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Lerche et al.

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(54) **TRACTOR COMMUNICATION/CONTROL AND SELECT FIRE PERFORATING SWITCH SIMULATIONS**

(58) **Field of Classification Search**
USPC 166/255.1, 255.2, 251.1, 66; 175/4.51, 175/24, 45; 340/853.3, 853.2, 854.9
See application file for complete search history.

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(56) **References Cited**

U.S. PATENT DOCUMENTS

4,208,966 A 6/1980 Hart
4,986,183 A 1/1991 Jacob

(Continued)

FOREIGN PATENT DOCUMENTS

EP 2106494 9/2011
EP 2229503 B1 5/2012

(Continued)

OTHER PUBLICATIONS

Office Action of Canada Patent Application No. 2,708,007, dated Apr. 11, 2012, 4 pages.

(Continued)

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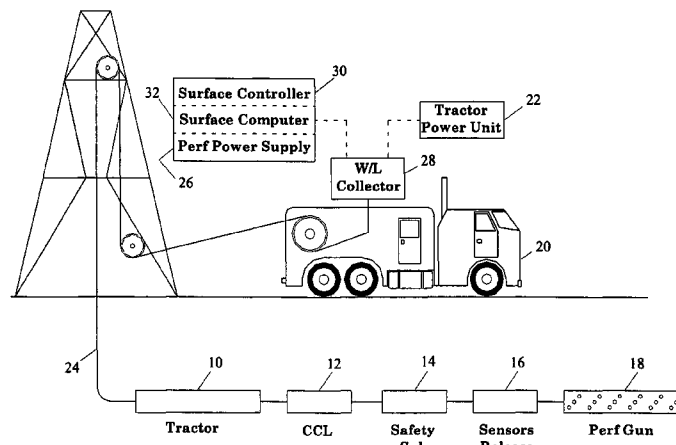
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(57) **ABSTRACT**

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. 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. The state machine need not return a signal including a unique identifier.

24 Claims, 18 Drawing Sheets



(56)

References Cited

U.S. PATENT DOCUMENTS

6,283,227	B1	9/2001	Lerche et al.
6,604,584	B2	8/2003	Lerche
6,938,689	B2	9/2005	Farrant
6,959,765	B2	11/2005	Bell
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
2004/0108114	A1	6/2004	Lerche
2005/0045331	A1	3/2005	Lerche
2006/0130693	A1	6/2006	Teowee

FOREIGN PATENT DOCUMENTS

EP	2402555	B1	4/2013
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

Co-pending U.S. Appl. No. 12/221,611, filed Aug. 5, 2008, Lerche et al.
 Co-pending U.S. Appl. No. 12/934,701, filed Nov. 3, 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.
 File history of European Patent Application No. 10075761.6, filed Dec. 15, 2010, 68 pages.
 Decision to grant European patent, European Patent Application No. 10075761.6, dated Sep. 1, 2011, 1 page.
 Response to Examination Report, European Patent Application No. 08754055.5, dated Nov. 12, 2010, 8 pages.
 Examination Report, European Patent Application No. 08754055.5, dated Jul. 6, 2010, 6 pages.
 File history of European Patent Application No. 11075202.9, filed Aug. 30, 2011, 63 pages.
 File history of European Patent Application No. 11075204.5, filed Sep. 1, 2011, 62 pages.

European Search Report dated Mar. 11, 2011, EPO Application No. 10075761.6, 5 pages.
 European Examination Report of European Application No. 10075761.6, dated Apr. 11, 2012, 5 pages.
 Response to European Search Report of European Application No. 11075202.9, dated Jul. 3, 12 pages.
 Response to European Search Report of European Application No. 11075204.5, dated Jul. 3, 11 pages.
 European Search Report dated Jan. 9, 2012, European Application No. 11075204.5, 4 pages.
 European Search Report dated Jan. 9, 2012, European Application No. 11075202.5, 5 pages.
 Response to Office Action of Canada Patent Application No. 2,708,007, dated Oct. 10, 2012, 25 pages.
 File history of European Patent Application No. 10075761.6, 20 pages.
 Response to European Search Report of European Patent Application No. 11075202.9, 12 pages.
 File history of European Patent Application No. 11075204.5, 71 pages.
 File history of Canadian Patent Application No. 2,708,183, 60 pages.
 File history of Canadian Patent Divisional Application No. 2,708,183, 72 pages.
 File history of European Patent Application No. 09741043.5, 17 pages.
 File history of European Patent Application No. 09741043.5, 197 pages.
 File history of related co-pending U.S. Appl. No. 12/221,611, 450 pages.
 File history of related co-pending U.S. Appl. No. 12/934,701, 385 pages.
 File history of PCT/US08/00200, filed Jan. 7, 2008, 99 pages.
 File history of PCT/US09/04477, filed Aug. 5, 2009, 135 pages.
 File history of Canadian National Phase Application 2,708,007, filed Jun. 4, 2010, 56 pages.
 File history of European National Phase Application No. 08754055.5, filed Aug. 6, 2009, Patent No. 2106494, issued Sep. 28, 2011, 396 pages.
 File history of European National Phase Application No. 10075761.6, filed Dec. 15, 2010, 231 pages.
 File history of European National Phase Application No. 11075202.9, filed Aug. 30, 2011, Patent No. 2402555, issued Apr. 3, 2013, 265 pages.
 File history of European National Phase Application No. 11075204.5, filed Sep. 1, 2011, Patent No. 2402556, issued Mar. 20, 2013, 255 pages.
 File history of Canadian National Phase Application No. 2,708,183, filed Jun. 4, 2010, 77 pages.
 File history of European Patent Application No. 09741043.5, filed Aug. 5, 2009, issued May 9, 2012, EP 2229503 292 pages.
 File history of European Patent Application No. 10075578.4, filed Aug. 5, 2008, 196 pages.
 File history of Norwegian Patent No. NO/EP2106494, issued Jan. 2, 2012, 59 pages.
 File history of co-pending U.S. Appl. No. 12/221,611, filed Aug. 5, 2008, 40 pages.
 File history of Canadian National Phase Application No. 2,792,007, filed Oct. 3, 2012, 75 pages.
 File history of Norwegian Patent No. NO/EP2229503, issued Aug. 20, 2012, 53 pages.
 Office Action, Canadian Patent Application No. 2,792,007, mailed Jul. 15, 2013, 2 pages.

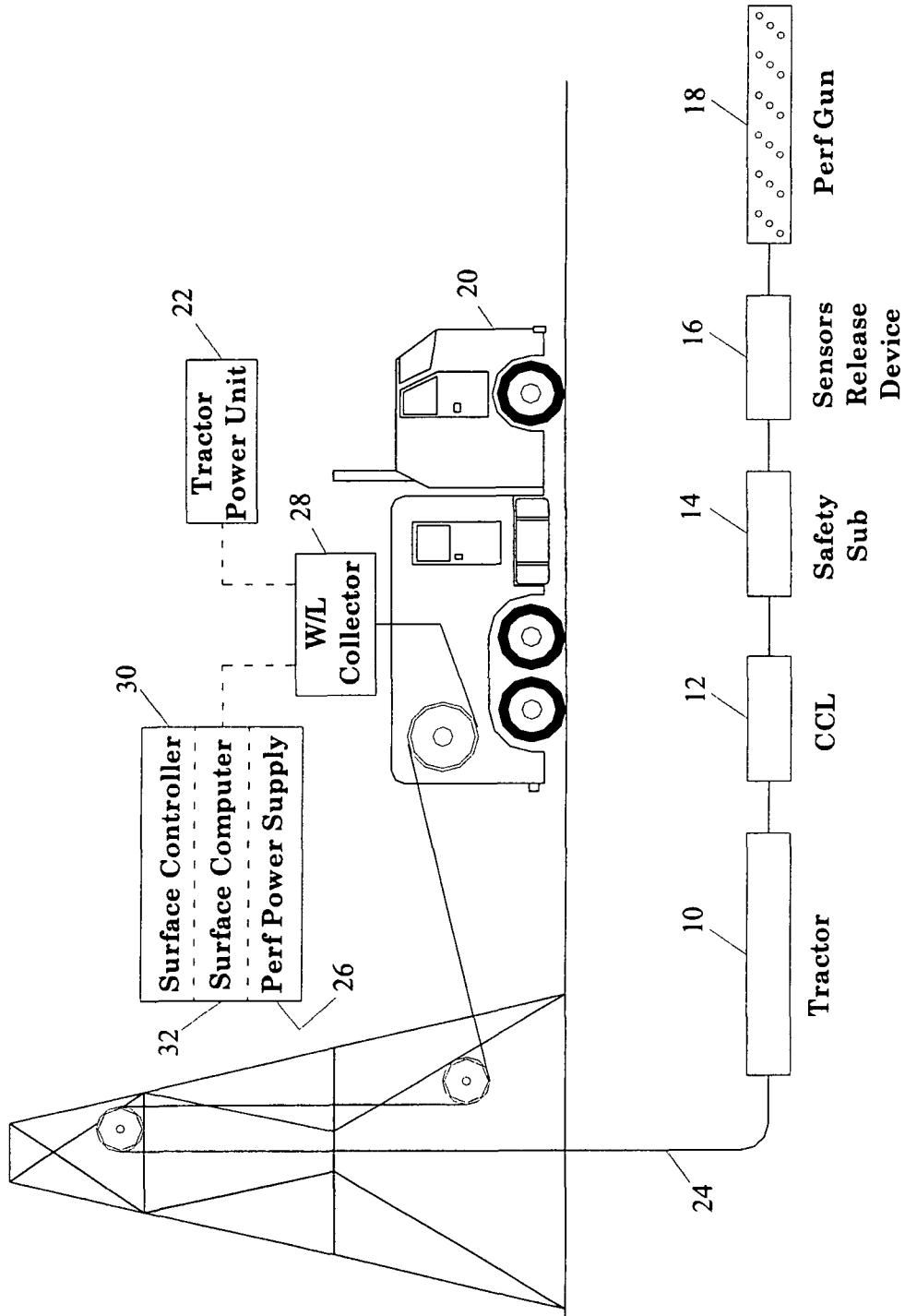


Figure 1

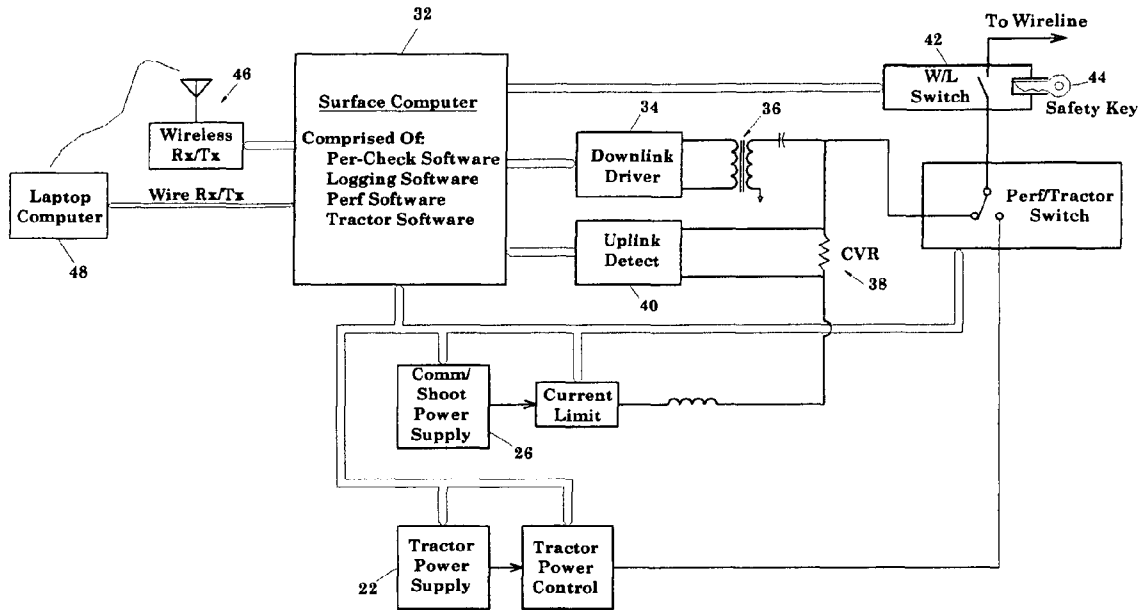


Figure 2

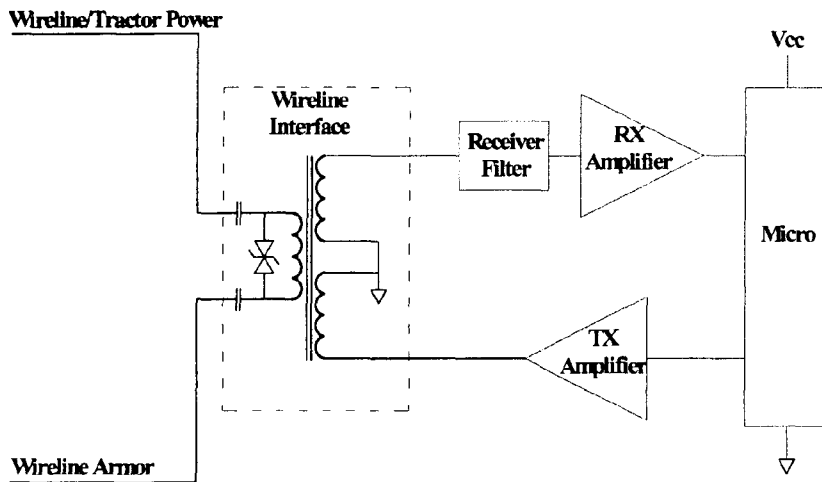


Figure 12

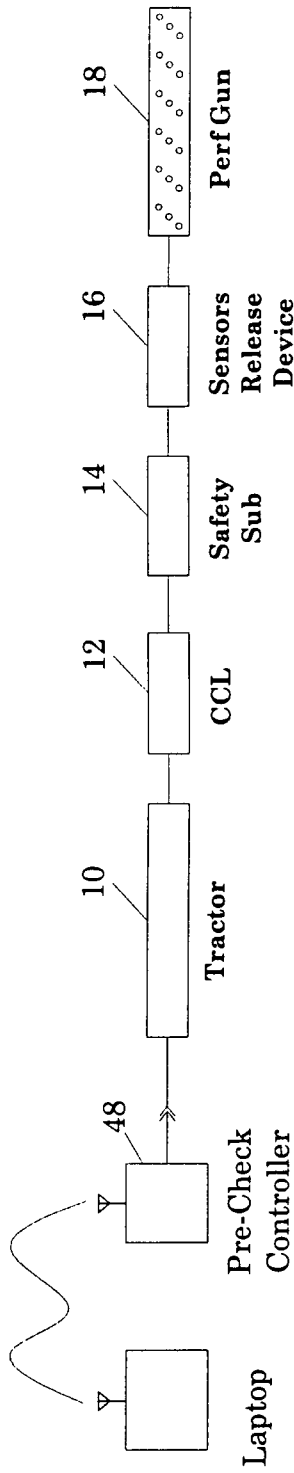


Figure 3A

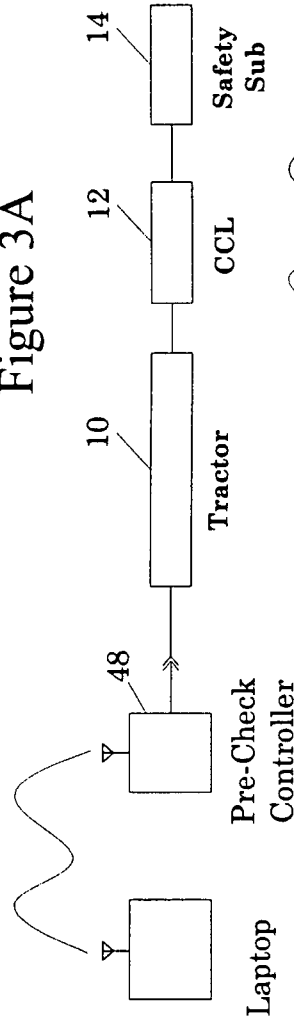


Figure 3B

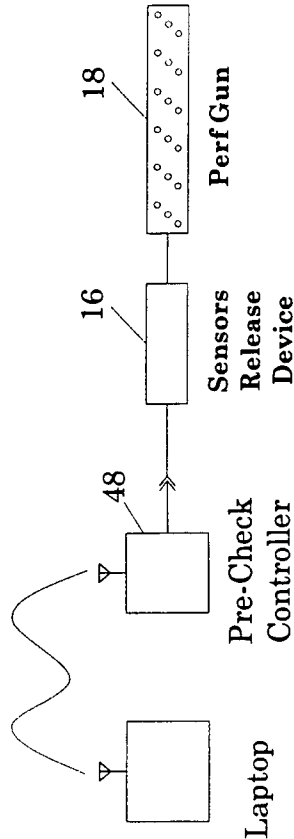


Figure 3C

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