NASA TECH BRIEF

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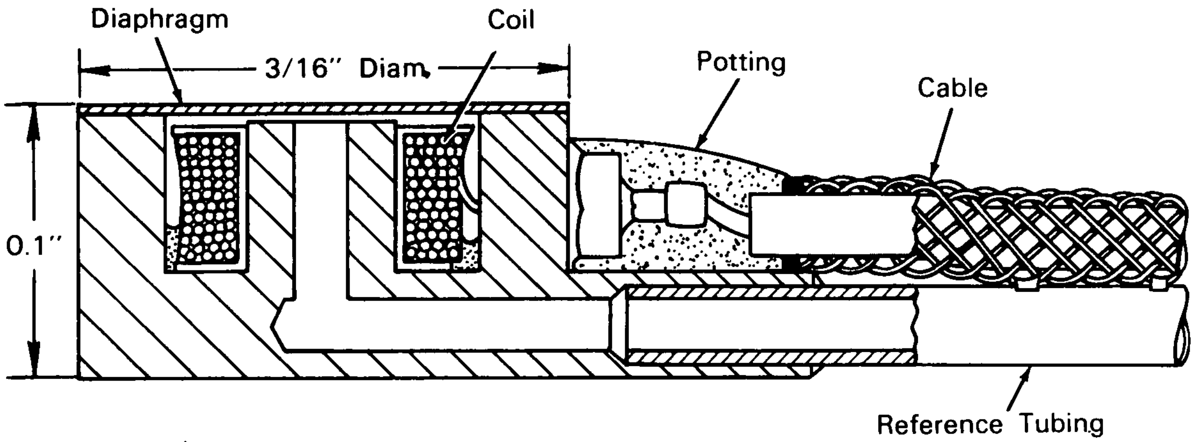
Improved Variable-Reluctance Transducer Measures Transient Pressures



The problem: Transducers that are used to measure dynamic pressure must combine a number of characteristics, such as proper frequency response, linearity, insensitivity to vibration, noise, and acceleration, and ease of calibration. When they are used for measuring rapidly varying pressures, such as occur in shock tubes and blast waves, the critical requirements are small size and high insensitivity to extraneous vibrations and connecting-cable noise. Safety requirements often dictate that the cable connecting the transducer to recording equipment be at least 1,000 feet long.

The solution: An improved variable-reluctance transducer with a flush-diaphragm pickup, a feedback-stabilized carrier amplifier, and other features as described below. The transducer has a diameter of 3/16 inch and a thickness of 0.10 inch. The principal reasons for selecting a variable-reluctance transducer are that (1) it can be a low-impedance device, to minimize stray pickup and permit remote location of the associated amplifiers, and (2) it responds to steady-state as well as transient pressures. Steady-state response is necessary to permit measurement before and after the pressure pulse, and calibration of the transducer with accurate standards.

How it's done: Both the case and the diaphragm of the transducer are made of iron-nickel alloy (58% iron, 42% nickel). Two models of the transducer were built, one with an 0.0015-inch-thick diaphragm, and a 15-psi range, and one with an 0.002-inch-thick diaphragm and a 30-psi range. Pressures from 4 psi through 150 psi have been measured with other models. The airgap, at zero pressure, between the diaphragm and the core piece in the case is 0.004 inch. The coil consists of 125 turns of number 42 manganin wire wound on a very thin-walled coil form machined from a tough polyester resin.

In assembling the transducer, an approximately two-inch length of stainless steel tubing is first silver-soldered to the reference pressure port of the case.

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The coil, electrical lead-ins (hypodermic needles), and their insulators (ceramic tubes) are then cemented in place. The coil leads are brought out through the tubes and are soldered externally.

The 1,000-foot cable consists of two number 32 stranded insulated conductors enclosed in a lightweight shield. The diaphragms are soft-soldered in place and are given the required initial tension by controlling the temperature gradients in the case when the solder is solidifying.

The system operates at a carrier frequency of 120 kc, has a demodulated linear output of one volt, and a linear frequency response from 0 to 21 kc. The carrier amplifier can be used with various bridge circuits and millivolt output transducers. Vibration effects on the system are negligible, and its low-impedance circuitry allows the use of long cable runs with minimum stray pickup and cable-generated noise.

Notes:

1. The instrument should be useful for measuring rapidly varying pressures, particularly on aircraft and missiles, where small size and minimum response to acceleration forces are desired.
2. Further information concerning this innovation is given in a paper presented at the 16th Annual ISA Instrument-Automation Conference, Los Angeles, California, Sept. 11-15, 1961, by Richard W. Morton and John L. Patterson, entitled "A Transient Pressure Measurement System for Blast Effect Research." Inquiries may also be directed to:

   Technology Utilization Officer
   Langley Research Center
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   Reference: B63-10321

Patent status: NASA encourages commercial use of this innovation. No patent action is contemplated.

Source: Richard W. Morton and
John L. Patterson
(Langley-10)