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2,438,916

WORK HOLDING NEST

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FIG. 1.

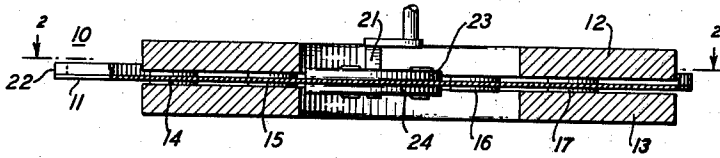


FIG. 2.

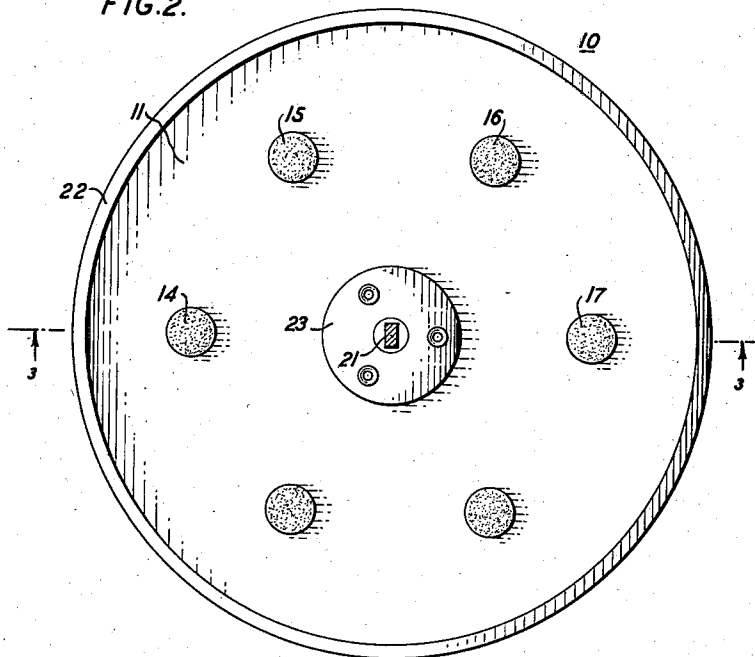


FIG. 3.

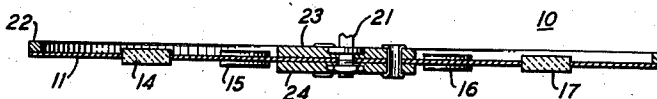
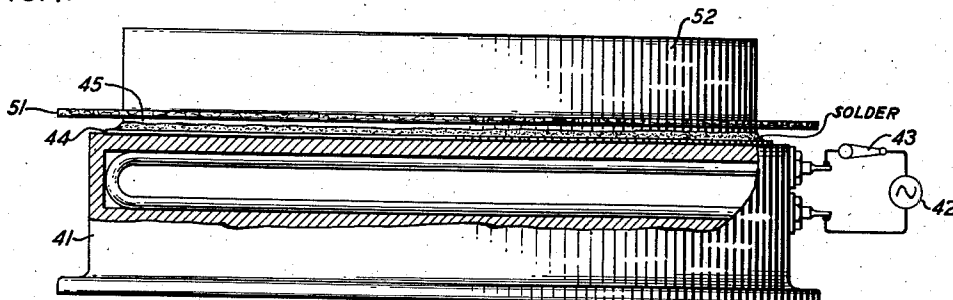


FIG. 4.



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WORK HOLDING NEST

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3 Claims. (Cl. 51-161)

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This invention relates to a lapping mechanism and, more particularly, to a work holding nest for use in such a mechanism.

An object of the invention is to facilitate the production of very thin elements such as piezoelectric crystal plates.

A more specific object of the invention is to facilitate the simultaneous grinding of both major surfaces of a plurality of very thin elements such as piezoelectric crystal blanks.

It is well known that in the production of certain elements, an example of which is quartz piezoelectric crystal plates, it is usual at one or more stages in the production to make use of a grinding procedure known as lapping; this procedure commonly involves simultaneously lapping the upper and lower surfaces of a plurality of elements and involves rotating the elements between two superposed abrasive discs or laps. The elements are usually moved around between the two stationary laps by means of a work holder in the form of a flat plate, usually referred to as the nest. In order that the elements or "work" may project both above and below the surface of the nest for engagement with the abrading surfaces of the upper lap and lower lap respectively, it is obvious that the thickness of the nest must be substantially less than that of the work. At the same time the nest must have sufficient strength and rigidity to withstand the stresses set up when it is being rotated in its fully loaded condition.

In the instances of the production of a certain type of quartz piezoelectric plate the problem is encountered of lapping the crystal blanks down to a thickness of 0.1 millimeter (.004 inch). The need for a nest much thinner than any used successfully heretofore and yet having the necessary strength and rigidity to perform satisfactorily under conditions of mass production is immediately apparent.

In accordance with a feature of the present invention the thin metal plate of a lapping nest is maintained in a stretched condition thereby resulting in the required combination of thinness with rigidity.

In accordance with a specific embodiment of the invention, a novel lapping nest comprises a thin stretched metal plate provided with properly shaped and dimensioned apertures for receiving the elements to be ground. The plate is secured at its periphery to a metal ring, being maintained in a stretched condition by said ring. A centrally located hub is provided on the nest for coupling to the driving arm. Preferably the

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plate is formed of a metal having a substantially higher coefficient of thermal expansion than that of the metal from which the ring is formed. This permits formation of the stretched nest by a method which comprises the general steps of first heating both plate and ring to a predetermined, relatively high temperature, then attaching the plate to the ring and allowing the combination to cool down to room temperature. The plate is expanded by the heating considerably more than is the ring due to the difference in the respective expansion coefficients so that as the combination is cooled down to room temperature the plate is stretched on the ring like a drumhead with all bulges, bends and indentations removed.

By following the novel procedure contemplated by the invention, nests as thin as 0.05 millimeter (0.002 inch) have been produced and used successfully under conditions of mass production.

A complete understanding of the arrangement contemplated by the present invention and appreciation of the various advantageous features thereof may be gained from consideration of the following detailed description and the attached drawings in which:

Fig. 1 is a sectional view showing a nest of the type contemplated by the present invention, positioned between the upper and lower laps of a typical lapping mechanism;

Fig. 2 is a plan view of the nest taken on line 2-2 of Fig. 1;

Fig. 3 is a sectional view of the nest taken on line 3-3 of Fig. 2; and

Fig. 4 is a view of an arrangement which may be utilized in the assembly of the nest.

Referring now to the drawings, nest 10, which includes nest plate 11, is shown in Fig. 1 in operative position between upper lap 12 and lower lap 13. A number of elements 14, 15, 16 and 17, which we will assume for example are thin quartz piezoelectric crystal wafers, are shown positioned in the nest. In accordance with the usual lapping practice, nest 10 is rotated while laps 12 and 13 are stationary. Force for rotating the nest is applied through crank 21 from a suitable source not illustrated. As is well understood, the shape of the crank may be varied and the nature of the driving force may likewise be modified in various ways in order to bring about various desirable motions of the nest.

As nest 10 is rotated the elements 14, 15, etc., with which the nest is loaded, are moved about, their upper surfaces being in contact with and ground by the abrading face of lap 12 and their lower surfaces being similarly in contact with and

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ground by the opposed abrading face of lap 13. It will be readily apparent from Fig. 1 that in order to permit this simultaneous grinding of both upper and lower surfaces of the elements 14, 15, etc., the thickness of nest plate 11 must be definitely less than that of the elements in order to permit said elements to extend both above and below the nest plate. It will be apparent further that the nest must have sufficient strength to withstand the stresses set up when it is rotated in loaded condition; the resistance offered to this rotation increases as the grinding progresses, that is, as the surfaces of the elements are brought into closer and closer conformity to the opposed abrading faces of the laps. It will be apparent further from Fig. 1 that the nest must have sufficient rigidity to assure maintenance of its position exactly midway between the upper and lower laps, that is, the nest plate must not sag at any point and it must likewise be entirely free of bulges. This is a particularly exacting requirement where extremely thin elements are being ground.

According to the features of the present invention the required thinness with extreme rigidity of plate 11 is achieved through the novel expedient of maintaining said plate 11 in a stretched condition. The plate is maintained in the tensioned condition by ring 22 to which it is attached (a preferred method of assembling the plate and ring will be described subsequently).

Two hubs 23 and 24, riveted to plate 11 at the center, provide means for attachment of driving crank 21.

Suitable holes are provided in plate 11 for reception of the quartz wafers or other elements to be ground. The shape of these holes will depend upon the shape of the elements being ground. In the present case round holes have been illustrated for reception of round elements; rotatable eyelets may be fitted in the holes if desired to provide free relative movement between the elements and the plate. If desirable pentagonal openings may be provided when square or rectangular elements are to be carried in the nest.

A preferred method of preparing the nest assembly whereby the carrier plate is maintained in a tensioned or stretched condition will now be described with particular reference to Fig. 4.

An electrical heater 41 of the hot plate type is illustrated schematically in Fig. 4 together with current source 42 and switch 43 for controlling the heater circuit.

A metal sheet 44 having a thickness of the order of one-half the thickness of the elements to be ground is first selected. Applicant has found a phosphor bronze sheet suitable for his purpose and it will be assumed for purposes of illustration that sheet 44 is of phosphor bronze although other suitable metals may be used. Sheet 44 should be slightly larger than the contemplated size of the completed nest, for example, in producing a nest seven inches in diameter a sheet seven and one-half inches square may well be used. The sheet selected must be of uniform thickness and free of bows, warp or buckle. The sheet should be rolled to obtain proper tensile strength.

A ring of solder flux about three-quarters of an inch in width is provided on one surface of sheet or plate 44 extending to about one-quarter inch from the edges of the sheet.

Nest ring 45, which in the present instance

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will be assumed to be steel, is now prepared by heavily tinning one face with solder. While in the operation flux may be permitted to overflow the outer side of the ring, the inner surface thereof should be kept free of the flux.

Plate 44 is now placed on heater 41, as shown in Fig. 4, with the surface carrying the ring of flux uppermost. Nest ring 45 is next placed on plate 44 in the approximate center of the flux ring, the solder-bearing face of the ring being down.

Switch 43 is now closed to energize heater 41 and the ring and plate are heated to approximately 238° C. until the solder melts and sweats to plate 44. Solder is now flowed around the outside of ring 45 as indicated in Fig. 4.

It should be noted that at this point plate 44 has expanded considerably more as a result of the heating than has ring 45 this being due to the fact that the coefficient of thermal expansion of phosphor bronze is substantially higher than that of steel.

Asbestos plate 51 is now rested on the upper face of nest ring 45, and block 52, weighing in the neighborhood of twenty pounds, is in turn placed on plate 51. Switch 43 is then moved to open position to interrupt the energizing circuit of heater 41. Ring 45 and plate 44 are now cooled down sufficiently to cause the solder to be thoroughly set, block 52 being left in position and other steps being taken to assure firm contact between the ring and plate 44 during this initial cooling.

After the solder has thoroughly solidified, the weight 52 is removed and the assembly of ring and plate is allowed to cool down to room temperature after which asbestos plate 51 is removed. The assembled ring and plate are then removed from heater 41 and the excess portion of plate 44, i. e., the portion extending beyond the outer edge of ring 45, is trimmed away.

It was pointed out above that at the end of the heating period plate 44 had expanded considerably more as a result of the heating than had ring 45, this being due to the difference in the respective coefficients of thermal expansion. It will be apparent, therefore, as the plate is attached to the ring while in this relatively more expanded condition, that as the assembly is cooled, ring 45 will reach its normal, stable condition while plate 44 is still in a partly expanded condition. Plate 44 is held in this stretched condition by ring 45, a position in which practically all bulges, bends and indentations are removed and in which the plate is very rigid and capable of withstanding considerable handling without damage.

Plate 44 in its tensioned condition may be likened to a drumhead.

After the excess portion of plate 44 has been trimmed away as outlined above, the holes for reception of the elements to be lapped may be punched or drilled in the plate and the hub portions, for reception of the driving crank, attached thereto by riveting or other suitable method.

Nest plates as thin as 0.002 inch have been produced by the above method which have been found to be capable of standing up under the conditions encountered in the production of quartz crystal plates on a mass production basis. The nests, as produced, have the required rigidity to stand up under the stresses set up when the nest is rotated in the lapping mechanism in a fully loaded condition. Further, the nests present a truly flat surface without bulges or

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bends and maintain exactly the required central position between the upper and lower laps.

While certain specific embodiments of the invention have been selected for detailed description, the invention is not limited in its application to such embodiments. For example, different metals from those described may be utilized for the ring and the plate if they have suitable characteristics and a different method of stretching the metal plate may be followed. In short, the embodiments disclosed should be taken as illustrative of the invention and not as restrictive thereof.

What is claimed is:

1. In a lapping mechanism, a work holding nest comprising a circular metallic plate and a metallic ring attached to the periphery of said plate for maintaining it under tension, said plate being of a metal with a coefficient of thermal expansion substantially greater than that of said metallic ring.

2. In a lapping mechanism, a work holding nest comprising a stretched circular plate of phosphor bronze and a steel ring attached to the periphery of said plate for maintaining it under tension.

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3. In a lapping mechanism, a work holding nest comprising a metallic plate that has been expanded by heating to a definite temperature, and means attached to the outer edge of said plate effective to maintain said plate in a tensioned condition upon cooling, said means having been heated to said definite temperature before being attached to said plate and being of a metal, the coefficient of thermal expansion of which is substantially less than that of said plate.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,486,337	Hoke	Mar. 11, 1924
1,486,341	Hoke	Mar. 11, 1924
1,509,823	Blood	Sept. 30, 1924
1,541,003	Smith	June 9, 1925
1,541,865	Smith	June 16, 1925
2,410,752	Sells et al.	Nov. 5, 1946