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Brief 71-10200

NASA TECH BRIEF

Ames Research Center

Inertia Diaphragm Pressure Transducer

The problem:

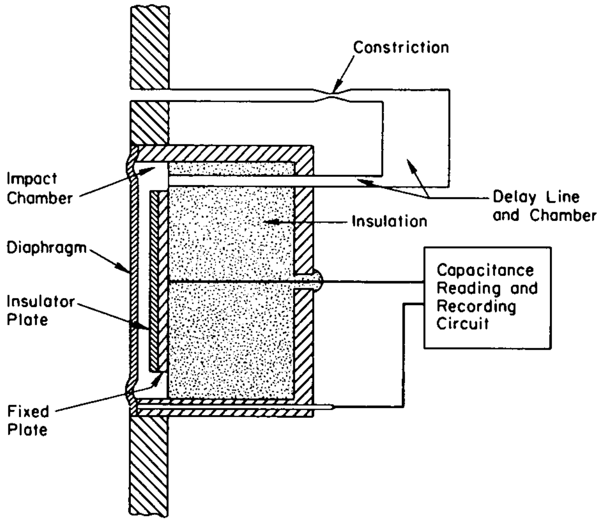
To devise a sensitive pressure transducer which can measure gas pressure profiles in the high temperature, short duration, gas flows characteristically found in shock tubes, wind tunnels, or other devices where pressure pulses may have durations of a few microseconds to several milliseconds. In available devices, diaphragm displacement depends upon elastic deformation under pressure, but the transducers are too insensitive for measurement of pressure pulses of short duration because an elastic system with the requisite rapid response requires a large spring return force.

The solution:

A new transducer consisting of a diaphragm mounted in such a way that its resistance to sudden movement is provided primarily by its inertia; in the new transducer, the acceleration of the diaphragm is measured instead of its displacement.

How it's done:

A diaphragm is freely supported so that only its inertia can resist the force of a pressure pulse. The periphery of the diaphragm is concentrically corrugated to provide a low spring constant and the diaphragm is mounted in a housing that is partially filled with an electrically insulating support for a fixed conducting plate. In operation, a pressure pulse of short duration and a very high rise time accelerates the diaphragm in the direction of the fixed plate. The diaphragm is accelerated in accordance with Newton's second law: $F=Ma$, where a is the acceleration,



F is the force exerted by the gas against the diaphragm, and the mass M is a fixed and known quantity. Since the diaphragm and the fixed plate form a capacitor, motion of the diaphragm toward the fixed plate can provide an electrical quantity related to the spacing between the diaphragm and the fixed plate. Thus, by recording the time-displacement history of the diaphragm movement, the acceleration and the displacement force (pressure) can be evaluated.

The transducer assembly includes a fluid delay line, a delay chamber, and a flow restrictor for equalizing the steady state pressure on both sides of the diaphragm; the delay prevents the pressure pulse from appearing simultaneously on both sides of the diaphragm.

(continued overleaf)

Notes:

1. Diaphragms are preferably made of soft, heavy, metals such as platinum; however, for certain applications, plastics with metallized surfaces may be preferable.
2. If the diaphragm is made of magnetic material, or if a magnetic plate is fastened to the diaphragm and a coil of wire is mounted close to it and within insulating material, the velocities of the diaphragm can be sensed as an induced output voltage.
3. No additional documentation is available. Specific questions, however, may be directed to:

   Technology Utilization Officer
   Ames Research Center
   Moffett Field, California 94035
   Reference: B71-10200

Patent status:

This invention has been patented by NASA (U.S. Patent No. 3,352,157) and royalty-free license rights will be granted for its commercial development. Inquiries about obtaining a license should be addressed to:

Patent Counsel
Mail Code 200-11A
Ames Research Center
Moffett Field, California 94035

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