PATENT SPECIFICATION (11) 1 601 977

1 601 977

(21) Application No. 23484/78 (22) Filed 26 May 1978 (19)
(31) Convention Application No 2 725 354 (32) Filed 4 June 1977 in
(33) Fed. Rep. of Germany (DE)
(44) Complete Specification published 4 Nov. 1981
(51) INT. CL.³ G01N 27/90
(52) Index at acceptance
G1N 19B1B 19B2F 19D2 19H1X

(54) A TESTING HEAD FOR THE INDUCTIVE SURFACE TESTING OF A METAL WORKPIECE

(71) We, SKF KUGELLAGERFABRIKEN GESELLSCHAFT MIT BESCHRANKTER HAFTUNG, a German Body Corporate, of 8720 Schweinfurt, Ernst-Sachs-Strasse 2-8, German Federal Republic, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a testing head for the inductive surface testing of a metal workpiece.

In one aspect the invention provides a testing head for the inductive surface testing of a metal workpiece, which head comprises a support having a plurality of bores and eddy current probes located one in each of the bores, the bores and probes being arranged side by side, each probe comprising a single ferrite core rod surrounded by a coil suitable for connection as part of a resonant circuit, the support having a surface intended, in use of the head, to face the workpiece and the axis of each coil extending substantially normally to the said surface, the support being of a material which is electrically conductive and/or magnetically permeable.

One end of each ferrite core and the said surface of the support may lie in a common plane.

The support may have a plurality of recesses, one for each bore and extending substantially normally to the said surface of the support.

The recesses may open one into each bore.

The radial distance between the cylindrical surface of one ferrite core and the nearest adjacent ferrite core may be less than the diameter of the said one ferrite core.

The support may be of brass.

In another aspect the invention provides a testing head for inductive surface testing of metal workpieces, comprising eddy-current probes disposed in bores arranged side by side in a bearing member, each probe being at least part of a resonant circuit and comprising a single-layer or multi-layer coil having a single ferrite core rod, the coil axis being arranged to be, when in use, substantially perpendicular to the surface of the workpiece, characterised in that the bearing member is made of an electrically conductive and/or magnetically permable material. As a result, electromagnetic fields occur in the bearing member and increase the resonance frequency of the resonant circuits in the individual probes and thus surprisingly improve the testing of the entire surface of the workpiece, i.e. the induction field of the punctiform eddy-current probes can be sensitively detected in almost its full strength, even between the probes.

According to a feature of an embodiment of the invention, the ends of the ferrite cores facing the workpiece when in use and the end face of the bearing member facing the workpiece when in use lie in a common plane. As a result of the last-mentioned feature, the ferrite cores in the bearing member can be disposed alongside and close to the surface of the workpiece in order to produce a strong induction field which can be sensitively recorded. The attenuating effect of the electrically conductive and/or magnetically permeable material in the bearing member simultaneously prevents interference to the fault indication caused by the approaching and receding movements of the workpiece surface, e.g. as a result of irregularities in the shape of the workpiece moving under the testing head.

According to another feature, the bearing member has slot-like recesses extending at right angles to the surface of the workpiece when in use in the neighbourhood of the eddy-current probes. According to other features, the recesses extend in the direction in which the surface of the workpiece moves relative to the bearing member, when in use, and each recess opens into the appropriate bore receiving the eddy-current probe. The recesses form an air gap which prevents eddy-currents being generated around the coils and damaging the bearing member by heating it, since the coil in-

duction field is not short-circuited in the bearing member. As a result of the recesses, the individual resonant circuits in the probes are also electromagnetically decoupled to some extent, thus increasing the sensitivity of detection, particularly in the case of differentially connected eddy-current probes.

According to another feature of an embodiment of the invention, the distance between eddy-current probes is considerably less than the diameter of the ferrite cores. This results in a strong surface induction field under the test head; the field intensity varies only slighty between adjacent probes, so that longitudinal and transverse faults in the workpiece surface can be detected very accurately.

According to a final feature, the bearing member can be made of brass.

The invention will now be described with reference to an embodiment shown in the accompanying drawings, in which:

Figure 1 is a view of the end face of a testing head according to the invention, on the side facing and workpiece, and

Figure 2 is a partical longitudinal section along line A—A of the testing head in Figure 1.

Figures 1 and 2 show a bearing member or support 1 made of electrically conductive brass secured in a plastics holder 2. Member 1 is formed with five cylindrical bores 3 at right angles to the direction of motion (arrow 4) of the workpiece surface 5 (chain-dotted in Fugure 2). Each bore 3 contains an eddy-current probe 6 forming part of a separate resonant circuit. Each probe 6 has a single-layer coil 7 having a ferrite core rod 8, its axis 9 extending at right angles to the surface 5 of the workpiece.

The ends of cores 8 facing the workpiece and the end faces of bearing member 1 facing the workpiece lie in a common plane 10 alongside and close to the surface 5. Advantageously surface 10 is ground flat after coils 7 and cores 8 have been secured in bores 3, e.g. by sticking.

Bearing member 1 has slot-like recesses 11 extending at right angles to surface 5 and in the direction of motion of surface 5 relative to member 1, one slot 11 opening into each cylindrical bore 3 having a probe 6.

The distance between the probes 6 is less than the diameter of the ferrite cores 8, which may be only 0.8 mm. In addition, probes 6 are disposed in a staggered array or zig-zag at an angle to the direction of motion (see arrow 4) so that the entire surface 5 of the workpiece can be probed and tested, although punctiform eddy-current probes 6 are incorporated in member 1.

Preferably the individual probes have a resonance frequency approximately equal to the testing frequency. In known manner, they can operate in pairs (differentially with a bridge circuit between each two coils) and can be equipped with individual amplifiers.

In Figure 2, the cables 12 of each coil 7 extend upwards from bores 3 and are secured to holder 2 at a solder union 13.

The testing head according to the invention has a great advantage in that it probes the entire surface of the workpiece and is very sensitive to longitudinal and transverse faults and does not have to be driven in reciprocation.

Modifications to the described embodiment are possible, for example, eddy-current probe coils 7 can be multi-layer. Instead of brass, a different electrically conductive and/or magnetically permeable material can be used for the bearing member, provided it attenuates the individual resonant circuits in the desired manner and is also adapted to the workpiece material (e.g. ball-bearing steel) so that the measurements are not sensitive to approaching of receding movements of the surface.

WHAT WE CLAIM IS:—

1. A testing head for the inductive surface testing of a metal workpiece, which head comprises a support having a plurality of bores and eddy-current probes located one in each of the bores, the bores and probes being arranged side by side, each probe comprising a single ferrite core rod surrounded by a coil suitable for connection as part of a resonant circuit, the support having a surface intended, in use of the head, to face the workpiece and the axis of each coil extending substantially normally to the said surface, the support being of a material which is electrically conductive and/or magnetically permeable.

2. A testing head as claimed in Claim 1, wherein one end of each ferrite core and the said surface of the support lie in a common plane.

3. A testing head as claimed in Claim 1 or 2, wherein the support has a plurality of recesses, one for each bore and extending substantially normally to the said surface of the support.

4. A testing head as claimed in Claim 3, wherein the recesses open into each bore.

5. A testing head as claimed in any preceding claim, wherein the radial distance between the cylindrical surface of one ferrite core and the nearest adjacent ferrite core is less than the diameter of the said one ferrite core.

6. A testing head as claimed in any preceding claim, wherein the support is of brass.

7. A testing head substantially as herein described with reference to and as shown in the accompanying drawings.

8. A testing head for inductive surface testing of metal workpieces, comprising eddy-current probes disposed in bores arranged side by side in a bearing member, each probe being at least part of a resonant circuit and comprising a single-layer or multi-layer coil having a single ferrite core rod, the coil axis being arranged to be, when in use, substantially perpendicular to the surface of the workpiece, characterised in that the bearing member (1) is made of an electrically conductive and/or magnetically permeable material.

9. A testing head according to Claim 8, characterised in that the ends of the ferrite cores (8) facing the workpiece when in use and the end face of the bearing member (1) facing the workpiece when in use lie in a common plane (10).

10. A testing head according to Claim 8 or 9, characterised in that the bearing member (1) has slot-like recesses (11) extending at right angles to the surface (5) of the workpiece when in use in the neighbourhood of the eddy-current probes.

11. A testing head according to Claim 10, characterised in that the recesses (11) extend in the direction in which the surface (5) of the workpiece moves relative to the bearing member (1) when in use.

12. A testing head according to Claim 11, characterised in that each recess (11) opens into the appropriate bore (3) receiving the eddy-current probe (6).

13. A testing head according to any one of the preceding Claims 8 to 12, characterised in that the distance between eddy-current probes (6) is considerably less than the diameter of the ferrite cores (8).

14. A testing head according to any one of the preceding Claims 8 to 13, characterised in that the bearing member (1) is made of brass.

BOULT, WADE & TENNANT,
27 Furnival Street,
London EC4A 1PQ.

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1981.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY,
from which copies may be obtained.

1601977 COMPLETE SPECIFICATION
1 SHEET This drawing is a reproduction of the Original on a reduced scale

FIG. 1.

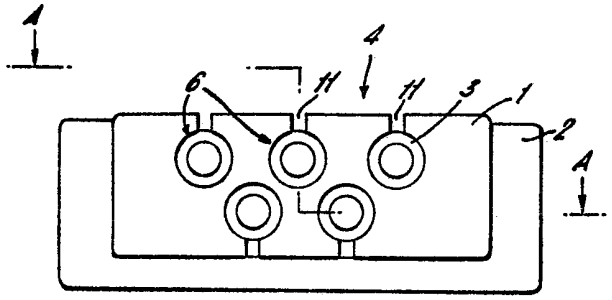

FIG. 2.

