

EXHIBIT 4

- [54] **SINGLE PATH RADIAL MODE CORIOLIS MASS FLOW RATE METER**
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- [73] Assignee: **Direct Measurement Corporation**, Longmont, Colo.
- [21] Appl. No.: **167,719**
- [22] Filed: **Dec. 15, 1993**

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Related U.S. Application Data

- [63] Continuation of Ser. No. 843,519, May 8, 1992, abandoned, and Ser. No. 651,301, Feb. 5, 1991, abandoned.
- [51] Int. Cl.⁵ **G01F 1/78**
- [52] U.S. Cl. **73/861.37; 73/861.18**
- [58] Field of Search **73/861.37, 861.38, 861.18**

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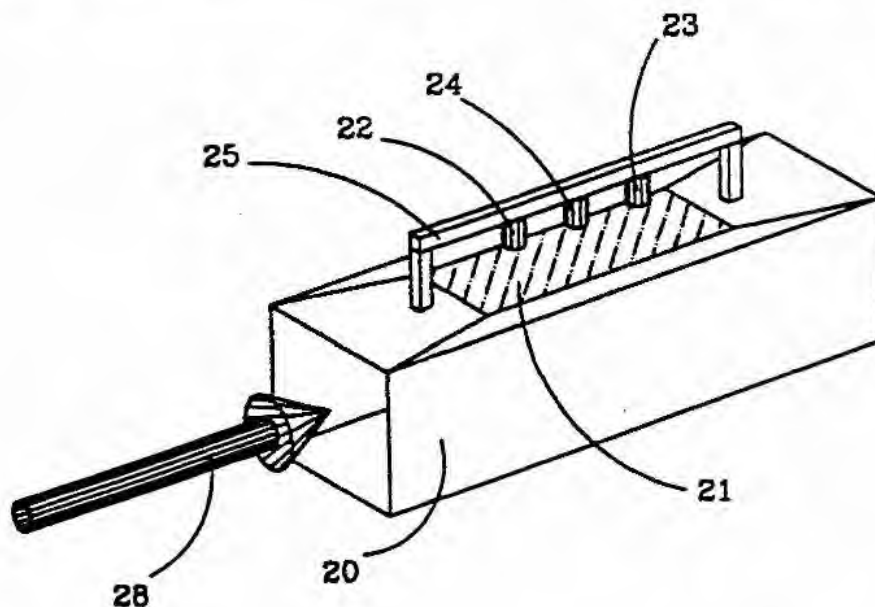
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Assistant Examiner—Raymond Y. Mah
Attorney, Agent, or Firm—Konneker Bush Hitt & Chwang

[57] **ABSTRACT**

A flow meter apparatus for measuring the mass flow rate of a fluid using the Coriolis principle. A single straight flow conduit is employed which is vibrated in a radial-mode of vibration. Coriolis forces are thereby produced along the walls of the flow conduit which deform the conduit's cross-sectional shape as a function of mass flow rate. Additional embodiments are disclosed employing vibration of selected portions of the flow conduit walls. In addition, a method is described to determine the pressure and the density of a fluid by simultaneously vibrating a flow conduit in two modes of vibration and thereby determining pressure and density based on changes in each frequency.

38 Claims, 27 Drawing Sheets



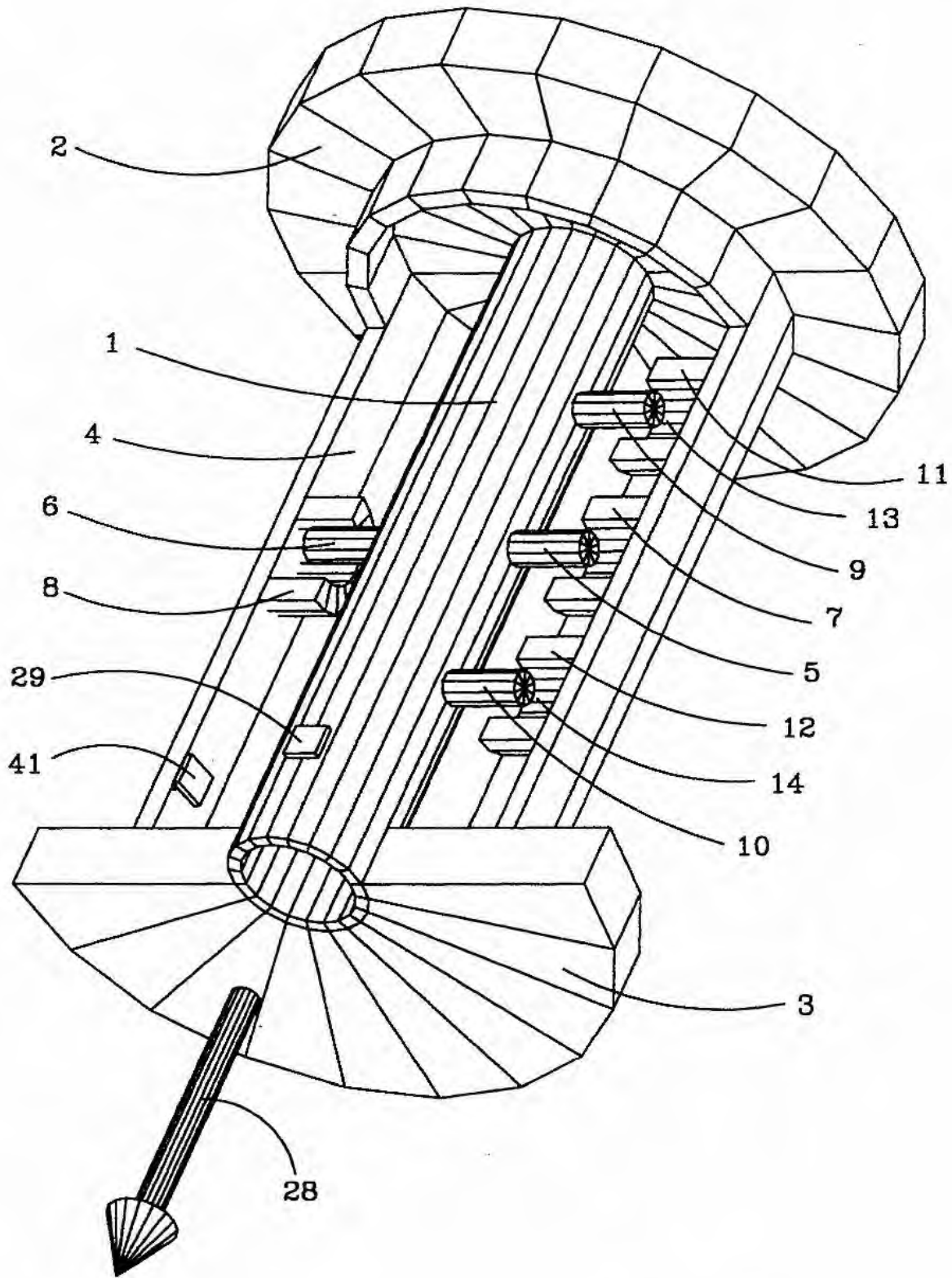


FIG. 1

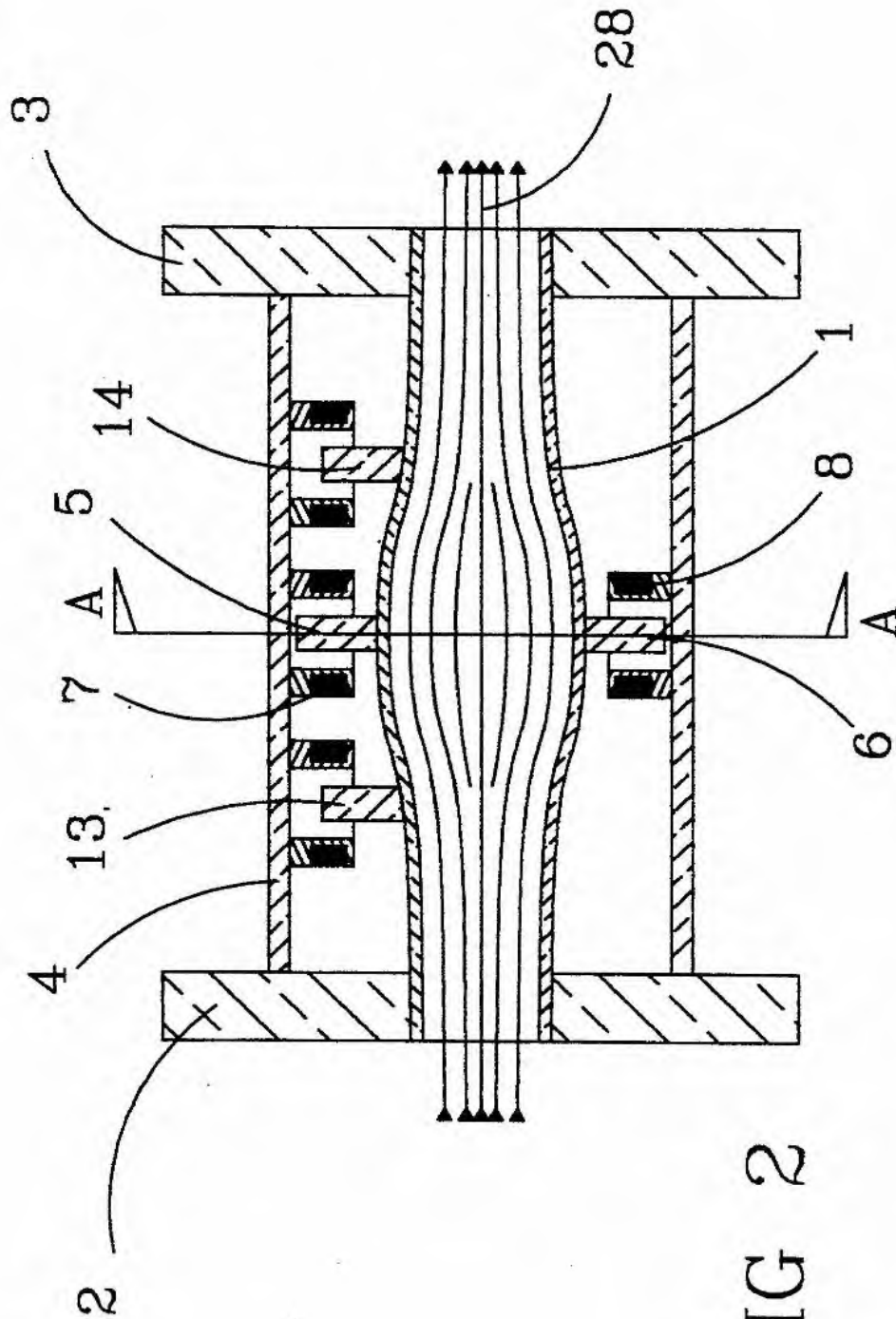


FIG 2

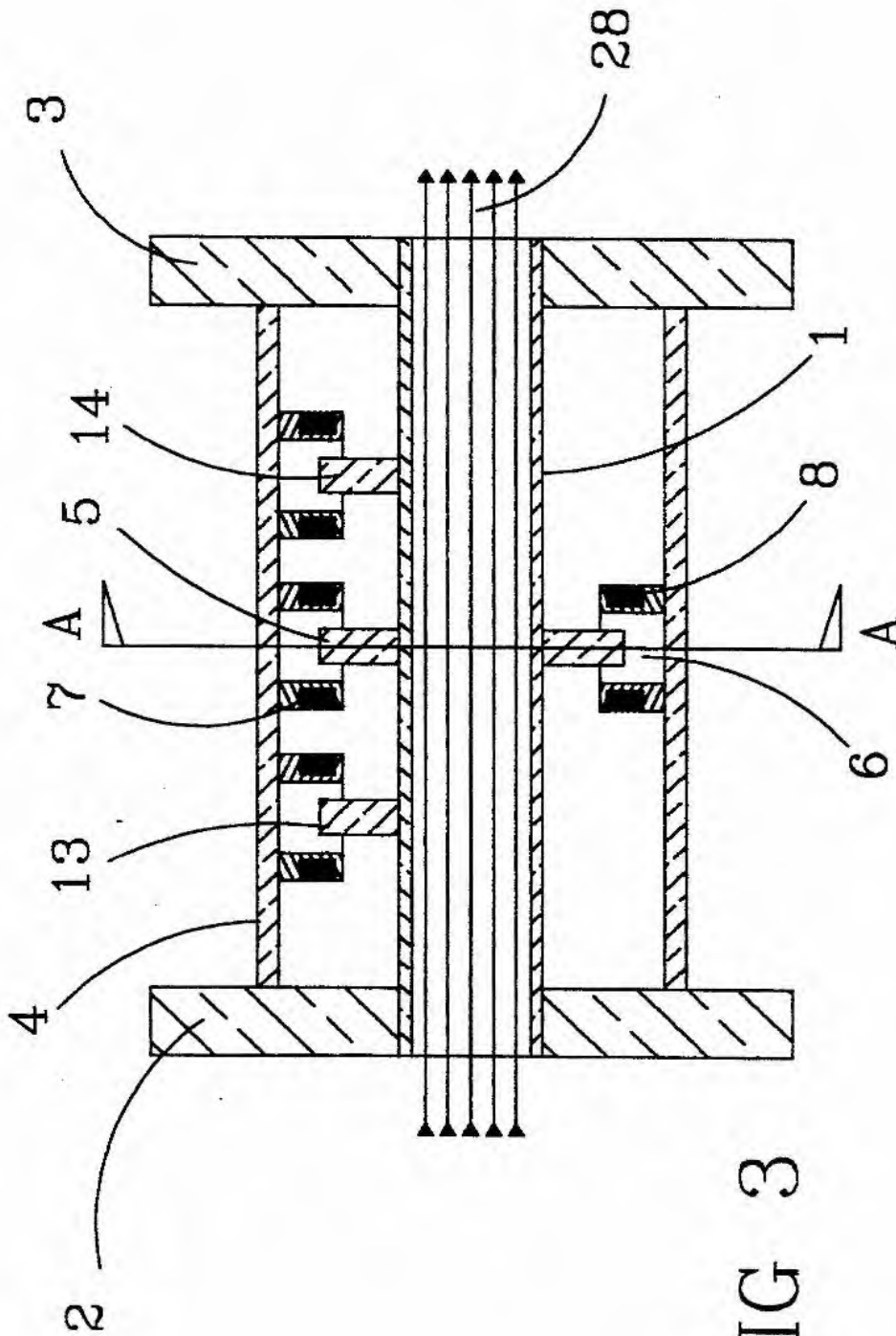


FIG 3

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