the ceiling of the cab, he pulls himself up from the floor until he can grab hold of the overhead grip bar mounted on the cab ceiling. He transfers to the tractor seat by using the overhead grip bar, closes the cab door and is ready to start the tractor and go to work.

To dismount, Mr. Gundrum transfers from the tractor seat to the cab floor, slides out onto the cab entry platform and proceeds to move onto the lift platform. He closes the cab door, then releases the mechanical latch holding the platform in the raised position. He activates the switch to lower the lift where his wheelchair is within reach.

CONTROL MODIFICATIONS

Clutch:

A lever constructed of flat steel bar stock is attached to a fixed pivot point located on the side of the control console. On the lower end of the steel bar, below the pivot

Figure 9. Switch mounting on Guide Tubes

Figure 10. Operator on lowered Platform

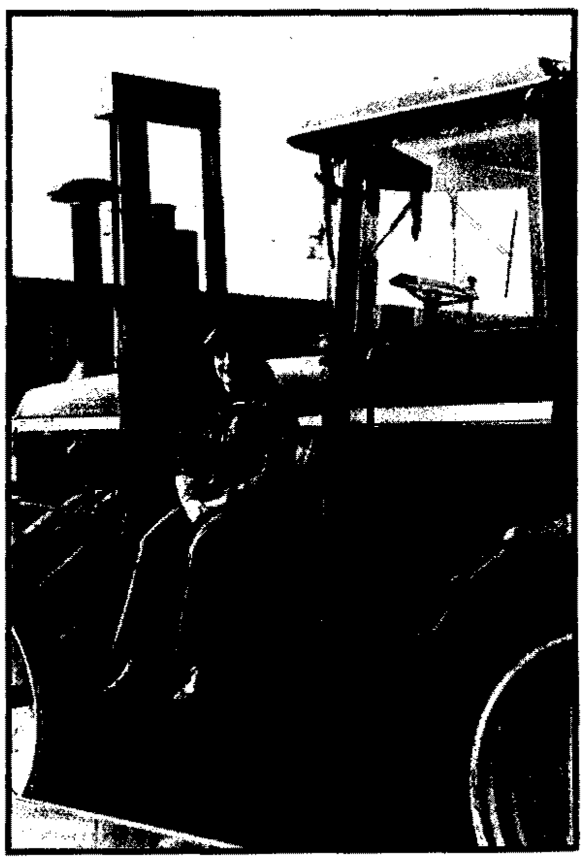

Figure 11. Lift in raised Position

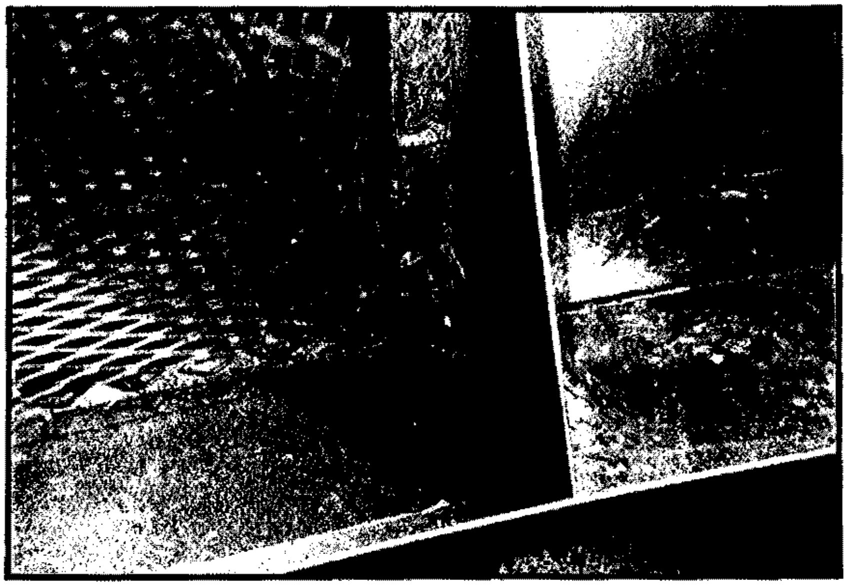

Figure 12. Mechanical Latch

point, a roller bearing is attached to the lever so that it rests on top of the clutch pedal shank. Tape added to the upper end of the steel bar acts as a handgrip. Behind the hand lever, a metal bracket is attached to the tractor console to serve as a stop, preventing the hand lever from moving forward and out of the reach of Mr. Gundrum (Figure 14).

As the lever is pulled toward the operator, the roller bearing rolls along the shank of the clutch pedal and forces it down, disengaging the clutch. An able bodied operator can use the clutch pedal with the lever in place.

Brake:

The brake lever is constructed the same way as the clutch lever and operates in the same manner. Only one lever is needed since the tractor is equipped with only one brake pedal.

ACCESSORIES

Overhead Grip Bar:

A grip bar is mounted inside the cab, passing over the tractor seat to aid transfer in and out of the cab.

Overhead Strap:

A length of leather strap is mounted inside the cab for Mr. Gundrum to pull himself up to reach the overhead grip bar to transfer to the tractor seat.

Steering Aid:

A length of flat steel bar stock is attached across the diameter of the tractor steering wheel. A friction surface is mounted in the middle of the bar and a spinner knob is located on the outer end of the bar. This device allows Mr. Gundrum to rest his arm on the steering wheel and grab hold of the spinner knob, providing better steering control (Figure 15).

Figure 13. Mr. Gundrum transferring into Tractor Cab

Figure 14. Hand Control Clutch

Figure 15. Steering Aid

ESTIMATED COST*

Estimated price of modifications $4,500.00

*At time of construction, 1979

BOB MEDD'S PORTABLE PLATFORM LIFT

FARMER: **Bob Medd**
Box 86
Hollandale, MN 56045

SUMMARY

Function:

Bob Medd's portable platform lift is designed primarily for servicing equipment (Figure 1). Bob Medd indicates the lift can be used to access equipment cabs, but farmers with physical handicaps would have difficulty doing so.

Figure 1. Bob Medd's Portable Platform Lift

Farmer:

Bob Medd raises about 152 acres of corn in Minnesota. He has no physical disability, yet he has designed two portable lifts and a lift for a tractor and a combine. Designing lifts is his hobby.

One of Mr. Medd's portable lifts has a movable seat that allows the operator to sit down or stand up. It is described later in this section. The other portable lift is designed with a larger platform and without a seat. It allows the operator to roll his wheelchair onto the platform. This lift is not described in this manual. Mr. Medd uses the portable lift with a seat for preventive maintenance work on his farm. He still uses the lifts on the tractor and combine for himself.

Mr. Medd's innovation is apparent in the description of his portable lift on the following pages. He has a sincere interest in helping handicapped farmers. Anyone interested in a lift of this type should contact Bob Medd.

Adaptability:

The lift is adaptable for many uses. The lift can aid a farmer in machinery servicing, maintenance work on buildings, accessing grain bins or lofts in barns, and many other possibilities.

Compatibility:

1. The lift is intended for use by both handicapped and non-handicapped operators.
2. Mr. Medd indicates that the lift can be modified to make it self-propelled.
3. The telescoping tubes tilt down to allow the lift to be easily stored in a building.
4. The lift's design can be slightly altered to lift a wheelchair, using a wider platform which Mr. Medd has also designed.

Service and Maintenance:

1. The lift is easy to service and maintain.
2. The hydraulic system should be checked periodically for leaks.
3. Several moving parts should be lubricated periodically. Fittings are accessible for lubrication.
4. The hydraulic pump, hoses, battery and other features of the lift are accessible.

Accessibility and Ease of Use:

1. The lift is accessible from a wheelchair, ATV, or by a farmer who uses leg braces and/or crutches.
2. The lift is easy to use. However, transferring to the lift seat may require some practice. Transferring to any equipment cab may be difficult.
3. There are several ways to move the lift to desired locations. This makes it compatible with the different abilities of handicapped farmers.
4. The lift is fairly quiet during operation.

CONSTRUCTION DESCRIPTION

The construction of Bob Medd's portable platform lift is discussed in the following subsections: Stationary Frame, Moving Frame, Lift Platform, Lift Actuation, and Lift Controls.

Stationary Frame:

The frame of this lift is made of rectangular steel tubing. The steel tubing is welded together to form a square frame which serves as the base of the lift. Three wheels with pneumatic tires in a tricycle arrangement support the frame. The two front wheels are independent of each other, and each is mounted on a small spindle welded to a flat steel bar. Each steel bar extends upward where it is bolted to the inside of the main frame (Figure 2 and 3).

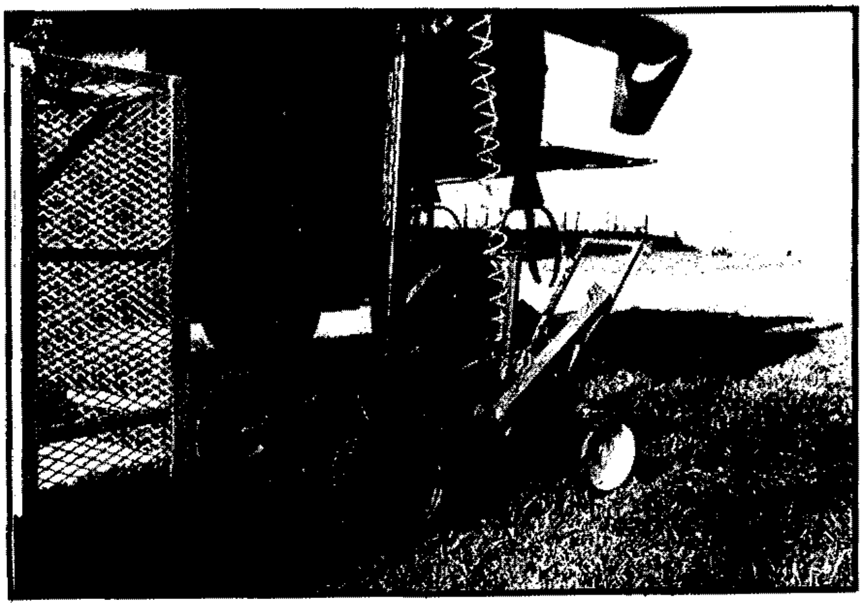

Figure 2. Mounting of Front Wheels

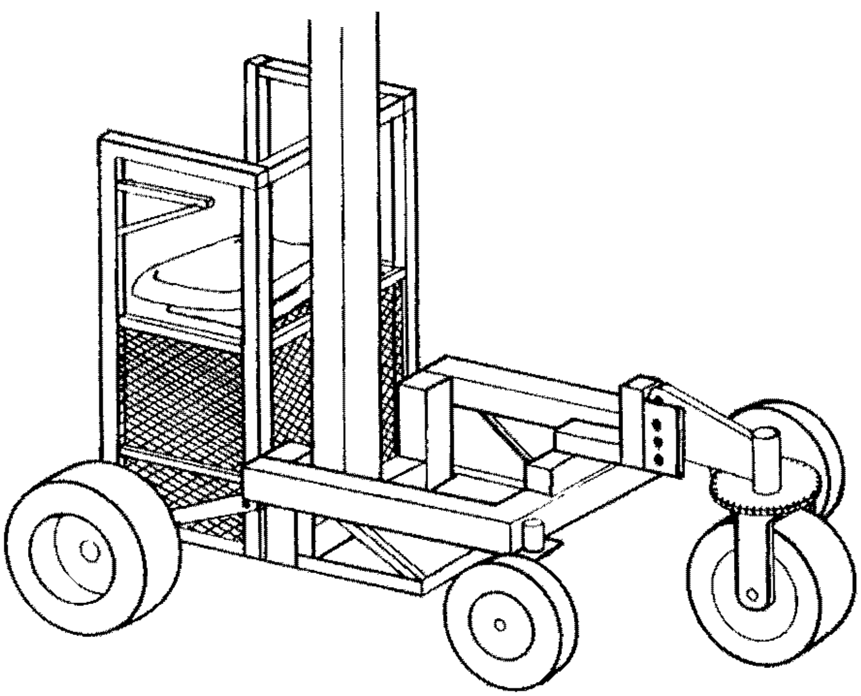

Figure 3. Main Frame of Portable Lift

The third wheel is steerable and is mounted on a cast-iron arm extending from the rear of the main frame. The wheel is straddled by a "U"-shaped holder of flat steel, and pivots on a kingpin mounted in the cast-iron arm. A sprocket on the kingpin is used in conjunction with a roller chain to steer the wheel (Figure 3).

A vertical shaft with a small sprocket mounted on its lower end is located on the left front side of the frame. A removable automotive steering wheel is mounted on top of the vertical shaft. The vertical shaft and the sprocket on the kingpin are attached by a chain, enabling the farmer to steer the lift (Figure 4). Use of this steering method would only be practical if the lift were self-propelled.

For farmers able to push the lift, a push bar is provided on the rear left side of the main frame. The push bar consists of two steel tubes extending up and rearward from the main frame, with a cross piece linking them and providing a place to push (Figure 5).

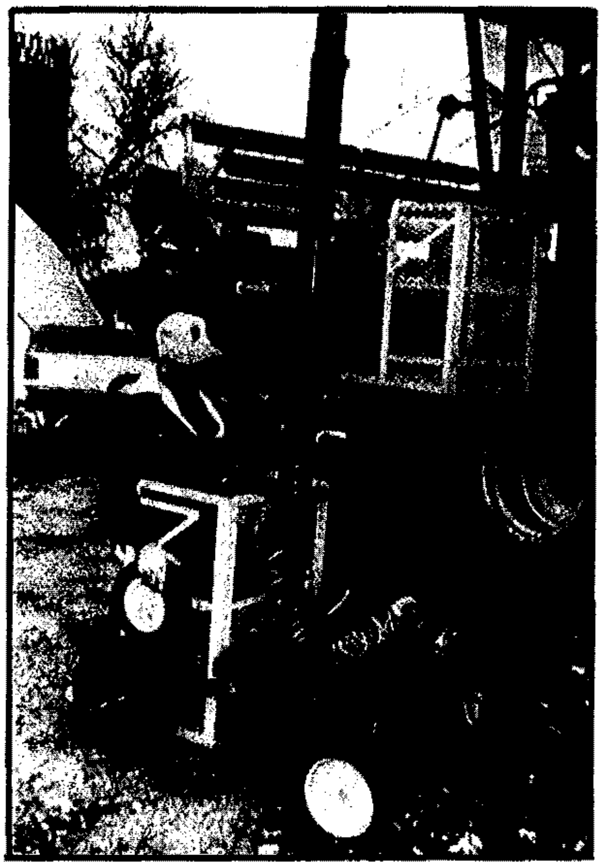

Figure 4. Steering Lift from Seat

An alternative steering device is also shown in Figure 5. A length of rectangular steel tubing is bolted to the wheel holder that straddles the steerable wheel. The extended height grants the operator ease in steering.

To add stability when the lift is raised, two caster-action press wheels from a cultivator are mounted on the corners of the main frame. Each wheel spindle has a kingpin welded to it; the kingpin fits into a mounting welded on the corner of the main frame (Figure 5).

Outriggers, constructed of rectangular steel tubing, are hinged onto the main frame. They tilt down during lift operation, providing stability for the lift. Pins lock them in the raised or lowered position. The outriggers are shown in the raised position in Figure 5.

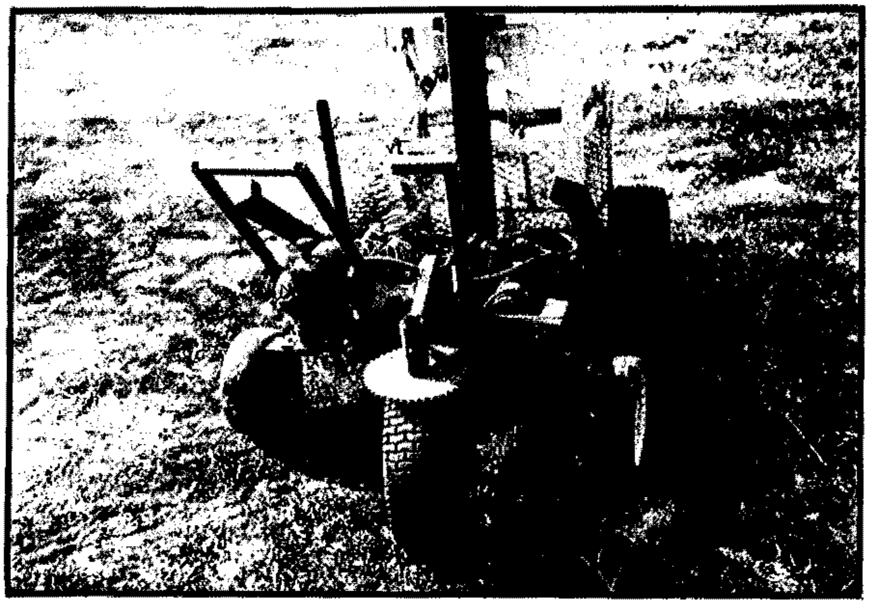

Figure 5. Push and Steering Bar, and Stability Wheels

Moving Frame:

Attached to the main frame, (opposite the steerable ground wheel and between the two front wheels), is a two-piece, telescoping rectangular steel tube. The inner length of the telescoping tube is attached to the main frame, while the outer length telescopes upward. The inner tube is hinged at its base, enabling it to tilt down for transport or storage. This is done by lifting the steering wheel from the vertical shaft, removing the lock pin, tilting the lift tube down, and replacing the steering wheel (Figure 1).

The telescoping tubes stand about 8' high in the lowest position and reach approximately 14' when fully extended.

The inner length of the two tubes contains a 72" stroke hydraulic cylinder that raises and lowers the outer tube.

Lift Platform:

The lift uses a platform constructed of steel tubing with expanded steel welded to the tubing at the base and also partially on the sides. A protective cage is formed by the expanded steel and guardrails on three sides of the platform. The guardrails, constructed of rectangular steel tubing, are welded to the platform base. The platform is attached to the outer telescoping tube. The entrance to the platform faces away from the telescoping tubes.

Connected to one of the vertical guardrails is a metal seat (Figure 6). The seat rests on a pivot pin mounted to a horizontal steel bar, which pivots from a vertical guardrail in the front. This type of mounting enables the seat to swing outside of the platform, allowing the operator to transfer to the seat and then move into the platform cage. The operator can turn the seat to face either forward or backward. The seat also has a foot-rest constructed of steel tubing (Figure 6).

Attached to the front vertical guardrail on the opposite side of the seat mounting is a swinging protective guardrail constructed of steel tubing. The guardrail is triangular in shape and can be swung either in against the side of the cage (Figure 4), or out to help prevent the operator and lift seat from moving outside the platform.

Wheels may be attached to the outside of the lift platform so that they rest on top of the two front tires when the platform is in the lowered position (Figure 4). This would allow the operator to move the lift while sitting on the lift seat, by grabbing the wheels on both sides of the platform and pushing them down. This method of moving the lift would be difficult for most operators with physical handicaps, or for anyone moving the lift on rough ground. It would also be difficult to steer the lift using this method. Use of this method also would not allow the operator to lower the outriggers and would require movement with the tube extending 8' into the air.

Further descriptions in this section will refer to movement of the lift by someone who can push the lift into position.

To help the operator transfer to the lift seat, a removable, horizontal telescoping grab bar is hinged to the outer length of the telescoping lift tube (Figure 6). The bar moves in a horizontal arc above the operator's head, aiding transfer from a wheelchair. A chain attached to the bar keeps it from telescoping out too far. He then moves the switch to lower the lift, which lowers by gravity to the ground.

Lift Actuation:

The lift utilizes a 12-volt DC electrically-operated hydraulic system. The battery mounts low under the main frame of the lift in a protective mounting bracket. The hydraulic pump is mounted inside the main frame and is easily accessible. As mentioned earlier, a 72" stroke hydraulic cylinder is located inside the telescoping lift tubes.

Lift Controls:

A toggle switch to operate the lift is mounted in the platform cage toward the top of the rear corner guardrail post.

SAFETY CONSIDERATIONS

If the lift is modified to be self-propelled; the engine should always be shut off during lift operation.

The outriggers help provide stability to keep the lift from tipping over while in use. The cultivator wheels on the corners of the frame in the rear also aid stability. Additional stabilization devices should be considered for use of the lift on uneven ground, for windy conditions, and for other possible unstable positions. The operator should position the lift on level ground only, in order to minimize the chances of the lift tipping over. The operator should always lock the outriggers down when using the lift.

The footrest on the seat helps the operator stay in his seat and offers some balance so the operator cannot slide out of the seat. A seat belt also helps hold the operator onto the seat and provide security.

The swinging guardrail on the front of the platform keeps the operator in the confines of the lift platform. The guardrail is not adequate when the operator is standing on the platform.

A self-centering switch offers protection for the operator. As soon as the switch is released, the lift stops. This protects the operator from losing balance and prevents the lift from being left on accidentally.

If a hydraulic hose were to break on the lift, the operator could be seriously injured. No braking device is on the lift to prevent it from falling rapidly to the ground.

A braking device needs to be placed on the lift to prevent it from rolling.

The operator should form a habit of looking up when using the lift, to make sure he will not contact a power line or any other obstacle. Warning signs should be placed on the lift to remind the operator.

If the operator chooses to stand on the platform, he will reduce the stability of the lift when the platform is raised. Stability will be further decreased if the operator leans outside the confines of the platform or is reaching out with a heavy object.

Use of this lift to transfer to a tractor or combine is hazardous because the lift cannot be placed close enough to the equipment to ensure safety of the operator (Figure 7).

Figure 6. Lift Platform, Seat and Grab Bar

DESCRIPTION OF OPERATION

The operator moves the lift to the desired location. The lift can be pushed, as shown in Figure 8, by operators who can walk or have another propelling device.

It was noted earlier that the lift can be designed for the operator to sit in the platform seat and move the lift to the desired location. However, there are many safety concerns with this method, as mentioned earlier.

Once the lift is in position, the operator raises the telescoping lift tubes to the vertical position (if they are not already raised). The operator then pulls a pin that holds each outrigger in a raised position and lowers the outriggers. He replaces the pin to securely fasten the outriggers, which provides stability for the lift.

An operator in a wheelchair can now transfer to the lift. He positions his wheelchair beside the platform where he can reach the lift seat. He grabs the overhead grab bar (Figure 6), and pulls himself over into the lift seat. He then fastens his seat belt, places his feet on the footrest and pulls the seat into the lift platform cage. He can move into the lift platform facing forward or rearward. If the operator is using leg braces and/or crutches, he can move into the platform using his braces and transfer to the lift seat. Once in the lift platform cage, he moves the triangular guardrail out to hold the seat and operator in the platform cage. The operator uses the switch, (mounted on

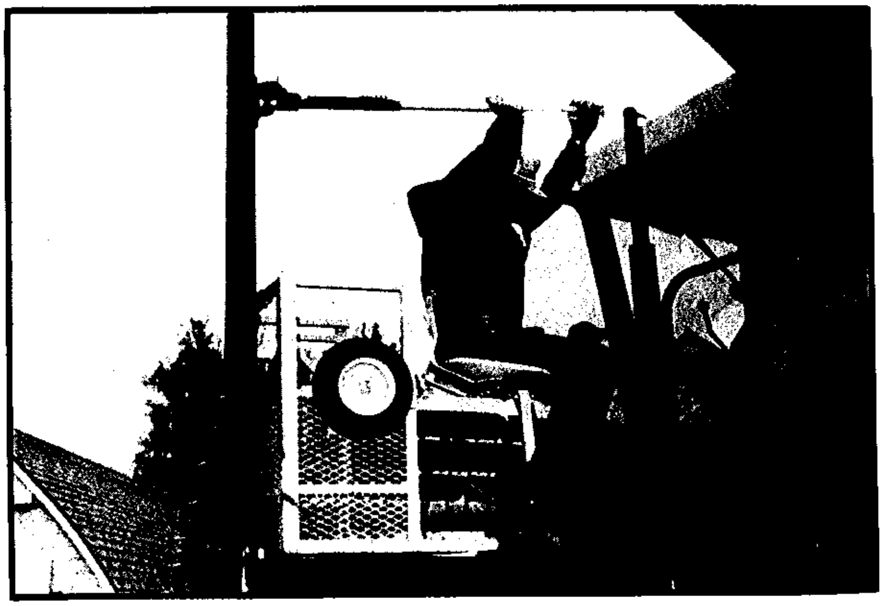

Figure 7. Mr. Medd transferring from Portable Lift to Combine

Figure 8. Pushing Lift into Position

the rear of the platform cage), to raise the lift to a position for work. He may perform maintenance work on machinery or buildings. Many other farm activities may be accomplished from the lift. He may opt to remain seated while working on machinery (Figure 9), or if he uses leg braces, the operator might stand to access his work (Figure 10). He should keep in mind the safety consideration mentioned earlier.

By reversing the process, the operator will lower the lift. He moves the switch to lower the lift until the platform reaches the ground. He moves the protective guardrail against the side of the platform cage and proceeds to push the seat to the outside of the cage. He unbuckles his seat belt, grabs the overhead grip bar, and transfers to his wheelchair.

Figure 9. Mr. Medd in Lift Seat performing Maintenance

Figure 10. Standing on Platform performing Maintenance

ESTIMATED COST*

	Weight	Retail Cost
Cylinder; Pump & Battery	150 lbs.	$ 580
Platform & Seat	130	173
Square Tubing	285	313
Wheels; Tires & Bearings	80	120
Solenoid; Switches & Wire	--	88
Hose & Hardware	15	80
Total	660 lbs.	$ 1,354

Labor Cost Not Available

Note: Mr. Medd indicates that to make the lift self-propelled (using a gas engine and hydraulic motor), add about $500.

* At time of construction, 1985

IV. WHEELCHAIR PLATFORM LIFTS

GENE LINE'S WHEELCHAIR LIFT

FARMER: **Gene Line**
11126 County Road 26
Findlay, OH 45840

SUMMARY

Function:

Gene Line's wheelchair lift is designed to be mounted on an Allis-Chalmers 200 tractor to enable him to gain access to the operator's station. This lift enables Mr. Line to remain in his wheelchair during the lift from the ground to the operator's platform and to keep his chair on the tractor during field operations.

The lift is shown mounted on an Allis-Chalmers 200 tractor in Figure 1. The tractor contains control modifications and accessories which are described in a later section.

Figure 1. Gene Line's wheelchair lift

Farmer:

Gene Line was a full-time farmer until an accident resulted in a spinal cord injury. After the accident, his son took over the 450 acre cash grain farm. The Line's also manage a 35 sow swine operation and raise a small herd of beef cows.

Mr. Line decided in 1986 he would like to drive a tractor again. A wheelchair lift was built for his Allis-Chalmers 200 tractor. Hand controls and an overhead grip bar were also mounted on the tractor.

Modified Machine:

Tractor: Allis-Chalmers 200

Features:
Rear Tire Size: 15-34
Front Tire Size: 10.0-16

CB Radio

Adaptability:

This lift was designed specifically to be mounted on an Allis-Chalmers 200 tractor. With changes in the lift mounting and in the platform deck, the same lift could possibly be mounted on another farm tractor of similar design.

Compatibility:

1. The lift interferes with an able-bodied farmer's mounting of this tractor; thus he also must employ the lift for tractor use.
2. The tractor's original mounting steps were removed for the installation of the lift.
3. No major permanent alterations were required on the tractor to install the lift.

Service and Maintenance:

1. The cable should be checked regularly for damage, corrosion or wear and replaced if necessary, to prevent failure. Failure of the cable could cause a serious fall, especially if the failure were to occur while the lift was in the raised position.
2. The lift components are accessible for ease of service and maintenance.

Accessibility and Ease of Use:

1. The lift is practical for a farmer who uses a wheelchair and wishes to have his wheelchair with him while operating the tractor.
2. Operation of the lift requires little practice. However, the transfer to the tractor seat may require much practice.

3. The cable and winch are noisy during operation.
4. The lift guide extends down below the tractor frame and may cause damage to crops during field use.

Safety Concern:

Most cable and winch manufacturers warn against the use of their products for lifting human beings. This is a major concern of the evaluators. If, however, a farmer proceeds with a winch-type lift, it is strongly recommended that a high quality unit be selected that is self-locking when not activated. Experience has also shown that the electric switches included with some winches do not withstand frequent use. Heavy duty switches or solenoids which allow for lower current flows are recommended.

CONSTRUCTION DESCRIPTION

The construction of Gene Line's wheelchair lift is described in the following subsections: Stationary Frame, Lift Guide, Lift Platform, Lift Actuation, Lift Controls, and Extended Platform Deck.

Stationary Frame:

A mounting frame for the wheelchair lift attaches to the tractor frame. A steel plate is bolted to the tractor frame above the brake linkages. The steel plate extends downward at an angle where a horizontal steel plate is welded to the inside of it. The horizontal steel plate passes underneath the engine and attaches to the lift guide (Figures 2 and 3). A triangular steel gusset is welded where the lift guide and horizontal plate meet, for added strength and support. A rectangular steel plate is welded to the lift guide and has four holes drilled through it for bolting the plate to the tractor frame (Figures 3 and 4).

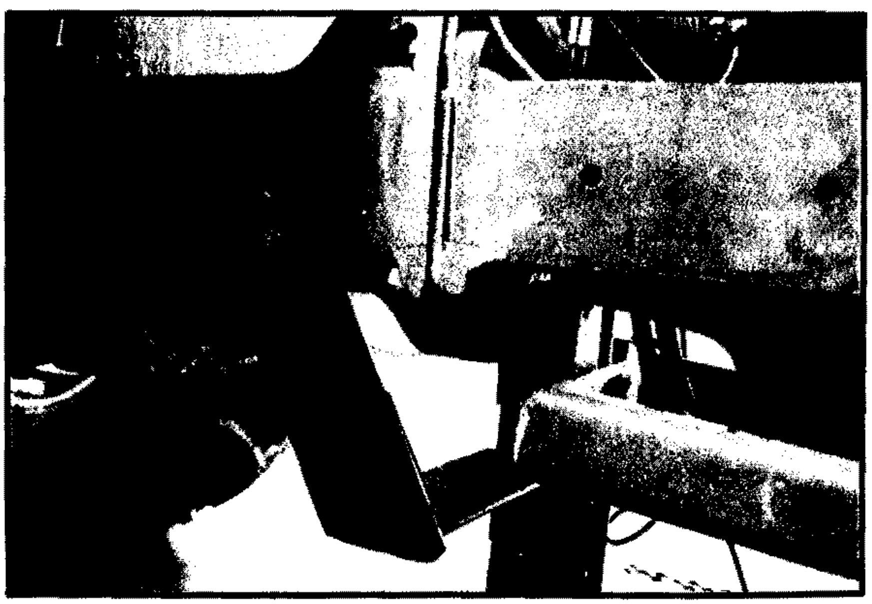

Figure 2. Mounting Frame

Figure 3. Mounting Frame and Lift Guide

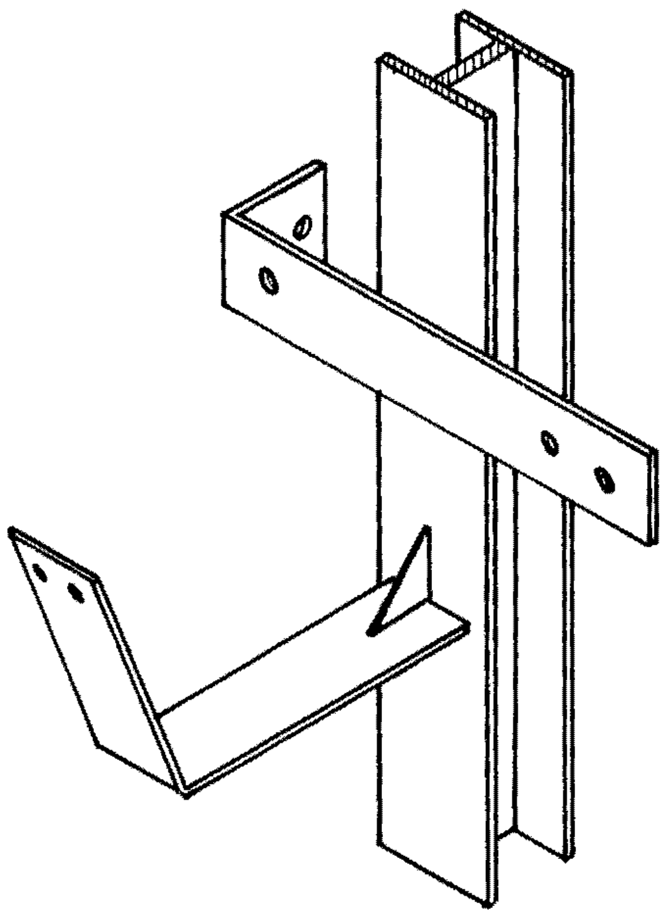

Figure 4. Mounting Frame attached to Lift Guide

Lift Guide:

The lift guide is a vertical length of I-beam welded to the mounting bracket (Figures 4 and 5). The lift guide is positioned next to the tractor engine compartment on the lift side. The I-beam extends below the tractor frame and could damage crops when the tractor is in the field (Figure 4).

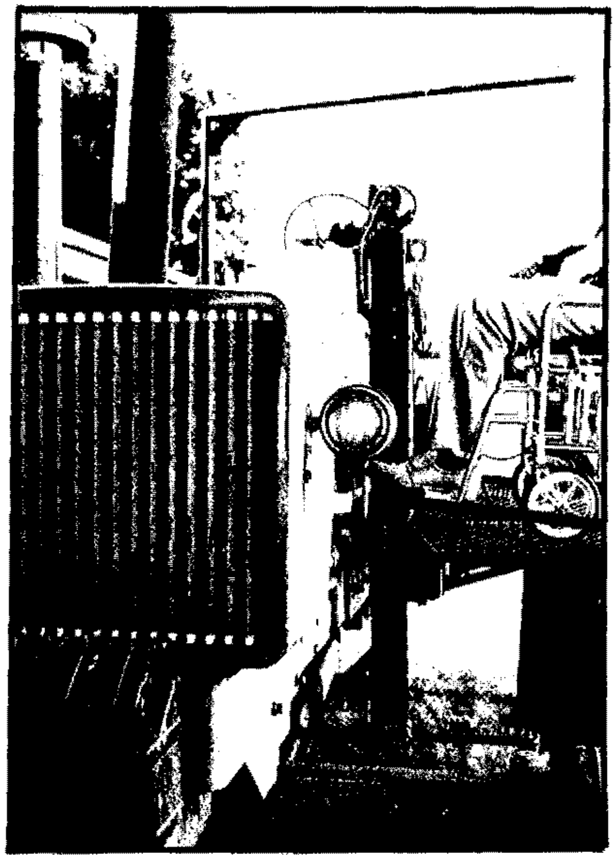

Figure 5. I-beam Lift Guide

Lift Platform:

The lift utilizes a platform to raise the operator and his wheelchair to the operator's platform (Figure 6). The platform is constructed of 3/4" square steel tubing and angle iron to form a rectangular frame. The steel tubing is placed around the perimeter of the platform and also through the center of the frame. Angle iron is welded within this frame to add support to the platform floor. Expanded steel welded over the rectangular frame forms the platform floor.

An angle iron welded to the rear of the platform forms a raised side on the platform, to the left of the lift guide. This assists in holding the wheelchair on the platform (Figure 6).

A hinged steel guard on the front of the platform flips down to allow transfer onto the lift. When raised, the guard aids holding the wheelchair on the platform. A hand lever to raise the hinged guard is located on the left side of the platform. The lever is constructed from a steel rod with a rubber handgrip mounted on the end. It is fastened on a pin passing through a bracket bolted to a length of flat steel bar stock. The steel bar travels across the width of the platform. A linkage connects the hand lever and the hinged guard (Figure 6).

Figure 6. Lift Platform and Slip Plate on I-beam

A steel plate wider than the I-beam is welded vertically to the front of the lift platform. Two flat steel bars, one on each side of the I-beam, are vertically positioned and located directly behind the front edge of the I-beam. Another length of flat steel bar is placed between the steel plate and the steel bars, even with the edge of the I-beam flat side. These three steel structures are fastened together with 12 bolts, six on each side of the steel plate to form a slip plate (Figure 7). This assembly guides the lift platform along the I-beam when it's being raised or lowered.

Figure 7. Slip Plate

A small steel bracket with the center cut out is welded to the top left edge of the slip plate and is used as a holder for the remote control switch (Figure 7). A chain and hook is mounted on the top right edge of the slip plate (Figure 7) and used to lock the platform in the raised position. The hook fastens to a square steel plate with the center cut out mounted on the top right edge of the I-beam near the winch (Figure 8).

Lift Actuation:

The lift is powered by a 12 volt DC electric winch. The winch is mounted on a steel plate welded to the back side of the I-beam (Figure 8).

The cable travels downward to the slip plate pulley located on the platform (Figure 6). It then travels back to the top of the I-beam. There the hook on the cable fastens to the square bracket at the top of the I-beam (Figure 8). This arrangement causes the platform to move half as fast as the winch.

Figure 8. Winch Mounting

Lift Controls:

A hand held remote control switch is shown on the lift platform in Figure 6. The electrical wiring travels from the winch motor to a control box and battery, then to the remote switch. The remote switch is placed in a holder on top of the platform slip plate when not in use.

Extended Platform Deck:

A rectangular framework of angle iron and expanded steel is mounted on the side of the tractor platform deck in front of the rear tire. The angle iron frame is bolted to the tractor frame. A steel plate is fastened underneath the platform deck to the tractor frame. Two angle iron braces extend from the steel plate to the outside edge of the deck for support (Figure 6).

SAFETY CONSIDERATIONS

As a safety precaution, the tractor engine should be turned off during lift operation.

The chain hook and bracket, described in the "Lift Platform" subsection, allow the lift to be locked in the raised position. A rigid lock should be considered to reduce vibration.

Most cable and winch manufacturers warn against using their equipment for lifting human beings. If the cable were to break, the operator would fall rapidly, possibly resulting in serious injury. This is due to the absence of a braking device on the lift. The operator might also be struck by the broken cable.

A wheelchair accessible switch located 36" above the ground on the tractor would increase the operator's independence. Otherwise, if the lift were left partially raised, the operator might not be able to reach the remote switch, and would not be able to access the lift.

Another hazard is the extension of the lift platform beyond the width of the rear tractor wheel. The platform deck or lift platform may be damaged by running into another object during operation of the tractor.

The operator should be aware of a pinch point which occurs as the lift platform approaches the platform deck. A wider distance between the two platforms and the use of a hinged steel plate as a guard would help reduce this hazard.

DESCRIPTION OF OPERATION

To mount the tractor, Mr. Line moves his wheelchair onto the lowered platform. He then raises the hinged side guard to hold his wheelchair onto the platform. Mr. Line uses the remote switch to raise the lift until it reaches the tractor platform deck (Figure 9). He locks the raised platform using the chain and hook mounted on the platform slip plate (Figure 9). He transfers to the tractor seat using the overhead grip bar (described in the "ACCESSORIES" section).

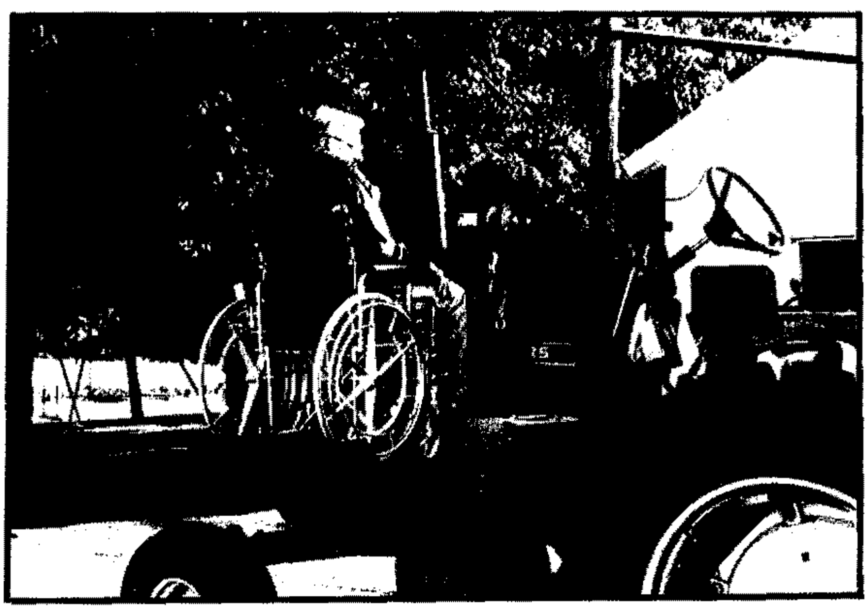

Figure 9. Lift in raised Position

To dismount, Mr. Line transfers from the tractor seat to the wheelchair by using the overhead grip bar. He unlocks the lift platform from the I-beam and then uses the remote switch to lower the lift platform to the ground. Mr. Line unlocks the hinged side guard and moves off the lift platform.

CONTROL MODIFICATIONS

Clutch:

The clutch lever is constructed of round steel tubing with a rubber handgrip to assure proper grip and for protection of the operator. The lever is welded to a formed steel bar that pivots on a bolt attached to the side of the tractor (Figure 10). A rod connecting the steel bar to the clutch linkage completes the assembly.

To disengage the clutch, Mr. Line pulls the hand lever toward him. An able-bodied person can use the pedal to operate the clutch with the lever in place.

Brake:

The right brake lever is constructed of round steel tubing. A rubber hand grip on the end assures proper and comfortable grip. The lower end of the lever is welded to a formed steel bar that pivots on a bolt mounted on a panel to the right of the tractor seat (Figure 10). An adjustable linkage

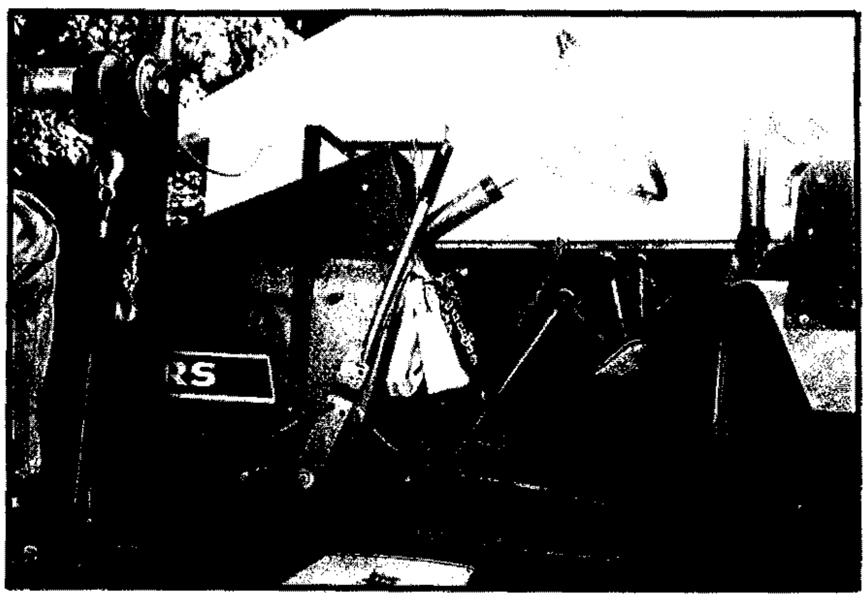

Figure 10. Clutch and Brake Hand Levers

extends from the formed steel bar to the right brake, where it is attached to a bracket fastened around the pedal shank (Figure 11). To engage the right brake, Mr. Line pushes forward on the lever.

The left brake lever is constructed from flat steel bar stock. The lower end of the lever fastens to a bracket bolted around the pedal shank (Figures 10 and 11). To engage the brake, Mr. Line pulls back on the lever. The lever could be improved by the addition of a handgrip.

To engage one brake, the operator pushes the lever forward. To engage the other brake, the operator pulls back on the second lever. This arrangement of the brake levers presents a situation that may be confusing to the operator, especially in emergencies.

Figure 11. Attachment of Hand Levers to Brakes

ACCESSORIES

Overhead Grip Bar:

A length of vertical pipe is welded to a steel plate bolted to the right rear tractor fender. Triangular gussets welded around the pipe add support for the pipe. A smaller diameter pipe slips inside the pipe stand. A crank is provided on the stationary pipe for proper height and position adjustment of the grip bar. A horizontal pipe is welded to the inner pipe and a triangular gusset welded at the joint provides support (Figure 12). This overhead grip barn provides support during transfer from the wheelchair to tractor seat.

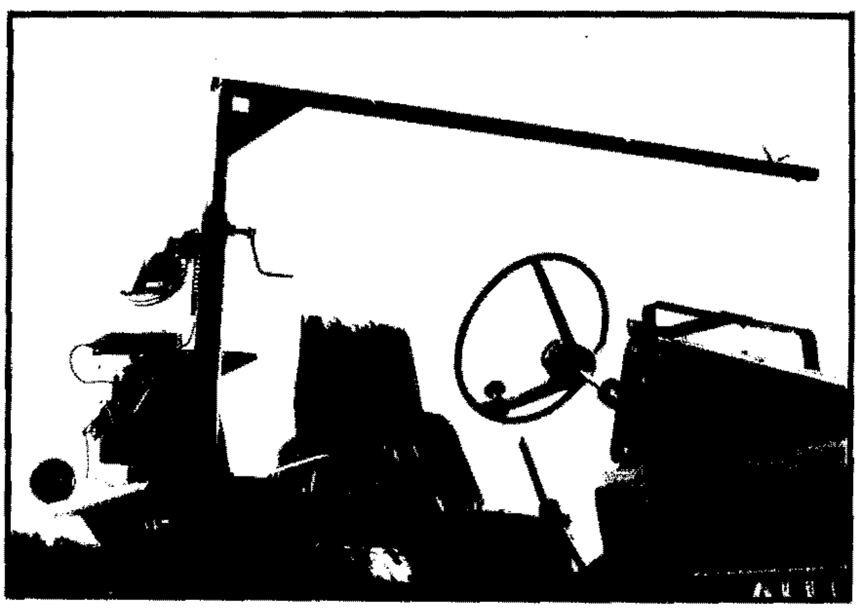

Figure 12. Overhead Grip Bar and Tractor Seat

Tractor Seat:

The original tractor seat was replaced with a sports car seat for added support and comfort (Figure 12).

Rear View Mirror:

Mirrors mounted on the overhead grab bar allow Mr. Line to monitor trailing implements (Figure 13).

Figure 13. Rear View Mirrors

ESTIMATED COST*

Total Material Cost: $950.00

Labor Cost not available.

*At time of construction, 1986

PAUL AUGSBURGER'S WHEELCHAIR PLATFORM LIFT

FARMER: **Paul Augsburger**
2147 Rd. K-1
Ottawa, OH 45875

DESIGNED BY: **Braun Corporation**
1014 S. Monticello
Winamac, IN 46996

SUMMARY

Function:

Paul Augsburger's wheelchair platform lift is designed to be mounted on a farm tractor. This lift enables the farmer to remain in his wheelchair during the lift from the ground to the operator's platform and keep his chair on the machine during field operation.

The lift is shown mounted on an International Harvester 186 Hydro tractor in Figure 1. The tractor contains control modifications and accessories which are described in a later section.

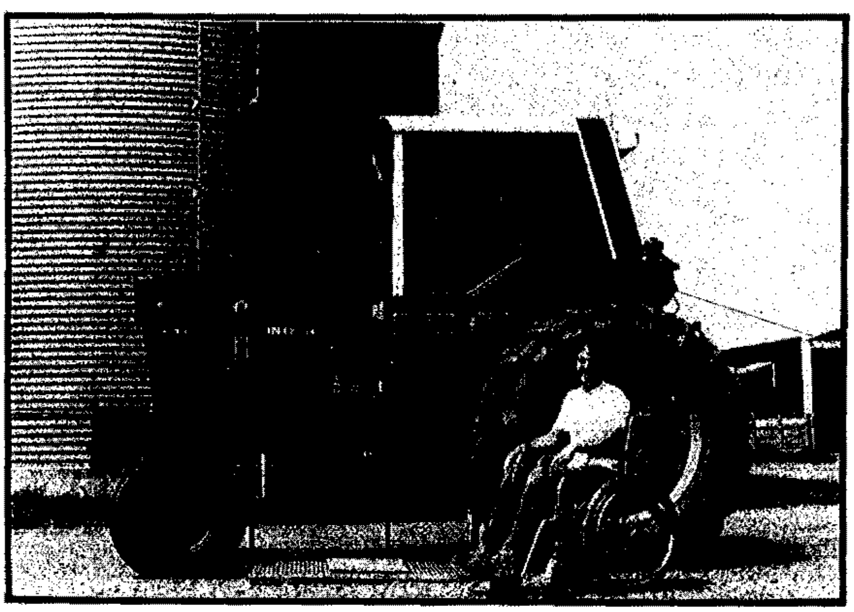

Figure 1. Paul Augsburger's Wheelchair Platform Lift

Farmer:

Paul Augsburger, a paraplegic, farms about 95 acres of corn and soybeans near Ottawa, Ohio. He uses his brother's machinery in exchange for his labor. Mr. Augsburger also helps on nearby vegetable farms by performing custom work for these farmers.

Mr. Augsburger owns the International Harvester 186 tractor on which the modifications have been made. The lift and control modifications were completed in 1982 by the Braun Corporation of Winamac, Indiana and R.J. Mobility of Chicago, Illinois. He is able to attach most of the essential field machinery to the tractor by himself.

Mr. Augsburger believes farmers with handicaps should have their wheelchairs with them on the tractor so that they can attach machinery themselves, perform maintenance work in the field, and in the case of an emergency, have an escape alternative from the tractor. This concept also allows him to use the tractor as an alternative vehicle and to have additional mobility by taking his wheelchair with him.

Modified Machine:

Tractor:	International Harvester 186 Hydro
Features:	ROPS Cab
Rear Tire Size:	18.4-38
Front Tire Size:	11-15
PTO HP:	105

Doors on Both Sides
Steps on One Side
Rear View Mirrors
CB Radio

Adaptability:

This lift is designed specifically to be mounted on an International 186 Hydro tractor. The same lift can be mounted on other farm tractors with changes in the mounting frame. Similar lifts without the wheelchair carrying capacity have been installed by the Braun Corporation on a John Deere 8430, Ford TW-20, and an International 186 Hydro tractor.

Compatibility:

1. The lift does not interfere with the use of the tractor by an able bodied individual, since the tractor is designed with a door and steps on both sides of the cab.
2. The door was rehinged to accommodate the placement of the lift.
3. The lift is designed to be easily removed for servicing the tractor.

Service and Maintenance:

1. Periodic service and maintenance of the lift is required.
2. The chain may require periodic tightening and lubrication.
3. The hydraulic circuit should be checked periodically for leaks.
4. Electrical switches and wiring need to be kept in good repair to prevent failure.
5. The components are accessible for ease of service and maintenance.

Accessibility and Ease of Use:

1. The lift is accessible for a farmer who uses a wheelchair and wishes to have his wheelchair with him while operating the tractor.
2. The lift is quiet during operation.
3. Little training is required to operate the lift. However, the transfer from the wheelchair to the operator's seat may require some practice.

CONSTRUCTION DESCRIPTION

The construction of Paul Augsburger's wheelchair platform lift is described in the following subsections: Stationary Frame, Lift Guide, Lift Platform, Lift Actuation, and Lift Controls.

Stationary Frame:

The mounting frame is constructed from steel tubing and welded steel bars. The frame attaches to both sides of the tractor and passes over the top of the engine compartment. The frame is bolted to the tractor frame for support. This type of design ensures adequate support and prevents twisting in rough terrain.

On the opposite side of the tractor's lift platform, the mounting frame is constructed of two vertical steel tubes welded to an "L"-shape bracket that is bolted to the tractor frame. These vertical steel tubes are bent slightly to fit tightly around the contour of the tractor's engine compartment. Two steel rods are welded between the two vertical tubes to increase the strength and rigidity of the frame (Figure 2). The same construction extends horizontally over the top of the engine compartment.

The horizontal frame section is bolted to a steel bar which is welded between two vertical steel tubes that form the guide mechanism for the lift (Figure 3). The mounting frame attaches on the lift side to a steel compartment enclosing the hydraulic pump and components which power the lift. This compartment is bolted to the tractor frame. Two triangular steel plates extend up from each side of the compartment and are welded to the lower end of the vertical lift guide tubes (Figures 4 and 5).

The design of the mounting frame allows for quick removal of the lift for tractor service.

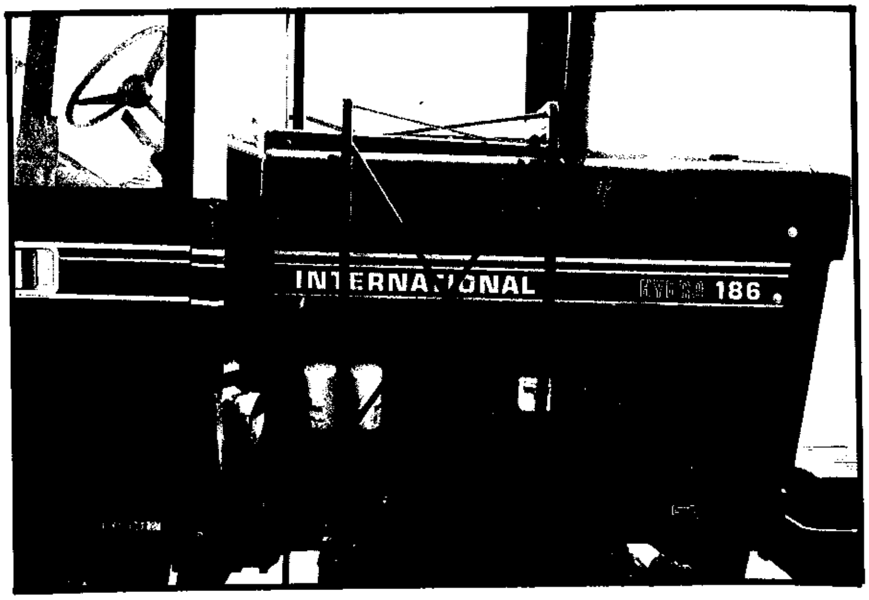

Figure 2. *Lift Mounting Frame on right Side of Tractor*

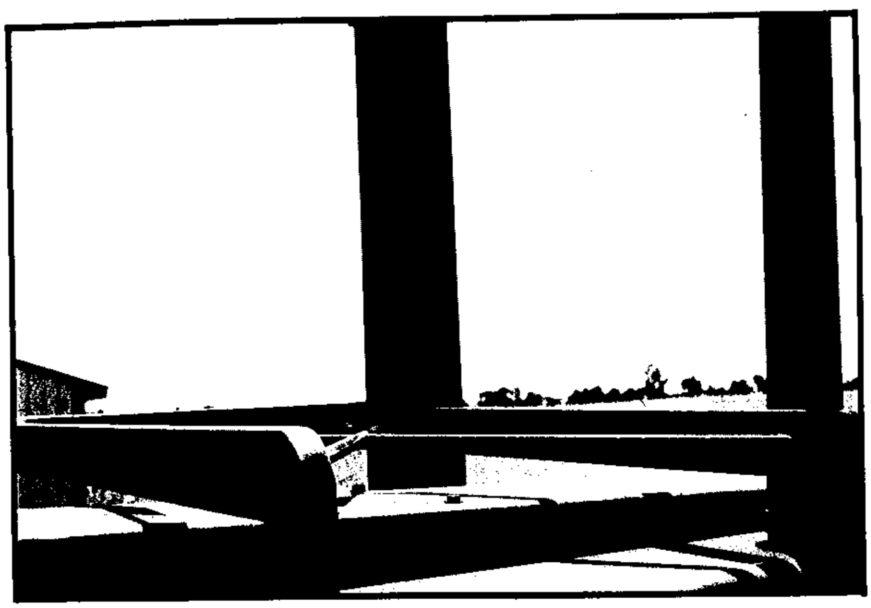

Figure 3. *Mounting Frame passing over Engine Compartment*

Figure 4. Hydraulic Component Box and mounting to Tractor

Figure 5. Mounting Frame connected to Guide Tube

Lift Guide:

The lift guide is constructed from two rectangular steel tubes that are attached vertically to the mounting frame. Inside the vertical tubes, steel channels covered with a teflon-like coating are added to provide bearing surfaces which eliminates the need for grease. Vertical steel tubes attached to the lift platform slip inside the guide tubes.

Lift Platform:

The lift utilizes a platform to lift the operator in his wheelchair (Figure 6). The platform is a rectangular steel frame with expanded steel welded over it.

Two rectangular steel tubes are welded to the lift platform and extend up vertically into the lift guide tubes. Sprockets are mounted on the upper end of each vertical tube to which a chain passes around to raise and lower the platform. Each chain travels from the sprocket up through the lift guide tube where it passes over another set of sprockets at the top of the guide tubes. The chain travels horizontally at this point in a protective steel covering then travels down along the outside of the left guide tube where both chains pass around sprockets mounted on the lift's hydraulic cylinder rod.

The operator moves his wheelchair onto the platform facing the tractor rear tire. He then locks his wheelchair onto the platform by using a lock supported by a vertical steel rod welded to the platform (Figure 7). Hinged side guards raise to help secure the chair on the platform and protect the operator.

The area of the platform where the wheelchair's rear wheels rest has been covered with plywood (Figure 6). The plywood is necessary because vibrations during field work cause the tires to wear out when resting on the steel platform.

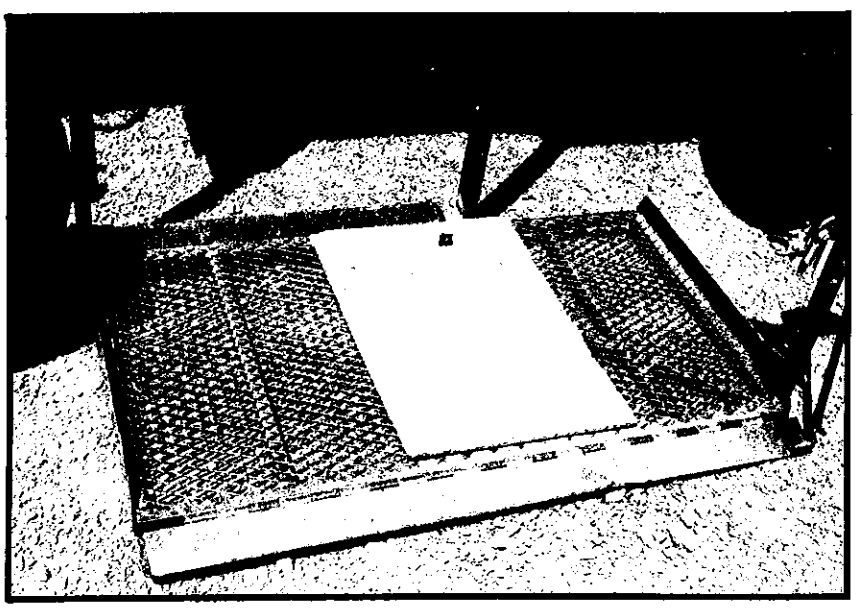

Figure 6. Wheelchair Lift Platform

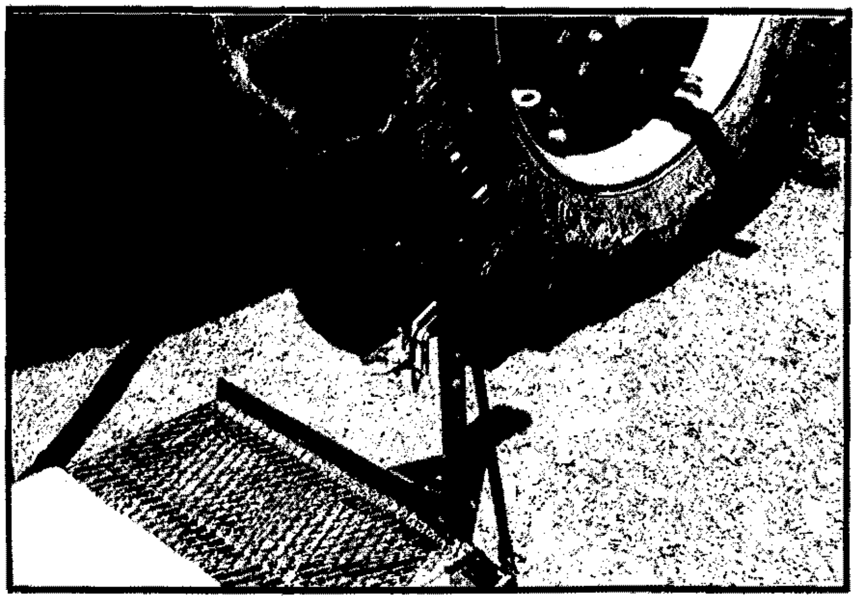

Figure 7. Wheelchair Locking Device

Lift Actuation:

The lift is powered by a 12-volt DC hydraulic system separate from the tractor hydraulic system. Figure 7 shows the components in the hydraulic system. The system is powered by a Monarch pump that has a capacity of 0.8 to 0.9 gallons per minute at 2000 psi. The pump is equipped with a bypass valve that functions when the lift is in the raised position, to prevent damage to the pump if the control switch is not released. A pressure compensated flow control valve is installed in the hydraulic system to control the rate of lift descent.

The lift uses one single-acting cylinder to raise and lower the lift. The cylinder allows gravity to lower the lift, reducing the battery drain and eliminating half of the cycle wear on the hydraulic pump. The hydraulic cylinder is attached to the roller chains which are attached to both telescoping lift tubes to raise and lower the lift. A schematic of the hydraulic system is shown in Figure 8.

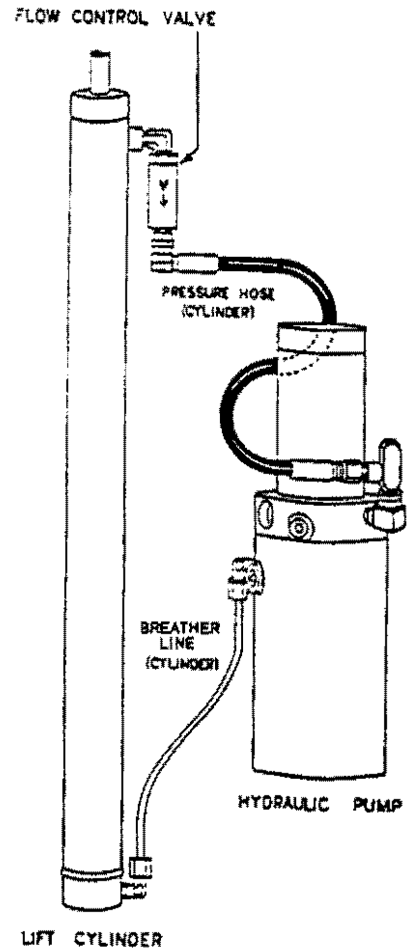

Figure 8. Hydraulic Schematic

Figure 9. Lift Switch Control

Lift Controls:

Weatherproof switches were mounted approximately chest high on the lift guide tube, (Figure 9) and also inside the cab. The placement of these switches allows the operator to use the lift on the platform or to lower the lift to close the cab door once inside the cab.

SAFETY CONSIDERATIONS

As a safety precaution, the tractor should be turned off during lift operation.

Braun has chosen a separate 12-volt DC hydraulic system which allows the lift to be operated with the tractor shut off. This type of system also allows the placement of several switches wherever needed for accessibility.

The locking device on the lift platform secures the wheelchair in position to prevent possible damage to the wheelchair. The hinged platform sides are raised when the lift is in use to assist in holding the wheelchair on the platform.

The roller chains used in the lift mechanism provide a smooth riding platform. The chains can be adjusted to increase tension and to keep the platform level. The chain is size 40 and has a tensile strength of 3700 pounds (Braun Specifications).

The lift could use a device that would raise the lift platform immediately after the engine is started. This would help prevent the possibility of an able bodied individual mounting the tractor on the opposite side, driving off with the lift in the lowered position, and thus damaging the lift.

Another hazard is that the lift platform extends beyond the rear tractor wheel if duals are not on the tractor; the platform could be damaged if it were to run into another object.

DESCRIPTION OF OPERATION

To mount the tractor, Mr. Augsburger moves his wheelchair onto the lowered lift platform and positions it to face the rear of the tractor (Figure 10). He raises the lift, using the switch mounted on the lift guide tube, (Figure 9), until he can open the door; and then continues raising the lift until it reaches the transfer height (Figure 11). (The door was rehinged with hinges in the rear so it would swing open to the rear). He then removes the footrests from his wheelchair and locks the wheelchair onto the platform, using the locking device mentioned earlier (Figure 7). Mr. Augsburger then transfers from his wheelchair to the tractor seat (Figure 12), using the overhead grip bar shown in Figure 16. He then uses a switch located in the cab to lower the lift so he can close the door and position the raised lift against the cab door.

To dismount, Mr. Augsburger transfers from the tractor cab by using the overhead grip bars, and moves into his wheelchair on the lift platform. He then lowers the lift by pressing the switch mounted on the lift. When the platform reaches the ground, he releases the locking device holding his wheelchair. He moves his wheelchair back so he can install the footrests on his wheelchair. He then proceeds to move his wheelchair off the lift platform.

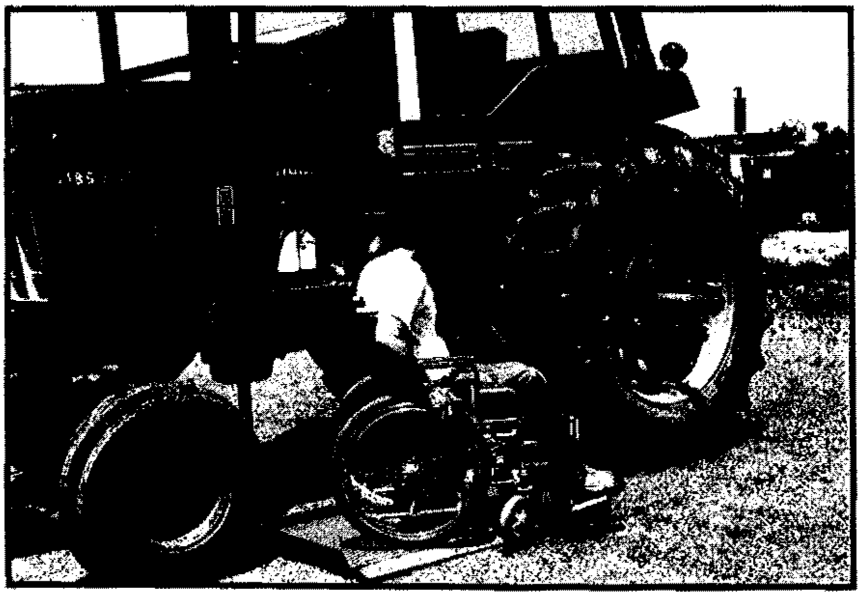

Figure 10. Mr. Augsburger moving Wheelchair onto Platform

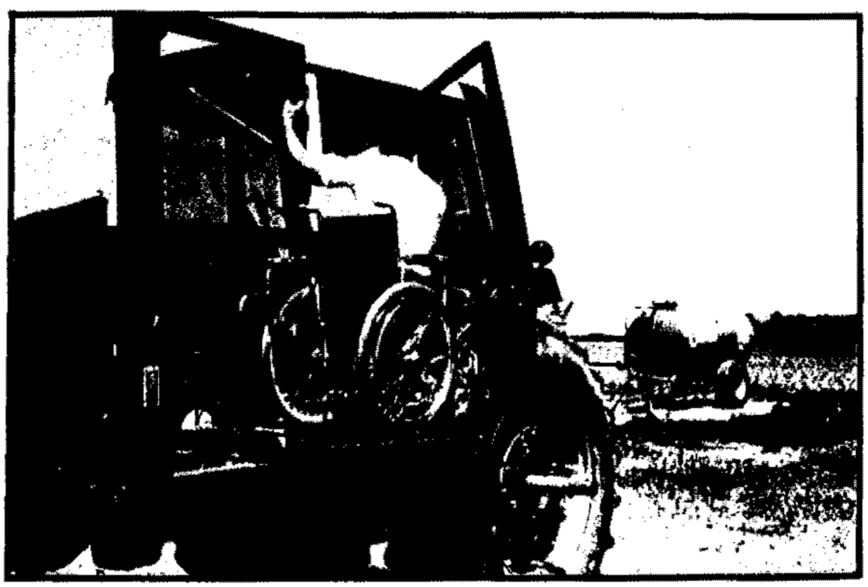

Figure 11. Mr. Augsburger transferring to Tractor Cab

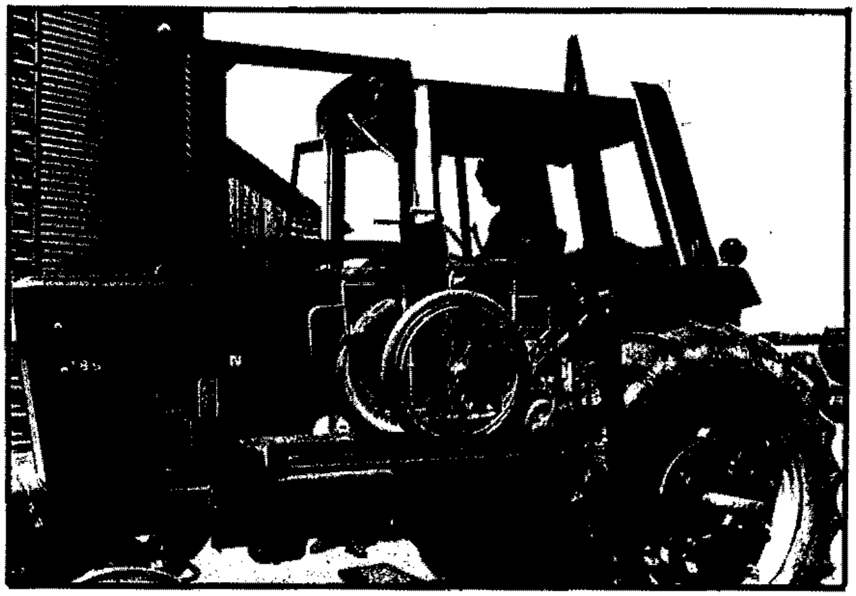

Figure 12. Lift in raised Position

CONTROL MODIFICATIONS

Clutch:

The International 186 Hydrostatic tractor contains a valve that acts like a clutch. It is only used for applications where slight movements of the tractor are needed.

The clutch pedal is modified by welding a steel lever at a right angle to a short length of steel rod, attached to the tractor console by a pin so that it can pivot. On the opposite end of this steel rod, a pin connects an adjustable steel rod that extends down vertically and attaches to a steel plate fastened to the pedal shank (Figure 13). A rubber hand grip is placed over the upper end of the steel rod to assure proper grip.

To disengage the clutch valve, the operator pulls back on the lever.

Figure 13. Hand Control Clutch Mechanism

Brake:

Mr. Augsburger's hand brakes consist of two vertical steel levers mounted to a bracket on the cab floor, allowing them to pivot around a pin. These levers are connected by adjustable linkages to another pivot assembly underneath the brake pedals. From this second pivot assembly another set of linkages connect to the brake pedal shanks (Figures 14 and 15).

To engage the brakes, the operator pushes forward on the vertical levers. The extended length of the steel levers decreases the amount of strength required to operate the brakes. The hand levers feature rubber handgrips which reduce the chance of the operator's hand slipping off the lever (Figure 14).

Grease fittings are installed at each pivot point to help reduce wear and friction.

Figure 14. Side view of Brake Mechanism

Figure 15. Close-up of Brake Mechanism

ACCESSORIES

Overhead Grip Bar:

An overhead grip bar is mounted inside the cab above the tractor seat. The grip bar, constructed of round steel tubing, is bolted to the ceiling of the cab and extends from one door to the other. A horizontal length of steel tubing is welded perpendicular to the first length of tubing and attaches to the rear of the cab ceiling (Figure 15).

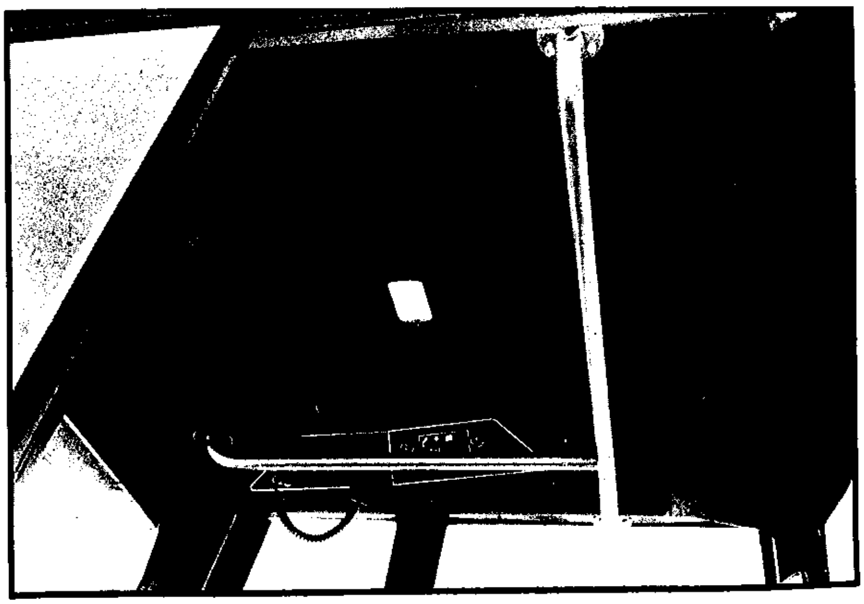

Figure 16. Overhead Grab Bar

ESTIMATED COST*

Estimated price of all modifications:
$18,500.00

*At time of construction, 1982

V. SLING LIFT

FRED LUTHJE'S SLING LIFT

FARMER: **Fred Luthje**
Box 68
Baldwinton, Saskatchewan
Canada S0M 0B0

SUMMARY

Function:

Fred Luthje's winch operated sling lift is designed to be mounted inside the cab of a farm tractor. The lift enables Mr. Luthje who has a physical handicap to gain access to the operator's station. The sling lift is shown mounted on a John Deere 4020 tractor in Figure 1.

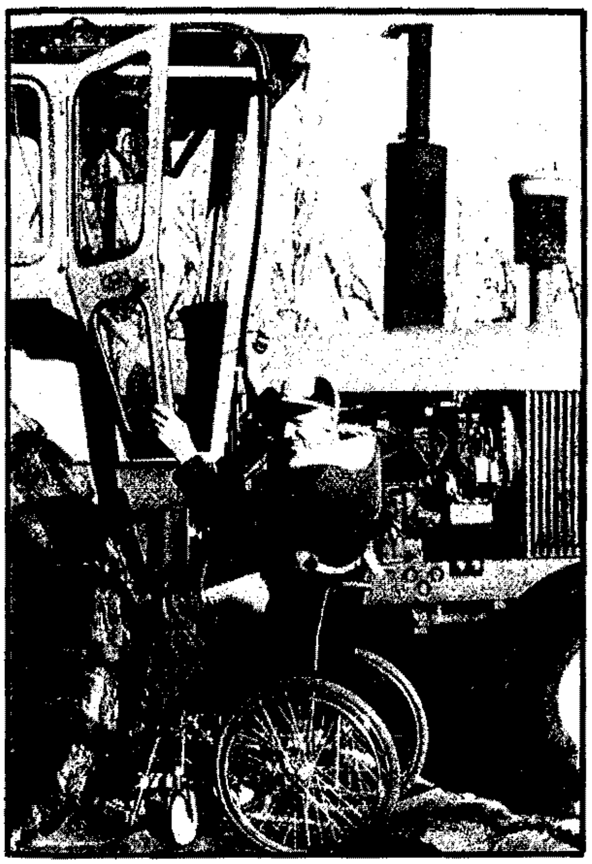

Figure 1. Fred Luthje's Sling Lift

Modified Machine:

Tractor: John Deere 4020

Features: Aftermarket cab
Doors on both sides of cab

Adaptability:

This lift concept is suitable to be used on other farm tractors. Several lifts of this type have been fabricated and are being used successfully.

Compatibility:

1. The lift does not interfere with other operators using the tractor because the lift folds against the inside of the cab frame.
2. The lift causes some inconvenience because it obstructs the operator's view to the right.

Service and Maintenance:

1. The cable should be checked regularly for damage, corrosion or wear and be replaced if necessary. Failure of the cable could cause a serious fall, especially if the failure were to occur while the lift was in the raised position.
2. The hinges will need periodic lubrication to ensure ease of use.

Accessibility and Ease of Use:

1. The lift is accessible from a wheelchair or ATV.
2. The lift is designed for ease of transfer to the tractor seat. However, it may require some practice to become successful in using this type of lift.
3. The cable and winch are noisy during operation.

Safety Concern:

Most cable and winch manufacturers warn against the use of their products for lifting human beings. This is a major concern of the evaluators. If, however, a farmer proceeds with a winch-type lift, it is strongly recommended that a high quality unit be selected that is self-locking when not activated. Experience has also shown that the electric switches included with some winches do not withstand frequent use. Heavy duty switches or relay solenoids which allow for lower current flows are recommended.

CONSTRUCTION DESCRIPTION

The construction of Fred Luthje's sling lift is discussed in the following subsections: Mounting Frame, Moving Frame, Lift Sling, Lift Actuation, and Lift Controls.

Mounting Frame:

The lift is mounted inside the after-market cab of a John Deere 4020 tractor. A 1/2″ x 3″ flat steel bar is bolted vertically to the cab frame near the door on the right side. Two horizontal flat steel bars are welded 12″ apart at the upper end of the vertical steel bar. The horizontal steel bars serve as hinges for the moving frame (Figure 2).

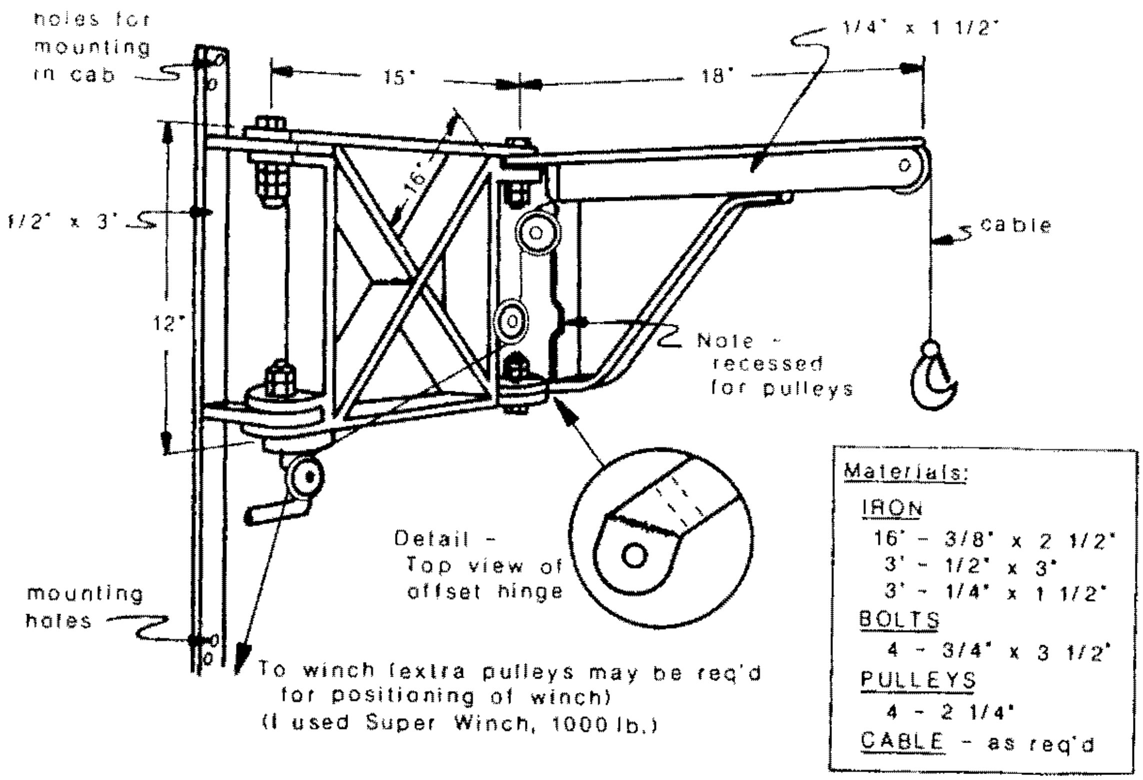

Figure 2. Drawing of Lift Construction

Moving Frame:

The moving frame consists of a double-hinged frame attached to the mounting frame (Figure 2). The first section of the hinged frame is a square shaped structure constructed of flat steel bar with flat steel bars welded diagonally within the frame to increase its rigidity. Two horizontal 15″, 3/8″ x 2 1/2″, flat steel bars are welded to two vertical 11 1/4″, 3/8″ x 2 1/2″, flat steel bars. Two short lengths of flat steel bar are welded horizontally to the outer side of each vertical bar of the square frame. They are mounted so that they leave an approximate 1/2″ gap between them and the horizontal steel bar. The hinges on the mounting frame fit between the gap formed by the steel bars, and the moving frame is attached to the hinges by bolts. The second section of the moving frame is an "L"-shaped boom constructed of flat steel bar. An 18″, 3/8″ x 2 1/2″ horizontal flat steel bar with offset hinges welded on one end pivots on a bolt mounted on the top pivot of the moving frame's first section. Two 1/4″ x 1 1/2″ flat steel bars are welded edge-wise underneath this bar to form a channel with a pulley mounted between the bars on the outer end. A brace constructed of 3/8" x 2 1/2" flat steel bar is welded underneath the channel and extends down where the end contains an offset hinge.

The offset hinge is attached by a bolt to the lower pivot of the first section of the moving frame. A vertical flat steel bar is mounted between the horizontal beam and the brace. Figure 3 shows the frame fully extended while Figure 4 shows the frame

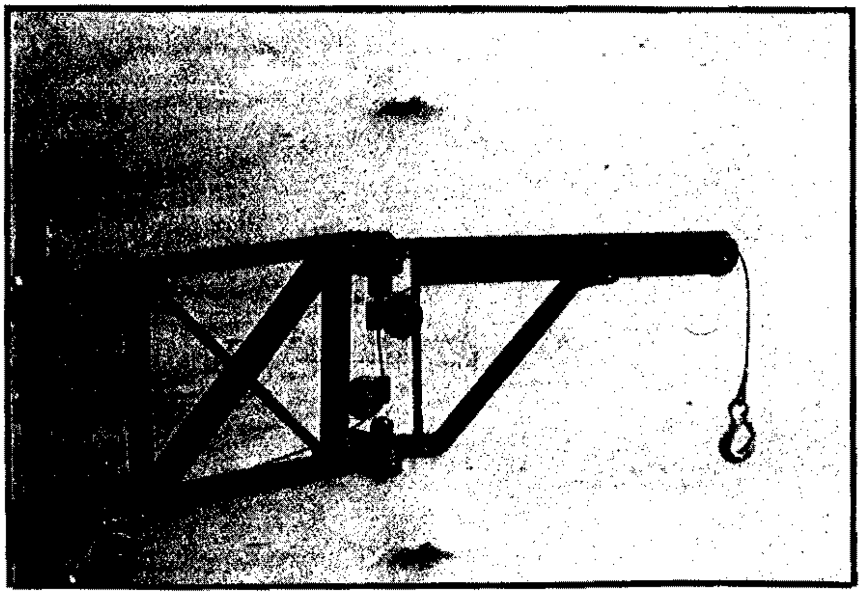

Figure 3. Frame fully extended

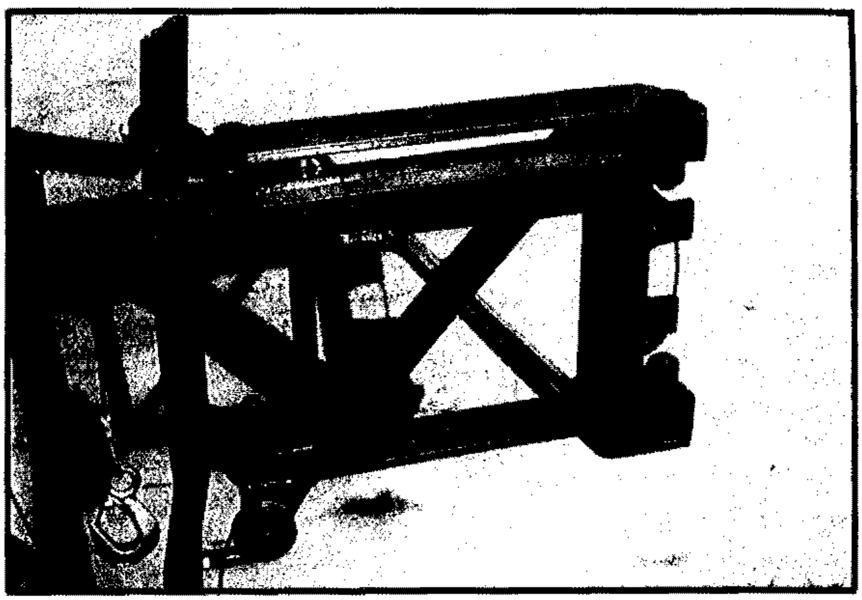

Figure 4. Frame folded

folded. The lift frame is 32″ when fully extended. The lift is shown inside the cab in Figure 5.

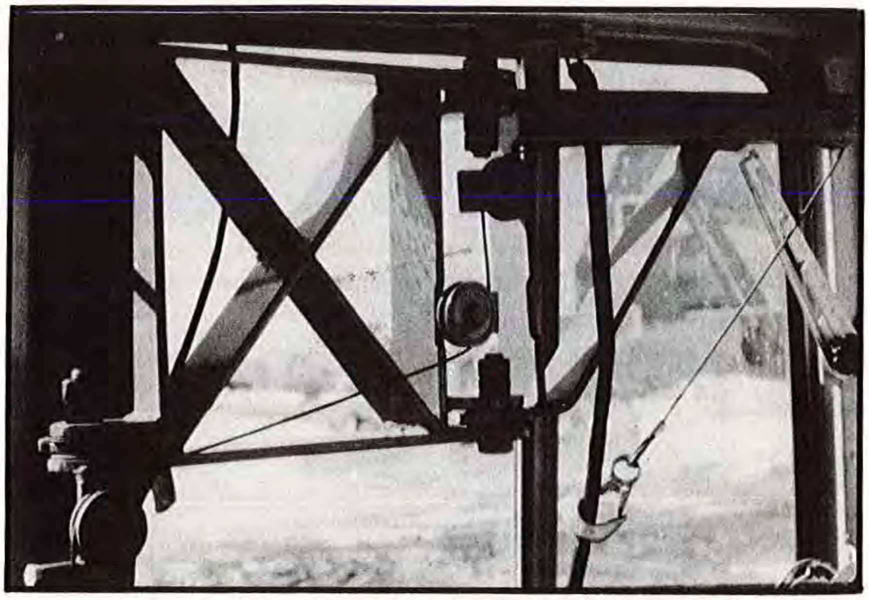

Figure 5. Frame inside Cab

Lift Sling:

The lift utilizes a canvas sling which Mr. Luthje places around himself while sitting in the wheelchair. He attaches it to the end of the cable. The sling carries the operator from the wheelchair to the tractor seat (Figure 1).

Lift Actuation:

The lift is powered by a 12 volt DC winch that operates off the tractor battery. The winch is mounted at the back of the cab. The cable travels from the winch, over a pulley mounted to a steel bar under the lower hinge on the mounting frame (Figure 4), around two pulleys mounted at the center axis of the two moving frame sections (Figure 6), then through the channel of the lift arm and over a pulley mounted on the outer end of the lift arm (Figure 4).

Lift Controls:

A hand-held remote control unit is used to operate the lift. Figure 1 shows Mr. Luthje holding the control unit in his right hand.

SAFETY CONSIDERATIONS

For safety, the tractor engine should be shut off during lift operation. This lift provides the safety feature of not requiring the engine to be running.

Most cable and winch manufacturers warn against the use of their products for lifting human beings. If the cable were to break, the operator would fall rapidly, which could result in serious injury. This is due to the absence of a braking device on the lift. The operator might also be injured if struck by the cable.

Figure 6. Close-up of Pulleys

Figure 7. Lift Frame extending out of Cab

DESCRIPTION OF OPERATION

To gain access to the tractor, Mr. Luthje moves his wheelchair up next to the right side of the tractor. An able-bodied person opens the cab door and moves the lift arm outside the cab door (Figure 7). He lowers the cable hook so Mr. Luthje can reach it. Mr. Luthje then places a canvas sling around himself and attaches it to the cable hook. He operates the hand-held remote control unit to raise himself to the cab, while holding onto the door and cab frame (Figure 1). After reaching the cab, he releases the switch and moves into the cab by using his arms. The lift arm pivots simultaneously. He positions himself over the seat and actuates the switch to lower himself into the tractor seat. Mr. Luthje then fastens the lift frame against the cab with a rubber strap (Figure 5).

To dismount, Mr. Luthje reverses the order of operation and lowers himself into his wheelchair.

ESTIMATED COST*

Cable and Winch	$130.00

Other material costs not available.

*At time of printing

VI. STEINER PARAPLEGIC TRACTOR

STEINER PARAPLEGIC TRACTOR

CONTACT: **Kim Bell**
Steiner Corporation
12657 Church Road
Orrville, OH 44667
(216) 683-0055

DESIGNED BY: **Steiner Corporation**

SUMMARY

Function:

Steiner's Paraplegic Tractor is designed to give the paraplegic the freedom to become more mobile and productive at home, on the farm, or in industry.

The Steiner Paraplegic Tractor shown in Figure 1 was loaned to the Breaking New Ground project in the Agricultural Engineering Department at Purdue University for the evaluation of its usefulness to handicapped farmers.

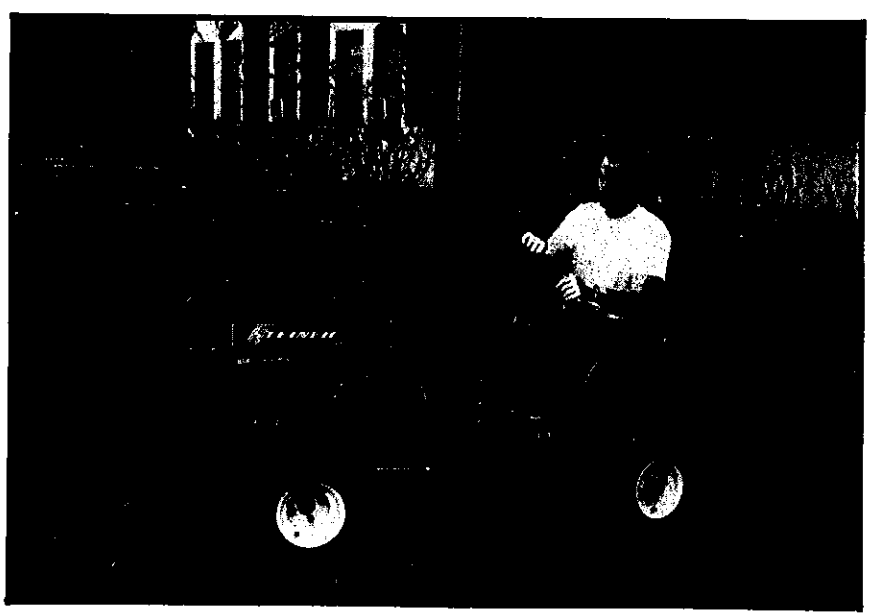

Figure 1. Steiner Paraplegic Tractor

Modified Machine:

Tractor: Steiner Paraplegic Tractor

Features:

19.9 HP Onan Engine
2 Cylinder
Air - Cooled
5 Gallon Fuel Capacity
Hydrostatic Transmission
2-speed transaxle
0-8 MPH Forward and Reverse
12 Volt Battery

Tilt Console
Electric Start
Lights
Ammeter
Hour Meter
Hydraulic Lift
Power Steering
Power Lift Tailgate
Emergency Horn
Roll-in Operator Platform

Dimensions:

48″ Wheel Base
44″ Overall Width
90″ Overall Length
46″ Overall Height
Approximate Weight: 950 lbs.
Rear Tire Size: 21-11.00
Front Tire Size: 4.80-8

Hand Controls:

Hydrostatic Transmission
Power Ramp
Power Attachment Control

Current Attachments:

48″, 60″ or 72″ Lawn Mower
48″ Tiller

54″ Power Angle Rotary Broom
48″ Snowblower
48″ or 60″ Manual or Power Angle Blade

These attachments are made so the handicapped operator can change them himself in a minimal amount of time from a wheelchair.

Adaptability:

The lift and tractor are a self-contained unit and is not adaptable to other machines.

Compatibility:

1. The tractor can only be used by an individual in a wheelchair because no seat is provided for a non-handicapped user.
2. The tractor is manufactured by the Steiner Corporation.

Service and Maintenance:

1. Normal service and maintenance of a lawn and garden tractor are required.
2. Other required maintenance includes the checking of the transaxle oil level and the lubrication of the pivot ball.
3. The service areas of the tractor are accessible for a handicapped operator.

Accessibility and Ease of Use:

1. The lift is easy to access and operate from a wheelchair.
2. The ramp lift, controls and overall tractor are designed for ease of operation.

CONSTRUCTION DESCRIPTION

The construction of the Steiner Paraplegic Tractor is discussed in the following subsections: Operator's Platform, Power Unit and Controls.

Operator's Platform:

The unique feature of this tractor is the operator's ability to roll his wheelchair onto the operator's platform. His wheelchair serves as the seat for the tractor. The Steiner Paraplegic Tractor is shown in Figure 1.

This tractor articulates with the operator's platform and control console in the rear. The operator's platform on this tractor is a combination ramp-trailer. The engine, drive wheels, and attachments are located in the front. Steel platform sides keep the operator's wheelchair on the tractor. A rubber non-skid padding placed in the bottom of the trailer prevents the wheelchair from sliding around. A gas tank is mounted on the left side of the operator's platform and is positioned for easy access.

The hydraulic tailgate allows the opera-

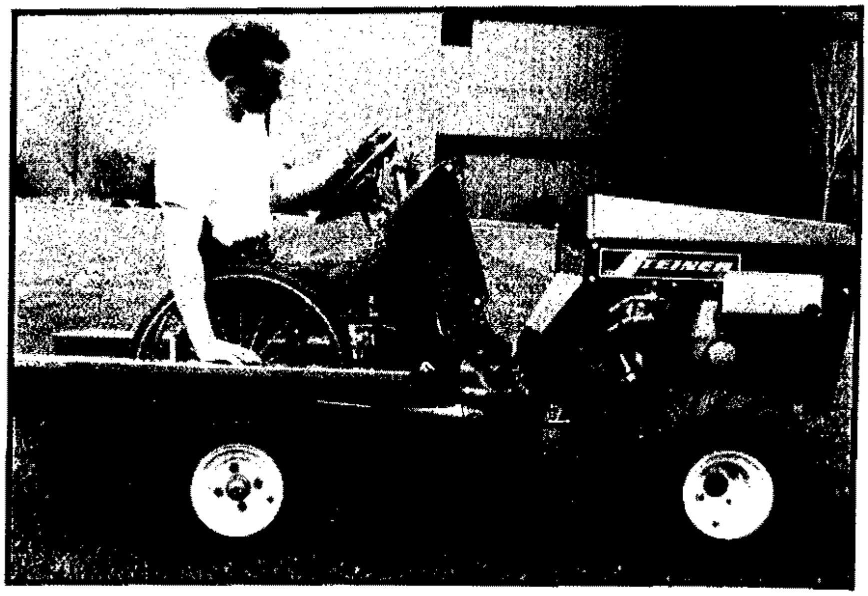

Figure 2. Lift Cylinder and Linkages on Side of Platform

tor to roll on and off the platform. A cylinder attached to the platform's right side is connected to a series of mechanical linkages on both sides which raise and lower the tailgate and the operator's platform simultaneously (Figure 2).

A control console, located at the front of the operator's platform, contains all of the hydraulic controls, gages and engine controls. These will be discussed further under the reference to "Controls".

Power Unit:

The Steiner Paraplegic Tractor is powered by an air-cooled 19.9 horsepower Onan twin-cylinder engine. The engine powers a front-wheel drive axle unit. The transmission is a 2-range hydrostatic that allows speeds from 0-8 MPH in forward and reverse. The engine also supplies the power to operate the hydraulic circuits. The hydraulic features on this tractor include power steering, power lift for the tailgate and operator's platform, hydraulic and belt-driven power attachments, and the hydrostatic transmission.

Controls:

The tractor's many controls are easily accessible to the operator.

On the left side of the control panel there are three hydraulic levers (Figure 3). The outside lever raises and lowers implements. The middle lever raises and lowers the tailgate and the operator's platform. The inside lever serves special functions for attachments, for example; to control the angle on a power blade.

Two remaining levers are located on the console to the right of the three hydraulic levers. The outside lever is the power take off control to operate attachments. The inside lever is a parking brake. These levers are shown in Figures 3 and 4.

In the center of the console panel lies the steering wheel. The choke lever is located to the left of the steering wheel. The ammeter and hour meter gages are positioned above the steering wheel. To the right of the steering wheel is the key, throttle lever and hydrostatic transmission control (Figure 4).

Mounted on the inside of the right front wheel is the transaxle shift lever (Figure 5). Moving the lever in one direction places the

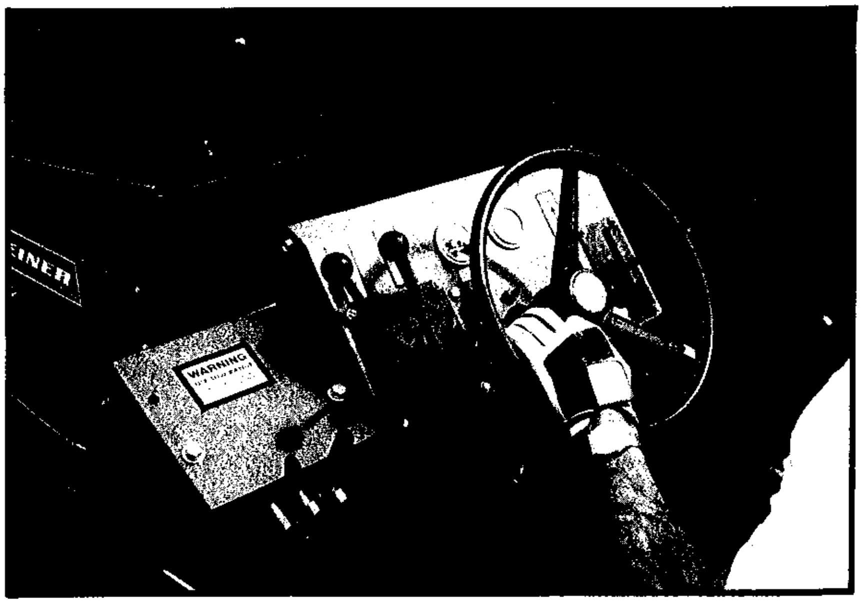

Figure 3. Hydraulic Levers and Controls

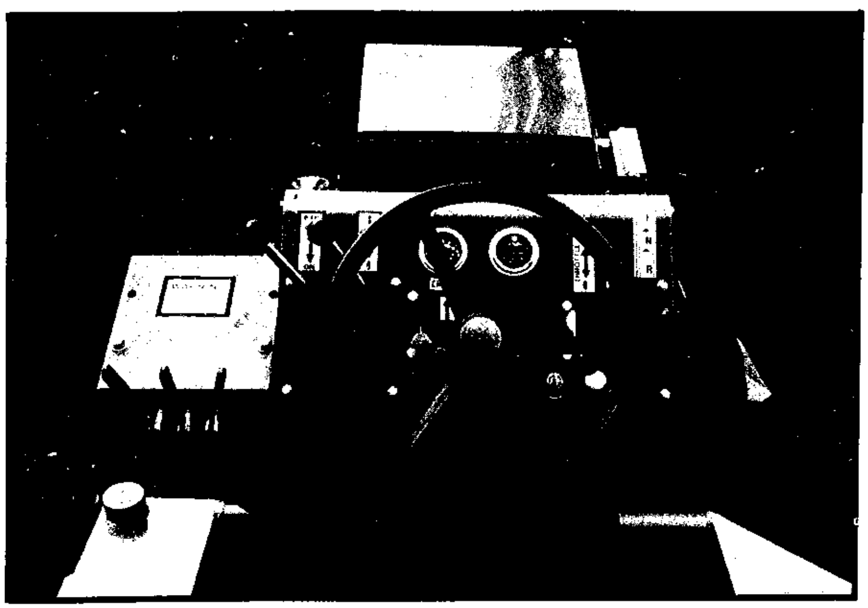

Figure 4. Control Panel

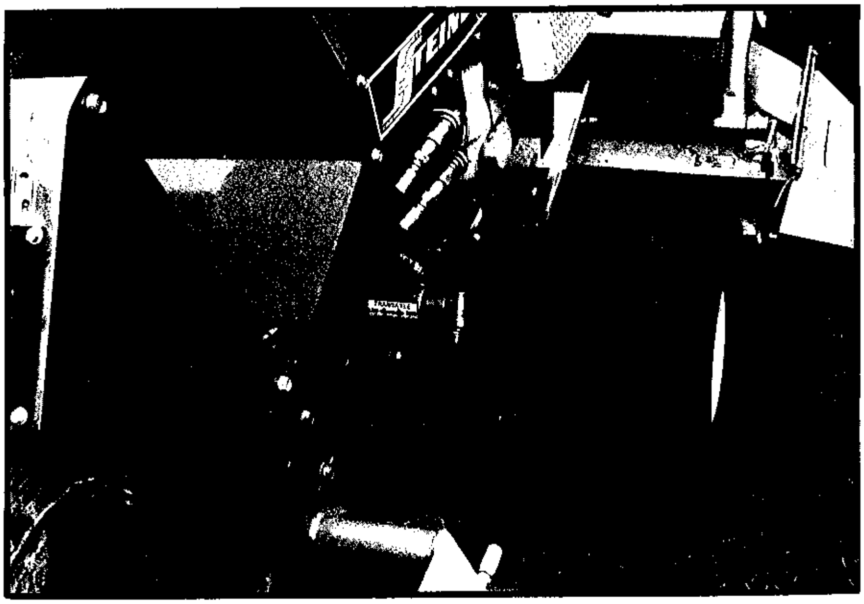

Figure 5. Transaxle Lever

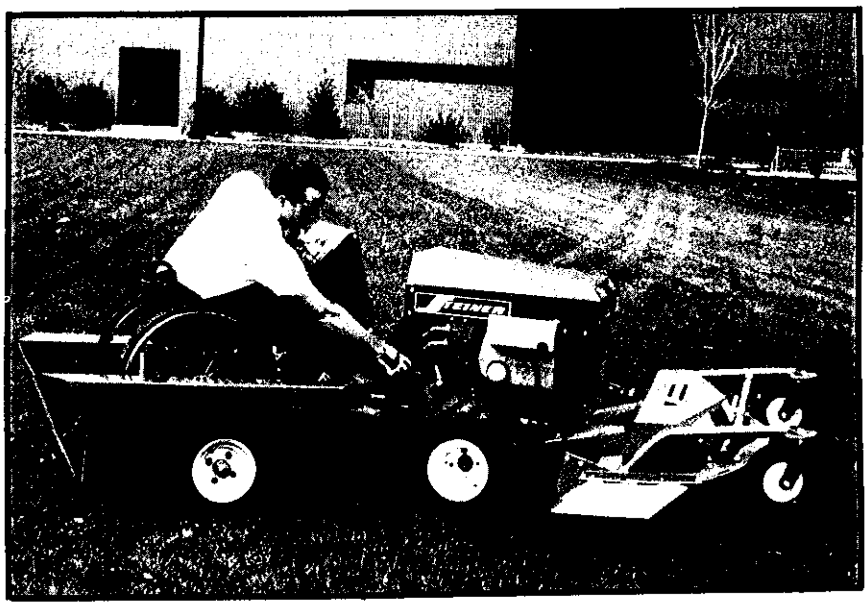

Figure 6. Operator Shifting Transaxle

transaxle in low while the other direction engages high transaxle. To shift the transaxle, the operator turns the tractor wheels right (placing the shift lever within reach), and then shifts to low or high as shown in Figure 6.

Mounted above the transaxle shift lever are two hydraulic hook-ups used for additional attachments. Figure 7 demonstrates they are easily accessible to the operator.

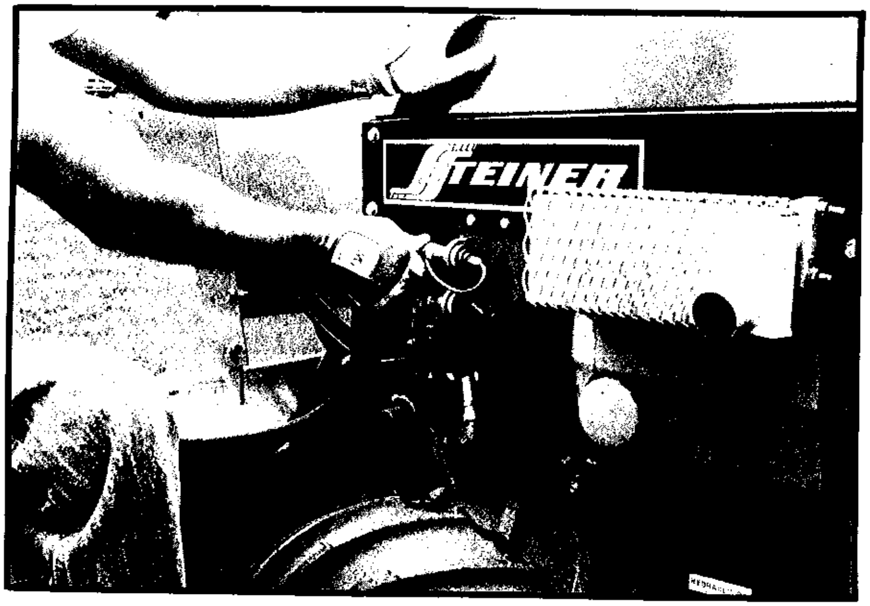

Figure 7. Hydraulic Connections for Accessories

SAFETY CONSIDERATIONS

The tailgate lift on this tractor can be lowered while the tractor is turned off.

The operator's platform on the tractor could use a set of straps to tie down the wheelchair to the trailer to prevent the chair from moving around and possibly causing the operator to lose control.

Before making adjustments to power attachments, the operator should turn the tractor off.

One problem discovered in the Steiner Tractor is the location of the muffler. The muffler is located toward the front on the right side of the tractor. When attaching the drive belts to the attachments, the operator could contact the muffler, resulting in a severe burn.

To prevent accidents, it is important that the operator not allow anyone else on the tractor while it is in use.

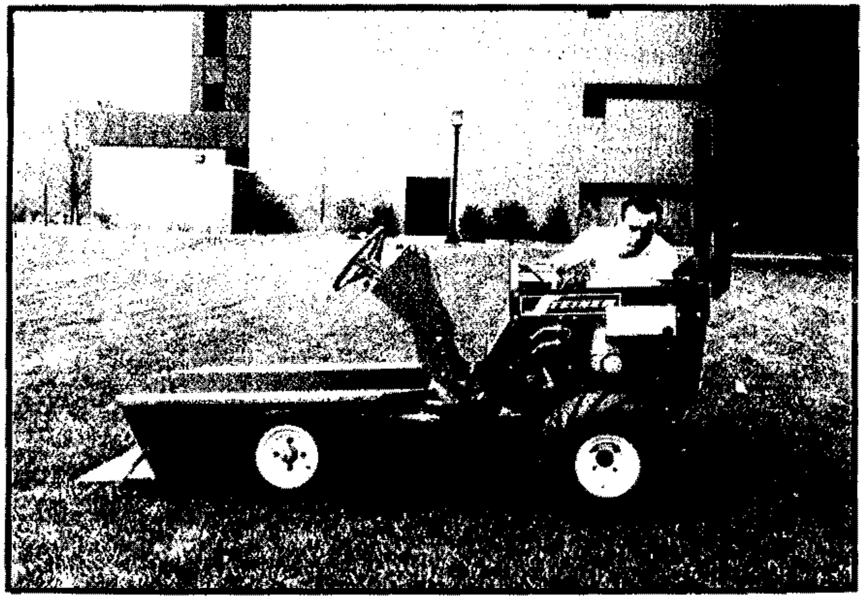

Figure 8. Servicing Tractor

DESCRIPTION OF OPERATION

Before operation, the operator should check the tractor for any servicing needs. The engine can be checked by lifting the hood (Figure 8).

To mount the tractor, the operator rolls his wheelchair up over the lowered tailgate and up onto the operator's platform (Figure 9). He moves his wheelchair to the front of the platform deck and then locks the brakes on his wheelchair. The operator starts the tractor by turning the key, then raises the tailgate lift by operating the middle hydraulic lever, (as described previously under the reference to "Controls"). The operator releases the parking brake after the tailgate has been raised, moves the hydrostatic lever in forward or reverse, and moves the tractor to the desired attachment. The mower attachment is shown in Figure 10.

When adding an attachment to the tractor, the operator first positions the tractor behind the attachment. He then continues to drive slowly toward the attachment and uses the outside hydraulic lever to line up the lift arms on the tractor with the hook-up arms on the attachment (Figure 11). Once the arms are in line, he moves forward until the tractor starts to push the attachment. The attachment latch should then lock. He then shuts the tractor off and lowers the tailgate using the middle hydraulic lever. The operator rolls out of the platform and goes

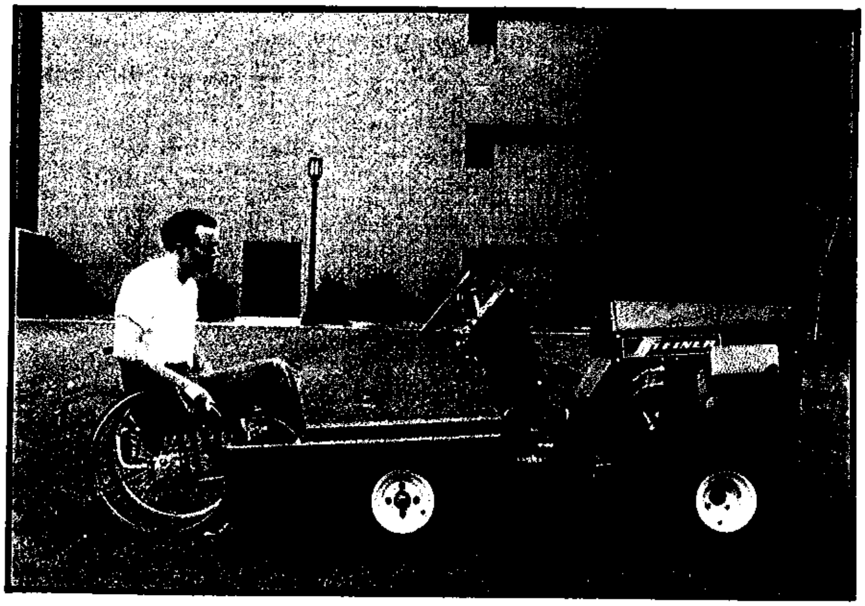

Figure 9. Moving Onto Tractor Platform

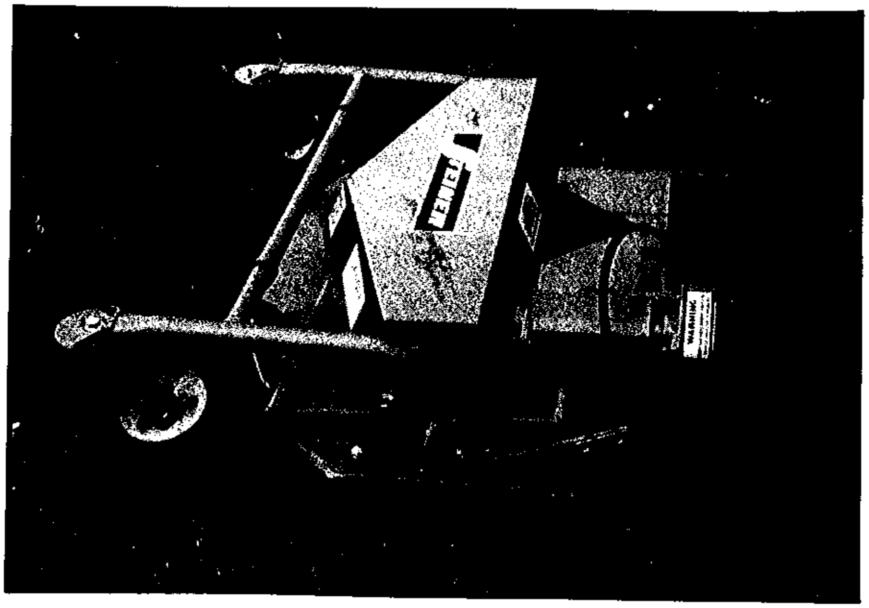

Figure 10. Steiner Mower Attachment

to the front of the tractor to attach the drive belt to the mower and the tractor. He pulls the belt over a pulley on the tractor by using a release mechanism. Moving to the other side, he attaches the belt to the pulley on the mower (Figures 12 and 13). He also makes sure the attachment is securely latched to the tractor. The operator moves back onto the operator's platform after completing this process. He starts the tractor, raises the tail-gate and releases the parking brake. He is ready to commence working. The mower is shown in use in Figures 14, 15 and 16.

To operate an attachment, the operator engages the power take off lever. The out-side hydraulic lever adjusts the height of attachments. These control levers are described further under the reference to "Controls".

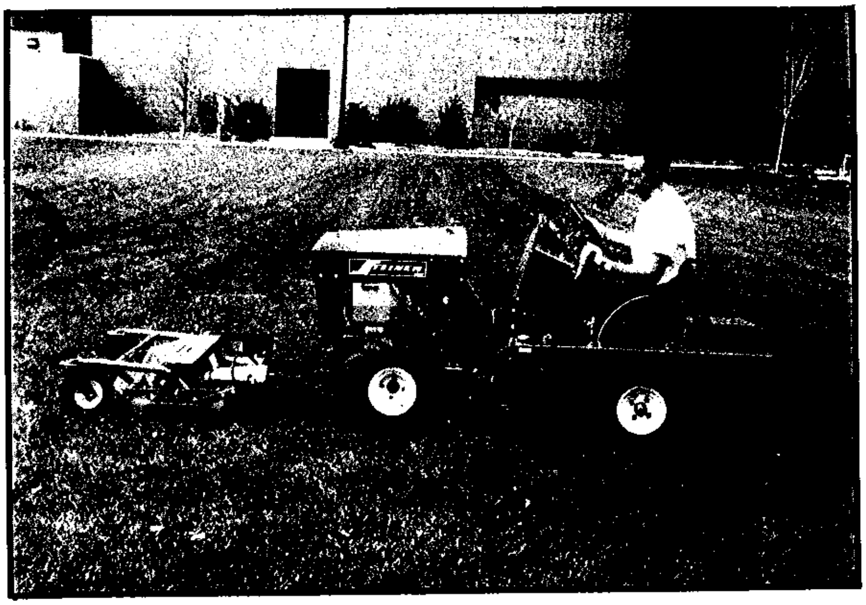

Figure 11. Aligning Lift Arms to Attach Mower

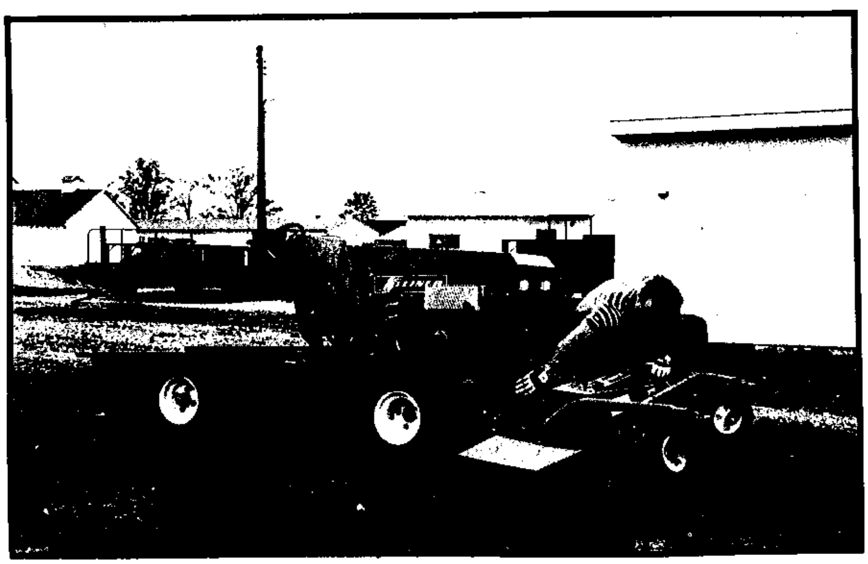

Figure 12. Attaching Drive Belt to Mower

Figure 13. Attaching Drive Belt to Tractor

Figure 14. Steiner Paraplegic Tractor in Use

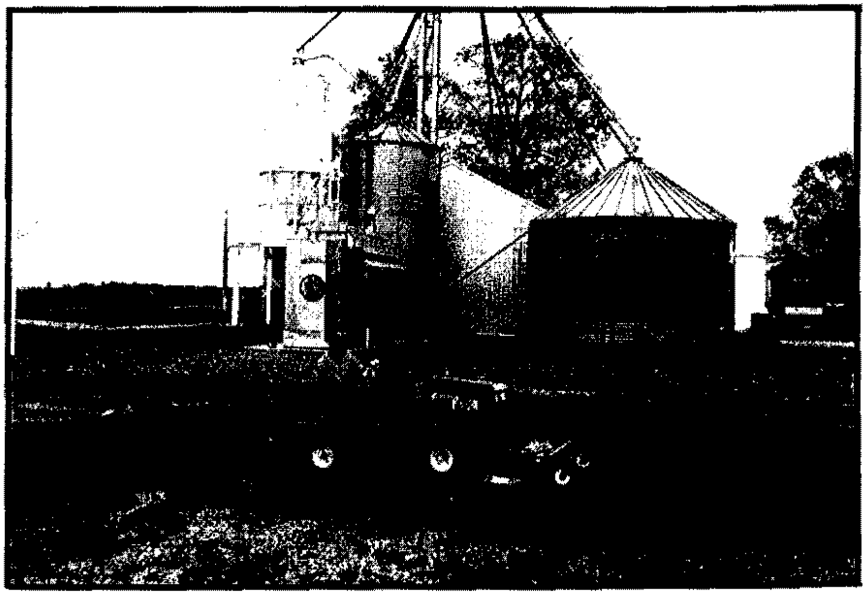

Figure 15. Steiner Paraplegic Tractor in Use

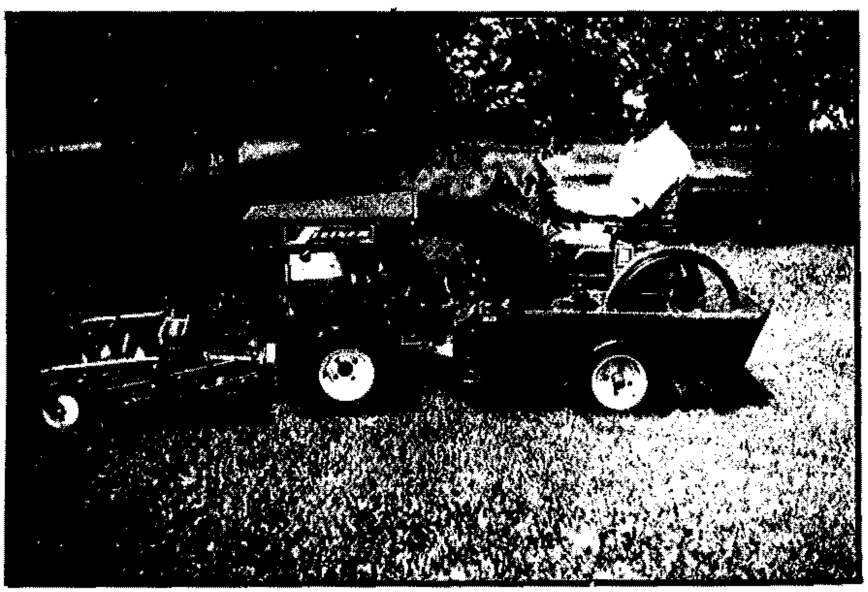

Figure 16. Steiner Paraplegic Tractor in Use

ESTIMATED COST*

List Price:	$ 7,780
*At time of construction, 1986.	Price is subject to change.

VII. RESOURCES

BREAKING NEW GROUND RESOURCES*

Agricultural Tools, Equipment, Machinery & Buildings for Farmers & Ranchers with Physical Handicaps, Volume I

This manual contains over 350 pages of ideas and resources currently being used by agricultural producers with physical handicaps, which enables them to remain active in their operations. The ideas have been collected from farmers and ranchers throughout the United States and Canada. Each idea contains a description of the concept, method of operation and a brief overview of how the item was constructed, and a contact person for further information.

Breaking New Ground Newsletter

In 1982, Breaking New Ground began publishing a quarterly newsletter for farmers with physical disabilities. The newsletter now has a circulation of more than 4,000 farmers, rehabilitation professionals, libraries, media and government organizations, and extension offices. The newsletter provides a list of upcoming seminars, workshops and meetings held around the country for farmers with disabilities and rehabilitation professionals. Articles range from personal accounts of farmers who have been disabled, to technical reports on various lifts and adaptive equipment being researched and developed by Breaking New Ground. Subscriptions to the newsletter are free of charge.

Plowshares

These are special Breaking New Ground technical reports.

Plowshares #1: Potential Health and Safety Risks of Farming with Physical Handicaps

Plowshares #2: Hand Controls for Agricultural Equipment

Plowshares #3: Prosthetic and Worksite Modifications for Farmers with Upper Extremity Amputations

Plowshares #4: Purdue Designed Chairlift Attachments for Farmers with Restricted Mobility

Video Tape, Slide/Tape Set

Rehabilitation Technology - "A Challenge For All", provides an overview of how everyone can have a part in helping to meet the needs of the physically disabled through the application of rehabilitation technology. Specific areas addressed include an overview of the applications of rehabilitation technology; utilizing community resource people, places, and materials; approaches to solving unique problems; and accessing commercially available devices and materials. This narrated 15 minute audio visual program with 110 slides is available in either slide/tape set or VHS video tape format.

Video Tape

Farming With An Arm Amputation is a 58 minute video program that features 10 farmers with various levels of upper extremity amputations, who share their techniques and modifications they have developed to continue farming. The program is designed for farmers, their families and rehabilitation professionals working in rural areas. This narrated 58 minute video is available in VHS video tape format.

*All Breaking New Ground resources, as well as additional information concerning them, may be obtained by addressing your requests to:

Breaking New Ground
Department of Agricultural Engineering
Purdue University
West Lafayette, IN 47907

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