Construction of a Bale Fork

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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".

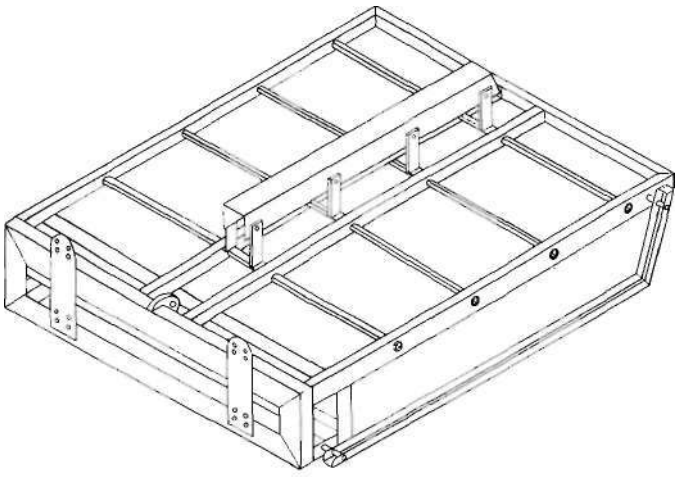
The corners of each piece were cut on 45° angle to make a 90° corner. A 1/4"x 3"x 3″ angle iron piece six inches long was welded to the bottom two corners of the back frame.

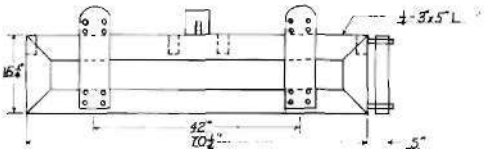
The next step was to construct a rectangle which measured 12"x 70-1/2", of l/4"x 3"x 3" angle iron. Each piece was cut on a 45° angle to make 90° corners. This portion was welded onto the two 6" stubs on the back frame. It serves as a spacer to hold the bales away from the back frame.

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.

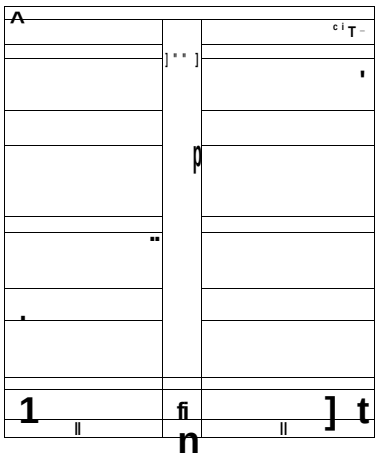
Before the 2"x 4" tubing was welded in place, the holes for the teeth bars had to be drilled. Each hole was drilled 1-7/8", in order that a 1-1/2" i.d. pipe bushing could fit through it. The holes were drilled at intervals of 24, 42, 60, and 78" from the ends of the 86 and 88" pieces of rectangle tubing. 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

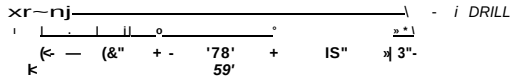




END *VIEW*



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.

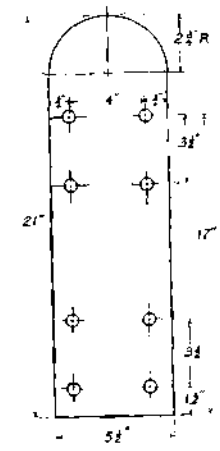
The next step was to make the teeth turning brackets. They were constructed of 1 /4"x 1-1 */2"* strap iron. Eight pieces were cut 6" long and sixteen pieces 2" long. A 3/4" diameter hole was drilled 1" from one end of all the 6" pieces.

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."

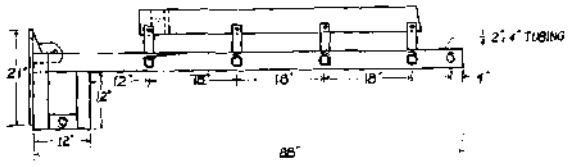
The brackets were then bolted to the teeth bars with 3/8"x 2-1/4" machine bolts. Two brackets were bolted to each bar. The brackets were spaced 5" apart so that the 5"x 5" channel could fit between. The channel iron was then bolted to the brackets with 5/8"x 1" machine bolts. A bushing was placed in 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.

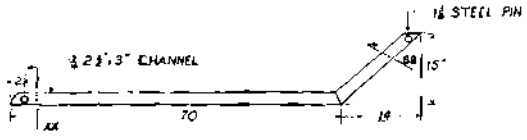
The next step was to cut the plate which holds the cylinder to the back frame. It was constructed from a flat plate 1 "x 4"x 6".



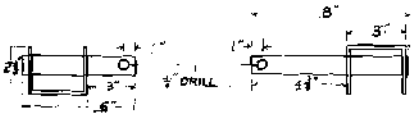
MOUNT BRACKET



SIDE VIEW - WITHOUT RAIL



RAIL



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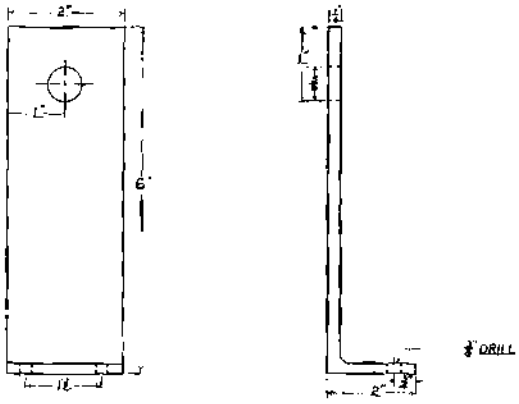
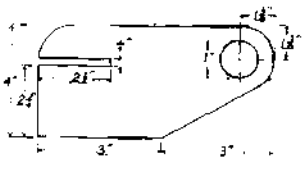


TEETH TURN BRACKET



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