

WHAT IS CLAIMED IS:

1. An eddy current sensor comprising a first detector that detects an eddy current generated in a detection target and a second detector that detects the eddy current, wherein
the first detector includes a first exciting coil configured to generate the eddy current and a first detecting coil configured to detect the eddy current,
the first exciting coil and the first detecting coil are air-core coils or coils with a core of a nonmagnetic material,
the second detector includes a second exciting coil configured to generate the eddy current and a second detecting coil configured to detect the eddy current, and
the second exciting coil and the second detecting coil are coils with a core of a magnetic material,
wherein the first detector is disposed peripherally around the second detector.
2. An eddy current sensor comprising:
a first detector that detects an eddy current generated in a detection target and a second detector that detects the eddy current, wherein
the first detector includes a first exciting coil configured to generate the eddy current and a first detecting coil configured to detect the eddy current,
the first exciting coil and the first detecting coil are air-core coils or coils with a core of a nonmagnetic material,
the second detector includes a second exciting coil configured to generate the eddy current and a second detecting coil configured to detect the eddy current, and
the second exciting coil and the second detecting coil are coils with a core of a magnetic material, wherein
the first detector is disposed between the detection target and the second detector.
3. The eddy current sensor according to claim 1, wherein

a central axis of the first exciting coil, a central axis of the first detecting coil, a central axis of the second exciting coil, and a central axis of the second detecting coil are aligned.

4. The eddy current sensor according to claim 1, wherein

the first exciting coil and the first detecting coil are coils obtained by winding a conductor in a single column with multiple layers or in multiple columns with multiple layers, a column being defined as a direction perpendicular to the detection target, a layer being defined as a direction parallel to the detection target.

5. An eddy current sensor comprising:

a first detector that detects an eddy current generated in a detection target and a second detector that detects the eddy current, wherein

the first detector includes a first exciting coil configured to generate the eddy current and a first detecting coil configured to detect the eddy current,

the first exciting coil and the first detecting coil are air-core coils or coils with a core of a nonmagnetic material,

the second detector includes a second exciting coil configured to generate the eddy current and a second detecting coil configured to detect the eddy current, and

the second exciting coil and the second detecting coil are coils with a core of a magnetic material, wherein

the core of the magnetic material includes

a bottom magnetic material,

a central magnetic material provided in a center of the bottom magnetic material, and

a peripheral magnetic material provided on a periphery of the bottom magnetic material,

the second exciting coil includes a second central exciting coil disposed at the central magnetic material, and

the second detecting coil includes a second central detecting coil disposed at the central magnetic material.

6. The eddy current sensor according to claim 5, wherein
the second exciting coil includes a second peripheral exciting coil disposed at the peripheral magnetic material, and

the second detecting coil includes a second peripheral detecting coil disposed at the peripheral magnetic material.

7. The eddy current sensor according to claim 5, wherein
the bottom magnetic material has a rod shape, and the peripheral magnetic material is disposed at both ends of the rod shape.

8. The eddy current sensor according to claim 1, wherein
the first exciting coil and the first detecting coil are a same coil, or the second exciting coil and the second detecting coil are a same coil.

9. A film thickness detection method using an eddy current sensor, the eddy current sensor comprising a first detector that detects an eddy current generated in a detection target and a second detector that detects the eddy current, wherein the first detector includes a first exciting coil configured to generate the eddy current and a first detecting coil configured to detect the eddy current, the first exciting coil and the first detecting coil are air-core coils or coils with a core of a nonmagnetic material, the second detector includes a second exciting coil configured to generate the eddy current and a second detecting coil configured to detect the eddy current, and the second exciting coil and the second detecting coil are coils with a core of a magnetic material,

the film thickness detection method comprising:

obtaining a film thickness by detecting the eddy current with the first detector when an electrical resistance of the detection target is less than a predetermined value; and

obtaining the film thickness by detecting the eddy current with the second detector when the electrical resistance of the detection target is greater than the predetermined value.

10. A film thickness detection method using an eddy current sensor, the eddy current sensor comprising a first detector that detects an eddy current generated in a detection target and a second detector that detects the eddy current, wherein the first detector includes a first exciting coil configured to generate the eddy current and a first detecting coil configured to detect the eddy current, the first exciting coil and the first detecting coil are air-core coils or coils with a core of a nonmagnetic material, the second detector includes a second exciting coil configured to generate the eddy current and a second detecting coil configured to detect the eddy current, and the second exciting coil and the second detecting coil are coils with a core of a magnetic material,

the film thickness detection method comprising:

obtaining a film thickness by detecting the eddy current with the first detector when the film thickness of the detection target is greater than a predetermined value; and

obtaining the film thickness by detecting the eddy current with the second detector when the film thickness of the detection target is less than the predetermined value.