



[54] SINGLE PATH RADIAL MODE CORIOLIS MASS FLOW RATE METER

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4,798,091	1/1989	Lew	861/73
4,811,606	3/1989	Hasegawa et al.	861/73
4,823,614	4/1989	Dahlin	861/73
4,831,885	5/1989	Dahlin	861/73
4,852,410	8/1989	Corwon et al.	861/73
4,856,346	8/1989	Kane	861/73
4,891,991	1/1990	Mattar et al.	861/73
4,934,195	6/1990	Hussain	861/73
4,949,583	8/1990	Lang et al.	
5,024,104	6/1991	Darnes	

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

FOREIGN PATENT DOCUMENTS

8607340	5/1986	France	
8814606.5	11/1988	Germany	
0272758	12/1987	Italy	
62-180741	7/1987	Japan	
1008617	3/1983	U.S.S.R.	73/861.37

[56] References Cited

U.S. PATENT DOCUMENTS

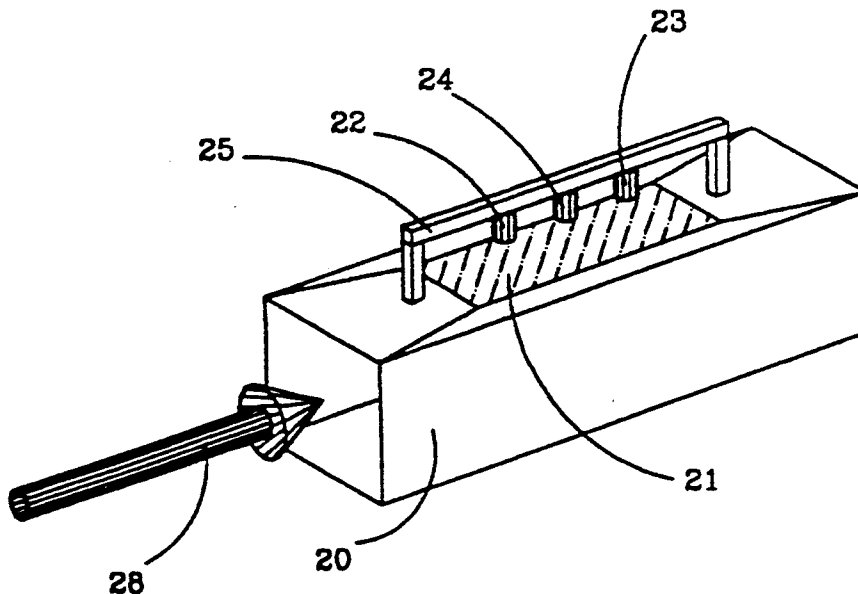
Re. 31,450	11/1983	Smith	861/73
3,927,565	12/1975	Pavlin	73/861.38
4,109,524	8/1978	Smith	194/73
4,420,983	12/1983	Langdon	73/861.18
4,422,338	12/1983	Smith	861/73
4,491,025	1/1985	Smith et al.	861/73
4,622,858	11/1986	Mizerak	861/73
4,628,744	12/1986	Lew	861/73
4,653,332	3/1987	Simonsen	861/73
4,680,974	7/1987	Simonsen et al.	861/73
4,691,578	9/1987	Herzl	861/73
4,716,771	1/1988	Kane	861/73
4,728,243	3/1988	Friedland et al.	861/73
4,733,569	3/1988	Kelsey	73/861.38
4,756,197	7/1988	Herzl	861/73
4,756,198	7/1988	Levien	861/73
4,768,384	9/1988	Flecken et al.	861/73
4,776,220	10/1988	Lew	861/73
4,793,191	12/1988	Flecken et al.	861/73

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[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



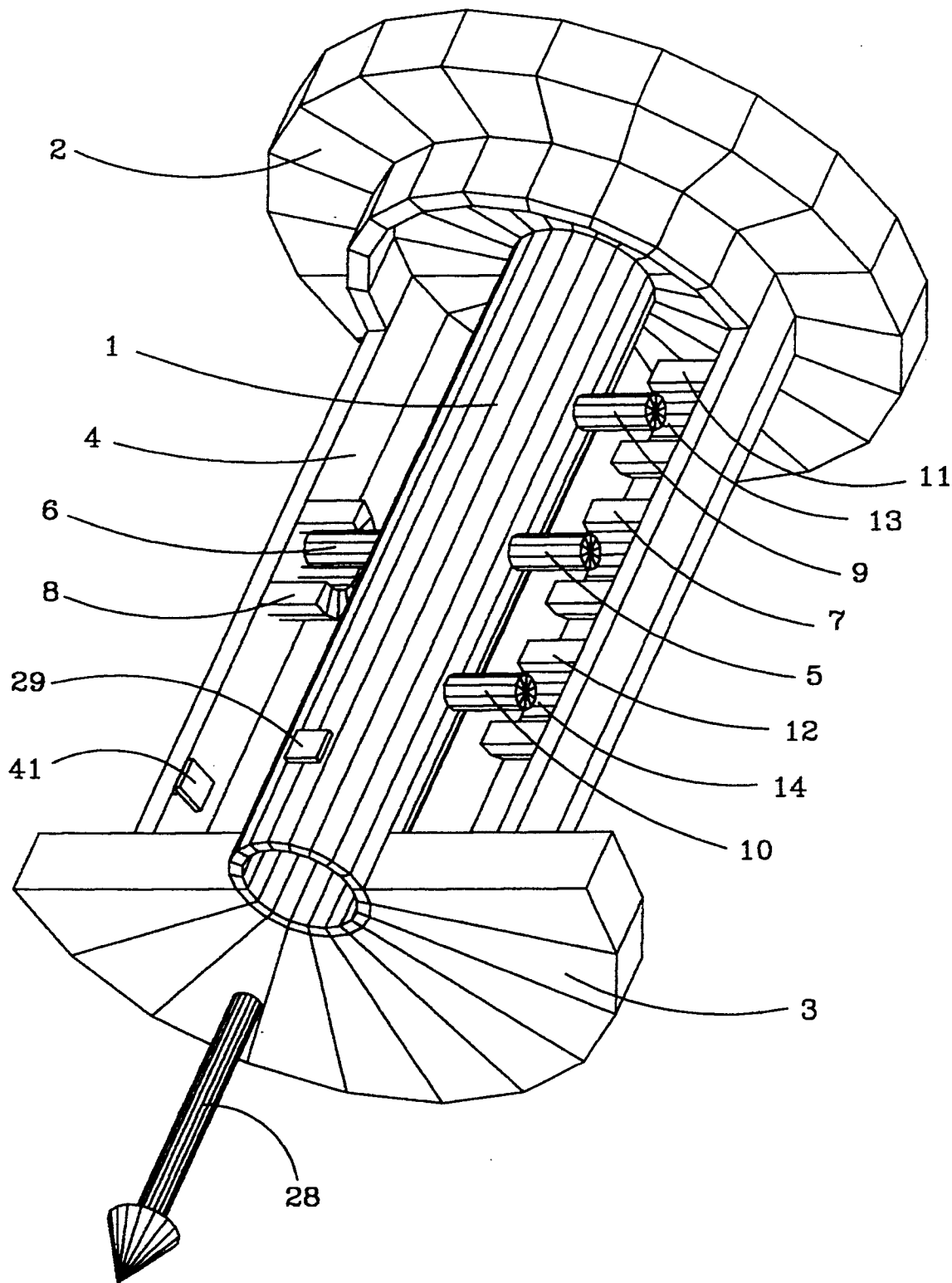


FIG. 1

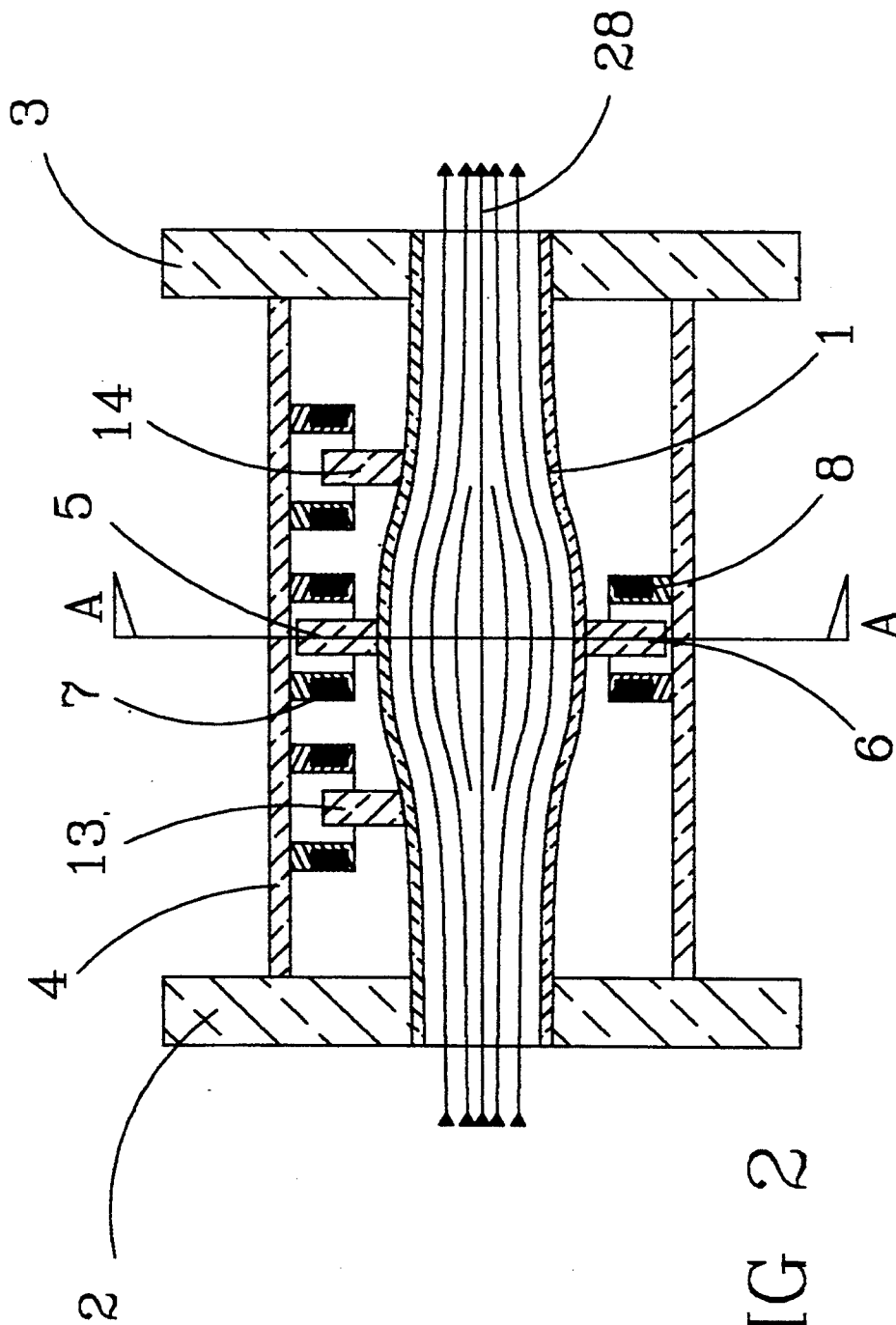


FIG 2

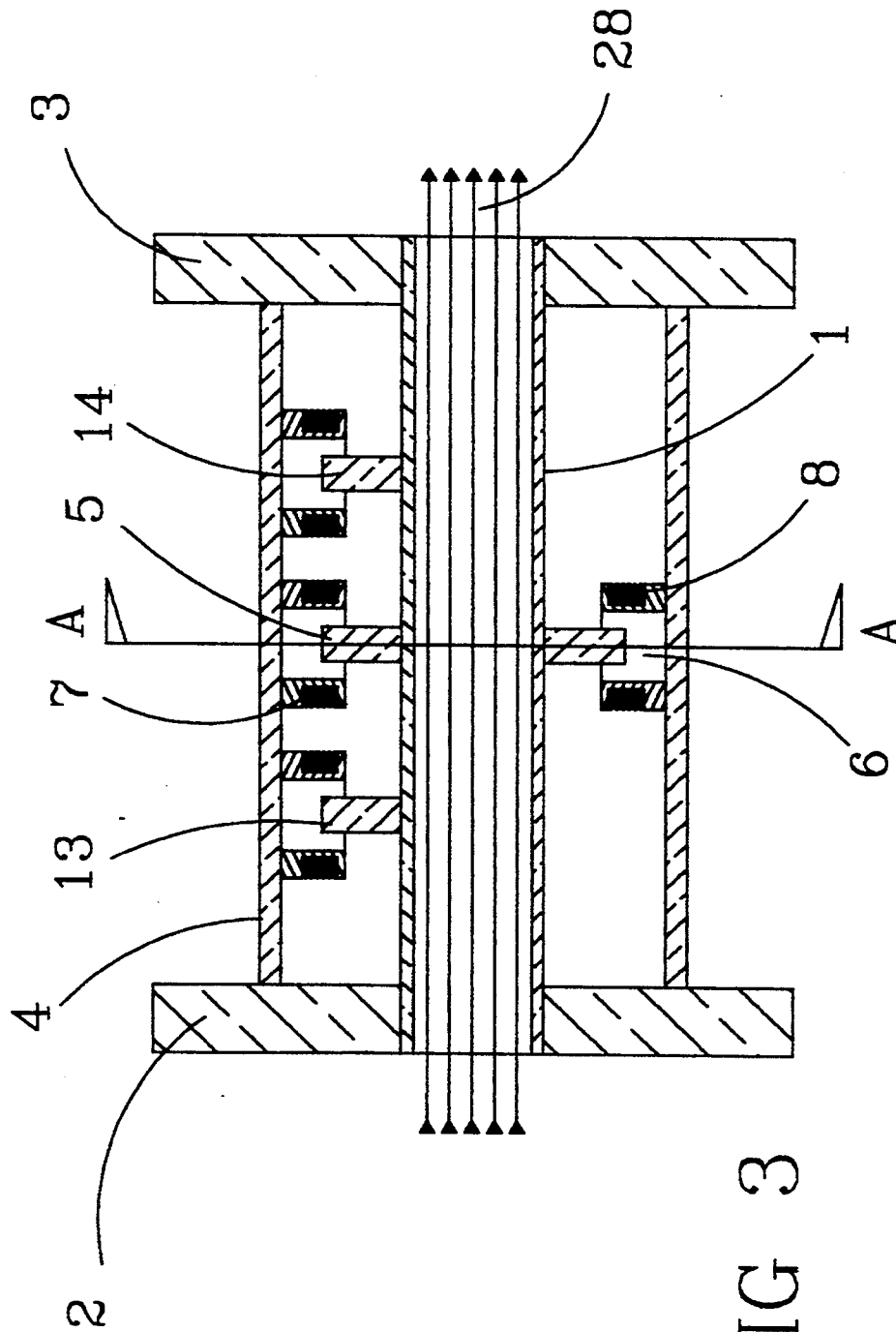


FIG 3

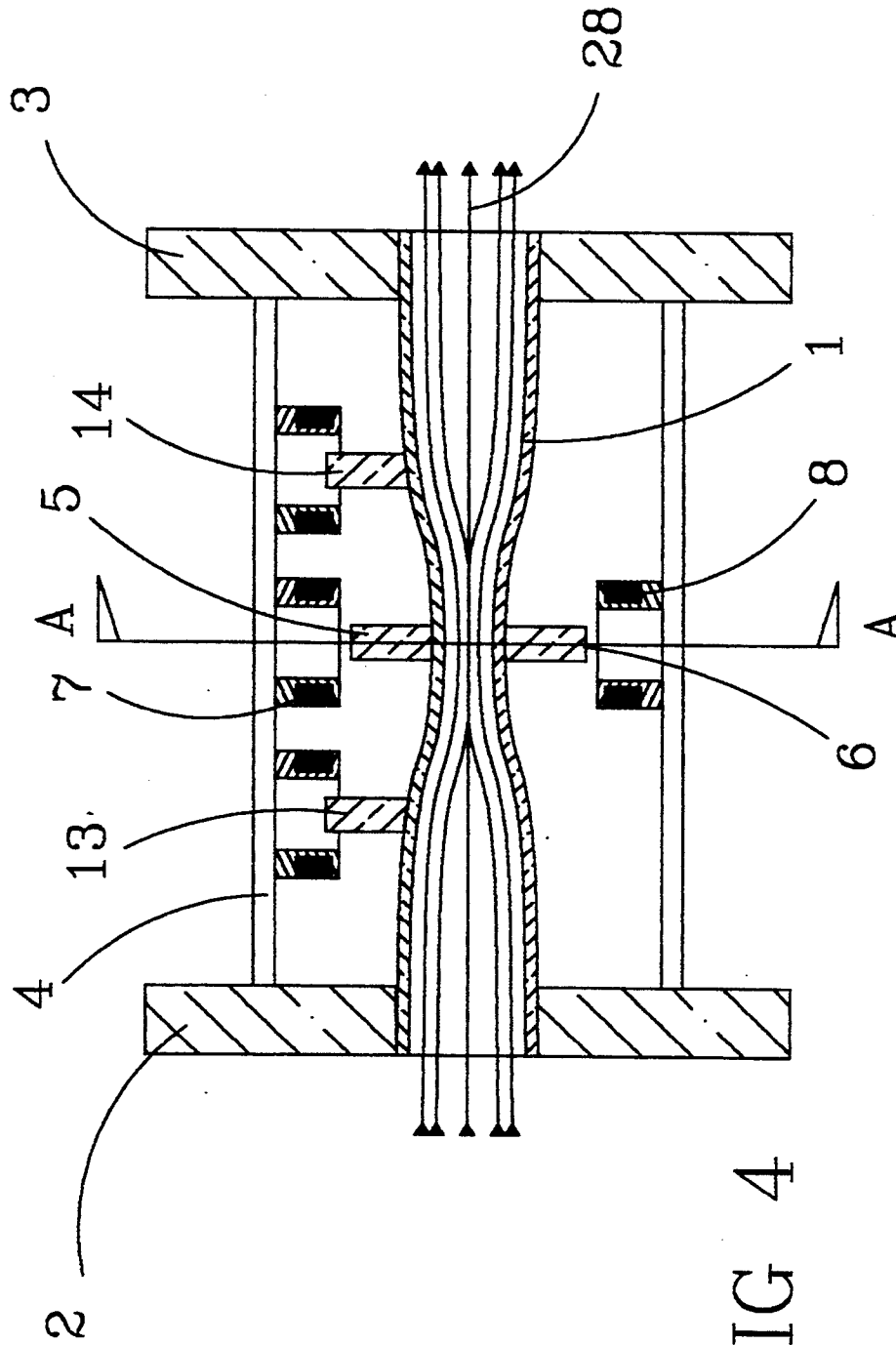


FIG 4

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