existing techniques exist to monitor and measure CUI, many of those techniques require internal access to the pipe, which may not be feasible in all situations. The additional existing techniques for measuring and monitoring CUI involve breaching the insulation barrier to allow access to the pipe surface, which is very costly, time consuming, and inefficient.

BRIEF SUMMARY OF THE INVENTION

[0001] The present invention is directed to pipe scanning systems. More particularly, the present invention is directed to pipe scanning systems that may be mounted to an exterior surface of a pipeline (e.g., an exterior surface of a pipe for non-insulated pipelines or an exterior surface of an insulation barrier for insulated pipelines) and that may provide 360° circumferential scans of a section of the pipeline. In a first aspect of the present disclosure, there is provided a pipe scanning system for circumferentially scanning a pipeline. The pipe scanning system may include a track system configured to secure to a circumference of the pipeline and a scanning device. The scanning device may include a drive carriage, an x-ray emitter, a digital x-ray detector, and a control system in communication with the emitter, the digital x-ray detector, and the motor. The drive carriage may include a motor, a power source, and one or more drive components in mechanical communication with the motor. The power source may be configured to provide power to the motor. The one or more drive components, when driven by the motor, may be configured to move the drive carriage about the circumference of the pipeline along the track system. The one or more driven components may include a first gear driven by the motor, a second gear interfaced with the first gear and with the track system, and a resilient member arranged to bias the first gear towards the second gear.

[0002] The x-ray emitter may be configured to emit a scanning signal. The digital x-ray detector may be configured to detect the scanning signal. The x-ray emitter and the digital x-ray detector may be configured to move with the drive carriage as the drive carriage moves about the circumference of the pipeline along the track system. The control system may be configured to provide a drive signal to the motor to cause the motor to drive the one or more drive components in a particular direction, provide an emitter control signal to the emitter, the emitter control signal configured to instruct the emitter to output the scanning signal, and receive information representative of a portion of the pipeline scanned by the scanning signal from the detector, wherein the information representative of the portion of the pipeline comprises information associated with one or more defects present in the pipeline.

[0005a] In some embodiments, the scanning device may be mounted on the drive carriage. In some embodiments, the scanning device may include an x-ray emitter and a digital x-ray detector that may capture media content indicative of a scanned section of the pipeline (e.g., a 360° circumferential scan). For example, as the drive carriage moves about the circumference of the pipeline the emitter may output a scanning signal (e.g., x-rays) and the digital x-ray detector may detect the scanning signal. For example, the digital x-ray detector may generate media content based on the detected scanning signal as the emitter and the detector move about the circumference of the pipeline, thereby providing a full 360° scan of the pipeline. In some embodiments, multiple drive carriages may be utilized (e.g., a drive carriage for the emitter and a drive carriage for the detector). The media content output by the detector may be stored locally by the scanning device or may be transmitted to a remote computing device. The media content may be analyzed to detect the presence of one or more defects, such as CUI, moisture trapped in the insulation barrier, scratches or gouges on the surface of the pipe, corrosion or defects on the interior of the pipe, or other defects.

[0003] In some embodiments, the pipe scanning system may be configured to be stationary—that is, it may be mounted to a section of the pipeline to facilitate a scan of that section, and then when the section is complete the pipe scanning system may be (manually) relocated to a

new section of the pipeline where another section may be scanned. In some embodiments, the pipe scanning system may include one or more lateral travel members (e.g., wheels, treads, etc.). The lateral travel members may be used to move the pipe scanning system along a length of the pipeline to facilitate scans of new sections of the pipeline (i.e., instead of having to manually move the pipe scanning system). Utilizing pipe scanning systems having lateral travel members may enable automated or semi-automated scanning of a length of pipeline in a more rapid fashion, which may improve the speed at which a pipeline may be scanned.

[0006a] In a second aspect of the present disclosure, there is provided a method for circumferentially scanning a pipeline. The method may include providing, by one or more processors, a drive signal to a motor of a drive carriage of a scanning device. The drive signal may be configured to cause the motor to drive one or more drive components in a particular direction along a track secured to a circumference of a pipeline. The scanning device is moved about the circumference of the pipeline along the track based on the one or more drive components of the drive carriage being driven by the motor, wherein the one or more drive components includes a first gear driven by the motor, a second gear interfaced with the first gear and with the track, and a resilient member arranged to bias the first gear towards the second gear. The method may include outputting, by a x-ray emitter, a scanning signal. The x-ray emitter may be coupled to the scanning device. The scanning signal may be output by the emitter as the scanning device is moved about the circumference of the pipeline. The method may include receiving, by the one or more processors, information representative of a portion of the pipeline scanned by the scanning signal from a digital x-ray detector. The information representative of a portion of the pipeline scanned by the scanning signal comprises information may be associated with one or more defects present in the portion of the pipeline

[0004] The foregoing has outlined rather broadly the features and technical advantages of the present invention in order that the detailed description of the invention that follows may be better understood. Additional features and advantages of the invention will be described hereinafter which form the subject of the claims of the invention. It should be appreciated by those skilled in the art that the conception and specific embodiment disclosed may be readily utilized as a basis for modifying or designing other structures for carrying out the same purposes of the present invention. It should also be realized by those skilled in the art that such equivalent constructions do not depart from the spirit and scope of the invention as set forth in the appended claims. The novel features which are believed to be characteristic of the invention, both as to its organization and method of operation, together with further objects and advantages will be better understood from the following description when considered in connection with the accompanying figures. It is to be expressly understood, however, that each of the figures is provided for the purpose of illustration and description only and is not intended as a definition of the limits of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] For a more complete understanding of the present invention, reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which:

[0006] FIG. 1 is a block diagram of a pipe scanning system in accordance with aspects of the present disclosure;

[0007] FIG. 2A is a block diagram of a pipe scanning system in accordance with aspects of the present disclosure;

CLAIMS

What is claimed is:

1. A pipe scanning system for circumferentially scanning a pipeline, the pipe scanning system comprising:

a track system configured to secure to a circumference of a pipeline;

a scanning device comprising:

a drive carriage comprising:

a motor;

a power source configured to provide power to the motor; and

one or more drive components in mechanical communication with the motor, wherein the one or more drive components, when driven by the motor, are configured to move the drive carriage about the circumference of the pipeline along the track system, the one or more driven components including a first gear driven by the motor, a second gear interfaced with the first gear and with the track system, and a resilient member arranged to bias the first gear towards the second gear;

an x-ray emitter configured to emit a scanning signal;

a digital x-ray detector configured to detect the scanning signal, wherein the x-ray emitter and the digital x-ray detector are configured to move with the drive carriage as the drive carriage moves about the circumference of the pipeline along the track system; and

a control system in communication with the emitter, the digital x-ray detector, and the motor, wherein the control system is configured to:

provide a drive signal to the motor to cause the motor to drive the one or more drive components in a particular direction;

provide an emitter control signal to the emitter, the emitter control signal configured to instruct the emitter to output the scanning signal; and

receive information representative of a portion of the pipeline scanned by the scanning signal from the detector, wherein the information representative of the portion of the pipeline comprises information associated with one or more defects present in the pipeline.

2. The pipe scanning system of claim 1, wherein the pipeline is an insulated pipeline comprising a pipe surrounded by insulation, and wherein the track system is secured to the circumference of the pipeline on an exterior surface of the insulation.

3. The pipe scanning system of claim 2, wherein the one or more defects comprise a corrosion under insulation (CUI) defect.

4. The pipe scanning system of claim 2, wherein the one or more defects comprise moisture trapped within the insulation.

5. The pipe scanning system of claim 1, wherein the emitter is configured to continuously output the scanning signal as the drive carriage moves about the circumference of the pipeline along the track system.

6. The pipe scanning system of claim 1, wherein the track system comprises one or more lateral travel members in communication with the control system, the one or more lateral travel members configured to move the track system and the scanning device along a length of the pipeline in response to a lateral movement control signal provided by the control system.

7. The pipe scanning system of claim 6, wherein the lateral movement control signal is provided by the control system in response to completion of a scan of a first section of the pipeline, and wherein movement of the track system and the scanning device along the length of the pipeline is configured to facilitate scanning of a second section of the pipeline.

8. The pipe scanning system of claim 7, wherein the first section of the pipeline at least partially overlaps with the second section of the pipeline.

9. The pipe scanning system of claim 7, wherein the first section of the pipeline does not overlap with the second section of the pipeline.

10. The pipe scanning system of claim 1, further comprising:

a remote computing device;

wherein the scanning device comprises a communication interface communicatively coupling the scanning device to the remote computing device, and

wherein the control system is configured to transmit the information representative of the portion of the pipeline scanned by the scanning signal to the remote computing device via the communication interface.

11. The pipe scanning system of claim 10, wherein the information representative of the portion of the pipeline scanned by the scanning signal comprises media content.

12. The pipe scanning system of claim 1, wherein the scanning device comprises a memory, and wherein the control system is configured to store the information representative of the portion of the pipeline scanned by the scanning signal at the memory.

13. The pipe scanning system of claim 1, wherein the control system is configured to provide a first drive signal to the motor to cause the motor to drive the one or more drive components in a first direction and to provide a second drive signal to the motor to cause the motor to drive the one or more drive components in a second direction that is opposite the first direction.

14. The pipe scanning system of claim 1, wherein the x-ray emitter is coupled to the drive carriage via a first arm, and wherein the digital x-ray detector is coupled to the drive carriage via a second arm.

15. The pipe scanning system of claim 14, wherein an orientation of the x-ray emitter is adjustable to control a direction of transmission of the scanning signal, and wherein an orientation of the digital x-ray detector is adjustable to control a field of view for detecting the scanning signal.

16. The pipe scanning system of claim 1, wherein the information representative of the portion of the pipeline scanned by the scanning signal comprises a full 360° circumferential scan of a section of the pipeline.

17. A method for circumferentially scanning a pipeline, the method comprising:

providing, by one or more processors, a drive signal to a motor of a drive carriage of a scanning device, the drive signal configured to cause the motor to drive one or more drive components in a particular direction along a track secured to a circumference of a pipeline, wherein the scanning device is moved about the circumference of the pipeline along the track based on the one or more drive components of the drive carriage being driven by the motor, wherein the one or more drive components includes a first gear driven by the motor, a second gear interfaced with the first gear and with the track, and a resilient member arranged to bias the first gear towards the second gear;

outputting, by a x-ray emitter, a scanning signal, wherein the x-ray emitter is coupled to the scanning device, and wherein the scanning signal is output by the emitter as the scanning device is moved about the circumference of the pipeline; and

receiving, by the one or more processors, information representative of a portion of the pipeline scanned by the scanning signal from a digital x-ray detector, wherein the information representative of a portion of the pipeline scanned by the scanning signal comprises information associated with one or more defects present in the portion of the pipeline.

18. The method of claim 17, wherein the pipeline is an insulated pipeline comprising a pipe surrounded by insulation, and wherein the one or more defects comprise a corrosion under insulation defect, moisture present in the insulation, a scratch in a surface of the pipe of the pipeline, or a combination thereof.

19. The method of claim 18, wherein the portion of the pipeline is scanned without disturbing the insulation.

20. The method of claim 17, wherein the information representative of a portion of the pipeline scanned by the scanning signal comprises image content, video content, or both, and wherein the method further comprises:

transmitting the media content to a remote computing device.