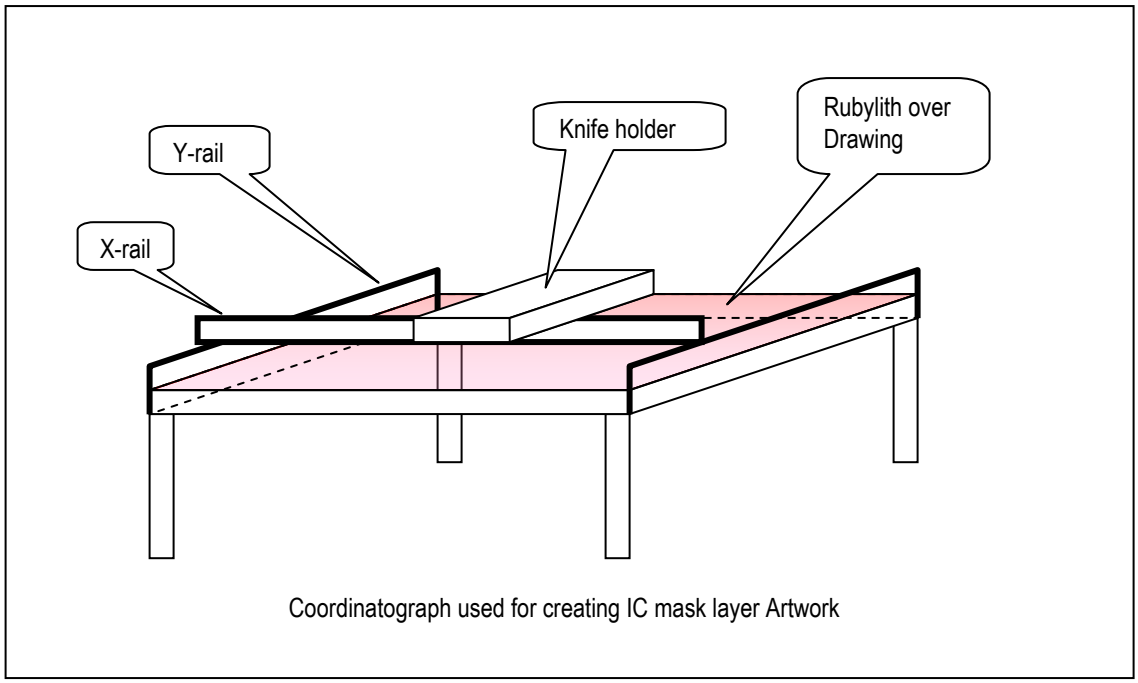
Mask Making facility at GM-e (1964)

The mask making facility was designed and built by Electromask
(Gerry Henriksen, Chris Van Peski, Tice Vanos, Les Woods)

Circuit layouts (with multiple layers on the drawing) were drawn at 500X on quadrille-lined Mylar

Create 500X Artwork

The drawing was placed on, and was aligned with the XY rails, a coordinatograph (a flatbed machine with X and Y rails that had a knife attached).



Coordinatograph used for creating IC mask layer Artwork

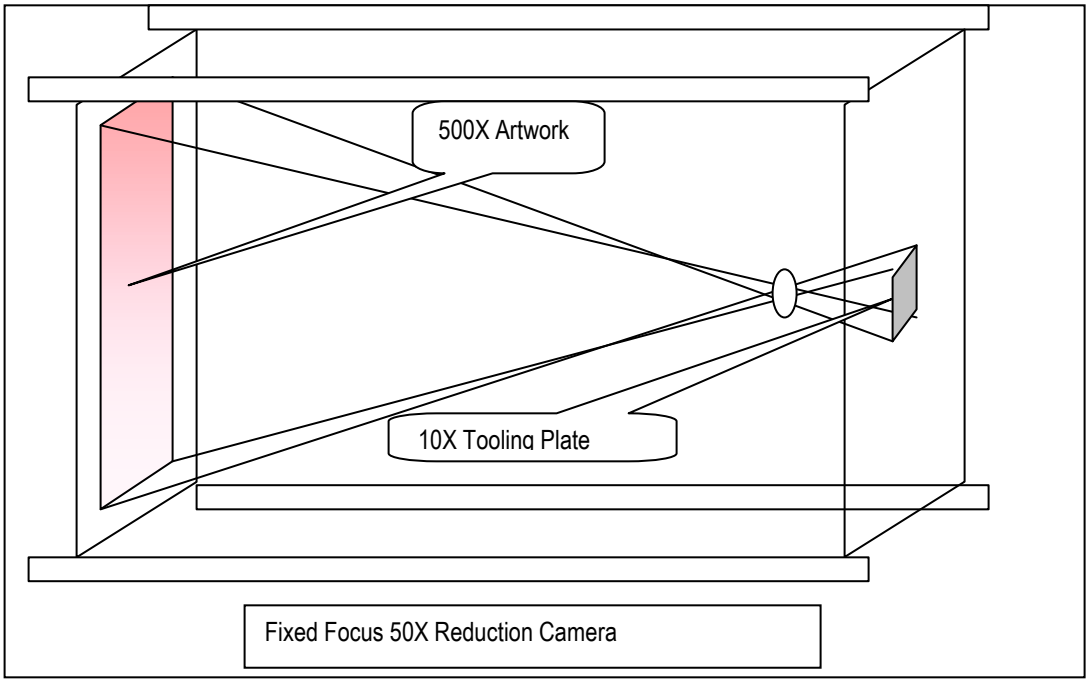
"Rubylith" (Mylar coated with a red coating) was placed over the drawing.

The knife was oriented to either the X or Y rail and was depressed onto the Rubylith along a line drawn on the 500X circuit layout drawing and the was drawn along the rail, scoring the Rubylith according to the drawing patterns underneath.. The knife cut through the red coating but not the Mylar underneath. After X and Y cuts were made (defining closed areas), the red coating was peeled off the Rubylith leaving a clear area of Mylar in a field of red-covered Mylar (Rubylith). This was a 500X rendering of the layout of single layer of the circuit (Diffusion, Gate, Metal, …).

The Artwork was serifed to ensure sharp corners. However, this is a detail that is not central to the process.

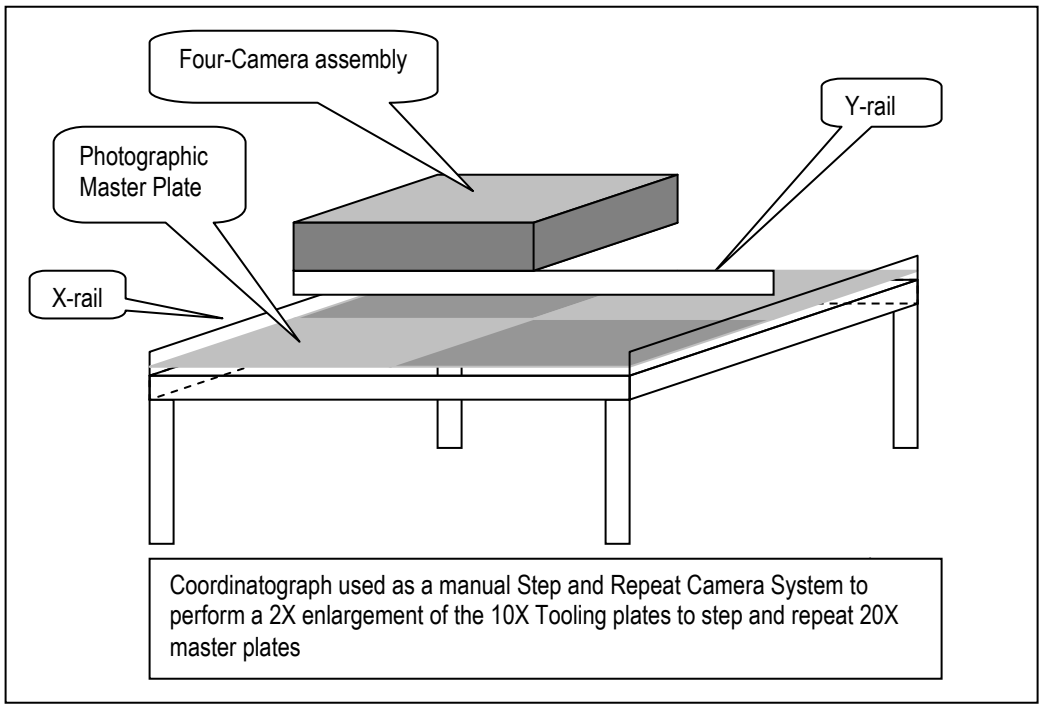
Tooling Plate Camera (50X Reduction)

A 50X reduction of the Art was made using a custom camera and the resulting 10X image was copied onto a 2” glass photographic (tooling) plate.



Step and Repeat Camera System

Four cameras were mounted on a similar coordinatograph with four, unexposed Master Plates placed on the coordinatograph table. Four tooling plates were placed on the cameras. The camera assembly was moved over the master plates and an image was flashed onto the master plates. The camera assembly was moved to the next location and the image was reproduced onto the master plate next to the first. This “step and Repeat” process continued until four arrays were reproduced onto the four master plates. Each master plate was of a different IC layer (diffusion, Gate, Cutouts, Metal, …etc.).



Coordinatograph used as a manual Step and Repeat Camera System to perform a 2X enlargement of the 10X Tooling plates to step and repeat 20X master plates

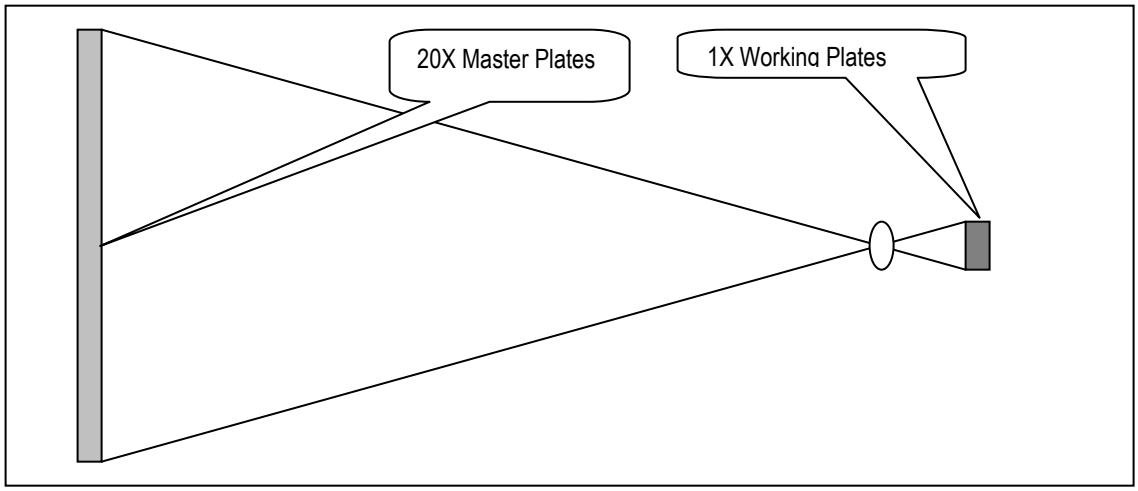
Four, 2X enlargement camera assemblies were attached to another coordinatograph, and four, 10X tooling plates were placed on them. Then, their photographic images were stepped and repeated onto four, 20” by 24” glass photographic plates simultaneously, guaranteeing step-and-repeat registration among the four plates.

The step and repeat process was done manually, using the X and Y measurement indicators on the rails of the coordinatograph. When the rails were stopped over the correct location, the cameras with their tooling plates were flashed and the 20X image copied onto the 20” by 24” Master plates. This process was repeated until the photo array was completed.

After processing, these 20” by 24” plates had 20X images of a particular circuit-layer stepped and repeated in X and Y on them.

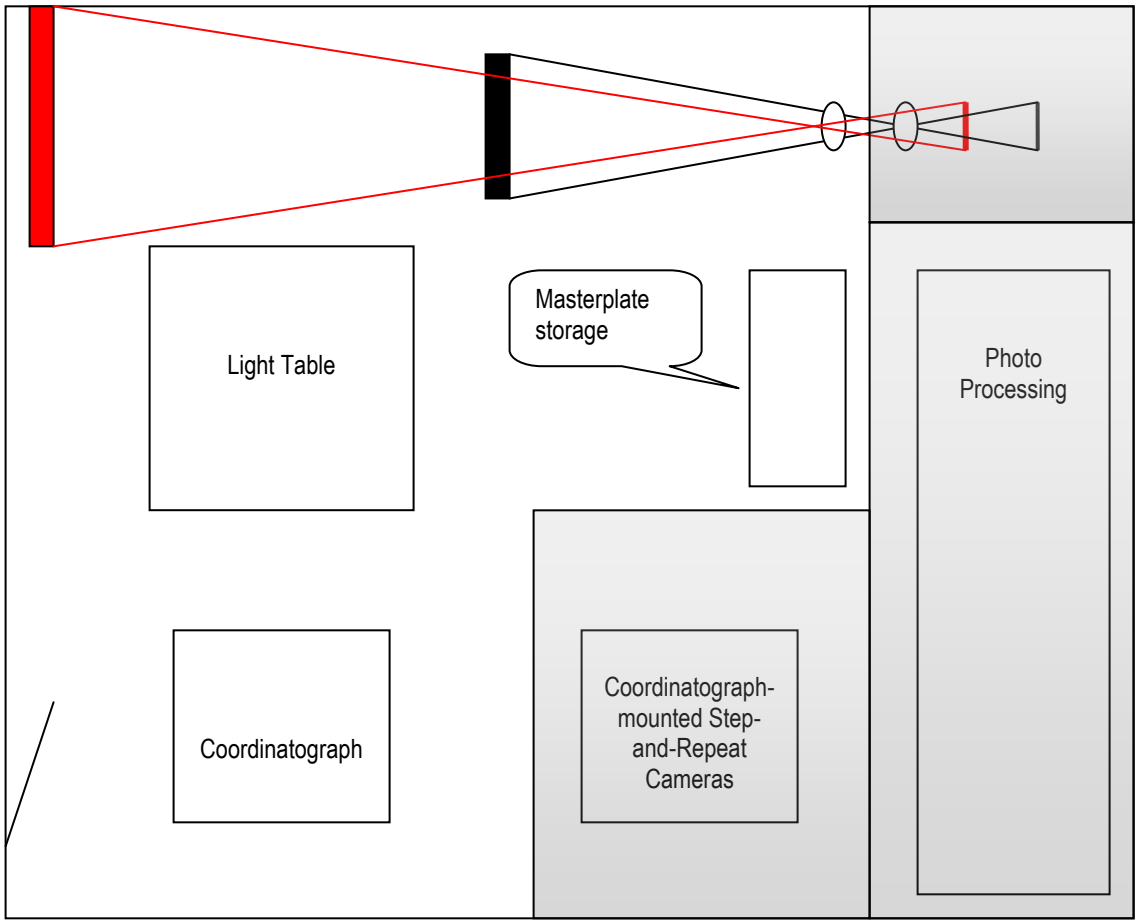
Fabricating Working Plates from the Master Plates

These (master) plates were mounted onto a 20X reduction camera and photographically reduced onto a 2" "working plate".



The working plates were used to transfer the images onto wafers by contact printing using an alignment machine and photo resist.

Layout of the Mask Making Facility



* Coordinatigraphs were designed to be used as plotting machines, primarily for map-making