BULLETINS

OF THE

Aerial Experiment Association

Bulletin No. ~~XXI~~ _____ Issued ~~MONDAY, NOV. 30,~~ 1908

MR. McCURDY'S COPY.

BEINN BHREAGH, NEAR BADDECK, NOVA SCOTIA

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Bulletins of the Aerial Experiment Association.

BULLETIN NO. XXI ISSUED MONDAY NOV. 30, 1908.

Beinn Bhreagh, Near Baddeck, Nova Scotia.

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AERODROME NO.4, McCURDY'S SILVER-DART:
By A.D. McCurdy.

Upon receipt of the following telegram from our Chairman on July 6th, designs were immediately got out preparatory to building the new A.E.A. No.4:-

To The Aerial Experiment Association,
Hammondsport, N.Y.

Pictou, N.S., July 6, 1908:-

If McCurdy wishes to follow on line of "June Bug", I recommend that McCurdy's machine be now built at Hammondsport and headquarters be retained there for the present. In meantime don't run any risk of injuring "June Bug" until an application for a patent has been prepared. Would like Baldwin to help me in Baddeck soon as possible, and when we are ready for motor would like all to come to Baddeck. If these plans are acceptable would simply let it be known that at my request further trials of "June Bug" will be postponed until another aerodrome has been completed so that in case of accident to one machine another will be available for experiments. Would say nothing about patents outside as this would only stir up other inventors to forestall us in the patent office. Telegraph reply to Baddeck.

(Signed) Graham Bell.

Experiments with the June Bug seemed to indicate that more powerful tip controls would be an advantage, (Fig.1) especially in attempting to complete a turn and possibly describing a circle. To accomplish this end we gave the machine greater lateral extension than in the case of either of the former machines, (49 ft.) and also increased the area of the tip controls themselves, (40 sq.ft. total area). Although it was conceded that a plane having the form of the letter S (roughly) in cross section was the form having the greatest efficiency, as demonstrated by W.R. Turnbull of New Brunswick,

we came to the conclusion that if a rib was formed up being of single curvature, it would take the form of the Turnbull curve when acted upon by the air pressure as the machine glided through the air, if the rear was unrestricted and flexible, but if the rib was moulded with the double curve form the air pressure would bend it up abnormally at the rear and hence produce a detrimental effect.

We, therefore, decided to make up our ribs for the "Silver-Dart" (as A.E.A. No.4 was afterwards named), having the single curvature form (Fig.2). The depth of the planes was reduced at the center from 6ft. 6 inches to 6 ft., and the distance between the planes consequently reduced in the same ratio, (6 ft. 6 inches to 6 ft).

We designed the ends of the supporting planes to have a depth of 4 ft. as in former cases, and also to be 4 ft. apart. This re-proportioning gave the lateral curve of the back edges an evener form and the machine as a whole finer lines (Fig. 3 & 4).

The fish-shaped material used all through is of heavier stock and hence capable of greater rigidity of structure.

Turnbuckles, (Fig.5 shows fastening at top and Fig. 6 that at bottom) are used on each individual wire, so that they can be separately adjusted to receive their proper strain. Two special instruments were devised; one as a tool for constructing the turnbuckle and the other a wrench to facilitate the screwing up of these turnbuckles. (Fig. 7 & 8).

The sockets used to connect the struts to the lateral chords are in their simplest form, doing away with the jack joint used on the "June Bug". The projecting spike at the end of the socket passes through the straps to which the guy wires are secured and then into the hole prepared in the socket connecting the sections of the lateral chords. (Fig. 9 & 10).

The tightening up of the turnbuckles of the guy wires prevents these spikes from coming out. A single wire passing through the middle of the struts and connected by a V wire to both the top and bottom chord at the lateral extremities of the machine seems to answer the purpose of steadying the struts better than two wires, as in former cases, and it also offers less head resistance. (see Fig. 1).

The cloth used to cover the ribs, etc., forming the supporting surface is similar to that used by Capt. T.S. Baldwin for his Government balloons, although lighter in weight, (2 ounces per sq. yard) and having silk on only one side of the rubber coating. It forms a beautiful surface, rubber side down, and is easy to handle, and capable of being cemented, as ordinary rubber. he tip controls were covered by making the silk in the form of a triangular bag and drawing it on tightly over the frames thus making an equally clean surface on the top and bottom. As in the case of the June Bug, a steel tube rib is placed at the junction of each section and acts as a spreader for the lateral chords. (Fig. 11,12,13 & 14).

The central panel is made exceptionally strong for various reasons. The bending moments are greatest there and

also as the dead load is located at that point the racking strains tell more there than elsewhere. This panel is made up first and is complete in itself. The four wings when placed in position fit into projecting sockets from each side of this panel, and are secured in place by the same method employed throughout the structure, viz. of attaching and tightening up the turnbuckles. Thus the four wings can be readily removed without disturbing the central panel, engine-bed, propeller or running gear. Figs. 15,16,17 & 18 show the various points of construction of this panel.

The silk of the "Silver-Dart" is made in sections corresponding to the panel where it is to be used, and laces o a steel rib at each end. Thus the whole machine, silk and all, is made in sections so as to facilitate in repair work, should we be unfortunate enough to have an accident. The advantage of having silk in sections in "knocking down" the machine is also apparent. The ribs slide into pockets prepared on the silk, from the rear passing under the back lateral chord and butting neatly against the back edge of the front chord and are secured in place by square tin caps, which slip over the rear end. These caps, one for each, and are strung on a wire which passes through a seam in the rear of the silk and is secured at its ends to the lateral margin of the aeroplane, and to the central panel, being drawn taut by means of a turnbuckle. There are two of these wires to a plane, one for the port wing and one for the starboard.

The rudder used on the "Silver-Dart" is of quite small dimensions (4ft. high by 2 ft. deep) and is constructed, as far as the silk is concerned, similarly to the tip controls,

i.e. covering made as a bag and drawn on over the framework and laced at the top. As both sides of the rudder act at different times, this method gives them even resistances. The rudder is placed 11 feet back from the rear lateral chord, and is supported simply by four hinged bamboos so constructed that by releasing two lateral guy wires the whole thing folds up flat against the rear of the planes. The rudder is operated by small wire cable connected to the tiller of the front wheel (fig. 19). The bow control is double-decked, rigidly constructed throughout and placed 15 feet forward of the front lateral chord. It is operated similarly to that used in the "June Bug", by a direct bamboo rod at the rear end of which is the steering wheel. Push the wheel forward, it depresses the machine; pull it back and the machine rises; turn it to port or starboard, and the machine obeys respectively, whether on the ground or in the air.

The front control measures 12 feet long by 28 inches wide and 30 inches between the planes. It is supported five inches back from its front edge by a bamboo cantilever truss as shown by Fig. 4.

It was our original intention to carry two persons in the "Silver-Dart", one sitting directly behind the other; hence a seat was designed for the purpose and made adjustable so that it could be slipped forward and backward readily in balancing up the machine. The second man would sit directly over the theoretical center of pressure at our traveling speed, so that the carrying of the passenger on leaving him behind would not affect the balance. The tips are controlled

by a device which does not interfere with the man sitting behind the operator, and the device is also adjustable with the seat. (Fig.3).

The pole connecting the steering wheel to the front control can be lengthened out or shortened in determining where the operator shall sit, by means of a telescopic tube which can be secured at any desired point.

The running gear or truck is almost the same as that used in the "June Bug". There are improvements of construction and the material is heavier (Fig. 20).

The engine used was especially built for the "Silver-Dart" and is a Curtiss eight cylinder, water-cooled 50 H.P. motor, (see Bulletin XVI) which weighs without water or oil, but including all water connections and counter-shaft 202 lbs. It is placed with its bed immediately on top of the lower rear lateral chord, and braced directly from the stringers of the truck (see Fig. 3 & 4). Its being placed so low will produce less strain on the structure in landing and will bring the center of gravity of the machine, as a whole, a little lower than in the case of the "June Bug".

The radiator is designed somewhat after that used by the Wright Brothers, (see Fig.4) and the gasoline and oil tank (one tank having a partition) holds 10 and 2 gallons, respectively.

The propellers used are of different designs and are driven by a chain drive in the ratio of 1-1/2 to 1. (Engine turning 1500 revolutions and the propeller turning 1000).

One propeller is used, and the thrust comes about through the line of resistance of the machine, but inclined above the horizontal 3 1/4 degrees. These are made of laminated wood and weigh, including the two clamps, 8 1/4 lbs; of 8 ft. diameter and 17 to 18 degrees pitch at the tip.

The supporting surfaces of the machine are given an angle of attack of 9 1/4 degrees at their lateral margins. This angle is excessive for economical flights, but it facilitates rising from the ground. After the machine is in the air, the angle will be reduced to perhaps 6 degrees.

It is for this reason that the propeller thrust is a little above the horizontal when the machine is on the ground. The proper angle at which to place the counter-shaft for propeller can only be determined by actual experiment.

The actual work of construction of the "Silver-Dart" was under the supervision of our foreman, Mr. Kenneth Ingraham and too much cannot be said in his praise for the care taken by him in the detail work and in generally rushing the assembling to a successful finish.

All the structural members of the "Silver-Dart", fish struts, wires, tubing, bamboo etc., were carefully measured and in accordance with the method and co-efficients used by Mr. Octave Chanute the head resistance of the machine was computed and reduced to its equivalent flat surface in square feet. All figures in square inches.

FISH-SHAPED MATERIAL		NON VIBRATING WIRE	VIBRATING WIRE
Wings	1928.5	976.89	131.30
Struts	1068.0		
Additional fish	326.0		
	3342.5		

TUBING	TIMBER	BAMBOO
668.00	365.5	345.0

---oOo---

DESCRIPTION	SQ. INCHES	CO-EFF.	EQUIV. SURFACE
Fish-shaped	3342.50	1/6	557.08
Non Vib Wire	976.89	1/2	488.44
Vib Wire	131.30	1.5	196.95
Tubing	668.00	1/2	334.00
Timber	365.50	1	365.50
Bamboo	490.00	1/2	245.00
		Total	2188.97

Hence the total head resistance , 2188.97 sq. inches,

or 15.19 sq. ft.

DATA.

Total area of supporting surfaces.....420 sq. ft.

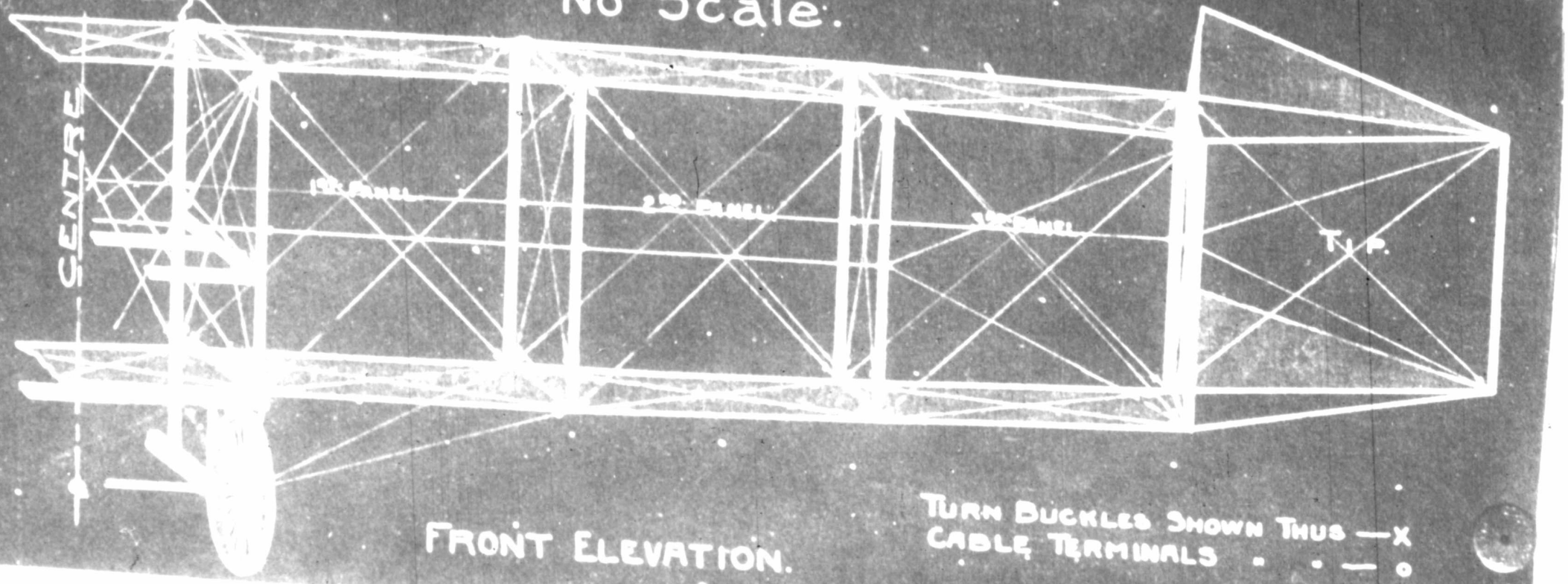
Weight of machine, exclusive of engine and accessories	345 lbs
Weight of engine, propeller and counter-shaft etc	210 lbs
Weight of radiator	15 lbs
Weight of water	30 lbs
Weight of gasoline, oil and tank, full	110 lbs
Weight of man, say	150 lbs
Total	860 lbs

and as $\frac{860}{420}$ = 2.04. Hence ratio equals 2.04 lbs. per sq. ft.

i.e., flying weight = 2.04 lbs. per sq. ft.

J.A.D. McC.

LEFT WING OF GLIDER IN PERSPECTIVE, SHOWING WIRE SUPPORTS AND STEEL RIBS IN POSITION.
No Scale.



FRONT ELEVATION.

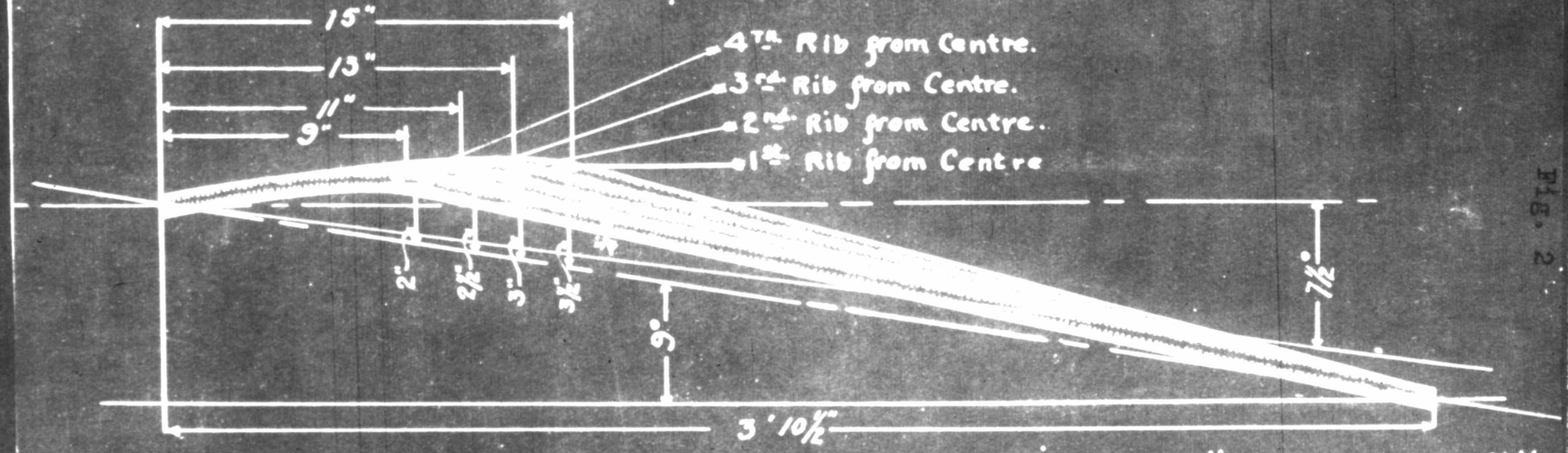
TURN BUCKLES SHOWN THUS —X
CABLE TERMINALS . . — o

HAMMONDSPORT N.Y.
SEPTEMBER 24TH 1908.

Bulletin No. XXI

SHOWING DECREASE IN CURVATURE OF STEEL TUBING RIBS.

Scale – 2 inches = 1 ft.



SIDE VIEW.

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SEPTEMBER 23RD 1908.
PAT.

FIG. 2

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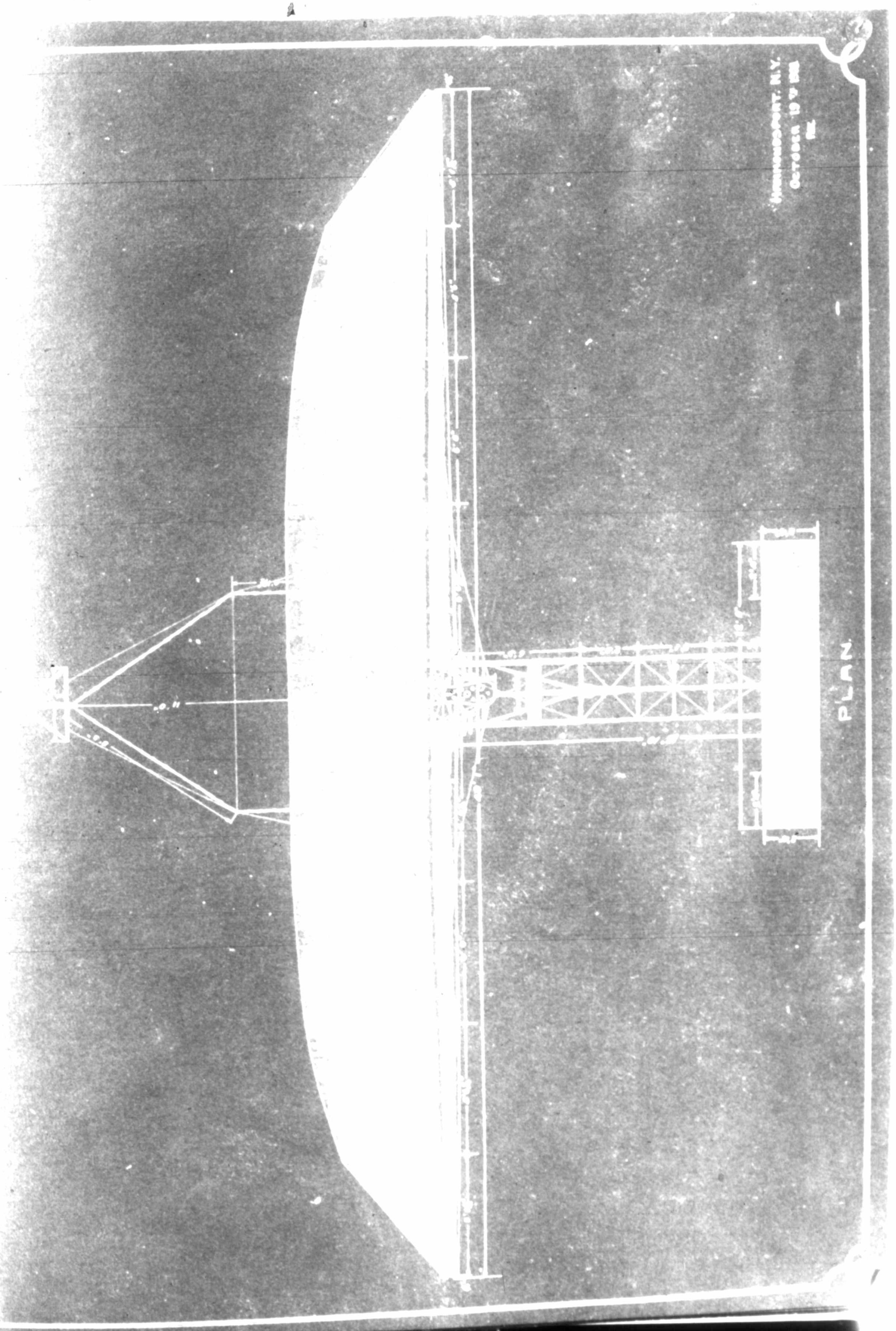
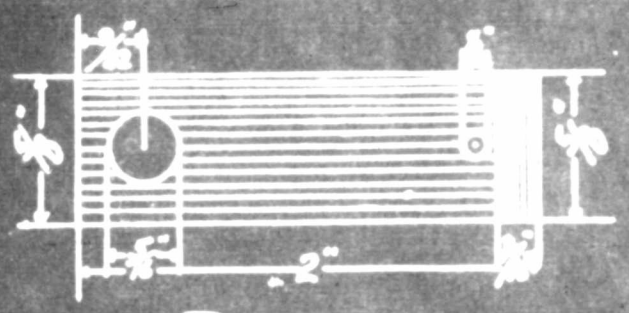


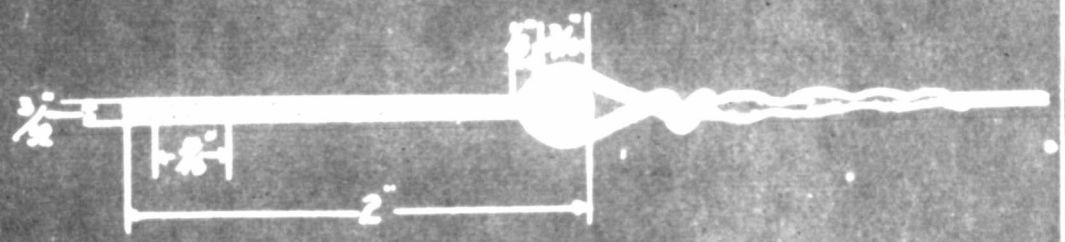
SILVER DART

22 GAUGE BAND IRON CABLE TERMINAL, LARGE SIZE.

FULL SIZE.



PLAN.

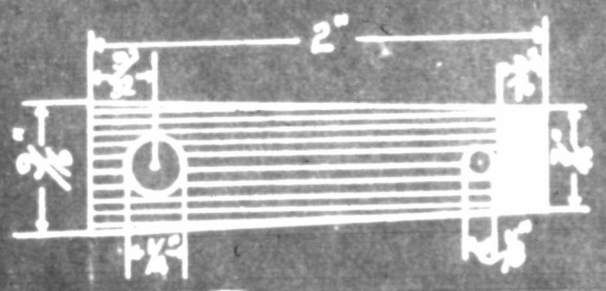


SIDE VIEW.

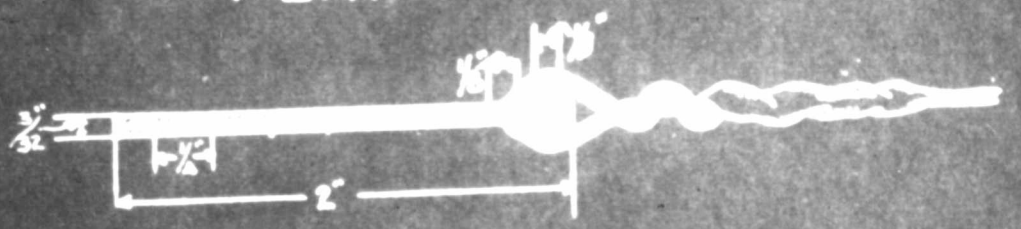
HAMMONDSPORT N.Y.
SEPTEMBER 21ST 1908.
PAT.

22 GAUGE BAND IRON CABLE TERMINAL SMALL SIZE.

FULL SIZE.



PLAN.

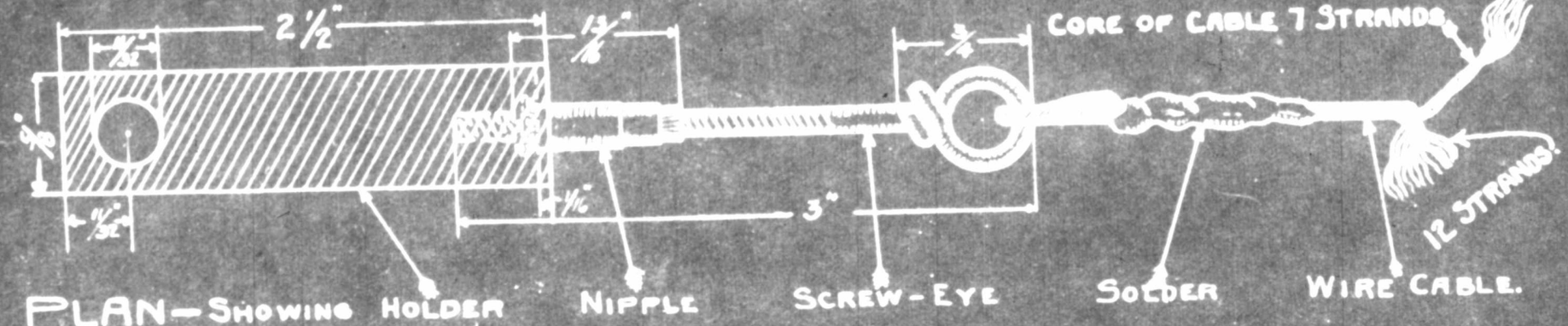


SIDE VIEW.

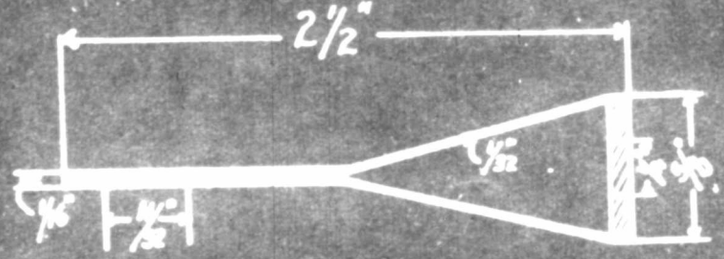
HAMMONDSPORT N.Y.
SEPTEMBER 17TH 1908.
PAT.

LARGE TURN BUCKLE OF 22 GAUGE SHEET IRON WITH BRACE ATTACHED.

FULL SIZE



PLAN—SHOWING HOLDER NIPPLE SCREW-EYE SOLDER WIRE CABLE.



SIDE VIEW OF HOLDER.

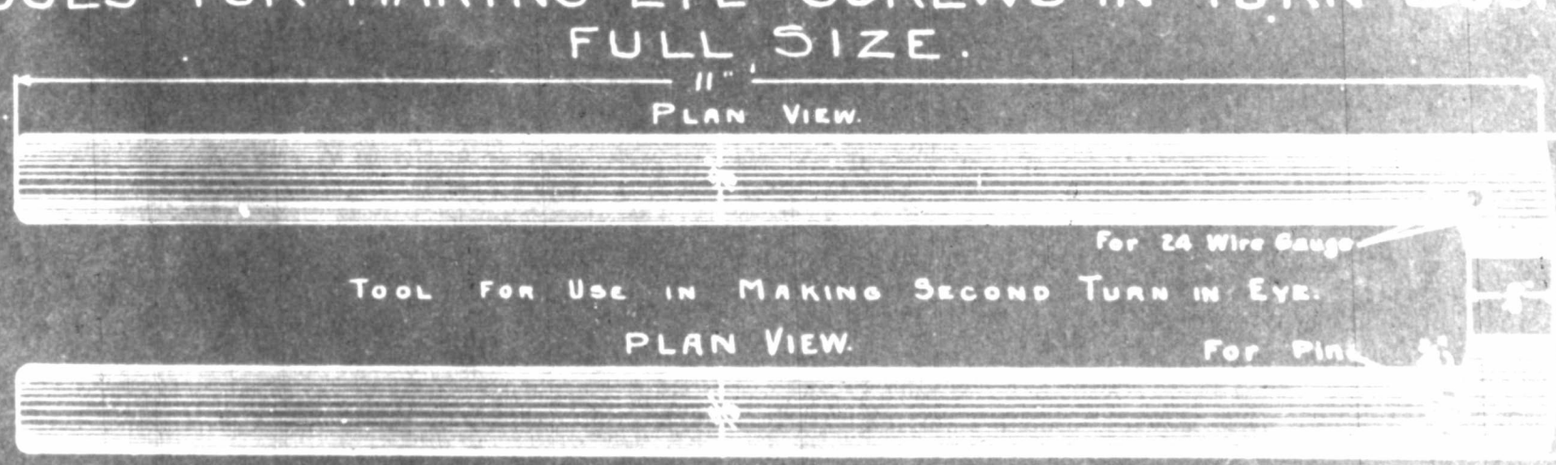
END VIEW.

HAMMONDSPORT. N.Y.
SEPTEMBER 17TH 1908.
Pat.

Fig. 6

TOOLS FOR MAKING EYE-SCREWS IN TURN BUCKLES.

FULL SIZE.



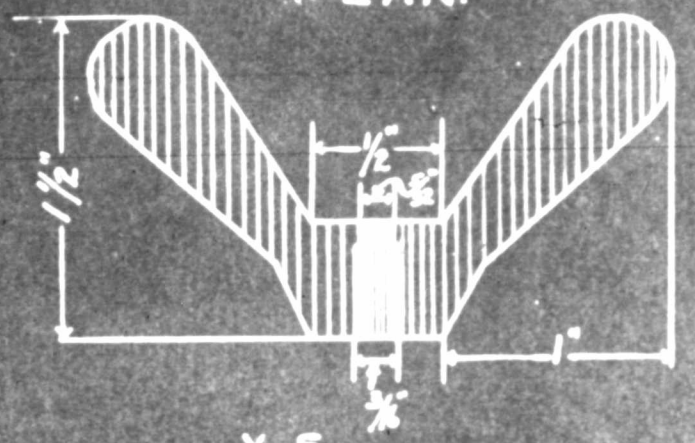
PIN AROUND WHICH EYE IS MADE.
FULL SIZE.

Fig. 7

NICKLE PLATED TURN BUCKLE ADJUSTER.

FULL SIZE.

PLAN.



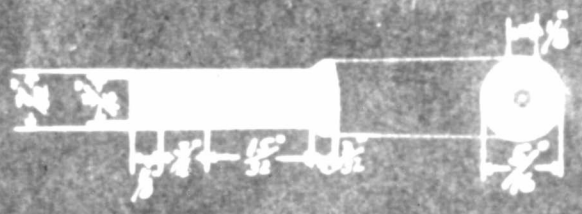
X SECTION.

BOTTOM VIEW.

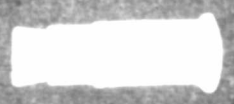
HAMMONDSPORT. N.Y.
SEPT. 19TH 1908.
CBT

9/64"-40 THREAD SPOKE NIPPLE.

FULL SIZE.



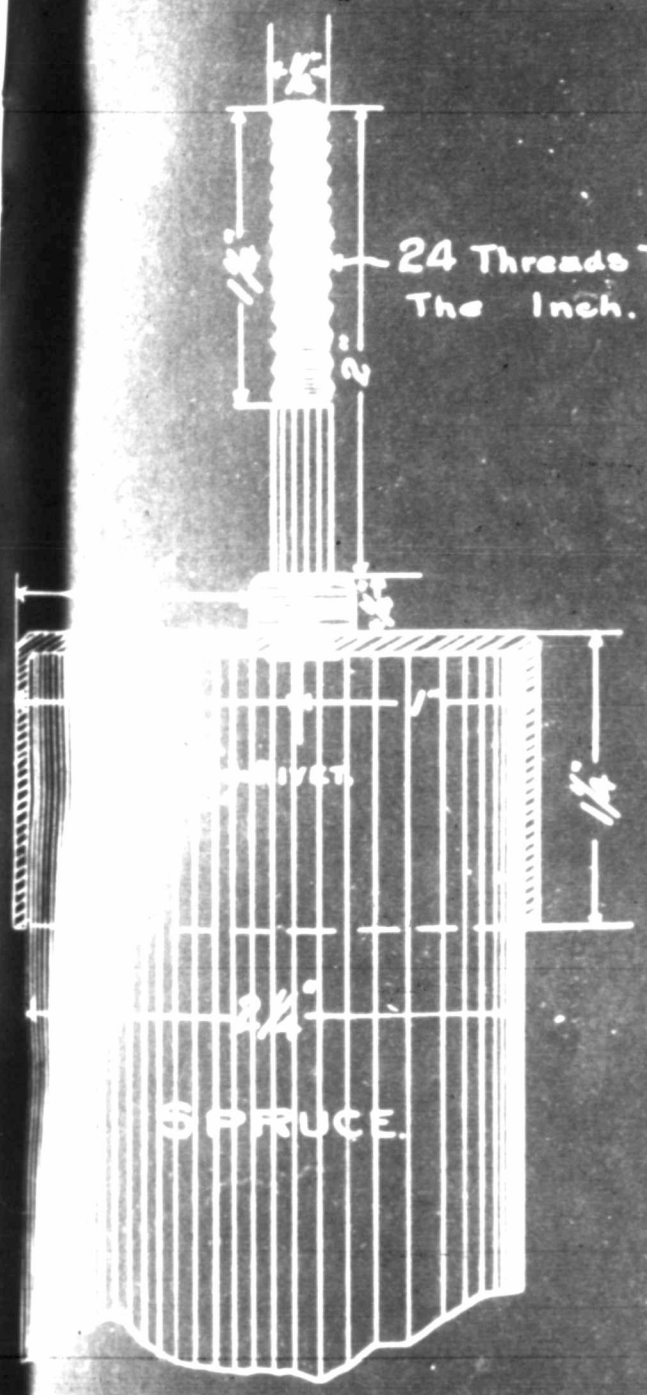
PLAN. END VIEW.



X SECTION.

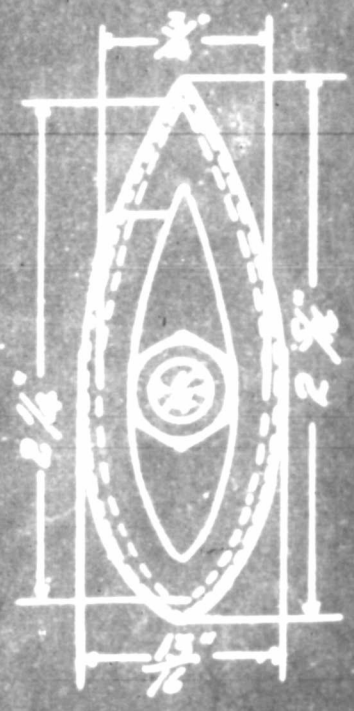
HAMMONDSPORT N.Y.
SEPTEMBER 14TH 1908.
PBT.

2 G[illegible]GE SHEET IRON SOCKET FOR LARGEST STRUT. FULL SIZE.



SECTION OF SOCKET AND SIDE VIEW OF STRUT.

FRONT END VIEW.

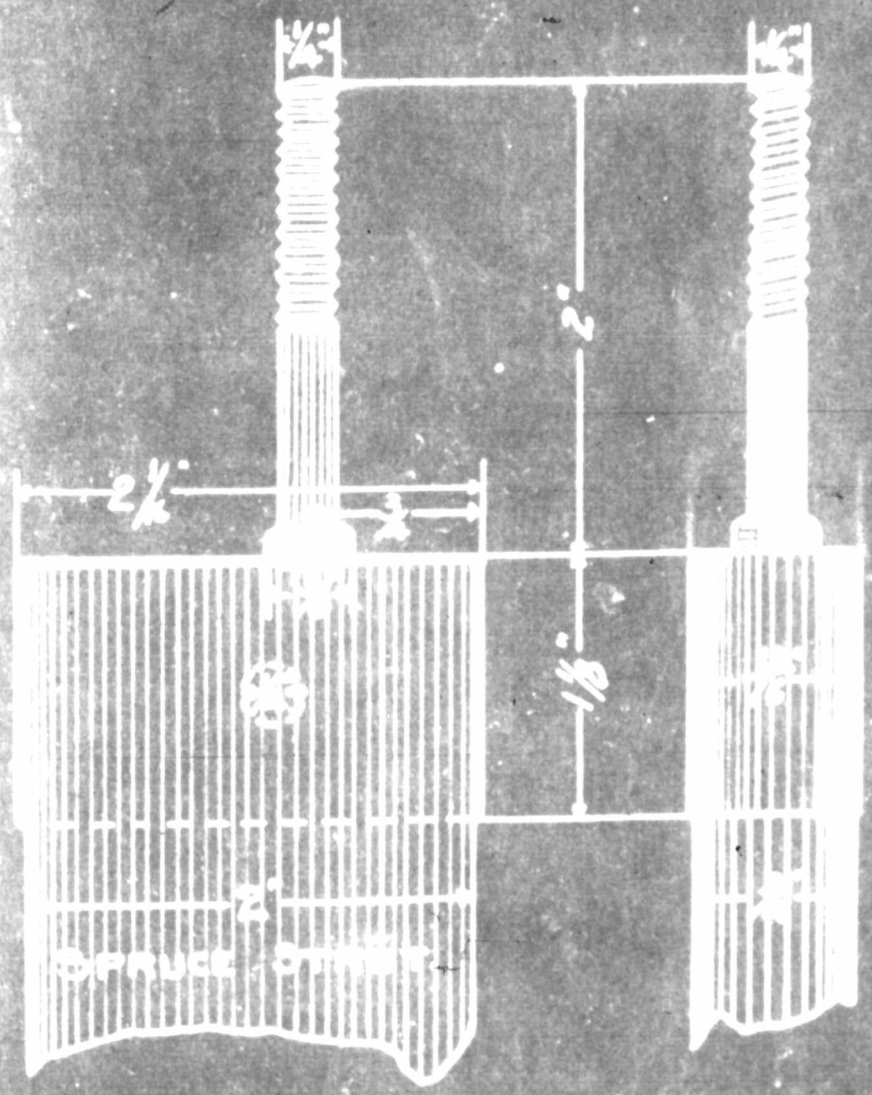


PLAN.

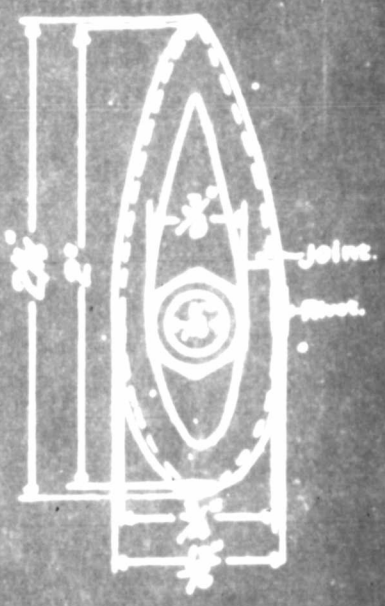
HAMMONDSPORT N.Y.
SEPTEMBER 14TH 1908.

2 Gauge Sheet Iron Socket For Small Strut.

Full Size.



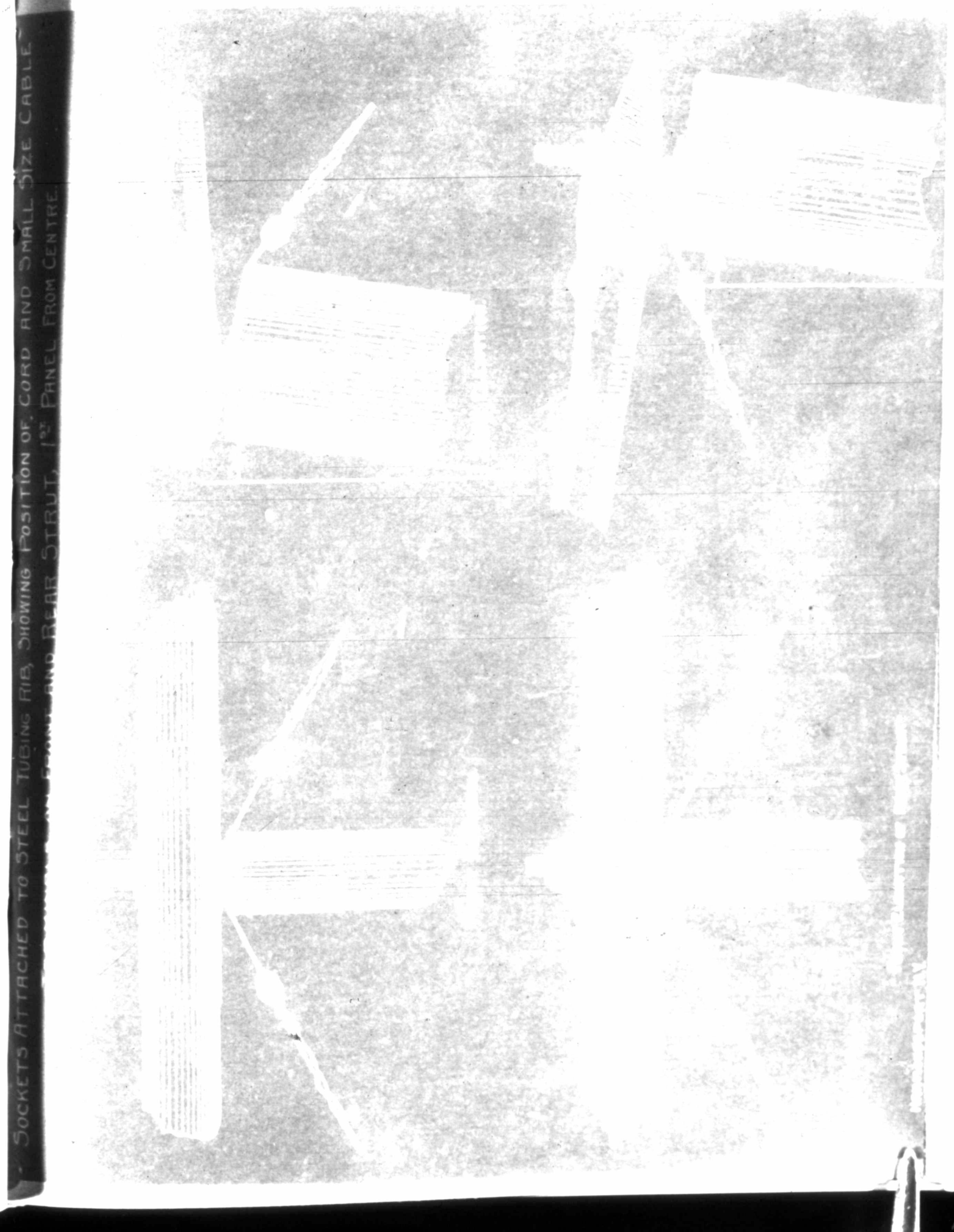
X Section.



Plan.

Front End View.

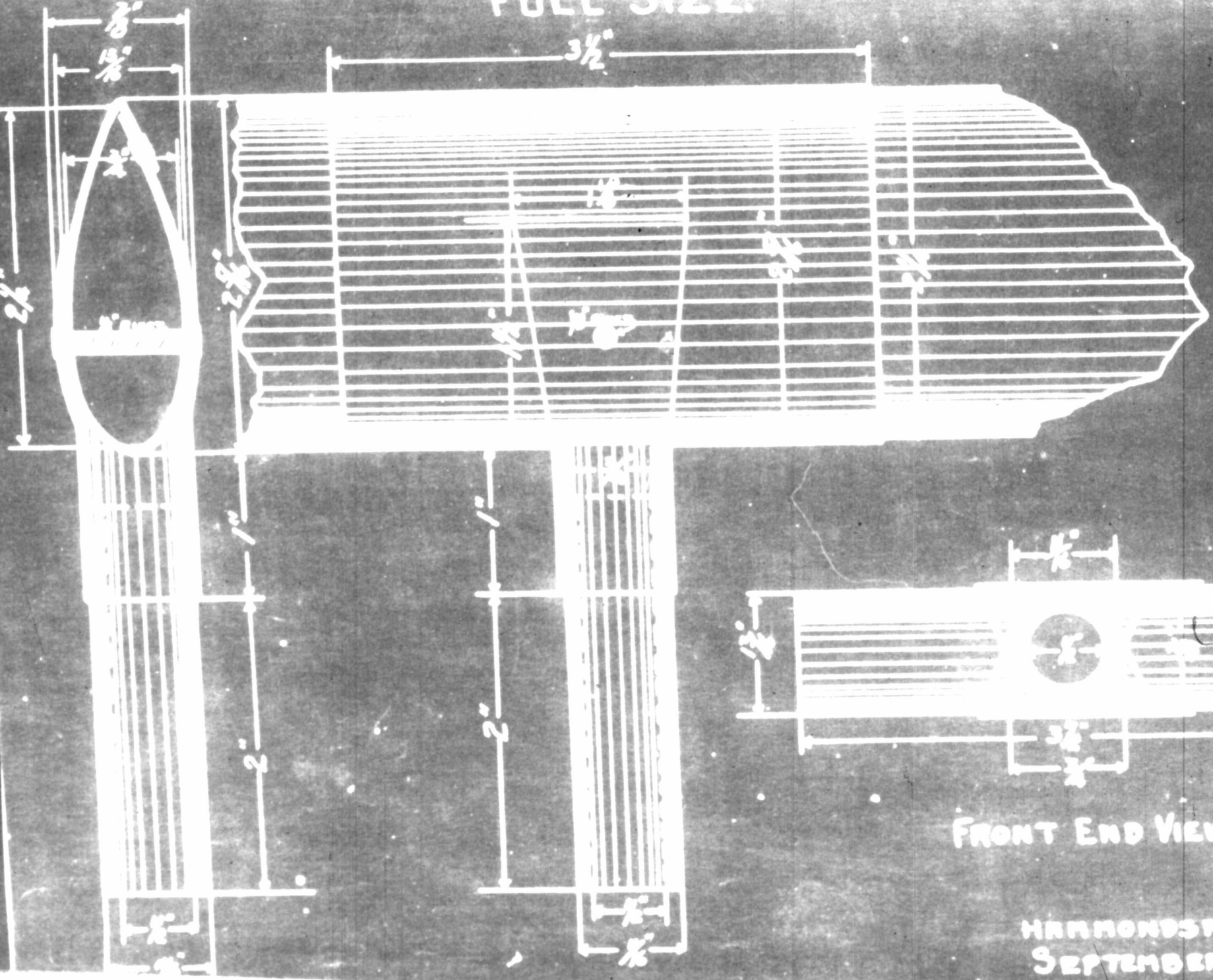
Harmonsport N.Y.
September 15th 190



Sockets Attached to Steel Tubing Rib, Showing Position of Cord and Small Size Cable Front and Rear Strut, 1st Panel from Centre.

STEEL RIB SMALL SIZE SHOWING

FULL SIZE



FRONT END VIEW.

HAMMONDSPORT. N.Y.
SEPTEMBER 22ND 1908.

Bulletin No. XXX

Fig. 13

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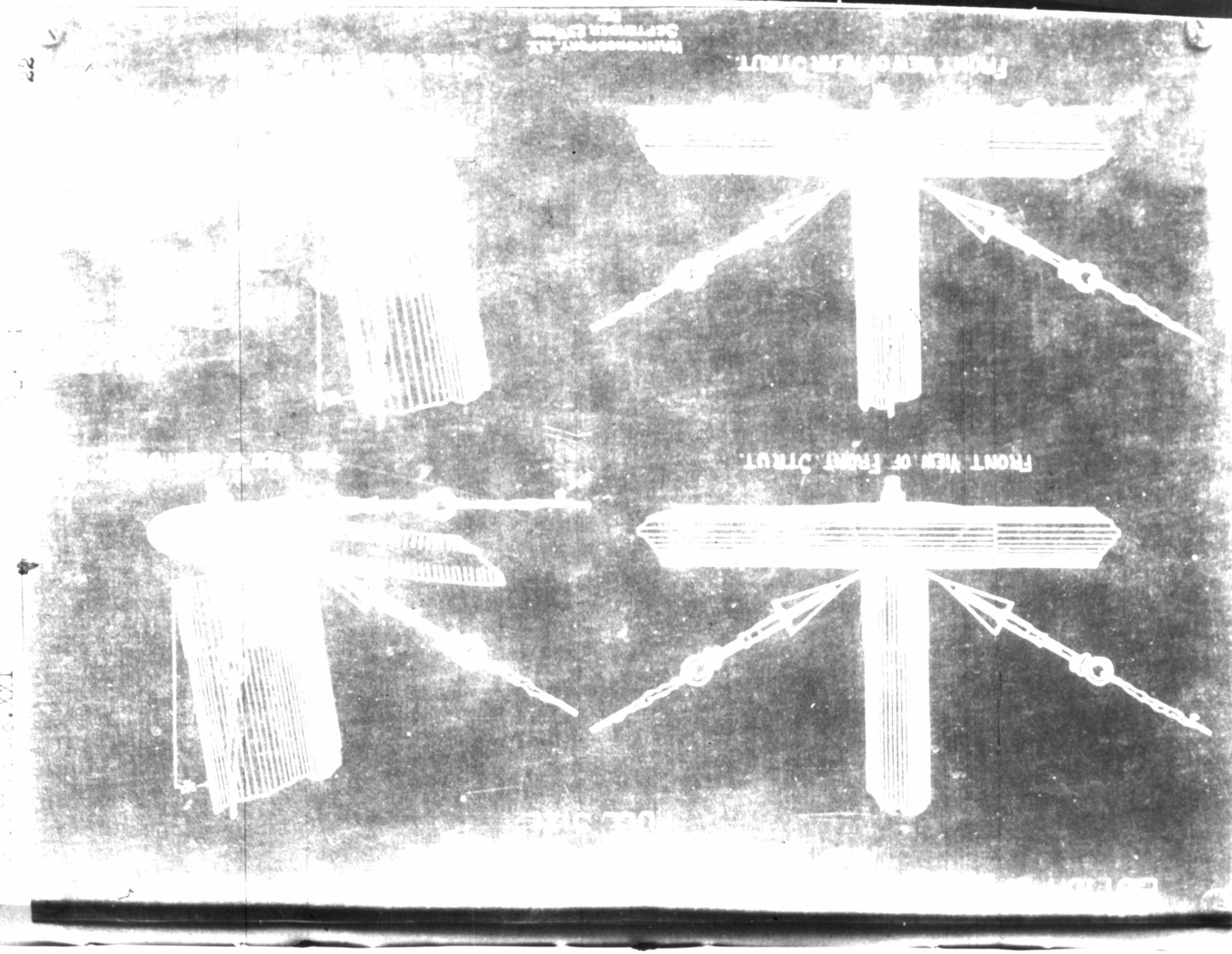
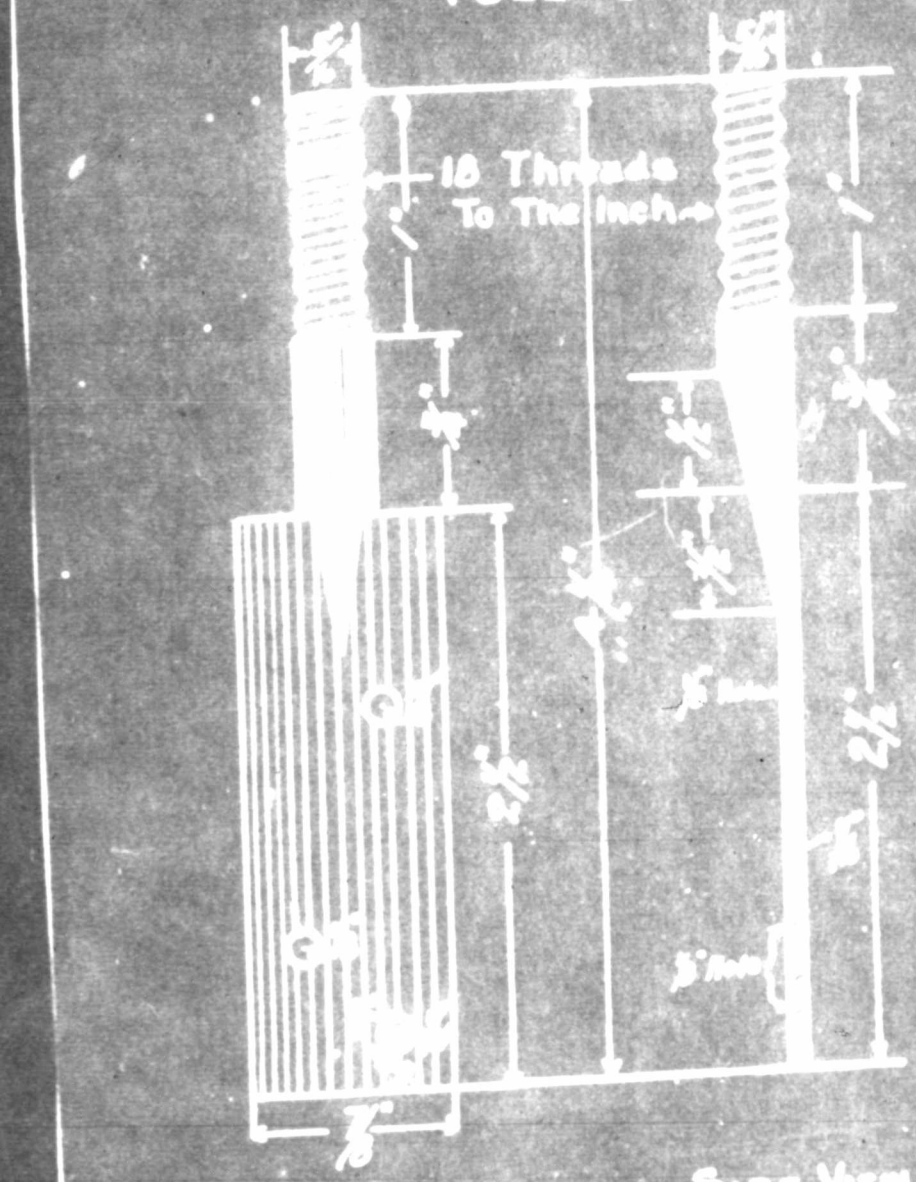
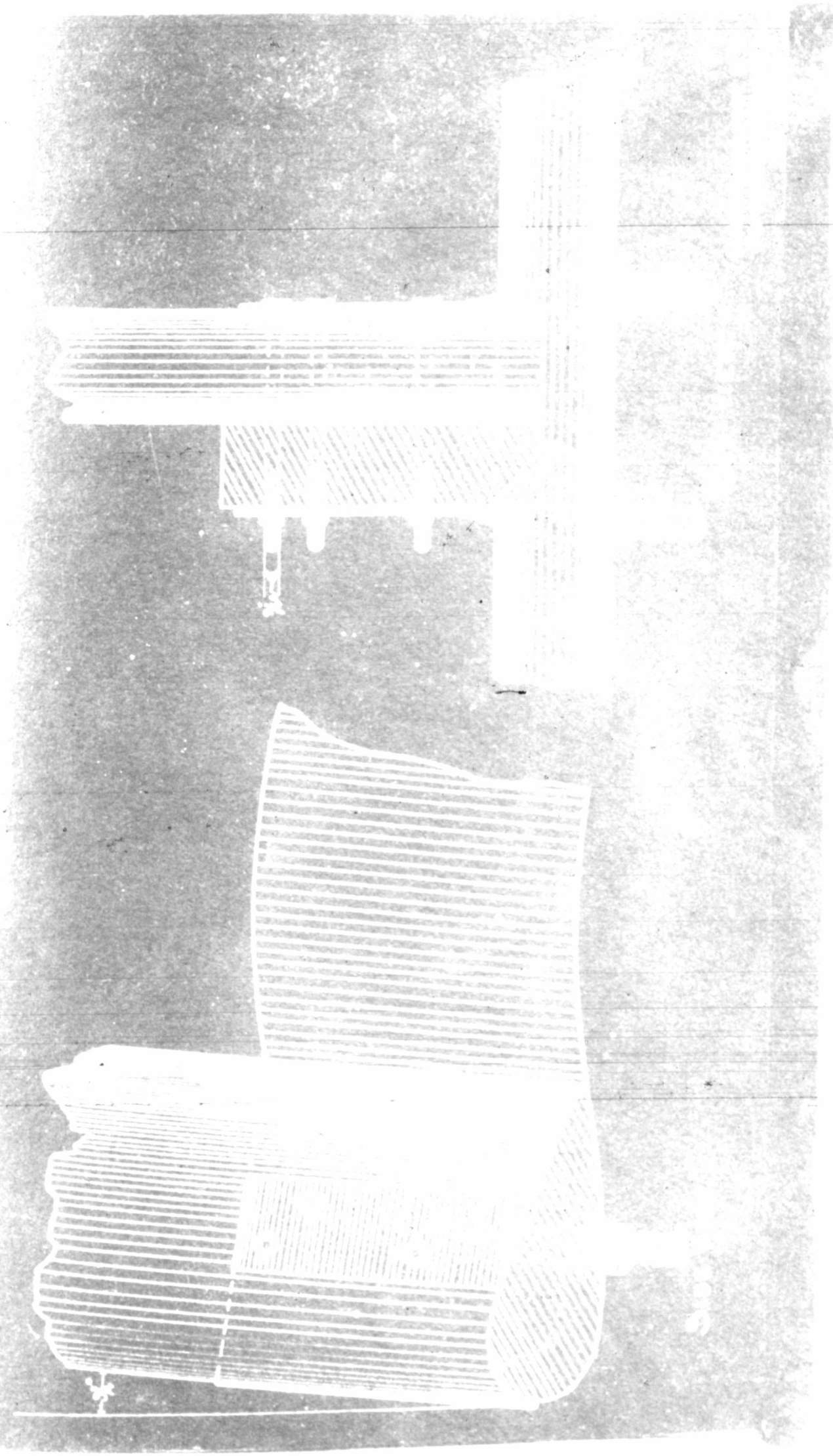

FRONT VIEW OF REAR STRUT.
FRONT VIEW OF FRONT STRUT.

17 Gauge Sheet Iron Strut End Fastener at Lower Centre Panel. Full Size.



Hammondsport N.Y.
September 16th 1908



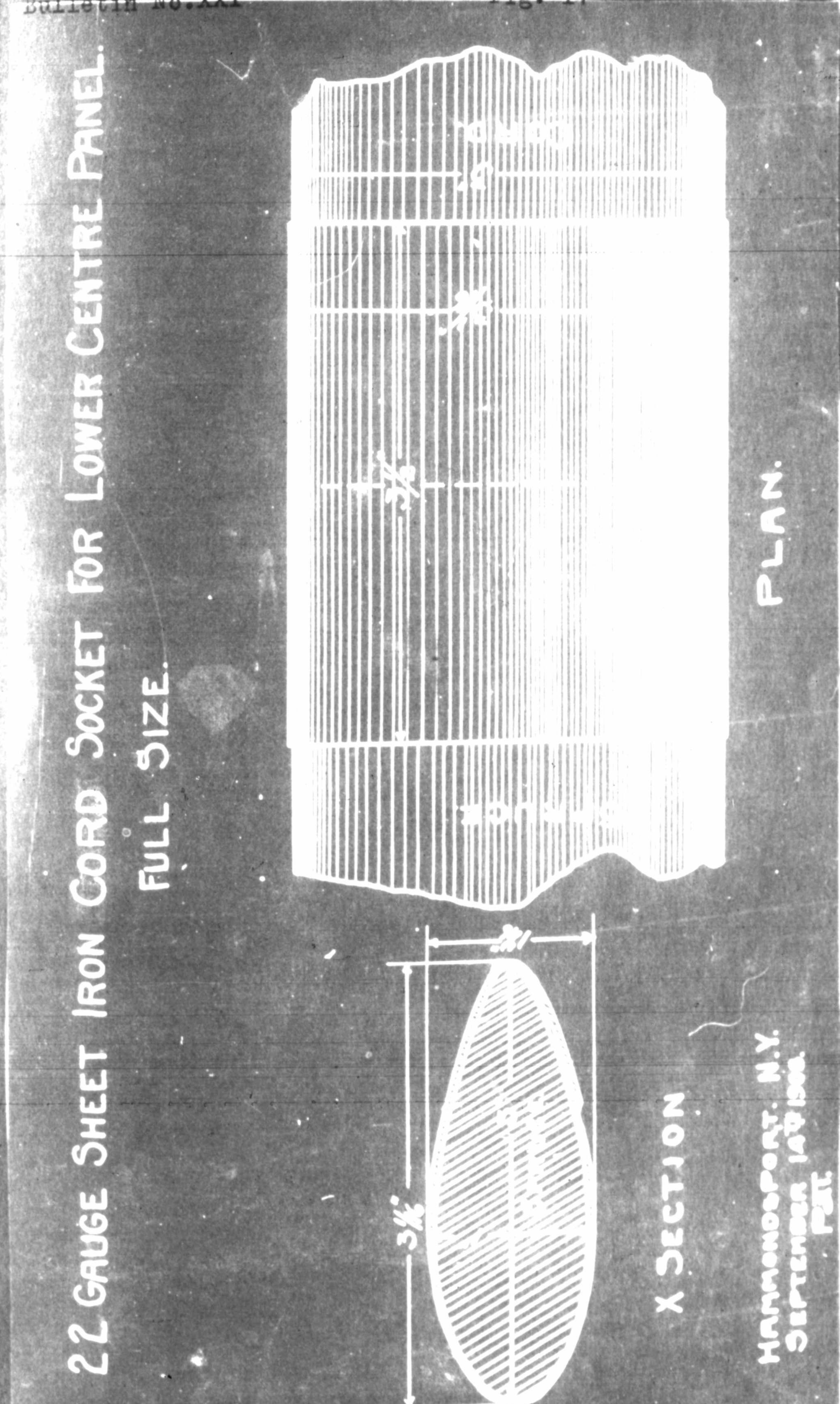
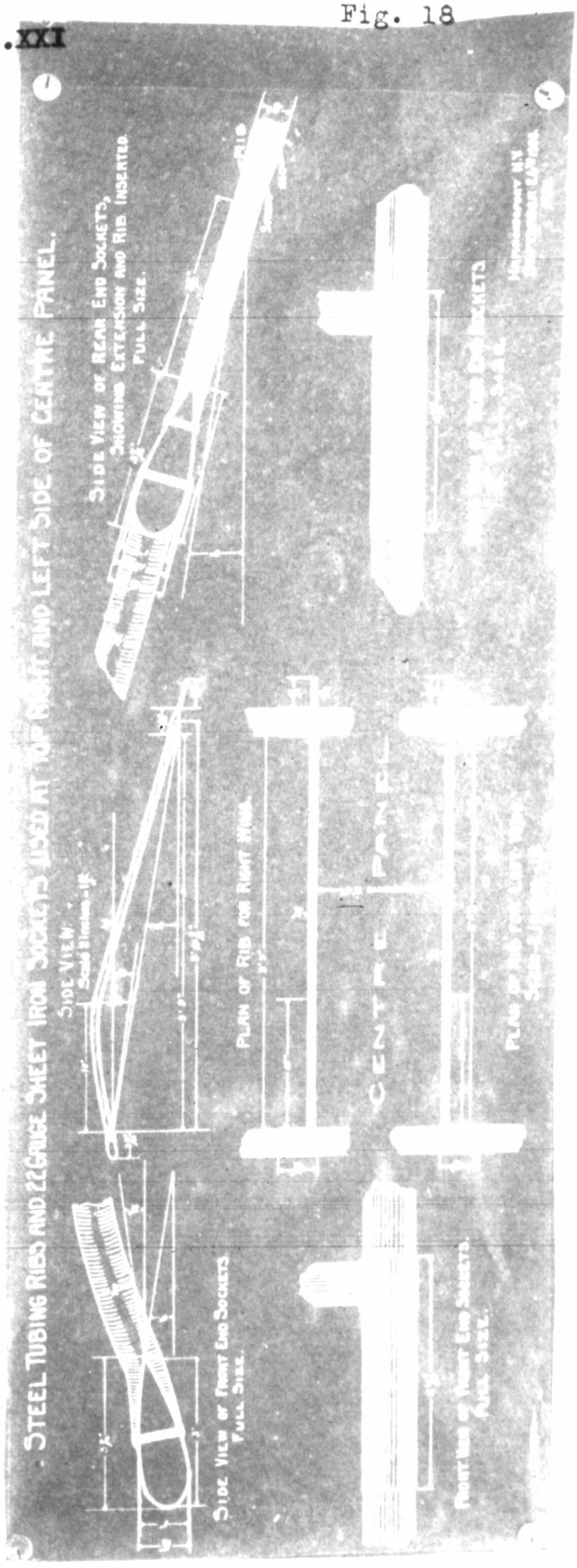

22 GAUGE SHEET IRON CORD SOCKET FOR LOWER CENTRE PANEL.
FULL SIZE.
PLAN.
X SECTION
HAMMONDSPORT, N.Y.
SEPTEMBER 14TH 1908.

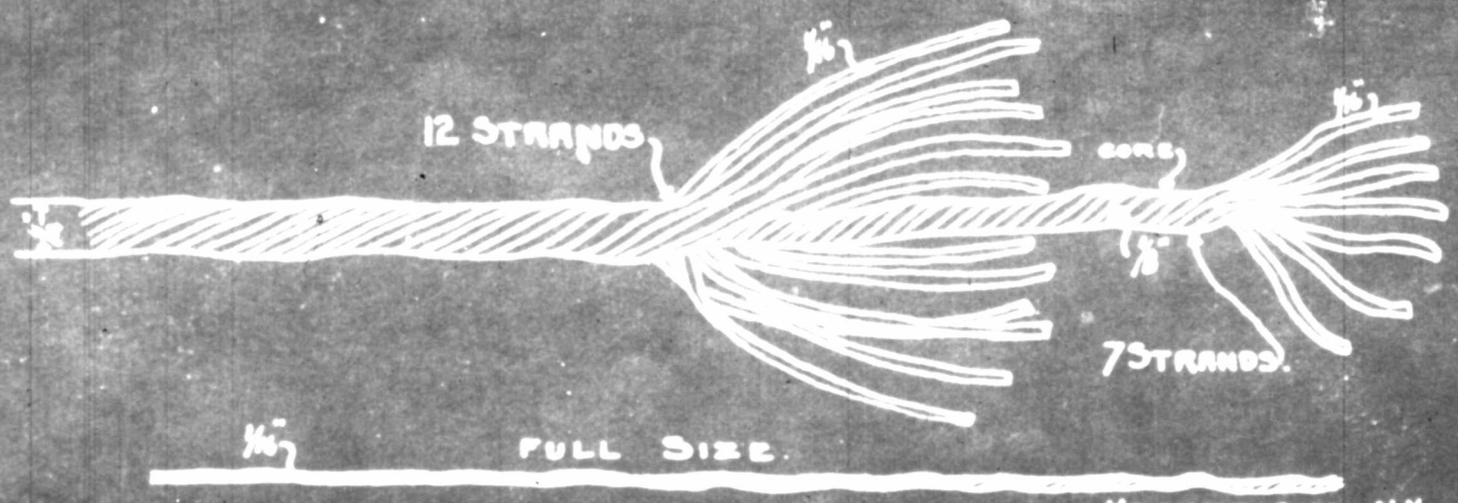
Fig. 18


STEEL TUBING RIBS AND 22 GAUGE SHEET IRON SOCKETS
USED AT TOP RIGHT AND LEFT SIDE OF CENTRE PANEL.
SIDE VIEW OF REAR END SOCKETS, SHOWING EXTENSION AND RIB INSERTED. FULL SIZE.
SIDE VIEW OF FRONT END SOCKETS FULL SIZE.
PLAN OF RIB FOR
CENTRE
PLAN OF REAR END SOCKETS. FULL SIZE.

Bulletin No. XXI

HAMMONDSPORT N.Y.
SEPTEMBER 26TH 1908.
PAT.

GALVANIZED PLOUGH STRAND CABLE OF 1/16" DIA. WITH 19 WIRES.
Scale - ENLARGED 4 TIMES.



HAMMONDSPORT N.Y.
SEPTEMBER 29TH 1908.
PAT.

FIG. 19

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Fig. 20

INGRAHAM'S FOLDING TAIL: By J.A.D. McCurdy.

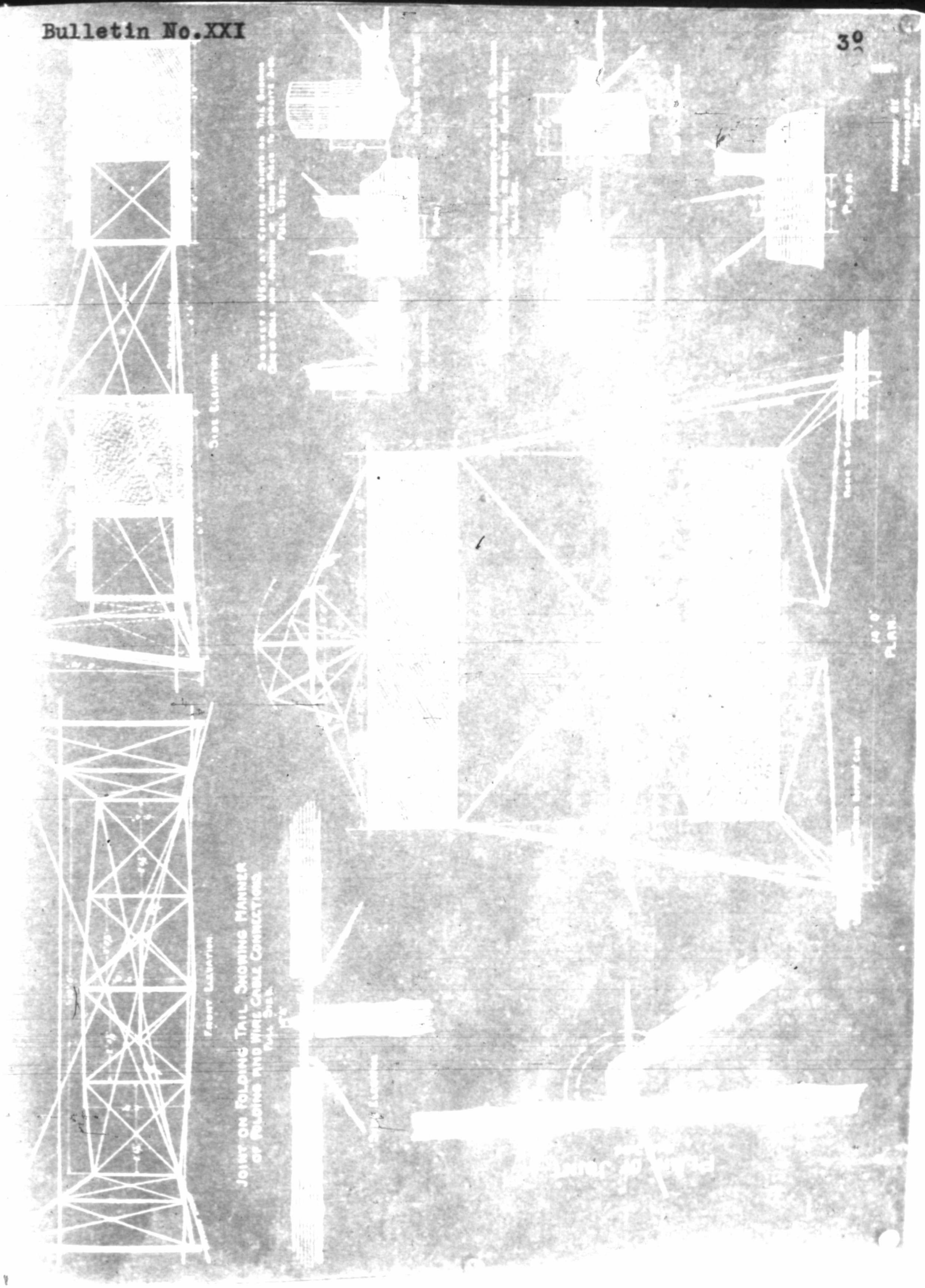
Although we have in our experiments with the "Red Wing", "White Wing", and "June Bug" gone through the stage of using a horizontal tail on Chanute type aerodrome, it may be as well to place on record some account of the folding tail used on the "June Bug".

The following diagrams show pretty well how, by the letting go of a few guy wires which brace the tail to the main planes, the bamboo sticks forming the tail, supporting lines, double up on themselves and allow the box tail to fold right in against the rear of the main planes.

This was found to be of great advantage in housing the machine as the size of the tent required, especially in the lateral dimension, was considerably reduced.

The idea of folding was thought of an worked out by Mr. Ingraham.

J.A.D. McC


JOINT ON FOLDING TAIL SHOWING MANNER
OF FOLDING AND WIRE CABLE CONNECTIONS
Full Size.