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NASA TECH BRIEF

Marshall Space Flight Center

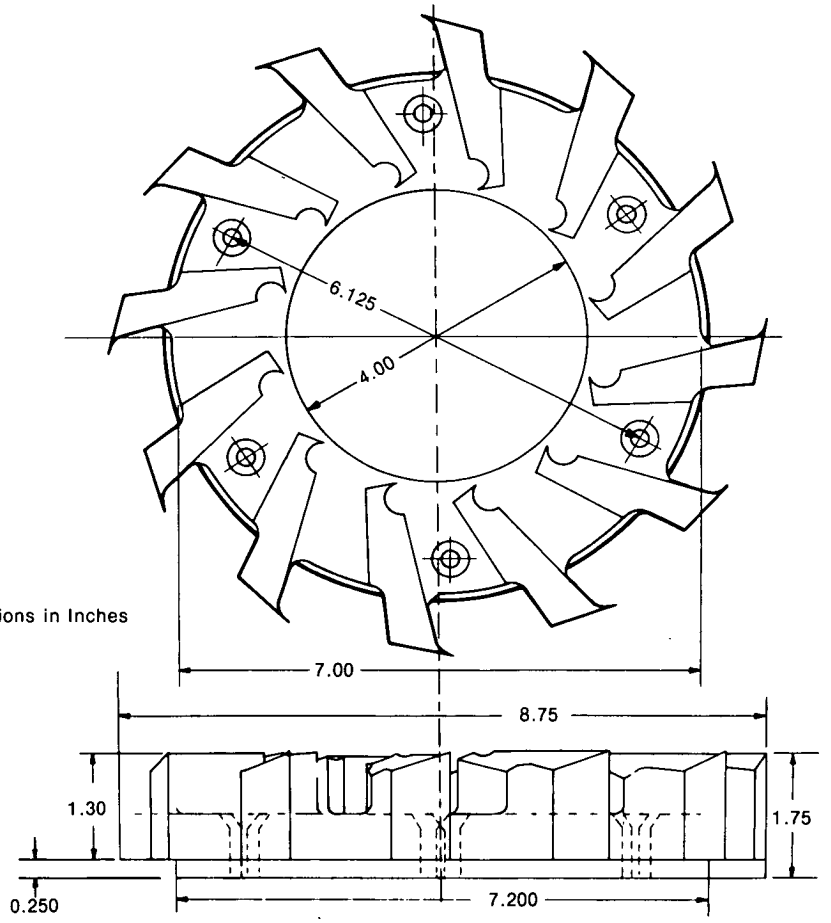
Foam-Machining Tool With Eddy-Current Transducer

The problem:

Previous methods of machining large-diameter foam-covered tanks depended on a microwave transducer to direct machine-tool activity. A microwave transducer, however, is complicated and cumbersome to mount on the machine-tool head and requires extensive support equipment. Prior foam-maching tools also require a specially designed cutterhead.

The solution:

A three-cutter machining system incorporates an eddy-current sensor. This type of sensor is smaller and enables more accurate cuts to be made than microwave-based sensors. The eddy-current transducer feeds a signal to a numerical controller which programs the rotational and vertical axes of sensor travel, thus enabling the cutterhead to profile around tank protrusions. The chips produced are evacuated through a hollow spindle.



Note: All Dimensions in Inches

Foam Machining-Tool Cutter Blade, Top and Side Views

(continued overleaf)

How it's done:

The multicutters slice a 24-inch (61-cm) bandwidth per pass and operate at a maximum of 12 surface feet (3.5 m) per minute around a tank measuring 33 feet (10 m) in diameter. The sensor is installed in the center of the cutter and spindle. A servocontroller directs the movements of a servomotor which drives a ball-screw-and-nut advance/retract mechanism.

The servosystem is activated by electrohydraulic components. A 12-inch (30-cm) double-acting primary positioning cylinder is controlled by a four-way solenoid-actuated valve. A 4-inch (10-cm) double-acting secondary positioning cylinder moves the machining unit into or away from the foam. This cylinder is directed via a two-stage flow-control servovalve which, in turn, receives its signal from the eddy-current sensor.

The machining head has three hollow spindles. Each consists of an aluminum spindle body and a hollow steel shaft with ball bearings pressed into the spindle bodies. The spindles are alined vertically in the cutter mechanism.

The sensor operates via eddy-current loss. A bridge circuit is activated by a 1-MHz carrier signal. Two arms of the bridge (two coils) comprise the transducer. Magnetic-flux lines emanating from the transducer pass into the conductive surface being sensed and produce eddy currents. As the conductive surface moves closer (or further away) the transducer eddy-current loss increases or decreases accordingly. Sensed impedance variations are converted to a dc voltage proportional to the distance being sensed.

Note:

Requests for further information may be made in writing to:

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Reference: B75-10309

Patent status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

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Categories: 08 (Fabrication Technology)
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