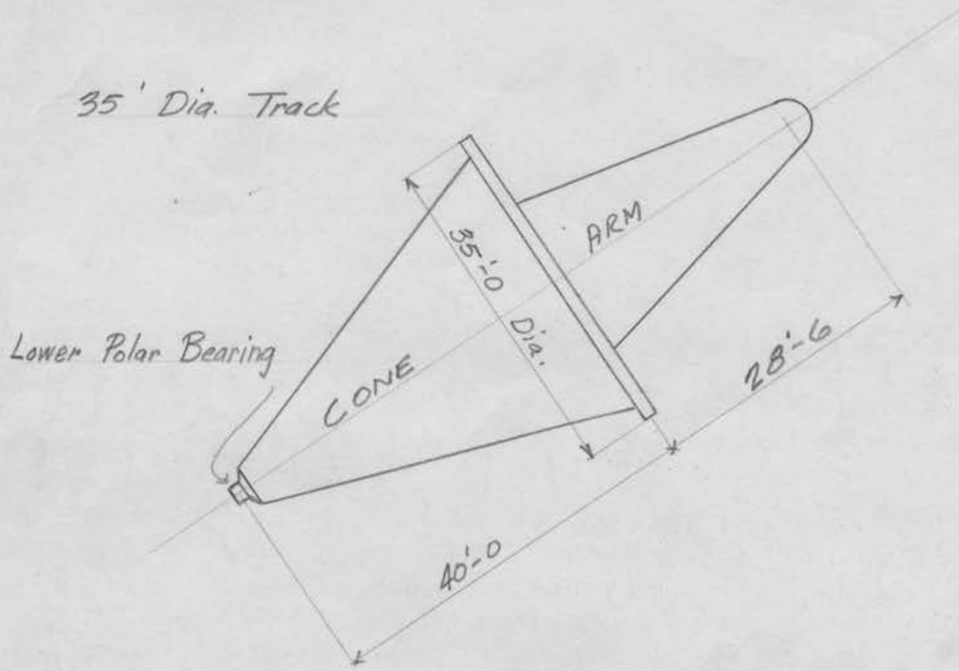
NOTES ON THE CONSTRUCTION OF THE FORK FOR THE 200-INCH TELESCOPE



Sketch No. 1.

Three methods of building the fork have been investigated. Each arm can be built up as a shop unit and field bolted to the cone. This is common to all three methods. The methods differ as to the manner of building and erecting the cone. These methods will be discussed later in these notes: briefly, they are:

I. The conical part can be built up from 6 large steel castings.

II. This is the same as method I, except that the pieces are built up from plates and angles.

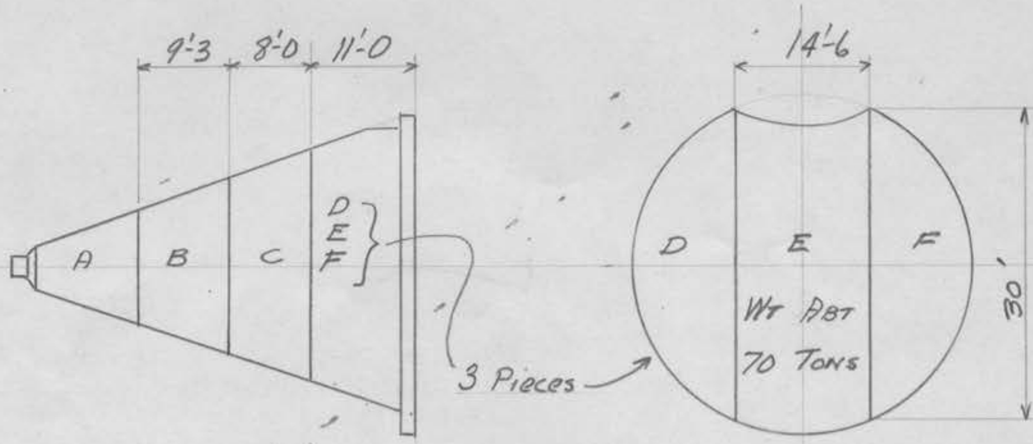
III. The conical part can be built up from a large number of pieces, rivetted and welded together in place at the site.

The requirements of the fork are as follows: When finished, the 35-ft. diameter track and the seat for the lower polar bearing (see Sketch No. 1) must be concentric within 1/8". The track does not need to be perfectly circular, but the variations from the circular must not exceed say 1/32" and the transitions must be very gradual.

A Discussion on the Methods of Building the Cone

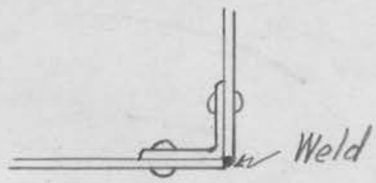
Method I This method appears to be impracticable because of the difficulty in obtaining satisfactory steel castings of the size required.

Method II The cone is divided into shop units as shown in Sketch No. 2.



Sketch No. 2.

The shop units are built up from plates and angles. If all welded construction is used the units will necessarily have to be stress relieved in a fornace. The only furnace in the West large enough to take these units is the one at Boulder Dam. A combination of rivetting and welding can be designed which would make stress relieving ~~txx~~ in a furnace unnecessary. The shop units can be made as an ordinary rivetted job, except that a few less rivets need be used, and then the joints welded so that the rivets cannot slip.



Sketch No. 3.

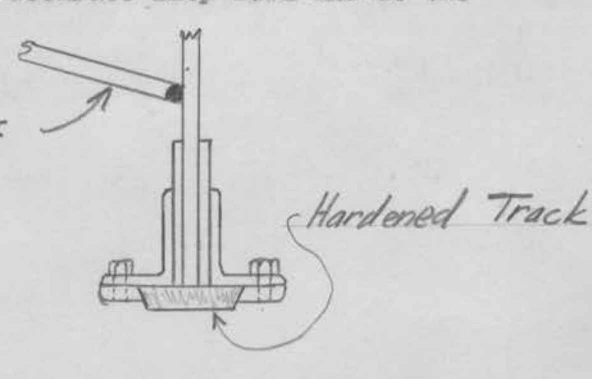
The plates are rigidly held in position by the rivets. The weld metal is deposited in layers, and each layer hammered or peened so as to stretch the weld metal and relieve the welding stresses. (A pipe line 90 inches in diameter was welded together in the field and stress relieved solely by peening - L. A. Water Dept.).

The contact surfaces of the shop units are very large; therefore the surfaces would be machined and made to fit together. The most difficult piece is Unit E, which is about 11 ft. x 14 ft. 6 in. x 30 ft. long, and which has to be finished on 3 sides and one end (for the 35-ft. diam. track). There is no equipment in the West which could handle this part of the work in a normal manner.

The machining of the 35-ft. diam. track can be divided into three steps:

1. Rough machining of cone.
2. Finish " "
3. Finish grinding and polishing of hardened track (see Sketch No. 4).

The rough machining of the cone can be done in the shop. The finish machining can also be done in the shop provided the shop units are dowelled and bolted together with sufficient accuracy. It may be economical to do less accurate shop work and do the



Sketch No. 4.

finish machining after the cone is assembled on the mountain. If the pieces were roughly handled during transportation this might be necessary anyway. The finish grinding of the track will have to be done after the cone is assembled.

The seat for the lower polar bearing can be finished in the shops.

The advantage of this method is simpler field erection.

The disadvantages are:

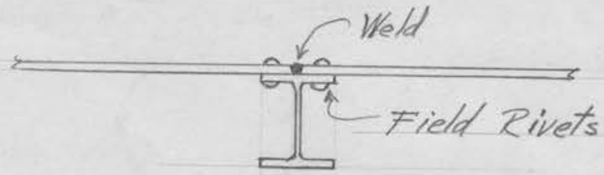
1. The difficulty and cost of machining the contact surfaces of the shop units and of bolting them together. A great number of large fitted bolts will be required.

2. Extra weight due to the extra metal required at the contact surfaces.

3. The joints between the shop units may slightly increase the deflections.

4. It may be rather difficult to transport the larger pieces.

Method III. The frame-work of the cone can be built up from plate girders and beams. This frame-work will be covered with a conical plate skin composed of rolled plates. These plates will be fastened to the frame, as shown in Sketch No. 5.



Sketch No. 5.

The plates would be bolted and then rivetted to the beams. The welding would be done after the entire cone is assembled and rivetted. The rivets will hold the plates in place. The weld is made in layers and each layer hammered or peened so as to stretch the weld metal and relieve the welding stresses. The amount of peening necessary can be determined experimentally on samples. This method of stress relieving is much used and is very satisfactory. Stress relieving by heating is unnecessary, especially in view of the fact that the joint is thoroughly rivetted, and because the maximum stresses in the plate are very low - on the order of 6000 lbs. per sq. inch.

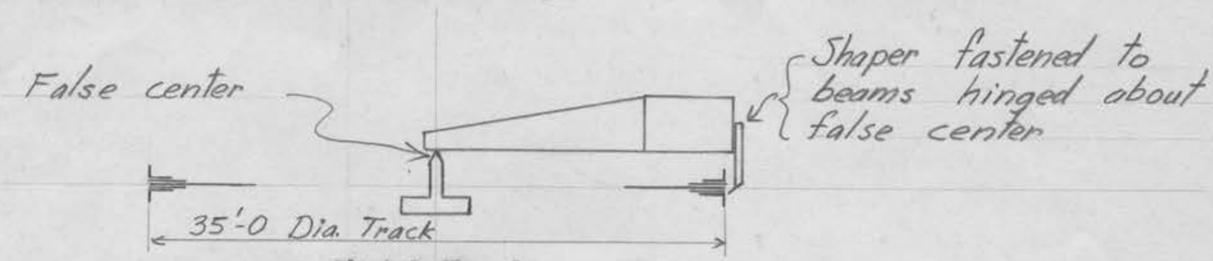
There is more field work involved in this method of construction, but none of it is at all difficult, nor does it involve anything that a structural steel erector has not done before. The frame-work is composed of about 20 large pieces and about 45 small pieces. The skin is divided into 21 plates. The shop work is ordinary structural steel work, such as is involved in building a rolling lift bridge. It can be handled with equipment now available in Los Angeles.

The machining of the 35-ft. track is again divided into three steps:

1. Rough machining of the cone.
2. Finish " "
3. Finish grinding of the track.

The rough machining of the cone can be done in the shops.

The finish machining of the cone would have to be done after the cone is all assembled and welded. Since no boring mill is available for rough fininging in the shops, the following set-up can be used handily.



Sketch No. 6.

This set-up could also be used when the cone is in place on the mountain, if it should prove desirable.

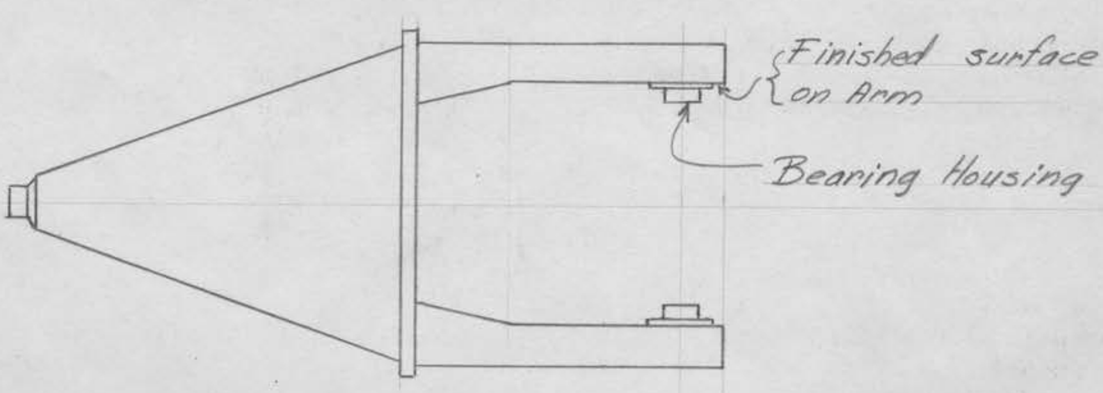
The seat for the lower polar bearing will have to be machined after the cone is welded and the center of the 35-ft. track determined. This involves no particular difficulty.

The advantages of this method are:

1. The difficult machining of the shop units is eliminated.
2. It can be done with equipment now in use in Los Angeles.
3. The cone, when welded, is one unit, which is the most rigid possible construction. There is no possibility of getting other than ~~simat~~ elastic deflections.
4. The pieces are small enough so that they can be easily handled and transported.

The disadvantage is that a little more field work will be required.

<u>Adjustment of Position of Declination Axis</u>



Sketch No. 7.

If Method II is used, the holes for bolting the arms on to the cone can be drilled in the shops: then when the arms are erected on the mountain the position and inclination of the finished surfaces on the arms can be determined by actual measurement. The bearing housing, which supports the declination bearing can then be made in the shop, the end bevelled and lengthened or shortened, so that the bearing will be in its proper position.

If Method III is used, the holes for bolting the arms will have to be drilled at the site after the cone has been welded. The arms can be supported in their proper positions on a temporary wood frame and the holes drilled to match. Then the position of the finished surface can be determined by actual measurement and the housing made accordingly.

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June 19, 1934.