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SPECIAL STUDY OF TIE WIRES FOR SNOW FENCE CONSTRUCTION

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SUPPLEMENTARY STUDY TO PAPER SNOW FENCE INVESTIGATION

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In paper snow fence construction, the paper is held in place by a wooden stick which binds the paper into the U-shaped groove in the snow fence post. The wooden stick is pressed into the U-shaped groove and held in place by tie wires at the top and bottom ends of the wooden stick. It was the object of this study to determine the number of twists of these tie wires, of various lengths and sizes, to develop a maximum force against the wooden stick. Erection problems encountered during the 1952-1953 paper snow fence installations prompted this study.

Six specimens of each of the following sizes and lengths were tested: number 14 gauge wire in lengths of eight and ten inches, number 15 gauge wire in lengths of eight and eight and one-half inches, and number 16 gauge wire in lengths of eight and eight and one-half inches.

A device for measuring the force exerted by the wire on the wooden stick was made. This device which replaced the wooden stick was essentially a simple supported steel beam, with A-7 type electrical strain gauges mounted on the upper and lower surfaces of the beam. (See Figure 1). These strain gauges were electrically hooked up to a Brush Oscillograph so that an actual record was obtained, showing the force exerted by the wire as the wire was twisted. Figure 2 shows the testing arrangement used.

The resulting forces, for various sizes and lengths of wires, on the simulated wooden stick at the point where the tie wire gripped the stick are given in Table 1. In Table 2 the maximum force on the stick and the safe number of rotations of the twisting device for various sizes and lengths of tie wires are given.

It should be noted that generally the shorter length tie wires produce a greater force on the stick than the longer wires. Typical oscillograph traces of tests on two

number 14 gauge wires of 8 inch and 10 inch lengths are shown in Figure 3. Each turn is marked on the trace, but it should be explained that the peak values of force for each turn shown on the trace are while the wire is being twisted and additional force is being applied by the operator. The straight portion, beyond this on the trace and before the next turn commences, is the force applied by the wire on the stick.

From the results of this test it appears that, for the same gauge tie wire, the shorter length tie wire, with fewer rotations of the twisting device, develops more force than the longer tie wire with more rotations. It therefore seems reasonable to use heavier gauge wire and shorter length wire for best results. Figure 4 shows the length of wire consumed by one complete twist of the wire for various gauge wires. On the basis of this study a tie wire length sufficient to allow 3 twists is recommended. Although the study showed that less than three twists gave a greater force, practical considerations and possible variations in the size of the wood pieces to be used seems to dictate 3 twists as the most practical number. The formula shown on Figure 4 and the data supplied by the graph would indicate for a No. 14 gauge wire that the proper length of wire should be:

$$L = C + 3K + 2B$$

$$L = 6.0'' + 3(0.65'') + 2(.44'')$$

$$L = 6.0'' + 1.95'' + 0.88''$$

$$L = 8.83'', \text{ say } 9''$$

where; L = optimum length of tie wire

C = circumference of post plus 1 x 2 wood stick

K = length of wire required per twist

B = length of end loop (7/16")

The force exerted by the No. 14 gauge tie wires proved to be substantially greater than those for the No. 15 and No. 16 gauge wires and therefore it is recommended that No. 14 gauge tie wires of 9" length be used for paper snow fence installations. The same reasoning may be applied to wooden slat snow fence construction.

Table I. Variation in Force on Stick with Number of Twists for Various Sizes and Lengths of Tie Wires. (Average of 6 specimens of each type)

Number of Twists	No. 14 Gauge Wire length in inches		No. 15 Gauge Wire length in inches		No. 16 Gauge Wire length in inches	
	8	10	8	8 1/2	8	8 1/2
1	2 lbs.	0 lbs.	0 lbs.	0 lbs.	1 lbs.	0 lbs.
1 1/2	13	---	---	---	4	---
2	20	1	10	3	---	1
2 1/2	22	---	17	---	---	---
3	Broke	1	Broke	11	11	4
4	---	6	---	Broke	Broke	10
4 1/2	---	---	---	---	---	Broke
5	---	11	---	---	---	---
6	---	17	---	---	---	---
7	---	Broke	---	---	---	---

Table 2. Variation in Maximum Force on Stick and Safe Number of Twists for Various Sizes and Lengths of Tie Wires. (Average of 6 specimens of each type.)

Test Specimens	No. 14 Gauge Wire		No. 15 Gauge Wire		No. 16 Gauge Wire	
Length of Wire	8"	10"	8"	8 1/2"	8"	8 1/2"
Max. Force on Stick	22#	17#	17#	11#	11#	11#
Safe No. of Rotations of Twisting Device	2 1/2	6	2 1/2	3	3	4

FIGURE 1. ELECTRONIC DEVICE FOR MEASURING FORCE EXERTED BY TIE WIRE

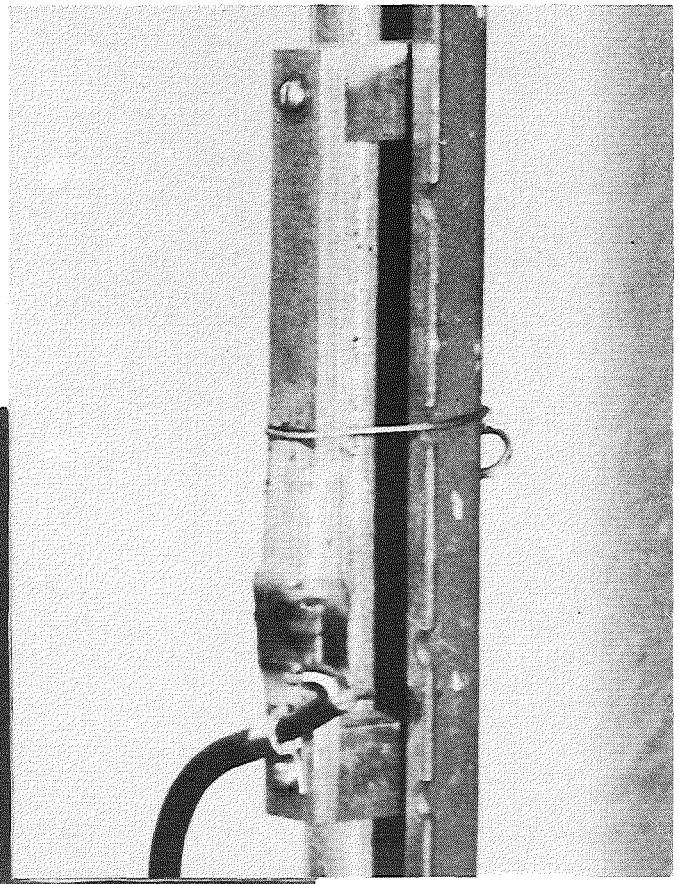
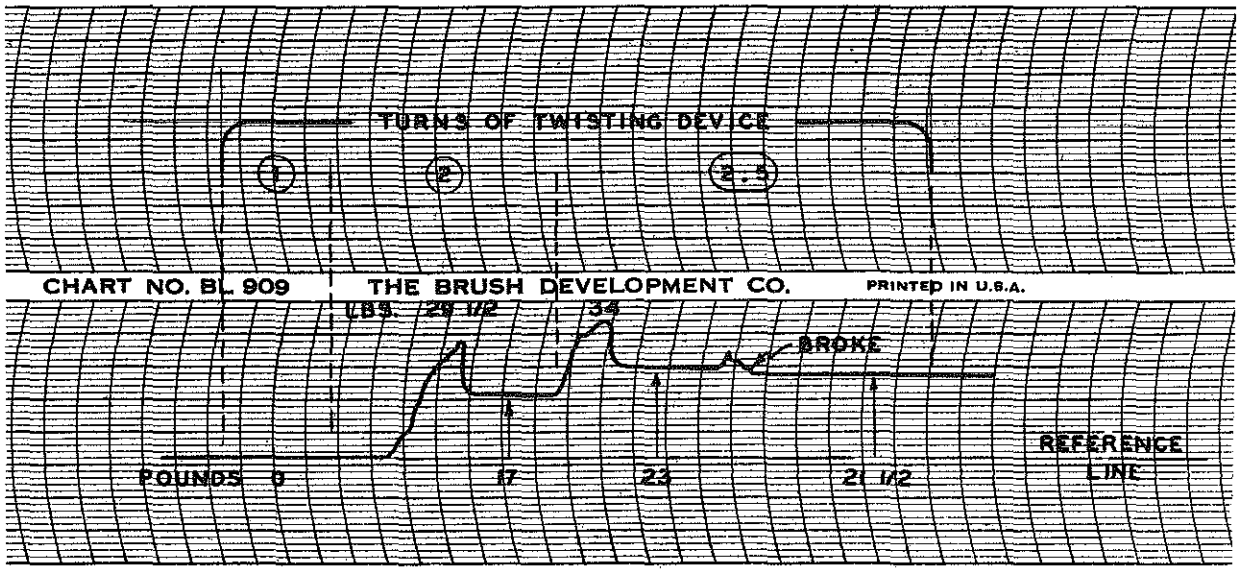
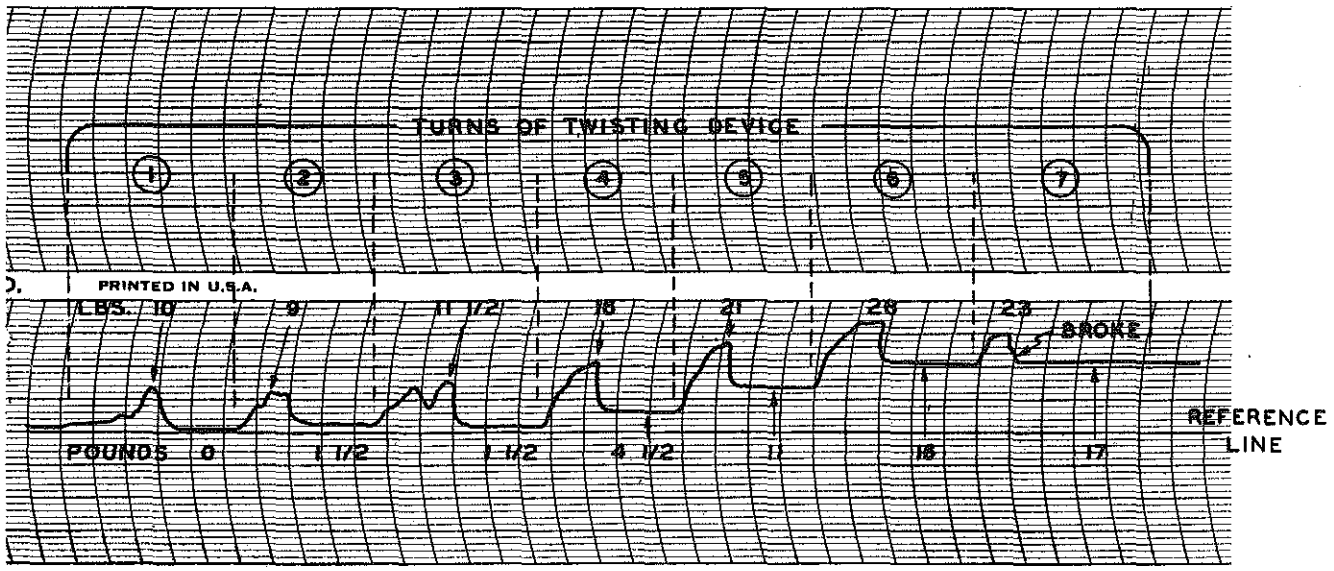


FIGURE 2. TESTING EQUIPMENT USED FOR MEASURING THE FORCE EXERTED BY THE TIE WIRE.



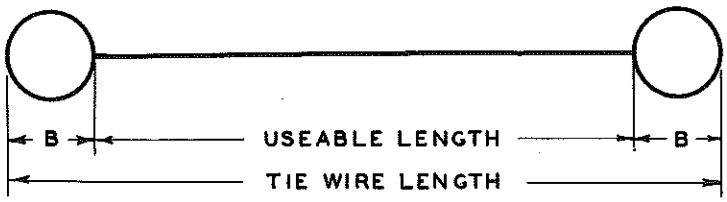
TIE WIRE — NO. 14 GAUGE — 8 INCH LENGTH.

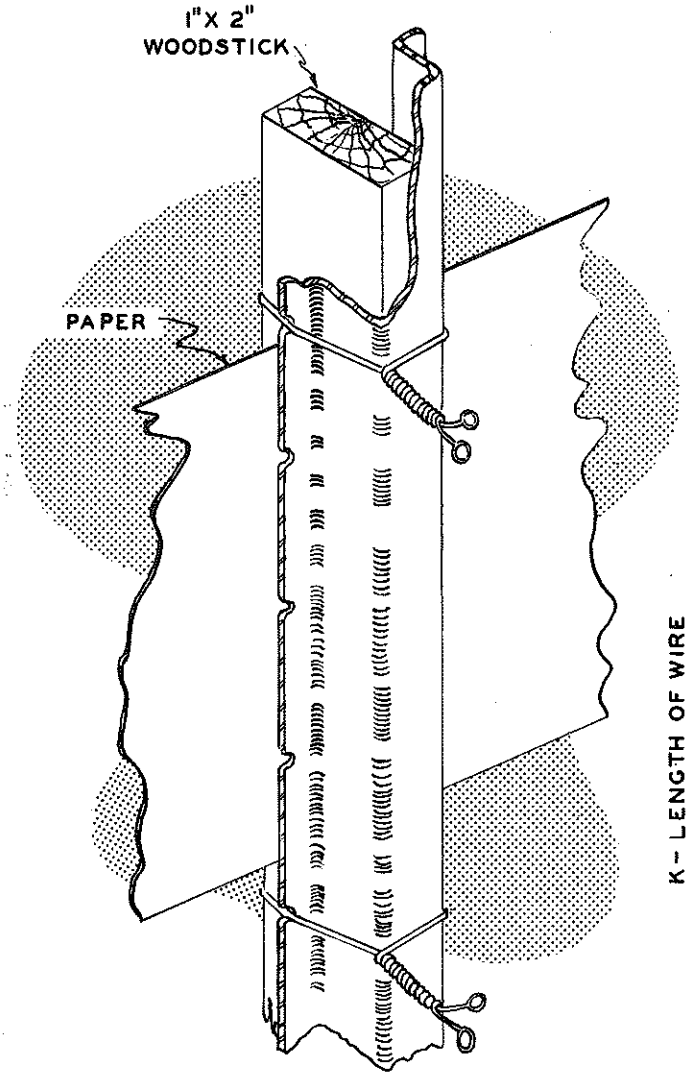


TIE WIRE — NO. 14 GAUGE — 10 INCH LENGTH.

FIGURE 3

TYPICAL OSCILLOGRAPH TRACES FOR TESTS ON NO. 14 GAUGE WIRES OF 8" AND 10" LENGTH.





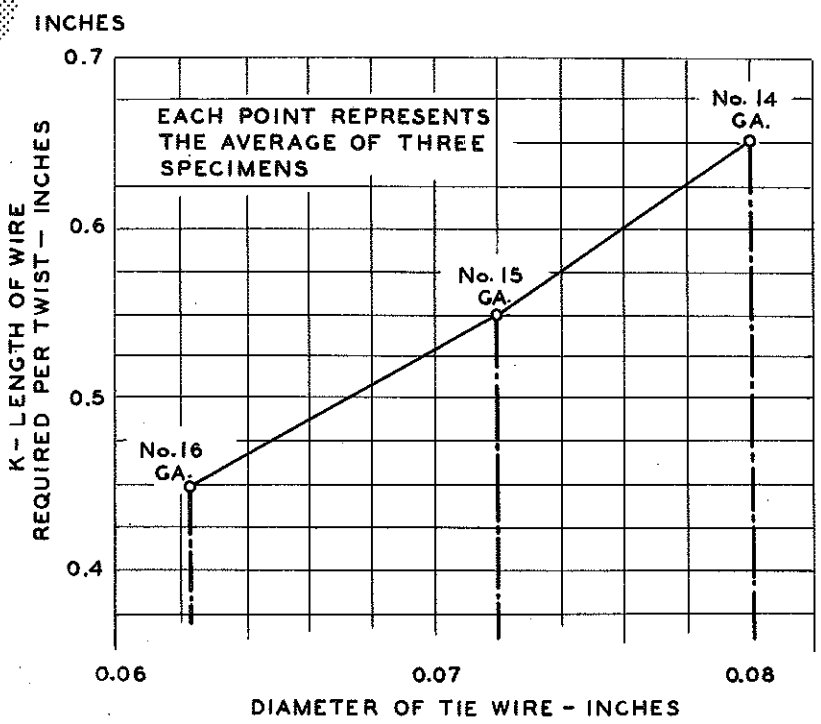
L = OPTIMUM LENGTH OF TIE WIRE.

C = CIRCUMFERENCE OF POST PLUS 1"X 2" WOOD STICK BINDING PAPER TO POST.

K = LENGTH OF WIRE REQUIRED PER TWIST.

B = LENGTH OF END LOOP.

$$L = C + 3K + 2B$$



VARIATION IN LENGTH OF WIRE REQUIRED PER TWIST FOR VARIOUS SIZED WIRES

FIGURE 4