It's Been Done

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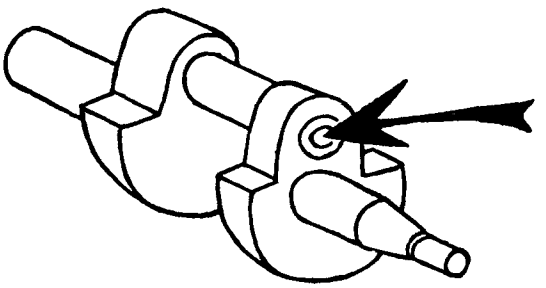
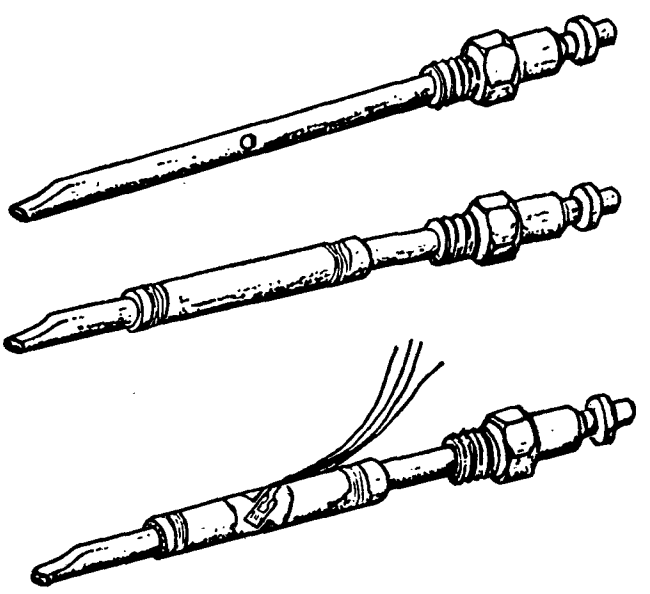
Stress analysts at Outboard Marine were faced with the problem of mounting a full torque bridge (4 gages at 45°) inside a 1/4" diameter hole in a crankshaft. This was a problem because no one had fingers small enough to fit.

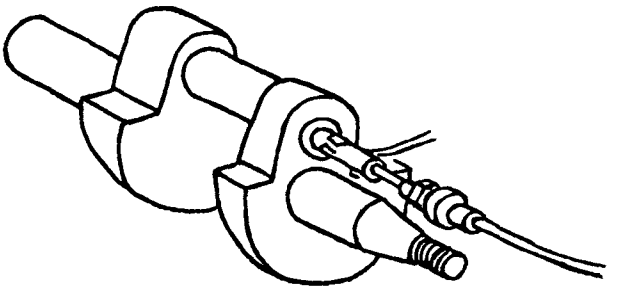


A technician, Lloyd Christensen, solved the problem with a piece of 1/8" copper tube, rubber tubing, two faced cellophane tape, and an air compressor.

First, he mounted an air hose fitting to one end of the copper tube, pinched the other end shut, and drilled a fine hole through the wall. A piece of 3/16" rubber surgical tubing about 6" long was slipped over the copper tube so as to cover the hole, and sealed with rubber bands wound around the ends. Two faced sticky tape was wound around the rubber tubing.

Standard 1/8" 120 OHM foil gages were to be used for the torque bridge. Four gages were prewired and





stuck face down on the sticky tape. Each was positioned at the proper 45° angle, with the bonding face outward.

The gages were bonded with low temperature epoxy adhesive. The exposed faces were coated with the epoxy, then the tube was inserted in the crankshaft hole and aligned. Compressed air applied to the copper tube forced the rubber tubing to expand and clamp the gages while the epoxy cured. After bonding, the deflated tubing, sticky tape, and all, was removed—very, very carefully.

The completed bridge was then used to measure the torque transmitted through the crankpin under a variety of operating conditions. The tests showed that not all of the flywheel torque was transmitted to the output end as torque in the crankpin. A significant portion was transmitted by a couple between crankpin and main bearing.

Gaging of Rock Specimens

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An attempt to determine crack propagation on a granite rock cylinder 12 inches long, 6 inches in diameter with a 1-inch hole in the center. Applying the strain gage at the center section of the 1-inch hole presented a problem. I resolved this by using a tapered rod with a pressure pad around it. Using Duco cement, I attached the four strain gages to the pressure pad. I then applied epoxy adhesive to the other surface of the strain gages. Wires were attached to the strain gages before installation (see sketch). Tapered rod, gages, and all were then inserted into the hole and allowed to cure. The rod and pressure pad were removed by applying acetone which dissolved the Duco cement leaving the strain gages bonded to the surface of the 1-inch hole.

The first series of the test after applying the strain gage bridge in the borehole generated a feedback signal proportional to the circumferential displacement. To insure that a crack would initiate immediately beneath the