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**Lerche et al.**

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(54) **APPARATUS AND METHODS FOR CONTROLLING AND COMMUNICATING WITH DOWNHOLE DEVICES**

6,959,765 B2	11/2005	Bell	
7,081,831 B2 *	7/2006	Dodge	340/855.4
7,347,278 B2	3/2008	Lerche et al.	
7,530,397 B2	5/2009	Bell	
7,536,942 B2	5/2009	Bell	
7,698,982 B2	4/2010	Bell	
2002/0062991 A1	5/2002	Farrant	

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(51) **Int. Cl.**  
**E21B 43/1185** (2006.01)

(52) **U.S. Cl.**  
USPC ..... **340/853.2**; 340/855.3; 340/855.7;  
166/66

(58) **Field of Classification Search**  
USPC ..... 340/853.2, 854.1, 855.3, 855.5, 855.7;  
166/66

See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

4,208,966 A	6/1980	Hart
4,986,183 A	1/1991	Jacob
6,283,227 B1	9/2001	Lerche et al.
6,604,584 B2	8/2003	Lerche
6,938,689 B2	9/2005	Farrant

**FOREIGN PATENT DOCUMENTS**

CA	2708183 A1	2/2010
EP	2229503 B1	5/2012

(Continued)

**OTHER PUBLICATIONS**

International Preliminary Report on Patentability, PCT/US09/04477, dated Feb. 17, 2011, 9 pages.

(Continued)

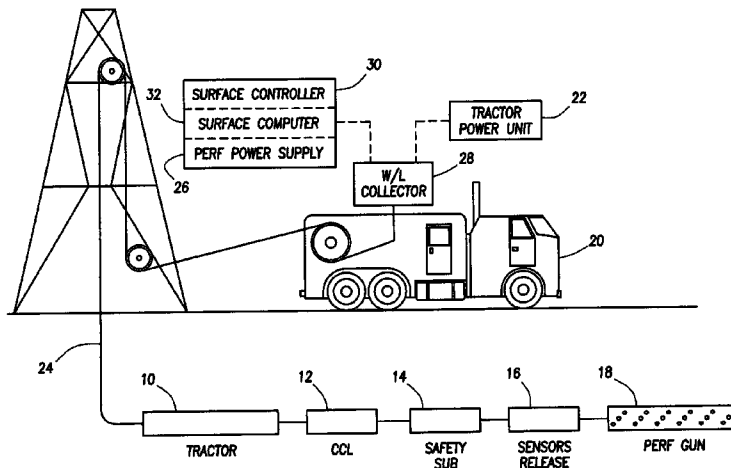
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(57) **ABSTRACT**

Apparatus and methods for controlling and communicating with one or more tools in a downhole tool string including a tractor, an auxiliary tractor tool, a logging tool, a safety sub, a release mechanism, a unit containing sensors for monitoring downhole conditions, a setting tool, and a perforating gun. Also provided are apparatus and methods for controlling and communicating with one or more perforating guns, release devices, and explosive devices in a string to be lowered into a wellbore. Control and communication are accomplished by sending signals from the surface to control switches in the control units on the tool, with redundant switches for safety, to state machines in the respective control units, each state machine returning a signal verifying switch status to the surface. Control and power functions are accomplished with voltage of different polarities for safety.

**12 Claims, 27 Drawing Sheets**



(56)

**References Cited**

U.S. PATENT DOCUMENTS

2004/0108114 A1 6/2004 Lerche  
2005/0045331 A1 3/2005 Lerche  
2006/0130693 A1 6/2006 Teowee  
2011/0066378 A1 3/2011 Lerche et al.

FOREIGN PATENT DOCUMENTS

GB 2340157 A 2/2000  
WO 0024999 A1 5/2000  
WO 2007143759 A1 12/2007  
WO 2008100362 A2 8/2008  
WO 2010016897 2/2010

OTHER PUBLICATIONS

Examination Report, European Patent Application No. 09741043.5, dated Jan. 13, 2011, 3 pages.  
File history of European Patent Application No. 10075578.4, filed Aug. 5, 2008, 61 pages.  
European Search Report dated Oct. 18, 2011 European Patent Application No. 10075578.4, 8 pages.  
File history of European Patent No. 2229503, 290 pages.  
File history of European Patent Application No. 10075578.4, 180 pages.  
Response to Communication pursuant to Rules 70(2) and 70a(2) of European Patent Application No. 10075578.4, 8 pages.  
File history of Canadian Patent Application No. 2,708,183, 61 pages.  
File history of Canadian Patent Application No. 2,708,007, 30 pages.

File history of European Divisional Patent Application No. 10075761.6, 26 pages.  
File history of European Divisional Patent Application No. 11075202.9, 141 pages.  
File history of European Divisional Patent Application No. 11075204.5, 137 pages.  
Communication pursuant to Article 94(4) EPC, Application No. 10075761.6, 4 pages.  
U.S. Appl. No. 12/451,913, filed Dec. 3, 2009, Lerche et al.  
U.S. Appl. No. 12/934,701, filed Sep. 27, 2010, Lerche et al.  
International Search Report of PCT/US08/00200 dated Feb. 2, 2009, 4 pages.  
Written Opinion of the International Searching Authority, PCT/US08/00200, dated Feb. 2, 2009, 6 pages.  
International Preliminary Report on Patentability, PCT/US08/00200, dated Jul. 7, 2009, 7 pages.  
International Search Report of PCT/US09/04477, dated Mar. 11, 2010, 6 pages.  
Written Opinion of the International Searching Authority, PCT/US09/04477, dated Mar. 11, 2010, 8 pages.  
File history of Canadian National Phase Application 2,708,007, filed Jun. 4, 2010, 66 pages.  
File history of European National Phase Application No. EP08754055.5, filed Aug. 6, 2009, 54 pages.  
File history of Canadian National Phase Application based on PCT/US09/04477, filed Jun. 4, 2010, 67 pages.  
File history of European National Phase Application No. EP09741043.5, filed Jul. 8, 2010, 61 pages.

\* cited by examiner

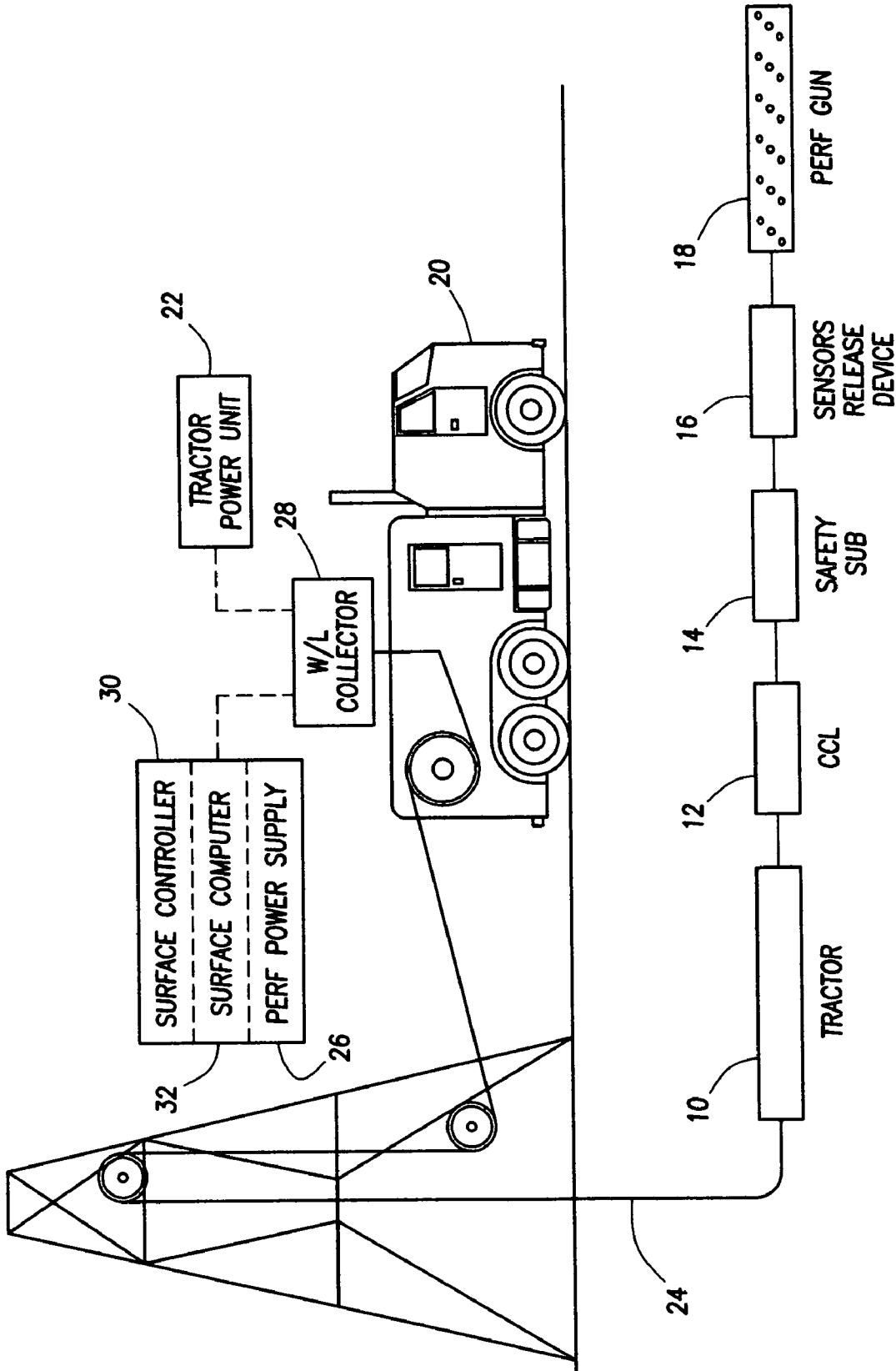


FIG. 1

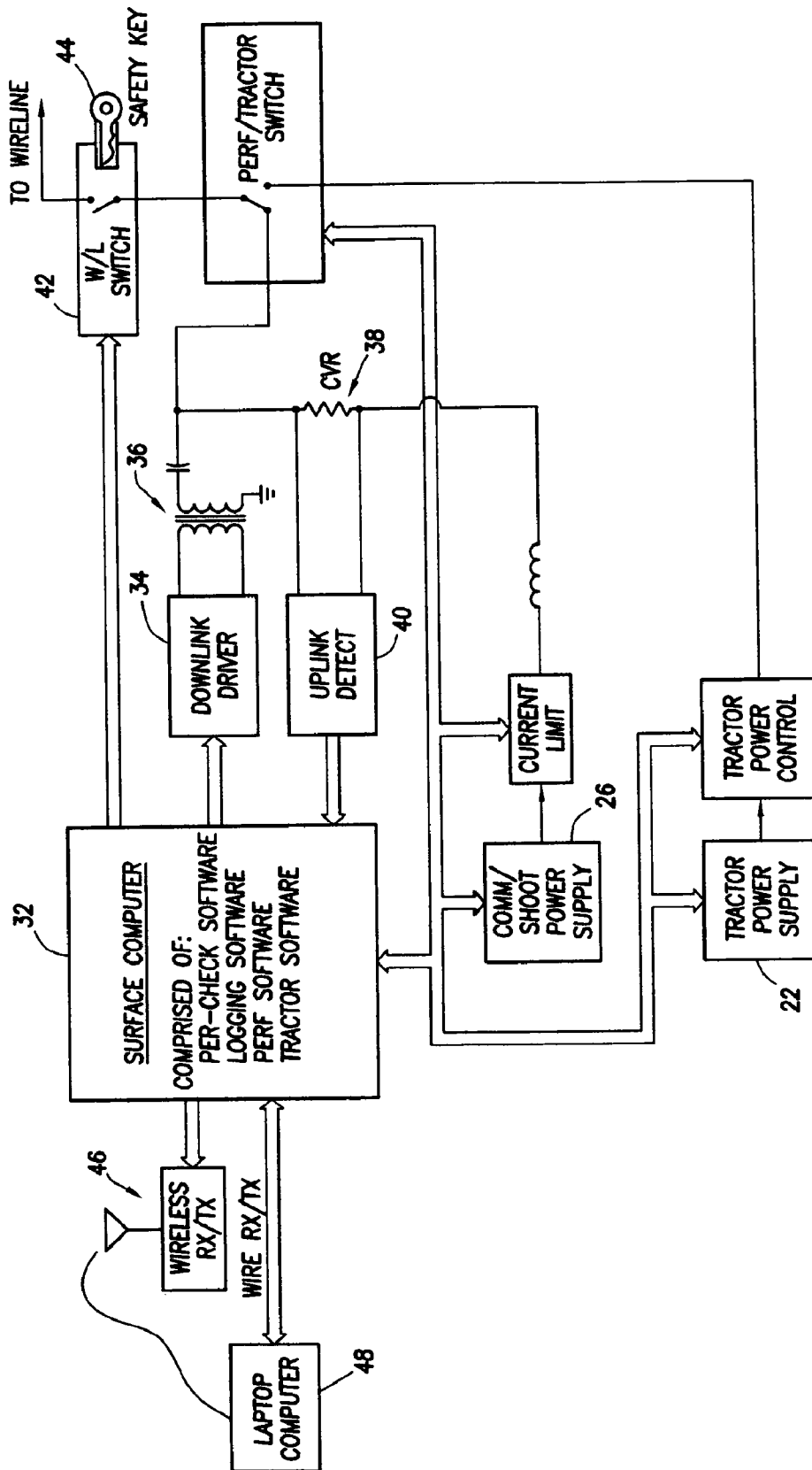


FIG. 2

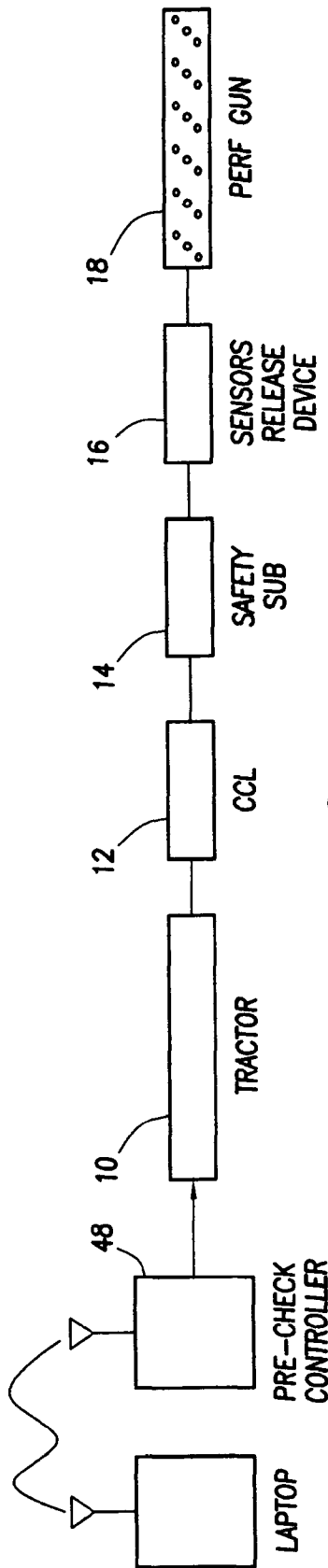


FIG. 3A

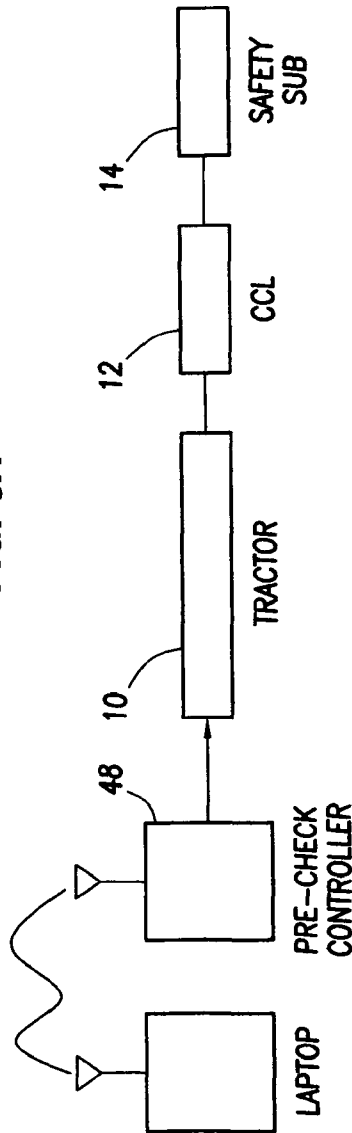


FIG. 3B

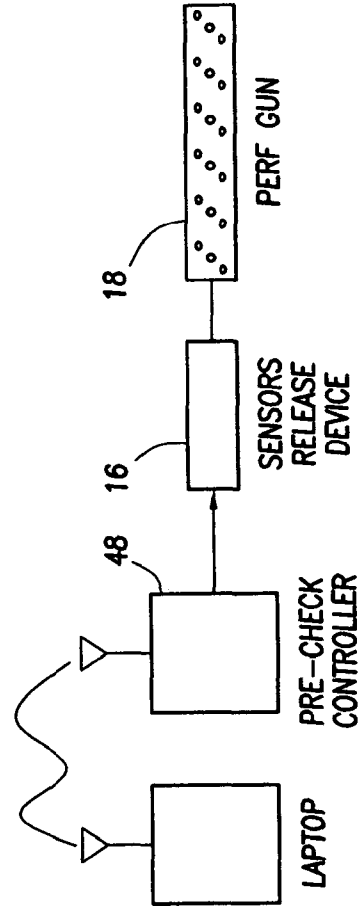


FIG. 3C

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