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F. J. KENT

2,375,003

METHOD OF LAPPING

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2 Sheets-Sheet 2

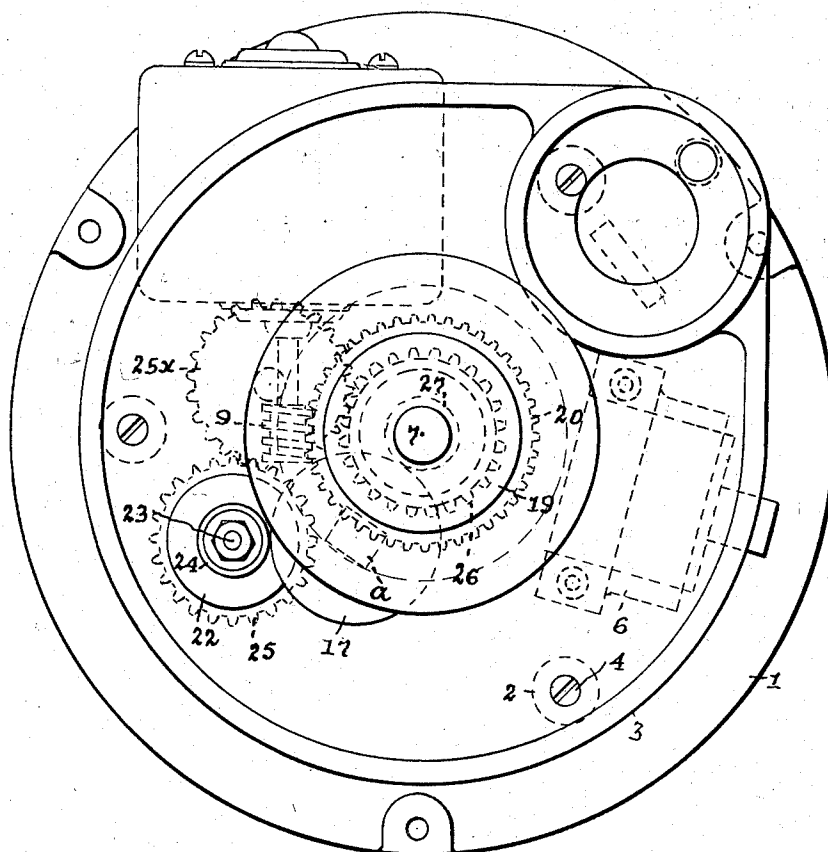


Fig. 2.

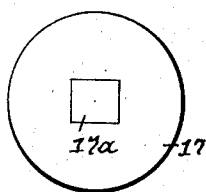


Fig. 4.

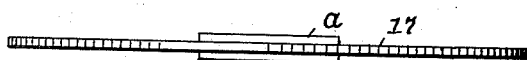


Fig. 4a.

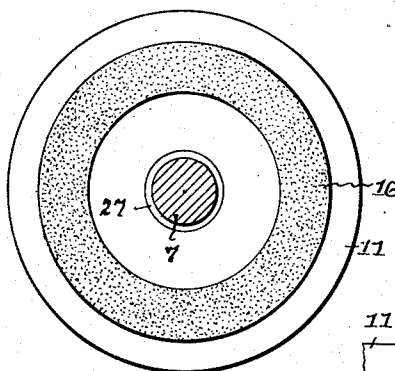


Fig. 3.

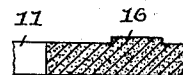


Fig. 3a.

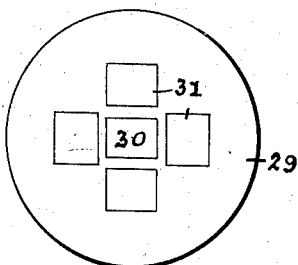


Fig. 5.

BY

INVENTOR,
Frederick J. Kent
John Steward,
ATTORNEY.

UNITED STATES PATENT OFFICE

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METHOD OF LAPPING

Frederick J. Kent, Glen Rock, N. J., assignor to
Sipp-Eastwood Corporation, Paterson, N. J.,
a corporation of New York

Application January 16, 1943, Serial No. 472,605

1 Claim. (Cl. 51—118)

This invention relates to the art of lapping and it consists in a novel method of lapping applicable especially in the case where, as in lapping quartz crystals, a quite uniform distribution of the attrition over the face of the work is required.

I illustrate my invention in the accompanying drawings by reference, merely for example, to a particular apparatus, and in said drawings

Fig. 1 is a side elevation of the apparatus or machine;

Fig. 2 a plan thereof;

Fig. 3 a plan of the abrading side of, say, the lower lap;

Fig. 3a a fragmentary sectional view of a lap;

Figs. 4 and 4a are, respectively, a plan and a side elevation of one form of the work-holder;

Fig. 5 is a plan of a modified form thereof;

Fig. 6 is an elevation of the peak portion of the machine, as seen from the right in Fig. 1; and

Fig. 7 is a side elevation of a portion of the main shaft.

A frame is formed by a base 1, standards 2 and a table 3 rigidly held together by screws 4. On the base are an electric motor 5 and a switch 6 for controlling the motor. A main shaft 7 is stepped in a socket 1a of the base on a ball-bearing 8 and has a bearing in the table, being confined by the base and table to a fixed axis of rotation therein. By a worm 9 on the motor shaft and a worm-wheel 10 on the main shaft, inter-gearred with each other, such shaft is driven by the motor.

A lower disk or lap 11 has an integral depending half-hub 11a which coacts with another half-hub 12, when the two such half-hubs are secured together by screws, as 13, to clamp the lower lap rigidly to the main shaft, the latter being perpendicular to the upper or abrading side of the lap, or at least to its actual abrading surface, and central thereof.

14 is the upper lap having an elongated up-standing hub 14a which at each of its upper and lower ends, as at 15, obtains a limited bearing on the shaft, the lower side of lap 14, or at least its actual abrading surface, being thus confined to parallelism with the actual lapping surface of the lower lap as well as concentric and coincident therewith.

The actual lapping surface of each lap is a relief surface in the sense to be indicated and such as is shown at 16 in Figs. 3 and 3a; the two such relief surfaces are of the same width and diameter.

The work *a*, which is here assumed to be a quartz crystal oscillator or resonator of quite little thickness, as but a fraction of an inch and is usually rectangular, is to be received in a work-holder 17 so that its broad face or opposite broad faces to be abraded may undergo abrading independently of the work-holder, which is therefore of stiff material thinner than the work and here in the form of a circular disk having a central space, as an aperture 17a of such conformation, as rectangular, that when the work is received therein complete rotation of either of the parts of the assembly they form relatively to the other is prevented.

For entering this assembly between the laps the upper lap may be elevated on the main shaft, to be supported temporarily in elevated state by a hook 18, pivoted to a collar 19 fixed on said shaft, and to be engaged with a radial stud 20 on the hub 14a.

When the shaft and, with it, the lower lap is driven a depending pin 21 fast to said collar engages said stud to drive the upper lap in synchrony with the lower lap.

The assembly formed by the work-holder and work, while the laps undergo rotation, is to be rotated around an axis penetrating and preferably central of such assembly and its advance with the laps is to be opposed. For this purpose there is journaled in a pedestal 22 upstanding from the table a rotary member comprising a spindle 23 parallel with the main shaft, a traction roller 24 fast to the spindle and supported on the pedestal, and a gear 25 fixed to the spindle below the table and geared through a gear 25x with a gear 26 fast to the main shaft. Fixed to said shaft is preferably provided a traction sleeve 27, both it and the roller being cut by a plane between and parallel with the actual abrading or lapping surfaces of the two laps when they are in lapping relation to the work. The assembly formed by the work-holder and the work is of a diameter greater than the space between the traction elements 24—27. The roller, sleeve and said assembly should all be so proportioned that when the work-holder abuts both said roller and sleeve the axis of the said assembly will penetrate said actual lapping surfaces.

When the machine is operating to lap, said assembly having been interposed between and subjected to compression by the laps incident to the weight of the upper lap, the laps tend to advance said assembly around the main shaft, but this is opposed by said traction elements, and

meanwhile said assembly is made by the gearing 25—26 to undergo rotation around its aforesaid axis. Such advance of said assembly being thus opposed to insure constant impelling, with consequently a uniform dispersion of the lapping action on the work, it is preferable that both laps be rotated.

In the example the lower lap may be taken as the aforesaid rotary abrading element and 16 as its aforesaid abrading surface. With the assembly comprising the work-holder and work positioned as shown in Fig. 2, with its own axis penetrating said surface, and the work held, as by the upper lap, with a broad face thereof (as of the work proper) in contact with said surface, rotation of said element is accompanied by its tractive effort to displace said assembly. But said assembly is not only positively confined to an orbit having the axis of rotation of said element as its center and hence constantly penetrating said surface but it is positively confined against said displacement, in this example by the member 23—24 and sleeve 27, and simultaneously it is rotated around its own axis by tractive effort applied to its periphery, in this example by said member and sleeve. I herein use the term "periphery" in the actual or geometric sense, thus to distinguish from a toothed form of the margin of the work to be engaged, gear-fashion, by another marginally toothed member, in which latter case the impelling effort is applied thrustwise (or against the sides of the teeth) and not as an incident of friction.

If the actual lapping surface is, as shown, a planiform elongated relief surface of a width less than the maximum dimension of that (non-circular) planiform face of the unit which is to be abraded and, during the relative advance, as between them and lengthwise of said surface, said unit is rotated around an axis penetrating it and the implement (as here either lap) and which is between the long margins of said surface, the whole area of said face may undergo the lapping

and said surface will remain planiform. By the term "relief surface" I mean one that adjoins at each long side thereof a surface extending relatively back from it.

In some instances the work-holder, besides having a central opening for the work, may have other openings for other pieces of work arranged around the central opening, as in Fig. 5 where 29 is the work-holder having at 30 the central opening and at 31 supplemental openings. This disk is of greater diameter than disk 17, being suitable for use where the actual lapping surfaces are proportionately of greater diameter.

As hereinbefore indicated and as per the annexed claim, my invention is a method of lapping and as such is not dependent on any particular apparatus as will be apparent from the circumstance, for instance, that the holding of the work in contact with the abrading surface of a rotating abrading element could be performed manually.

Having thus fully described my invention, what I claim is:

In the art of lapping in which the work is a generally flat piece and is contained in a space of a generally flat and substantially circular work-holder with one broad face of the work protruding from a broad face of the work-holder and by which work-holder the work is held, relatively thereto, against rotation, the method which consists in holding the work with its said broad face in contact with the circular abrading surface of a rotating abrading element whose axis of rotation is perpendicular to and is central of said surface and so that the axis of the work-holder penetrates said surface and, while the work is so held, positively confining the work-holder with its axis constantly coincident with a linear orbit having the first-named axis as its center and against tractive displacement by said element around said first-named axis and simultaneously, by tractive effort applied to the actual periphery of the work-holder, rotating the latter around its own axis.

FREDERICK J. KENT.