Box Scraper

Bill of Materials

Name of Part	Qty.	Metal	Dimensions
Mould board	1	Plate	24″x 24″x ⅜″
Back brace for mould board	1	Channel	10″x 10′
Axle brackets	4	Flat	10″x 10″x ⅜″
Wheel axle arms	2	Rec. tubing	¼″x 2″x 4″x 25″
Mould board to frame support	2	Flat	¼″x 3″x 30″
Mould board to tongue support	1	Flat	¼″x 3″x 20″
Tongue	1	Square tubing	¼″x 4″x 4″x 9′
Front frame	2	Square tubing	¼″x 4′x 4″x 58″
Tongue braces	2	Rec. tubing	¼″x 2″x 4″x 34″
Corner brace	2	Rec. tubing	¼″x 2″x 4″x 17″
Lateral brace for top link	2	Flat	½″x 3″x 18″
Cylinder bottom link	1	Flat	1″x 4″x 8½″
Transport locking bracket	2	Flat	¾″x 4″x 4″
Scoop end	2	Plate	⅜″x 24″x 32″
Reinforcement for top of mould board	2	Rec. tubing	3/16″x 1″x 2″ x 58′
Top hitch	1	Flat	1″x 4″x 12″
Bottom hitch	1	Flat	1″x 4″x 8″
Spacer for hitch	1	Square tubing	1¼″x 4″x 4″x 8″
Front cap on hitch	1	Flat	⅛″x 4″x 4″
Back cap on hitch	1	Flat	⅛″x 4″x 5″
Axle	1	Pipe	¼″x 3″x 81″
Axle sleeves and collar	5	Pipe	¼″x 3½″x 6″
Top link for cylinder	1	Flat	1″x 4″x 25″
Transport locking arm	1	Flat	1″x 4″x 5″
Transport storage pin plate	1	Flat	⅛″x 2″x 2″
Caps for wheel axle arm	2	Flat	⅛″x 2″x 4″
Tongue reinforcement	1	Square tubing	¼″x 3½″x 3½″ x 60″

The majority of the welding on this project was done using a Lincoln SP200 wire-feed welder. It was equipped with L-56 wire. I usually set the dial at 18-23 volts (coarse) and 7-8 (fine). The wire speed was usually set at about 300 inches per minute. I set the amps lower when welding thin metal to reduce the chance of burning holes. Occasionally, the wire speed was set higher when a wide bead was needed.

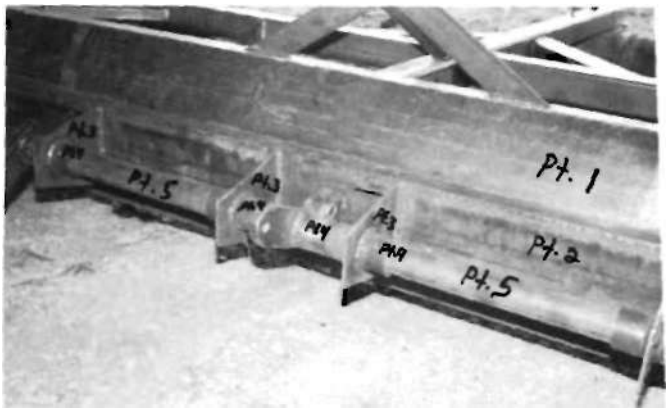
I also used a Lincoln AC-DC 250 stick welder. This was used especially where I needed a great amount of strength. For this, I used a 7018 low-hydrogen rod. The welder was set on DC + for deep penetration, while the amperage was set around 150. The amperage varied with the job. Sometimes I used a 6013 or 6011 rod when the wire-feed welder wasn't available. While using these rods, the welder was set on DC+ or AC, with the amperage set around 90.

Hitch Assembly

Start the project by cutting two pieces of 1" x 4" flat metal on the band saw. Cut one piece 8" long and the other 12" long. After cutting, tack them together with the welder while making sure that both sides and one end are flush with the other piece of metal. When they are tacked together, drill a 1-1/32" hole exactly center 1-1/2" back from the flush ends. While the metal is still tacked together, bevel the corners. Do this by measuring 1-1/4" from each corner and making a mark. After the marks are made, connect the two on each side and cut them off with the band saw. When this is finished, break the tack and set them aside. Next, cut a piece of 1/4" x 4" x 4" square tubing 12" long. Angle off one end of the tubing by measuring back 4" from one corner, and then drawing a line connecting this mark to the corner above the measuring corner. Cut this piece off with a torch and throw it away. The tubing should measure 12" on the top and 8" on the bottom. Next, cap both ends of the tubing with a piece of 1/8" x 3-1/2" x 3-1/2" flat metal. The caps should be welded flush with the inside of the tubing. After it is welded, grind both ends off smooth. After this is finished, place the 8" hitch plate on the bottom of the tubing and the 12" plate on top. Insert a \" pin through both of the hitch plate holes to keep the holes aligned. When the plates and tubing are square, tack them together with the welder. When you are sure everything is square and flush, weld the plates and tubing together. After this is welded together, take the grinder and grind the back off so it looks like one solid angle. Set the hitch aside until later.

Mould Board Construction

Start this construction by retrieving a piece of 3/8"x 24" plate 10' long. The plate should already have a 4" deflection in it, which is exactly what you need. Lay the plate down with the convex side up. Cut a piece of 10" channel iron 10' long on the band saw. Place this channel iron exactly 4" off center of the plate. Make sure the channel iron is exactly in place, and tack it in place with the welder. Cut four pieces of flat 3/8"x 10"x 10". Shape these into four 5"x 10" trapezoids to serve as axle brackets. Cut a 3-9/16" hole exactly center, 3" back from the 5" end. After this, cut five pieces of 3-1/2"x 6" pipe to serve as axle mounts and a collar. Drill a 5/16" hole 1-1/2" in from each end of the four axle mounts. Tap the holes so they will be ready later for grease serts. Set them aside and cut a piece of pipe 3"x 81" to serve as an axle. After these pieces are cut, insert the axle through the axle mounts and collar, with the collar in the center. Insert the four mounts through the holes in the axle brackets. Place the axle brackets on the channel iron. Place a bracket 24" in from each end of the channel iron. The other two brackets are placed 28" in from the first brackets. Make sure they are in place and square, and then tack them to the channel iron with the welder. Center the axle mounts in the axle brackets, and tack them to the brackets while making



sure the axle will still turn. Next, use the torch to make three incisions through the collar and the axle. Weld the incisions back together in order to connect the collar, which is exactly center on the axle, to the axle. Also, weld together the channel to the plate, the brackets to the channel, and the mounts to the brackets. While welding, alternate sides in order to prevent distortion. After finishing welding, use the grinder to grind the collar back off smooth. Then, set the mould board construction aside.

Construction of Frame

Cut two pieces of plate 3/8"x 24"x 32" with the torch. These will serve as scoop ends. After cutting them, grind all edges to give it a better appearance. Retrieve the mould board construction and place it on 4" blocks. Place the scoop ends on both ends of the mould board. Place the scoop ends with the long end on the ground, with the back flush with the ends of the channel iron. After they are in place, square them and tack them to the mould board. Cut a piece of 1/4"x 4"x 4" square tubing 9' long to serve as a tongue. Angle one end 45° by measuring and marking back 4" from the end and connecting this mark to the bottom corner. After the marks are made, cut the angle on the band saw. Cut a piece of l/8"x 3-1/2"x 3-1/2" flat metal to serve as a cap. Weld the cap on the inside of the angled end, and grind it smooth with the grinder. Cut an arc off of the other end and equal to the first four inches of the mould board. This end is to be placed against the mould board Next, retrieve the hitch construction, and place it on the tongue, with the long end of the hitch against the bottom of the angle and of the tongue. Square everything and make sure it is protruding 6" past the end of the tongue. Weld together. Center

ind square the tongue on the top of the mould board, with the hitch protruding out front. After squaring, tack the tongue to the mould board. Cut two pieces of 1 /4"x 4"x 4" square tubing 58" long to serve as the front frame. Place these pieces flush between the top of the scoop end and the tongue. After squaring it to the sides and tongue, tack it with the welder. Cut two pieces of 1 /4"x 2"x 4" rectangular tubing 17" long to serve as braces. Cut a 45° angle off each end by using the same process earlier described on the tongue. After cutting these, place the braces flush between the corners of the top of the front frame and the scoop end. When these are in place, tack them to the front frame and the scoop ends with the welder. Next, cut two pieces of 1 /4"x 2"x 4" rectangular tubing 34" in length to serve as tongue to frame braces. Cut 45° angles off of these. After the angles are cut, place them flush with the top between the tongue and the front frame. When these are in place, tack them to the tongue and front frame. Cut two pieces of 1 /2"x 4"x 30" and one piece of 1 /2"x 4"x 20" flat metal to serve as tongue to frame braces. Mark an arc on one end of the pieces, equal to the arc of deflection on the mould board. Mark the opposite ends of the 30" pieces with a 60° angle. Mark the opposite end of the 20" piece with a 30° angle. After the marks have been made, cut the metal using the torch. Grind all cuts smooth with the grinder. Place the 30" pieces between the front frame and mould board. The pieces should be exactly center between the scoop ends and the tongue. The mould board ends of the braces should be placed 5" up from the bottom of the mould board. When they are placed and squared correctly, tack them in place. The mould board end of the 20" brace should be placed in exactly the center of the mould board, 5" up from the bottom. The opposite end should be placed flush in the center of the tongue piece. When they are placed correctly and squared, tack the brace in place. Check all parts that are tacked together to make sure they are in their proper position. Weld the scoop ends to the mould board. Proceed to weld the rest of the tacked together metal. After all welding is finished, set it aside.

Wheel Assembly

Start the wheel assembly by retrieving two spindles that have been cut off of the front of a junk car. To prepare the spindles for use, do the following:

1.) Remove the brakes from the discs, if they are still on.

2.) Remove the dust cap, retainer cotter pin, spindle nut, and outer bearings.

3.) Using the torch, cut away the tie rods, tie rod arms, A-frame connectors, etc. Cut until the back of the spindle is flat. A portable grinder may be used to smooth the surface.

4.) Be sure to mark and secure all spindle parts, such as the spindle, spindle nut, bearing, seals, cotter pin, etc.

Cut two pieces of 1 /2"x 4" flat metal 5" long to serve as spindle mounts. To mount the spindles on the spindle mounts, find a perfectly level surface and a machinists' level. Place the spindle mounts on the level surface and make sure it is still level. Screw the spindle nut back on the spindle. Place the flat spindle surface on the spindle mounts, while centering them. Place the machinists' square on the spindle nut. Position the spindle until it is level in every direction. Shims may be used to make it level. After it has been perfectly leveled, tack the spindle to the spindle mount. After tacking it, re-check it to make sure it is perfectly level. This is a must. When you are sure everything is perfectly level, weld in place. Repeat the procedure on the other spindle, also. After all spindle welding is done, cut two pieces of 1 /4"x 2"x 4" rectangular tubing 25" long to serve as wheel axle arms. Cut a 3-1 /8" hole exactly center *2"* back from one end in each arm. Cap both ends of the wheel axle arm by cutting four pieces of 1 /8" x 1 -1 */2"* x 3-1 /2" flat metal. Weld these caps on the inside of the tubing. After welding, grind smooth. Place the axle arm on a perfectly level surface. Place the spindle mount and spindle on the end of the axle arm without the hole. Place the machinists' level on the spindle and make sure it is perfectly level in every direction. Shims may be needed here also to make it level. When everything is level, tack the mount to the arm. Re-check for levelness, then weld between the mount and arm. Retrieve the spindle bearings and proceed to pack them with grease. Reassemble the spindle by reversing the procedure of taking it apart. After the spindle is assembled, bolt on the wheel rim with the lug nuts. Do this to both axle arms. Retrieve a piece of 8" channel iron, any length over 7'. Place this behind the axle. Slip the wheel axle arms over the axle with the rims facing outward. Set both rims in the channel iron. This is to insure squareness. Square the wheel axle arms to the axle. Using shims, slightly raise the inside of both rims. This will provide the necessary tow-in. Measure from the rims to the frame to see if everything is fitted perfectly. When everything is in place and squared, weld the wheel axle arms to the axle. After this is done, take the rims off and take them to have tires put on and balanced.

Cylinder Assembly

Cut a piece of 1 "x 4" flat metal 25" long to serve as the cylinder mount. Measure 8" up from one end, and draw a line connecting this mark to the opposite corner on the same end. Cut this off in the band saw. This cut will give you the proper mounting angle. Next, drill a 1-1/32" hole exactly center 2" back from the straight end. Round this end by first cutting with the torch, then grinding smooth with the portable grinder. Center this on the tongue with the angled end on the tongue and the rounded end protruding 1" past the back of the mould board. Square it to the mould board, and then tack it in place. Cut two pieces of 1/2"x 12" flat metal to act as mount braces. Cut a 30° angle

from one end and a 60° angle from the other end. Place these braces on each side of the cylinder mount, centered on the piece of tubing on the back of the mould board. Square them to the tubing and the mount, and tack in place. When everything is in place, weld them together. Retrieve the cylinder and hook the stable end to the cylinder mount. Remove the plugs and fully extend the shaft. Set the scraper frame on 4" blocks. Remount the rims, with tires, on the spindles. The tires should be sitting firmly on the floor. Cut a piece of l"x 4" flat metal 8" long to serve as the cylinder arm. Cut a 1-1/32" hole exactly center 1" back from one end. Round this end by repeating the procedure described earlier. Using the torch, cut out an arc on the other end to fit over the axle collar. Hook the moving end of the cylinder to the cylinder arm. Place the arm on the collar, and square it to the collar. When it is square, weld the arm to the collar.

Transport Locking Assembly

Cut two pieces of 3/4"x 4" flat metal 4" long. Also cut a piece of 3/4"x 4" flat metal 1" long. These will serve as the transport locking bracket. Drill a 1-1/32" hole exactly center 2" back from one end of both pieces. Mark these edges by measuring back 1" both ways from both ends. Connect these marks and cut off on the band saw. Next, position the unbeveled ends with the 1" piece between them. Insert a 1" pin through both holes to keep them aligned. Square the pieces and weld them together. Cut a piece of 3/4"x 4" flat metal 4" long to serve as the transport locking arm. Drill a 1-1/32" hole exactly center 2" back from one end. Bend the edges by the same process as described earlier. Also, cut an arc to fit over the collar in the opposite end of the arm. When this is completed, connect the arm to the bracket with a 1" pin. Place the arm over the collar between the collar and channel iron, next to the cylinder arm. Square the bracket and arm to the channel iron and collar. Make sure the frame is 4" off the ground with the tires still touching the ground. When everything is in place, weld the bracket to the channel iron, and the arm to the collar. The pin should still be connecting the arm and bracket to prevenl distortion.

Cutting Edge Assembly

Use a 10' road-grater blade for the cutting edge. Use C-clamps to fasten the cutting edge to the bottom of the mould board. The cutting edge should protrude 2" past the bottom of the mould board. Make sure the cutting edge is fastened correctly and in the proper place. Use the acetylene torch to cut holes in the mould board that match those in the cutting edge. Remove the cutting edge, and grind both sides of the mould board smooth around the holes. Use two plow shear blades as side cutting edges. Plow shear blades work well since they are made of hi-carbon steel. Shaping may be required to produce the shape to fit the bottom of the side plates. This shaping can be done with the torch and the grinder. Fasten the side-cutting edges to the side plate, with 2" protruding past the bottom of the side plates. After these have been fastened with the C-clamps, cut three evenly spaced holes through both the side-cutting edge and the side plates. Use the torch to cut these holes that a 5/8" bolt will fit through. Remove the side-cutting edges, and grind both sides of the cutting edge and side plate smooth with the portable grinder.

Finishing Process

Use a wire brush to go over the entire project. This will remove any rust or oil that has accumulated.

Use a brush to apply a thick coat of primer to all bare metal parts. This primer will prevent rust and enable the paint to stick better.

Construction of a Custom Buflt Front-End Loader

(ill of Materials

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Juantity	Description
25'	3"x5"x 1/4" tube
6 sq ft	1/4" plate
3/4 sq ft	3/8" plate
4"	Pipe for bushings
4	3/4"x 6" bolts w/nuts & lockwashers
2'	1" round stock
21"	5/8" round stock
4	l/4"x 2" bolts w/nuts & lockwashers
2	l/2"x 2" bolts w/nuts & lockwashers
10"	l/4"x 1" strap
30"	l"x 1-1/2" bar stock
4	3/8" grease fittings

Arms

30'	3"x 5"x 1/4" tube
5-1/2 sq ft	1/4" plate
2-1/2'	Pipe for bushings
8"	1/2"x 4" steel plate
6	l/4"x 2" bolts w/nuts & lockwashers
3'	1" round stock
10"	l/4"xl" strap
6	3/8" grease fittings
8	3/8"x 2" bolts w/nuts & lockwashers
2'	l/8"x 1" strap

Bucket

1	5'x 10'x 1/4" plate
1'	1" round stock
2	1/4"x 2" bolts w/nuts & lockwashers
2	3/8" grease fittings
1	5/8"x 3" bolt w/nut & lockwasher
10'	l/2"x4"plate
6"	2"x2"x 1/4" angle iron
1-1/2'	Pipe for bushings

Steel

55'	3"x5"x 1/4" tube
1'	5'x 10'x 1/4" plate
3'	l"x 1-1/2" bar stock
7'	1" round stock
1	l'x l'x 3/8" plate
12'	l/2"x4"plate
5'	Pipe for bushings
2'	l/4"x 1" strap
2'	l/8"x 1" strap

Hydraulics

2	2-1/2" bore x 30" stroke cylinders
2	2-1/2" bore x 24" stroke cylinders
44'	5/8" steel hydraulic tubing
39.5'	1/2" two wire rubber hose
1	Double spool valve w/float
10	1/2"-90° swivel fittings
4	1/2" - 90° rigid fittings w/flare & pipe thread

Quantity	Description
4	Tees w/flare & pipe thread
4	Quick disconnect couplers
2	3/4" to 1/2" pipe reducers
4	1/2" to 2" nipples
28	1/2" rubber hose end fittings
16	5/8" flare nuts
16	5/8" flare collars

Hardware

12	3/8"x 2" bolts w/nuts & lockwashers
1	5/8"x 3" bolt w/nut & lockwasher
12	1/4"x 2" bolts w/nuts & lockwashers
1	Chain hook
12	3/8" grease fittings
3	3/8"x 3" bolts w/nuts & lockwashers
2	l/2"x 6-1/2" bolts w/nuts & lockwashers
4	5/8" nuts & lockwashers
4	3/4"x 6" bolts w/nuts & lockwashers
2	l/2"x 2" bolts w/nuts & lockwashers
1-1/4	Gallons of paint

Construction Procedures

1.) The frame is constructed of 3"x 5" rectangular tubing with 1/4" walls. The frame consists of two halves. The procedure for one-half, is described, the other half is identical to the first. The first piece to make is the front support bracket. It bolts solid on the side, near the front of the tractor. The front end of the frame bolts to this piece. It is made of 3-1/2"x 5"x 3/8" angle iron with triangles, made of 3/8" plate, placed in the corners on each end for strength. Read step 4 before drilling any holes.

2.) The next step is to make the U-bolts which attach the rear end of the frame to the rear axle of the tractor. They are made of 5/8" rod, and they are threaded with a 5/8" - 12 die.

3.) Next, make spacers out of the 3"x 5" tubing. They will be used later in another step. Cap off both ends of the spacers with 3/16" plate.

4.) Cut the tubing into the lengths needed for the frame. The lengths are:

Part A — 4'6"
Part B — 27"
PartC — 3'1"

At one end of Part A, drill two 3/4" holes on 2-1/2" centers, 1-1/2" in from the end of the tube. These holes should also be centered width-wise on the tube. Drill into the 3" wide, side of the tube and go all the way through both sides. These holes are used to bolt the front end of the frame to the front support bracket. The front support bracket and Part A should be drilled at the same time to ensure proper alignment of the holes.

5.) Parts B and C should now be welded together at a 90 degree angle. Make two plates to reinforce this weld. Place one on each side of this joint that you have just made.

6.) The next step is to make plates for the U-bolts to attach to. These plates are welded to Part C, opposite the end that Part B is welded to.

7.) Mark off a square line, 1 *'2"* on Part B, from the top of Part C. The bottom of the spacers that you made earlier should line up with that line. Tack weld the spacer to Part B. Part A is now welded to the outside of the spacer. IMPORTANT! Be sure all joints are square. Go back and finish the welds that are not fully completed.

8.) To reinforce the previous joint, a plate must be cut and welded to the frame. The dimensions for this plate are 8-1/2"x 5"x 1/4" thick.

9.) The next pieces to make are two lift cylinder plates. They need to be cut and drilled. Later you will fit bushings into these holes. On Part B mark a square line 8" from the top of Part C. The bottom edge of these plates should line up with this line. Each plate must be welded on opposite sides of Part B, 1-1 */2"* back from the front of Part B.

10.) A stabilizer bar connects each half of the frame together. It bolts to each side of the frame at the corner of Parts B and C. It is made of l"x 1-1/2" solid stock. (Only one of these is required for the entire frame.)

11.) Two - 2"x 2"x 1/4" plates with 1/2" holes drilled in the center of them are welded to the frame at the corner of Parts B and C. These are used to bolt the stabilizer bar to the frame. Each end of the stabilizer bar should fit between two of these plates.

12.) The next pieces to make are the arm pivot plates. They must be bent and drilled. Bushings will be welded into these holes later. They are welded to the top of Part B. Mark a square line, 1" down on both sides from the top of Part B. The bottom edge of these plates should align with this line. A bead should also be run on the backside of the plates where they meet, and on the inside of the same joint.

13.) Cut and drill plates for a step. They are welded together, and then welded to the frame at the corner of Parts B and C. The step makes mounting the tractor much easier. The step should be welded to the left-hand frame.

14.) The final step in the construction of the frame is to cap off all open ends of the tubing with 1/4" plate.

The construction of the arms is as follows:

1.) There are two halves to the arms, as with the frame. The following describes the construction of one half. The arms are made of 3" x 5" x 1/4" rectangular tubing. The lengths that need to be cut are listed below:

Part A — 4'6"
Part B — 4'8"

2.) On one end of Part A, cut a 57.5 degree angle. Then on the end opposite this angle, drill a 1-9/64" hole (this may vary depending on the size of bushings you use. This hole should be centered width-wise and 1-1/2" in from the end of the tubing.

Perform this same procedure on Part B.

3.) On the topside of Part A, drill a 3/4" hole 1-1/2" in from the end of the tubing so that it is directly in line with the hole that you have drilled previously. Do this on Part B also, except drill in from the bottomside. These are access holes to grease the bushings that you will weld in later.

4.) Weld the arms together by abutting Parts A and B at the angle that you cut on the ends of each. Be sure that the arms are straight from end to end. Also, be sure to lay strong beads on this joint, since it is a critical stress area.

5.) Make bushings that weld into the holes in the arms that you drilled in Step 2. A steel tube with 3/16" walls was used. The inside diameter was 29/32". Cut two - 3" long pieces, and then drill and tap for a grease fitting on each one. Harden by quenching in oil. Weld these bushings into the holes in the arms that you drilled in Step 2.

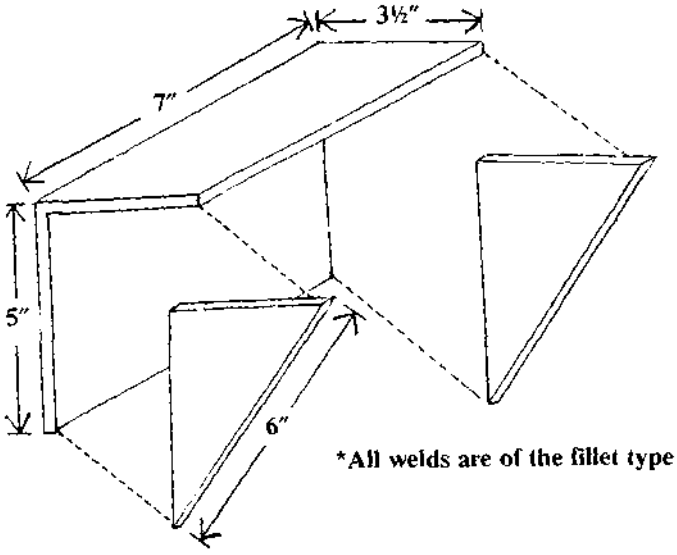
6.) Turn down pins from 1" stock to fit these bushings. Weld handles onto the ends of these pins. (Handles only need to be welded onto the arm pivot pins.)

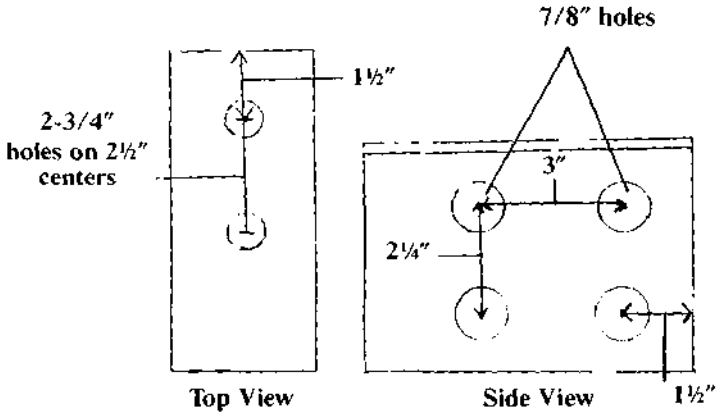
7.) These pins must not turn while the loader is in operation. To secure the pins, drill 1/4" holes through the bushings that are welded to the arm pivot plates and the bucket mount plates. Drill these holes on the inside bushings, (the bushings closest to the tractor). Drill the pins and the bushing at the same time so that the holes line up. Then use 1/4"x *2"* bolts in these holes.

8.) Once both arms are made, cut a piece of 3"x 5" tubing, 31" long, to use as a crossbrace, connecting the arms. Weld this piece to the arms. The bottom of this brace should be 19-1/2" from the end, with the bushing, of Part B on each arm. Before this crossbrace is welded to the arms, mount the frame to the tractor, and then mount the arms to the frame. This will ensure proper alignment of the arms to the frame. Make sure that the arms are parallel and level to each other, and then weld the crossbrace to the arms.

9.) Cut a piece of 1/2" thick plate, 3" wide x 4" long and weld it on the backside of Part B, 2" in from the end with the bushing. This is used as a knock plate. When the bucket is dumped, part of the bucket mounting plates hit these plates instead of the arm.

10.) Make the arm corner plates. They are made of 1/4" thick plate. Cut and drill. The holes will be used to weld bushings in later. Weld these to the arms. Leave about 1/2" of each plate sticking out above the top of the arm. This will allow enough surface area to weld to.





*Left hand side front support bracket

11.) Cut and bend two plates 3" wide x 6" long to fit over the corners of the arm, on the topside and the underside. They should fit in between the arm corner plates. Weld these into place. These plates provide added structural support for this joint.

The contruction of the bucket is as follows:

1.) Start with a 5'x 10' piece of 1/4" plate. The plate that was left over from this piece was used for other parts of the loader. Lines were drawn on the sheet of metal. Partial cuts were made along these lines, leaving the other areas uncut. A torch was used to heat the areas left uncut, and the sides and the back of the bucket were bent so that they were at a 90 degree angle. Then the remaining portion of the back of the bucket, that protruded above the sides of the bucket, was bent over to meet the top edge of the sides, thus forming the roof of the bucket. All the joints were then welded.

2.) To provide support for the top, front edge, cut a 5' long piece of l/4"x 2" angle iron to fit inside the bucket along the top edge. Then weld in so the outside corner of the angle iron is facing down.

3.) Cut a piece of 1 /2"x 4" wide plate, 5'8" long. Using a torch, cut a 45 degree angle along one edge of this piece, then smooth with a hand grinder. This piece is used as a cutting edge for the bucket. When this piece is welded to the bottom of the bucket, the cutting edge should protrude about 1-1 *IT* from the front edge of the bucket. On each end, 4" should be left sticking out past the side of the bucket. This extra amount on each end is bent up at a 90 degree angle to meet the sides of the bucket and then welded into place.

4.) Cut 3 pieces of 1 /2"x 4" plate, 21" long. These are welded to the bottom of the bucket, running from front to back. Place one on each end of the bucket and one in the middle. These are used as wear plates.

5.) Make the bucket mounting plates. When you weld these on, leave a 1/8" gap between the arm and the mounting plate on each side to allow free swiveling action. Also, make sure that the bucket is centered when it is mounted to the arms.

6.) The last step in the construction of the bucket is to make the chain hook plates. This is an optional but handy feature to have. The mounting plates are made of 1 /4"x 2" angle iron.

The attachment of hydraulic cylinders is as follows:

1.) Cut and drill the bushings and pins listed below. Remember to drill only the inside bushings and drill the pins and bushings at the same time.

Plates	No. of Bushings	Pin Size	No. of Bushing to be Drilled
Arm Pivot	4	29/32"	2
Lift Cylinder	4	1"	2
Arm Corner	8	1"	4
Bucket Mount	4 - for cylinders	1"	2
	4 - for arms	29/32"	2

Note: All pins must be cut six inches long. A total of 12 pins are needed

2.) With the frame bolted to the tractor and the arms and bucket attached, line up the cylinders, by inserting the bushings in the plate holes and the pins through the bushings and the cylinder ends. Then weld the bushings onto the plates. This process ensures proper alignment of the cylinder ends and the bushings so that the pins fit through easily.

3.) Make the control valve mounting plate. It bolts to the right hand side of the frame.

4.) For the hydraulic lines use 1 /2" I.D. steel line and 1 /2" double wire rubber hose where flexing occurs. Quick-disconnect connectors were used at the control valve so that the arms and bucket can be easily disconnected. They also prevent the loss of oil from the lines when the loader is disconnected.

5.) To attach the steel line to the arms, weld a 3/8"x 1-1/2" long stud to the arm on each side of the set of four lines in four places as shown. Then bolt on brackets. You will need four brackets placed in the locations shown.

6.) The clevis end type of hydraulic cylinders were used. As they were, there was no way to grease these ends. Bushings were cut with a 1" inside diameter, so that they fit in between the clevis on each end of each cylinder. They were drilled and tapped for a grease fitting. These bushings were then welded to the clevis.

7.) The final step in this project is to give the entire loader two coats of paint with the color of your choice.

Note: Be sure to grease all pivot points before operating.

Fan

The purpose of this stationary barn fan is to keep fresh air circulating in a stanchion barn and to help cool the barn. It was designed to move large quantities of air, but also to be compact in size.

Bill of Materials

37' of 3/16 x 1-1/2 x 1-1/2 angle iron
32' of 1/8 x 3/4 x 3/4 angle iron
1' of 1/8 x 1 band iron
32'of l/8"x 3/4 band iron
10'of 3/16 x 1-1/2 band iron
4'of 1/4 x 1-1/2 band iron
11' of 11 gauge x 1" square tubing
3'of 1/2" round rod
1/2' of 4/8" round rod
1/2'of5/8"I.D. pipe
1-1/2 sq. ft. of 1/8" thick plate
1/4 sq. ft. of 3/8" plate
3/4 sq. ft. of 1/2" plate
Bearings and Shaft
6 sq. ft. of 16 gauge blk. iron
22 sq. ft. of 28 gauge sheet metal
V-Pulley
1 - 1-1/2 h.p. motor
1 heavy duty 10' electrical cord
V-belt
bolts, washers and nuts
electrodes
wire screen
primer and paint

Barn Fan Parts

Angle Iron

4 pes. 3/16"x 1-1/2"x 1-1/2"x 43-1/2"
4 pes. 3/16"x 1-1/2"x 1-1/2"x 43-1/8"
4 pes. 3/16"x 1-1/2"x 1-1/2"x 15"
4 pes. l/8"x 3/4"x 3/4"x 43-3/4"
4 pes. l/8"x 3/4"x 3/4"x 43-1/2"

Band Iron

1 pc. 3/16"x l"x 5-3/8"
6 pes. 3/16"x 1-1/2"x 15"
3 pes. 3/16"x l-l/2"x4"
6 pes. l/4"x l-l/2"x7"
8 pes. l/8"x3/4"x42"
1 pc. l/8"x l-l/2"x8"

Square Tubing

2 pes. 11 gauge x l"x 43-1/8"
2 pes. 11 gauge x l"x 17-9/16"

Plate Steel

1 pc. l/8"x7"x 17-5/8"
1 pc. 3/8"x 4-1/2"x 5-1/2"
1 pc. l/2"x 6"x 8"

Sheet Metal

6 pes. 16 gauge x 15" long right trapezoids with 7 and 10" bases
2 pes. 28 gauge x 18"x 88-1/2"

Round Stock

1 pc. 5/8" dia. x 1" long
2 pes. 1/2" dia. x 18"
1 pc. 5/8" dia. x 1-5/8" long
1 pc. of 5/8" I.D. pipe x 1-1/2" long
1 pc. of 5/16" round stock 43-1/8" long

Pulleys

1 - 2-1/2" V-pulley with 5/8" hole
1 - 9" V-pulley with 5/8" hole
1 - 2-1/4" V-pulley with 5/8" hole and bearings

Hardware

1 set of bearings with 5/8" shaft
1 - l/2"x 69" V-belt
1 - 1-1/2 h.p. motor
1 heavy duty electrical cord
4 - 3/8"x 2" long bolts with nuts
5 - 5/16"x 1" long bolts with nuts
1 - 5/8"x 2" long bolt
5 - 5/8" washers
3 - 5/8" nuts
16 - l/8"x 1/2" long sheet metal screws
2 pes. wire screen with 1/2" holes 43"x 43"
12" spring

The first step in making a 3-1/2' diameter barn fan is to construct an angle iron frame that will measure 43-1/2"x 43-1/2"x 18" on the outside edges. To do this, cut four pieces of 3/16"x 1-1/2"x 1-1/2" angle iron to 43-1/2". Four more pieces have to be cut to 43-1/8" and have 1-1/2" cut off the same flange on each end of these four pieces.

To start the assembly of the frame, lay two pieces of the 43-1/2" angle and two pieces of the 43-1/8" angle on a flat surface in the shape of a square.

With a framing square, check the four corners of the angle iron and adjust them to 90°. Tack weld each corner in two spots.

check the corners with the framing square and then weld the rners solid on both sides of each seam to make a 43-1/2" igle iron square.

nee two of these squares are needed for the frame, repeat this rocedure with the other four pieces of angle iron that were cut.

b finish the angle iron parts of the frame, cut 4 pieces of ./16"x l-l/2"x 1-1/2" angle to 15". These are the pieces that vill connect the corners of one angle iron square to the ;orresponding corners of the other.

Hold the angle iron flush in the corners between the large angle squares with four 2' bar clamps. Check the squareness from the 15" angle to the 43-1/2" angle iron squares and adjust if necessary. When all the corners are square, tack weld the four pieces on both flanges at each end. (Four tacks on each 15" piece.) Check for squareness and then weld all the joints on both sides (inside and outside).

The next step is to make the inner braces that will support the bearings. Cut 6 pieces of 3/16"x 1-1/2" band iron to 15". Locate the center of each side on both — 43-1/2" angle iron squares (21-3/4" from the outside edge). Weld two of the pieces on these center lines on opposite sides of the frame, flush between the two 43-1/2" squares. Weld the remaining four pieces onto the other sides of the frame (2 on each opposite sides). The two pieces of band iron should be 7" apart if you measure from their center lines (each piece being 3-1/2" from the frame centerline).

Cut two pieces of 1" square tubing to 43-1/8" for vertical braces. Weld them on the center line of the band iron pieces that are 7" apart on center. There should be 6" between these two pieces of tubing, and they should be set in 6" from the back of the frame.

Cut two more pieces of 1" square tubing to 17-9/16" long for the horizontal braces. These should be welded to the single piece of band iron that is across the center of the angle iron frame to the middle of the vertical tubing. They are set 6" in from the back of the frame. To make a solid base to bolt the bearings to, cut a 6"x 8" piece out of some 1/2" plate steel. The plate should be placed between the two vertical square tubes with the top surface of the plate 1-5/8" below center of the frame so that when the bearings are bolted on, the center of the shaft is in the exact center of the frame. The plate has to be welded on perfectly horizonal so that the fan blades aren't on a slant when compared to the frame. Cut two pieces of 3/16"x 1-1/2" band iron to 4" long. Grind the ends to 45° angles and weld one on each edge of the 1/2" plate down to the vertical square tubing supports.

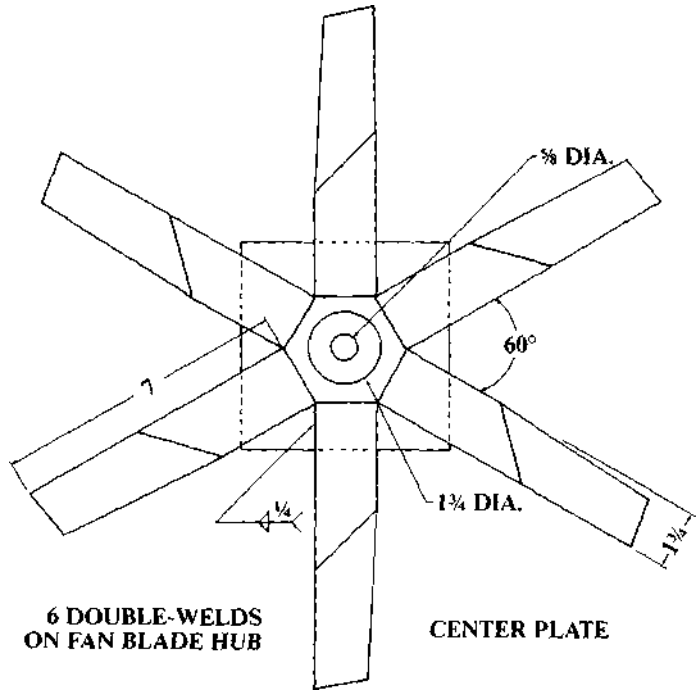
To finish the frame, cut a piece of 1/8" plate steel to 7"x 17-5/8" and weld it into the bottom right side corner (when facing the front of the fan frame), flush with the top edge of the 1-1/2" angle frame (plate will be 1-1/2" off the floor). This plate will be used for the motor mount.

Grind all the welds smooth so that when the sheet metal is put on, it can lay smooth over the frame.

The next step is to build the fan. Start by cutting a 5-1/2"x 5-1/2" square out of 3/8" plate steel. Grind the edges and check with a square to make sure each corner is exactly 90°.

With a straight edge, scribe two lines, connecting opposite corners. Where they cross is the center of the plate. Center punch at the point of intersection. Clamp the plate in a drill vise and drill a 1/4" pilot hole and then a 5/8" hole through the plate with the drill press. Cut a 1/4"x 1/4" key slot in the side of the 5/8" hole with a cutting torch.

Then cut 6 pieces of l/4"x 1-1/2" band iron to a 7" length. Scribe a center line on each piece. There also has to be two scribed lines 2" and 3-1/2" from one end. Clamp a piece in the vise with the 3-1/2" mark flush with the top of the vise jaws, the 2" mark above the jaws. With an 18" monkey wrench tightened with the bottom edge flush to the 2" mark, give the band iron a 45 clockwise twist. Clamp a tall stock block to the workbench so that the handle of the wrench butts against it when the twist is at 45°. Repeat this twisting procedure with the other five pieces of band iron. These pieces will hold the fan blades to the 5-1/2" square center plate.



Lay the center plate on a welding table and place the six twisted band iron pieces around the 5/8" center plate hole with the end that has the twist away from the hole. From the center of the 5/8" hole to the tip of each twisted piece should be 8-1/4". Using a 60° angle template made out of sheet metal, and the center lines on the twisted band iron, set each of the 6 pieces of band iron 60° on center from each other and tack each piece on both sides. After they are tacked in their exact position, weld each piece to the center plate.

The next parts that have to be made are the fan blades. Cut six pieces of 16 gauge black iron into right trapezoids 15" long with 7" and 10" bases. The four corners of each blade can be given a 1" radius to avoid having sharp corners.

Scribe a center line on each blade going lengthwise from the middle of the 10" side to the middle of the 7" side. Slightly curve each blade starting from the center line and ending at the slanted edge of the trapezoidal blade. Lightly clamp each blade onto the twisted band iron pieces, with the slanted edge of each blade being the front of the fan. Line up the center line of the

twisted band iron to the center line of the blade. From the center of the 5/8" hole to the end of the blade should be 21". Do this to all the blades, then tack weld them in place. When welding the 16 gauge to the 1/4" band iron, be careful not to burn through the sheet metal. Concentrate the arc on the thicker plate, and weave onto the 16 gauge blade.

Mount the 9-inch V-pulley onto the 12" long shaft with two bearings, 7" apart from each other. Set the shaft onto the 1/2" plate. Lift the fan onto the shaft and turn it until the key and keyway meet. Slide the fan back and lock it onto the shaft key and fasten it solid with the factory shaft washer and two 5/8" right-handed nuts.

Place the shaft in the middle of the 1/2" plate. The pulley should be parallel and set in 1" from the back side of the frame. Slowly spin the fan to make sure the blades clear all the frame parts. When this is done, center punch the 1/2" plate inside the two holes in each bearing. Use a hand drill to drill the four 3/8" holes and then bolt the shaft/bearings assembly into place with four 3/8"x 2" bolts.

To balance the fan, slowly spin it (so it spins about two turns) and let it coast to a stop. Make sure there aren't any drafts in the shop. If a certain blade stops on the bottom (or rocks back and forth before stopping on the bottom) more than twice in a row, that means that the blade is slightly heavier than its opposite blade. On the opposite blades lightly weld 1-1/2" long beads on the back of the 1/4" thick twisted band iron to counterbalance the heavier blade. Keep adding beads until the fan stops in a different spot when slowly spun. Repeat this procedure until the fan stops in a different spot every time. On this fan, a total of seven beads were welded on the backs of three different blades.

The 2-1/2" V-pulley is also tightened onto the 5/8" motor shaft.

Place the motor (1-1/2 h.p. with 2-1/2" V-pulley on shaft) on the motor mount plate so that the pulley is 1" from the back of the fan frame, and in line with the 9" pulley, so that the fan blades miss the motor by 1/2". Center punch where the holes should be located through the five motor base holes. Drill the five 5/16" holes and bolt the motor in place.

To make the belt tightener, bend a 3/16"x 1"x 6-3/8" piece of band iron into a U-shape to fit around the 2-1/2" pulley.

Center punch a mark on one of the flanges 1/2" from the end and 1/2" from the edge of the band iron. Drill a 1/4" pilot hole through both flanges and then a 5/8" hole for the pulley bolt. Cut a piece of l/8"x 1-1/2" band iron to 8"long. Weld one end of the band iron to the 1-7/8" side of the pulley holder so that it is 90° to the two flanges. Next, cut a piece of 5/8" inside diameter pipe 1-1/2" long. Weld this to the other end of the 6-3/8" long band iron so that the 1-1/2" length of pipe is against the 1-1/2" width of the band iron. The section of pipe will slide over a 5/8" rod that is 1-5/8" long to create a pivot point for the belt tightener. The 5/8" rod is welded on the inside of the angle iron frame, 15" from the floor, and a washer is welded onto the end of the rod to hold the belt tightener on the rod.

Drill a 3/16" hole 2" from the pulley end of the belt tightener and weld a 5/8"x 1" long round rod horizontally to the inside of the angle iron frame 6" from the top corner over the belt tightener. Hook a 12" spring from this rod to keep the proper tension on the belt.

To test run the fan, unhook the spring, put the 1/2" wide x 69" long V-belt between the flanges in the belt tightener mechanism. Then line up the 2-1/2" pulley (with the internal bearing) with the 5/8" holes in the flanges and bolt the pulley into place with a 5/8"x 2" long bolt. Put the belt onto the motor pulley and the fan pulley and rehook the spring to engage the belt tightener. In a cleared area (preferably outside), run the fan and check for any vibration or problems with the motor.

Cut two 43"x 43" pieces of 1/2" hole screen to serve as a safety device on the front and back of the fan.

Cut eight pieces of l/8"x 3/4" band iron to 42". Lay the fan on its front side and set the wire screen into the inside of the angle iron frame. Lay four pieces of the band iron along the edges of the screen. Pinch the screen between the frame and the band iron. Weld 1/2" long beads every six inches weaving from the frame to the band iron. Repeat this process for the screen on the back.

Weld a 5/16"x 43-1/8" rod in the center of the back of the fan that extends from the inside of the top of the frame to the inside of the bottom of the frame. This rod keeps the screen from rubbing the 9" pulley. (When the fan is running, the vacuum created will pull the back screen towards the pulley and belt.)

Carrying handles are made out of two pieces of 1/2"x 18" long round rod. Heat with an acetylene torch 2-1/2" from both ends and bend to 90°. Weld each handle onto the 3/16"x 1-1/2" band iron that is holding the horizontal pieces of 1" tubing.

Cut two pieces of 28 gauge galvanized sheet metal to 18"x 88-1/2". Scribe two lines on each piece 3/4" from each end (across the 18" width). Scribe another line across the 44-1/4". Then lay out a 1" wide by 14" slot that is 21-1/4" from one end of the sheet metal on both pieces. The 14" slot should be centered in the 18" width. Then, on one piece, lay out a 7" square which has a center point 7" in from one side and 39-3/4" from the same end that the 14" slot was measured from. Cut out this square for the motor's electrical box and cut out the slot on both pieces of sheet metal for the handles. Bend the three scribed lines to 90° (all in the same direction) on both sheets. Each piece will cover two sides of the fan. At opposite corners the two sheets will meet, and one will overlap with the other.

The final step in assembling the fan is to make two trim irons that will hold the sheet metal in place.

These trim irons are made out of 1/8"x 3/4"x 3/4" angle iron. Four pieces are 43-1/2" long and four are 43-3/4" long. The 43-3/4" long pieces had 3/4" cut off both ends of one flange to allow a flush joint. They are pressed on to hold the sheet metal in place. If the belt has to be changed or bearings greased, these trim irons can be removed and the sheet metal opened up for easy access without the need of tools. The motor's electrical box can be reached from the outside of the fan.

With the motor taken out, the sheet metal taken off, and the screens masked, the fan can be cleaned, primed, and spray painted.

RT.O. Driven Buzz Saw

Bill of Materials

Material	Amount
3″x 3″x 1/4″ angle	40′
2″x 2″x 1/4″ angle	16′
2″x 8″x 1/4″ channel	4′
2″x 1/8″ flat	5′
3″x 1/8″ flat	3′
1″x 1″x .063″	2′
2″x 2″x .250″	16′
2″ cold roll	48″
14 gauge	1 sheet
1/2″x 1/2″x 1/8″ angle	5′
1/2″x 3″ flat	2′
3/8″ bolts and washers	10
Right angle gear box	1
Hitch pins	4
36″ Blade	1

This P.TO. Driven Buzz Saw is equipped with a 36" diameter blade which allows the operator to cut a 15" log without turning the material. It is designed to be carried on a tractor with the 3 point hook up. Built from the ground up on a rugged steel frame, this unit is designed to stand up to heavy duty use.

Construction of Main Frame

The first step of construction consisted of cutting six pieces of 3"x 3"x 1/4" angle iron 46 inches long. Cut a 60 degree angle on one end of each piece and a 30 degree angle on the other end of each piece. These will form the "A" frame structure which will serve as the main frame of the cutting unit. Then cut two pieces of 3"x 3"x 1/4" angle iron 39 inches long.

Connect two of the 46" pieces at the 30 degree end to form a "V". Tack the pieces together and form one more so there is a left and a right side. Put another 46" piece at the bottom overlapping the two angled pieces. This will form the bottom or base of the main frame. Be sure to make both sides the same and tack weld. Using a cutting torch cut the overlapping edge of the bottom angle iron pieces so that they are flush with the 46" pieces headed upward.

Once the two sides of the main frame are equally matched put the 39" pieces in the corners of the angled sides. Tack these two pieces so that the two sides are joined and make up the main frame. After checking to see that all pieces are square, the main frame structure can be welded.

Three Point Hook Up

The three point hook up is constructed with 2"x 2"x .250" square tubing and 1/2"x 4" flat iron. Using the 2"x 2"x .250" tubing, cut one piece 38-1/2" long. Mount it to the main frame at 11" from the top. Cut a piece 14" long, a piece 20" long, and cut a 45 degree angle on one end of each piece. Put the 45 degree ends together squarely and tack. Place this under the 38-1/2" piece, square it, and tack weld it to the bar and main frame. Do the same procedure to form the other side of the three point hook up.

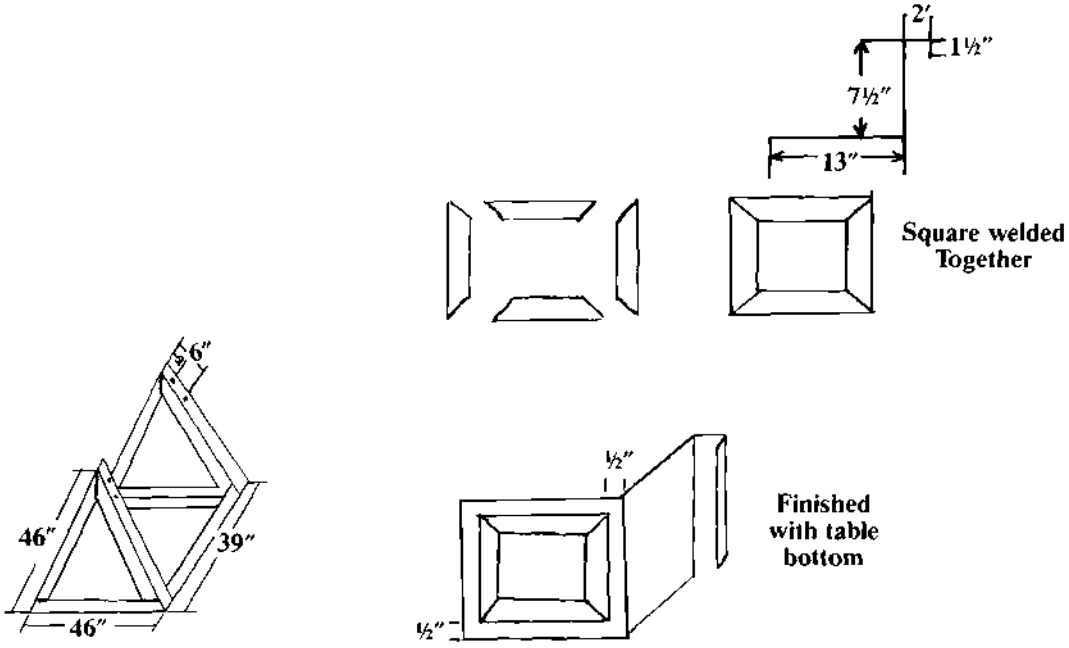
Next, cut four pieces of 1/2"x 4" flat iron 5" long, and drill a 13/16" hole at 1-1/2" down from one end. These will be used for mounting the hook up pins. Notch these pieces so that they will fit over the 2"x 2"x .250" square tubing. Mount two of these pieces to the center of the 38-1/2" long tubing. These need to be mounted with a 2" spacing between them. These will be used to connect a tractor third arm. Of the remaining two pieces mount one on each side of the frame at 24" apart. These will be used to mount the 13/16" pins for tractor hook up. Weld entire structure.

Fabricating and Mounting Table for Gear Box

A right angle gear box must be used so that the saw can be driven from the power take off unit on a tractor. A table or base must be constructed so that the gear box can be mounted to the main frame of the saw. This table is fabricated by using 3"x 3"x 1/4" angle iron and 8" channel iron. Start by cutting two pieces of the angle iron 39" long. A 60° angle must be cut on each end of each piece so that it will fit into the main frame structure. These are mounted at 8" from the bottom of the main frame and welded.

Cut the 8" channel iron 45-1/2" long and cap both ends using 1/4"x 2" flat iron. This will allow the channel iron to mount flush with the outside edges of the 39" long angle irons. Center the channel iron on the angle iron braces and weld.

In order to mount the gear box to the 8" channel base, 2 pieces of 2"x 2"x 1/4" angle cut 10" long will be needed. These need to be slotted. The slots can be formed by drilling a 3/8" hole at 3/4" from one end and 4" in from the other end. Using a soapstone, draw a line connecting the outer edges of the holes. Cut out the marked area with cutting torch and smooth out the cut edges with a double cut file. This will form a clean, straight 3/8" slot to allow for adjustment of the gear box. One piece is tacked on at 13-1/2" from the left side facing the 3 point hook up, and the other piece at 17-3/4" from the other end. These must both be mounted square with the slotted part facing



upward. Before welding, place the gear box on the slotted angle irons and check that it fits correctly. Then they can be welded.

The power take off will drive the right angle gear box, which will drive a 8" pulley, which will drive a 3" pulley mounted to the *2"* shaft turning the blade.

Mounting the Blade Shaft

The shaft is made from 2" diameter cold roll 47" long. It is threaded 2" on one end. It needs to have a 3/8" key way 8" long. This key way must start at 15-3/4" from the threaded end. The key way is for securing the 3" drive pulley.

The shaft is mounted to the main frame by using two *2"* pillow block bearings. Drill two 5/8" holes at 2" down from the top of the frame and two holes at 6" from the top of the frame. Mount one bearing flush with the end of the shaft then slide the 3" drive pulley over the key way. Then mount the other bearing so that there will be 9-1/2" of shaft beyond the bearing. This is the threaded end of the shaft at which the cutting blade will be mounted.

Belt Safety Guard

A belt safety guard must be constructed and mounted to this unit to protect the operator from danger of getting hands, feet, or clothing into the drive belts.

This guard is made with l/8"x 4" flat iron and 3/4"x #9 expanded metal. When forming this guard, the shaft, gear box, and drive belts must be in place. The flat iron is bent and formed by heating it with a torch making sure that it is in line with the pulleys. Leave at least 3/4" clearance around the belts. When the bending is complete, weld, grind, and sand the connecting joint. This piece will serve as the outer portion of the guard. Lay this piece on a piece of 3/4"x #9 expanded metal and trace around it with a soapstone marker. Cut the traced area, with a torch and weld the expanded metal to the 1/8"x 4" flat iron. The guard mounts to the frame structure using two pieces of 1/8"x 2" flat iron with 3/8" holes in them.

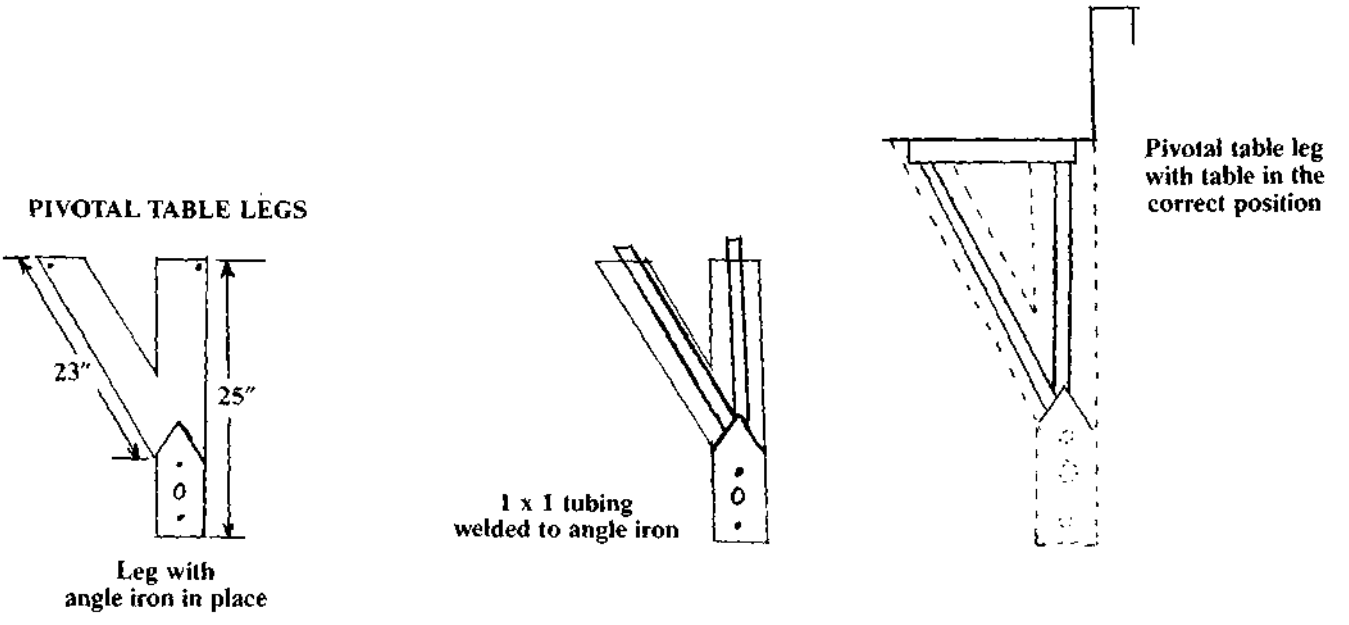
Fabricating Pivotal Table Legs **and Table Top**

The pivotal legs are made of 3"x 3"x 1*1 A"* angle iron. Cut two pieces 23" long and cut a 25° angle on one end of each. Cut two more pieces 25" long. Drill two 3/8" holes, one at 3/4" high and the other at 5-1/2" high. Drill a 1" hole between the two 3/8" holes. These holes will be used for the pivot bearings.

At this point connect the 25° pieces to the other two pieces. Weld the angled end at 5-3/4" high with the angle iron facing the same direction. When these have been joined, weld a piece of 2"x 1/4" flat 4-3/4" long at 9-1/2" from the bottom of the leg which the bearing is mounted to. Weld a 8-1/2"x 3/8" carriage bolt in the center of the flat iron at a 70° angle. After these are together, cut a 2"x 1*/2"* notch in the main frame at 22" from the bottom. File and clean cut with a grinder. These slots will accommodate the 8-1/2"x 3/8" carriage bolt, thus allowing the table to pivot inward toward the main frame.

To mount the legs to the main frame cut a 1-1/2" hole at 13" from the bottom of the main frame. Bolt on a stationary hook up pin. The legs with the bearings slip onto these pins, allowing the table to pivot. The table top mounts onto these pivotal legs.

The table on this saw consists of two components. One is 4' long and the other is 8-1/2" long. Both are 13" high with a 2" and a 1-1/2" bend. The 4' table is mounted to the legs with two pieces of 2"x 1/4" angle iron. These angle irons have a piece of 1/4" flat stock welded on the ends with a 3/8" hole drilled in them. These are the mounting brackets so the table can be mounted to the legs. The angle irons are welded to the sheet



metal table top at 1/2" from the front and 4" from one side. The other piece is mounted at 1/2" from the back and 4" from the side, and welded.

The smaller table is mounted to the legs by connecting two pieces of l"x l"x .063" square tubing to a piece of 2"x 2"x 1/4" angle iron at 5" from the bottom of the leg. Cut two pieces of 2"x 2"x 1/4" angle iron 12" long and two pieces 7-3/4" long. These will form the frame for the small table. Place the small sheet metal table on this angle iron frame and weld. Then, weld the]"x l"x .063" pieces of tubing to the angle iron on the legs. Place the framed table top on 1" tubings. Make sure the two tables are level and lined up and weld the 1" tubings to the angle iron frame.

Main Blade Guard

The main blade is built from 14 gauge sheet metal. Cut two 38" diameter circles to accommodate the 36" blade that will be used. Using a piece of 1/8"x 2" flat, bend and tack weld it to the sheet metal circles along the outer edge. When it is tacked all the way around, take the other circle and tack it to the 1/8"x 2" flat. Weld the entire structure. Then grind and sand the welds to assure a smooth, finished appearance.

Draw a line down the center of the circle and from the center draw a 30° line to the edge. Cut this portion out with a torch. This opening will allow mounting the guard over the blade. The guard must be reinforced using l/2"x l/2"x 1/8" angle iron.

To mount the guard to the frame, cut two pieces of l"x l"x .063" tubing. Cut one 8" long with a 60° angle at each end. Weld this piece onto a piece of 1/8"x 2" flat 3" long. Drill a 3/8" hole into the flat iron. These will bolt to the main frame. The other tubing is cut 6" long with a 3" piece of flat. Weld the 8" piece at 8" in from the cut edge and 14" down from the top of the guard. The 6" piece is welded at 10" below this and 6" from the curved edge.

Weld two 3/8" bolts to the guard 10" from the cut edge and 8" from the curved edge. These will be used to mount the moveable guard.

Moveable Blade Guard

The moveable blade guard moves when the table pivots. This is a safety feature so that the blade is enclosed when the table is in the back position.

The guard is made from the cut out portion of the main blade guard. Use a piece of l/8"x 3" flat and the remaining pieces from the other guard. Measure up 6" and draw a line. Then measure over 6" and draw a line at a 70° angle connecting the two lines. Cut this portion out with a torch. Grind both pieces evenly. Drill a 3/8" hole at 2" from the bottom and 2" from the angled side. Using a 3/8" bolt and cutting the head off, mount it at 6" down and 9" over. Weld onto the side that will be facing the main frame. Use a piece of l/8"x 3" flat to join the two sides together to form the enclosed guard. Grind smoothly and sand. The arm that connects the guard to the table is a piece of l/4"x 1" flat 15" long with two 3/8" holes at the ends. This will allow the guard to pivot as the table moves.

Painting

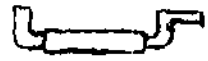
In order to prepare the unit for painting, it is necessary to remove all slag and weld particles. The entire structure must be sanded and wiped down with a metal prep solution. This will allow the paint to stick readily to the metal surfaces. A primer sealer is used to eliminate having to sand between paint coats. Paint all of the parts with three even coats of paint.

After the unit is dry all parts can be assembled, including mounting the 36" diameter blade.

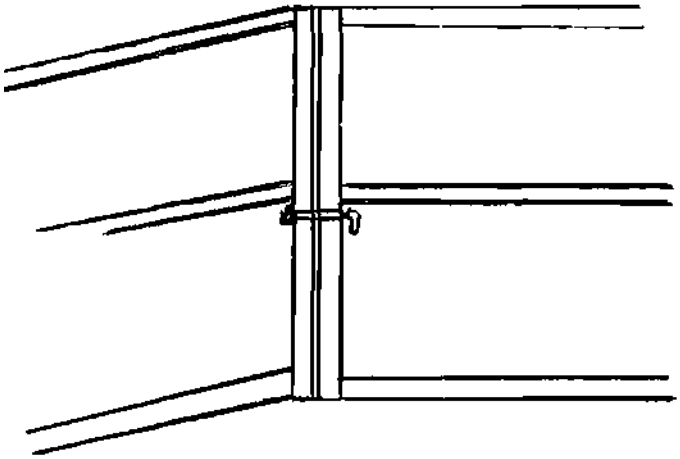
The Wheelchair Ramp

A ramp was needed to aid the physically handicapped students, participating in a therapeutic horsemanship program. The ramp would provide a way for a person confined to a wheelchair to mount a horse while the horse is standing. The ramp would save the college much needed time and money, because the horses would not have to be specially trained to lie down while being mounted.

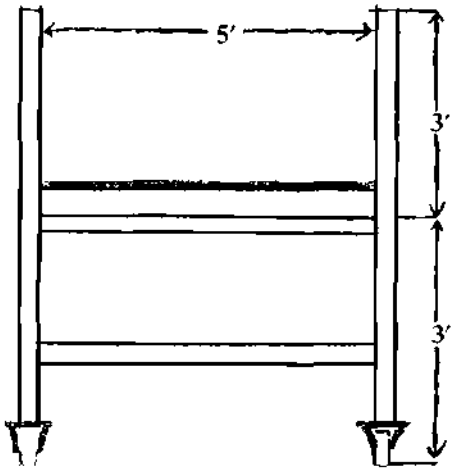
The structure consists of a 16'x 5' ramp and a 5'x 5' platform which can be connected by small latches on each side. The ramp was constructed of two parts to make it easier to move. Both the ramp and the platform have locking swivel casters so they can be rolled instead of carried. The mobility of the ramp was a necessity, because trucks would unload where the ramp was positioned.



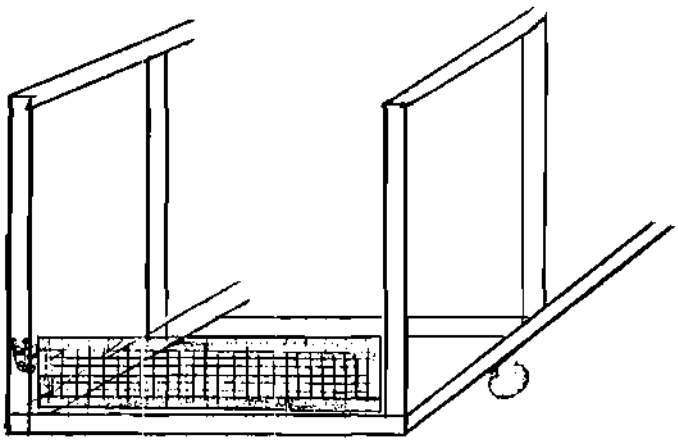
LATCH SYSTEM

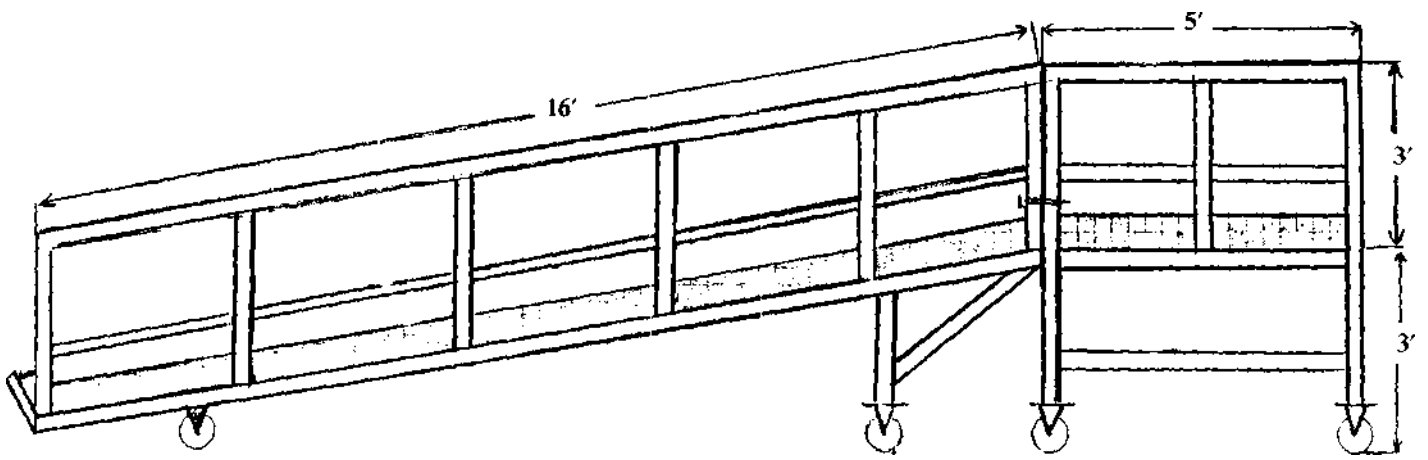


FRONT VIEW
OF PLATFORM



BACK VIEW
OF RAMP





The ramp and platform were both constructed of 1-1/2" square tubing with 1" square tubing braces in the floor and hand railing. The floor was covered with 3/4 #9 expanded metal with a 4" kick plate made of 1/8" steel running around the floor of the platform and ramp. The kick plate was a safety device to keep feet and the front of the wheelchairs from going under the hand rails. The front kick plate was designed with a 3/4" sucker rod positioned on top of it to protect the horses and riders from the sharp edge while mounting.

The ramp measures 3' in height at the front and 1" at the rear. Below this is a small ramp, made of 1" square tubing covered in expanded metal. It aids the wheelchairs in entering. It folds up to allow moving of the large ramp. The hand rails are 3' high with vertical supports every 4'. The vertical supports in the platform's hand rails are centered at 2-1 *IT*.

Hydraulically Operated Ditching Unit

This ditching unit is equipped with two 14" hydraulic rams which raise and lower the depth of the unit as well as the angle of the cut being made. It is designed to quick couple to a rubber tire tractor and to cut ditches for irrigation of various farm crops. The curved mold board easily cuts through the hardest of soils and the wings at the ends of the mold boards push the soil outward away from the ditch.

The unit is designed for safe, rugged, and efficient operation.

Bill of Materials

Quantity	Description
5'	2"x 5"x .250" tubing
4'	3"x 3"x .250" tubing
40'	2"x 2"x .250" tubing
8'	4"x 6"x .250" tubing
36"x72"	3/16" plate
7'	3/4"x 3" flat
2'	l/2"x3"flat
2'	l/2"x 4-1/2" flat
1'	l"x 2" flat
1'	l"x 4" flat
2	14" hydraulic rams
2	15' wheels
2	15" tires (9.51 x 15)
28'	1/2" hydraulic hoses
2	6' cutting blades
1	Furrow type point
2 qt.	Paint

Main Frame

The first phase is the construction of the main frame. Cut a piece of 4"x 6"x .250" tubing, 60" long. Cut one end of this piece to a convex form so to serve as the pivot end. Cap both ends of the main frame tubing with 10 gauge sheet metal. Weld with a metal inert gas welder.

The next step is to cut 2 pieces of 4"x 6"x .250" tubing, 12" long. Taper one side of each piece to where it measures 6" on one end and 4" on the other end. Weld and cap the end of the 4" side.

The next step of the main frame is to take the axle bracket mounts and weld them to the 6" side of main frame with the tapered end facing down. These mounts should be 13-1/2" from the square end of the main frame.

The next step is to cut a 4" bushing with a 2" inside diameter. Then cut a 2-1/4" hole, 1" from the convex end of the main frame.

The first phase of constructing the main frame swivel arm is to cut a piece of 3"x 3"x .250" tubing, 43" long. Cut the center pivot end concave so that it matches the main frame center pivot end. Cap both ends with 10 gauge sheet metal. Weld caps.

Cut 2 pieces of 3"x 1/2" flat, 9" long. Drill a 2" hole on one end of each plate at 3/4" from the end. Convex both ends of the flat iron. These pieces will then have to be bent so that when they are mounted to the concave end of the swivel arm it measures 4" on the center pivot end of the plate.

The final step of main frame swivel arm is to cut a hole 1" from the hitch end. Cut it 2-1/2" outside diameter. Then cut a bushing 3" long with a 2" inside diameter. Insert the bushing and weld. This bushing will be used so that the hitch can swivel up and down.

Construction of Hitch

The first phase of constructing the hitch is to cut 2 pieces of 3/4"x 3-1/2" flat, 7" long. Convex one end of each piece and drill a 2" hole on the convex end at 1-1/2" from the end. Then cut a piece of 3/4"x 3-1/2" flat, 5" long. Drill a 1-1/7" hole in the center of the flat and weld the convex piece to the 5" piece.

The back half of the swivel hitch is built the same, except that you use a piece of 3/4"x 3-1/2" flat for the back side. Then cut a piece of 1-1/2" shaft, 2-1/2" long. This shaft will be used to connect the 5" piece to the 4-1/2" piece of hitch. Cap the ends of the shaft with a bushing. Weld the bushing to the shaft. This will allow the hitch to swivel.

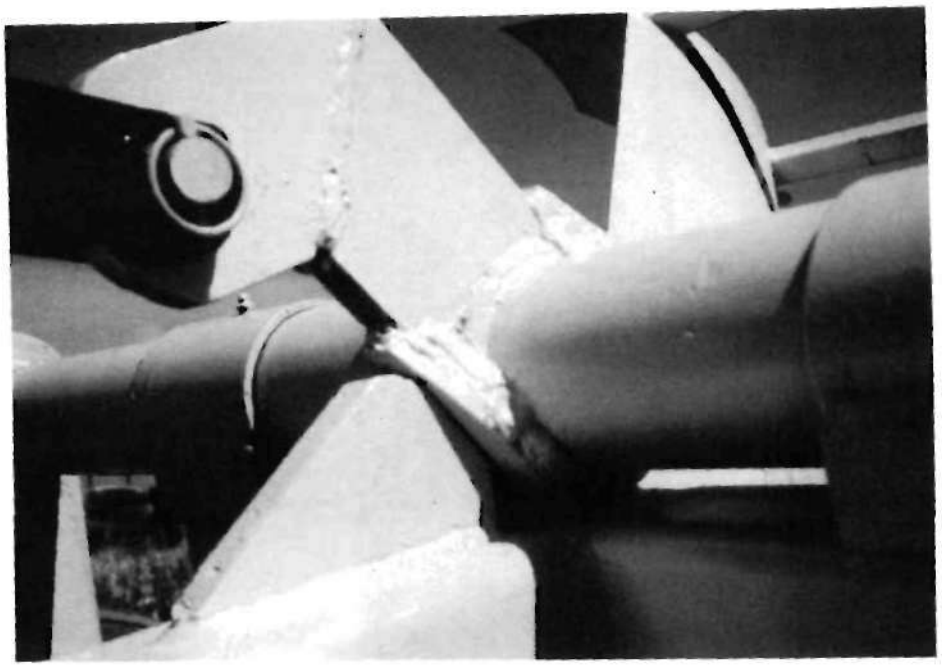
Mounting Hitch to Main Frame Swivel Arm

The first phase of mounting the hitch to the main frame swivel arm is to cut a 2" shaft, 4-1/2" long. Connect the hitch to the square end of the main frame swivel arm with the shaft. Weld the end of the shaft to the hitch. This type of hitch will allow it to act as a universal type joint for unlevel working conditions.

Construction of Axle

The first phase of construction of the axle is to cut a piece of 4" outside diameter pipe 60" long. Then cut cwo pieces of pipe *4"* inside diameter 4" long. These will be used as axle bearings.

The next step is to cut two pieces of 2"x 5"x .250" tubing, 28" long. Cap both ends with 10 gauge sheet metal and weld. Cut a hole 1" from one end of each tubing 4-1/2" in diameter. Cut it on the 5" side of the tubing. This hole will be used in mounting the axle pipe to the axle arm.



Cut a 2"x 2" square hole 1" from the bottom of the 2"x 5" tubing on the 5" side. Mount the spindle into the hole and weld.

The next phase is to cut a piece of 1 "x 4" flat, 8" long. Convex one end and drill a 1" hole, 1" from the convex end. Concave the other end so that it fits the axle pipe. Weld it to the center of the axle pipe at 57° from the axle arms going downward.

Construction of Ditcher Angle Ram Bracket Arm
The first phase of the Ditcher angle ram bracket arm is to cut two pieces of 3/4"x 3" flat, 29" long. Convex both ends of the bracket arm and drill a 2" hole, 1" from the end of one end of each arm. On the opposite ends drill a 1" hole, 1" from the end. These arms will have to be bent.

The second phase is to cut a piece of 1 "x 2" flat, 8" long. Drill a 1" hole, 1" from each end of the ram bracket. The ram bracket will be welded to the angle arm at 15-1/2" from the top of the angle arm to the center of the hole of the ram bracket.

Mounting of the Center Pivot Pin
The first phase is to cut a 2" shaft, 7" long. Drill a 1/2" hole into the center of the pin and tap it with a 1/2" tap. Weld a 1" bushing on the other end of the shaft. This pin will be used to connect the main frame, the swivel arm, and the ditcher angle bracket arms together. Use a 1/2"x 2" bolt and a 2"x 2"x 1/2" plate to hold the shaft in place.

Mounting Axle to Main Frame
The first phase of mounting the axle to the main frame is to weld a piece of 4" channel iron, 4" long, to the top of the axle bearing mounts. Weld them flush with the end of the mount. Then weld the bearing to the channel.

The second phase is to center the axle on the frame and weld a stopper on each side of each bearing. This will hold the axle in the center of the frame.

Fabrication of Vee Mold Board
The first phase of vee mold board is to cut two pieces of 3/16" sheet metal 18" x 72" then bend on a brake press to form the mold board.

The second phase of the mold board fabrication is to weld both mold boards with a metal inert gas welder at 165 amperes in a "V" shape. The end welded together must be concaved to make the proper fit.

The third phase is the mounting of the blades to the mold board. First take two blades 4"x 1/2"x 64" long and bolt them to the bottom of the mold board with 5/8"x 1-1/4" bolt. Holes must be drilled on the mold board according to the hole pattern on the blades. The blades must be flush with the wing end of the mold board.

The fourth phase is bracing the mold board. Cut two pieces of 2"x 2"x .250" tubing, 60" long, and 2 pieces of 2"x 2"x .250" tubing, 30" long. Weld one of the 60" pieces 2" from the top rear of the mold board and the other 2" from the bottom. Then weld one of the 30" pieces to the center of the mold boards 2" from the top and the other 2" from the bottom.

The fifth phase is to mount the wings on the mold boards. Cut two pieces of 3/16" sheet metal 18"x 18". Bend them to fit around the mold board. When mounting the wings they must be 75° from the mold boards.

The sixth phase is the mounting of point to the concave end of the mold board. The point is a 9" furrow listing type point. It must be mounted according to the type of the hold pattern on the point.

Mounting Mold Board to Main Frame
The first phase in mounting the mold board to the frame is to raise the rear of the mold board 3 feet off the ground. Use a 3

foot stand for support. Then mount the square end of the main frame on top of the concave end of the mold board. The top of the rear main frame should be flush with the top of the mold board.

The outermost point of the mold board must be 9" to the bottom of the main frame.

The outermost point of the mold board must be 24" to the bottom of the rear of the main frame.

The next step is to cut four pieces of 1 /2"x 6" flat, 8" long. These will be welded to the side of the main frame. Next, cut two pieces of 1 /2"x 6", 7" long. These pieces will be mounted horizontally to the mold board. The 8" braces will then be welded to the horizontal pieces.

Mounting Ram Brackets to Frames

The first phase is mounting the ram bracket to the top of the main frame swivel arm 25" from the center pivot end. Cut a piece of l"x 3" flat, 4" long. This piece will have to be shaped to allow clearance on the ram. Then drill 1" hole in center.

The second phase is mounting the ram bracket to the top of the main frame 28" from center pivot end. Cut a piece of 1 "x 3" flat, 4" long. This piece will have to be shaped like a ramp to allow enough clearance on the ram. Then drill a 1" hole in center of the ramp.

Construction of Axle Pivot Arm

The first step is to cut a piece of 2"x 2"x .250" tubing ,4-1/2 feet long. Cut two pieces of l"x 2" flat, 4" long and drill a 1" hole on one end of each piece. Then weld 4" pieces to the 2"x 2"x .250" tubing, leaving a 2-1 /2" overhang.

The second phase is to cut a piece of 1 "x 2" flat, 4" long. Drill a 1" hole on one end of the flat, then notch making the end of the 2"x 2"x .250" tubing \" so that the l"x 2" flat slides into the tubing. Then weld. Mount the axle pivot arm from the ditcher ram bracket arm to the axle.

Mounting of Tires

Mount the 3500 pound rated capacity hubs to the spindles and mount the tires to the spindles. A heavy duty implement tire is used.

Mounting of Axle Stoppers and Rams

When project is completed, hitch the implement to a tractor. Mount the rams and hoses, then lift the implement until the axle arm is square with the main frame. Weld a stopper. This will keep the implement from going too far over when the rams are operated.

Painting Ditching Unit

The first phase of painting the unit is to wire buff all rust off of the unit. Wipe clean with a metal prep solution. Then prime with gray lacquer with an air gun at 40 pounds. Then remove ram, angle ram bracket arm, point, blades and tires. Paint these gloss black. The rest of the ditching unit is painted caterpillar yellow. Allow the unit to dry and reassemble parts.

60 Foot Spray Rig

3ill of Materials

Length	Size	Description
12 ft	2 x 4 x 1/4	rectangular tube
29 ft	2 x 2 x 1/4	square tube
6 ft	4 x 5.4#	channel iron
4 sq ft	1/2"	plate
2 ft	1-1/2	round stock
5 ft	1/2 x 3	flat iron
2 ft	1-1/2	black pipe
4 ft	3/8 x 2-1/2	flat iron
2 ft	2 x 1 x 3/16	channel iron
13 sq ft	3/8	plate
48 ft	1 x .072	square tube
1 sq ft	1/4	plate
4 ft	3"	black pipe
1 ft	3 x 4.1#	channel iron

Frame Construction

The frame is constructed of 2"x 4"x 1 /4 rectangular tubing 12'2" long. The tubing was cut on a horizontal band saw. Two pieces of plate 9-l/2"x 21"x 1/2" were cut with a tracking oxygen and acetylene cutter. Two notches 2"x 4" were cut for the rectangular tubing. Two holes were drilled 2" up from bottom and *2"* from the front side, with a 1-1/8" drill bit. (Pins are 1".) Two pieces of steel plate were tacked 14-3/4" from center on both sides, to the rectangular tubing. The plate was squared to tubing with a steel framing square, then welded solid.

After tubing and plate was squared and welded solid, a 2"x 2"x 2.50 piece of square tubing was cut to 29-1/2" long. A mark was made 3-1 /2" in from the front of the plate and flush with the top of plate and the tubing was tacked into place. Measurements were checked and the parts welded solid. Two pieces of 3"x 1/2" flat by 6" long were rounded on the ends with a vertical band saw. All rough edges were ground with a stationary grinder. A center punch was used to mark a spot 1-1 /2" in from the side, and 4-1 /2" up from the bottom of the flat iron. A 1-1/8" hole was drilled at the mark. A spot was marked 1-1/2" from center on each side, and the flat iron was tacked in place, squared with the square tubing and welded solid.

Tank Mount

The tank mount was constructed of 32"x 4"x 5.4 standard channel iron. The channel was tacked to rectangular tubing, centered with 21 "x 9"x 1 /2" plate, squared with steel framing, and then welded solid. Two pieces of 2"x 2"x 1/8" angle, 31" long was squared and welded to the top of the channel iron. Two braces were cut 6-1/2"x 6-1/2"x 1/2" steel. The plate was cut in a triangular form. The plate was squared and welded to the back of the 9-1 /2"x 21 "x 1 /2" steel plate and to the top of the channel iron, for extra support.

Sheet metal was cut and formed around the tank and tacked to the angle iron to hold the tank into place when spraying or transporting sprayer. Two sheet metal straps were cut and formed around the top of the tank for extra support. The straps are bolted by 1 /4" bolts to the tank cradle.

The sprayer is designed for two separate tank placements. A tank can be placed on the sprayer or on the tractor.

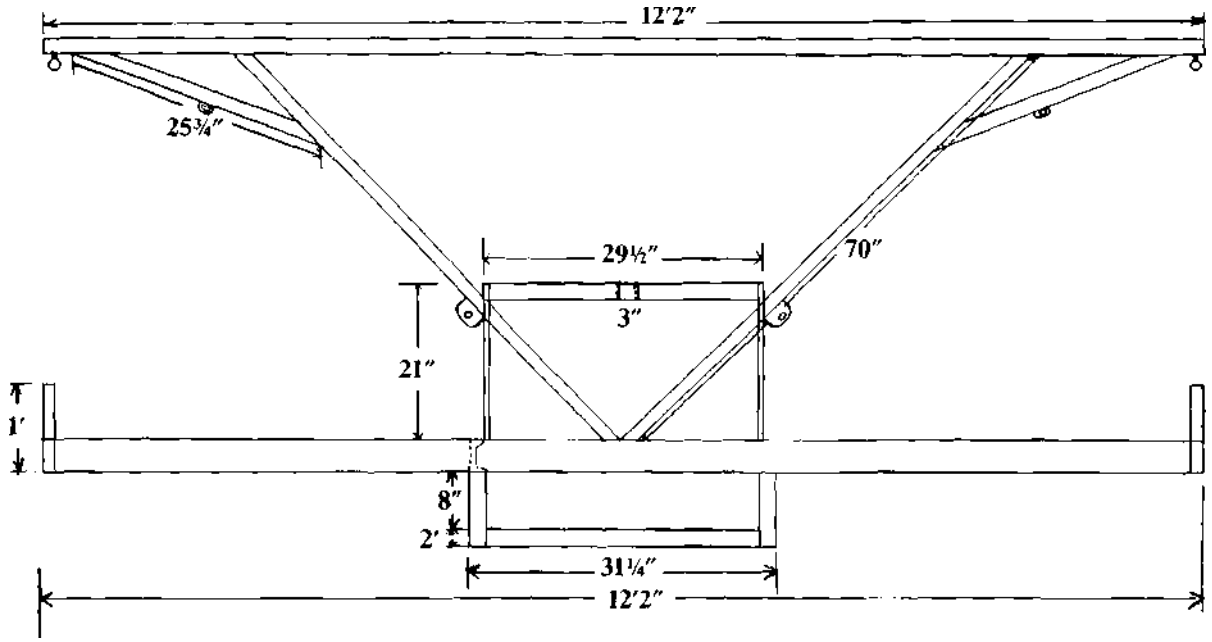
Boom Break-Away

Break-aways protect the boom and spray rig from getting bent. At the end of the frame on the sprayer are two pieces of 1-1 /2" round stock 1' long, welded to the end of tubing. For each break-away a 7"x 1-1/4" pipe was cut to fit over the round stock. A piece of 7"x 2" channel iron was centered and welded to the round pipe. Two pieces of flat iron 23"x 3-1 /2" were cut, along with 4 pieces 6"x 3-1 /2" flat iron. 49/64" holes were drilled in each end of the flat iron at 1-3/4" from the side and 2" from the end. The 6"x3-l/2 flat iron was squared and welded flush with the ends of the 23"x 3-1/2" flat iron. After this was done, this was squared and welded to the center of the channel iron.

Four pieces of 1 /2" flat iron were cut to 23"x 6". Two holes were drilled with a 49/64" drill at each end, at 3-1/2" in, from the end and 3" in, from the side of each piece. Four pieces of flat iron were cut to 6"x 3-1 /2". On one side of each piece, a 45° angle was cut so that when the boom is lifted it will not hit the 23"x 3-1 /2" flat iron. The 6"x 3-1 */I"* flat iron was squared and welded to the top, and flush with the ends of the 23"x 6" flat iron. When this was finished the flat iron with the 45° angle was faced toward the 23"x 3-1/2" flat iron, then 3/4" bolts were put through the bolt holes.

Note: all flat iron was cut with a tracking oxygen and acetylene cutter.

2' pieces of 3" steel pipe were cut with a band saw. 2-1 /2" holes were drilled 2" from center. Notches were made in 2 of the holes of the 23"x 6" flat iron on opposite sides, so that when the break-away comes back together it won't catch on the bolt. The pipe was centered to flat iron, tacked, then checked for center again, and welded solid. On the back center of the 23"x 6" flat iron, a chain link was welded. Two pieces of 6"x 3"x 4.1 # channel iron were cut with a horizontal band saw along with 2 pieces of flat iron 6"x 3"x 1/4". A 1/2 hole was drilled 1-3/4"



in from the side and *2"* down from the top of the channel iron. The flat iron is squared and welded to the end of the channel iron, so the flat iron won't interfere with the aluminum pipe sliding in the steel pipe. The channel iron was layed on the bottom side of the steel pipe, centered with the flat iron on the other end of the steel pipe. The 2 pieces of 23"x 3-1 /2"x 1 / 2" needed 2 braces on the back for extra support, the braces are 6"x 2-1 /2"x 3/8". They are centered and welded to the 23"x 3-1/2"x 1/2" and also centered to the 1-1/2" round pipe.

An eye bolt is inserted into the hole of the 6"x 3"x 1/4" flat iron. A spring is hooked to the chain link, then hooked to the eye bolt where the spring can be tightened. The spring is used to hold the booms from moving, when spraying. If the sprayer was to hit something solid, the booms would break-away, preventing damage to the booms or other parts of the sprayer. When the tractor backs up to avoid an object, the spring will pull the sprayer boom back into place.

Hydraulics

The sprayer is designed to operate on hydraulics. Four pieces of 4-l/2"x3"x l/4"andtwopiecesof6-l/2"x3"x 1/4" flat iron were cut. The two pieces of 6-1/2"x 3"x 1/4" flat iron was welded 1" from the 1-1/2" steel pipe. On the back side of the break-away the ram attachment is squared and welded. About 30" away, another ram attachment is welded to the rectangular pipe of the main frame. This ram is used to move the boom up close to the tractor and back out to the side of the sprayer. Then two other ram attachments are squared and welded to the boom braces, down flush against the 21 "x 9-1/2"x 1/2" steel plate. The ram is attached to the ram attachment, on one end of the two hydraulic rams that run along the boom braces. The cable runs through a pulley then hooks to a chain link about 41" away from the hydraulic attachment. These hydraulic rams raise and lower the booms.

Booms

The booms are constructed of two pieces of 24' aluminum pipe with a wall thickness of 1.88", the aluminum pipe has outside diameter of 3". The pipe of the break-away into which the aluminum pipe is inserted has an inside diameter measurement of 3.046". The aluminum pipe and the break-away pipe fit snug inside to reduce movement. The aluminum pipe is held in the break-away pipe by 2-3/4" bolts. The break-away pipe is centered and measured 1" out from each side of center. The hole was drilled with a 1 /2" drill bit.

The booms have a l"x 1" square tubing, that runs along the aluminum pipe, and along the bottom of the tank carry, which runs 3-1 */2"* away from the rectangular pipe of the main frame. The square tubing is 3-1/2" from the aluminum pipe on the back side. The square tubing attaches to the aluminum by clamps welded to the square tubing. Ten sets of clamps, five sets per boom, were used. The clamps are held to the aluminum pipe by 2-9/16" bolts per clamp. The clamps are 52-1 /2" apart.

The l"x 1" square tubing is used to carry to sprayer hoses.

The booms are braced by cables that run from a brace welded to the main frame. The cable holds the booms in four places. The cable runs from the brace that is mounted on the main frame. A 2"x 2" notch was cut out of the tops of the 21 "x 9-1/2"x 1/2" steel plate. Two pieces of 2"x 2"x 1/4" square tubing 70" long had the ends cut at a 45 degree angle. One piece of 2"x 2"x 1 /4" square tubing 12'2" long was cut with a 14" abrasive wheel cutter. The 70" pieces run from the center of the rectangular tubing of the main frame and out through the notches of the plate. The tubing was tacked to the rectangular tubing and to the plate. The 12'2" tubing was placed on the tops of the 70" tubing. When everything was squared, it was welded solid. The ends of two pieces of 2"x 2"x 1/4" square tubing 25-3/4" long were cut at angles with the vertical band saw to fit the angles running from the 70" tubing to the 12'2" tubing, held in place by C clamps, then welded solid.

A permanent stand on the sprayer lifts the sprayer off the ground, to make it easier to hook the tractor up to the sprayer. The stand is made up of 2" square tubing. Four legs 10" long are squared and welded to the bottom of the tank. The legs are 27-3/4" away from each other, two 29-1 /4" pieces are welded to the bottom of the legs.

Ginseng Seed Shaker

Bill of Materials

Material	Quantity
1-1/2 x 1-1/2 x 45″ Angle	2
1-1/2 x 1-1/2 x 60″ Angle	2
1-1/2 x 1-1/2 x 30″ Angle	1
2 x 2 x 30″ Angle	1
1 x 1 x 30″ Square	2
1 x 1 x 20″ Angle	2
1 x 1 x 9″ Angle	2
1/8 x 4 x 4 Plate	4
3/8 x 5 x 5 Plate	2
1/8 x 5 x 10 Plate	1
7 x 14.5′ 14 Gauge Sheet Metal	1
35″ x 1 Dia. Steel Shaft	1
6″ x 1-1/2 Dia. Steel Shaft	1
2-1/4 x 1-1/4 x 1/8 Pipe	8
1 x 30 x 1/8 Flat	4
15″ x 1-1/2 Pipe	2
15″ x 1 Pipe	2
12 x 12 24 Gauge Sheet Metal	1
2 x 4 Springs	4
30″ x 60″ Screen	1
1/2 Horse Motor	1
30″ Belt	1
8″ Dia. Pulley	1
1-1/2″ Dia. Pulley	1
1″ Inside Dia. Bearing	2
3/8 x 2″ Bolts	12

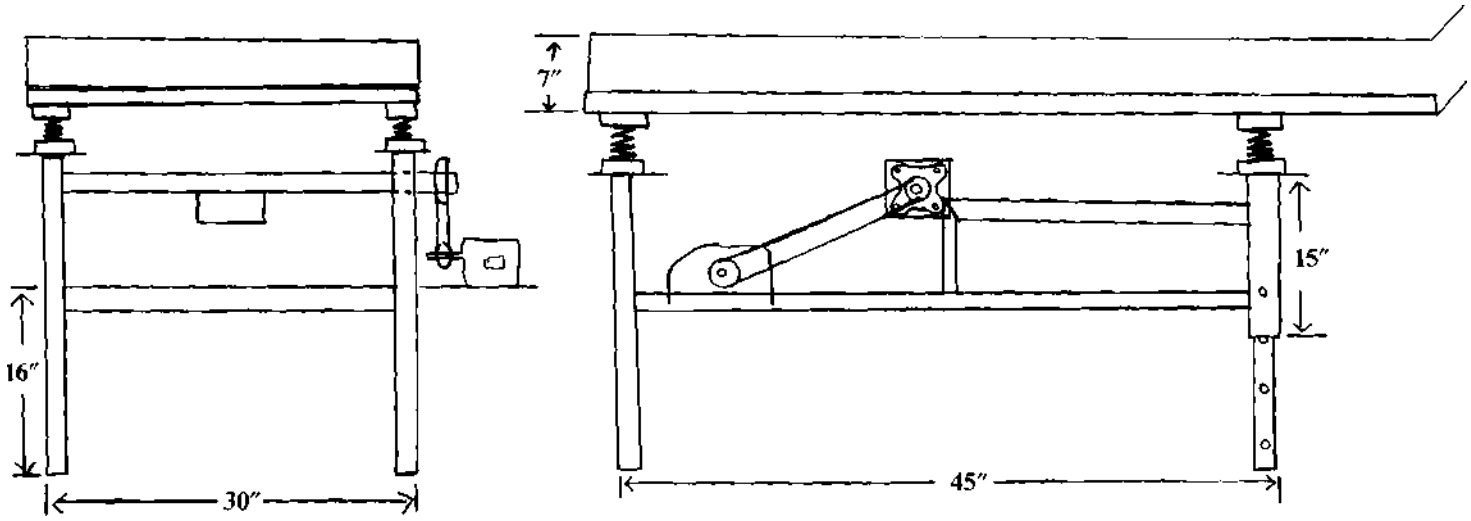
A ginseng seed shaker shifts sand from the ginseng seeds. This shaker sifts the mixed sand from seeds by vibrating down a 5 ft. screen in a box. Vibration is caused by a solid shaft welded on the side of the main shaft. This off-set feature causes an uneven motion. Four springs in the corners creates a jumping motion. The shaft is powered by a 1/2 horse electric motor which funnels the seeds into a container.

1.) Cut the metal into the proper lengths (specifications on Bill of Material). The base table is fabricated first. The back legs are 30" high and made out of l"x 3/16" square tubing. The front legs are made from 16" of 1-1/2" pipe and 14" of 1" pipe. Slipping the smaller pipe into the larger pipe makes the legs adjustable. Drill 4 holes evenly into both pipes to make numerous angles possible.

2.) The main box or table is made out of l-l/2"x l-l/2"x 3/16" angle iron. Cut the back piece of the box to a width of 30". The sides of the box are 60" long. On the front of the box, attach a I"x 3/16" flat piece of steel. With the box this size the sand will be sifted from the seeds. Make braces from the angle iron. Cut the two side braces 45" in length. Cut the back brace from 2" angle iron to support the motor.

3.) To make the frame of the box, cut angle iron at 45° angles and fit together. Square the pieces and arc weld together with a basic weave bead.

4.) Cut out and weld a 4"x 4" plate on top of each leg, making sure each plate is centered on the leg. Weld a 2" back brace in



between the back legs with the top edge of the angle iron 16" from the bottom of the leg. Weld side braces on the back leg assemblies, 16" from the bottom of the legs. Weld them on 1-1/2" pipe to allow the legs to be adjustable. Make sure the legs are straight and equal in length so the table sits level.

5.) Frames for the bearings and the shaft are made using 1-1/2" angle iron, cut into two 9" pieces and two 20" pieces. Cut one end of each piece at 45° and weld together. On the other end cut out grooves for a better fit and to give stronger welds. On one end, cut out a round groove to fit the front leg, which is made of round pipe. On the bottom of the 9" piece, a square groove is cut to fit the angle iron.

6.) The shaft consists of one 35" piece of \" solid steel. A 6" piece of solid 2" steel welded on the side of the 1" shaft at the center will create the vibration.

Shaft assembly: After completing the bearing frames two 5"x 5"x 3/8" pieces of flat steel are needed (one for each side). These pieces are welded on the corners where the 45° angles were cut. These are plates which the bearings will be bolted to. Line up the bearing holes with the plate. Mark each hole and drill it out with a 3/8" drill bit. Bolt down the bearing. Mark the main bearing hole on the plate making it a little bigger than the original \" bearing hole. Cut this hole out with a oxy-acetylene torch. File any rough edges. Weld one plate on each bearing frame, carefully keep the plate straight so the bearing and the shaft do not become twisted.

7.) After completing the bearing and shaft assembly the main table is fabricated. Under the table on top of the legs a 2"x 4" spring is placed. The springs sit in a 2-1/4" pipe, 1-1/4" in length. Use eight of these pieces, (two for each corner, one mounted on the plate on the leg, one welded to the bottom of the table).

To the table weld three 29-1/2" cross pieces, cut from l"x 3/16" flat steel similar to the front piece. These cross pieces support the screen in the table when the sand and the seed are poured in. The screen is 30"x 60" and is laid inside the table. On the sides against the angle iron 14 gauge sheet metal stands 7" high. Bend this sheet metal to fit inside the table with 12" hanging over the front. Bend with a slight angle so it will funnel the seeds into a container. Weld the sheet metal to the angle iron sides. Inside the sheet metal place one inch strips of wood around the table. Drill 3/8" holes in the wood strips, bolt down to keep the screen tight.

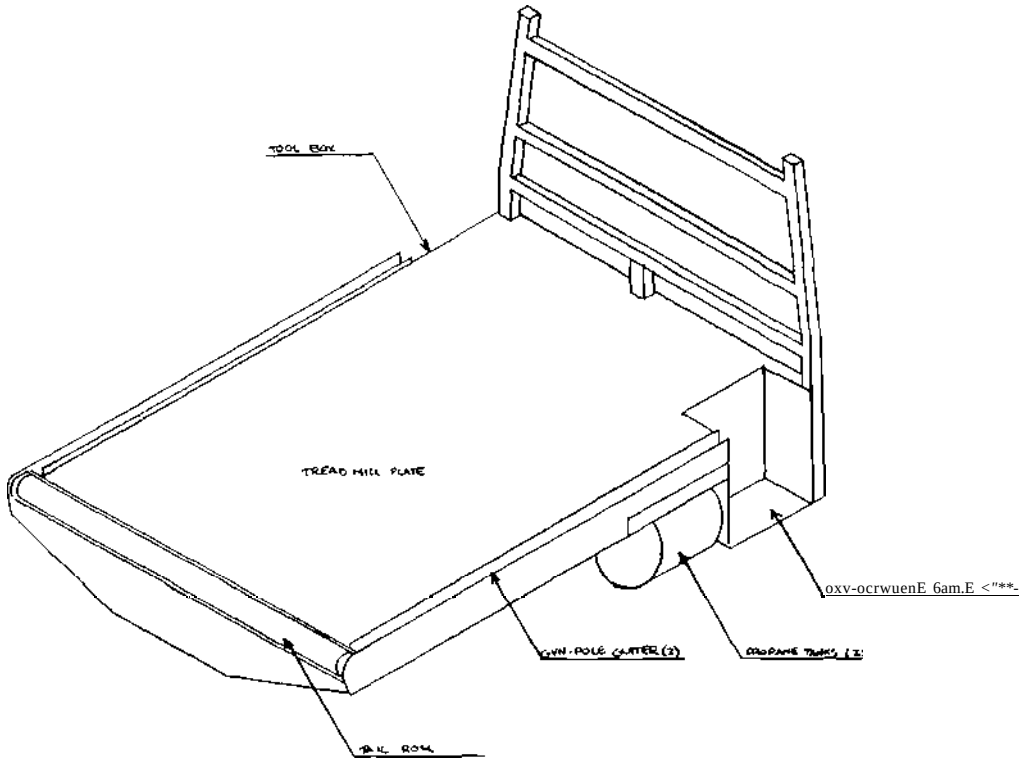
8.) Mount a l/8"x 5"x 10" piece of flat steel onto the back right leg with two 5/16" bolts. Cut slotted holes in the plate to mount the motor. With slots in the plate, the motor can be adjusted to tighten the belts. Place a 1/2 horse electric motor on the plate and mount pulleys on the shaft of the seed shaker and motor shaft. Place a 1-1/2" pulley on the motor and a 8" pulley on the shaker. Place a 30" belt on the motor and tighten down the bracket bolts. (These dimensions may vary according to the size and shape of the motor.)

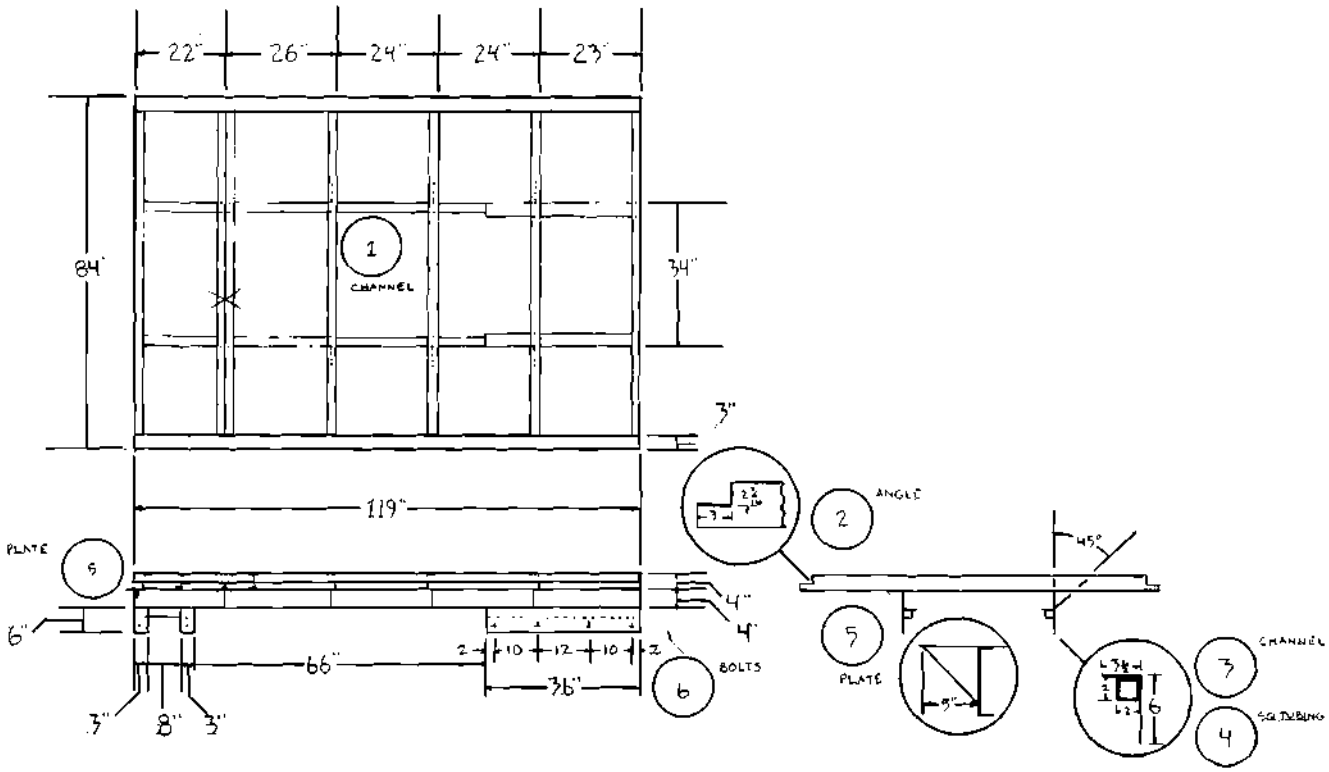
9.) By now the shaker should be in working order. For safety, place a shield around the motor and the shafts, Use 24 gauge sheet metal and spot weld. This shield will also help keep sand from building up around the motor.

To give the seed shaker a neat appearance it can be painted.

Flat Bed Truck

Before any welding was started, all gas tanks and gas lines were removed from the truck. When this was completed the first step was to weld a 2 x 2 x .250 tubing onto the bottom of the 6 x 3-1 /2 x 5/16 angle. This assembly was then bolted onto the truck frame with 12-1 /2 x 2 bolts. At this point the 4" channel was welded on top of the angle to form the base for the bed. The channel was welded with a 3-6 pitch on both sides of the channel. All welding was done on the angle, none on the frame of the truck to minimize distortion of the frame. At this point, more 4" channel was welded at right angles to the bottom channel pieces. At the front and back of the bed, a 4" I beam was welded in place to allow for the application of a winch and poles at a later time. One-quarter inch plate gussets were also welded solid under the 4" channel to add to the strength and rigidity of the bed. With all of the channel welded in place, the next step was to notch the channel and weld in the 2-3/16 x 3-3/16 x 1 /4 angle iron. The angle added increased rigidity to the bed and also provided a place where winch poles could be situated. With the frame of the bed completed, the next step was to place the 3/8 diamond plate on the top and the sides. This plate was purchased in a large sheet and cut to the proper size using an automatic track torch. It was then welded in place. With the bed welded in place the next step was to fabricate brackets for the propane tanks and fabricate the headache rack. Two propane tanks needed to be placed on the truck, one on each side. The tanks were bolted to a bracket which was designed to fit into a sliding jig in the bed of the truck. This way the tanks can be slid in and out to ease in filling them. The headache rack was constructed of 2 x 2 x .250 tubing. The primary reason for the rack is to protect the cab of the truck and the passengers from any objects on the bed which might slide around.





Three-Point PTO Wire Winder

Author: *Rodney Stewart*
Instructor: *Paul N. Stevenson*
School: *Kansas State University*
City & State: *Manhattan, KS*

Bill of Materials
2 pieces 3 x 2 rectangular tubing 48"
1 piece 3 x 2 rectangular tubing 26"
2 pieces 3 x 2 rectangular tubing 24"
1 piece 3 x 2 rectangular tubing 22"
2 pieces 3 x 2 rectangular tubing 12"
2 pieces 3 x 2 rectangular tubing 4"
1 piece 4 x 2 rectangular tubing 4"
1/2" rod 11-1/2'
5/8" pipe 1'
1-1/2" flat iron 12'
1/2" steel plate 3" x 12"
1 car axle
2 Wheels
PTO shaft — 6"
PTO shield

1.) The first step in constructing the wire winder is to build a frame to mount the car axle and 3-point hitch. The frame is made out of 14 ga. 3"x 2" rectangular tubing. Cut all of the pieces for the frame so that there are no open joints. Cut two pieces 48" long to make the bottom of the frame. Cut a 45° angle on each end.

Two pieces 12" long are used to support the car axle. On one end cut a 45° angle and the other end a half circle for the axle to fit in. The end with the 45° angle is welded to the bottom piece of the frame.

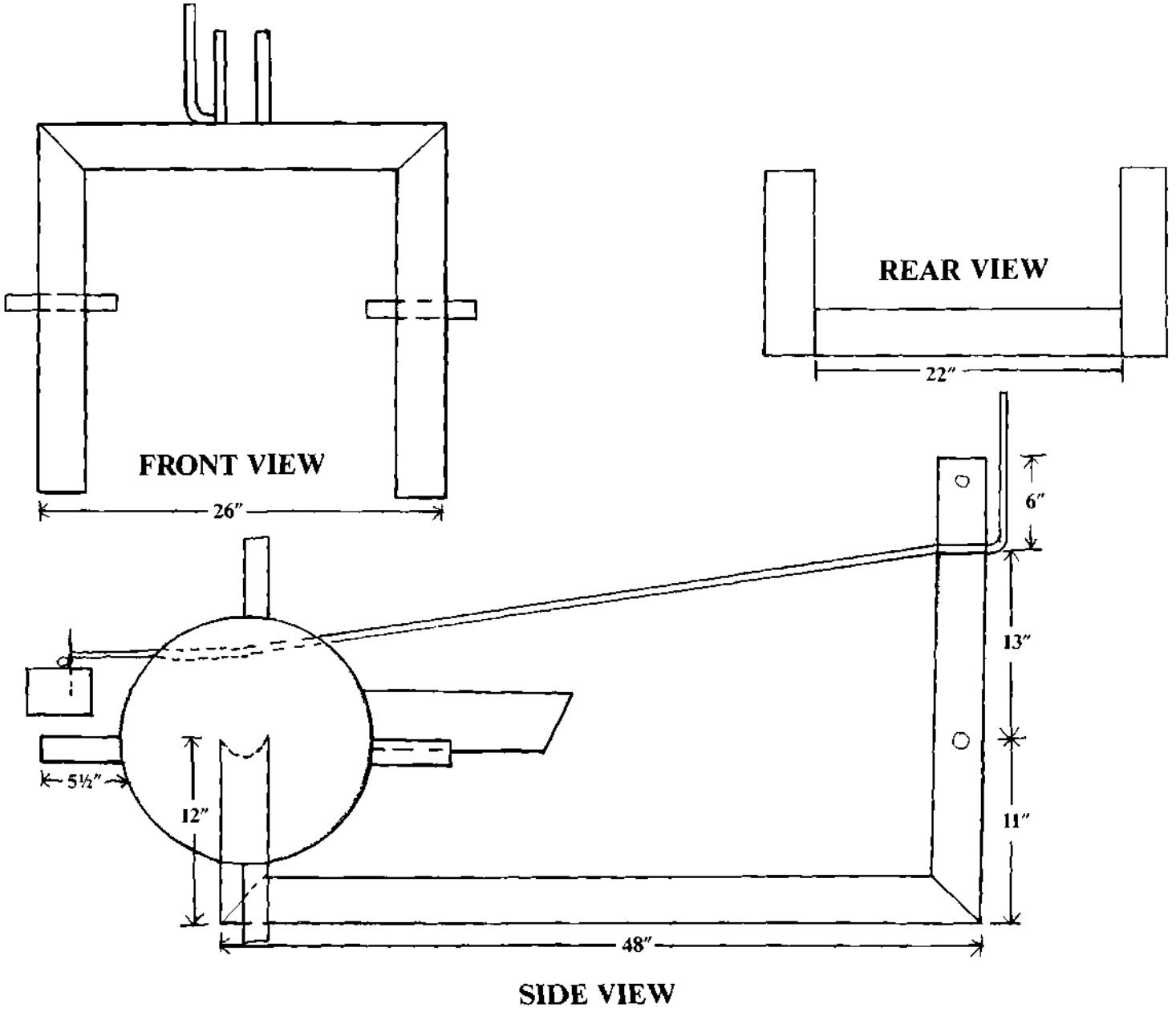
Cut two pieces 24" long and one piece 26" long to form a 3-point hitch. Cut a 45° angle on each end and weld the three pieces together. The 2-24" pieces are welded to the bottom pieces of the frame.

Cut one piece 22" long and weld it between the bottom pieces of the frame at the place that the axle supports are welded.

2.) Weld two pieces of 1 /2"x 3"x 6" steel plate to the top piece of the 3-point hitch on the frame. Place the two pieces 2-1/4" apart. Drill a 7/8" hole through them for the pin to fasten the centerlink. The two pins for the 3-point hitch were turned out on a metal lathe.

3.) Obtain an axle from a junked car. Use a cutting torch to cut off the braces, brackets, brake lines, and cables from the axle.

Clean the axle, center it on the frame, and weld.



4.) Fasten a 6" PTO stub shaft to the axle. In a 4" piece of 4"x 2" rectangular tubing drill a hole big enough for the PTO shaft. Weld the shaft to both walls of the tubing. Bolt the tubing to the U-joint on the axle. Place washers between the tubing and U-joint to make the shaft run straight. Bolt a PTO shield to the axle housing so it will cover the shaft. This shield will prevent accidents caused by PTO's.

5.) A brake on each wheel will allow winding on one wheel at a time. Locking one wheel out will keep the wire from unrolling if the wheel is full. To construct the brake, weld a small piece of flat iron to the axle and bolt another piece to it so it can pivot. Weld two pieces to the brake drum. Cut the sides back at an angle so that the piece that pivots will fit in easier. Weld eight 5-1/2" pieces of flat iron to each wheel (4 to a side) to allow more wire to be fed on the wheel.

6.) A wire guide is used to keep the wire feeding straight. A piece of 3"x 2" rectangular tubing is used for the wire to feed through. Cut each corner back 3/4" and bend each side out. Weld the corners shut. Bending these sides out allows barbed wire to feed through without catching.

The guide which the wire feeds through is welded to a piece of 1/2" rod, 33" long. The rod for each wheel pivots at the back by the axle and the rod slides back and forth through a 4" piece of 5/8" pipe. The pipe is supported by a 13" piece of flat iron welded to the axle. The guide is controlled by a 6' piece of 1/2" rod which runs to the front of the frame. The control rod pivots through a small piece of 5/8" pipe. By moving the control rod back and forth, both wire guides move and both wheels can be fed at once.

7.) After the wire winder is finished, paint with red enamel. Paint the wheels with black enamel.

Construction of a Bale Fork

Author: *Carl D. Isern*
Instructor: *Paul N. Stevenson*
School: *Kansas State University*
City & State: *Manhattan, KS*

Bill of Materials

Angle Iron	Length (ft.)
2 - 1/4″ x 3″x 5″	5.86
2 - 1/4″ x 3″x 5″	1.35
2 - 1/4″ x 3″x 3″	5.86
2 - 1/4″ x 3″x 3″	1.0
2 - 1/4″ x 3″x 3″	.5

Rectangular Tubing	Length (ft.)
2 - 3/16″ x 2″x 4″	7.33
2 - 3/16″ x 2″x 4″	7.16
1 - 3/16″ x 2″x 4″	5.83
1 - 3/16″ x 2″x 4″	.96

Square Tubing	Length (ft.)
4 - 11G (1-1/4″x 1-1/4″)	5.83

Pipe	Length (ft.)
16 - 1-1/2″ i.d.	.19
2 - 1-3/16″ i.d.	.19

Channel Iron	Length (ft.)
1 - 3/16″ x 5″ x 5″	5.25
1 - 1/4″ x 3″ x 2″	7.50

Miscellaneous
Metal and bolts
Wire welder 368"
5 - E6011 Lincoln electrodes
Cutting torch
1 - 2-1/2" cylinder with 8" stroke
16 - Farmhand bale teeth

Paint
1 gal. Thinner
2 qt. Metal primer
1 qt. Ming red enamel
1 qt. Gloss white enamel

Frame Construction

The back of the bale fork was constructed of 1/4" x 3"x 5" angle iron. It consisted of a rectangle 16-l/4"x 70-1/2".

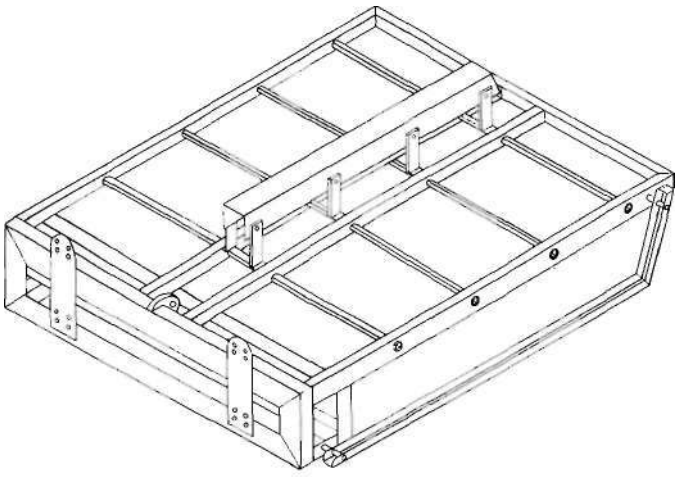
The corners of each piece were cut on 45° angle to make a 90° corner. A 1/4"x 3"x 3″ angle iron piece six inches long was welded to the bottom two corners of the back frame.

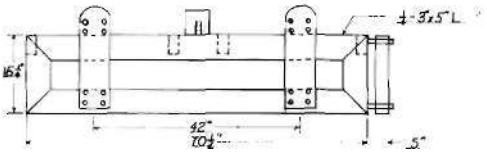
The next step was to construct a rectangle which measured 12"x 70-1/2", of l/4"x 3"x 3" angle iron. Each piece was cut on a 45° angle to make 90° corners. This portion was welded onto the two 6" stubs on the back frame. It serves as a spacer to hold the bales away from the back frame.

The next step was to cut the 2"x 4" rectangle tubing used to make the sides and front of the bale fork. The sides were cut 80" long with a 45° angle cut on one end. Two pieces of 2"x 4" tubing 86" long serve as supports in the middle of the bale fork.

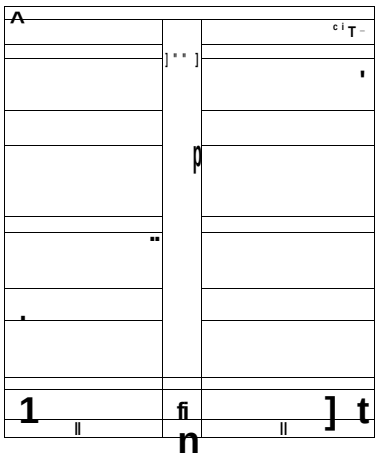
Before the 2"x 4" tubing was welded in place, the holes for the teeth bars had to be drilled. Each hole was drilled 1-7/8", in order that a 1-1/2" i.d. pipe bushing could fit through it. The holes were drilled at intervals of 24, 42, 60, and 78" from the ends of the 86 and 88" pieces of rectangle tubing. This is very important since it determines where the bale teeth catch the bales. After one piece has been drilled to the correct dimensions of 24,42,60, and 78", it was used as a guide for the other three pieces of tubing. The holes must be measured with accuracy because a piece of 1-1/4"x 1-1/4" square tubing will slide through all four pieces later on in the construction process. The holes and bushings serve as pivot points, the teeth being turned by hydraulic power.

16 pieces of 1-1/2" i.d. pipe, 2-3/8" long were used as bushings in the 1-7/8" holes drilled in the 2"x 4" tubing. Each bushing was placed through the 1-7/8" holes and welded into place. A bead was welded completely around the bushing to make the 2"x 4" tubing water tight. This will prevent the tubes from

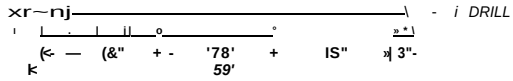




END *VIEW*



TOP VIEW



TURN MECHANISM

rusting from the inside. Once the bushings were welded, the 2"x 4" tubing was ready to be welded to the back frame of the bale fork.

The two pieces of 2"x 4" tubing, with the 45° angle on the end, were used to make the sides of the bale fork. The squared off end was slid into the corner of the angle iron frame constructed earlier. They were then squared completely, in all directions, with the back frame. Once these pieces were squared, they were welded in place.

The other two pieces of 2"x 4" tubing, 86 " long, were placed in the middle of the frame. They were each placed 5" on both sides from center on the bale fork. After these pieces were squared, they were welded.

The 2"x 4" tubing 70" long with the 45 degree ends was next to be put in place. This forms the front of the bale fork. The 45° corners will fit the 45° corners on the side piece to make a good fit. This piece can then be welded.

Turning Mechanism

Four pieces of 1-1/4"x 1-1/4" square tubing were used for the teeth bars. Each was cut 70 " long. They were then slid into the holes in the 2"x 4" tubing.

The next step was to build the turn mechanism. This consisted of a piece of 3/16"x 5"x 5" channel iron 59 " long. A 3/16" cap was welded onto one end of the channel while the other end remained open. Four 5/8" diameter holes were drilled on both sides of the channel. They were drilled at 18 " intervals, 1" from the bottom of the channel and beginning 2" from the open end. It is through these holes that power will later be transferred to the teeth bars for turning. It is important to drill holes in parts while in construction when they are small enough to fit in the drill press. It gives accuracy over a hand drill, is quicker, safer, and easier.

A piece of 3/4"x 4-3/4"x 4-3/4" strap was cut and welded inside of the channel 10" from the open end. Another piece 3/4"x 3"x 4-3/4" strap was also cut. A 1" hole was drilled in the center of this piece. The piece was then welded to the 4-3/4"x 4-3/4" piece inside the channel iron to form a "T." This will be used later on in construction for hooking up one end to the hydraulic cylinder ram.

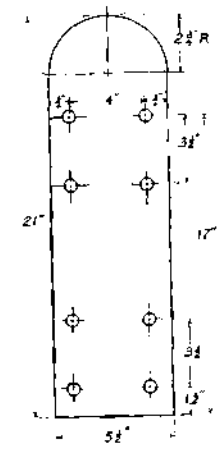
The next step was to make the teeth turning brackets. They were constructed of 1 /4"x 1-1 */2"* strap iron. Eight pieces were cut 6" long and sixteen pieces 2" long. A 3/4" diameter hole was drilled 1" from one end of all the 6" pieces.

Two 3/8" holes were drilled in the 2" pieces. They were drilled 1-1/4" from the edge and 3/4" on either side of center. One of the 6" pieces and one of the *2"* pieces were welded together to form an "L."

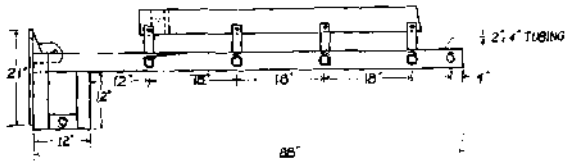
The brackets were then bolted to the teeth bars with 3/8"x 2-1/4" machine bolts. Two brackets were bolted to each bar. The brackets were spaced 5" apart so that the 5"x 5" channel could fit between. The channel iron was then bolted to the brackets with 5/8"x 1" machine bolts. A bushing was placed in the 3/4" diameter hole on the bracket to allow the bracket to turn on the bolt. This completed the turning mechanism on the bale fork, allowing all four teeth bars to turn at the same time when the channel iron is moved forward or backward, by the hydraulic cylinder.

The teeth were then bolted onto the teeth bars. The teeth were purchased from a local dealer. The teeth came with their mounting brackets bolted onto the teeth bars with one 3/8"x 2-1 */2"* carriage bolt. The teeth were spaced equally across the bar with four teeth on each bar. More teeth can be added if needed. Sometimes more are needed when handling loosely packed bales.

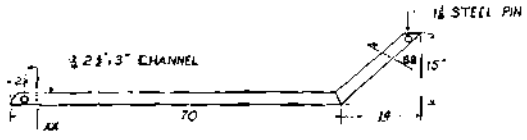
The next step was to cut the plate which holds the cylinder to the back frame. It was constructed from a flat plate 1 "x 4"x 6".



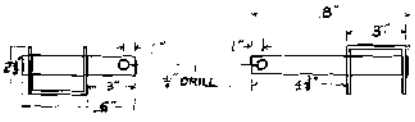
MOUNT BRACKET



SIDE VIEW - WITHOUT RAIL



RAIL



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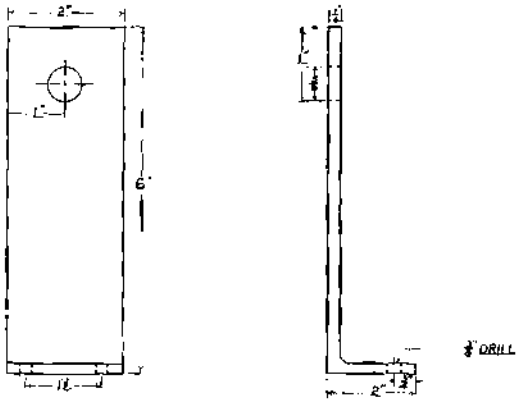
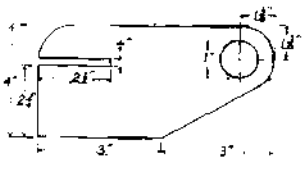


TEETH TURN BRACKET



CYLINDER BRACKET

A 1" diameter hole was drilled 1-3/4" from top and 1-3/4" from one end. The corners of the piece were all rounded and a 1/4" slot was cut in the end opposite from the hole, to allow the piece to fit over the edge of the 1/4"x 3"x 15" angle iron on the back frame.

The 2-1/2" diameter cylinder with an 8" stroke was placed between the cylinder mounted on the back frame and the hole in the 3/4"x 2"x 3" plate welded inside the 5"x 5" channel iron. This cylinder operates the movement of the bale teeth into and out of the bales.

An arm was then made to fit on the side of the bale fork to act as a guide to hold the bales together. It was made of 1/4"x 2"x 3" channel iron. A piece of 1/4"x 2"x 3" channel iron was cut 8" long. A 60° angle was cut in both sides 14" from one end. The remaining half of the channel iron was heated and bent upward to form a 60° angle on one end of the channel iron. The arm is a must in stacking tightly packed loads or stacks.

The next procedure was to cut two 1-1/8" steel pins, one 6" long and the other 8" long with a 1/4" hole drilled 1/2" from the end on both pieces. A 1-1/8" diameter hole was drilled through the 2"x 3" channel iron 2" from both ends. The 8" steel pin was then slid through the 1-1/8" diameter hole in the channel iron until it was flush with the opposite side and welded into place. The 6" pin was also welded in the hole on the other end of the channel iron. These pins were used to attach the arm to the bale fork frame.

Two 1-5/8" holes were cut into the main frame of the bale fork for the steel pins to fit in. One hole was cut 6" from the back of the bale fork, in the side of the 3"x 3" angle iron, and the other hole was cut 4-1/2" from the front in the 2"x 4" rectangular tubing. Two bushings were cut 1-3/16" i.d., one being 1-1/2" long and the other 2-1/2" long. A 1/4" diameter hole was drilled 3/8" from one end on both pieces of pipe. The 1-1/2" piece of pipe was fitted into the hole in the 3"x 3" angle iron. The 1/4" hole faced to the inside of the bale fork. The 2-1/2" piece was then fitted into the 2"x 4" rectangle tubing with the 1/4" hole to the inside of the bale fork. The steel pins on the channel iron were then slid into the pipe bushing to check for proper alignment. With the pins still in place, the bushings were tack welded into the frame. The side rail was then removed and the bushing was welded into place. The side rail is held in place by a 1/4" pin through the holes in the bushings and steel pins.

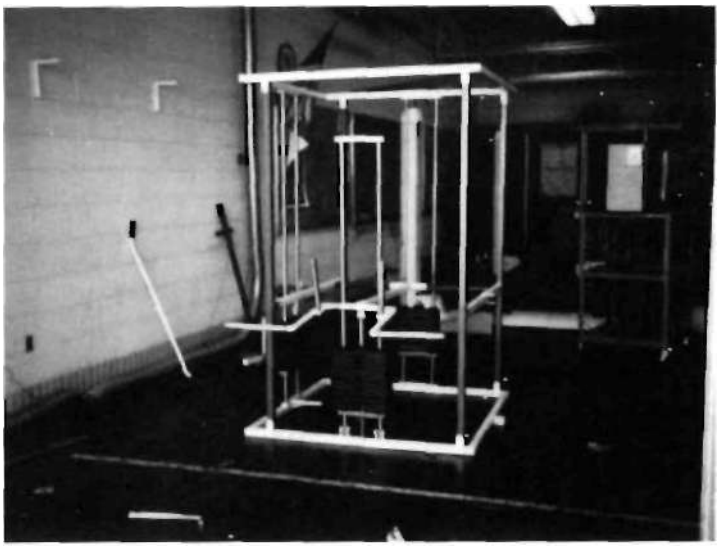
The last step was to make the plates onto which the mounting brackets for the tractor or front-end loader attach. They were made of 3/8" plating 5-1/2"x 21". The top of each piece was cut in a semi-circle. Eight 1/2" diameter holes were needed in each piece for the tractor bracket to bolt onto. The holes were spaced 4" apart and drilled at intervals of 1-1/2", 3-1/2", 13-1/2", and 17". These measurements will vary on different brands of front-end loaders. The plates were then welded onto the back of the 3"x 5" angle iron which is on the back of the bale fork. The two pieces were placed 42" center to center and 2" above the bottom of the 3"x 5" angle iron.

The final step was to clean the project and prepare it for painting. A spray gun was used to apply two coats of rust preventative primer followed with two coats of implement paint

SECTION B
TABLE OF CONTENTS
HOME AND RECREATIONAL

Physical Fitness Gym

Author: *Kenneth W. Carpenter, Jr.*
Instructor: *Donald M. Sanborn*
School: *Shadle Park High School*
City & State: *Spokane, WA*



Top and bottom frames were made by cutting 1-1 /2" square tubing the correct length and mitering the ends with an abrasive cut-off saw. It was then assembled on a flat surface, clamped in alignment, then tack welded. Alignment was checked again and then welded. Flanges were cut in various sizes with a power hack saw. One end was radiused on the belt sander. Some of these were located to accept vertical posts which are bolted to assembly.

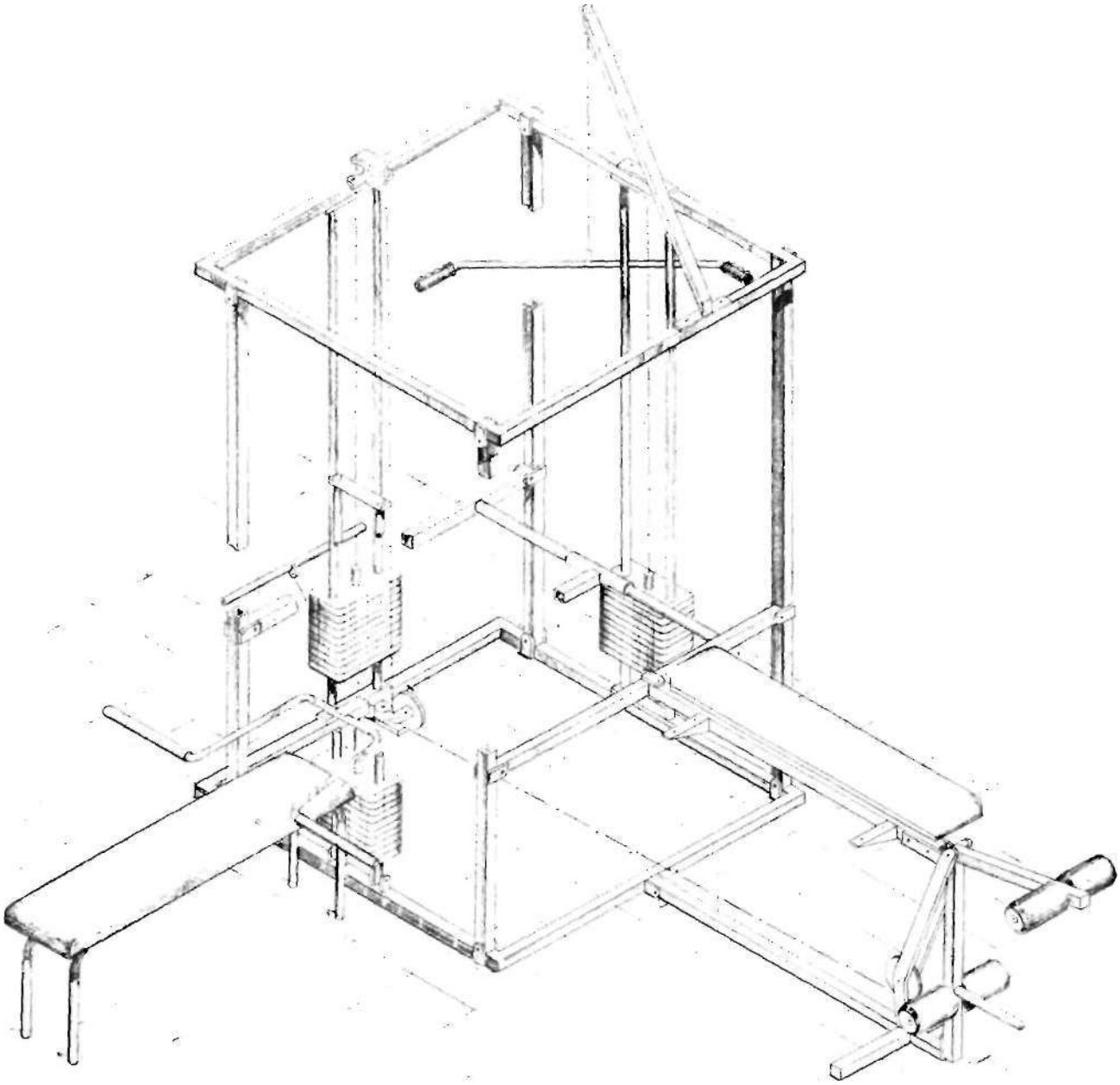
Two horizontal rails were located on vertical posts to support the pivot assembly for bench press. The bench press was assembled by installing the weights on the running guides. These were then placed on the frame according to the drawings. These running guides will pivot with the lifting of the weights. The weight can be adjusted by moving the pin in the center pin. Also, on this station dumb bell weights can be placed on the posts on the handle to provide more weight.

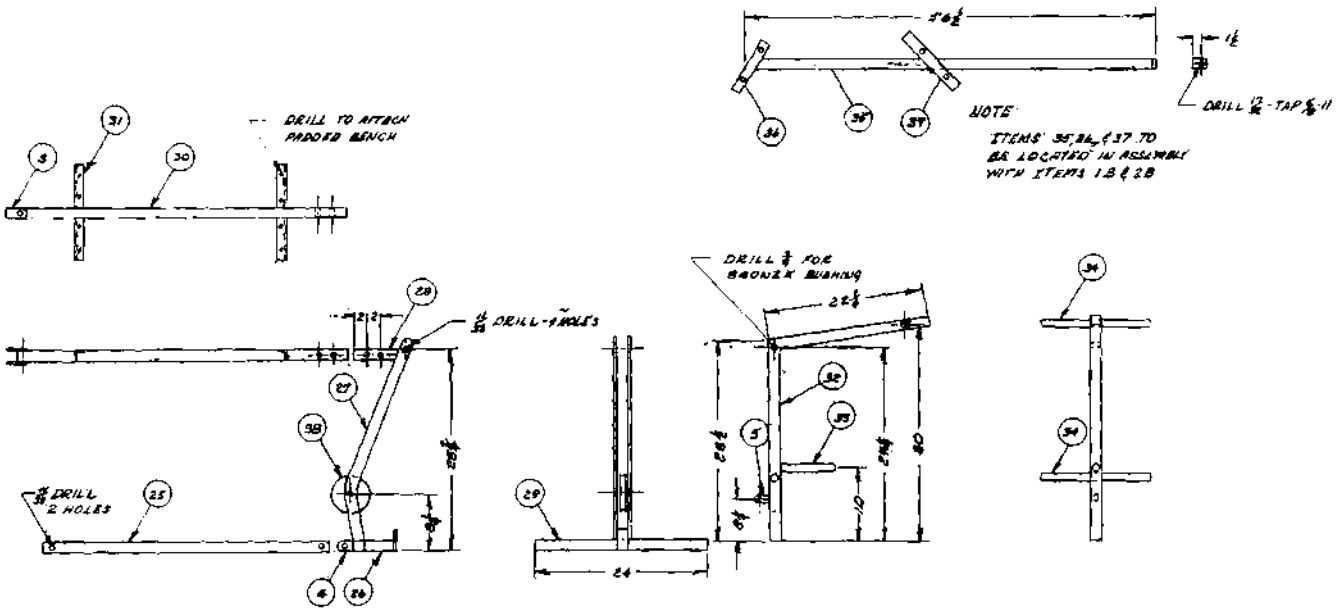
The next station to be assembled was the curling station. This was accomplished by first installing the flat steel in position on the running guides, and adding the rubber absorbers. The 11 10-pound weights were then slid onto the running guides. In order to maintain alignment of the guide rails, two half-inch flat bars were drilled with the correct spacing and then welded in position on the upper and lower main frame. Then the pulleys were installed for the cable.

The next station to be assembled was the lap pull. Installed on the running guides were the steel block, the rubber absorbers, and 11 10-pound weights. This is identical to the curling station weights that run on the steel guides. A diagonal bar was installed on the top frame to accommodate the cable for this station. A pulley was installed on this bar for the cable to run through. A pulley was also installed on the base frame for the cable.

The leg extension station consists of a bench extending from one side of the main frame. On the end of the bench frame is an "L" shape tube that pivots vertically. A cable passes beneath the bench and connects this tube to the stack of weight that are used jointly with the curling station. The edge boards on the curved pulley support, on the outer end, were formed on a Hossfeld Bender, and a brass bushing was provided at the proof point of the "L" tube. Then four 6-inch long and about 6-inch thick pads were installed on the holders.

Construction of the bench for the bench press completed the project.





Bill of Materials

Item	Qty.	Description	Material
1	2 ea.	Upper & lower frame	1½ x 1½ x .093 Tubing
2	4 ea.	Guide rail spreader	1 x 1½ x 10 CRS
3	26 ea.	Flange	¼ x 1½ x 3¾ HRS
4	2 ea.	Flange	¼ x 1½ x 2¼ HRS
5	4 ea.	Flange	¼ x 1 x 2 HRS
6	1 ea.	Pulley support	½ x 1½ x 7 HRS
6A	1 ea.	Gusset	¼ x 1¼ x 3½ HRS
7	4 ea.	Vertical leg	1½ x 1½ x .093 x 6′0″ Tubing
8	2 ea.	Horizontal rail	1½ x 1½ x .093 x 3′4″ Tubing
9	1 ea.	Pivot support	1¼ dia. x 40¾″ Sched. 40 pipe
10	4 ea.	Weight support	1 x 2 10 CRS
11A	2 ea.	Guide rail	1 dia. x 5′0″ CRS
11B	4 ea.	Guide rail	1 dia. x 6′0″ CRS
12	1 ea.	½″ eye bolt	Purchased
13	3 ea.	Lift pin	1 dia. x 16″ CRS
14	3 ea.	Lock pin	Purchased
15	3 ea.	Top plate	Purchased
16	30 ea.	Weights	Purchased
17	6 ea.	Rubber cushion	2″ dia. hard rubber
18	11 ea.	5/16-Spring rolled pin	Purchased
19	18 ft.	Bench frame	1 dia. x 14 ga. Tubing
20	1 ea.	Bench handle assem.	1½ dia. x 12 Sched. 40 pipe
21	1 ea.	Bench handle assem.	1½ x 1½ x .093 Tubing
22	1 ea.	Bench handle assem.	1 dia. x 6′0″ CRS
23	4 ea.	Bench handle assem.	1 x 14 Lexan tubing
24	8 ea.	Bench handle assem.	1 dia. Shaft collars
25	1 ea.	Leg extension assem.	1½ x 1½ x .093 x 40 Tubing
26	1 ea.	Leg extension assem.	1½ x 1½ x .093 x 4 Tubing
27	2 ea.	Leg extension assem.	¼ x 1½ x 30 HRS
28	2 ea.	Leg extension assem.	¼ x 1½ x 6½ HRS
29	1 ea.	Leg extension assem.	1½ x 1½ x .093 x 24 Tubing
30	1 ea.	Leg extension assem.	1½ x 1½ x .093 x 46 Tubing
31	4 ea.	Leg extension assem.	¼ x 1½ x 1½ x 6 Angle
32	1 ea.	Leg extension assem.	1½ x 1½ x .093 x 40¾ Tubing
33	1 ea.	Leg extension assem.	¾ dia. x 12 CRS
34	2 ea.	Leg extension assem.	¾ dia. x 15 CRS
35	1 ea.	Lap pull assembly	1½ x 2 x .093 x 56½ Tubing
36	1 ea.	Lap pull assembly	¼ x 1½ x 8 HRS
37	1 ea.	Lap pull assembly	¼ x 1½ x 8 HRS
38	5 ea.	Pulley wheel	Universal No. 20-1011
39	2 ea.	Bracket	Universal No. 11-5001
40	2 ea.	Bracket	Universal No. 10-5010
41	1 ea.	Curling station cable	Universal No. 12-2111
42	1 ea.	Lap pull station cable	Universal No. 12-2110
43	1 ea.	Leg extension cable	Universal No. 12-2112