

Fully Self-Contained, Enclosed, Mobile Welding Trailer

A Senior Project

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Bachelor of Science

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Abstract

The Purpose of this project was to create a fully self contained, enclosed, mobile welding trailer for Alvarado Land and Cattle in Shandon, CA. The trailer was created to help bridge the financial gap between growing seasons. The added income from the mobile welding operation would provide much needed financial support to allow for more investment and expansion. Alvarado Land and Cattle reasoned that diversifying their operations by adding a mobile welding operation would be a smart step towards the success of the company. This trailer when completed will fulfill the need generated by the diversification.

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Chapter One

Introduction

Statement of the Problem

Alvarado Land and Cattle (ALC), in Shandon, CA, needs a welding trailer to expand the scope of the operation from just farming and cattle to the mobile custom welding business. The trailer would help the company to expand the profit opportunities throughout the year not just during the couple of months when there is oat hay available to sell. The trailer needs to contain all of the tools required to be a fully self contained welding shop in a trailer. The problem is that ALC needs a fully self-contained, enclosed, mobile welding trailer to expand the operation of the company.

The Importance of the Project

The welding trailer will be an important part of ALC to expand the scope of the operation and expand the profit opportunities as well. When the trailer is done, ALC should have a fully functional trailer that is road legal, fully outfitted, and ready to go upon the completion of the project. The trailer will fully fill the requirements of what ALC requires for the trailer.

Objectives of the Project

The project has some strict requirements to adhere to based upon laws and regulations put forth by the California DMV, CAL OSHA, and U.S. DOT. There are some other requirements put in place by ALC as well for the functionality of the trailer and the flow of the work space. The requirements from the DMV include proper lighting, licensing and safety equipment. CAL OSHA requires that the cylinders for the Oxygen and Acetylene be secured properly for transport and use. There are other requirements put in place that include safety of the workers and the workplace. The U.S. DOT also has requirements pertaining to the trailer and the bottles, as well

as the safety of the load and the loading of the trailer to ensure proper towing and weight distribution.

- 1) Trailer must be legal for the road, and properly licensed as well with the DMV.
- 2) The pressurized cylinders for oxygen and acetylene must be properly secured for transport and use. The securing method may not interfere with the ability to use the cylinders while secured.
- 3) The trailer must be designed to provide a proper workspace that is safe and functional such as exposed wires, loose hoses and cables, and sharp edges.
- 4) The trailer needs to have all of the openings closed up to prevent the chance of theft of materials.
- 5) The welder needs to be able to be serviced for oil, filter and air cleaner from where it is located in the trailer as well as vent the exhaust and draw in cool air.

Definitions of terms

- GMAW: Gas Metal Arc Welding
- TGAW: Tungsten Gas Arc Welding
- SMAW: Shielded Metal Arc Welding
- FCAW: Flux Core Arc Welding
- CAD: Computer Aided Drafting

Summary

The project will consist of a trailer being constructed for Alvarado Land and Cattle that will be a fully contained and functional mobile welding trailer. The trailer will fulfill a set of requirements placed by ALC and following requirements in place for the safe operation of a trailer on the road. The trailer will be designed to allow for an easy, safe workspace which allows

for productivity. The trailer will allow ALC to expand the operation from just farming and cattle to mobile welding. At the completion of the project the trailer will be fully functional and ready to roll down the road and go to work.

Chapter Two

Review of Literature

The process of welding and cutting has been a staple in American life for many years. Without the processes used today many people may still be using barbed wire and other wires exclusively for fencing, equipment would not be repaired in the same way and other things we take for granted would not be built the same way.

Welding

Welding is a method of repairing or creating metal structures by joining the pieces of metal or plastic through various fusion processes. Generally, heat is used to weld the materials. Welding equipments can utilize open flames, electric arc or laser light. When talking about metals the most common methods of welding use open flame or electric arc. For the scope of this project the welder will be a Miller Bobcat 250 engine driven welder. When it comes to electric arc welders there are welders which are hard wired into the power grid, or plugged into the wall, and there are engine driven welders. The welder that will be used for this project is an engine driven welder. An engine driven welder was chosen for this project because of the portability and wide variety of processes the welder is capable of. The processes in welding are the different types of welding. There are SMAW (Shielded Metal Arc Welding), GMAW (Gas Metal Arc Welding), GTAW (Gas Tungsten Arc Welding), and FCAW (Flux Core Arc Welding). As a mobile welder the main process used is SMAW, or more commonly known as Stick welding. Stick welding is chosen more widely for mobile welding applications because of the lack of a need for bottles of shielding gasses, needed for GMAW and GTAW, as well as when the weld is performed outdoors there is no need to protect the weld from wind to keep the shielding gasses

from blowing away. As a mobile welder the majority of welds will be performed outdoors on projects such as fences, equipment repairs, and other large or immovable projects.

The Welder: Miller Bobcat 250

Miller welders are one of the many different welder manufacturers on the market today. The two major manufacturers of welders are Lincoln Electric and Miller. The welder has been chosen for this project because of availability, price and familiarity with the operations platform of the welder. The welder was purchased used for \$1900 delivered with 51.3 hours on it. The welder is capable of four different processes; three are possible with the correct accessories, GTAW, GMAW, and FCAW. SMAW is possible with no accessories other than the cables to transfer the power and ground. From the Miller website CAD drawings were obtained to determine the locations of the bolt holes to secure the welder to the trailer for installation in the trailer. CAD or Computer-aided design. Common CAD programs include: AutoCAD, Vectorworks, Microstation. Programs differ greatly in features, complexity, cost, and hardware requirements (University of Virginia). The website also features information on the output, the duty cycle and other valuable information about the Bobcat 250. The welder weighs 501 lbs which is important to note when the trailer is being designed to take into account the proper loading of the axles and the hitch. The welder has an oil change life of 50 hrs which is also important to note for reference because a properly maintained engine will operate for a long time.

Trailer

The trailer base has been obtained through a donation from Frank Hook of Shandon, CA. The trailer is a tandem axle two horse enclosed trailer. The idea of an enclosed trailer provides more security for the equipment as well as shelter for the equipment as well. The trailer is not

large but will be a good fit and will conform to all laws so that anyone with a driver's license can tow the trailer behind any pickup. Additionally there are a set of recommendations and rules from the California DMV (Department of Motor Vehicles) about weights, loading, and other safety concerns. "Trailers must be carefully weighed to make sure that loads are properly distributed, front to rear as well as left to right" (California DMV). The DMV mentions that an improperly loaded trailer will result in an unstable trailer while towing. The rule of thumb for a trailer weight distribution is 85% over the trailer axles and 15% on the hitch. This weight distribution method, supported by many including Dr. Mark Zhons of the BioResource and Agricultural Engineering Department and the California DMV. Even the way the trailer and tow vehicle sit has recommendations. "The tow vehicle and trailer should be in a level position (altitude) in order for the hitch to do its job properly" (California DMV). "Trailers in California are required to have reflectors, tail, brake, and license plate lights. Signal lights are also required if the tow vehicle's lights are hidden. Trailers over 80 inches wide must have clearance lights. Most manufacturers comply with these requirements; however, it is up to you to be sure that all lights operate correctly" (California DMV). "In California, brakes are required on any trailer coach or camp trailer having a gross weight of 1500 lbs. or more. Usually the braking capacity on tow vehicles is good; however, it may not be good enough to safely stop the several hundred to several thousand additional pounds that your trailer weighs" (California DMV). Beyond all of the different recommendations and regulations for towing a trailer there are some simple steps that should be followed to ensure a safe trip. The list of steps includes: Checking the tire pressure, ensuring the lights work properly, and the hitch is secured properly, the electrical connections are secure, and the safety chains are connected.

Oxygen-Acetylene Torch Safety and Handling (OSHA)

“Under no condition shall acetylene be generated, piped (except in approved cylinder manifolds) or utilized at a pressure in excess of 15 psig (103 kPa gauge pressure) or 30 psia (206 kPa absolute)” (OSHA 1910.253(a)(2)). “Acetylene is volatile at pressures above 15 psi (pounds per square inch) however can be safely stored in pressurized cylinders at pressures above 15 psi. The release of the gas must be regulated to no more than 15 psi. Only approved apparatus such as torches, regulators or pressure-reducing valves, acetylene generators, and manifolds shall be used” (OSHA 1910.253(a)(3)). “Workmen in charge of the oxygen or fuel-gas supply equipment, including generators, and oxygen or fuel-gas distribution piping systems shall be instructed and judged competent by their employers for this important work before being left in charge. Rules and instructions covering the operation and maintenance of oxygen or fuel-gas supply equipment including generators, and oxygen or fuel-gas distribution piping systems shall be readily available” (OSHA 1910.253(a)(4)). “All portable cylinders used for the storage and shipment of compressed gases shall be constructed and maintained in accordance with the regulations of the U.S. Department of Transportation, 49 CFR Parts 171-179” (OSHA 1910.253(b)(1)(i)). All of the regulations listed are part of the OSHA requirements for just the Oxy-Acetylene torches and bottles. When the transportation of cylinders is required there are a different set of regulations that are enforced by the DOT (Department of Transportation) of the states as well as most places where cylinders can be filled or exchanged will not accept or release cylinders to an individual without proper transportation equipment. “Valve protection caps, where cylinder is designed to accept a cap, shall always be in place, hand-tight, except when cylinders are in use or connected for use (OSHA 1910.253(b)(2)(iv)). When transporting the cylinders in a trailer such as a welding trailer it is acceptable to secure the cylinders in two places

on the cylinder and leave the regulators on the cylinders as long as a drop ring is installed on the cylinders in place of the caps. There are also some clamshell caps available on the market they still require the removal of the regulators every time but do not require the caps to be screwed on and off repeatedly, sometimes multiple times a day. The caps are just like a standard pressurized cylinder caps but they are split just like a clamshell. The caps can be screwed on but the split can be locked together and unlocked to attach the regulators. For this application the valve protector of choice will be the ring that allows the regulator to stay attached to the cylinder while still protecting the valves. In the event that something goes wrong there are resources to help. “DOT Emergency Response guides are included in this booklet. If an emergency occurs during the transportation of compressed gases, you can obtain guidance on how to handle the emergency by calling the CHEMTREC emergency hotline at: 800/424-9300” (Airgas).

Welding Safety (OSHA)

Fire watchers shall be required whenever welding or cutting is performed in locations where other than a minor fire might develop, or any of the following conditions exist: (OSHA 1910.252(a)(iii)(A)(1-4))

- 1) Appreciable combustible material, in building construction or contents, closer than 35 feet (10.7 m) to the point of operation.
- 2) Appreciable combustibles are more than 35 feet (10.7 m) away but are easily ignited by sparks.
- 3) Wall or floor openings within a 35-foot (10.7 m) radius expose combustible material in adjacent areas including concealed spaces in walls or floors.
- 4) Combustible materials are adjacent to the opposite side of metal partitions, walls, ceilings, or roofs and are likely to be ignited by conduction or radiation.

Helmets or hand shields shall be used during all arc welding or arc cutting operations, excluding submerged arc welding. Helpers or attendants shall be provided with proper eye protection (OSHA 1910.252(b)(2)(i)(A)). The helmet used should also contain a shield at a proper darkness to effectively block out the harmful arc rays but still allow for enough vision to see clearly the weld being placed. The main theme in all of the regulations is to use simple common sense and put safety above all else when working in these environments. Welding is a dangerous activity and can be hazardous to your health if proper safety procedures are not followed correctly. Furthermore others health may be compromised by an individual's lack of safety procedures.

Chapter Three

Methods and Materials

This project was originally created because the author's company saw a need for a mobile welding trailer to diversify the business operations. By creating a mobile welding unit the company saw an opportunity to bridge the financial gap between crop seasons. Currently between crop seasons there is little to no income and adding a mobile welding unit would provide this important source of income.

Components of a Fully Self-Contained, Enclosed, Mobile Welding Trailer

The first part of the process included obtaining a trailer. The trailer is the base for the whole project and needed to fulfill a set of requirements. That list of requirements included:

- 1) A tandem axle trailer with a weight rating sufficient enough to carry all equipment that would be required for the trailer to be fully self-contained, ie welder, torch bottles, etc.
- 2) A trailer with a sufficient size to house everything in the space provided and not be too cramped, to allow free movement around the trailer, but still be small enough to back into, or pull into the area where work will be done.
- 3) Trailer must be structurally sound with little to no work needed to make it structurally sound.
- 4) Trailer should be preferably enclosed such as a horse trailer or cargo trailer.
- 5) The hitch system should be a system that is compliant with all highway safety laws and work with the truck to be towing the trailer with no modifications needed.
- 6) The light system should need little to no work to be fully functional.

The author acquired a 1980's model tandem axle two-horse trailer with working brakes. The conditions of acquiring it were as simple as, it hadn't been used in a few years and the owner

would like to see it put to good use. The trailer cost nothing to acquire and there is very little work needed to make it highway legal. The repairs cost nothing to make, it was all simple wiring that was required.

The next item to find was a welder. The welder should be an engine driven model that is capable of running SMAW, GMAW, and GTAW. It should also act as a generator for running power tools such as grinders and other electric tools.

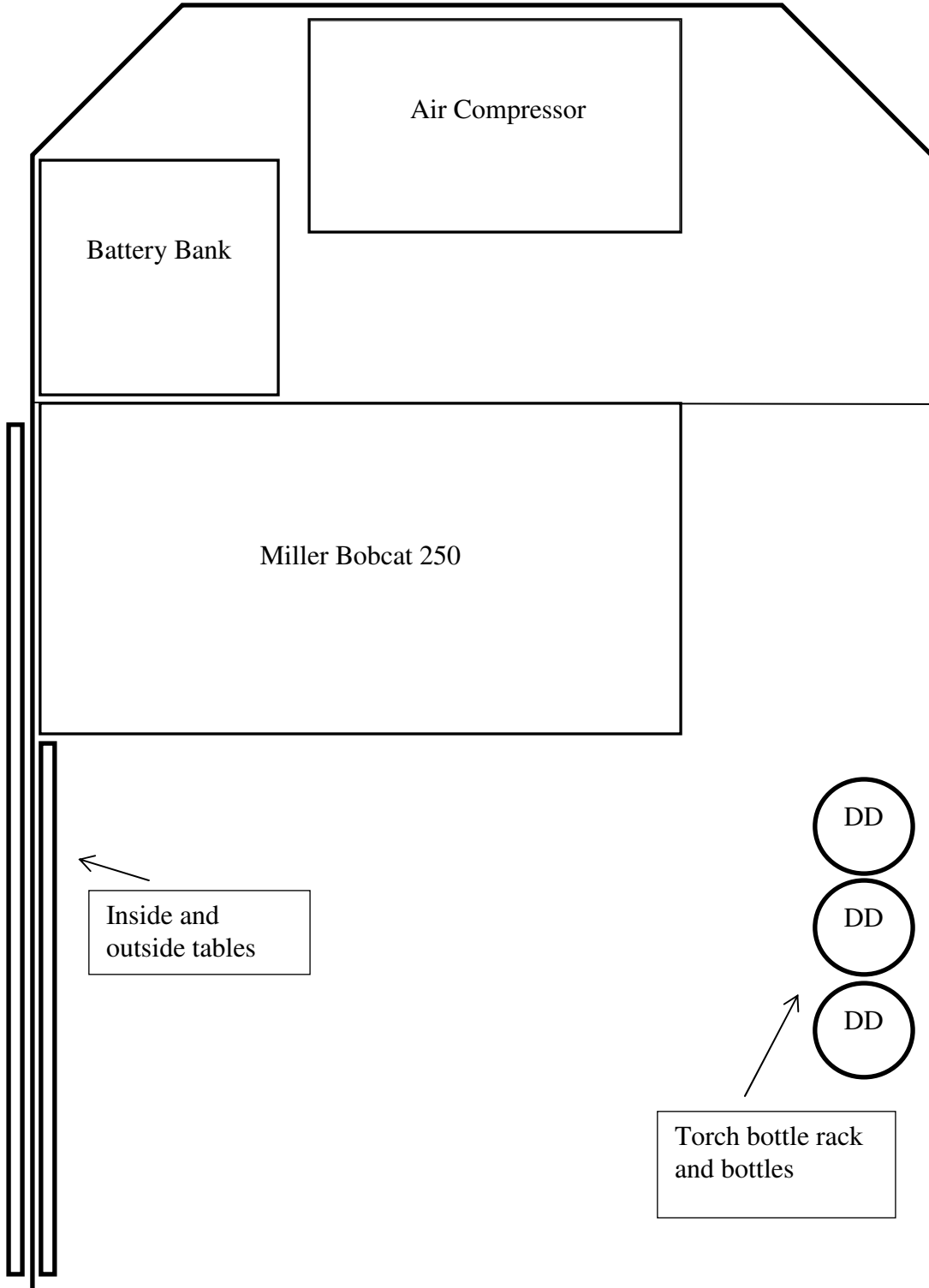
The welder the author was able to acquire was a Miller Bobcat 250. The Bobcat is capable of 11,000 watts of power in generator use and less as the need for welding power goes up. The welder and generator is the same power unit so they have to work with each other. The Bobcat is capable of welding SMAW with no special adapters or anything needed just two welding cables. To use the GMAW and GTAW an adapter unit is required for each, a wire spool feeder for the GMAW and a gas shielding set-up, and a foot pedal control and gas shielding set-up for the GTAW. The welder with cables and some welding rod cost about \$1900 from a Shane Myhre of Modesto, CA.

Creating a Fully Self-Contained, Enclosed, Mobile Welding Trailer

After finding a welder and a trailer, work could begin on making the trailer into a welding trailer (see Figure 1). The first thing that was done was to replace the floor. From years of use as a horse trailer the floor was pretty rotten. The old floor was pulled out and re-done with plywood so there are no cracks or seams for welding slag to get caught in. The floor will be sheeted in thin gauge sheet metal in the future when more funds are available. The rear doors were just half doors from when it was a horse trailer. The author used 10 gauge sheet metal to cover the top half of the doors and used some 3/4" angle to make a frame to support the sheet metal. The sheet metal overlaps over the center divider post and there will be a ring welded to

the center post to pass through the two doors and will be used to lock the doors closed for security.

Figure 1:



The openings in the trailer on the sides for ventilation were closed up with expanded metal, to allow for air flow but to keep the trailer secure. The front windows over the mangers had plexi-glass in place but it was cracked and disintegrating so it was replaced with new clear plexi-glass to seal up the windows. The mangers will be used as storage for miscellaneous things such as welding rod, tools and extension cords. The lower storage area under the mangers holds the battery bank, air compressor, and other miscellaneous stuff.

Inside the trailer there is a drop down table for small projects on one wall, as well as a torch bottle set up and some hangers for cables and hoses. The torch bottles are mounted in a way that satisfies all of the federal regulations regarding the transport of compressed gas cylinders. Federal regulations state that there must be three points of contact on a compressed gas cylinder when it is transported, one below the cylinder, and two around it. The bottles in the trailer are sitting on the floor, which satisfies the below the bottle support, and there are two straps that are tightened around the bottles evenly spaced along the height of the cylinders. The rack the bottles are tightened into was made from 6 inch tall pieces of 4" C-channel to prevent the bottles from rolling along the wall. The pieces of C-channel are placed two per bottle, in line with the straps. The cylinder rack is set up to hold the two torch bottles, and a compressed welding gas bottle. The compressed welding gas bottle is not in the trailer at this time because the welder is not set up for gas-shielded welding processes yet. The author planned for the gas-shielded processes knowing in the future the need for it would be there.

The welder is mounted on a rack in the trailer to pick the height up to make servicing the engine easier and using the controls on front easier as well. The rack is solidly mounted to both the frame of the trailer as well as the interior walls and frame. The rack is made from 1 1/2" by 1/8" wall thickness square tubing. The exhaust from the welder is run straight up and out of the

trailer through a small exhaust stack on the roof. The stack has a flapper top to keep rain out when the trailer is not in use. There are lights set up inside the trailer run in parallel circuits for either 110v or 12v so when the generator is running the trailer is supplied on the 110v system and when it is not running the lights can use the 12v from the battery bank in the trailer. There are lights outside as well to allow for light to work at night if needed. The 12v lights for the trailer, (four of them) cost \$30 for all four of them. The light used inside on the 110v circuit is an old fluorescent tube fixture that was donated by Jesse Sprister from Drive Customs in San Luis Obispo.

On the outside of the trailer there is a drop down table similar to the one inside. The outside table is three feet long and 18" deep. There is a piece of 2" angle steel welded to the outside edge of the table to hold pipe form rolling for cutting or welding. The outside of the trailer also has one 110v flood light on each side of the trailer that can be angled to a work area as well as a 12v flood light that can be angled to a work area. All of the lights and the table are all securely mounted as to not fall off when transporting the trailer from job site to job site.

Chapter 4

Results and Discussion

The author built a fully self-contained, enclosed, mobile welding trailer for Alvarado Land and Cattle. The author wanted a mobile welding unit to expand his business to bridge the financial gap between crop seasons. The mobile welding unit is designed to be an all in one welding facility that can be transported from one job location to the next. The added income will help the company to ensure a stable financial future.



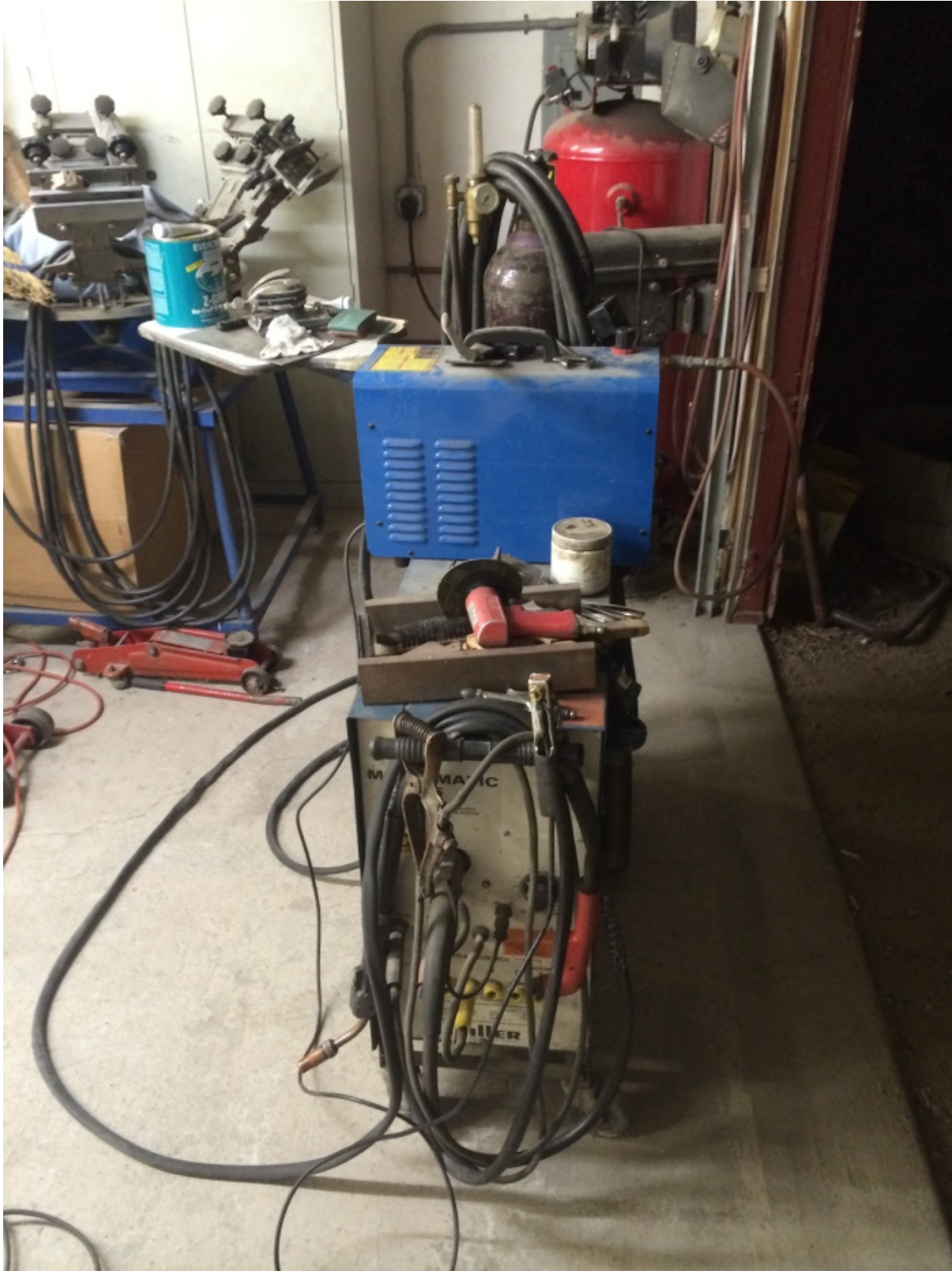
The welder the author located for the fully self contained, enclosed, mobile welding trailer. The welder is going to be lifted into the trailer with an engine crane due to the weight.



1980's two-horse tandem axle trailer with working brakes prior to modifications.



10 Gauge sheet metal cut with a plasma torch to fill in the half doors on the trailer.



Welder and plasma torch (bright blue box) used to cut and weld the half-door sheets.



Top: Left side on, attaching bracing for right side

Middle: Attaching right side half door

Bottom: Both doors attached and completed

Chapter 5

Conclusions and Recommendations

Conclusions

This project resulted in a fully self-contained, enclosed, mobile welding trailer that fulfilled all the requirements that Alvarado Land and Cattle set forth. The trailer is fully road legal, all of the components were arranged to allow for the most space and work area, and everything is in place as requested.

Recommendations

The author thought of a few recommendations after the project was completed.

1. The trailer should have been bigger in size to allow for more space inside the trailer to move around once all of the equipment was in place.
2. It should have been taken into consideration that using an engine driven welder inside a trailer, routing the exhaust outside the trailer would result in a hot exhaust pipe running through the trailer from the welder to the outside world. This pipe should have been wrapped in a heat absorbing material and spacing grate material should have been used to keep objects from contacting it.
3. The air compressor that was chosen was too small to power all of the air tools that Alvarado Land and Cattle wanted to run. The biggest issue was with the plasma they tried to use off of the trailer power and air.

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