

CLAIMS

What is claimed is:

1. A system comprising:
 - a first connector that includes a first positive contact and a first negative contact;
 - a second connector that includes a second positive contact and a second negative contact, the first positive contact and the second positive contact being made from a self-passivating transition metal, wherein the self-passivating transition metal has a property of forming a non-conductive outer layer on the first positive contact and the second positive contact when immersed in a fluid or other corrosive environments; and
 - an auxiliary electrode made from a conductive material electrically connected to at least one of the first positive contact and the second positive contact and spaced apart from a mating end of the first positive contact and the second positive contact,wherein when the first positive contact is mated with the second positive contact while immersed in the fluid and a high voltage source is applied to the first positive contact and the second positive contact that exceeds a breakdown voltage of the self-passivating transition metal, a high resistance fluid pathway is created from the auxiliary electrode to the first and second negative contacts, the auxiliary electrode being configured to pass current into and along the high resistance fluid pathway to create a voltage drop in the fluid between the auxiliary electrode and the first and second negative contacts, thereby limiting the voltage applied to the first and second positive contacts relative to the fluid to a voltage below the breakdown voltage of the self-passivating transition metal.
2. The system of claim 1, further comprising a voltage limiting circuit that electrically connects the auxiliary electrode to at least one of the first positive contact and the second positive contact.

3. The system of claim 2, wherein the voltage limiting circuit limits the voltage between first and second positive contacts and the auxiliary electrode.

4. The system of claim 2, wherein the voltage limiting circuit includes a Zener diode, transistor, or other electronic circuit.

5. The system of claim 4, wherein the voltage between the first and second positive contacts and the auxiliary electrode is limited to a voltage of the voltage limiting circuit.

6. The system of claim 1, wherein when the first positive contact is mated with the second positive contact while immersed in the fluid, at least a portion of the non-conductive outer layer is removed from the first positive contact and from the second positive contact via scraping to form an electrically conductive connection.

7. The system of claim 1, wherein the self-passivating transition metal is selected from a group comprising niobium, tantalum, titanium, zirconium, molybdenum, ruthenium, rhodium, palladium, hafnium, tungsten, rhenium, osmium, and iridium.

8. The system of claim 1, wherein the first connector is a male connector that includes a plurality of fingers having a first positive contact disposed at an end of one of the plurality of fingers and a first negative contact disposed at an end of another one of the plurality of fingers and the second connector is a female connector that includes a plurality of sockets having a second positive contact disposed inside one of the plurality of sockets and a second negative contact disposed inside another one of the plurality of sockets and wherein when the first and second connectors are mated, the plurality of fingers extend into the plurality of sockets such that the first positive contact and the first negative contact engage and mate with the second positive contact and the second negative contact respectively to form a tight fit.

9. The system of claim 1, wherein the first connector includes a first face, a first positive contact having a contact surface flush with the first face, and a first negative contact having a contact surface flush with the first face, and wherein the second connector includes a second face, a second positive contact having a contact surface flush with the second face, and a second negative contact having a contact surface flush with the second face.

10. The system of claim 9, wherein the auxiliary electrode forms a ring around at least one of the first positive contact and the second positive contact, the auxiliary electrode having a contact surface that is flush with at least one of the first face of the first connector and the second face of the second connector.

11. A high-voltage underwater electrical connector comprising:
a first positive contact made from a self-passivating transition metal;
a second positive contact made from a self-passivating transition metal that mates with the first positive contact, the first positive contact and the second positive contact being made from the self-passivating transition metal, wherein the self-passivating transition metal has a property of forming a non-conductive outer layer on the first positive contact and the second positive contact when immersed in water;
a first negative contact;
a second negative contact that mates with the first negative contact;
an auxiliary electrode made from a conductive material electrically connected to the first positive contact and spaced apart from a mating end of the first positive contact and the second positive contact; and
a voltage limiting circuit that electrically connects the auxiliary electrode to the first positive contact, the voltage limiting circuit limiting a voltage between first and second positive contacts and the auxiliary electrode,
wherein when the first positive contact is mated with the second positive contact while immersed in the water and a high voltage source is applied to the first positive contact and

the second positive contact that exceeds a breakdown voltage of the self-passivating transition metal, a high resistance water pathway is created from the auxiliary electrode to the first and second negative contacts and the auxiliary electrode is configured to pass current into and along the high resistance water pathway to create the voltage drop in the water between the auxiliary electrode and the first and second negative contacts, thereby limiting the voltage applied to the first and second positive contacts relative to the water to a voltage below the breakdown voltage of the self-passivating transition metal.

12. The high-voltage underwater electrical connector of claim 11, wherein when the first positive contact is mated with the second positive contact while immersed in the water, at least a portion of the non-conductive layer outer is removed from the first positive contact and from the second positive contact via scraping to form an electrically conductive connection.

13. The high-voltage underwater electrical connector of claim 11, wherein the self-passivating transition metal is selected from a group comprising niobium, tantalum, titanium, zirconium, molybdenum, ruthenium, rhodium, palladium, hafnium, tungsten, rhenium, osmium, and iridium.

14. The high-voltage underwater electrical connector of claim 11, further comprising a first connector and a second connector, wherein the first connector is a male connector that includes a plurality of fingers having the first positive contact disposed at an end of one of the plurality of fingers and the first negative contact disposed at an end of another one of the plurality of fingers and the second connector is a female connector that includes a plurality of sockets having the second positive contact disposed inside one of the plurality of sockets and the second negative contact disposed inside another one of the plurality of sockets and wherein when the first and second connectors are mated, the plurality of fingers extend into the plurality of sockets such that the first positive contact and the first negative contact engage and mate with the second positive contact and the second negative contact respectively to form a tight fit.

15. The high-voltage underwater electrical connector of claim 11, wherein the voltage limiting circuit includes a Zener diode, transistor, or other electronic circuit.

16. The high-voltage underwater electrical connector of claim 17, wherein a voltage between the auxiliary electrode and the first positive contact is limited to a voltage limiting circuit voltage.

17. The high-voltage underwater electrical connector of claim 11, wherein the first and second negative contacts are made from a conductive material selected from a group comprising copper, graphite, platinum, mixed-metal oxides and aluminum.

18. The system of claim 11, wherein the auxiliary electrode is made from a conductive metal selected from a group comprising platinum, graphite, and mixed-metal oxides.

19. The system of claim 11, wherein the first connector includes a first face, a first positive contact having a contact surface flush with the first face, and a first negative contact having a contact surface flush with the first face, and wherein the second connector includes a second face, a second positive contact having a contact surface flush with the second face, and a second negative contact having a contact surface flush with the second face.

20. The system of claim 19, wherein the auxiliary electrode forms a ring around at least one of the first positive contact and the second positive contact, the auxiliary electrode having a contact surface that is flush with at least one of the first face of the first connector and the second face of the second connector.