

Jan. 24, 1950

M. RAMSAY
LAPPING MACHINE

2,495,600

Filed June 2, 1947

Fig. 1.

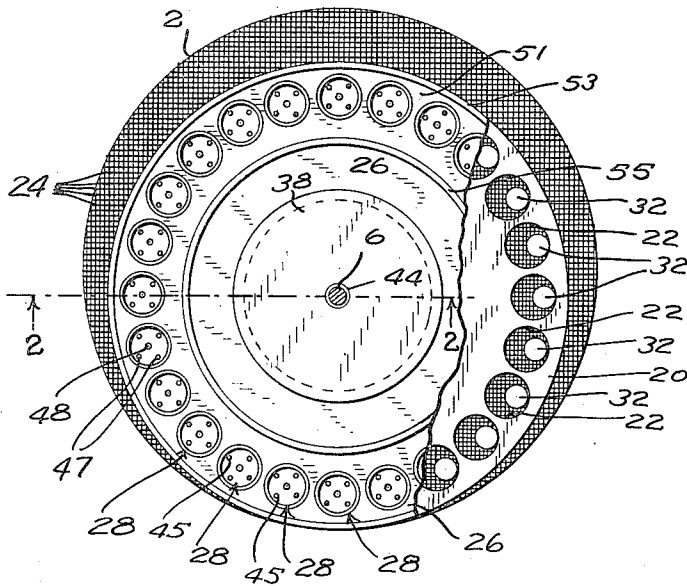


Fig. 2.

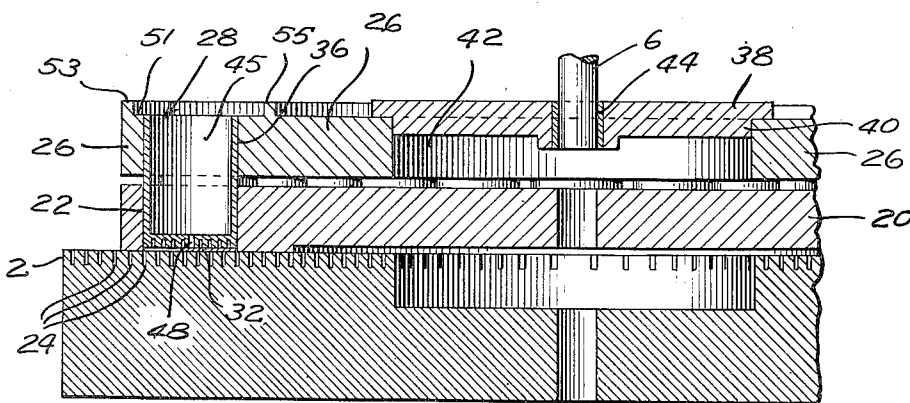
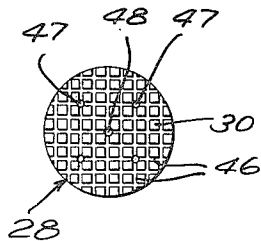


Fig. 3.



INVENTOR
MARCUS RAMSAY.

BY
H. D. Spencer
ATTORNEY

UNITED STATES PATENT OFFICE

2,495,600

LAPPING MACHINE

Marcus Ramsay, New York, N. Y.

Application June 2, 1947, Serial No. 751,785

5 Claims. (Cl. 51—161)

1

This invention relates to lapping machines and processes and particularly to lapping machines and processes designed to finish to required thickness dimensions relatively thin articles, usually having parallel or substantially parallel faces, such as piezo-electric quartz crystals of the type used to control the frequencies or wave lengths of radio broadcasting sets or stations.

More particularly the invention relates to improvements in the lapping machine and process disclosed in my Patent 2,423,118 issued July 1, 1947. In the practice of the lapping process disclosed in my co-pending application above-identified by means of the lapping machine there disclosed, it is found to be particularly important to insure relative movements of the upper laps or lapping fingers and the crystals to be lapped in the crystal confining openings in the work holder. The relative movement of each crystal and the lower lap is brought about positively by the engagement of the positively driven work holder therewith. On the other hand the relative movement of a crystal and the upper lap depends upon the differential drag on the two faces thereof by the lower and upper laps. If, therefore, for any reason the limited relative movement of a crystal and the upper lap or lapping finger does not take place freely in the crystal receiving opening of the work holder during the lapping operation, the desired parallelism of the upper and lower faces of the crystal will not be maintained.

As pointed out in the specification and claims of said co-pending application above identified, it is desirable to maintain both parallelism of the faces of the laps and parallelism of the lapped surfaces of the crystal throughout the lapping operation and to this end, in the co-pending application, the crystal engaging ends or lapping faces of the fingers projecting from the upper lap carrier plate are provided with grooves for the purpose of receiving and partially containing the lapping abrasive and the liquid used therewith and for preventing the formation of a vacuum between the lapping face and the crystal sufficient to interfere with its movements over said lapping face. In the machine of the co-pending application reliance is had entirely upon the supply of lapping liquid for the lower lap to provide these grooves in the lapping fingers or upper laps with the necessary liquid and with the lapping abrasive, where required. Because this lapping liquid must first enter the crystal-receiving opening in the work holder, which usually has a flat face resting on the lower lap, the supply of lapping liquid thus provided for the grooved crystal-engaging faces of the upper laps does not always prove to be adequate with the arrangement just described, with the result that there is not always the amount of relative move-

2

ment of the crystals over the crystal-engaging faces of the upper laps required to insure parallelism of these upper faces of the crystals with the faces which engage the lower lap.

An object of the present invention is to make provision for so supplying lapping liquid to the adjacent faces of each upper lap and its associated crystal as to insure the relative movement of these faces necessary to maintain parallelism of the upper face of the crystal with the lower face. To this end provision has been made for introducing the lapping liquid or a mixture of liquid and lapping powder through the upper lap to points on the face thereof that will insure the maintenance of a sufficient supply of the lapping liquid or mixture between the contiguous faces of the upper lap and the crystal for the purposes aforesaid.

Although emphasis has here been placed upon the introduction of a lapping mixture through the upper lap, it has been found that for some purposes, for example where a high polish is desired upon the crystal face, a mere wetting liquid may be supplied to the contiguous faces, unmixed with any lapping abrasive. It has further been found that where such polish is desired, if the mere metal surface of either the upper or the lower lap be not sufficient to effect the desired polishing action a surface may be provided upon one or both laps made up of very fine abrasive particles bound into the surface and constituting a substantially permanent part of the lap, wear excepted. In reading the following specification and claims, therefore, it should be understood that one of the principal purposes of the invention is to insure the introduction of a suitable liquid between the otherwise contiguous faces of each upper lap and its associated crystal, whether or not the liquid be mixed with a lapping abrasive.

Other objects, important features and advantages of the invention, to which reference has not specifically been made hereinabove, will appear hereinafter when the following description and claims are considered in connection with the accompanying drawings, in which—

Figure 1 is a plan view of the lapping elements of a lapping machine of the general type shown in my copending application Serial No. 645,644, filed February 5, 1946, which matured as Patent No. 2,423,118, granted July 1, 1947;

Figure 2 is a section on the line 2—2 of Figure 1, drawn to a somewhat larger scale, and

Figure 3 is a bottom plan view, drawn substantially to full scale, of one of the upper laps.

For convenience of reference and so far as practicable, the same reference numerals will be used in this application to designate corresponding parts as are used in my copending application. The lower lap 2, as in the machine of my

co-pending application, is stationary and the lapping face of this lap is preferably annular in contour as may be seen from a study of Figure 2. The upper laps are constituted by lap-faced fingers 28 mounted on an annular carrier plate 26 which need not be of as large diameter as the lower lap 2. The fingers 28 are fixed in openings 36 in the carrier plate 26 and approximately fit within correspondingly shaped openings 22 in the work holder 20. The fit of the fingers 28 in the work holder openings 22 is loose enough so that the fingers 28 may freely follow the diminishing thickness of the crystal 32, under the action of gravity, as the crystal is lapped to increasing thinness.

As brought out more fully in my co-pending application, the machine in which the invention is embodied may be of the so-called drill press type and the relative movement of the laps may be brought about by the engagement of an eccentric pin 6 with a central bearing opening in a circular plate 38 having a concentric shoulder 40 fitting within the opening 42 in the annular carrier plate 26 for the upper laps. The central opening in plate 38 may be provided with a bearing bushing 44.

From an inspection of Figures 2 and 3, it will be seen that the upper laps or lapping fingers 28 differ from the corresponding elements disclosed in my co-pending application Serial No. 645,644 hereinabove identified in that each of the fingers is partially bored out or otherwise provided with a hollow interior or chamber 45. This hollow interior serves two purposes, it lightens the overall weight of each finger so that when a large number of fingers are mounted on the upper lap carrier 26 the pressure upon the crystals 32 will not be too great and, secondly, it provides a reservoir in which a supply of lapping liquid may be held and gradually fed between the lapping surface 30 of the upper lap and the upper face of the crystal 32 through openings 47 and 48 provided in the bottom of the chamber 45.

As shown in Figure 3, there are four of the smaller openings 47 which are so drilled through the bottom of the hollowed out finger 28 that each comes through at a point of intersection of the grooves 46 in the face 30. It will also be seen that the grooves 46 shown in Figure 3 are more numerous than the corresponding grooves shown on the lapping faces of the upper laps 28 in my co-pending application. This is to insure spread of the lapping liquid over the entire lapping face of each upper lap 28.

One reason for making the central hole 48 somewhat larger than the holes 47 is that it accomplishes the same purpose as the central hole in Figure 11 of my co-pending application in that it prevents the lapping of a ridge at the center of the face 30 of the upper lap particularly where the diameter of the crystal 32 is less than one-half the diameter of the opening 22 in the work holder 20 so that the crystal in its travel might not always reach across the center of the face 30 of the upper lap 28.

It will further be seen that the lapping faces 28 of the upper laps are preferably round, in the embodiment illustrated in the drawings, since they are employed primarily for lapping round crystals. If, therefore, for example, the face 30 of the upper lap have a diameter of one inch and the round crystals to be lapped have each a diameter of one-half inch and the diameter of the opening 22 in the work holder 20 be slightly more than one inch to provide for free movement of

the upper lap 28 toward the lower lap 2 during the lapping operation, then the hole 48 does not need to be very much larger than the holes 47 to compensate for any tendency of the crystal to form a ridge at the center of the face 30. It needs, of course, only to be large enough so that the crystal 32 when it engages the inner wall of the opening 22 will always overlap an edge of the hole 48.

The carrier 26 for the upper laps 28 is provided with an annular channel 51 on its upper face formed between an outer flange 53 and a rib 55 on said upper face. It will also be seen that the upper ends of the fingers 28 are substantially flush with the bottom of the channel 51 so that lapping liquid poured into the channel 51 at any point will tend to run into the chambers 45 in the lapping fingers 28 and that, when all these chambers 45 are filled, an additional supply of lapping liquid may be maintained in the channel 51.

As hereinabove suggested, although in ordinary practice the lapping liquid will comprise a mixture of a suitable carrier liquid, such, for example, as an oil, and usually a finely powdered abrasive, it has been found that, when it is desirable to provide a very high polish upon the faces of the crystals 32, this may be done, without mixing an abrasive with the liquid, by providing one or both laps with an abrasive face, that is, with a face in which the very fine abrasive has been permanently embedded, except for wear. It will be understood, therefore, that when speaking of the lapping liquid which it is the purpose of this invention to introduce between the lapping faces of the upper laps 28 and the otherwise contiguous upper faces of the crystals 32 I do not necessarily refer to a liquid having a powdered abrasive mixed therewith.

From the foregoing description the operation of the present invention will readily be understood. The crystals 32 to be lapped having been placed in their respective work-receiving openings 22 in the work holder 20, each with one face resting on the lower lap 2, and the upper lap carrier 26 having been brought into position to introduce the upper laps or fingers 28 carried thereby into the openings 22 in the work holder 20, twenty-four of these fingers 28 being shown as being received in a corresponding number of openings 22, and the fingers or upper laps 28 having been brought to rest with their lapping faces 30 bearing upon the upper faces of the crystals 32, the eccentric pin 6 carried upon a suitable arm on the drill shaft of the drill press is inserted in the bearing opening in the plate 38 preparatory to effecting the desired movement of the upper laps 28 over the lower lap 2. It is obvious that this movement of the upper laps produces a corresponding movement of the work holder 20 and that, by reason of the fact that each crystal 32 is of a diameter considerably less than that of the opening 22, there will be a relative movement of the upper face of each crystal 32 and the lapping face 30 of the associated upper lap 28, provided lapping liquid is introduced between the two faces. In accordance with the present invention lapping liquid is provided not only for the upper faces of the crystals 32 but also for the lower faces thereof by introducing it in the manner hereinabove set forth through the bottoms of the upper laps 28. It will be seen that, as the lapping liquid flows through the openings 47 and 48 in the bottoms of the chambers 45 in the upper laps 28, it will

5

flow out also upon the upper face of the lower lap 2 and thus, by travelling through the grooves 24 on this face, will come into position between the upper face of the lower lap 2 and the lower faces of the crystals 32.

Although other means and methods of insuring a supply of lapping liquid to both lapping faces and both crystal faces have been considered and some tried, the means and method of the present invention have been found to be the most practicable, especially since they insure delivery to the points of use on both laps. It is possible, of course, to run both of the laps in a bath of lapping liquid, in which both lapping faces would be immersed during the lapping operation, but such procedure complicates both the insertion and removal of the crystals and the reversal usually practiced during the lapping operation, and also the interchange of the crystals in the work holder openings on one side with those on the other side. It will be seen that, with the present invention, in which the lapping liquid for both laps is introduced through passages through the upper laps, there is no special problem involved in removing the upper laps from the work holder and reversing the crystals or interchanging the crystals in the openings on one side of the work holder with those in the openings on the other side. It will further be seen that the character of the lapping fluid which is delivered to the point of operation can be more closely controlled by the use of the present invention.

What is claimed as new is:

1. In a machine for lapping piezo-electric crystals to insure high activity and approximate face parallelism, the combination with opposed parallel-faced laps, between the lapping faces of which a crystal to be lapped may be placed, of a work holder arranged for crystal-lapping relative movement over one lap and having a work-receiving opening therein in which the crystal and the other lap are laterally confined for limited relative lapping movement in respect to each other during the crystal-lapping relative movement of the work holder and the first mentioned lap, the laterally confined lap being freely movable in said holder toward the other lap and having a conduit therethrough for conducting lapping liquid to its lapping face, the lapping face of the laterally confined lap being provided with lapping liquid distributing grooves arranged in transversely intersecting and intercommunicating groups and the conduit discharging into an intersection.

2. A machine according to claim 1 in which the laterally confined lap is provided with a plurality of conduits discharging at points dis-

6

tributed over the lapping face thereof, and said conduits each discharging into an intersection of the lapping liquid distributing grooves.

3. A machine according to claim 1 in which the laterally confined lap is provided with a plurality of conduits, including one at its center, the conduits outside the center conduit discharging at points equi-angularly spaced about the center and all conduits discharging into intersections of the lapping liquid distributing grooves.

4. A machine according to claim 1 in which a liquid conducting conduit discharging at the center of the lapping face has a discharge opening of such diameter in relation to the diameter of the crystal to be lapped that an edge of the crystal overlaps the edge of the discharge opening at all times during the lapping relative movements thereof.

5. In a lapping machine of the class described, the combination with opposed lapping members and means for effecting relative lapping movements thereof, of a work holder provided with spaced openings therethrough to receive and loosely confine, in separated relation to each other, articles the opposite faces of which are to be lapped, one of said lapping members having a lapping surface of an area sufficient to engage simultaneously, throughout the lapping operation, the faces of all the articles to be lapped which are exposed on one face of said work holder and the other lapping member comprising interconnected fingers adapted to enter the work holder openings and to press the articles therein into lapping engagement with the first-mentioned lapping member, said fingers having lapping faces on their article engaging ends provided with intersecting and intercommunicating lapping liquid distributing grooves and each having a conduit therethrough for conducting lapping liquid to its lapping face at an intersection of said grooves.

MARCUS RAMSAY.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
70,656	Weaver	Nov. 5, 1867
267,783	Folsom	Nov. 21, 1882
376,537	Marshall	Jan. 17, 1888
1,465,117	Dey	Aug. 14, 1923
1,541,001	Searles	June 9, 1925
2,369,107	Indge	Feb. 6, 1945
2,382,903	Pash	Aug. 14, 1945
2,423,118	Ramsay	July 1, 1947