SUMMARY

[0007] An aspect of the present disclosure provides a method of balancing an unbalanced power cable using a transformer that has one or more phases, comprising: selecting a voltage on a tap handle; disposing a first bushing on the one or more phases at a different voltage than the selected voltage; and balancing the unbalanced power cable based on the disposition of the first bushing on the one or more phases at the different voltage.

[0008] Another aspect of the present disclosure provides a system comprising a flat cable, wherein the cable comprises comprising: a plurality of conductors, wherein at least one of the plurality of conductors comprises an impedance value differing from impedance values of each of the remaining plurality of conductors; wherein the cable is converted from an unbalanced mode to a balanced mode by disposing a bushing on one or two or all three phases at a voltage for one or more electrical submersible pump applications downhole.

[0009] These and other objects, features and advantages of the exemplary embodiments of the present disclosure will become apparent upon reading the following detailed description of the exemplary embodiments of the present disclosure, when taken in conjunction with the appended claims.

[00036] Cable 500 may include an electrical submersible pump cable. Cable 500 may comprise a plurality of conductors 505. Cable 500 may comprise an insulation 510. Cable 500 may comprise a barrier 515. Cable 500 may comprise bedding tape 520. Cable 500 may comprise an armor 525. For example, cable 500 may include Type HTF3 Flat Electrical Submersible Pump Cable by Kerite ®.

[00037] The cable 500 may comprise a flat power cable. The cable 500 may further include a plurality of conductors 505. In some examples, one or more conductors selected from the plurality of conductors 505 may comprise an impedance value different from the remaining conductors 505 of the cable. For example, one of the conductors may include a different impedance value than each of two remaining conductors 505 of the cable 500. The plurality of conductors 505 may be sequentially arranged on a horizontal axis. Further, the cable 500 may be balanced and configured for one or more electrical submersible pump applications downhole. The cable 500 may be injected into a length of coiled tubing. As explained above, the cable 500 may be converted from an unbalanced mode to a balanced mode by disposing a bushing on one or two of three phases at a voltage for one or more electrical submersible pump applications downhole. The cable 500 may include one or more additional bushings disposed at each of the second and third phases. In some examples, the voltage may exceed a value than that selected by a tap handle. As previously explained, the cable 500 may be configured to transmit power to an electrical load.

[00038] The cable 500 may include a variety of dimensions. Without limitation, a length of the cable 500 may exceed 3,657.6 meters. In another example, a length of the cable 500 may comprise about 4,572 meters. The width of the cable 500 may include a range of about 2.54 centimeters to 5.08 centimeters, such as3.18 centimeters. The thickness of the cable 500 may include a range of about 0.254 centimeters to about 2.54 centimeters, such as 1.27 centimeters.

[00039] The cable 500 may be a #2, #4, or #6 AWG conductor, insulated with polypropylene or ethylene propylene diene monomer (EPDM), and covered with nitrile or lead jacket (for downhole protection) and covered or wrapped with a galvanized steel, stainless steel or Monel ® armor. For example, a #4 AWG EPDM/ Lead Flat 5 KV cable may include a DC resistance of .846 ohms per thousand meters with and XL of .138 uh/ 1000 meters and Xc of .213 uf / 1000 meters. These impedances may increase with the length of the cable 500 as per the depth of well.

[00040] In the preceding specification, various embodiments have been described with references to the accompanying drawings. It will, however, be evident that various modifications and changes may be made thereto, and additional embodiments may be implemented, without departing from the broader scope of the invention as set forth in the claims that follow. The specification and drawings are accordingly to be regarded as an illustrative rather than restrictive sense.

CLAIM

1. A method of balancing an unbalanced power cable using a transformer that has one or more phases, comprising:

selecting a voltage on a tap handle;

disposing a first bushing on the one or more phases at a different voltage than the selected voltage; and

balancing the unbalanced power cable based on the disposition of the first bushing on the one or more phases at the different voltage.

2. The method of claim 1, further comprising transmitting, based on the different voltage, power to an electrical load.

3. The method of claim 2, wherein the electrical load comprises a permanent magnet, induction motor, a servomotor, or a switch reluctance motor.

4. The method of claim 1, wherein the different voltage is different from the selected voltage by a predetermined percentage.

5. The method of claim 1, wherein the power cable is balanced based on the disposition of the first bushing on the one or more phases at the different voltage that is higher or lower than the selected voltage.

6. The method of claim 1, wherein the different voltage is less than 10 kV.

7. The method of claim 1, wherein the different voltage is fixed for the one or more phases based on an attachment of the first bushing to the transformer.

8. The method of claim 1, wherein the different voltage is fixed for three phases based on an attachment of the first bushing to the transformer.

9. The method of claim 1, further comprising implementing one or more turns on the transformer to fix the different voltage for the one or more phases.

10. The method of claim 7, wherein the transformer comprises a step up transformer or a step-down transformer.

11. The method of claim 7, wherein the transformer comprises one or more cores including an E lamination, I lamination, or a U-I lamination.

12. The method of claim 7, wherein the transformer comprises primary and secondary windings configured in a plurality of configurations.

13. The method of claim 12, wherein the plurality of configurations comprises a wye configuration, a delta configuration, or a mixed wye-delta configuration.

14. The method of claim 1, wherein one of a plurality of conductors of the power cable comprises an impedance value differing from impedance values of each of the remaining plurality of conductors.

15. The method of claim 1, further comprising adjusting the voltage by implementing one or more turns on a phase-shifting transformer.

16. The method of claim 1, further comprising adding impedance by utilizing a magnetic core of the transformer.

17. The method of claim 1, further comprising balancing a voltage and a current to an electrical load through one or more additional tap handles so as to allow a selection of a value exceeding a tap ratio.

18. The method of claim 1, further comprising selecting, via a second tap handle, one or more changes to a line-to-line voltage.

19. The method of claim 1, further comprising adding two or more additional bushings to each of the one or more phases.

20. The method of claim 1, wherein the power cable comprises a flat power cable.

21. The method of claim 1, wherein the power cable is balanced for one or more electrical submersible pump applications downhole.

22. A system comprising a flat cable, wherein the cable comprises:

a plurality of conductors, wherein at least one of the plurality of conductors comprises an impedance value differing from impedance values of each of the remaining plurality of conductors, wherein the cable is converted from an unbalanced mode to a balanced mode by disposing a bushing on one or more of three phases at a voltage for one or more electrical submersible pump applications downhole.

23. The system of claim 22, wherein a length of the cable exceeds 3,657.6 meters.

24. The system of claim 22, wherein a length of the cable is about 4,572 meters.

25. The system of claim 22, further comprising one or more additional bushings disposed at each of second and third phases.

26. The system of claim 22, wherein the voltage exceeds a value than that selected by a tap handle.

27. The system of claim 22, wherein the cable is configured to transmit power to an electrical load.

28. The system of claim 27, wherein the electrical load comprises a permanent magnet, induction motor, a servomotor, or a switch reluctance motor.

29. The system of claim 22, wherein the plurality of conductors are sequentially arranged on a horizontal axis.

30. The system of claim 22, wherein the cable comprises a width of about 3.18 centimeters and a thickness of about 1.27 centimeters.

31. The system of claim 22, wherein the cable is injected into a length of coiled tubing.