[0049] Referring now to **FIGS. 1 and 2**, there is shown in **FIG. 2 a** cathodic protection system **18** including a plurality of the cathodic protection circuits **20** shown in **FIG. 1**. Over time, the coating material **14** may develop defects **16**, such as cracks or breaks **16***a,b*. To prevent corrosion at these defects **16**, cathodic protection system **18** is disposed on pipeline **10**.

[0050] Referring particularly to **FIG. 1**, each cathodic protection circuit **20** includes a power source **22**, such as an overhead power line, providing alternating current to a rectifier **24**. The rectifier **24** transforms the alternating current from power source **22** to direct current for use in the cathodic protection circuit **20**. Cathodic protection circuit **20** includes a first electrical conduit **26** extending to the pipeline **10** and a second electrical conductor **28** extending to a ground bed **30**. The electrical conductor **26** has one end **36** welded to the surface **38** of a pipe **12** of pipeline **10** with the connection then being coated with a coating material for corrosion protection. Ground bed **30** includes a plurality of buried conductors **32** serving as anodes for passing current **34** into the soil.

[0051] In operation, current **34** flows from the power source **22** to the rectifier **24** and then to ground bed **30**. The current **34** then flows through the soil as indicated by arrows **35** to the pipeline **10**. Current **34** from the pipeline **10** then flows back to the rectifier **24** via steel pipes **12** and electrical conductor **26**. The current **34** passing onto the steel pipes **12** at defects **16** changes the electrochemical characteristic potential of the surface **38** of the pipes **12** of pipeline **10** so as to inhibit corrosion. The corrosion protecting coating material **14** is the primary form of corrosion protection for the pipeline **10**, while the cathodic protection provided by cathodic protection system **18** is the secondary form of corrosion protection.

[0052] The number of cathodic protection circuits **20** in system **18** depends upon the condition of the coating material **14** on the surface **38** of the pipeline **10** and the condition of the soil for conducting current **34**. If the coating material **14** is in poor condition or the soil condition is unfavorable for conducting current **34**, then a greater number of cathodic protection circuits **20** will be required by pipeline **10**. If the pipeline **10** is bare, having no coating around it, the greatest number of cathodic protection circuits **20** will be required by pipeline **10**.

[0053] Regulations require that the pipeline **10** be inspected regularly, such as at least once every one to three months, to ensure that each cathodic protection circuit **20** is operating and in a good condition. Each rectifier **24** includes a device that permits a determination as to whether rectifier **24** is on and to ensure that current **34** is flowing, such as providing 10 amps and 12 volts of current output. This device may allow remote monitoring of the rectifiers **24** so as to send the results to a central location on a daily or weekly basis by some remote transmission method. Further, typically once a year, it is necessary that the electrical potential is measured along the pipeline **10** to ensure that the cathodic protection is working and that the coating **14** on the pipeline **10** is not deteriorating.

[0054] In the prior art, an inspector manually makes an inspection of each rectifier **24** to ensure that the rectifiers **24** are receiving AC power, that they are providing a DC output, and that the rectifiers **24** are in good operating condition. The frequency of these rectifier **24** inspections is typically once per month. Sometimes, a remote monitoring device is installed into the rectifier and the output current and output voltage of the rectifier is transmitted periodically to a central location, in which case visits to the rectifier to manually check the output are no longer required. Furthermore, the inspector typically manually performs an inspection of each test station **40** to ensure that the output from the rectifiers **24** are resulting in a satisfactory pipe-to-soil potential at each test station **40**. These test station **40** inspections are typically carried out once per year using a portable pipe-to-soil measurement unit.

[0055] Referring now to **FIG. 3**, there is shown a pipe-to-soil potential measurement unit **41** for measuring the effect of the current **34**, being supplied by a cathodic protection circuit **20** on the pipeline **10** at one of the test stations **40**. The pipe-to-soil measurement unit **41** is normally portable but may also be installed at the pipeline such as in a remote monitoring unit, hereinafter described. The pipe-to-soil potential measurement unit **41** includes a volt meter **42** having a test lead **44** extending from the volt meter **42** to a wire connection **43** extending to and connected with the surface **38** of pipeline **10**. The pipe test lead **44** is electrically connected to wire connection **43** from the pipeline **10** above ground. The pipe-to-soil potential measurement unit **41** also includes a reference electrode **46** extending into the ground **48**. The reference electrode **46** has an electrode potential that does not vary such that it supplies the pipe-to-soil potential measurement unit **41** with a stable reference potential. The reference electrode **46** typically includes a copper rod in a copper sulfate solution. Volt meter **42** then measures the potential difference between these two half-cells. The difference in potential will vary depending upon the current **34** that is being supplied to pipeline **10** by virtue of one or more of the cathodic protection systems **18** along the length of the pipeline **10**.

[0056] To monitor the cathodic protection circuits **20**, a pipe-to-soil measurement is carried out at each test station **40** using pipe-to-soil potential measurement unit **41**. As current is supplied to the pipeline **10** by cathodic protection system **18**, the pipe-to-soil potential measured by voltmeter **42** will tend toward the negative, preventing corrosion from forming. Various criteria are used in the industry to determine if the pipe-to-soil potential has been shifted sufficiently negative to negate or prevent corrosion. The most common criterion is that while the cathodic protection circuits **20** are switched "on", the potential difference measured by voltmeter **42** is more negative than −0.85V when using a copper/copper sulfate reference electrode. This is referred to as the "on" potential.

[0057] A second criterion includes the measurement of the pipe-to-soil potential by voltmeter 42 immediately (typically within 1 second) after switching the cathodic protection circuits **20** off. In this way, possible errors that may be inherent in measuring the pipe-to-soil potential while the cathodic protection circuits **20** are energized are eliminated. This value is the "instant off" potential. A third criterion requires that the difference between the "instant off" and the "static" potential is at least 0.1 V. The "static" or "native" potential is measured by voltmeter **42** and is approximately −0.5 volts to −0.6 volts.

[0058] For the purpose of the following discussion, the "on" potential will be used, unless where stated otherwise.