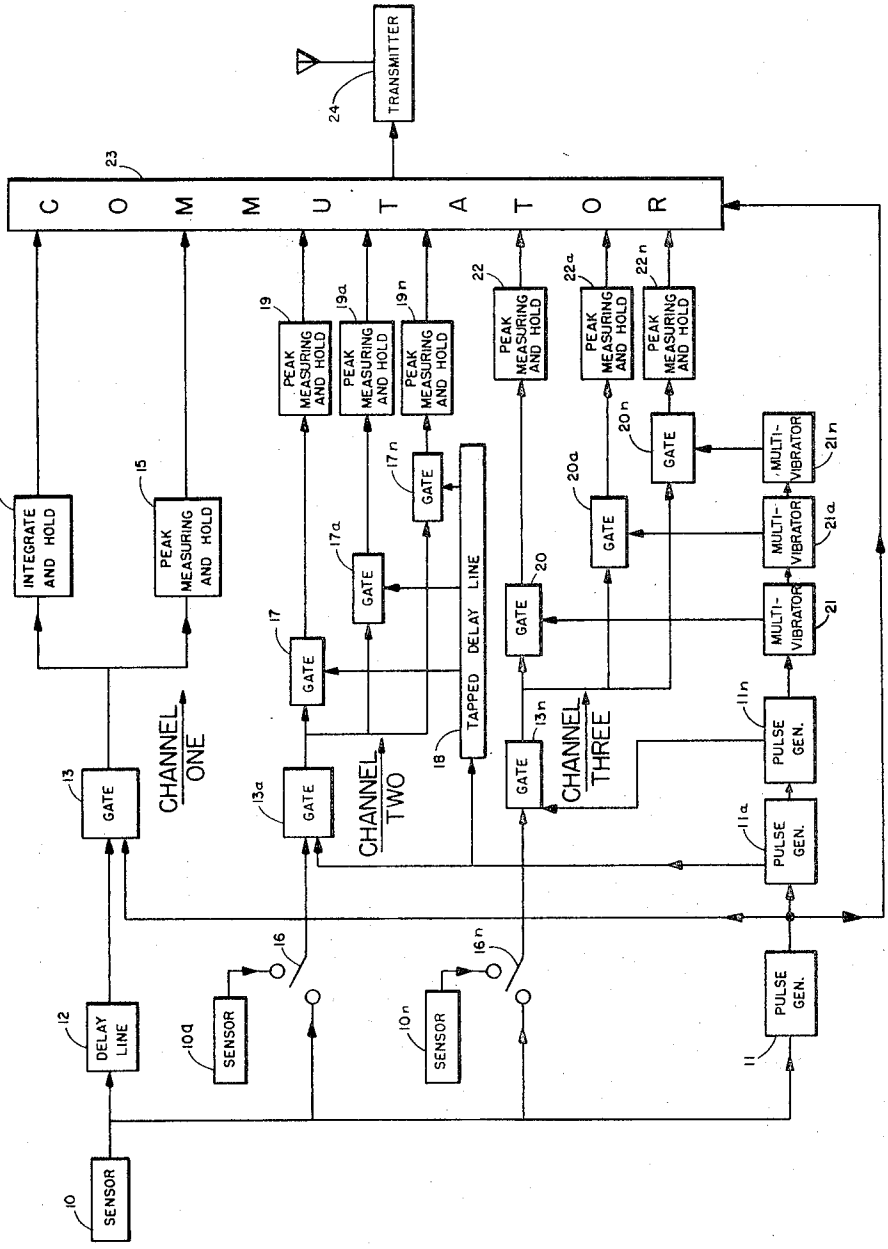
340-870.11 SR 2E X762Y SEARCH ROOM
XR 3,364,466 X744D X762Y CROSS REFERENCE

Jan. 16, 1968 P. T. STINE 3,364,466

DATA COLLECTION SYSTEM HAVING PLURAL CHANNEL STORAGE OF SEQUENTIAL SIGNALS

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FIG. 1

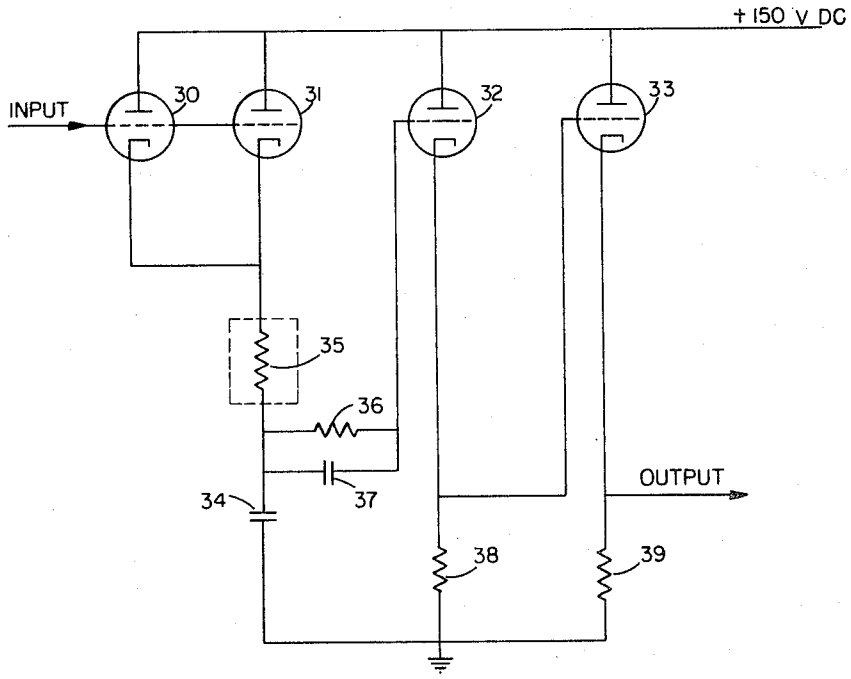


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FIG. 2



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DATA COLLECTION SYSTEM HAVING PLURAL CHANNEL STORAGE OF SEQUENTIAL SIGNALS

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ABSTRACT OF THE DISCLOSURE

Telemetering system for short duration phenomena. Plurality of channels, which include sensors and different arrangements of sequenced, peak holding and intergrating circuitry to store data, are sequentially connected to transmitter.

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

This invention relates to a telemetering system and more particularly to a telemetering system for sensing extremely short duration phenomena in an environment which prohibits broadcasting at the time of the data occurrence.

It is often desirable to obtain information concerning events which occur while the vehicle containing the sensor and telemetering transmitter is located either at a great distance from the receiver or in a highly ionized area wherein electromagnetic propagation will not be supported. Many of these events are of such short duration that the desired information cannot be transmitted by conventional practices because of telemetering bandwidth limitations.

Previous systems which have been developed for the purpose of obtaining information under the conditions described, have for the most part included magnetic storage and playback, and have not been entirely satisfactory because of their bandwidth limitations. Other considerations relating to previous systems are their complexity and an accompanying unreliability, size, weight and electrical power requirements.

An object of the present invention is the provision of an improved system for sensing, storing and telemetering data concerning short duration phenomena which may be nonrecurrent.

It is another object of this invention to provide an improved system with greatly decreased bandwidth limitations capable of processing data pulses in the order of a few microseconds which may occur during periods of temporary radio isolation.

A further object of the present invention is to provide a system which is activated by a first event; senses, stores and later transmits data concerning the amplitude and duration of the first event and, at scheduled periods after the first event, senses, samples, stores the samples and later transmits data concerning the samples of the sensed events which occur during the scheduled periods subsequent to the first event.

With these and other objects in view, as will hereinafter more fully appear, and which will be more particularly pointed out in the appended claims, reference is now made to the following description taken in connection with the accompanying drawings in which:

FIG. 1 is a block diagram of an embodiment of the invention, and

FIG. 2 shows a circuit suitable for use as the peak read and hold and the integrate and hold circuits of the invention.

In brief, this invention is a system which is normally in an unenergized condition and which is activated by a sensor signal resulting from a first event. The system includes two or more channels which are sequentially gated in chronological order to receive the signals from a sensor or sensors. The sensor signal representing the first event, which is used to activate the system, is delayed as required for the initiating the gating and system activating processes and is then applied to the first channel wherein the signal is integrated and its peak measured and this information stored. All of the remaining channels, if more than one other channel is required, are functionally similar and are sequentially gated to receive later signals from the sensor or sensors. The gating periods may, of course, be different for the various channels. The other channel, or channels, periodically sample the amplitude of the respective signal received and store this information. The information stored in all the channels is later removed by a commutator and transmitted by a conventional telemetering transmitter.

In the embodiment of the invention illustrated in FIG. 1, a sensor **10**, which produces an electrical signal representative of a condition about which information is desired, is connected to a pulse generator **11** and through delay line **12** to input, or channelizing gate **13** of channel **1**. The function of delay line **12** is to withhold the initial sensor signal from gate **13** for a period of time sufficient for pulse generator **11**, which is energized by the initial signal from sensor **10**, to initiate a pulse which opens gate **13** and thereby allows the signal from sensor **10** to reach the integrate and hold circuit **14** and the peak measuring and hold circuit **15**. FIG. 2 illustrates a circuit suitable for use as the integrate and hold circuit **14** and the peak measuring and hold circuit **15** and the other holding circuits of this invention. While FIG. 2 will be later described in more detail, for the present it is sufficient to functionally describe circuit **14** as integrating the initial signal from sensor **10** and holding in storage the integrated value and to describe the function of circuit **15** as measuring the peak value of the initial signal from sensor **10** and holding in storage the peak value of this signal.

Pulse generator **11*a*** is connected to pulse generator **11** and is keyed to the trailing edge of the pulse from generator **11** to supply a pulse to open input, or channelizing gate **13*a*** of channel **2**, thereby allowing a signal from either sensor **10** or sensor **10*a***, as determined by switch **16**, to reach the sampling gates **17**, **17*a*** . . . **17*n***, which are illustrated as being three in number but could obviously be a larger number as desired. The sampling gates **17**, **17*a*** . . . **17*n*** are sequentially opened by the tapped delay line **18** which is energized by a pulse obtained by conventional means from the leading edge of the pulse from pulse generator **11*a***. Peak measuring and hold circuits **19**, **19*a*** . . . **19*n*** are connected to sampling gates **17**, **17*a*** . . . **17*n***, thereby receiving to measure and store the peak value of sequential samples of the sensor signal.

Pulse generator **11*n*** is connected to pulse generator **11*a*** and is keyed to the trailing edge of the pulse from generator **11*a*** to supply a pulse to open the input, or channelizing gate **13*n*** of channel **3**, thereby allowing a signal from either sensor **10** or sensor **10*n***, as determined by switch **16*n***, to reach the sampling gates **20**, **20*a*** . . . **20*n***, which are illustrated as being three in number but could be a larger number as desired. It is also obvious that the system of FIG. 1, which for simplicity of illustration has been limited to three channels, could include a larger number of channels as desired. The sampling gates **20**, **20*a*** . . . **20*n*** are sequentially opened by the multivibrators **21**, **21*a*** . . . **21*n***, which for signals of longer duration are preferable to a delay line. The multi-

vibrator 21 is keyed to the leading edge of the pulse from pulse generator 11*n* to produce a pulse which opens the sampling gate 20 and the multivibrators 21*a* . . . 21*n* are keyed to the trailing edges of the pulses from the preceding multivibrators to produce pulses which open the sampling gates 20*a* . . . 20*n*. Peak measuring and hold circuits 22, 22*a* . . . 22*n* are connected to sampling gates 20, 20*a* . . . 20*n*, thereby receiving to measure and hold the peak value of sequential samples of the sensor signal.

Commutator 23 is connected to the output of holding circuits 14, 15, 19, 19*a* . . . 19*n*, 22, 22*a* . . . 22*n* and functions to sequentially connect the holding circuits to transmitter 24 which may be any one of the several, suitable well known types of telemetering transmitters, such as pulse width, PM, FM, FM/FM, etc. The commutator 23 is also conventional in nature and may be either electronic or mechanical, continuously running or delayed start after triggering by pulse generator 11, etc. The speed of commutator 23, must of course, be compatible with the limitations of transmitter 24.

The operation of the system illustrated in FIG. 1 will now be described in the function of gathering data relating to three chronologically predictable events which occur, not necessarily recurrently, at a time when radio transmission is temporarily not advisable. Such events could occur, for example, in such diversified circumstances as when a probe missile is being used to gather data in the highly ionized area near a nuclear blast, when a satellite is far from a telemetering receiving station and when a body is surrounded by an ionized sheath on reentering the atmosphere.

The system of FIG. 1 is in an unenergized condition, requiring little or no electrical power, until the sensor 10 produces a signal representative of an extremely short duration, high magnitude first event. This signal triggers pulse generator 11, which produces a pulse that is effective to maintain the input, or channelizing gate 13 in an open condition for a period of time, such as 150 microseconds. As a finite time is required for the initiation of the gating and system actuating processes, the signal from sensor 10 is passed through delay line 12 where it is delayed a short time, typically 8 microseconds, before passing through input gate 13 into channel 1. In channel 1 the signal representative of the first event is integrated, and the integral value stored, by circuit 14 and the peak value of this signal is measured and stored by circuit 15. It is to be noted that for extremely short duration, high amplitude signals, obtaining information concerning the peak value and energy integral is considered to be more feasible than attempting to reproduce the signal shape.

The pulse generator 11*a* is triggered by the trailing edge of the 150 microsecond pulse produced by pulse generator 11. Generator 11*a* produces a pulse that is effective to maintain input gate 13*a* in an open condition for a period of time, such as 50 microseconds. In this period of time, the predictable second event occurs and is sensed by sensor 10, or by sensor 10*a* as desired, and the resulting sensor signal passes through channelizing gate 13*a* into channel 2. For this signal, it is desirable to reproduce the signal shape. This is accomplished in channel 2 by passing a pulse, typically of 2 microsecond duration obtained by conventional means from the leading edge of the 50 microsecond pulse from generator 11*a*, through tapped delay line 18. The taps from delay line 18 are connected to sampling gates 17, 17*a* . . . 17*n*, which are typically 10 in number. This arrangement is effective to sequentially open these sampling gates and pass sequential samples of the sensor signal to circuits 19, 19*a* . . . 19*n* which measure and hold the amplitude of the sequential samples. These samples must, of course, be sufficient in number to allow a plotted reconstruction of the signal shape.

Channel 3 is functionally similar to channel 2 and is used to obtain and store information relating to a third event which is of relatively longer duration. The pulse generator 11*n* is triggered by the trailing edge of the 50 microsecond pulse produced by pulse generator 11*a*. Generator 11*n* produces a pulse which maintains input, or channelizing gate 13*n* in an open condition for a relatively longer period of time, such as 30 milliseconds. During this period the predictable third event occurs and is sensed by sensor 10, or sensor 10*n* as desired. The resulting signal is passed through input gate 13*n* into channel 3. In this channel, sampling gates 20, 20*a* . . . 20*n* are sequentially opened by multivibrators 21, 21*a* . . . 21*n*, the first of which is keyed to the leading edge of the 30 millisecond pulse from generator 11*n*. The remaining multivibrators 21*a* . . . 21*n* are keyed to the trailing edge of the pulses from the preceding multivibrators. This arrangement is effective to sequentially open sampling gates 20, 20*a* . . . 20*n* and pass sequential samples of the sensor signal to circuits 22, 22*a* . . . 22*n* which measure and hold the amplitude of the sequential samples.

After a predictable period of time, conditions will become favorable for radio transmission, such as when the satellite approaches a receiving station or the transmitter is no longer located in an ionized medium. At that time, the commutator, if not continuously running, will be energized by conventional, built-in, programming apparatus, and will function to sequentially withdraw and broadcast the information stored in the holding circuits by transmitter 24. The information received by the ground station will include a signal representing the energy integral of the first event, a signal representing the magnitude of the first event and two sequences, each of ten signals, suitable for plotting a reproduction of the shape of the sensor signals associated with the second and third events.

By using a commutator speed such that the signal samples are withdrawn over a longer period of time than the original occurrence, typically 500 times longer, the signal samples in channels 2 and 3 can be used to reconstruct the wave shapes of sensor signals relating to short duration events. Such short duration wave shapes cannot be accurately transmitted and reproduced over conventional telemetering links.

FIG. 2 shows a circuit suitable for use as the integrate and hold circuit 14 and as the peak measuring and hold circuits 15, 19 and 22. In this circuit the plates of the four tubes 30, 31, 32 and 33 are connected to a source of plate supply, typically +150 v. D.C. The circuit input is connected to the grids of tubes 30 and 31 which are connected in parallel to lower the impedance which these tubes present in series with the storage capacitor 34. A resistor 35 is connected in series with capacitor 34 if the circuit is to be used as the integrate and hold circuit 14, the values of capacitor 34 and resistor 35 being chosen so that their time constant is at least five times as long as the longest input pulse expected to be integrated. The resistor 35 is not included in the circuit if it is to be used as a peak measuring and hold circuit 15, 19 or 22. The charge on storage capacitor 34, which is related either to the integral or peak of the input signal, is connected through the parallel connected circuit of resistor 36 and capacitor 37 to the grid of tube 32. This tube is connected as a cathode follower and functions to prevent loading by the output load impedance. The resistor 38 is connected as the cathode load of tube 32 and provides the grid signal to tube 33 which is connected as a cathode follower in the output stage of the circuit. The output, a D.C. voltage proportional either to the integral or the peak value of the input signal, is produced at a low impedance level across the cathode load resistor 39 of tube 33.

It is apparent that the system described has greatly decreased bandwidth limitations when compared to previous systems and is capable of processing data pulses in the order of a few microseconds duration which may occur during periods of temporary radio isolation. Many obvious modifications and variations of the present invention are possible in the light of the above teachings. It is, there-

fore, to be understood, that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A system for gathering data relating to short duration events, the chronological sequence of which is predictable and which occur under conditions wherein transmission of the data at a later time is desirable, comprising:

sensor means which produce electrical signals representative of the events being investigated;

a plurality of channels operatively associated with said sensor means wherein each of said channels includes storage means for receiving and storing a signal;

gating means operatively associated with said sensor means and connected to said plurality of channels and adapted to be energized by the first of said electrical signals to operatively connect in an ordered chronological sequence, related to the predicted sequence of events, individual ones of said plurality of channels to said sensing means;

a transmitter and

a commutator connected to said transmitter and to said storage means to sequentially connect said storage means to said transmitter.

2. A system as set forth in claim 1 wherein a first channel includes an integrate and hold circuit and a peak measuring and hold circuit.

3. A system as set forth in claim 1 wherein one of said channels includes a plurality of storage means and control means which sequentially connect said plurality of storage means to individually receive sequential samples of the sensor signal received by said channel.

4. A system for gathering data for transmission at a later time comprising:

sensor means for producing an electrical signal representative of the data being gathered;

a first channel connected to said sensor means and used for gathering data relating to short duration events and including gating means operatively associated with storing means and a tapped delay line wherein short duration signals are sequentially sampled at approximately 5 microsecond intervals by said gating means and said samples are stored by said storing means under the control of said tapped delay line;

a second channel connected to said sensor means and used for gathering data relating to longer duration events and including gating means operatively associated with storing means and multivibrator means wherein longer duration signals are sequentially sampled at approximately 3 millisecond intervals by said gating means and said samples are stored by said storing means under the control of said multivibrator means and;

a transmitter and a commutator connected to said transmitter and to said storage means to sequentially connect said storage means to said transmitter.

References Cited

UNITED STATES PATENTS

2,933,689	4/1960	Johnson	328—151 X
3,059,228	10/1962	Beck et al.	340—147
3,063,014	11/1962	Shanks	328—151 X
3,169,233	2/1965	Schwartz	328—151 X
3,197,700	7/1965	Schwartz et al.	324—77
3,274,576	9/1966	Guignard	340—147

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