command signal from facility **50**, or the passage of a pig, or a signal from the time clock within the computer. Signals from other sensors may be treated accordingly by the computer **68**.

As the magnetic pig passes each monitoring station **20**, an event is generated which causes information to be transferred to the central monitoring facility **50**. In addition to the information discussed above, a station identification and time of the event is passed to the central monitoring facility. As the pig passes a number of the monitoring stations **20**, the central monitoring facility **50** is able to use this information in determining the speed of the pig and the estimated time of arrival at the next station **20**.

Magnetic circuitry carried by the pig may be utilized to activate external equipment, such as valves, which may be sequenced during operations by the passage of the pig. Control in this manner may direct flow from the pipeline into holding tanks, e.g., when products carried by the pipeline do not need to be transported the entire pipeline length. Due to the configuration of the magnetic pig, the magnetic fields on board the pig may be arranged in a north-south configuration, or conversely in a south-north configuration, that is detectable by the magnetic pig position detector **24**. The different polar configurations may then be used to cause the opening and closing of the valves at certain points along the pipeline.

While various pipeline maintenance and operational data may be easily gathered by the sensors **88** of the monitoring station **20**, none is more important than cathodic protection tested with test leads **70** and potential pipeline damage sensors. Periodic checks of cathodic protection may be easily performed when a pig is sent through the pipeline. Monitoring stations **20** near CPRs **36** may thus relay rectifier voltages data to the central monitoring facility **50** to ensure that the pipe is protected by cathodic currents. Geophones, vibration sensors, or other pipeline damage sensors may forward a potential pipeline damage signal in substantially real time to the central monitoring facility. The same or other stations may take measurements to detect leakage and ensure proper settings. Fluid temperature, pressure and flow rates may be easily monitored and relayed to the facility **50** in a similar manner. Sensors may be provided for cathodic rectifier metering, alarm notification, external pipeline damage, flow rates, fluid temperatures and pressures, valve status, valve control, and pipeline pig monitoring. Various types of alarms may be provided, including system failure alarms, high and low limits.

Station identification may be easily correlated to a GPS location, and all triggering events may be monitored as a function of time. Monitoring according to the system of the present invention increases safety and allows the pipeline operator to better protect the pipeline asset. As one example, component failure may trigger an alarm which allows the pipeline operator to promptly correct problems while minimizing downtime. According to the method of the invention, a central monitoring facility computer may easily determine the speed of the pig as it is passing through the pipeline, and pig travel can be displayed in substantially real time to the operator, since the flow rate of the pig may be easily determined and the spacing between stations is known. Additionally, the monitoring station is able to control electronic settings of rectifiers at or near the monitoring station.

A magnetic sensing device, which serves as the pig position detector **24**, may be a single axis magnetoresistive circuit HMC1O1 made by Honeywell, connected to the inputs of the amplifier. Other magnetic sensing means, such as inductive coils, flux gates and hall-effect sensors may be used. A reset circuit responsive to the computer **68** may be used to eliminate signal degradation of the magnetic sensing device caused by continuous exposure to magnetic fields.

The magnetic sensing device **24** may be calibrated to a predetermined reference point by computer **68**. An analog feedback signal may be provided from the computer to compensate for background magnetic fields, such as those created by the earth and overhead electrical lines.

A low operational cost pipeline monitoring system is thus disclosed which may utilize a magnetic pig to automate the collection of data from a number of sources and transmit the data via a satellite communications systems to the central monitoring facility. A pipeline monitoring system as disclosed herein may also be used for transmitting pipe/soil potentials from a plurality of monitoring stations to the central monitoring facility. Additionally, a satellite transmission system may be used for monitoring pipeline damage, and signals from a geophone, vibration sensor, or other pipeline damage sensor may be transmitted to the central monitoring facility upon the generation of a potential pipeline damage signal.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the size, shape, materials, components, circuit elements, wiring connections and contacts, as well as in the details of the illustrated circuitry and construction method of operation may be made without departing from the spirit of the invention.

What is claimed is:

1. A pipeline monitoring system, comprising:

a plurality of monitoring stations positioned along a pipeline;

a central monitoring facility for generating command signals to operate each of the plurality of monitoring stations;

a satellite communications module at each of the plurality of monitoring stations for interfacing with the central monitoring facility; and

a magnetic pig position detector at each of the plurality of monitoring stations for detecting the passage of a magnetic pig and outputting a pig position signal to the central monitoring facility;

cathodic test leads for detecting pipe/soil potentials for outputting a voltage signal to the satellite communications module; and

a pipeline damage detector including at least one of a pipeline vibration sensor and a geophone for outputting a potential pipeline damage signal to the satellite communications module.

2. The pipeline monitoring system as defined in claim **1**, wherein the central monitoring facility includes a control station to output command signals to the plurality of monitoring stations.

3. The pipeline monitoring system as defined in claim **1**, wherein each of the plurality of monitoring stations includes a computer for outputting an activity signal to operate the monitoring station.

4. The pipeline monitoring system as defined in claim **1**, wherein said satellite communications module outputs a time signal in response to the magnetic pig position detector.

5. The pipeline monitoring system as defined in claim **1**, further comprising:

a pipeline marker for housing the satellite communications module.

6. The pipeline monitoring system as defined in claim **1**, further comprising: