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COVER SHEET FOR TECHNICAL MEMORANDUM

TITLE-- The Jansky Antenna Replica
at Green Bank, W. Va.

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ABSTRACT

A brief history of the circumstances leading to the construction of a full scale replica of the Jansky rotating antenna array for the National Radio Astronomy Observatory is given. Copies of the source materials and photographs of the original antenna, which provided the information used to ensure the accuracy of the replica, are attached. A complete set of the drawings made for building and assembling the replica is included. Photographs showing details of the initial replica assembly on Crawford Hill, and a view of the final installation at Green Bank, are also attached.

Text 5 Pages
Figure Captions w/Photo Numbers
Figures 1 - 16 Inc.
Drawing List
Drawings 23

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BELL TELEPHONE LABORATORIES
INCORPORATED

SUBJECT: The Jansky Antenna Replica
at Green Bank, W. Va.
Case - 22098

DATE: October 3, 1966

FROM: A. C. Beck

MM-66-1261-2

MEMORANDUM FOR FILE

On April 15, 1960, Grote Reber wrote a letter to George C. Southworth saying, "It would be suitable and appropriate to have a replica of Jansky's original antenna to full scale" at the National Radio Astronomy Observatory in Green Bank, West Virginia. A copy of this letter is attached to this memorandum as Fig. 1. Southworth called me the day he received the letter, and later sent it to me. He answered Grote Reber the next day, saying that I had agreed to go through Jansky's records and other sources to find out as much as possible about the original antenna.

Most of the records were readily available to me, for I had looked up much of the background material on which Southworth's paper about Jansky's work entitled "Early History of Radio Astronomy" was based. In addition, I had used Jansky's rotating array structure for a number of antenna measurement projects, and was quite familiar with its construction, as I had made numerous alterations and additions during this work. C. P. Clausen had been responsible for its original erection

at Holmdel after its move from Cliffwood, and had made alterations on it later for me and for other members of staff. We think its last use was for testing an early warning radar antenna during the war by W. D. Lewis.

Written records proved to be scarce. Jansky's notebooks contained only diary type entries, samples of which are shown on Fig. 2, but these were sometimes helpful. Progress Reports helped with dates, but told little about antenna details. The notebook referred to "drawing up plans for the array". Investigation showed that shop sketches were not returned to staff members at that time, but were bound in covers and retained. The old ones were located in the attic, but there were only four sheets that had any connection with this antenna. Copies of these sheets are attached as Figs. 3, 4, 5 and 6. They had some dimensions, so helped considerably. Array element sizes and lengths could be found from some notebook entries, a knowledge of the design and operating wavelengths, and some information still in existence about other Bruce arrays. A small amount of information was found in Jansky's publications, particularly "Directional Studies of Atmospherics at High Frequencies". Perhaps the most useful information was available from two photographs. One was used in his original publications, and is attached as Fig. 7. Another was the famous one that has been used and published in many places. It was taken by a

commercial photographer, Jake Eickenbush of Newark, N. J., on June 6, 1933, for publication in an article about the Holmdel Laboratory in the July 1933 issue of "New Jersey Bell" magazine. A copy is attached as Fig. 8.

When it became evident that there was enough information to prepare drawings, the matter was discussed with the publication department. They contacted the National Observatory people, and consideration began to be given to having the Laboratories construct and donate a replica. As a result, on July 19, 1960, A. R. Thompson and I made a visit to the Green Bank Observatory. Grote Reber was there on that day, and we had a very interesting time discussing the possibilities of erecting a replica, what parts were available, how much of the work they could do, and other details. After this, A. R. Thompson wrote a memorandum proposing that the antenna be built by us and presented to the Observatory.

Drawings for the replica project were prepared by S. J. Bennett as information was found or worked out. His thorough study of all the source material, discussions with people who knew about the antenna, and determination of details from the photographs, made a large contribution to this project. The complete set of these drawings is attached to this memorandum, and listed on the summary sheet.

The antenna replica was then constructed at Crawford Hill by our carpenter shop under the personal supervision of

C. P. Clausen, whose background of experience and knowledge of the original antenna contributed greatly to this undertaking. No parts of the original antenna were found, although a diligent search was made, except the main gear reducer on the motor drive. This was used on the replica.

A number of old Ford Model T wheels and axles had been obtained personally by Grote Reber for such an antenna. They were stored in New Jersey, and he donated them for use on this structure. We got them from storage, and installed them on the framework.

Every effort was made in the construction of this replica to ensure the longest possible life. The best available materials were used, such as Wolmanized lumber, extra heavy galvanizing on steel parts, many brass and bronze fittings, teflon as well as glass curtain insulators, and weatherproofing of the drive mechanism. Although some materials are slightly different from the original for this reason, care was taken to make this an accurate and true replica of the original in all other respects.

Since it had to be taken apart and shipped to Green Bank in "kit form", markings on the parts together with detailed assembly drawings and photographs were provided to facilitate reassembly by Observatory personnel. These photographs, as well as the drawings, are also attached to this memorandum as Figs. 9-15, inclusive.

After its first assembly here, the replica was dismantled, and then shipped to Green Bank on November 12, 1963. It was reassembled on a new circular track near the main entrance by the Observatory staff, where it is capable of rotation at the same rate Jansky used. I stopped at Green Bank later on a vacation trip, and discussed details with them. The installation there is very well done, and is flood lighted at night, as is Reber's original antenna, making it quite spectacular. A bronze plaque on a monument near the structure gives pertinent data and the fact that it is a gift from Bell Telephone Laboratories, Inc. A photograph of the final installation at Green Bank is attached as Fig. 16.

Formal presentation to Associated Universities was made with fitting ceremonies by W. O. Baker during a visit to Green Bank by the National Science Board on March 17, 1966.



A. C. BECK

HOH-1261-ACB-BCF

Att.
Figure Captions w/Photo Numbers
Figures 1 - 16 inc.
Drawing List
Drawings 23

FIGURE CAPTIONS

- Fig. 1. Copy of Letter dated 15th April 1960 from Grote Reber to George C. Southworth.
- Fig. 2. Copy of typical entries in K. G. Jansky's notebook 10136.
- Fig. 3. Copy of original shop sketch entitled "Jansky's Turntable Array Frame 5/26/30".
- Fig. 4. Copy of original shop sketch entitled "Side bracing of first one".
- Fig. 5. Copy of original shop sketch entitled "2nd one at each end".
- Fig. 6. Copy of original sketch of center post and main bearing details.
- Fig. 7. Copy of photograph B66-8710HO of original Jansky Array used in Jansky's publication "Directional Studies of Atmospherics at High Frequencies".
- Fig. 8. Copy of photograph 234550 of K. G. Jansky and the original antenna array taken on June 6, 1933.
- Fig. 9. Photograph A63-9757HO of replica assembly on Crawford Hill.
- Fig. 10. Photograph A63-9753HO of replica center post, sprocket and lower center section - detail.
- Fig. 11. Photograph A63-9751HO of replica lower section at wheel supports - detail.

Fig. Captions - 2

Fig. 12. Photograph A63-9752HO of replica lower section between wheels and end - detail.

Fig. 13. Photograph A63-9755HO of replica end section lower part - detail.

Fig. 14. Photograph A63-9749HO of replica upper section at wheels - detail.

Fig. 15. Photograph A63-9750HO of replica upper section between wheels and end - detail.

Fig. 16. Photograph B66-8674HO of replica final installation on track at Green Bank, West Virginia.

DRAWING LIST - JANSKY ANTENNA REPLICA

B608241	Center Post
B608242	Collar
B608249	Plate
B608250	Angle
B608251	Plate
B608252	Center Bearing Assembly
B608253	Clamp
B608254	Holder
B608255	Side, Motor Box
B608256	End, Motor Box
B608257	End, Motor Box
B608258	Corner Angle
B608259	Mounting, Angle
B608260	Lid, Motor Box
B608261	Motor Box
B796283	Array Element (Fixed)
B796284	Array Element (Adjustable)
B796285	Array Element (End Section)
B796287	Array Assembly
B796291 - Sheet 1	Basic Frame
B796291 - Sheet 2	Basic Frame
B796296	Clamp
B799805	Turntable Assembly

15th April 1960
General Delivery
Wailuku, Maui
Hawaii

Dr. George C. Southworth

Catham, New Jersey

Dear Dr. Southworth:

During the past several months I have been in Australia and Macquarie Island looking for a good place to do low frequency radio astronomy during the next solar activity minimum. Presently, I am in the process of folding up my affairs here preparatory to returning to Green Bank for a spell.

My old Wheaton dish is being rehabilitated as an ornament on the left side of the entrance to NRAO. It would be suitable and appropriate to have a replica of Jansky's original antenna to full scale on the right side. This is one of the projects I hope to undertake at Green Bank. We have a variety of fotos showing many details, but nothing suitable for giving absolute size and proportion. I wonder if you could locate some drawings showing overall dimensions or else some fotos giving independent side and end views. If the old foundation ring can still be seen, some accurate dimensions of this will be very useful as the rest of the structure may be scaled from it.

The wheels and axels were taken from model T Ford cars. These seem to be still available in West Virginia. The antenna was driven by some kind of a chain and sprocket arrangement. Please try to locate some details on this so that we can get it right. Perhaps if you make inquiry among the old timers at Holmdel, enough information may be secured to produce an accurate reproduction in working order. My own opinion is that, if the job is worth doing, it is worth doing well.

I should be back in the New York area by early June. Maybe we can get together then. You should come to Green Bank and see NRAO next summer. The establishment is now taking form and is quite something.

73, (best regards)

Grote Reber
Grote Reber

FIG. 1

12/10/29 Work on the array.
 The array is now on its wheels & center post. 72
 Let about maximum starting torque at
 any position is 17 lbs.
 Allowing a safety factor of 100%
 force required to pull at the end is 34 lbs.
 Distance travelled is 282.7 ft.
 Work done in one revolution is the for $34 \times 282.7 = 9613.3$
 ft lbs.

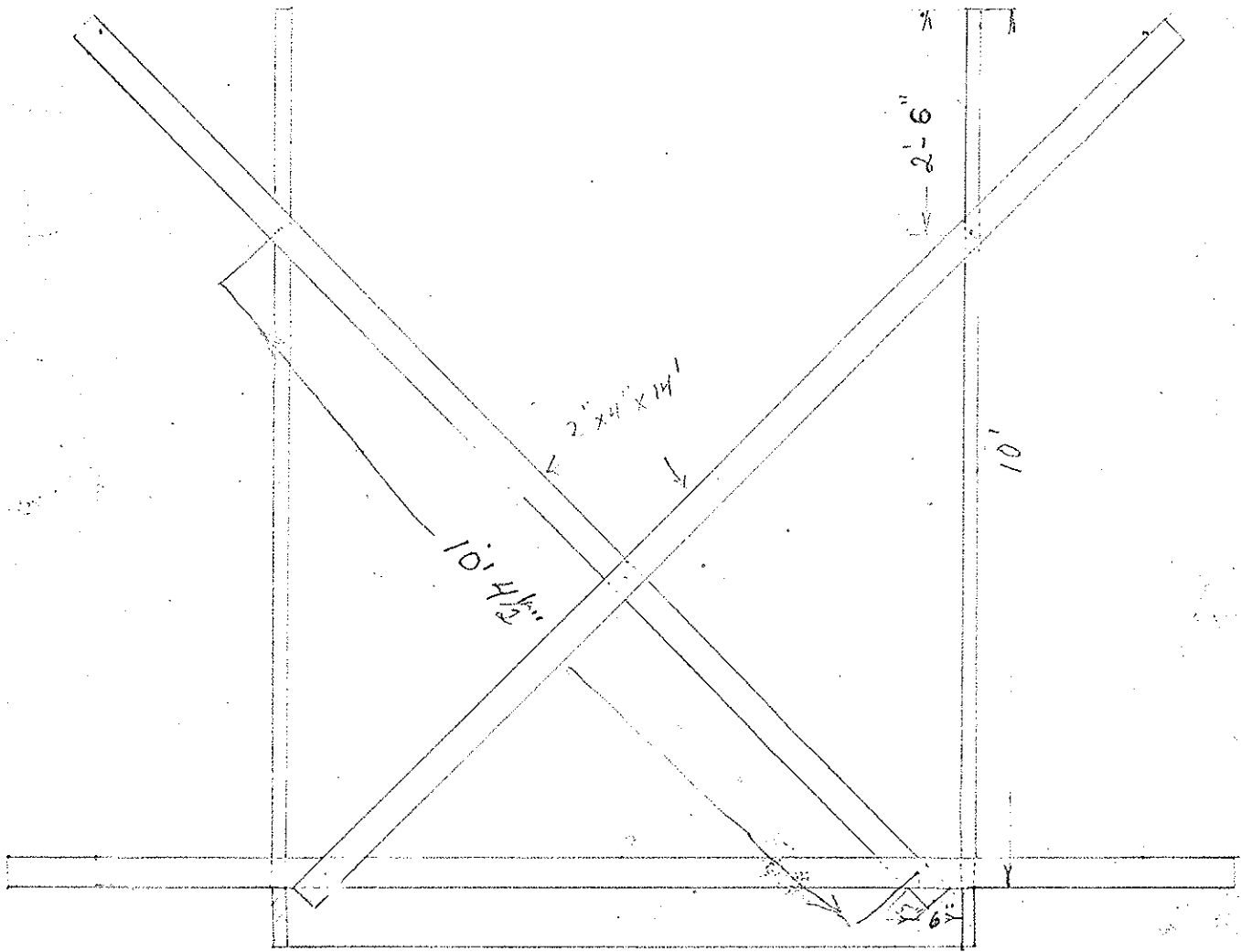
72
 $3600 \times 16 = 500$
 $1500 \text{ RPM} = 500$
 $1200 \text{ RPM} = 500$
 $36000 \times 5 = 3$
 $36000 \times 5 = 3$
 1152
 96
 36000
 24800
 1080
 11
 36000
 5
 720
 116
 432
 72
 576
 72
 192
 48
 12
 73
 DATE

But the array is to make one rev per 20 min
 Therefore power required is $\frac{9613.3}{20} = 480.7 \frac{\text{ft lbs}}{\text{min}}$
 $= .0145 \text{ H.P.}$
 Allowing 50% of output for friction power req. $= .0290 \text{ H.P.}$
 Thus it will be seen that a 1/4 H.P. motor
 should give plenty of reserve power &
 regulated.

7/19/30 Work begun Monday.
 Motor and gear box were connected to the array and tested. It was discovered that a chain tightener would be needed. One was designed & the necessary parts ordered.
 The pipe for the array proper has been installed.
 Both jaws of my set were calibrated as V.T.M. The jaws were adjusted.
 A battery charger was set up in my shack.
 I found that static was getting enough to read on one day at least: July 17. My observations were made during the first 3 days as nothing is known about them.
 -Sheet were static
 Static about 3d & -100 below to read during working hours
 7/21/30 " reached a peak of 15 db above zero level during working hrs.
 7/22/30 and was still going up at 5:00 PM.
 7/23/30 Static reached a peak of 7db above zero during working hrs.
 7/24/30 " 5.29 db.
 and was still going up at 4:30 PM when I turned the set off.
 7/25/30 Static were just barely recordable when I turned off the set at 4:50 PM.

FIG. 2

Jansky's Turntable Array frame 5/26/30

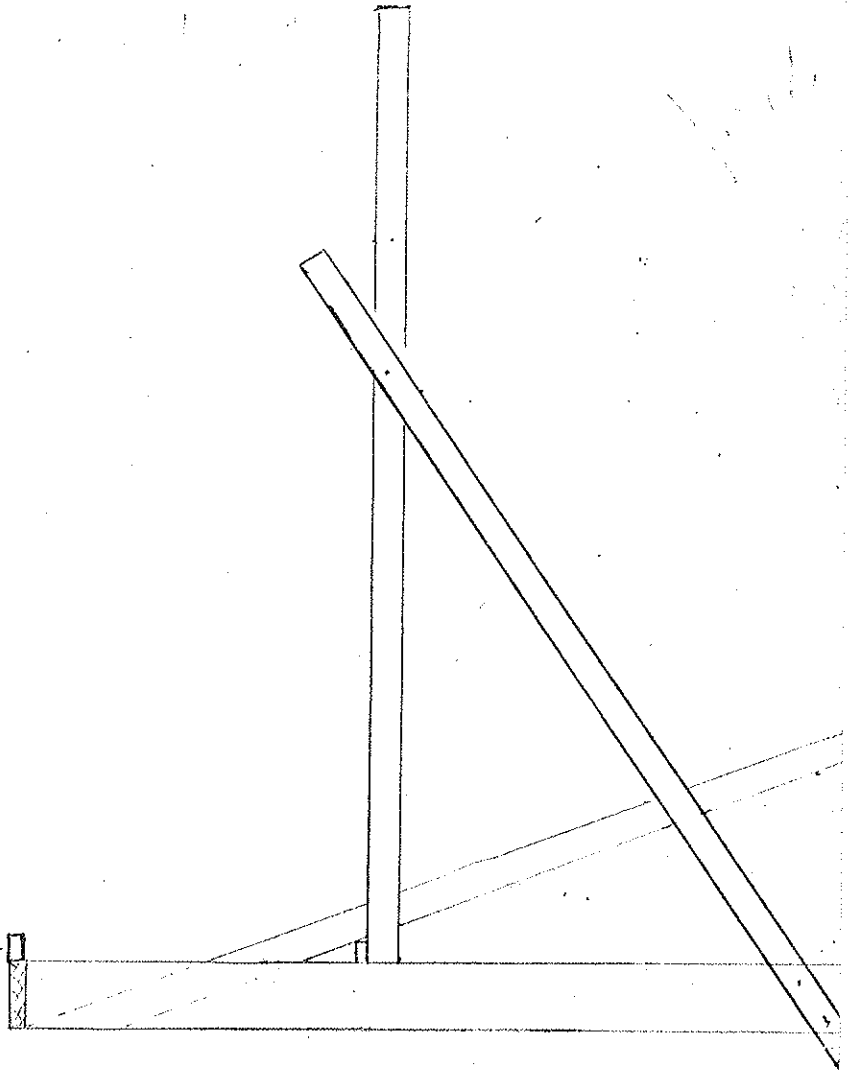


1st one at each end

firm
6-13-
O.J.

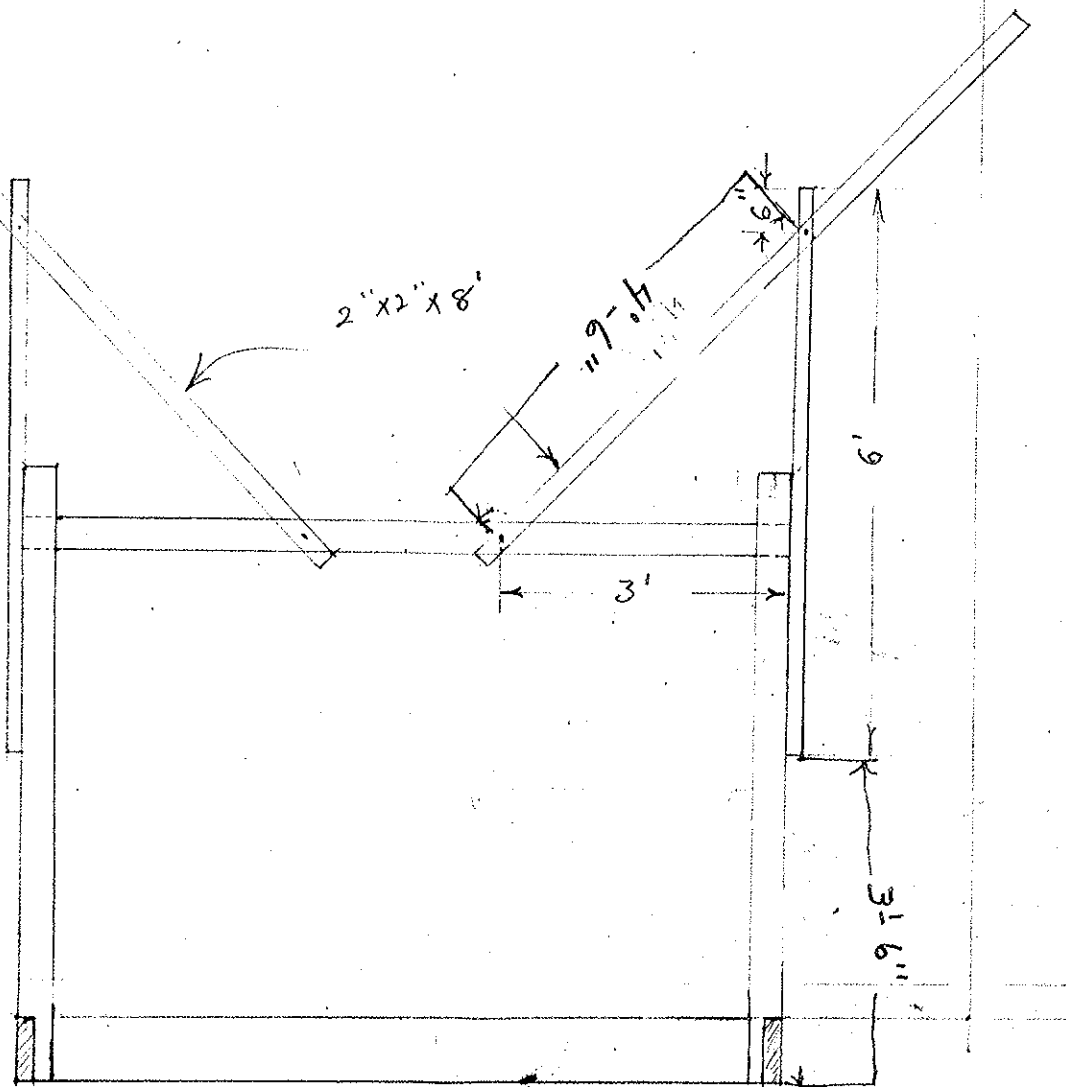
FIG. 3

2" x 4" x 14'



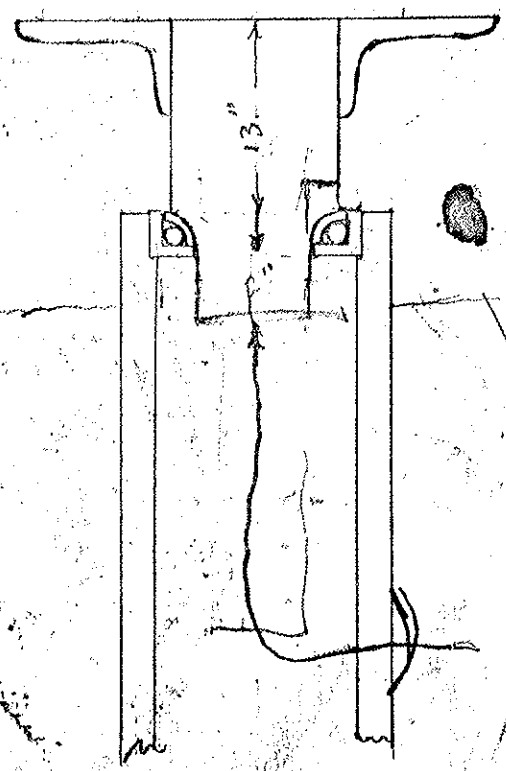
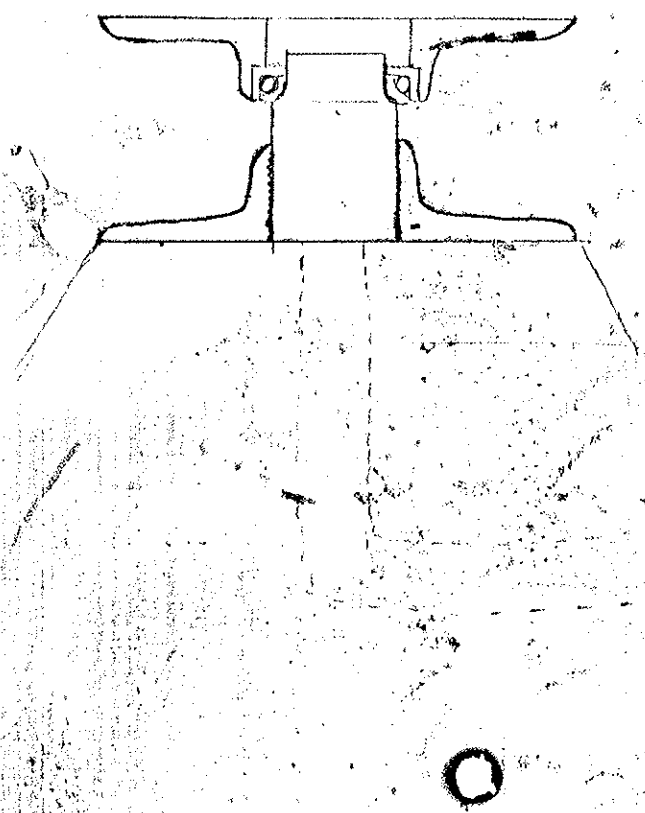
Side bracing of first one

FIG. 4



2nd one at each end.

FIG. 5



$1\frac{1}{2}$ Double explosion paper
 size $2\frac{1}{2}$ page 15 cut

Handwritten signature or initials

FIG. 6