Why Not a Tilting Tower?

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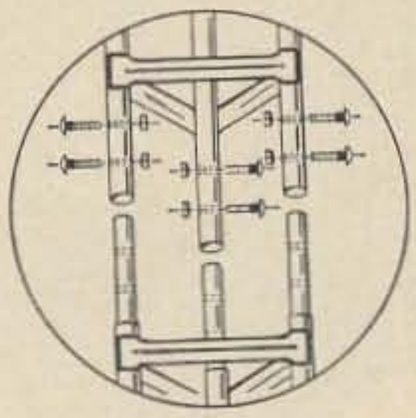


FIGURE 1

Fig. 1. Method of joining sections together.

This article describes a sixty-five foot tilting tower made up of commercial TV tower sections and two home brew tilting sections which are hinged together. Tilting of the upper portion of the tower is accomplished by means of a twenty foot cantilever boom which is attached to the upper tilting section and controlled by means of a boat winch attached to the tower at ground working level, with the winch cable secured to the lower end of the boom. The tower can be tilted down or raised in a few minutes and provides safe access to the rotor or beam working at ground level or from a moderate height step ladder. The idea for this type of tower is not new; however, the particular tower described here is not commercially available. It was built by the author for $260.00, included all costs for galvanizing, winch, shipment of purchased tower sections, etc.

The tower sections used are manufactured by Reference 1 and are the model 500 Super Kwick-Climb, hot dip galvanized units. These triangular sections are ten feet long and when two sections are bolted together, 5½ inches of tower height is lost due to overlap. Construction is of 1¼ O.D. x 16 ga. wall high strength tubing with cross braces spaced on 13" centers. Method of joining sections is shown in **Fig. 1.** Sections available are shown in **Fig. 2.** The tower pictured utilizes two F sections and one each of sections A, C, D, and E for the tower proper and one each of sections A and B for the boom. Two tilting sections must be fabricated and interposed between sections E and F at 20 feet above ground.

As shown by the close-up photographs, the lower tilting section which was made 2′ long (but which can be made longer if a higher tower is desired) is constructed of three pieces of 1¼ inch O.D. x 16 gauge wall seamless steel tubing welded to an angle iron framework made up of 2 x 2 x 3/16 inch steel angle iron. Three pieces of 1 x 1 x ⅛ inch angle iron are used as horizontal braces and three pieces of 1 x 1 x ⅛inch angle are welded between the tubing and the 2 x 2 x 3/16 inch angle framework as diagonal braces. The three tubing legs of the lower tilting section are drilled to match the holes in the F tower section with which it mates. The angle iron framework was clamped together and welded first. The three 2′ long legs were then bolted in place on the F tower section and welded to the angle iron framework. The 1 x 1 inch angle braces were welded in place last. When welding is finished it is advisable to mark one of the mating tower legs with tape, or in some other manner, for ease of later alignment when the sections are reassembled.

The upper tilting section is a 2 x 2 x 3/16 inch angle framework welded to three five foot lengths of 1¼ inch O.D. x 16 gauge wall seamless steel tubing. Three pieces of ¾" black pipe 10" long are inserted three inches into the upper end of the 1¼ inch tubing and plug and seam welded in place. The ¾ inch pipe fits inside the lower end of the E tower section with which it mates and two ⅜ inch holes are drilled in each piece of ¾ inch pipe to mate with the holes

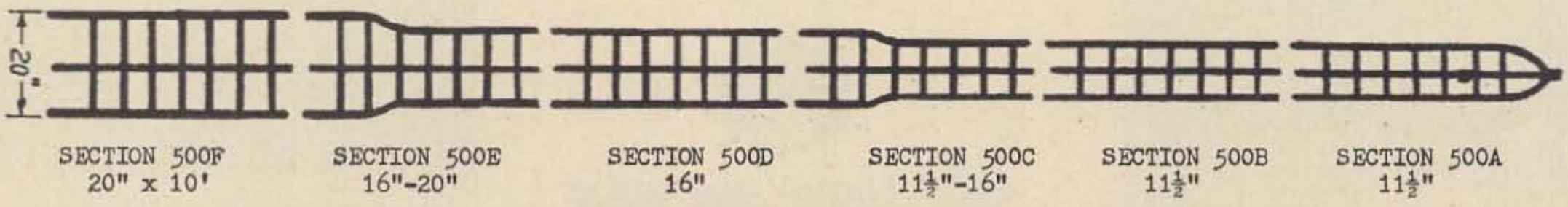


Fig. 2. Typical TV tower sections available.

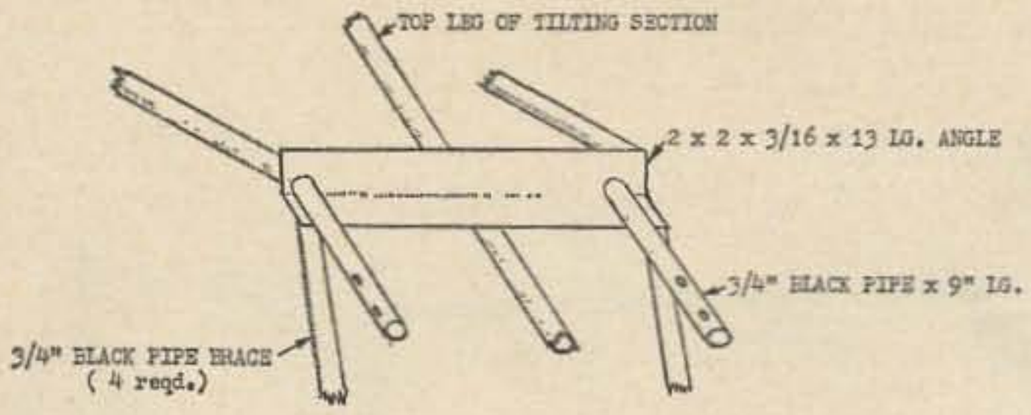


FIGURE 3

Fig. 3. The 2X2 cross angle is braced to the lower tilting section legs by four pieces of ¾ inch pipe.

in the E tower section. The holes in the pipe are drilled prior to welding the pipe to the 1¼ inch tubing.

1½ x 1½ x ⅛ inch angle is used as cross bracing on the upper tilting section. Twelve 19⅛ inch long pieces are required, spaced at approximately equal intervals along the 5 foot length of the tubing. The sequence of assembly of the upper tilting section members is as follows: As a first step the 2 x 2 angle upper framework is first clamped to the 2 x 2 angle framework of the lower tilting section for alignment since these two sections butt together when the tower is in the erect position. The four angle iron members which form the upper framework are then welded together. The three pieces of ¾ inch pipe are next welded into the 1¼ inch tubing (5 foot long) legs being careful to end up with three legs of the same length (5′ - 7″ lg.). One ¼″ diameter plug weld is used on each leg to hold the pipe in place in the tubing and then a weld bead is run around the circumference of the end of the tubing, thus joining it to the pipe. The three legs are next bolted to the E tower section and clamped to the 2 x 2 angle iron framework. The F tower section should be bolted to the lower tilting section and the entire assembly consisting of the F tower section, lower tilting section, upper tilting section and E tower section blocked up into alignment for tower straightness before welding the upper tilting section legs to the 2 x 2 angle framework. A simple and yet effective means of checking straightness is to stretch a piece of string from one end of the assembly to the other on all three faces of the tower section setup. After aligning, butt tack weld the 1¼ diameter legs to the 2 x 2 angle framework. With the setup still in place, tack weld the 12 horizontal braces in place on the 1¼ tubing legs. The E and F tower sections used for alignment can now be removed and the upper tilting section moved around for easiest finish welding positions.

The boom used for tilting the tower consists of one A and one B tower section bolted together. The B section of the boom attaches to the tilting section at two points. The upper end of the boom bolts to two 9″ long pieces of ¾ inch pipe which are shown in **Fig. 3** welded to a 2 x 2 cross angle which is in turn welded to the tilting section leg opposite the hinged side of the tilting secton. The 2 x 2 cross angle is braced to the lower tilting section legs by four pieces of ¾ inch pipe, shown in **Fig. 3.**

The boom is fastened with U bolts to the 2 x 2 angle framework of the tilting section as depicted in **Fig. 4.** Two clamps as shown in **Fig. 4** are required. The 1¼ x 1¼ angles space the boom out from the tower so that the winch can be attached to the lower part of the tower adjacent to the end of the boom. In setting up to weld the boom supports to the tilting section it is suggested that the A and B boom sections be bolted together and blocked up in place on the tilting section. The prefabricated clamps of **Fig. 4** are set in place and the boom aligned with the lower tilting section and F tower section before tack welding the boom supports. With tack welding complete the boom can be removed and welding completed in the easiest positions.

The B boom section as purchased is not strong enough in bending for use as a boom member and must be reinforced by means of a piece of ¾ inch black pipe, ¼ x 1 steel spacers and five ⅜ diameter tension members as shown in **Fig. 5.** As shown, the ¾ pipe extends across the A and B section joint and is bolted to the A section of the boom by two ⅜ inch bolts. One loose piece of 1¼ O.D. x 16 gauge tubing completes the

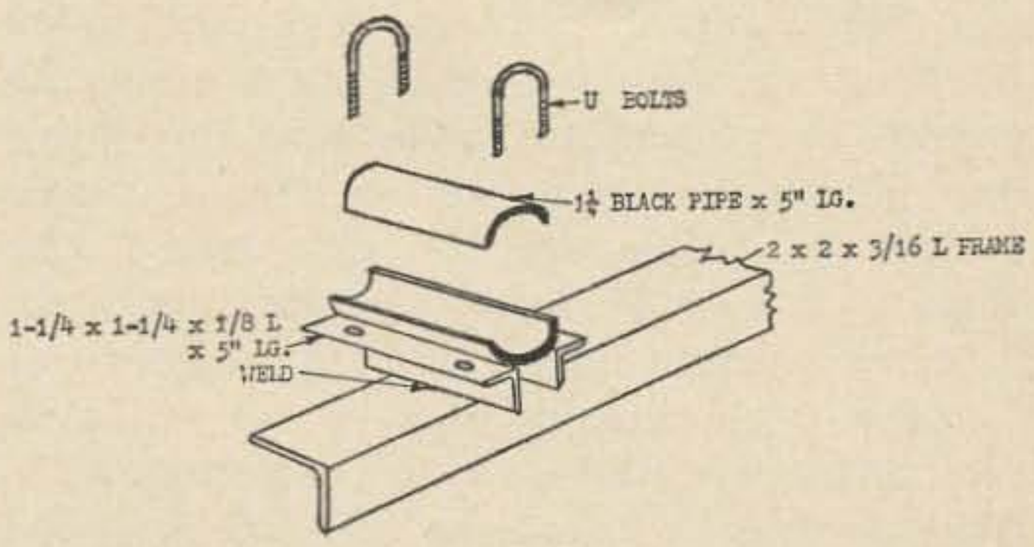


FIGURE 4

Fig. 4. The boom is fastened with U bolts to the angle framework of the tilting section.

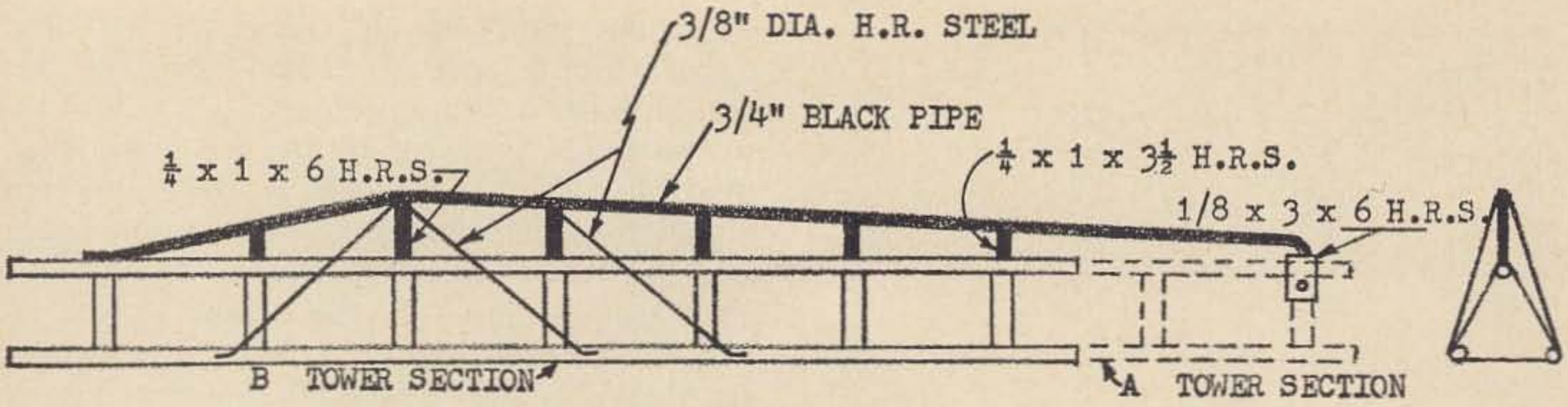


FIGURE 5

Fig. 5. Reinforcing the boom for greater strength.

boom. This tube bolts between the end of the B section and the E tower section to serve as a tension member as can be seen in **Fig. 7**.

Two hinges are welded to the front face of the 2 x 2 angle frameworks of the upper and lower tilting sections. One hinge is shown in **Fig. 6**. A ⅝ diameter bolt serves as a hingepin.

A Sears Roebuck double rachet boat winch costing $5.99 is adequate for tilting the tower. The winch is bolted to a plate which is fastened to the tower leg by U bolts. The winch rope is ⅜ x 30 foot long polyethylene. 3/16 diameter steel winch cable can be used alternately.

Erection of tower

Select a site having clearance for the tower and boom to raise and lower. This may be a problem, what with telephone wires and trees. The author's tower is set next to a ranch style house and the tower lowers across the roof so that one stands on the roof to work on the antenna. The tower should be set in a concrete base a minimum of 24 x 24 x 36 inches deep. Set up two F sections and the lower tilting section bolted together and block in place over the base hole. Set a plumb bob up, level the tower and leave the plumb bob in place while the concrete is poured to make sure the tower stays plumb. Let concrete cure for a couple of days and then set the guy wires. Use either 2′ x 2′ x 1′ deep concrete blocks set 3′ below ground level for guy anchors or 6″ screw type anchors such as are available from Sears Roebuck & Co. Tension guys to equal pretension of about 300 lbs. Proceed with erection of remainder of tower and boom using either extension ladders or a gin pole. A gin pole is a simple pipe and pulley arrangement which can be clamped to the tower section already erected so that the next tower section can be hoisted up to the man who is setting the sections. Use a safety belt in standing directly on the tower during erection. Once the upper tilting section is in place you can alternately attach a tower section and a boom section while tilting the tower back and forth. This tilting procedure limits tower climbing to the twenty foot level, which helps the safety problem.

Guying

The 65′ tower as described herein will safely withstand 87 mph winds carrying an antenna load such as a small three element Yagi-Uda or 2 section Quad beam when guyed with three ¼-inch diameter high strength guy wires attached to the tower just below the tilting section and anchored to the ground 22 feet out from the tower. (No comment is offered relative to survival

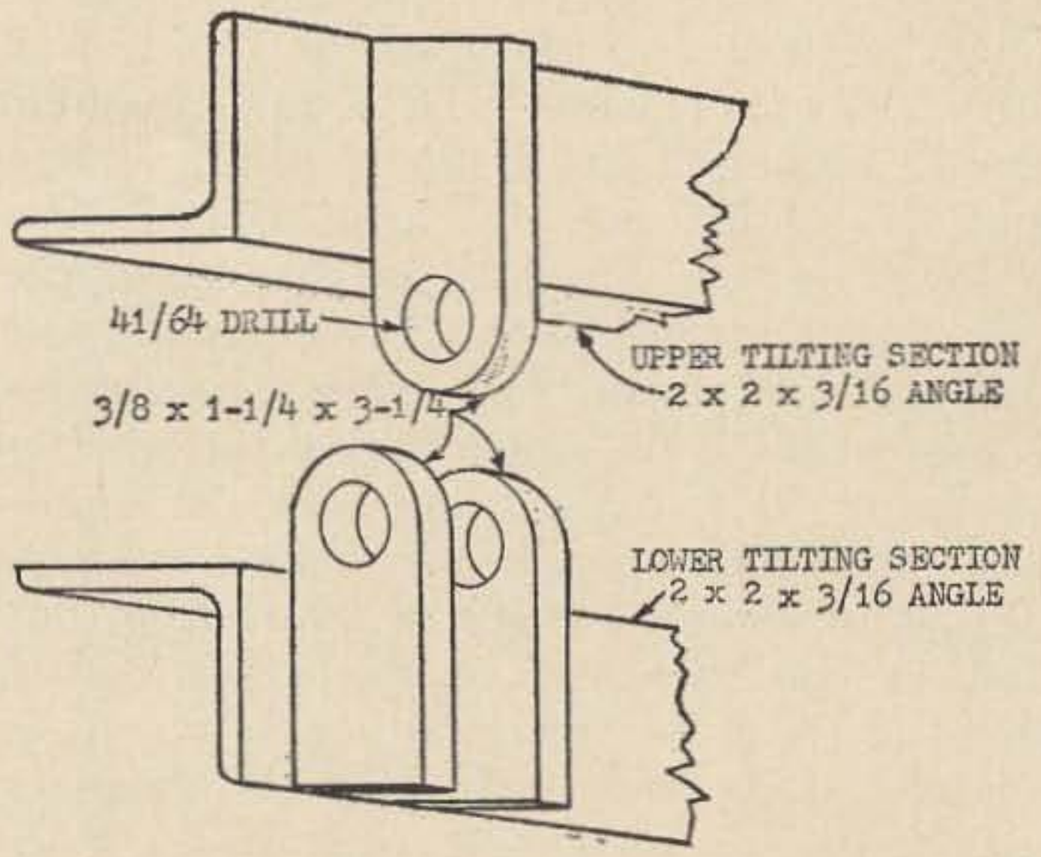
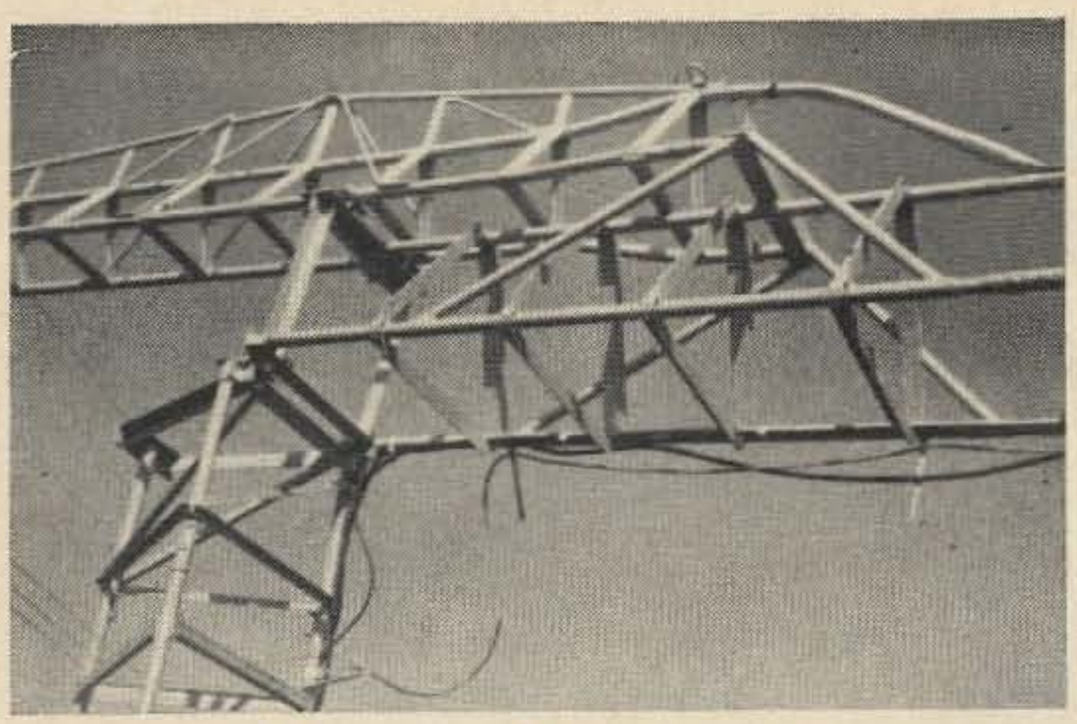


FIGURE 6

Fig. 6. The hinge assembly for the tilting tower.



Close-up of hinged section

of the beams.) If a large beam such as a four section quad (9 sq. ft. wind load area) is used, three ¼-inch diameter high strength guy wires attached 50′ above ground and at least 25′ away from the base of the tower at ground level will be adequate for 87 mph winds. (An 87 mph wind imposes a 30 pound per square foot load on the tower and antenna.) However, since the tower can be tilted down in a few minutes, it is logical to do so if hurricane velocity winds are anticipated. In a reasonable amateur installation where the tower is tilted down during severe wind storms, this tower carrying a 9 square foot antenna wind load and guyed with three ¼ inch diameter high strength guy wires attached just below the tilting section is adequate for 65 mph winds.

Welding

If you like to build, it is recommended that you buy one of the low cost arc welding units on the market, learn to weld, and do your own set up and welding on your tower. This was the author's method. With the contact rods available today, anyone can learn to run a strong weld bead in a few weeks of spare time practice. The welding and technique, incidentally, are invaluable in building antennae and many other things. Reference 2 is suggested for the beginner welder. Use 7014 welding rod for all of the tower welds.

Another variety of the tilting tower, which is incidentally stronger than the tower described, is to use three F tower sections below the lower tilting section and one each of the A, C and E sections above the upper tilting section. This has one disadvantage, namely, the end of the boom is now 15 feet above ground level instead of 5.5 feet. With the boom elevated, a pulley can be installed 15 feet above ground on the tower and the winch cable run from the end of the boom over the pulley and straight down the side of the tower to the winch. Still another variation which results in a 76 foot high tower is to build the tower as described, except use three F sections below the tilting section instead of the two F sections used by the author.

One last thought. If this all sounds like too much work and if you will be satisfied with a fixed tower, the Jontz tower is an excellent low cost unit, 60 feet for $141.00.

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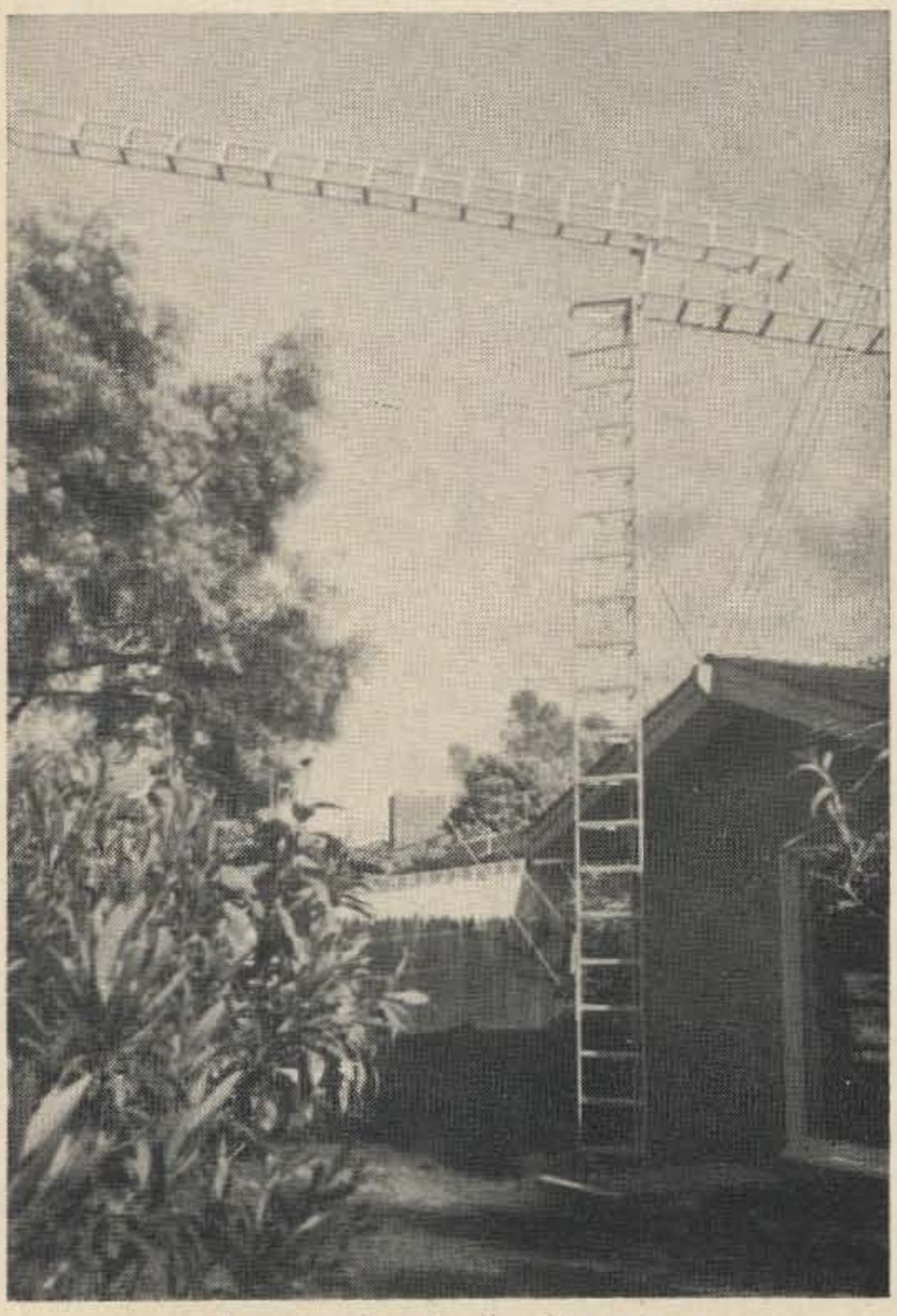

The completed tower in action

Ref. 1. Jontz Manufacturing Co.
1101 East McKinley Avenue
Mishawaka, Indiana

Ref. 2. *New Lessons in Arc Welding* (The Lincoln Electric Co.; Cleveland 17, Ohio). Price: $1.00

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