LAMINATED MAGNETOSTRICTIVE TRANSDUCER APPARATUS

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Filed Mar. 15, 1967, Ser. No. 623,348
Int. Cl. H04R 15/00

ABSTRACT OF THE DISCLOSURE

A transducer assembly in which a plurality of thin corrugated magnetostRICTive elements are vibratory coupled at their one end to a radiating plate and arranged such that the laminations abut one another in space-separated stacks, each stack comprising two or more laminations in which the respective corrugations nest within one another, and alternate stacks being reversed in direction for abutment of stack corrugation ridges to obtain substantial adjacent stack separation.

BACKGROUND OF THE INVENTION

Field of the invention.—Magnetostrictic transducer apparatus for ultrasonic agitation of a liquid.

Description of the prior art.—Ultrasonic transducer apparatus in which thin magnetostrictic laminations are bonded to a radiating plate with distributed spacing between each lamination, as disclosed in U.S. Patents 3,161,792 and 3,173,037, are being employed with considerable success in most instances; the latter patent disclosing use of corrugation containing laminations arranged to obtain self-spacing between each adjacent laminations. Under certain circumstances, such as where the liquid volume being ultrasonically vibrated by the radiating plate contains a high volume of solid material, such as workpiece parts to be cleaned in an ultrasonic bath, or where the liquid bath contains gas or air bubbles, the performance of such transducer apparatus tends to become degraded according to the degree such conditions prevail.

SUMMARY

According to the present invention improved performance of a spaced lamination magnetostrictic transducer is obtained by a novel arrangement of the self-separating type of laminations containing corrugations or ribs as shown in U.S. Patent 3,173,037, for example wherein the laminations are bonded to the radiating plate in spaced-apart stacks of two or more, often three, where the respective corrugations of the several laminations of each stack nest within one another, and the series of stacks in a particular array alternate in direction of facing to obtain self-separation by abutment of stack corrugation ridges.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an end elevation view of an exemplified lamination array bonded to a radiating plate which is shown in cross-section; and

FIG. 2 is a fragmentary bottom view in outline of the array of FIG. 1, showing details of the array of self-spaced stacks of corrugation-containing laminations in accord with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing, the transducer apparatus of the present invention comprises a radiating plate 5 for subjection to a liquid, such as a cleaning fluid, to impart vibrations thereto for cavitation as in ultrasonic cleaning of parts immersed in such liquid, for example. Often such radiating plate will constitute the bottom of a cleaning tank and at other times may constitute the vibratory wall of an immersible transducer disposed within a separate liquid-containing tank. Vibratory coupled at their one edge to the bottom, or, driven side, of the radiating plate 5, as by epoxy cement 7, are a plurality of thin (less than six mils, for example) laminations 8 of magnetostrictic material (nickel, for example) each of which is formed to have one or more corrugations 10, or other bends, which extend along the length. On one face of each lamination a respective corrugation represents an indentation and on the opposite face such corrugation represents a raised part or rib. In accord with the present invention, the laminations are ranged in groups 12 of two or more, three being exemplified in the drawing, which face mutually in the same direction such that the corrugation 10 or corrugations 10 of the several laminations of each group nest in one another and provide substantial abutment between such grouped laminations, and the groups are alternated in their facing directions, wherein one group abuts another along corrugation areas that provide separation spaces 13 between substantial portions of adjacent groups.

It is to be noted that the laminations 8 in each stack or group 12 has been shown as having corresponding nested corrugations of different sizes and with right-angled edges. This is merely by way of simplifying a showing of such nesting. In practice, all laminations 8 may be made of the same shape and proportions, and nesting is readily accomplished by exerting a compressing force to oppose ends of an overall array of suitably arranged stacked groups 12; the yieldability of the laminations, due to thinness and ductility, enabling sufficient deformation to accommodate the desired nesting.

In accord with the practice set forth in Patent 3,173,037, each lamination has a pair of spaced-apart slots 15 which are aligned in each stacked array of laminations 8 to accommodate the energizing coil (not shown herein) for such array to obtain the vibratory response of such laminations and hence vibration of the radiating plate 5.

I claim as my invention:

1. A transducer assembly comprising a radiating plate for subjection to a liquid to which vibration is to be imparted, a plurality of thin magnetostrictic laminations each having at least one longitudinal corrugation therein and each bonded at its one edge to said radiating plate, said laminations being arranged in a series of alternately-facing corrugation-ridge abutting groups of corrugation-nested laminations having substantial abutment between the laminations of each group and space separating substantial portions of each adjacent group.

2. The transducer assembly of claim 1, wherein the laminations have equally-proportioned respective convolutions and are made of ductile nickel less than six mils thick.

References Cited

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U.S. Cl. X.R.

259—1

Patented July 29, 1969