

CLAIMS

1. An electromagnetic acoustic transducer for exciting ultrasonic vibrations within a test object, said electromagnetic acoustic transducer comprising:

at least one magnet configured to generate a magnetic field;

a fluxguide having a test face for placing against said test object, said fluxguide shaped to receive said magnetic field from said at least one magnet and to direct said magnetic field such that repulsion between magnetic field lines within said fluxguide directs at least part of said magnetic field towards said test face; and

an electrical coil, comprising at least:

an active portion of said electrical coil disposed to cover said test face, wherein within said active portion conductors of said electrical coil are substantially parallel, straight and carrying current in a same direction, and

a further portion of said electrical coil not disposed over said test face, wherein in the further portion conductors of said electrical coil carry current in a different direction to the conductors in the active portion.

2. An electromagnetic acoustic transducer as claimed in claim 1, wherein said electrical coil is a butterfly coil comprising two adjacent spiral coils wound in opposite senses.

3. An electromagnetic acoustic transducer as claimed in claim 2, wherein a medial portion of said butterfly coil between said adjacent spiral coils is said active portion and is disposed between said test face and said test object.

4. An electromagnetic acoustic transducer as claimed in any one of the preceding claims, wherein

said test face has dimensions such that a smallest radius of a circle wholly containing a projection of said test face in a plane normal to a mean direction of magnetic field lines passing through said test face is R_a .

5. An electromagnetic acoustic transducer as claimed in claim 4, wherein

said at least one magnet has dimensions such that a smallest radius of a circle wholly containing a projection of said at least one magnet in said plane is R_b ; and

R_a/R_b is in the range 0.2 to 0.8.

6. An electromagnetic acoustic transducer as claimed in claim 4, wherein R_a/R_b is in the range 0.45 to 0.55.

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7. An electromagnetic acoustic transducer as claimed in any one of claims 4, 5 and 6, wherein R_a is in the range 2.5mm to 25mm.

8. An electromagnetic acoustic transducer as claimed in claim 7, wherein R_a is in the range 5mm to 10mm.

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9. An electromagnetic acoustic transducer as claimed in any one of claims 4 to 8, wherein said fluxguide has a height normal to said plane of H and H is in the range of one of; $0.2R_a$ to $10R_a$; and R_a to $4R_a$.

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10. An electromagnetic acoustic transducer as claimed in claim 9, wherein H is in the range 5mm to 50mm.

11. An electromagnetic acoustic transducer as claimed in any one of the preceding claims, wherein said at least one magnet has one or more magnet faces proximal to said fluxguide and said magnetic field passes between said one or more magnet faces and said fluxguide in respective directions that are non-normal to said test face.

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12. An electromagnetic acoustic transducer as claimed in any one of the preceding claims, wherein said repulsion of said magnetic field lines increases flux density within said fluxguide and said test face above that within said at least one magnet.

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13. An electromagnetic acoustic transducer as claimed in claim 12, wherein flux density within said fluxguide and said test face is more than double flux density within said at least one magnet.

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14. An electromagnetic acoustic transducer as claimed in any one of the preceding claims, wherein said fluxguide has a shape of a prism or frustum and said test face is polygonal base face of said prism or frustum.

15. An electromagnetic acoustic transducer as claimed in claim 14, wherein said polygonal base face is an N sided polygon, where N is in the range 4 to 8.

16. An electromagnetic acoustic transducer as claimed in any one of the preceding claims, comprising a housing surrounding said at least one magnet and said fluxguide, said housing having a magnetic permeability μ , where μ is less than $2\mu_0$ and μ_0 is the permeability of free space.

17. A method of exciting ultrasonic vibrations within a test object using an electromagnetic acoustic transducer, said method comprising the steps of:

placing a fluxguide with a test face against said test object;

generating a magnetic field with at least one magnet;

receiving in said fluxguide said magnetic field from said at least one magnet; and

directing said magnetic field within said fluxguide such that repulsion between magnetic field lines directs at least part of said magnetic field towards said test face;

providing at least an active portion of an electrical coil disposed to cover said test face and a further portion of said electrical coil not disposed over said test face, wherein within said active portion conductors of said electrical coil are substantially parallel, straight and carrying current in a same direction, and in the further portion conductors of said electrical coil carry current in a different direction to the conductors in the active portion; and

driving an electric current through said coil to excite substantially mode pure and uni-directionally polarised shear wave in said test object.