J.C.N.

T4

January 23, 1956

Trip Report

Destination: John Unertl Optical Company, Pittsburgh, Pa.
Dates: January 1 - 5, 1956
Personnel Contacted: Mr. John Unertl

The purpose of the visit was to deliver sagged plates for evaluation and grinding and to discuss the problems and specifications needed for future grinding of master plates.

The Grinding Process

The grinding of large cylindrical surfaces is a rather unusual one and requires special tooling for each job. The grinding operator follows this general pattern:

The sagged glass plate is embedded in a wood and plaster base, one side exposed, for example; the concave side.

Preliminary grinding is accomplished with a curved metal plate as a grinding tool.

The grinding tool, with abrasive, is placed on the embedded glass and slid about in a series of circular motions. The motion in the horizontal plane is determined by the driving machine. The machine does nothing directly to determine the cylindrical surface. The latter is entirely due to the shape of the grinding tool.

The second grind is done with a discontinuous glass tool. First, a cylindrical surface is ground in metal with a surface generating machine. Discs of glass about two inches in diameter have one face ground to this radius. After these ground faces are given a thin coat of oil they will adhere to the metal cylinder. A second plate of a curvature roughly concentric with the machine ground one is heated and coated with pitch. This coated plate is brought into contact with the glass discs and allowed to cool. The ground metal cylinder is then removed. The grinding is then continued with this new tool. For final polish, a curved plate is coated with pitch, grinding compound and cloth strips.

This approach was used in producing the master plates now in use. Errors in the surface were as large as .008". This is caused mainly by two things: the pressure of the grinding tool is greater at the edge; and the glass has a tendency to "spring back" when the grinding tool has been removed. To remedy the situation, steps must be taken to modify the rate of grinding as a function of position on the plate and additional controls must be placed on the glass mounting during the grinding operation. One such system involves the grinding of one glass panel (in a manner as described above) and using it as a base for the next panel while it is being ground.

Tolerances

The grinding is too rapid at the edges for both the convex and concave grind. This not only distorts the plane of the master (the convex surface) but destroys the parallelism of the master plate surfaces which introduces an unwanted "lens effect".

The distortions of the convex surface are as shown in Figure 4. The fact that the corners grind faster than the top or bottom edge introduces a smaller radius of curvature in the horizontal plane as you move off the x-axis. The calculated master surface possesses a constant radius of curvature. In addition to the change of curvature, the distance from the master to the screen varies along the vertical central axis. For each distance from master to screen a different radius would be optimum, however such changes would be small and would need further consideration. Whether or not a pattern change would be sufficient to overcome these errors would depend upon the type of compromises made during the printing process and the magnitude of the resulting deviations.

It was these considerations which made it important to know what factors could be controlled during the grinding operation. Mr. Unertl stated that holding any particular toroidal surface resulting from uneven grinding, within close limits, from plate to plate would be a job of the same magnitude as grinding all panels to a perfect cylindrical surface within those same close limits.

This modifies our thinking in eliminating the considerations of changing the radius as a function of master to screen distance and forces us to consider the random errors from plate to plate to be of the same order as the deviations from the perfect cylinder.

Costs

Due to the extra tooling (some of which is mentioned above) required to achieve closer tolerances, a minimum of $300. per plate was quoted for grinding both sides and grinding to contour. In regard to the contour, a metal template was requested.

Further estimates of cost would be forthcoming as the operation is continued.

Glass Quality

The pyrex plates did not appear to meet our specifications of "clear and bubble free". Mr. Unertl felt that it was of good quality and the pyrex will, in most cases, contain a few bubbles. Plate or optical glass would be better in this regard but would introduce greater problems in annealing. Pyrex glass has been used on this project after many glass plates shattered during the first grind.

It is best to keep the radius of the blank smaller than the intended grinding radius for concave surfaces and the reversed situation holds for convex.

Where both sides are to be ground, the final radius should be held as close as possible during the sagging procedure.

The thickness is important and the minimum is 3/8". This is to eliminate springing.

Twenty sagged plates were left with Mr. Unertl for future grinding. He will use the poorest for initial work and keep the best for final work or to be used as we desire.

Raymond G. Olsson

Raymond G. Olsson
Color Picture Tube
Production Engineering
CATHODE-RAY TUBE SUB-DEPARTMENT

/fmd

Dist: L. C. Maier
J. C. Nonnekens
E. F. Schilling

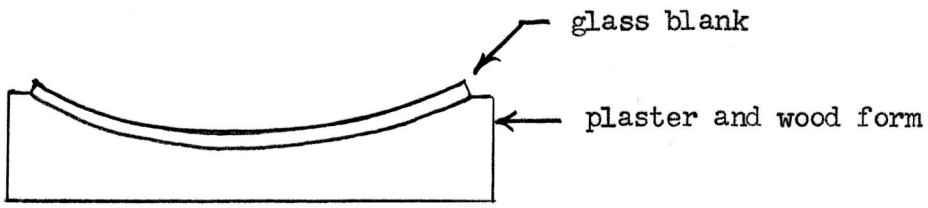

Figure 1

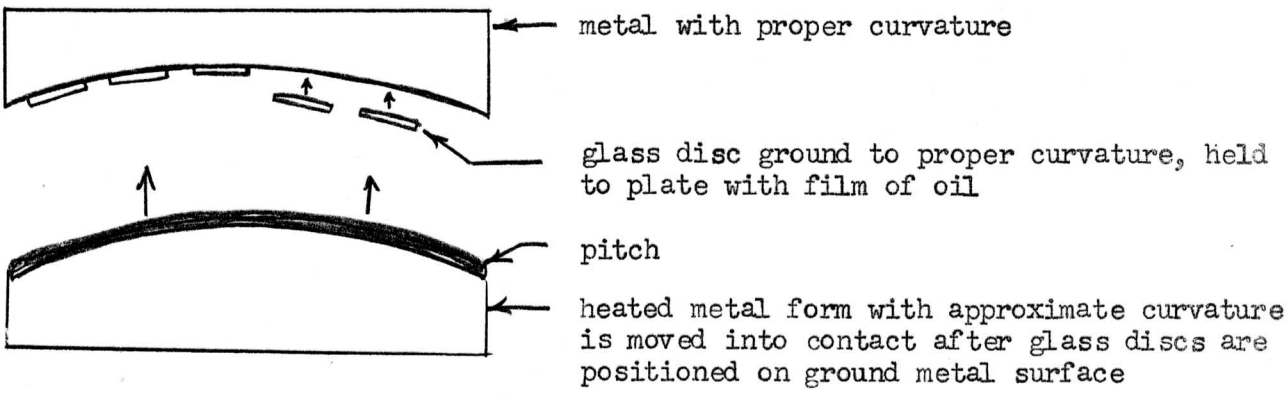

Figure 2

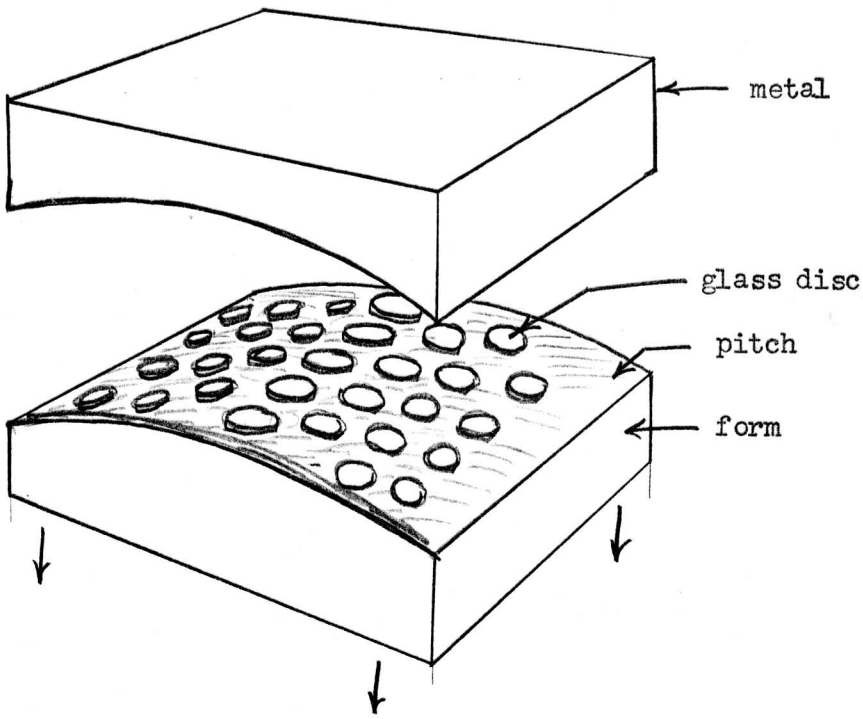

Figure 3

After being placed in contact and cooled, the lower form has the glass discs embedded in its surface.

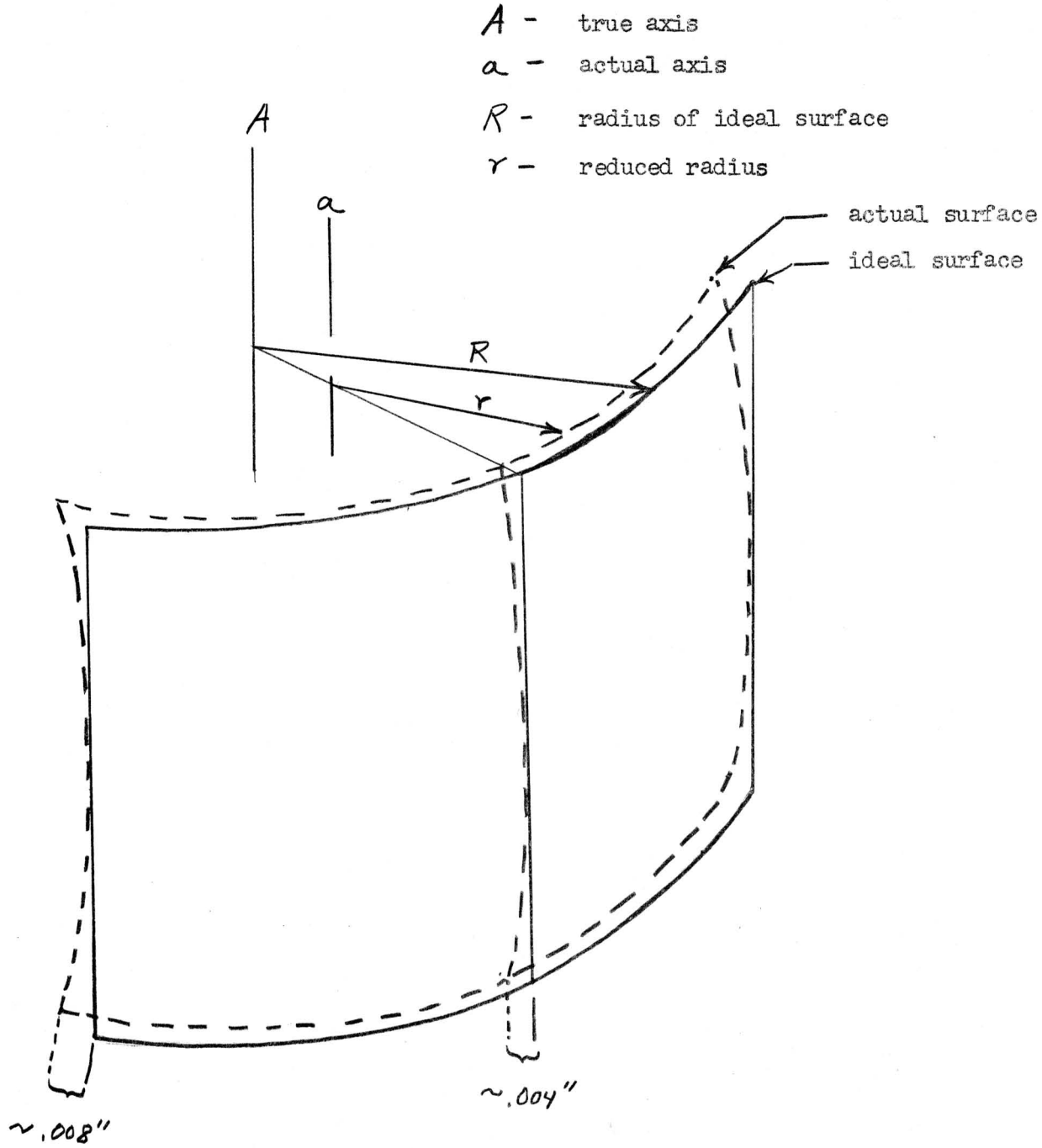
A - true axis
a - actual axis
R - radius of ideal surface
r - reduced radius
A
a
actual surface
ideal surface
R
r
~.008"
~.004"

Figure 4