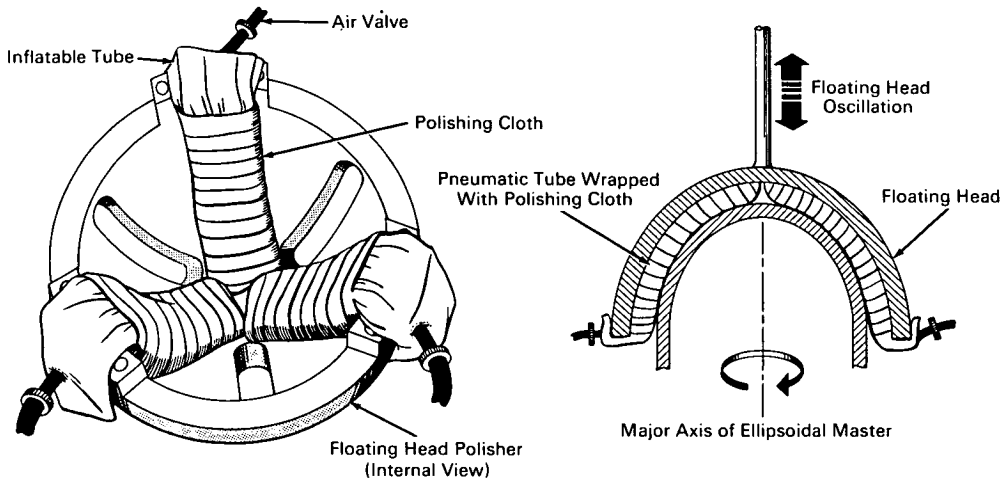
NASA TECH BRIEF

Ellipsoidal Optical Reflectors Reproduced by Electroforming



The problem: Quantity production of high-quality, thin-walled, ellipsoidal optical reflectors. For use in solar simulators, the inside surface of each reflector was required to be an ellipsoid of revolution about the major axis. Dimensions were: major axis, 20 inches; minor axis, 16 inches; and wall thickness, 1/4 inch.

The solution: A three-step method involving numerical-control machining of a master, polishing of the convex surface of the master to the desired optical quality with a modified floating-head polisher, and replication of the concave reflectors by electroforming a layer of nickel on the master.

How it's done: An accurately dimensioned convex ellipsoidal surface, which will become a master after polishing, is fabricated from 316L stainless steel by numerical-control machining. Polishing of the convex surface is performed on a modified 36-inch floating-head polishing machine. The concave polishing head of the machine, which generally conforms to the shape of the master, was modified by installing three inflatable tubes (ordinary bicycle inner tubes sufficed) around which cloth containing polishing material was wrapped, as shown in the illustration.

The distribution of pressure of the polishing material on the surface of the master can be controlled by adjusting the air pressure in the tubing. To provide relative motion between the polishing head and the surface to be polished, the machined ellipsoidal master is rotated within the polishing head, while rotation of the head is restrained. The head, however, is caused to oscillate over a small amplitude in the direction of the polar axis (major axis) of the master in order to improve the polishing action.

When polishing of the master is completed as indicated by optical tests, the master is removed from the machine and suspended in a modified Watt's bath for

(continued overleaf)

electroforming of the nickel reflectors. No difficulty has been experienced in removing the electroformed reflectors from the stainless-steel master. The composition of the electroforming bath and operating conditions are as follows:

nickel sulfate	35–40 oz/gal
nickel chloride	3–8 oz/gal
boric acid	5–7 oz/gal
pH	4.0–4.8
temperature	125°–135° F
current	50 a
current density	15a/sq ft

Notes:

1. A stress-relieving agent should be added to the electroforming bath at intervals during the processing in order to minimize stress in the electroformed reflectors.
2. Fine polishing of the electroformed reflectors may be necessary in order to remove surface discolorations.
3. This method can be used for quantity production of optical reflectors of other shapes and sizes.
4. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Goddard Space Flight Center
   Greenbelt, Maryland, 20771
   Reference: B63-10547

Patent status: NASA encourages the immediate commercial use of this invention. It is owned by NASA and inquiries about obtaining royalty-free rights for its commercial use may be made to NASA Headquarters, Washington, D.C., 20546.

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