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ARTICLE WORKING APPARATUS

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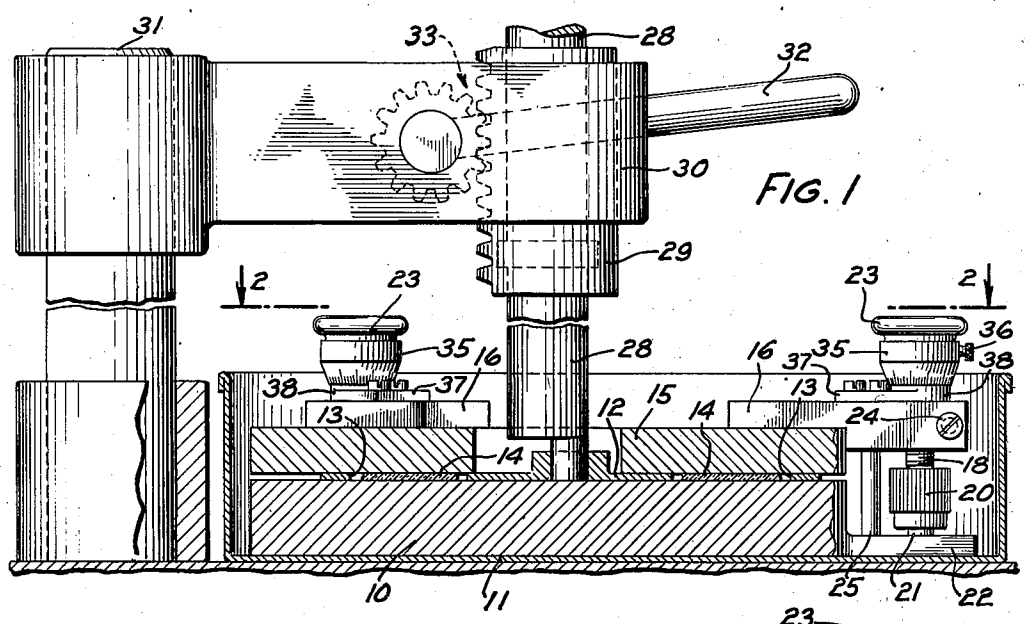



FIG. 1

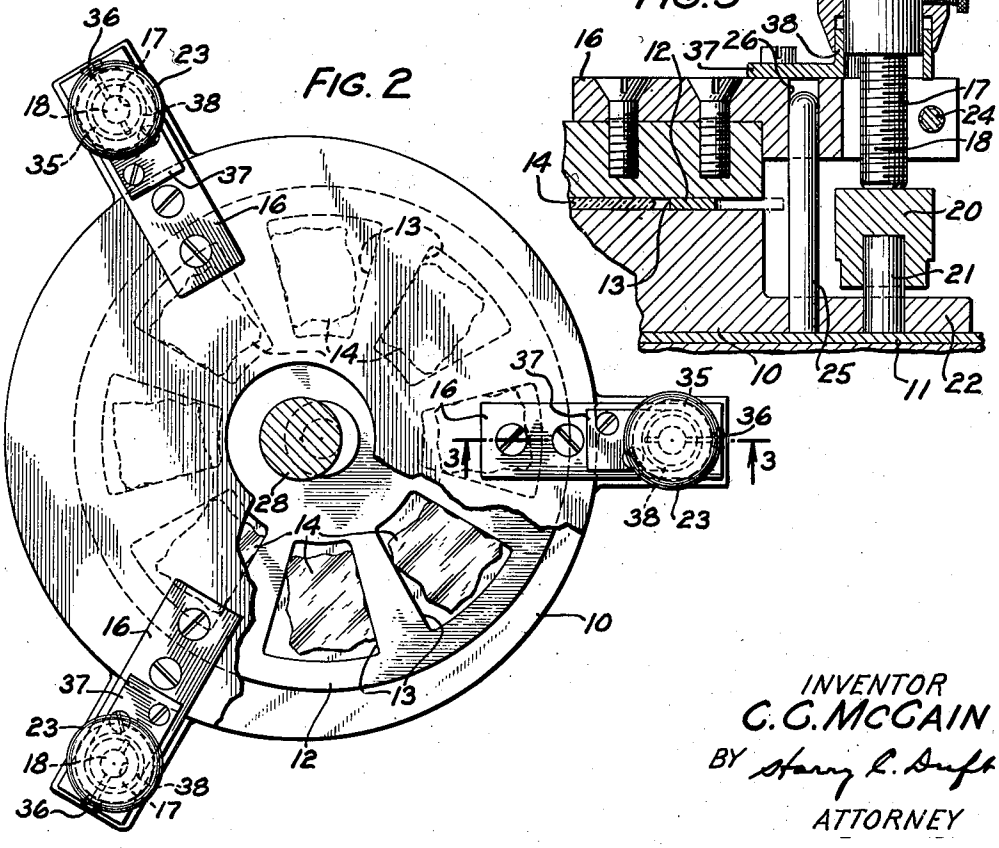



FIG. 2

FIG. 3

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## ARTICLE WORKING APPARATUS

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6 Claims. (Cl. 51—161)

This invention relates to article working apparatus, and more particularly to a fixture for lapping quartz crystals.

During the manufacture of certain types of quartz crystals, such as those used as frequency control devices in electronic communication equipment, the rough crystals may be cut into slabs and the slabs lapped to the required thickness. A convenient method of lapping such slabs has been to assemble a plurality of slabs in a nest of disc shape and to interpose the nest between a pair of lapping plates, the slabs resting on the lower plate while the upper plate rests on the slabs. It will be apparent then that, as the nest rotates, the slabs will be lapped on either side at substantially the same rate. Consequently, the same relative thicknesses among the slabs will be maintained throughout the lapping operation. If the slabs on one side of the nest are slightly thicker than those on the other, they will remain so and, since the upper lapping plate will be tipped relatively to the lower, the lapped sides of the slabs may not be parallel. To overcome this difficulty, the thicker slabs may be disposed about the nest so as to be lapped first. However, it is difficult to ascertain the relative thickness of the slabs with accuracy and, consequently, the lapping is both laborious and quite uncertain as to precision.

An object of the present invention is to provide an effective and efficient article working apparatus.

In accordance with one embodiment of this invention, a fixture for lapping quartz crystals may be provided having a rotatable nest for supporting and moving a plurality of crystals between a pair of spaced lapping plates. The lower plate is fixed and the upper plate, while it rests on the crystals at the beginning of the lapping operation, is provided with a number of adjustable supporting brackets mounted at several points on its periphery to prevent the plate from moving closer to the fixed plate than a predetermined distance.

Other objects and advantages of the present invention will be apparent from the following detailed description taken in conjunction with the drawing, wherein.

Fig. 1 is a fragmentary, side elevation, partly in section, of a lapping fixture constructed in accordance with this invention;

Fig. 2 is a vertical sectional view along the line 2—2 of Fig. 1; and

Fig. 3 is an enlarged, fragmentary, sectional view along the line 3—3 of Fig. 2.

Referring now to the drawing, a portion of a lapping apparatus is there illustrated having a circular lapping plate 10 mounted inside a circular container 11 and resting on the base thereof. A thin disc-shaped nest 12, provided with a plurality of apertures 13 spaced in a circle therein to receive slabs 14 of quartz, is rotatably supported immediately above the upper surface of the plate 10. The thickness of the nest 12 is selected to be substantially less than that of the thinnest final dimension required in the slabs being lapped. It will be apparent that if too great a thickness were used for the nest 12, then as the slabs nested therein were lapped, eventually the nest itself might be ground down.

An upper lapping plate 15 of annular shape is positioned above the nest 12 and at the beginning of the lapping operation this upper lapping plate rests on the upper surfaces of the quartz slabs 14 which are assembled in the apertures 13 of the rotatable nest 12. As the lapping operation proceeds and the slabs are lapped, the upper plate, bearing on the slabs, moves closer to the lower plate. In order to predetermine the minimum separation between the lapping plates and, consequently, the final thickness to which the slabs will be lapped, three supporting bracket arms 16 are fixed to the upper side of the plate 15 and are equally spaced about the periphery thereof. A vertically disposed, threaded aperture 17 is formed in the outer end of each of the bracket arms 16 to receive a threaded member 18, the lower end of which is engageable with the upper surface of a cylindrical block 20, rotatably supported on a fixed shaft 21. The shaft is mounted on a projecting lug 22, integrally formed with the base plate 10. By rotating the threaded members 18 through a knob 23, associated with each threaded member, the upper lapping plate 15 may be raised a short distance from the plate 10 and aligned therewith, the blocks 20 serving as stop members for the threaded members 18. The clearance between the threaded member 18, which threadedly engages the arm 16, and the arm 16 may be adjusted by a threaded member 24 which is positioned near the outer end of the arm 16, the outer portion of which is split. The member 24 may be rotated to move the split portions of the arm closer together to reduce the clearance between the threaded member 18 and the arm. Guide posts 25, mounted on the lugs 22 of the lower plate 10, extend into vertically disposed apertures 26 formed in the bracket arms 16 and serve to prevent the upper plate from being ro-

tated as the disc 12 is rotated, as well as to guide the upper plate during vertical movement.

Rotation of the disc 12 with respect to the lapping plates 10 and 15, is accomplished by a power shaft 28 journalled in a bearing 29 which is, in turn, mounted on a horizontally extending beam 30, supported on a vertically mounted post 31. The bearing 29 and power shaft 28 may be moved up or down with respect to the beam 30 by a rack and pinion assembly 33 actuated by a lever arm 32. Eccentric rotation of the disc 12 is had by mounting the disc off the center of the shaft 28, as shown in Fig. 1. During the operation of the apparatus, the power shaft 28 is lowered by the lever arm 32 to position the disc 12 slightly above the fixed plate 10.

In the operation of this apparatus, a number of gauging devices of the same thickness are inserted between the upper and lower plates 10 and 15, respectively, preferably near the bracket arms 16, and the separation between the plates adjusted by rotating the threaded members 18, as explained hereinbefore. With the gauges inserted, the threaded members 18 are adjusted so that the tips thereof, which rest on the upper surface of the rotatable blocks 20, barely contacts these blocks. This may be determined by rotating the blocks 20, the sides of which are knurled. If a block rotates too freely, then the associated threaded member does not rest tightly enough on the block. On the other hand, if a block 20 resists rotation too strongly, the associated threaded member 18 should be readjusted to relieve the contact pressure thereon. It will be apparent from the foregoing that the separation between the lapping plates may be exactly predetermined and that by selecting gauges of the necessary thickness, the slabs may be lapped with a high degree of accuracy to any desired thickness. When slabs to be lapped are positioned between the plates and in the apertures 13 formed in the disc 12 to receive them, regardless of any original unevenness in the relative thickness of the slabs which might tend to cause the slabs to be lapped to differing thicknesses, all slabs will be lapped to the same thickness for, when the plate 15 has moved downward toward the plate 10 to the point where each threaded member 18 is resting on its associated rotatable blocks with the same pressure as the other members 18, the plate 15 can move no further and, consequently, lapping is halted.

After the threaded members 18 have been adjusted so that their tips just contact the upper surfaces of the rotatable blocks 20, with the gauges in position between the lapping plates, a calibrated collar 35 mounted on the upper portion of each member 18 is set at "zero" and locked in position by a set screw 36. A fixed plate 37 having a sleeve portion 38 positioned about the member 18 and extending inside the collar 35, may be suitably marked to facilitate determining the position of the collar 35.

The gauges are then removed and the upper plate 15 lifted to permit insertion of the slabs to be lapped in the apertures 14. Then the upper plate 15 is lowered. It is sometimes desirable to extend the threaded members 18 a short distance beyond that determined, as explained hereinbefore, in order to allow for slight variations in the lapping operation inherent in the use of lapping compound with this type of apparatus. This is easily effected by rotating each of the members 18 a small amount, the calibrated collars facilitating determination of the new setting. When the slabs have been lapped to such a thickness that the threaded members 18 rest on the rotatable blocks 20, the exact thickness of the slabs may be determined and the threaded members adjusted if necessary to reduce the minimum separation between the plate 15 and the plate 10, to permit further lapping of the slabs.

What is claimed is:

1. In a fixture for lapping an article, a fixed lapping plate, a movable lapping plate spaced therefrom, an adjustable member mounted on one of said plates for adjusting the minimum separation therebetween, a rotatable stop member having a stop surface at a constant relation to one of said lapping plates engaged by said adjustable member, and means for rotatably supporting said stop member, said stop member being normally freely rotatable and having its rotation impeded by the engagement thereof of said adjustable member.

2. A lapping apparatus comprising a pair of non-rotatable lapping plates, one of said lapping plates being movable relative to the other means for guiding the movable lapping plate during the lapping operation, means for moving the work between said lapping plates, and rotatable stop members having stop surfaces in a predetermined relation to one of said lapping plates, cooperating stop members on the other of said lapping plates to engage said rotatable stop members to limit the movement of said lapping plates toward each other to a predetermined distance of separation, each of said rotatable stop members being normally freely rotatable and having its rotation impeded by engagement therewith of said cooperating stop member on said other lapping plate.

3. A lapping apparatus having a pair of non-rotatable relatively movable lapping plates, means for guiding one toward the other of said plates during the lapping operation, means for moving the work between said lapping plates, rotatable stop members carried by one of said lapping plates and having stop surfaces in a predetermined relation thereto, cooperating stop members carried by the other lapping plate for engaging said rotatable stop members and limiting the movement of said lapping plates toward each other to a predetermined distance of separation, each of said rotatable stop members being normally freely rotatable and having its rotation impeded by engagement therewith of said cooperating stop members.

4. A lapping apparatus having a fixed lapping plate, a lapping plate movable toward said stationary lapping plate during the lapping operation, means for guiding said movable lapping plate, means for moving the work between said lapping plates, a set of rotatable stop members carried by one of said lapping plates and having stop surfaces in a predetermined relation thereto, means for supporting said rotatable stop members, a set of cooperating stop members carried by the other lapping plate for engaging said rotatable stop members and stopping the movement of said movable lapping plate toward said fixed lapping plate to a predetermined distance of separation, and means for adjusting one set of said stop members, each of said rotatable stop members being normally freely rotatable and having its rotation impeded by engagement therewith of one of said cooperating adjustable stop members.

5. A lapping apparatus having a stationary lapping plate, a lapping plate movable toward

said stationary lapping plate during the lapping operation, means for guiding said movable plate, means for moving the work between said lapping plates, a plurality of posts having contact surfaces thereon carried by said stationary lapping plate, rotatable stop members journaled on said posts and having surfaces engaging said contact surfaces on said posts and having stop surfaces in a constant relation to said lapping plate, threaded members adjustably carried by said movable lapping member for engaging said rotatable stop members for limiting the movement of the movable lapping plate toward the stationary lapping plate to a predetermined distance of separation, said rotatable stop members being normally freely rotatable and having their rotation impeded by engagement thereof with said threaded members.

6. In an apparatus for lapping an article, a fixed lapping plate, a movable lapping plate spaced therefrom, rotatable threaded members mounted on one of said plates for adjusting the minimum separation between said lapping plates, rotatable stop members engaged by said threaded members, means for supporting said stop members, each of said rotatable stop members being normally freely rotatable and having its rotation impeded by engagement thereof with one of said threaded members, a calibrated sleeve adjustably mounted on each of said rotatable threaded members, means for securing said sleeve in adjusted position on said threaded member, and a fixed index member associated with each of said calibrated sleeves.

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