EMPULSER

CONTACTLESS POWER TRANSFER

System and Method for High Speed
Contactless Power Transfer to Drones Using Resonant Loop Arrays.

[redacted]

[redacted] [redacted] [redacted]

[redacted] [redacted] [redacted]

System and Method for High Speed Contactless Power Transfer to Drones Using Resonant Loop Arrays

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Abstract

A system and method for high speed contactless power transfer (CPT) to drones is disclosed. The system comprises a series of resonant transmitter loops mounted on stands, each loop generating a magnetic field for wireless power transfer. A drone, equipped with dual receivers and multiple rectifier circuits, flies through the loops at speeds of up to [redacted] km/h. The receivers capture the magnetic field and convert it to direct current (DC), charging the drone's battery and extending flight time significantly beyond current limitations. The system is scalable, adaptable, and weatherproof, making it suitable for applications in drone racing, delivery and logistics highways, surveillance, and search and rescue operations.

[redacted]

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A system and method for high-speed contactless power transfer (CPT) to drones is disclosed. The system comprises a series of resonant transmitter loops mounted on stands, each loop generating a magnetic field for wireless power transfer. A drone, equipped with dual receivers and multiple rectifier circuits, flies through the loops at speeds of up to [redacted] The receivers capture the magnetic field and convert it to direct current (DC), charging the drone's battery and extending flight time significantly beyond current limitations. The system is scalable, adaptable, and weatherproof, making it suitable for applications in drone racing, delivery and logistics highways, surveillance, charging stations and search and rescue operations.

Background of the Invention

Field of the Invention

The present invention relates to wireless power transfer systems, and more specifically to high speed contactless power transfer (CPT) systems for extending the flight time of drones.

Description of the Related Art

Unmanned aerial vehicles (UAVs), commonly known as drones, have seen widespread adoption in industries such as delivery services, surveillance, agriculture, and search and rescue. However, their operational endurance is severely limited by battery life, with most drones achieving flight times of only a few minutes to an hour before requiring recharging or battery replacement. This limitation is particularly acute for high speed drones, such as those used in racing or emergency applications, where flight times are often measured in seconds.

Existing solutions for extending drone flight time include:

Static wireless charging pads, which require the drone to land and remain stationary for recharging. Battery swapping systems, which are impractical for high speed or continuous operations. Wired power transfer, which restricts the drone's mobility and is unsuitable for dynamic environments.

These solutions fail to address the needs of high speed drones and fluid systems such as logistics, which require continuous, on the fly power transfer without interrupting flight. Prior art in wireless power transfer (WPT) systems, such as inductive or resonant coupling, has focused primarily on low speed or stationary applications. No existing system provides an effective method for powering drones at speeds of [redacted] or higher while maintaining efficiency and safety.

Objectives of the Invention

The primary objective of this invention is to provide a high speed contactless power transfer system that: Extends drone flight time significantly by enabling continuous wireless charging during flight. Supports drone speeds of up to [redacted] making it suitable for racing, logistics and delivery applications. Uses resonant transmitter loops and dual receivers to maximize power transfer efficiency and alignment. Is scalable and adaptable for deployment in various environments, such as racetracks, delivery routes, or surveillance zones. Includes protective measures to ensure durability and safety in outdoor or harsh conditions.

Summary of the Invention

The present invention discloses a system and method for high speed contactless power transfer to drones. The system comprises: A series of resonant transmitter loops mounted on stands, each loop configured to generate a magnetic field for wireless power transfer. The loops are spaced and sized to allow a drone or a series of drones to pass through safely at high speeds.

A drone equipped with dual receivers, each receiver comprising a coil and six rectifier circuits to capture the magnetic field and convert induced alternating current (AC) to direct current (DC).

A power source connected to the transmitter loops to supply an alternating current (AC), creating the magnetic field. Protective casing around the transmitter loops to shield the system from weather and physical impacts.

The dual receivers and rectifier circuits ensure efficient power capture and conversion, even at high speeds. The system is designed to be scalable, allowing for deployment along racetracks, delivery routes, or surveillance zones. The protective casing ensures durability in outdoor environments, while the resonant loop design maximizes power transfer efficiency.

This invention significantly extends drone flight time by providing continuous wireless charging, addressing a critical limitation in current drone technology.

Detailed Description of the Invention

1. Overview of the System

The high speed contactless power transfer (CPT) system is designed to wirelessly power drones as they fly through a series of resonant transmitter loops. The system comprises: Transmitter loops mounted on stands, generating a magnetic field for power transfer. A drone with dual receivers and rectifier circuits to capture and convert the magnetic field into DC power for charging the drone's battery. A power source supplying AC current to the transmitter loops. Protective casing to shield the transmitter loops from environmental factors.

[redacted]

2. Transmitter Loop Design

Structure (FIGS. 1, 2, and 3)

Loop Geometry:

The transmitter loops are hexagonal with a diameter of 0.5 meters or more, allowing drones to pass through safely. The loops are mounted on stands 2 meters above the ground ensuring clearance for the drone's flight path.

Components:

Capacitors [redacted] Distributed along the loop to create a resonant circuit with a predefined frequency [redacted]

Wire Segments [redacted] Conductive wires [redacted] forming the loop structure.

Driving Loops: Smaller loops connected to the power source [redacted] inducing current in the main transmitter loop.

Magnetic Field Generation:

The alternating current (AC) from the power source creates an oscillating magnetic field within the loop.

The magnetic field is strong enough to induce a current in the drone's receivers as it passes through at very high speeds.

Protective Casing

The transmitter loops are enclosed in a weatherproof and impact resistant casing, ensuring durability in outdoor environments.

The casing is designed to not interfere with the magnetic field, allowing efficient power transfer.

3. Drone Receiver Design

Structure (FIGS. 4, 4.A, 4.B, and 4.C)

Dual Receivers:

The drone is equipped with two receivers, embedded in a ducted fan design to minimize aerodynamic interference. Each receiver comprises a coil aligned to capture the magnetic field from the transmitter loops.

Rectifier Circuits:

Six rectifier circuits are positioned around the perimeter of each receiver. The rectifier circuits convert the induced AC current to DC, charging the drone's battery. The multiple rectifier circuits improve current quality and boost power capture efficiency.

Alignment and Efficiency

The dual receivers increase the likelihood of optimal alignment with the transmitter loops, even at high speeds. The rectifier circuits ensure efficient conversion of the induced current, maximizing the power transferred to the drone's battery.

4. Power Source and Operational Flow

Power Source

The transmitter loops are powered by an AC power source [redacted] such as a grid connection, battery, or generator.

The power source supplies alternating current to the driving loops, which induce current in the main transmitter loop.

Operational Steps

The drone enters the transmitter loop at high speed (e.g., [redacted]). The magnetic field within the loop induces an AC current in the drone's receivers. The rectifier circuits convert the AC current to DC, charging the drone's battery. The drone exits the loop and repeats the process with the next loop in the series, ensuring continuous power transfer. In this configuration, there is also an option for the drone to hover and charge if the mission permits it.

5. Applications

The system is scalable and adaptable for various applications:

Drone Racing: Loops can be placed along racetracks to power drones continuously during races. Delivery Services: Loops can be installed at distribution hubs or along delivery routes to extend drone range and payload capacity. Police and emergency services/Surveillance: Loops can be deployed in strategic locations to enable long endurance UAV missions. Search and Rescue: Loops can be used in emergency response zones to increase the operational time of rescue drones.

6. Advantages

Extended Flight Time: Continuous wireless charging significantly increases drone endurance. High Speed Compatibility: Designed for drones traveling at [redacted]/h or higher. Efficiency: Dual receivers and rectifier circuits maximize power capture and conversion. Durability: Protective casing ensures the system operates reliably in outdoor conditions. Scalability: The system can be deployed in various environments and expanded as needed.

7. Example Embodiments

Embodiment 1: Drone Racing

Transmitter loops are placed at intervals along a racetrack. Drones fly through the loops at [redacted]/h, receiving continuous power to maintain speed and extend race duration.

Embodiment 2: Delivery Drones

Transmitter loops are installed at delivery hubs and along routes. Drones receive power during transit, enabling longer ranges and heavier payloads.

Embodiment 3: Police and Emergency Services Surveillance

Transmitter loops are deployed in strategic locations (e.g., risk area or patrol routes). Surveillance drones operate for extended periods without needing to return for recharging.

[redacted]

[redacted]

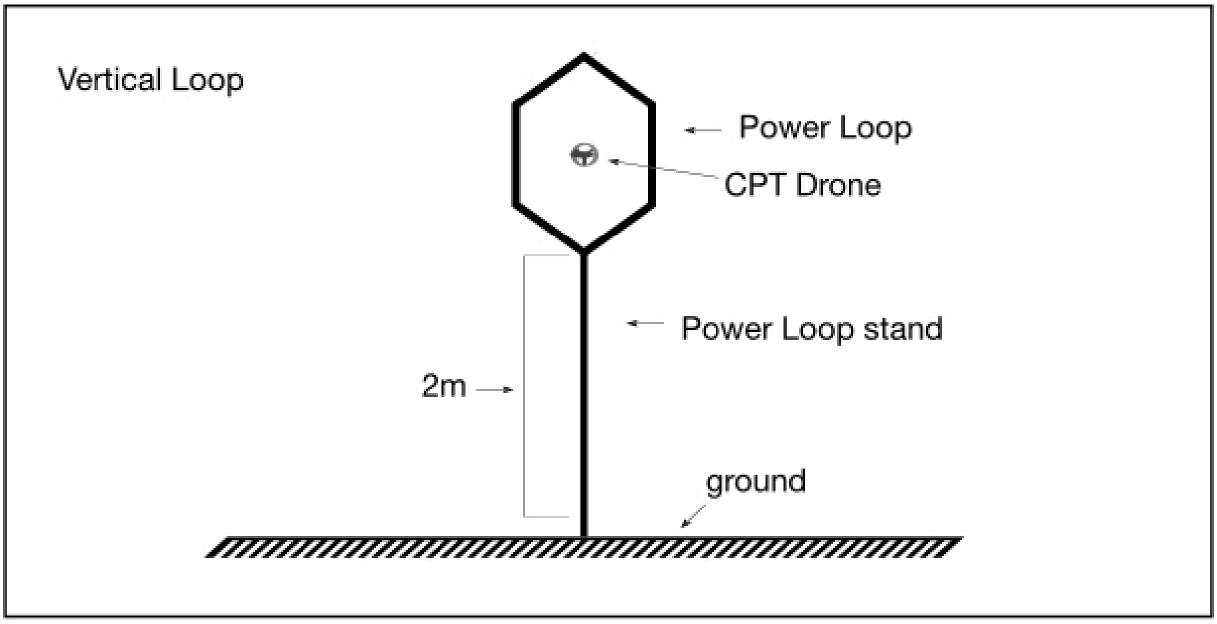
Vertical Loop
Power Loop
CPT Drone
Power Loop stand
2m
ground

FIG 1.

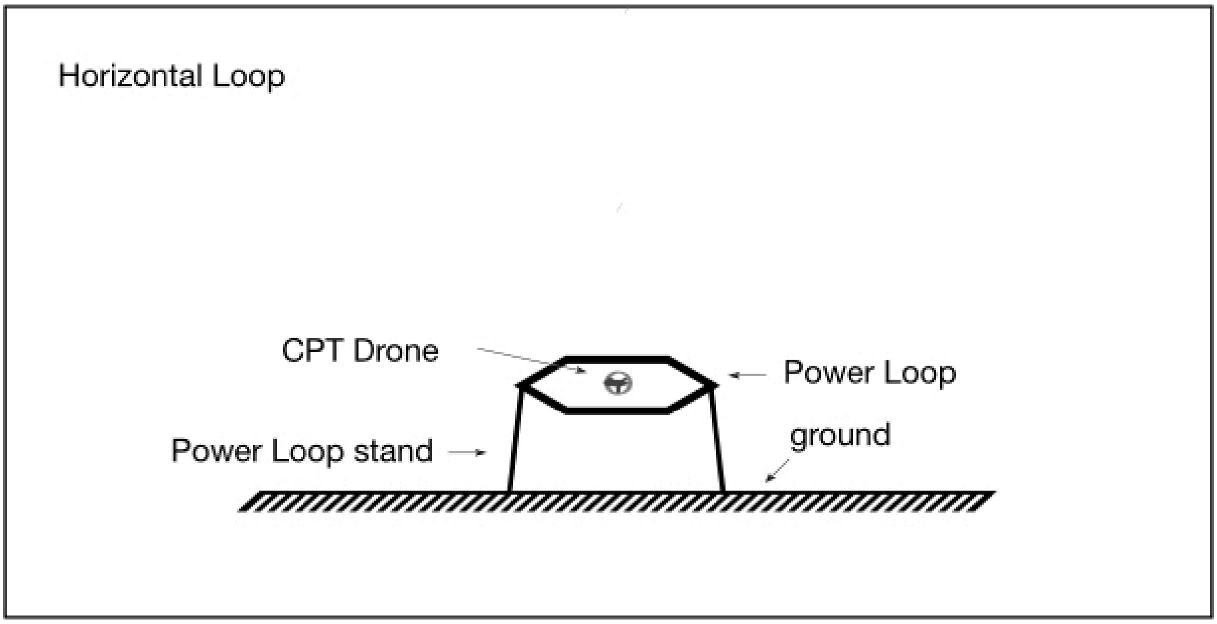
Horizontal Loop
CPT Drone
Power Loop
Power Loop stand
ground

FIG 1.B.

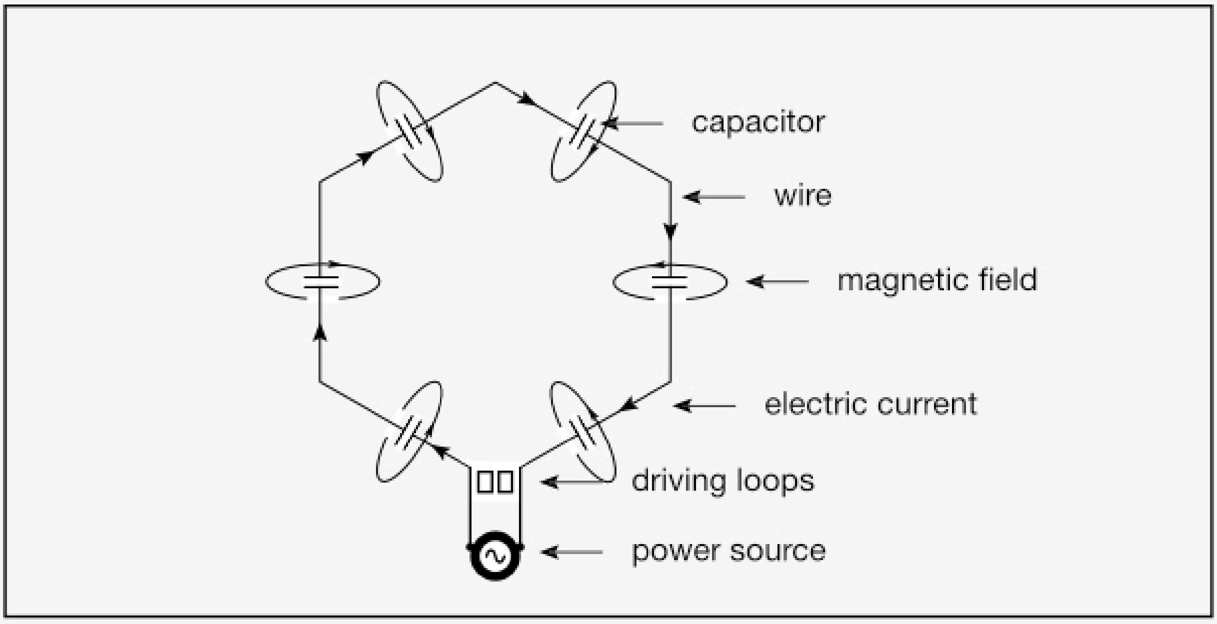
capacitor
wire
magnetic field
electric current
driving loops
power source

FIG 2.

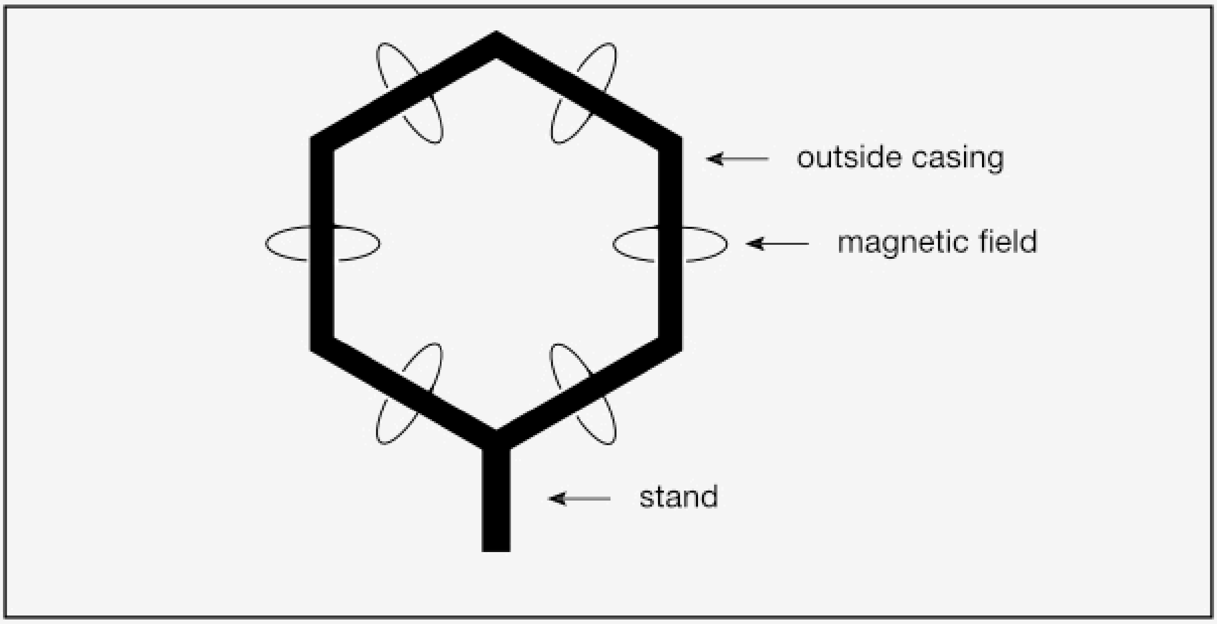
outside casing
magnetic field
stand

FIG 3.

[redacted]

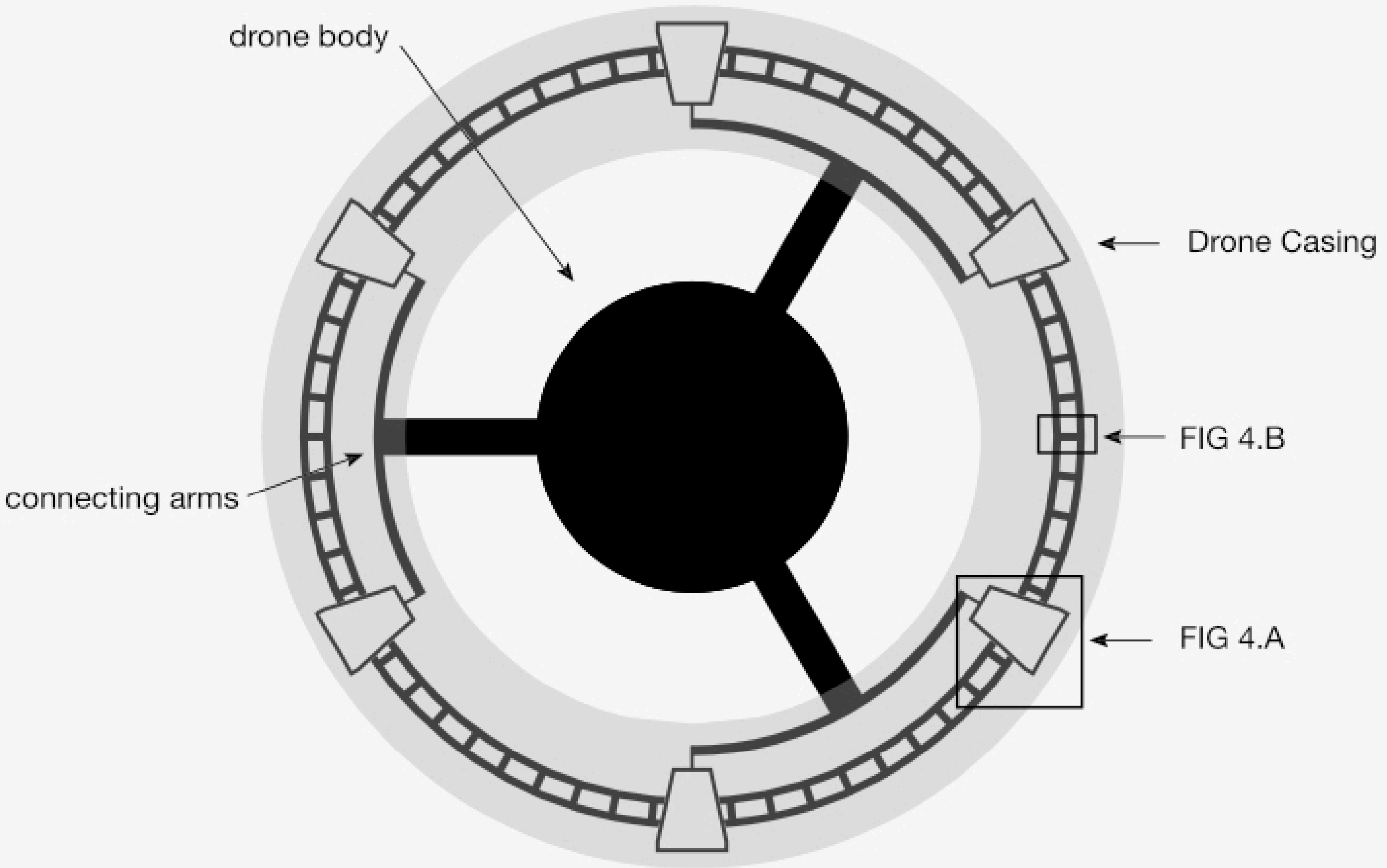

FIG 4.

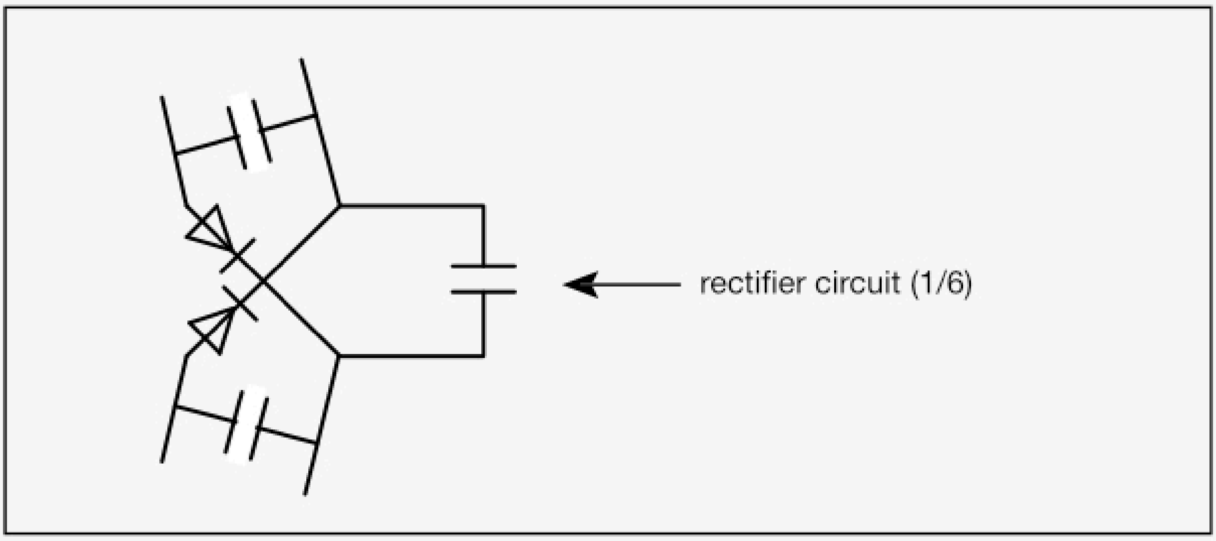

FIG 4.A.

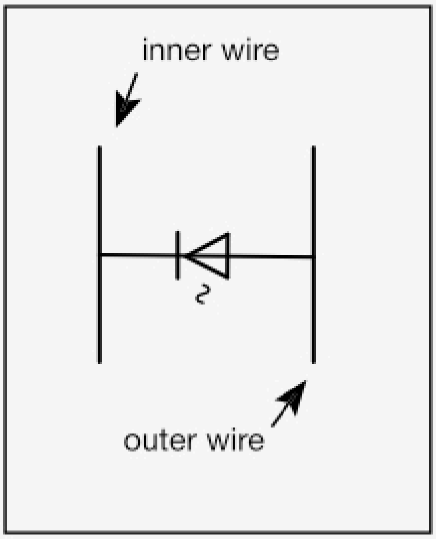

FIG 4.B.

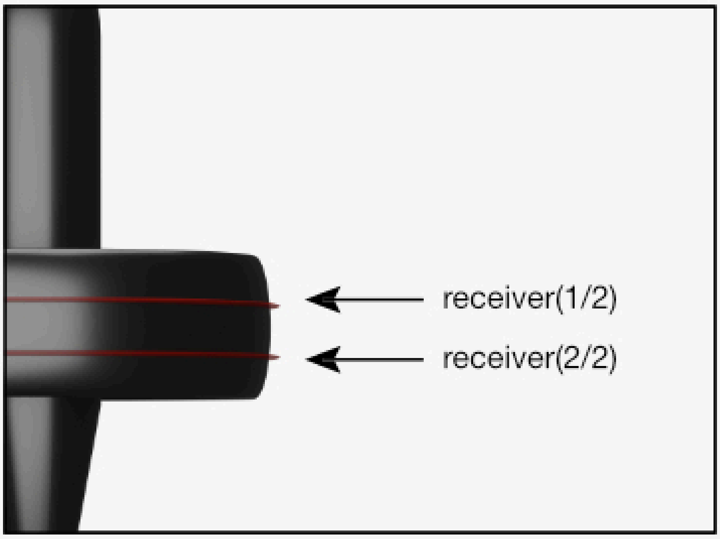

FIG 4.C.

[redacted]

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Contributors

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References

[redacted]