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Battery powered downhole cutting tool

Abstract

A downhole cutting tool may include a tubular housing securable to a downhole end of a conveyance and a cutting head secured to the tubular housing. The cutting head may have a retractable cutting blade configured to move between a radially extended position and a retracted position. Additionally, the cutting head may be configured to rotate with respect to the tubular housing to drive the retractable cutting blade, in the radially extended position, to cut a downhole tubular disposed in a wellbore. The downhole cutting tool may also include at least one motor secured within the tubular housing and configured to drive rotation of the cutting head. Further, the downhole cutting tool may include a power source disposed within the tubular housing and configured to supply power to the at least one motor, and the power source may include at least one battery.

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Background/Summary

BACKGROUND

(1) Downhole cutting tools are generally used to recover tubing (e.g., downhole tubulars) from old wells by cutting or parting the tubing at a predetermined location in the wellbore. That is, once the tubing is cut, the portion of the tubing disposed above the cut may be retrieved from the wellbore. Downhole cutting tools may include various types of cutting tools such as explosive, chemical, or mechanical cutters. Generally, explosive and chemical cutters are high risk and require numerous safety measures. As such, mechanical cutters are generally preferred over explosive and chemical cutters. However, mechanical cutters require electrical power to operate. As such, mechanical cutters are generally run-in-hole via a powered conveyance such as a wireline. Unfortunately, using

a wireline to power the downhole cutting tools requires surface power, which may not be available at some wellbores.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) These drawings illustrate certain aspects of some of the embodiments of the present disclosure and should not be used to limit or define the method.

(2) FIG. **1** illustrates an elevation view of a downhole cutting tool on a conveyance, in accordance with some embodiments of the present disclosure.

(3) FIG. **2** illustrates a cross-sectional view of the downhole cutting tool, in accordance with some embodiments of the present disclosure.

(4) FIG. **3** illustrates a cross-sectional view of a retractable anchor assembly of the downhole cutting tool, in accordance with some embodiments of the present disclosure.

(5) FIG. **4** illustrates a cross-sectional view of a second anchor of the retractable anchor assembly disposed in an extended position and a retractable cutting blade disposed in a retracted position, in accordance with some embodiments of the present disclosure.

(6) FIG. **5** illustrates a cross-sectional view of the cutting head having the retractable cutting blade extended radially outward to engage a downhole tubular, in accordance with some embodiments of the present disclosure.

(7) FIG. **6** illustrates a block diagram of a surface system and the downhole cutting tool, in accordance with some embodiments of the present disclosure.

(8) FIG. **7** illustrates a flow chart of the operation of the downhole cutting tool, in accordance with some embodiments of the present disclosure.

DETAILED DESCRIPTION

(9) Disclosed herein are systems and methods for cutting downhole tubulars. In particular, example embodiments may include a downhole cutting tool that is lowered into the wellbore, via a conveyance, to a predetermined position in a wellbore. Using a power source disposed within the downhole cutting tool, the downhole cutting tool is configured to deploy a retractable anchor assembly to restrain axial movement of the downhole cutting tool along the wellbore. Further, using the power source, the downhole cutting tool is configured to rotate a cutting head having a retractable cutting blade to cut the downhole tubular. Powering the downhole cutting tool exclusively with the onboard power source (e.g., the power source disposed in the downhole cutting tool may permit the downhole tool to be run-in-hole via a powerless conveyance such as a slickline.

(10) FIG. **1** illustrates an elevation view of a downhole cutting tool on a conveyance, in accordance with some embodiments of the present disclosure. As illustrated, a wellbore **100** may extend through subterranean formation **102**. During drilling and/or completion operations, a downhole tubular **104** (e.g., casing, tubing, liner, packer mandrel, etc.) may be disposed within the wellbore **100**. However, after abandonment, a downhole cutting tool **106** may partition the downhole tubular **104** such that an upper portion **108** of the downhole tubular **104** may be recovered/retrieved from the wellbore **100**. In particular, a downhole cutting tool **106** may be lowered into the wellbore **100**, via a conveyance **118**, to a predetermined location to cut the downhole tubular **104** and partition the upper portion **108** (e.g., a portion of the downhole tubular **104** disposed above the cut **112**) from a lower portion **110** of the downhole tubular **104**. Once the downhole tubular **104** is cut, the downhole cutting tool **106** may be pulled out of the wellbore **100** and a retrieval tool (now shown) may be lowered into the wellbore **100** to secure and recover the upper portion **108** of the downhole tubular **104**.

(11) As illustrated, a hoist **114** may be used to run the downhole cutting tool **106** into wellbore **100**.

In particular, the hoist **114** may be disposed on a vehicle **116** and may be used to raise and lower the downhole cutting tool **106**. While the hoist **114** is shown on the vehicle **116**, it should be understood that the conveyance **118** may alternatively be disposed from a hoist **114** that is installed at surface **120** instead of being located on vehicle **116**. The hoist **114** may be configured to raise and/or lower the conveyance **118** with respect to the wellbore **100**. Further, the downhole cutting tool **106** has a tubular housing **122** securable to a downhole end **124** of the conveyance **118**, such that the downhole cutting tool **106** may be run-in-hole or pulled-out-of-hole as the hoist **114** raises and/or lowers the conveyance **118** with respect to the wellbore **100**.

(12) Moreover, as set forth in greater detail below, the downhole cutting tool **106** includes a power source (shown in FIG. **2**) disposed within the tubular housing **122** and configured to supply power to components of the downhole cutting tool **106**. The components of the downhole cutting tool **106** may be independently powered by the power source secured within the tubular housing **122**. For example, as illustrated, the conveyance **118** may include a slickline **126** or digital slickline configured to lower the downhole cutting tool **106** into the wellbore **100**. Slicklines do not include wiring for transmitting electricity. As such, the power source may exclusively provide electricity to power the components of the downhole cutting tool **106**. Alternatively, the conveyance **118** may include a wireline, coiled tubing, drill pipe, or other suitable conveyance **118** having wiring to provide electricity from the surface **120** to the downhole cutting tool **106** such that power may be supplied to the components of the downhole cutting tool **106** via a combination of the power source disposed in the tubular housing **122** and power supplied from the surface **120** via the conveyance **118**.

(13) FIG. **2** illustrates a cross-sectional view of a downhole cutting tool, in accordance with some embodiments of the present disclosure. The downhole cutting tool **106** includes the tubular housing **122** securable to the downhole end **124** of the conveyance **118** (shown in FIG. **1**). Additionally, the downhole cutting tool **106** includes the power source **200** configured to provide power (e.g., electricity) to various components of the downhole cutting tool **106**. As set forth above, the power source **200** may exclusively provide power to the various components of the downhole cutting tool **106**. For example, some wells may not have power available at the surface or using powered conveyances (e.g., wireline, etc.) at such wells may be inconvenient. As such, the downhole cutting tool **106** may be lowered into the wellbore **100** (shown in FIG. **1**) via a non-powered conveyance **118** (e.g., a slickline), and the power source **200** disposed within the downhole cutting tool **106** may provide power to the various components of the downhole cutting tool **106** (shown in FIG. **1**). Alternatively, the power source **200** may provide power to the various components in combination with surface power source **620** supplying power to the downhole cutting tool **106** via a powered conveyance.

(14) Moreover, the downhole cutting tool **106** may include a retractable anchor assembly **202** secured to the tubular housing **122**. The retractable anchor assembly **202** is configured to extend radially outward at a predetermined position in a wellbore **100** to restrain movement of the tubular housing **122** along the wellbore **100**. The retractable anchor assembly **202** may also be configured to centralize the downhole cutting tool **106** in the wellbore **100**. Further, the downhole cutting tool **106** may include at least one motor **204** secured within the tubular housing **122**. The at least one motor **204** may be an electrical motor configured to operate using power supplied from the power source **200** disposed within the downhole cutting tool **106**. Moreover, as illustrated, the downhole cutting tool **106** may include a first motor **206** and a second motor **208**. However, the downhole cutting tool **106** may include any suitable number of motors. For example, the downhole cutting tool **106** may additionally include a third motor (not shown). The first motor **206** may be configured to drive the retractable anchor assembly **202** to deploy and retract. As set forth in greater detail below, the first motor **206** is configured to drive the retractable anchor assembly **202** to extend radially outward in response to receiving an output from a control system **210** disposed within the tubular housing **122**. Specifically, the control system **210** may include one or more

control boards (e.g., a first control board **212** and a second control board **214**) disposed within an electronics section **216** of the tubular housing **122**.

(15) The downhole cutting tool **106** may additionally include a cutting head **218** rotatably secured to the tubular housing **122**. The cutting head **218** has a retractable cutting blade **220** configured to move between a radially extended position and a retracted position. As set forth in greater detail below, the cutting head **218** may be configured to rotate with respect to the tubular housing **122** to drive the retractable cutting blade **220** to cut the downhole tubular **104** disposed in the wellbore **100** (shown in FIG. **1**). Further, the at least one motor **204** (e.g., the second motor **208**) may be configured to drive rotation of the cutting head **218**. In particular, the control system **210** of the downhole cutting tool **106** may be configured to direct the second motor **208** to rotate the cutting head **218** in a first direction in response to determining that the retractable anchor assembly **202** is deployed (e.g., disposed in the radially extended position). Additionally, the control system **210** may be configured to direct the at least one motor **204** to rotate the cutting head **218** in a second direction in response to determining that the retractable cutting blade **220** completed cutting the downhole tubular **104**. Rotating the cutting head **218** in the second direction may move the retractable cutting blade **220** radially inward from the radially extended position to the retracted position as illustrated. Alternatively, the third motor may be configured to move the retractable cutting blade **220** radially between the extended position and the retracted position. Further, after completing the cut on the downhole tubular **104** and retracting the retractable cutting blade **220**, the control system **210** may further direct the first motor **206** to rotate in a second direction to retract the retractable anchor assembly **202** such that the downhole cutting tool **106** may be pulled out-of-hole.

(16) Moreover, as set forth above, the at least one motor **204** (e.g., the first motor **206** and the second motor **208**) may operate using power supplied by the power source **200** disposed within the tubular housing **122**. Further, the power source **200** may be configured to supply power to other components of the downhole cutting tool **106**. For example, the power source **200** may be configured to supply power to the control system **210** of the downhole cutting tool **106**, which may include various electrical components. Moreover, the power source **200** may include at least one battery **222** secured within a battery section **224** of the tubular housing **122**. As illustrated, the at least one battery **222** includes a plurality of alkaline batteries, or other suitable batteries, arranged in series and in parallel within the battery section **224** of the tubular housing **122**. Other suitable batteries **222** may include nickel metal hydride (Nimh) batteries, lithium batteries, triple-A batteries, or some combination thereof.

(17) Additionally, the battery section **224** of the tubular housing **122** may include a battery cavity **226** for holding the plurality of batteries **222** in desired parallel and series configurations. The battery cavity **226** may be sized and shaped based on the type of batteries **222** used, such that the battery cavity **226** may be configured to hold a sufficient number of batteries **222** required for providing power to the various components of the downhole cutting tool **106** for the downhole tubing cutting process. Additionally, the battery section **224** may include battery springs **228** to bias the batteries **222** against each other such that batteries **222** maintain contact with each other during the downhole tubing cutting process. Further, the battery section **224** may include a wire passage **230** configured to house wires (not shown) for electrically connecting the batteries **222** to the various components of the downhole cutting tool **106**.

(18) FIG. **3** illustrates a cross-sectional view of a retractable anchor assembly of the downhole cutting tool, in accordance with some embodiments of the present disclosure. As set forth above, the retractable anchor assembly **202** is configured to extend radially outward at the predetermined position in the wellbore **100** to restrain movement of the tubular housing **122** along the wellbore **100**. The retractable anchor assembly **202** may include a first anchor **300** and a second anchor (shown in FIG. **4**). As illustrated, the first anchor **300** is deployed. That is, a first anchor pad **302** of the first anchor **300** is extended radially outward to contact the downhole tubular **104**. Contact

between the first anchor pad **302** and the downhole tubular **104** may restrain movement of the tubular housing **122** along the wellbore **100**.

(19) The first anchor **300** may include a shifting assembly **304** disposed within the tubular housing **122**. As illustrated, the shifting assembly **304** has a threaded bore **306** formed in an upper end **308** of the shifting assembly **304**. The threaded bore **306** is configured to interface with corresponding threads **310** of a motor shaft **312** of the first motor **206** (e.g., an electrical motor powered by the at least one battery **222**). To deploy the first anchor **300**, the first motor **206** may rotate the motor shaft **312** in a first direction in response to receiving an output from the control system **210**. Due to the threaded interface between the threaded bore **306** of the shifting assembly **304** and the motor shaft **312**, rotation of the motor shaft **312** in the first direction may drive the shifting assembly **304** to move axially away from the first motor **206**. Similarly, rotation of the motor shaft **312** in the second direction (e.g., opposite the first direction) may drive the shifting assembly **304** axially toward the first motor **206**.

(20) Moreover, the shifting assembly **304** may have a stepped diameter with an upper end portion **314** of the shifting assembly **304** having a larger diameter than a middle portion **316** and/or lower end portion **318** of the shifting assembly **304** such that a shoulder **320** is formed at a transition between the upper end portion **314** and the middle portion **316**. The shoulder **320** may be configured to contact a landing shoulder **322** formed on an inner surface **120** of the tubular housing **122** as the shifting assembly **304** moves axially away from the first motor **206** by a predetermined distance. As such, the landing shoulder **322** may limit the travel distance of the shifting assembly **304** in the downhole direction **324**, which may restrain radial extension of the first anchor pad **302** to a desired extension distance.

(21) The first anchor **300** may further include at least one mounting plate **326** rigidly secured to a radially outer surface **328** of the shifting assembly **304**. As illustrated, the mounting plate **326** may be secured to the radially outer surface **328** of the middle portion **316** and/or the lower end portion **318** of the shifting assembly **304**. However, the mounting plate **326** may be secured to any suitable portion of the shifting assembly **304**. Additionally, the first anchor **300** may include at least one first anchor rod **330** and at least one first anchor pad **302**. As illustrated, an upper end **332** of the first anchor rod **330** may be secured to the mounting plate **326** via a first upper hinged joint **334**, an upper end **336** of the first anchor pad **302** may be secured to a lower end **338** of the first anchor rod **330** via a first middle hinged joint (not shown), and a lower end **340** of the first anchor pad **302** may be secured to the tubular housing **122** via a first lower hinged joint **342**. However, the first anchor rod **330** and the first anchor pad **302** may be connected and secured in any suitable arrangement for deploying the first anchor **300**. For example, the lower end **340** of the first anchor pad **302** may alternatively be secured, via the lower hinged joint **342**, to a lower mounting plate **344** that is rigidly secured to the tubular housing **122**.

(22) Moreover, as the shifting assembly **304** moves axially away from the first motor **206**, the upper end **332** of the first anchor rod **330** moves toward the lower end **340** of the first anchor pad **302**, which is fixed to the tubular housing **122**. As illustrated, moving the upper end **332** of the first anchor rod **330** toward the lower end **340** of the first anchor pad **302** drives the first anchor rod **330** and the first anchor pad **302** to hinge with respect to each other, via the various hinged joints. Further, hinging the first anchor rod **330** with respect to the first anchor pad **302** may move the upper end **336** of the first anchor pad **302** to extend radially outward with respect to the tubular housing **122** and contact the downhole tubular **104** as illustrated.

(23) Further, the at least one mounting plate **326** may include a plurality of mounting plates secured about the radially outer surface **328** of the shifting assembly **304**. For example, the first anchor **300** may include three mounting plates (e.g., a first mounting plate, a second mounting plate, and a third mounting plate) disposed about the shifting assembly **304**. Each mounting plate **326** may have corresponding first anchor rods **330** and first anchor pads **302** such that deploying the first anchor **300** may extend a plurality of first anchor pads **302** radially outward with respect to the tubular

housing **122** to engage the downhole tubular **104**. Deploying the plurality of first anchor pads **302** may restrain axial movement of the downhole cutting tool **106** in the wellbore **100** while also keeping the downhole cutting tool **106** generally centralized in the wellbore **100**.

(24) Moreover, the downhole cutting tool **106** may also include a sliding sleeve **346** disposed proximate the first anchor **300**. The sliding sleeve **346** may be rigidly connected to the sliding shifting assembly. Accordingly, axial downhole movement of the shifting assembly **304** to deploy the first anchor **300** may also drive the sliding sleeve **346** in the axially downhole direction **324**. Thus, actuating the first motor **206** to deploy the first anchor **300** may also drive the sliding sleeve **346** in the axially downhole direction **324**. As set forth in greater detail below, moving the sliding sleeve **346** in the axially downhole direction **324** may deploy the second anchor.

(25) FIG. **4** illustrates a cross-sectional view of a second anchor of the retractable anchor assembly disposed in an extended position and a retractable cutting blade disposed in a retracted position, in accordance with some embodiments of the present disclosure. As set forth above, the retractable anchor assembly **202** may include the second anchor **400**, which is axially offset from the first anchor **300**. In particular, the second anchor **400** may be disposed downhole from the first anchor **300** (shown in FIG. **3**) in a position proximate to the cutting head **218**. Prior to rotating the cutting head **218**, the second anchor **400** may be deployed to help secure the downhole cutting tool **106**. That is, at least one second anchor pad **402** of the second anchor **400** may be extended radially outward to contact the downhole tubular **104** in a second extended position. Contact between the at least one second anchor pad **402** and the downhole tubular **104** may help restrain movement of the tubular housing **122** along the wellbore **100** to secure the downhole cutting tool **106**.

(26) Moreover, the second anchor **400** may be deployed (e.g., actuated from a retracted position to the extended position) in response to actuation of the first anchor **300**. As set forth above, deploying the first anchor **300** may drive the sliding sleeve **346** in the axially downhole direction **324**. The second anchor **400** may include a sliding connector plate **404** secured to the sliding sleeve **346**. As such, axial movement of the sliding sleeve **346** in the downhole direction **324** may drive the sliding connector plate **404** along a second anchor recess **406** from an upper plate position **408** to a lower plate position **410**. Moving the sliding connector plate **404** to the upper plate position **408** may retract the second anchor **400** and moving the sliding connector plate **404** to the lower plate position **410** may deploy the second anchor **400** as illustrated.

(27) The second anchor **400** may include at least one second anchor rod **412** and the at least one second anchor pad **402**. As illustrated, an upper end **414** of the second anchor pad **402** may be secured to the sliding connector plate **404** via a second upper hinged joint **416**, an upper end **418** of the second anchor rod **412** may be secured to a lower end **420** of the second anchor pad **402** via a second middle hinged joint (not shown), and a lower end **422** of the second anchor rod **412** may be secured to the tubular housing **122** via a second lower hinged joint **424**. However, the second anchor rod **412** and the second anchor pad **402** may be connected and secured in any suitable arrangement for deploying the second anchor **400**. For example, the lower end **338** of the first anchor rod **330** may alternatively be secured, via the second lower hinged joint **424**, to a second lower mounting plate **426** that is rigidly secured to the tubular housing **122**.

(28) Moreover, as the sliding sleeve **346** moves axially downhole in response to the first anchor **300** being deployed, the sliding connector plate **404** moves axially downhole to drive the upper end **414** of the second anchor pad **402** toward the lower end **422** of the second anchor rod **412**, which is fixed to the tubular housing **122**. As illustrated, moving the upper end **414** of the second anchor pad **402** toward the lower end **422** of the second anchor rod **412** drives the second anchor pad **402** and the second anchor rod **412** to hinge with respect to each other, via the various hinged interfaces. Hinging the second anchor pad **402** with respect to the second anchor rod **412** may move the lower end **420** of the second anchor pad **402** to extend radially outward with respect to the tubular housing **122** and contact the downhole tubular **104**.

(29) Further, as illustrated, the retractable cutting blade **220** is disposed in a retracted position. The

control system **210** (shown in FIG. **2**) may be configured to hold the retractable cutting blade **220** in the retracted position until the retractable anchor assembly **202** (e.g., the first anchor **300** and the second anchor **400**) is deployed. That is, the control system **210** may not direct power from the power source **200** to the second motor **208** until the control system **210** determines that the first motor **206** has driven the retractable anchor assembly **202** to deploy and secure the downhole cutting tool **106** against the downhole tubular **104** at the predetermined position in the wellbore **100**.

(30) FIG. **5** illustrates a cross-sectional view of the cutting head having the retractable cutting blade, in accordance with some embodiments of the present disclosure. As set forth above, the retractable cutting blade **220** may be configured to move between the retracted position and the radially extended position. As illustrated, the retractable cutting blade **220** is disposed in the radially extended position. That is, the retractable cutting blade **220** is extended radially outward to engage the downhole tubular **104**. Once extended, continued rotation of the cutting head **218** may drive retractable cutting blade **220** to cut the downhole tubular **104** disposed in the wellbore **100**.

(31) Moreover, as illustrated, the cutting head **218** may be secured to a downhole end **500** of the tubular housing **122**. In particular, the cutting head **218** is rotatably secured to tubular housing **122** such that the cutting head **218** may rotate with respect to the tubular housing **122** to drive the retractable cutting blade **220**. As set forth above, the second motor **208** may be configured to drive rotation of the cutting head **218** in a first direction in response to the control system **210** (shown in FIG. **2**) determining that the retractable anchor assembly **202** is disposed in the deployed position. The second motor **208** may include a drive shaft **502** configured to rotate in response to actuation of the second motor **208**. The cutting head **218** may be connected to the drive shaft **502** such that rotation of the drive shaft **502** may rotate the cutting head **218**. Further, the downhole cutting tool **106** may include a gear system **504** to control the direction of rotation of the cutting head **218**. That is, the gear system **504** may allow the cutting head **218** to be selectively rotated in the first direction or a second direction. Rotation of the cutting head **218** in the first direction may extend the retractable cutting blade **220**, and rotation of the cutting head **218** in a second direction may retract the retractable cutting blade **220**.

(32) The downhole cutting tool **106** may further include a feed gear **506** disposed within the cutting head **218**. As illustrated, the feed gear **506** may be configured to move the retractable cutting blade **220** radially outward from the retracted position to the radially extended position in response to rotation of the cutting head **218** in a first direction. Further, the feed gear **506** is configured to move the retractable cutting blade **220** radially inward from the radially extended position to the retracted position in response to rotation of the cutting head **218** in a second direction. In particular, the retractable cutting blade **220** may be secured to a retractable base **508**, and the retractable base **508** may include a threaded bore **510** configured to interface with the feed gear **506**. That is, the feed gear **506** may include a threaded shaft **512** configured to rotate in response to rotation of the drive shaft **502** of the second motor **208**. As the threaded shaft **512** of the feed gear **506** rotates, the retractable base **508** may move radially based at least in part on the orientation of the retractable base **508** in the cutting head **218** and the threaded interface between the feed gear **506** and the retractable base **508**.

(33) Moreover, as set forth above, the control system **210** may be configured to direct actuation of the second motor **208** to rotate the cutting head **218** in the first direction and extend the retractable cutting blade **220**. However, in response to the control system **210** determining that the retractable cutting blade **220** completed cutting the downhole tubular **104**, the control system **210** may be configured to direct the second motor **208** to rotate the cutting head **218** in the second direction to move the retractable cutting blade **220** radially inward and disengage the retractable cutting blade **220** from the downhole tubular **104**. Further, in response to the control system **210** determining that the retractable cutting blade **220** is sufficiently retracted, the control system **210** may actuate the first motor **206** in reverse (e.g., in the second direction) to retract the retractable anchor assembly

202 such that the downhole cutting tool **106** may be pulled out-of-hole. As set forth above, once the downhole cutting tool **106** is pull-out-of hole, the upper portion **108** of the downhole tubular **104** may be recovered from the wellbore **100**.

(34) FIG. **6** illustrates a block diagram of a surface system and the downhole cutting tool, in accordance with some embodiments of the present disclosure. As set forth above, the downhole cutting tool **106** may include the control system **210** having various electrical components for directing operations of the downhole cutting tool **106**. For example, as illustrated, the control system **210** may include a processor **600** and a memory **602**. The processor **600** may include one or more processing devices, and the memory **602** may include one or more tangible, non-transitory, machine-readable media. By way of example, such machine-readable media can include RAM, ROM, EPROM, EEPROM, or optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to carry or store desired program code in the form of machine-executable instructions or data structures and which can be accessed by the processor **600** or by other processor-based devices (e.g., mobile devices). The memory **602** may be configured to store controller instructions executable by the processor **600** to output various control system signals. For example, the processor **600** may execute the controller instructions to actuate the first motor **206** and/or the second motor **208** during downhole tubular cutting operations. Additionally, the control system **210** may include multiple processors and memory devices. For example, the control system **210** may include the first control board **212** (shown in FIG. **2**), having a first memory and a first processor, configured to direct operation of the first motor **206**, and the second control board **214** (shown in FIG. **2**), having a second memory and a second processor, configured to direct operation of the second motor **208**. Indeed, the control system **210** may include any suitable configuration for directing downhole tubular cutting operations of the downhole cutting tool **106**.

(35) The control system **210** may also include any suitable hardware for monitoring voltage of the power source **200**, current of the at least one motor **204**, blade displacement, etc. during downhole tubular cutting operations. Voltage and current data may indicate an operational status of the downhole cutting tool **106**. For example, the power source **200** may provide power to the first motor **206** to deploy the retractable anchor assembly **202** and to the second motor **208** to rotate the cutting head **218**. As the retractable cutting blade **220** engages the downhole tubular **104**, the power source **200** may output more power to the second motor **208** to maintain rotation of the cutting head **218** as the retractable cutting blade **220** cuts through the downhole tubular **104** (shown in FIG. **5**). As such, the voltage and current data, showing a maintained increase in power usage to the second motor, may be indicative of the operational status of the downhole cutting tool (e.g., that the downhole cutting tool is actively cutting through the downhole tubular **104**). Further, after completing the cut through the downhole tubular **104**, the power source **200** may output less power to the second motor **208** to maintain rotation of the cutting head **218** since the cutting head **218** no longer requires additional power to drive the retractable cutting blade **220** through the downhole tubular **104**. As such, the voltage and current data showing a decrease in power usage to the second motor may be indicative of another operational status of the downhole cutting tool (e.g., that the downhole cutting tool finished cutting the downhole tubular **104**) . . . . Thus, based on the voltage and current changes and/or levels corresponding to the power outputted to the first motor **206** and/or the second motor **208**, the operational status of the downhole cutting tool **106** may be determined.

(36) The control system **210** may further include communication circuitry **604** configured to both send and receive data and/or instructions during downhole tubular cutting operations. Using the communication circuitry **604**, the control system **210** may communicate/output the operational status of the downhole cutting tool **106** and/or other data to a surface system **606**. Additionally, the control system **210** may be configured to receive instructions from the surface system **606** via the communication circuitry **604**. For example, the control system **210** may output the voltage and

current data, as well as blade displacement data, via the communication circuitry **604**, to a corresponding surface communication circuitry **608** of the surface system **606**. The surface system **606** may include a user interface **614** configured to display the voltage and current data, as well as the blade displacement data. Based at least in part on the displayed voltage and current data and/or blade displacement data, an operator may determine the operational status of the downhole cutting tool **106** and output, via the user interface **614**, instructions to the control system **210** to actuate the first motor **206** and/or the second motor **208** (e.g., to transition the downhole cutting tool **106** from an anchor state to a cutting state). As such, the control system may actuate the first motor **206** and/or the second motor **208** in response to receiving instructions output based on the determined operational status of the downhole drilling tool **106**.
(37) For example, the surface system **606** may output instructions for the downhole cutting tool **106** to deploy the retractable anchor assembly **202** in response to a user determining that the downhole cutting tool **106** reached a desired location in the wellbore **100**. Further, the surface system **606** may output instructions to rotate the cutting head **218**, which may extend the retractable cutting blade **220** to engage and cut the downhole tubular **104** as set forth above. Further, in response to a user determining that the cut is complete, the surface system **606** may send instructions to disengage/retract the retractable cutting blade **220** and the retractable anchor assembly **202** such that the downhole cutting tool **106** may be pulled out-of-hole.
(38) As set forth above, the surface system **606** may communicate with the control system **210** of the downhole cutting tool **106** via the surface communication circuitry **608**. The surface communication circuitry **608** may include antennas, radio transceiver circuits, and signal processing hardware and/or software (e.g., hardware or software filters, A/D converters, multiplexers, amplifiers), or a combination thereof, and that may be configured to communicate over wired and/or wireless communication paths. Wire and or any other suitable communication medium may connect the surface communication circuitry **608** with the communication circuitry **604** of the downhole cutting tool **106**.
(39) The surface system **606** may also include at least one surface processor **610** and surface memory **612**. Additionally, the surface system **606** may include the user interface **614** set forth above. The user interface **614** may include an input/output device **616** (e.g., keyboard, mouse, or touch screen) configured to provide the user input to the processor **600**. Further, the user interface **614** may include a display **618** (e.g., computer monitor or personal device screen) configured to display user options for the surface system **606** as well as downhole data. Users may output instructions from the surface system **606** to the downhole cutting tool **106** via the user interface **614**. For example, as set forth above, a user may view data output from the downhole cutting tool **106** (e.g., voltage data, current data, blade displacement data, etc.) to determine the operational status of the downhole cutting tool **106** (e.g., that the downhole cutting tool **106** has finished cutting the downhole tubular **104**). In response, the user may use the input/output device **616** to send instructions from the surface system **606** to the downhole cutting tool **106** to rotate the cutting head **218**, via the second motor **208**, in the second direction to retract the retractable cutting blade **220**. Further, the surface system **606** may output instructions to selectively actuate the first motor **206** or the second motor **208**.
(40) Alternatively, the downhole cutting tool **106** may be configured to operate autonomously. That is, the downhole cutting tool **106** may be configured to operate without instructions from the surface system **606**. The control system **210** may include an internal timer. The control system **210** may be configured to autonomously direct the at least one motor **204** based at least in part on the internal timer. For example, the downhole cutting tool **106** may be run-in-hole on the conveyance **118**. Based on the internal timer, the control system **210** may direct the at least one motor **204** (e.g., the first motor **206** and the second motor **208**) to actuate after a predetermined amount of time. In particular, the first motor **206** may drive the retractable anchor assembly **202** to deploy at a first time based on the internal timer. Further, the second motor **208** may drive rotation of the cutting

head **218** and extension of the retractable cutting blade **220** at a second time, after the first time, based on the internal timer. Alternatively, the first motor **206** and the second motor **208** may be directed to actuate simultaneously. Moreover, the control system **210** may monitor the current and/or voltage from the power source **200** to self-determine when the retractable cutting blade **220** completes the cut through the downhole tubular **104**. In response to the control system **210** determining that the cut is complete, the control system **210** may then direct the first motor **206** and the second motor **208** to retract the retractable anchor assembly **202** and the retractable cutting blade **220**, respectively.
(41) Moreover, as set forth above, the at least one motor **204** (e.g., the first motor **206** and the second motor **208**) may be independently powered by the power source **200** (e.g., the at least one battery) secured within the tubular housing **122**. However, the power source **200** may alternatively operate in combination with a surface power source **620** to supply power to the downhole cutting tool **106**. That is, the downhole cutting tool **106** may be run-in-hole via a powered conveyance **118** such as a wireline. The powered conveyance **118** may transmit/relay power from the surface power source **620** to the downhole cutting tool **106**. The control system **210** may direct power from at least one battery **222** and the surface power source to operate the control system **210**, the first motor **206**, the second motor **208**, and/or any other components of the downhole cutting tool **106**.
(42) FIG. **7** illustrates a flow chart of the operation of the downhole cutting tool to cut a downhole tubular disposed in the wellbore, in accordance with some embodiments of the present disclosure. The downhole cutting tool may be run into the wellbore **700**. As set forth above, the downhole cutting tool includes the tubular housing, the retractable anchor assembly, the rotating cutting head having the retractable cutting blade, the at least one motor (e.g., the first motor and the second motor), the control system, and the power source disposed in the downhole cutting tool.
(43) Further, the control system and/or a user operating the surface system may determine if the downhole cutting tool has been run-in-hole to the predetermined position **702**. For example, the user operating the surface system may monitor the location (e.g., depth) of the downhole cutting tool using measurements from an instrumented measure wheel. Further, the user may verify/correct the location of the downhole cutting tool using tubing collars detected by a collar locating tool while being run-in-hole. If the cutting tool has not been run-in-hole to the predetermined position, then the downhole cutting tool may continue to be run-in-hole. However, in response to the control system and/or the user operating the surface system determining that the downhole cutting tool is disposed at the predetermined position, the retractable anchor assembly may be deployed **704**, via the at least one motor powered by the power source, to restrain movement of the tubular housing along the wellbore.
(44) The power source (e.g., the voltage and current of the power source) may be monitored as the retractable anchor assembly is deployed **706**. As set forth above, based on changes in the voltage and current of the power source, the control system and/or the user operating the surface system may determine whether the retractable anchor assembly is deployed **708**. If not, the control system and/or the user operating the surface system will continue to monitor the power source. However, in response to the control system and/or the user operating the surface system determining that the retractable anchor assembly is deployed, the control system may direct the cutting head to rotate in the first direction **710**, which may move the retractable cutting blade, via the feed gear, to the radially extended position to engage and cut the downhole tubular.
(45) The power source (e.g., the voltage and current of the power source) may be monitored as the retractable cutting blade engages the downhole tubular **712**. As set forth above, based on changes in the voltage and current of the power source, the control system and/or the user operating the surface system may determine whether the retractable cutting blade has completed the cut of the downhole tubular **714**. If not, the control system and/or the user operating the surface system will continue to monitor the power source. However, in response to the control system and/or the user operating the surface system determining that the retractable cutting blade has completed the cut of

the downhole tubular, the control system may direct the cutting head to rotate in the second direction **716**, which may retract the retractable cutting blade. Further, the control system may retract the retractable anchor assembly to release the tubular housing to move along the wellbore **718**. Moreover, in response to the control system and/or the user operating the surface system determining that the retractable anchor assembly and the retractable cutting blade are retracted **720**, the downhole cutting tool may be pulled out of the wellbore **722**.

(46) Accordingly, the present disclosure may provide a downhole cutting tool configured to cut downhole tubulars via at least one motor powered by a power source disposed within a tubular housing of the downhole cutting tool. The systems and methods may include any of the various features disclosed herein, including one or more of the following statements.

(47) Statement 1. A downhole cutting tool, comprising: a tubular housing securable to a downhole end of a conveyance; a cutting head secured to the tubular housing, the cutting head having a retractable cutting blade configured to move between a radially extended position and a retracted position, and wherein the cutting head is configured to rotate with respect to the tubular housing to drive the retractable cutting blade, in the radially extended position, to cut a downhole tubular disposed in a wellbore; at least one motor secured within the tubular housing and configured to drive rotation of the cutting head; and a power source disposed within the tubular housing and configured to supply power to the at least one motor, wherein the power source comprises at least one battery.

(48) Statement 2. The downhole cutting tool of statement 1, wherein the at least one motor is independently powered by the at least one battery secured within the tubular housing.

(49) Statement 3. The downhole cutting tool of statement 1 or statement 2, wherein the at least one battery comprises a plurality of batteries arranged in series and in parallel within a battery section of the tubular housing.

(50) Statement 4. The downhole cutting tool of any preceding statement, wherein the at least one battery comprises at least one alkaline battery, nickel metal hydride (Nimh) battery, lithium battery, or some combination thereof.

(51) Statement 5. The downhole cutting tool of any of statements 1, 3, and 4, wherein conveyance comprises a wireline configured to relay power from the surface, wherein the at least one battery and the wireline are configured to supply power to the at least one motor.

(52) Statement 6. The downhole cutting tool of statements 1, 3, 4, and 5, wherein the conveyance comprises slickline, digital slickline, wireline, coiled tubing, drill pipe, or some combination thereof.

(53) Statement 7. The downhole cutting tool of any preceding statement, further comprising a feed gear disposed within the cutting head, wherein the feed gear is configured to move the cutting blade radially outward from the retracted position to the radially extended position in response to rotation of the cutting head in a first direction.

(54) Statement 8. The downhole cutting tool of any preceding statement, wherein the feed gear is configured to move the cutting blade radially inward from the radially extended position to the retracted position in response to rotation of the cutting head in a second direction, wherein the second direction is opposite the first direction.

(55) Statement 9. The downhole cutting tool of any preceding statement, further comprising a retractable anchor assembly secured to the tubular housing, wherein the retractable anchor assembly is configured to extend radially outward at a predetermined position in a wellbore to restrain movement of the tubular housing along the wellbore.

(56) Statement 10. The downhole cutting tool of any preceding statement, wherein the at least one motor is configured to actuate to drive the retractable anchor assembly to extend radially outward in response to receiving an output from a control system.

(57) Statement 11. The downhole cutting tool of any preceding statement, further comprising a control system disposed within the tubular housing, wherein the control system is configured to

direct the at least one motor to rotate the cutting head in a first direction in response to determining that a retractable anchor assembly is disposed in a radially extended position.

(58) Statement 12. The downhole cutting tool of any preceding statement, wherein the control system is configured to direct the at least one motor to rotate the cutting head in a second direction in response to determining that the retractable cutting blade completed cutting the downhole tubular, wherein rotating the cutting head in the second direction is configured to move the cutting blade radially inward from the radially extended position to the retracted position.

(59) Statement 13. The downhole cutting tool of any preceding statement, wherein the control system is in communication with a surface system having a user interface, wherein the control system is configured to direct the at least one motor in response to user input via the user interface, and wherein the control system is configured to output data to the surface indicating an operational status of the downhole cutting tool.

(60) Statement 14. The downhole cutting tool of any of statements 1-12, wherein the control system comprises an internal timer, and wherein the control system is configured to autonomously direct the at least one motor based at least in part on the internal timer.

(61) Statement 15. The downhole cutting tool of any preceding statement, wherein the at least one motor comprises a first motor and a second motor, wherein the first motor is configured to actuate a retractable anchor assembly to deploy and retract, and wherein the second motor is configured to drive rotation of the cutting head.

(62) Statement 16. The downhole cutting tool of any preceding statement, further comprising a gear system coupled to the second motor, wherein the second motor is configured to drive rotation of the cutting head in a clockwise direction and a counterclockwise direction via the gear system.

(63) Statement 17. A system, comprising: a tubular housing securable to a downhole end of a conveyance; a retractable anchor assembly secured to the tubular housing, wherein the retractable anchor assembly is configured to deploy radially outward at a predetermined position in a wellbore to restrain movement of the tubular housing along the wellbore; a first motor secured within the tubular housing, wherein the first motor is configured to actuate the retractable anchor assembly to deploy and retract; a cutting head secured to the tubular housing, the cutting head having a retractable cutting blade configured to move between a radially extended position and a retracted position, and wherein the cutting head is configured to rotate with respect to the tubular housing to drive the retractable cutting blade, in the radially extended position, to cut a downhole tubular disposed in a wellbore; a second motor secured within the tubular housing, wherein the second motor is configured to drive rotation of the cutting head; and a control system configured to selectively actuate the first motor and the second motor; and a power source disposed within the tubular housing and configured to supply power to the first motor, the second motor, and the control system, and wherein the power source comprises at least one battery.

(64) Statement 18. The system of statement 17, wherein the at least one battery comprises a plurality of alkaline batteries arranged in series and in parallel within a battery section of the tubular housing.

(65) Statement 19. The system of statement 17 or statement 18, wherein the control system is configured to direct power output from the power source to the first motor and the second motor based at least in part on an operational status of the downhole cutting tool, wherein the control system is configured to receive voltage and current data, and wherein the control system is configured to determine the operational status of the downhole cutting tool based at least in part on the voltage and current data.

(66) Statement 20. A method, comprising: running a downhole cutting tool into a wellbore, wherein the downhole cutting tool comprises a tubular housing, a retractable anchor assembly, a cutting head having a retractable cutting blade, at least one motor, a control system, and a power source disposed in the downhole cutting tool, and wherein the downhole cutting tool is configured to cut a downhole tubular disposed in the wellbore; deploying the retractable anchor assembly, via the at

least one motor powered by the power source, at a predetermined position in the wellbore to restrain movement of the tubular housing along the wellbore; rotating the cutting head, via the at least one motor powered by the power source, in a first direction with respect to the tubular housing in response to a determination that the retractable anchor assembly is deployed at the predetermined position, wherein rotation of the cutting head moves the retractable cutting blade, via a feed gear, to a radially extended position to engage and cut the downhole tubular; rotating the cutting head in a second direction, via the at least one motor powered by the power source, to move the retractable cutting blade to a retracted position in response to a determination that the retractable cutting blade completed cutting the downhole tubular; and retracting the retractable anchor assembly to release the tubular housing to move along the wellbore in response to a determination that the retractable cutting blade is retracted.

(67) For the sake of brevity, only certain ranges are explicitly disclosed herein. However, ranges from any lower limit may be combined with any upper limit to recite a range not explicitly recited, as well as, ranges from any lower limit may be combined with any other lower limit to recite a range not explicitly recited, in the same way, ranges from any upper limit may be combined with any other upper limit to recite a range not explicitly recited. Additionally, whenever a numerical range with a lower limit and an upper limit is disclosed, any number and any included range falling within the range are specifically disclosed. In particular, every range of values (of the form, "from about a to about b," or, equivalently, "from approximately a to b," or, equivalently, "from approximately a-b") disclosed herein is to be understood to set forth every number and range encompassed within the broader range of values even if not explicitly recited. Thus, every point or individual value may serve as its own lower or upper limit combined with any other point or individual value or any other lower or upper limit, to recite a range not explicitly recited.

(68) Therefore, the present embodiments are well adapted to attain the ends and advantages mentioned as well as those that are inherent therein. The particular embodiments disclosed above are illustrative only, as the present embodiments may be modified and practiced in different but equivalent manners apparent to those skilled in the art having the benefit of the teachings herein. Although individual embodiments are discussed, all combinations of each embodiment are contemplated and covered by the disclosure. Furthermore, no limitations are intended to the details of construction or design herein shown, other than as described in the claims below. Also, the terms in the claims have their plain, ordinary meaning unless otherwise explicitly and clearly defined by the patentee. It is therefore evident that the particular illustrative embodiments disclosed above may be altered or modified and all such variations are considered within the scope and spirit of the present disclosure.

Claims

1. A downhole cutting tool, comprising: a powerless conveyance; a tubular housing securable to a downhole end of said powerless conveyance; a cutting head secured to the tubular housing, the cutting head having a retractable cutting blade configured to move between a radially extended position and a retracted position, and wherein the cutting head is configured to rotate with respect to the tubular housing to drive the retractable cutting blade, in the radially extended position, to cut a downhole tubular disposed in a wellbore; at least one motor secured within the tubular housing and configured to drive rotation of the cutting head; an onboard power source disposed within a battery cavity formed within a battery section of the tubular housing, wherein the onboard power source is configured to supply power to the at least one motor for driving rotation of the cutting head, wherein the onboard power source comprises at least one battery; and a wire passage positioned in a central portion of the battery cavity and extending axially down an entire length of the battery cavity.

2. The downhole cutting tool of claim 1, wherein the at least one motor is independently powered

by the at least one battery secured within the tubular housing.
3. The downhole cutting tool of claim 1, wherein the at least one battery comprises a plurality of batteries arranged in series and in parallel within the battery section of the tubular housing.
4. The downhole cutting tool of claim 1, wherein the at least one battery comprises at least one alkaline battery, nickel metal hydride (Nimh) battery, lithium battery, or some combination thereof.
5. The downhole cutting tool of claim 1, wherein the powerless conveyance comprises a slickline.
6. The downhole cutting tool of claim 1, further comprising a feed gear disposed within the cutting head, wherein the feed gear is configured to move the cutting blade radially outward from the retracted position to the radially extended position in response to rotation of the cutting head in a first direction.
7. The downhole cutting tool of claim 6, wherein the feed gear is configured to move the cutting blade radially inward from the radially extended position to the retracted position in response to rotation of the cutting head in a second direction, wherein the second direction is opposite the first direction.
8. The downhole cutting tool of claim 1, further comprising a retractable anchor assembly secured to the tubular housing, wherein the retractable anchor assembly is configured to extend radially outward at a predetermined position in a wellbore to restrain movement of the tubular housing along the wellbore.
9. The downhole cutting tool of claim 8, wherein the at least one motor is configured to actuate to drive the retractable anchor assembly to extend radially outward in response to receiving an output from a control system.
10. The downhole cutting tool of claim 1, further comprising a control system disposed within the tubular housing, wherein the control system is configured to direct the at least one motor to rotate the cutting head in a first direction in response to determining that a retractable anchor assembly is disposed in a radially extended position.
11. The downhole cutting tool of claim 10, wherein the control system is configured to direct the at least one motor to rotate the cutting head in a second direction in response to determining that the retractable cutting blade completed cutting the downhole tubular, wherein rotating the cutting head in the second direction is configured to move the cutting blade radially inward from the radially extended position to the retracted position.
12. The downhole cutting tool of claim 10, wherein the control system is in communication with a surface system having a user interface, wherein the control system is configured to direct the at least one motor in response to user input via the user interface, and wherein the control system is configured to output data to the surface indicating an operational status of the downhole cutting tool.
13. The downhole cutting tool of claim 10, wherein the control system comprises an internal timer, and wherein the control system is configured to autonomously direct the at least one motor based at least in part on the internal timer.
14. The downhole cutting tool of claim 1, wherein the at least one motor comprises a first motor and a second motor, wherein the first motor is configured to actuate a retractable anchor assembly to deploy and retract, and wherein the second motor is configured to drive rotation of the cutting head.
15. The downhole cutting tool of claim 14, further comprising a gear system coupled to the second motor, wherein the second motor is configured to drive rotation of the cutting head in a clockwise direction and a counterclockwise direction via the gear system.
16. A system, comprising: a powerless conveyance; a tubular housing securable to a downhole end of the powerless conveyance; a retractable anchor assembly secured to the tubular housing, wherein the retractable anchor assembly is configured to deploy radially outward at a predetermined position in a wellbore to restrain movement of the tubular housing along the wellbore; a first motor secured within the tubular housing, wherein the first motor is configured to actuate the retractable

anchor assembly to deploy and retract; a cutting head secured to the tubular housing, the cutting head having a retractable cutting blade configured to move between a radially extended position and a retracted position, and wherein the cutting head is configured to rotate with respect to the tubular housing to drive the retractable cutting blade, in the radially extended position, to cut a downhole tubular disposed in a wellbore; a second motor secured within the tubular housing, wherein the second motor is configured to drive rotation of the cutting head; a control system configured to selectively actuate the first motor and the second motor; an onboard power source disposed within a battery cavity formed within a battery section of the tubular housing, wherein the onboard power source is configured to supply power to the first motor for actuating the retractable anchor assembly to deploy and retract, the second motor for driving rotation of the cutting head, and the control system, and wherein the onboard power source comprises at least one battery; and a wire passage positioned within the battery cavity and extending parallel to a central axis of the tubular housing and configured to route wires which connect to the battery.
17. The system of claim 16, wherein the at least one battery comprises a plurality of alkaline batteries arranged in series and in parallel within the battery section of the tubular housing.
18. The system of claim 16, wherein the control system is configured to direct power output from the onboard power source to the first motor and the second motor based at least in part on an operational status of the downhole cutting tool, wherein the control system is configured to receive voltage and current data, and wherein the control system is configured to determine the operational status of the downhole cutting tool based at least in part on the voltage and current data.
19. A method, comprising: running a downhole cutting tool into a wellbore using a powerless conveyance, wherein the downhole cutting tool comprises a tubular housing, a retractable anchor assembly, a cutting head having a retractable cutting blade, at least one motor, a control system, and an onboard power source, wherein the onboard power source is disposed within a battery cavity formed within a battery section of the tubular housing of the downhole cutting tool, a wire passage positioned in a central portion of the battery cavity extending axially down an entire length of the battery cavity, wherein the onboard power source comprises at least one battery, wherein the at least one motor is disposed axially between the retractable cutting blade and the onboard power source, and wherein the downhole cutting tool is configured to cut a downhole tubular disposed in the wellbore; deploying the retractable anchor assembly, via the at least one motor powered exclusively by the onboard power source, at a predetermined position in the wellbore to restrain movement of the tubular housing along the wellbore; rotating the cutting head, via the at least one motor powered exclusively by the onboard power source, in a first direction with respect to the tubular housing in response to a determination that the retractable anchor assembly is deployed at the predetermined position, wherein rotation of the cutting head moves the retractable cutting blade, via a feed gear, to a radially extended position to engage and cut the downhole tubular; rotating the cutting head in a second direction, via the at least one motor powered exclusively by the onboard power source, to move the retractable cutting blade to a retracted position in response to a determination that the retractable cutting blade completed cutting the downhole tubular; and retracting the retractable anchor assembly to release the tubular housing to move along the wellbore in response to a determination that the retractable cutting blade is retracted.