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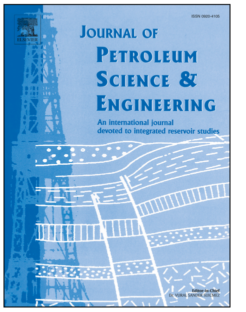

A novel intelligent sliding sleeve for shale oil and gas mining equipment

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A novel intelligent sliding sleeve for shale oil and gas mining equipment

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Abstract: The principal purpose of this paper is to develop a new sliding sleeve which can overcome the inherent disadvantages of the present sliding sleeves. The working principle and structure of the device were explained. The novel energy source which adopted an accumulator was studied. Parametric optimization of the pipeline was developed by simulation study to avoid resonance. The key component, a new micro solenoid valve, was researched to control the sliding sleeve. The electromagnetic simulation was finished to research electromagnetic force. The compact structure which can satisfy the underground working environment was obtained. Design rationality of the novel intelligent sliding sleeve was validated by theory analysis and experiments. The novel intelligent sliding sleeve can meet the design requirements and perform well.

Keywords: Sliding sleeve; Accumulator; Micro solenoid valve; Electromagnetic force

1. Introduction

Shale bed has the property of low permeability (Bocora, 2012; Holditch, 2013; McGlade et al., 2013) and hydraulic fracturing is recognized as an appropriate stimulation technique for this kind of low permeability reservoirs (Hossain et al., 2000). The sliding sleeve is the core component of the hydraulic fracturing which offers great potential for the efficient production of hydraulic fracturing (Valvatne et al., 2003), since it can improve oil recovery, increase profits and reduce risks of an early production of undesirable fluids by optimal placement design (Almeida et al., 2010; Alhuthali et al., 2010; Aitokhuehi and Durlofsky, 2005; Doublet et al., 2009; Yeten 2004). According to the operating mechanism, the present sliding sleeves can be divided into three kinds, including ball-activated sliding sleeves, hydraulic sliding sleeves and all-electric sliding sleeves.

The ball-activated sliding sleeves have been studied deeply (Edwards, 1953; Williams, 2014), and its operating principle can be described as seen in Fig. 1(a). The activated ball and the conical surface of the ball seat form a sealing face. The pin will fracture when it reaches the shear stress by pressing the activated ball, and then the inner sleeve slides till the oil duct is opened (Pei et al., 2014). However, the ball-activated sliding sleeves have some disadvantages. For instance, diameter of each sliding sleeve exists grade difference, so numbers of the fracturing segments are limited. In addition, the operation as it works in the horizontal segment is difficult, so the working

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