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Inventor            Dominik A. Kotlow

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3 METHOD FOR WIRE GUIDANCE TONE CERTIFICATION

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5 STATEMENT OF GOVERNMENT INTEREST

6 The invention described herein may be manufactured and used  
7 by or for the Government of the United States of America for  
8 governmental purposes without the payment of any royalties  
9 thereon or therefore.

10  
11 BACKGROUND OF THE INVENTION

12 (1) Field of the Invention

13 The present invention relates generally to wire guided  
14 weapons testing, and more particularly to a method for recording,  
15 displaying and certifying fire control tones being sent to a  
16 weapon over a guide wire.

17 (2) Description of the Prior Art

18 In order to certify that proper fire control tones are being  
19 sent to a wire guided weapon during an actual launch, test  
20 launches are conducted in which the weapon is launched and fire  
21 control command tones are sent to the launched weapon. The wire  
22 guidance command tones are recorded on a strip chart, which must  
23 be manually analyzed using a calibrated time-scale to establish  
24 tone duration. The tone frequency can be obtained by physically

1 counting the peaks over a time frame. In order for the peaks to  
2 be distinguished, the strip chart recorder must be run at maximum  
3 speed, creating extremely long recordings for each test firing.  
4 The manual interpretation of the strip chart is time consuming  
5 and prone to error and is very dependent on the experience level  
6 of the personnel performing the measurements.

7  
8 SUMMARY OF THE INVENTION

9 Accordingly, it is an object of the present invention to  
10 provide a method to obtain command tone signals for a wire guided  
11 weapon during a test launch.

12 Another object of the present invention is to provide a  
13 method to analyze the command tone signals, which does not rely  
14 on manual interpretation of the collected data.

15 A further object of the present invention is to provide a  
16 method to certify that the frequency and duration of the command  
17 tone signals are within proper operating parameters.

18 Other objects and advantages of the present invention will  
19 become more obvious hereinafter in the specification and  
20 drawings.

21 In accordance with the present invention, a method is  
22 provided to obtain and process wire guidance fire control command  
23 tones. The method is implemented on a computer, which is used in  
24 lieu of the strip chart recorder to capture the command tones.

1 When initiated, the method begins data monitoring and displays  
2 the data in real time, showing the tone, or signal over time.  
3 The real time display is typically updated once per second, or at  
4 some other predetermined time period. A user controls the  
5 beginning and ending of the capture period by pressing a  
6 RECORD/STOP RECORD button. The button may be either a visual  
7 display that activates data recording when "pressed" by a user  
8 mouse click on the display, or may be an electromechanical switch  
9 connected with the computer. The captured data is stored within  
10 the computer. The file structure of the stored data may include  
11 the hull number of the vessel conducting the test, the tube  
12 number from which the weapon is fired, the test event, the run  
13 number within the event and an identification of the weapon being  
14 fired. When the user presses the RECORD/STOP RECORD button once  
15 again, no further data is captured and the full record of the  
16 captured data is displayed. The display includes active cursors  
17 denoting the start and stop of the event. The user may position  
18 the cursors independently along the data display so as to bracket  
19 a tone event of interest. Once the cursors are positioned, the  
20 display is updated to show only the bracketed event along with an  
21 indication of the time duration of the event. In addition, the  
22 display also shows the signal frequency within the bracketed  
23 event. The method may use any one of several well known fast  
24 Fourier transform algorithms operating on the data between the

1 cursor locations to calculate the frequency. The user may then  
2 continue refining the positions of the cursors to accurately  
3 identify the event of interest. Once the event has been  
4 satisfactorily identified, the duration and frequency may be  
5 compared to specified parameters to certify or reject the wire  
6 guided fire control command tone signaling system.

7 Thus, the method of the present invention provides a  
8 computerized method of obtaining and analyzing command tone  
9 signals for a wire guided weapon during a test launch. Manual  
10 interpretation of the data includes only locating a tone event of  
11 interest and positioning a set of cursors about the event. The  
12 method automatically calculates the tone duration and frequency  
13 based on the cursor positions. The cursor positioning may be  
14 further refined to more accurately analyze the event and to  
15 certify or reject the system based on the analysis.

#### 16 17 BRIEF DESCRIPTION OF THE DRAWINGS

18 A more complete understanding of the invention and many of  
19 the attendant advantages thereto will be readily appreciated as  
20 the same becomes better understood by reference to the following  
21 detailed description when considered in conjunction with the  
22 accompanying drawing, labeled as FIG. 1 and showing a flow chart  
23 representation of the method of the present invention.  
24



1 the tube number from which the weapon is fired, the test event,  
2 the run number within the event and an identification of the  
3 weapon being fired. These identifiers are user inputs to the  
4 system as indicated at 28. Data capture and storage continues  
5 until the user activates the STOP RECORD button (16a, 20, 24).  
6 Once data capture is stopped, computer 12, using the stored data  
7 as indicated by link 29, generates and displays a full record of  
8 the captured data, showing the tone variation over time (30).

9 In addition to the data record, an active cursor is  
10 displayed at both the start and end of the record. The cursors  
11 are independently positionable by the user, so as to bracket and  
12 select a portion of the data record of interest (at 32). Once  
13 selected, the display is updated at 34 to show only the bracketed  
14 portion of the data record, with the active cursors shown at the  
15 start and end of the bracketed portion. Updating the display  
16 also involves computer 12 determining (at 36) and displaying the  
17 time duration of the selected record portion. In addition,  
18 computer 12 analyzes the selected record data to determine the  
19 tone signal frequency within the selected time frame (at 38) and  
20 displays the results of the analysis. In a preferred embodiment,  
21 the analysis is performed using any of several well known Fast  
22 Fourier Transform analyses on the selected record. The user can  
23 then reposition the active cursors to further refine the  
24 bracketed portion of the record as indicated by the return 40 to

1 32. The user may also return to the previously displayed portion  
2 of the record as indicated by the return 42 to 34. Once the  
3 bracketed portion, or event, has been satisfactorily refined, the  
4 duration and frequency may be compared to specified parameters to  
5 certify or reject the wire guided fire control command tone  
6 signaling system (44).

7 The invention thus described provides a method that  
8 eliminates manual interpretation of fire control command tones,  
9 while providing user control of the tone events to be analyzed.  
10 The tone duration and frequency are automatically determined to  
11 preclude human error. Further, a full record of the test results  
12 is available for further analysis, if necessary, without the need  
13 for storage of paper strip charts.

14 Although the present invention has been described relative  
15 to a specific embodiment thereof, it is not so limited. While  
16 the method has been described for the analysis of a fire control  
17 command tone for a wire guided weapon, the use of the active  
18 cursors to iteratively refine an event of interest can be applied  
19 to any data set where events of interest must be determined and  
20 analyzed. Also, the method can be used to monitor any signal for  
21 which frequency and/or time duration are required. Further, the  
22 RECORD/STOP RECORD button may be an electromechanical switch  
23 interfaced with the computer, rather than a visual display  
24 button.

1            Thus, it will be understood that many additional changes in  
2            the details, materials, steps and arrangement of parts, which  
3            have been herein described and illustrated in order to explain  
4            the nature of the invention, may be made by those skilled in the  
5            art within the principle and scope of the invention.

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1 Attorney Docket No. 80188

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METHOD FOR WIRE GUIDANCE TONE CERTIFICATION

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ABSTRACT OF THE DISCLOSURE

6 A method is provided to capture and process wire guidance  
7 fire control command tones. The method is implemented on a  
8 computer, which monitors and displays the wire guidance command  
9 tones in real time, showing the tone or signal over time. A user  
10 controls the beginning and ending of the capture period. The  
11 captured data is stored within the computer. Once data capturing  
12 has ended, the full record of the captured data is displayed.  
13 The display includes active cursors denoting the start and stop  
14 of the recorded event. The cursors may be positioned  
15 independently along the data display so as to bracket a tone  
16 event of interest. Once the cursors are positioned, the method  
17 updates the display to show only the bracketed event. The time  
18 duration of the event is also shown as well as a computed  
19 frequency for the event. The user may then continue refining the  
20 positions of the cursors to accurately identify the event of  
21 interest. Once the event has been satisfactorily identified, the  
22 duration and frequency may be compared to specified parameters to  
23 certify or reject the wire guided fire control command tone  
24 signaling system.

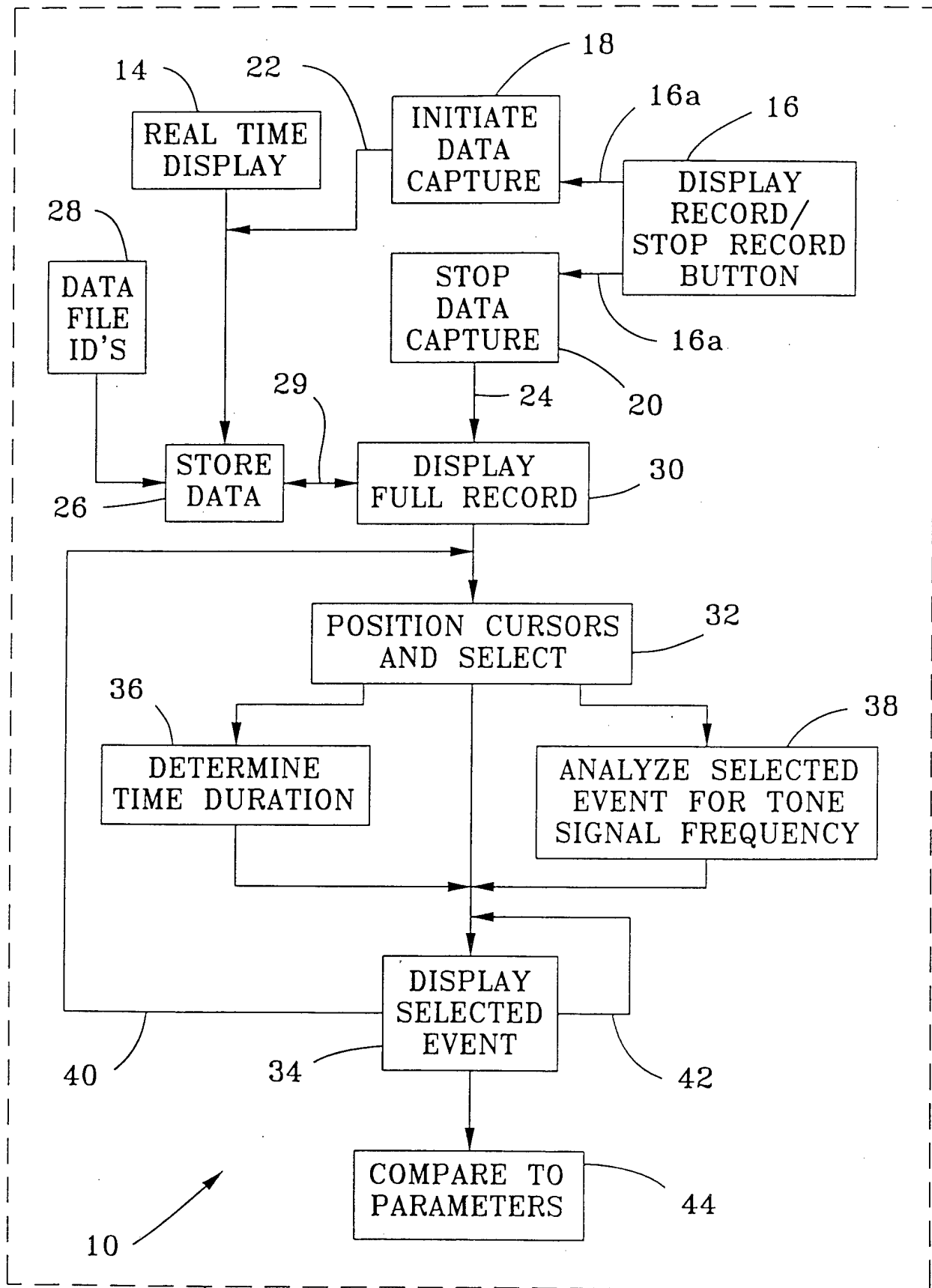


FIG. 1