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FABRICATION OF DIAPHRAGM PLATES WITH OPTICALLY  
FLAT AND REFLECTING SURFACES

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The photometer designed for observations at the prime focus ( $f/3.25$ ) needed a diaphragm on an optically flat and reflecting surface. Placed at the focal plane with a central hole the diaphragm is required for viewing and guiding the programme star which is to be centred as shown in Fig. 1. The required features of such a diaphragm plate is to have small elliptical holes of sizes 350, 500, and 1000 microns drilled at  $45^\circ$  with respect to the front surface and simultaneously have a surface with an accuracy better than  $\lambda/4$ . The success of a photometer depends upon the quality of the diaphragm in respect to the optical flatness and clarity of the hole.

Fabricating this diaphragm on two alternative materials was considered: Glass and Metal-In the case of glass, getting an optical flatness was possible but drilling small holes was difficult whereas in the case of metal it was possible to drill holes but achieving optical flatness was not easy. For both cases the possibility of making a hole using laser drilling, electrochemical machining and mechanical drilling were explored. But no source was readily available within the time frame of our requirement for laser drilling and electrochemical machining. Hence we resorted to mechanical drilling. Initially attempts were made to drill on glass using a syringe needle with carborandum as the abrasive which resulted in chipping of the edges, inspite of the thickness being reduced considerably at the location of the drill.

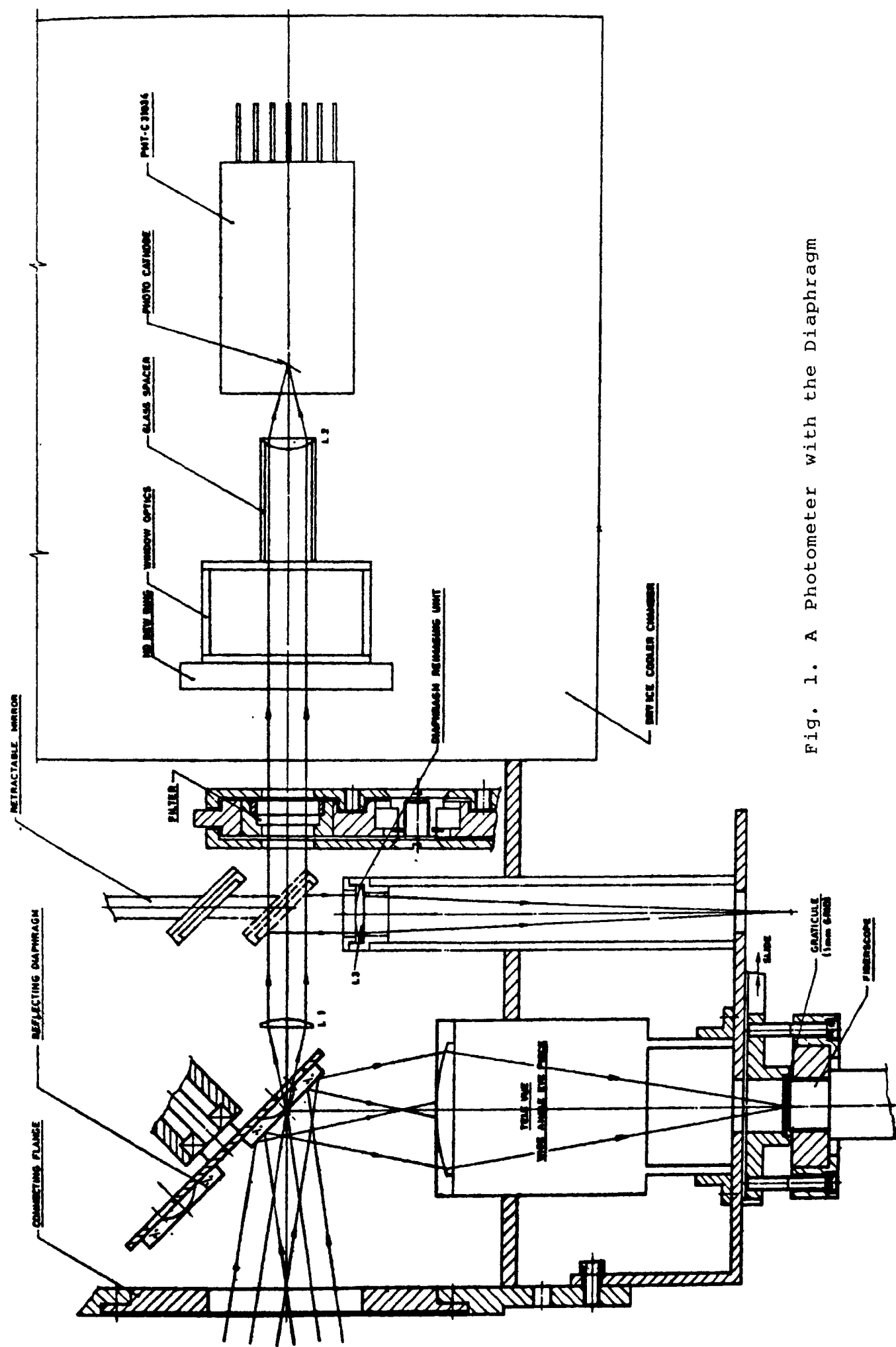


Fig. 1. A Photometer with the Diaphragm

Alternatively Nickel plate as substrate material (cut out of high purity electrode plate used for electro plating) was tried out and it gave better results. The procedure adopted for fabrication of Nickel diaphragm plates is described here.

#### Blank preparation

Nickel discs of 40MM diameter and 5.8MM thickness were cut and machined. Both the faces of the discs were ground on a surface grinding machine to 10 Micron surface accuracy and parallelism.

#### Diaphragm Drilling

The arrangement for drilling diaphragm holes is shown in Fig.2. A dummy blank of the same specifications as the diaphragm was held by a indexing head tilted to give a  $45^\circ$  plane to the job. The centre for drilling was defined. The job was mounted in such a way that the front surface of the diaphragm sat over the centred face of the dummy disc. This enabled the terminating drill to pass exactly through the centre of the front surface of the diaphragm. Since the drilling had to be done at  $45^\circ$  to the face, initial guide hole was made with the help of a centering drill. Pre-calculated depths with different drills ranging from 6MM to 1.5MM were drilled starting from the back surface and finally the required diaphragm holes were drilled using standard drills. This procedure ensured a clear passage of the diverging beam through the diaphragm hole.

#### Grinding and polishing

The front surface of drilled nickel plates held in a special fixture made for mounting four discs at a time were ground with different grades of alumina powder. Initial grinding and subsequent polishing was done in the same fixture. Because of the soft nature of the surface extra care was taken at every stage to avoid fine scratches. Polishing could not be done using Cerium oxide,

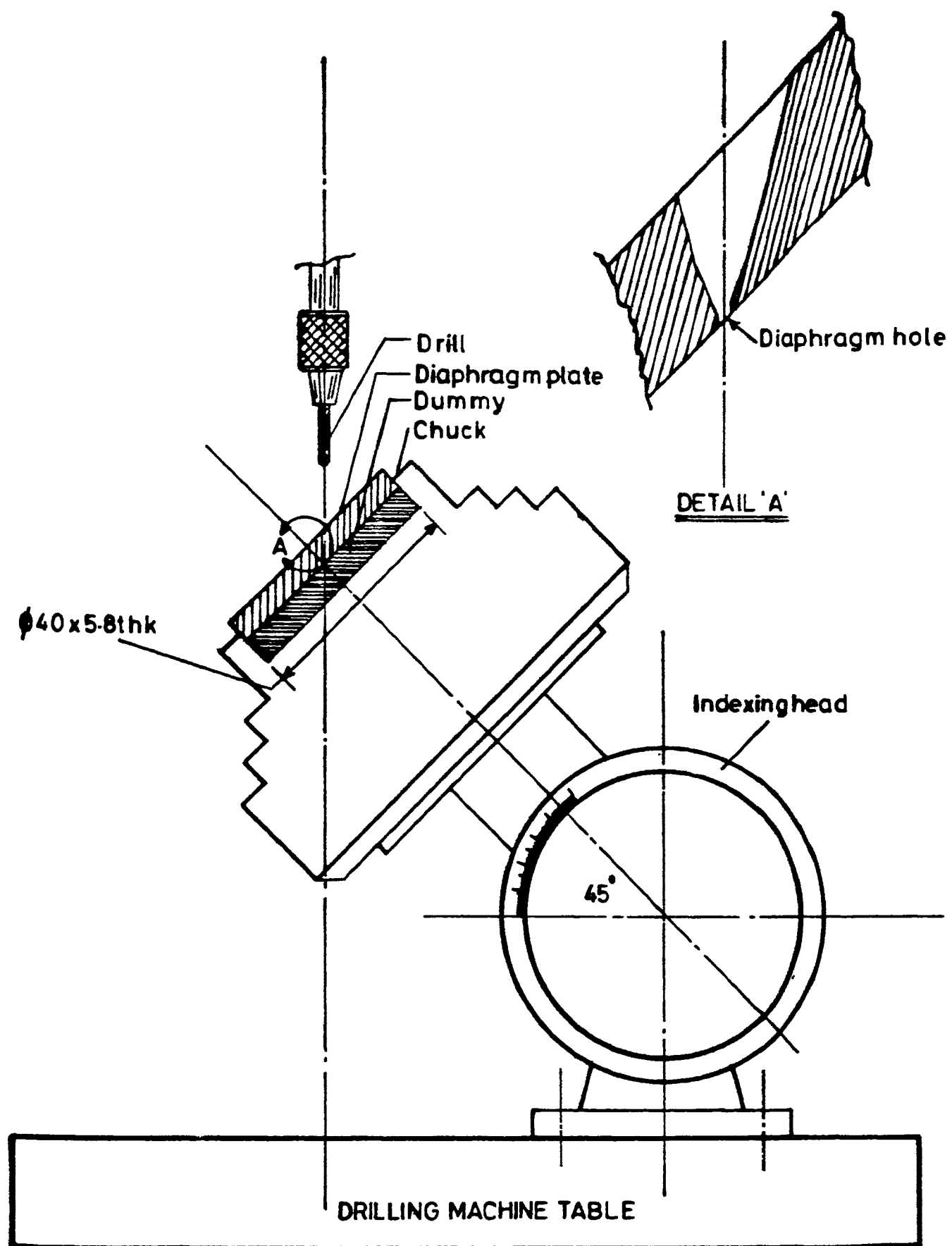


Fig.2 Diaphragm drilling set up

as it was giving a dull, black surface and poor texture. However Linde-A polishing compound was found as a suitable alternative. Slow polishing with extra soft pitch produced better results. Finally to achieve fine surface accuracy each plate was figured individually and a surface accuracy better than  $\lambda/4$  was achieved on each plate.

#### Aluminising

These plates were subsequently coated with high purity aluminium by the process of Vacuum deposition for reflectivity and longer life.

#### Remarks

A set of four diaphragm plates were fabricated and these have been used in the prime focus photometer of the 2.34M Vainu Bappu Telescope. A magnified photograph of one of the holes thus drilled is shown in Fig.3. Image quality at the focus through these diaphragm plates was found quite satisfactory. Viewing and guiding of stars upto 15th magnitude could be done in the photometer conveniently despite the loss of light in the fibre scope occurring while transmitting the image to the eye end.

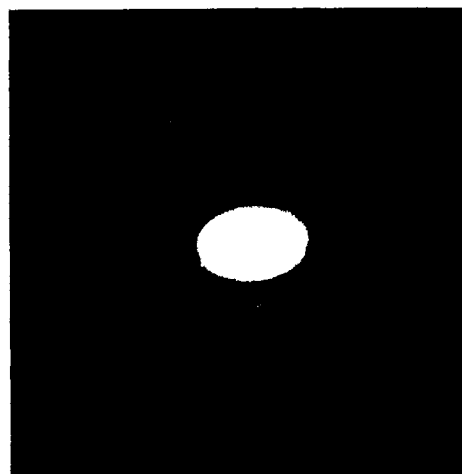


Fig.3. Photograph of a drilled hole.

Acknowledgement

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