



US005449039A

# United States Patent [19]

[11] Patent Number: **5,449,039**

Hartley et al.

[45] Date of Patent: **Sep. 12, 1995**

[54] **APPARATUS AND METHOD FOR HORIZONTAL WELL FRACTURE STIMULATION**

4,850,438	7/1989	Regalbuto .....	175/4.56
5,088,557	2/1992	Ricles et al. ....	166/297
5,107,927	4/1992	Whiteley et al. ....	166/50
5,224,556	7/1993	Wilson et al. ....	175/4.53

[75] Inventors: **Alan C. Hartley, Rocky Rapids; Russell S. J. Krasey, Calgary, both of Canada**

*Primary Examiner*—Hoang G. Dang  
*Attorney, Agent, or Firm*—John Wade Carpenter

[73] Assignee: **Canadian Occidental Petroleum, Ltd., Calgary, Canada**

### [57] ABSTRACT

[21] Appl. No.: **192,379**

An apparatus and method for perforating in deviated and horizontal wells. A firing pin and charge housing is integrally secured to a generally tubular body. The firing pin and charge housing has a structure defining at least one recess extending through the firing pin and charge housing and communicating with at least one tubular bore within the tubular body. The recess comprises at least one charge recess communicating with the at least one tubular bore. A firing pin is biasingly disposed in the recess and an explosive member is disposed in the charge recess. A detonator is positioned in the recess and is engaged to the explosive member for detonating the latter. A sleeve member is slidably disposed in the tubular bore and has at least one sleeve opening and a shear pin bound thereto and extending through the recess for engaging the firing pin. The sleeve member includes a sleeve seat for receiving a plug to slidably move the sleeve member and cause the shear pin to shear and to align the sleeve opening with the charge recess and cause the firing pin to contact the detonator and discharge the explosive member.

[22] Filed: **Feb. 7, 1994**

[51] Int. Cl.<sup>6</sup> ..... **E21B 43/117; E21B 43/12**

[52] U.S. Cl. .... **166/297; 166/50; 166/55.1; 175/4.56**

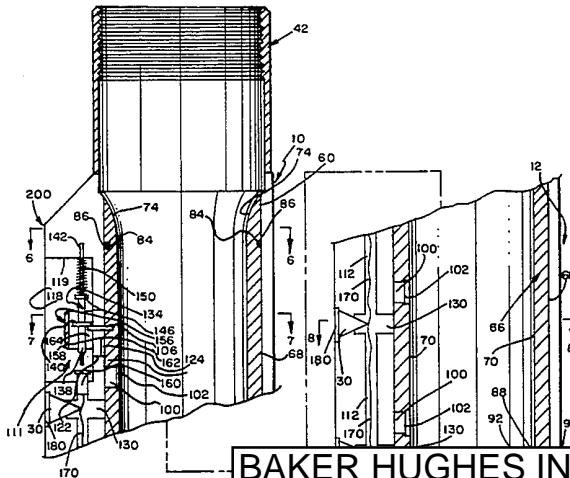
[58] Field of Search ..... **166/297, 55.1, 50; 175/4.56**

### [56] References Cited

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3,240,273	3/1966	Solari et al. .	
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4,299,287	11/1981	Vann et al. ....	166/297
4,484,632	11/1984	Vann .....	166/297
4,512,406	4/1985	Vann et al. ....	166/297
4,515,217	5/1985	Stout .....	166/297
4,544,034	10/1985	George .....	166/297
4,554,981	11/1985	Davies .....	166/55.1 X
4,619,333	10/1986	George .....	175/4.52
4,637,478	1/1987	George .....	175/4.51

**22 Claims, 8 Drawing Sheets**



**BAKER HUGHES INCORPORATED AND  
BAKER HUGHES OILFIELD  
OPERATIONS, INC.**  
Exhibit 1004  
**BAKER HUGHES INCORPORATED AND  
BAKER HUGHES OILFIELD  
OPERATIONS, INC. v. PACKERS PLUS  
ENERGY SERVICES, INC.**  
IPR2016-00598



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- [54] APPARATUS AND METHOD FOR HORIZONTAL WELL FRACTURE STIMULATION
- [75] Inventors: Alan C. Hartley, Rocky Rapids; Russell S. J. Krasey, Calgary, both of Canada
- [73] Assignee: Canadian Occidental Petroleum, Ltd., Calgary, Canada
- [21] Appl. No.: 192,379
- [22] Filed: Feb. 7, 1994
- [51] Int. Cl.<sup>6</sup> ..... E21B 43/117; E21B 43/12
- [52] U.S. Cl. .... 166/297; 166/50; 166/55.1; 175/4.56
- [58] Field of Search ..... 166/297, 55.1, 50; 175/4.56

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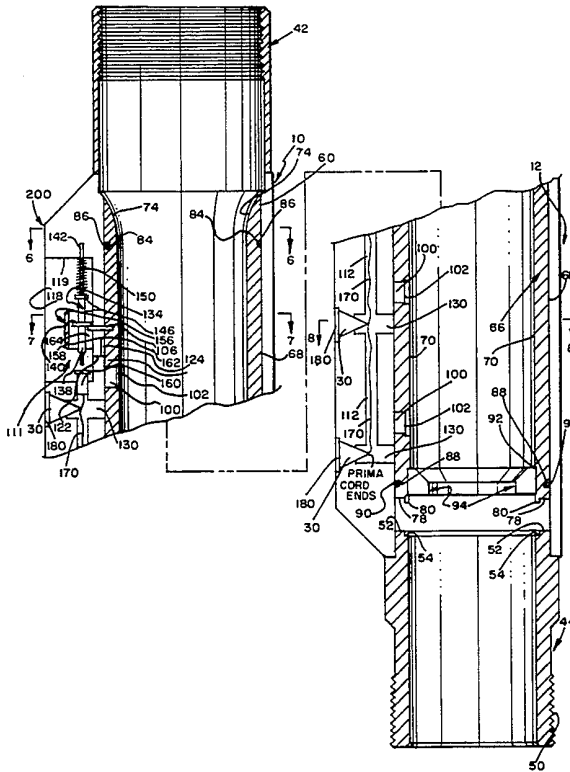
### [57] ABSTRACT

An apparatus and method for perforating in deviated and horizontal wells. A firing pin and charge housing is integrally secured to a generally tubular body. The firing pin and charge housing has a structure defining at least one recess extending through the firing pin and charge housing and communicating with at least one tubular bore within the tubular body. The recess comprises at least one charge recess communicating with the at least one tubular bore. A firing pin is biasingly disposed in the recess and an explosive member is disposed in the charge recess. A detonator is positioned in the recess and is engaged to the explosive member for detonating the latter. A sleeve member is slidably disposed in the tubular bore and has at least one sleeve opening and a shear pin bound thereto and extending through the recess for engaging the firing pin. The sleeve member includes a sleeve seat for receiving a plug to slidably move the sleeve member and cause the shear pin to shear and to align the sleeve opening with the charge recess and cause the firing pin to contact the detonator and discharge the explosive member.

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22 Claims, 8 Drawing Sheets



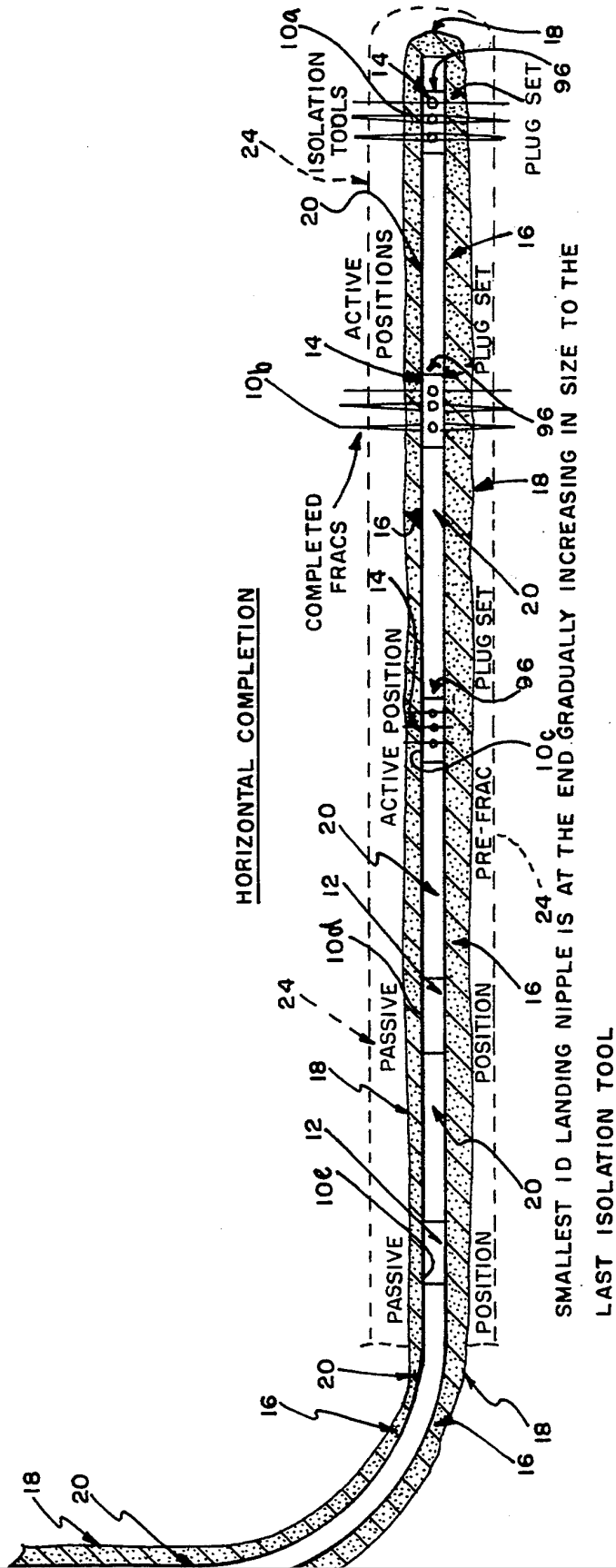
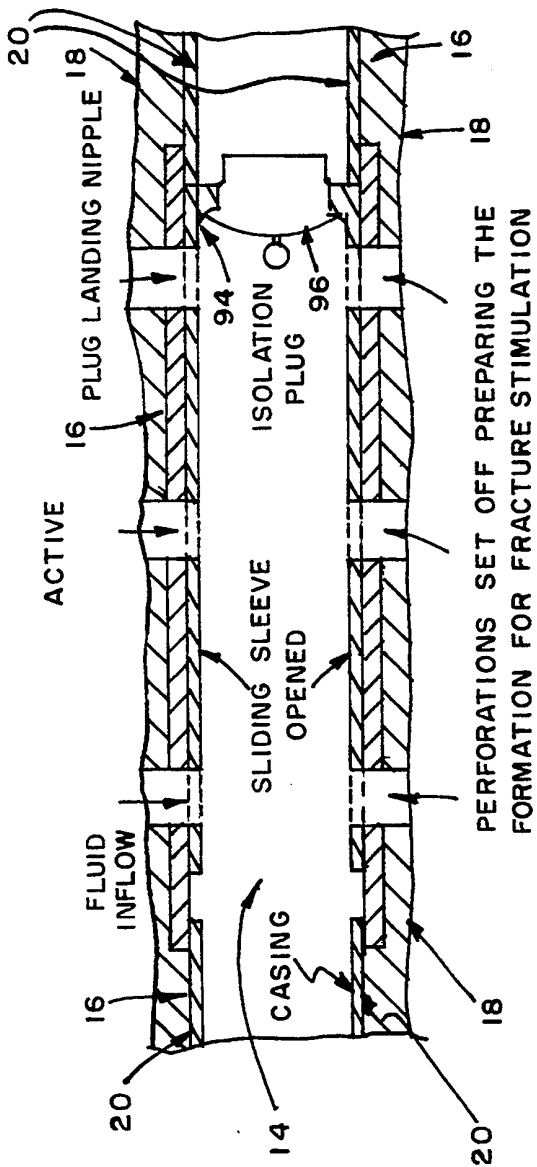
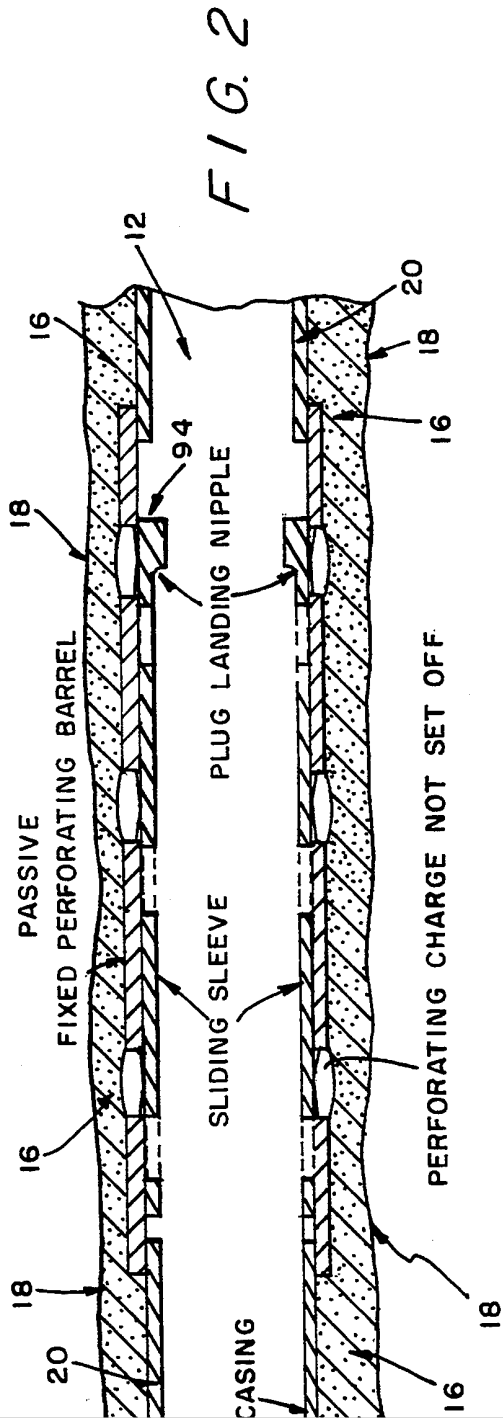
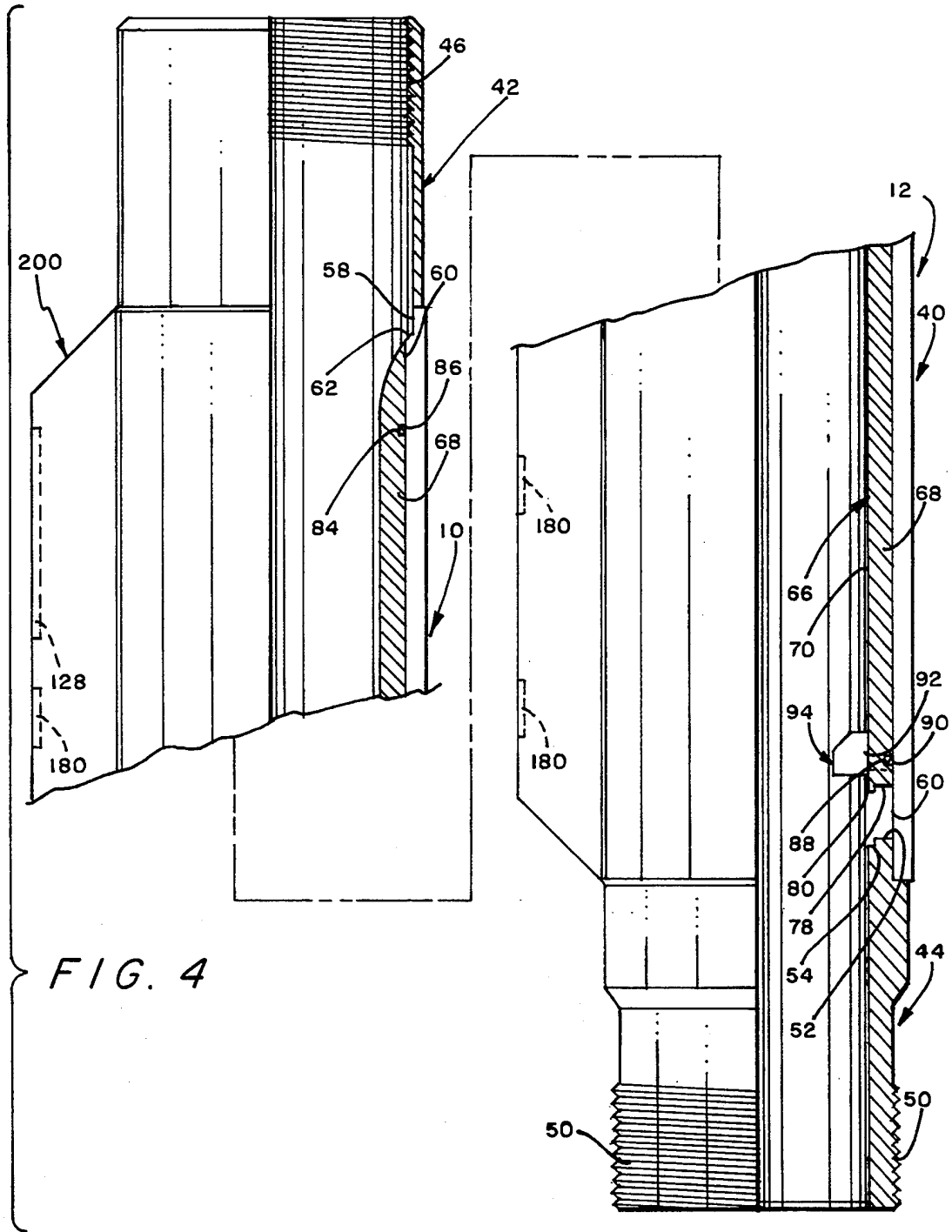


FIG. 1





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