METHOD AND APPARATUS FOR CORRELATING A PIPELINE INSPECTION RECORD TO KNOWN EXTERNAL LOCATIONS

BACKGROUND OF THE INVENTION

Buried pipelines are inspected to detect anomalies in the wall of the pipe by passing an instrumented device called a pig through the pipeline. The pig is propelled through the pipeline by the fluid product being transported therethrough and nondestructive testing apparatus carried by the pig continuously inspects the condition of the pipe. Electrical inspection signals produced by the testing apparatus are continuously recorded on a magnetic tape recorder, for example, which is carried by the pig. After the instrumented pig has completed its inspection run through a section of the pipeline, the tape record is recovered and played back on appropriate apparatus to produce a visual record of the inspection signals. An operator then views and interprets the visual record to determine the condition of the pipe.

After viewing the inspection record it may be concluded that one or more locations along the pipeline should be excavated in order to inspect the pipe in further detail and/or to replace one or more lengths of pipe. Because an inspection run of the instrumented pig may traverse from fifty up to or exceeding one hundred miles of the buried pipeline, the inspection record necessarily is made on a greatly reduced linear scale with the consequence that accurate determination of distance and correlation of the record to known external locations are difficult.

Considerable trouble and expense are involved in excavating any point along the pipeline. Consequently, to avoid excavating at the wrong locations, it is extremely important that the recorded inspection signals be accurately correlated to actual distance along the pipeline and to known external locations along the pipeline. In the past it has been difficult to achieve the desired accuracy in this correlation. The inspection apparatus usually produces a discernable signal each time the apparatus passes a girth weld in the pipeline. The lengths of sections of pipe between girth welds may be obtained from construction records of the pipeline, and by counting the number of girth welds on a record, an estimate of actual distance on the record may be made. However, in interpreting a complete record which may represent from 50 up to 100 miles of pipeline, it is easy for an operator to error in counting the many signals which correspond to girth welds.

SUMMARY

In accordance with one embodiment of the invention, an instrumented pipeline pig carrying nondestructive testing apparatus, a time code generator, and a magnetic tape recorder is passed through a section of buried pipeline. At external locations spaced along the route of the pipeline at intervals of approximately a mile, means are provided for detecting the passage of the pig past the respective locations. Means also are provided at each external location to transmit a unique location identification signal to a base station at the instant the pig is detected.

The base station includes means for receiving the transmissions from the known locations and for recording the location identifying signals along with coded time signals from a time code generator located at the base station. The base station time code generator has a known time relationship to the time code generator carried by the pipeline pig. The time coded signals recorded at the base station are correlated with the time signals on the record made in the pig and an inspection record is produced having thereon the inspection signals and time signals recorded in the pig, and indicia which identifies on the record the known external locations.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a simplified illustration of apparatus for making two magnetic tape recordings; one having inspection signals and coded time signals recorded thereon, and the other having time coded signals and marker station signals which indicate when the inspection pig passed a respective marker station;

FIG. 2 is a simplified block diagram illustrating means for correlating time signals on two magnetic tapes to identify on a strip chart read out of inspection signals the locations of marker stations;

FIG. 3 is a representation of a short section of a strip chart made by the apparatus of FIG. 2; and

FIGS. 4 and 5 are simplified illustrations of means for practicing an alternative embodiment of the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

In FIG. 1, a pipeline 10 is buried perhaps three or four feet below the surface of the ground 11. FIG. 1 is intended to represent several miles along a pipeline. For simplicity of illustration and discussion, only several segments have been illustrated. An instrumented pipeline pig 12 is illustrated at a particular location within the pipeline. The pig includes elastomeric packers 14 and 15 which are in sliding contact with the wall of the pipeline. The fluid product being transported through the pipeline urges against packers 14 and 15 to propel the pig through the line.

Pig 12 contains inspection equipment 18 for conducting nondestructive testing or inspection of the pipeline as the pig is propelled therethrough. Inspection equipment 18 may include one or more of many known types, such as magnetic, eddy current, acoustic, ultrasonic, or radiological. Whatever type of inspection is performed, it is assumed that the equipment produces inspection signals on one or more output leads 20. The inspection signals contain information relative to the condition of the pipe.

As illustrated in simplified form in FIG. 1, pig 12 is instrumented to perform magnetic flux leakage type of inspection. A source of magnetic flux 21 establishes a flux field in the wall of pipeline 10. Flux source 21 may be a solenoid which is energized by batteries carried by pig 12. A plurality of flux leakage detector means 22 are carried by the pig and are in sliding contact about the wall of the pipe to detect leakage flux caused by anomalies in the pipe wall. Anomaly signals from detector means 22 are appropriately processed by the inspection equipment 18 and appear in analog form on output leads 20. The inspection signals may be converted to digital form by equipment carried by pig 12 if it is so desired.

Pig 12 also carries recording apparatus such as magnetic tape recorder 24 which has the capability of recording many input signals on respective tracks on the magnetic tape.