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2,441,108

ABRADING APPARATUS

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FIG. 1.

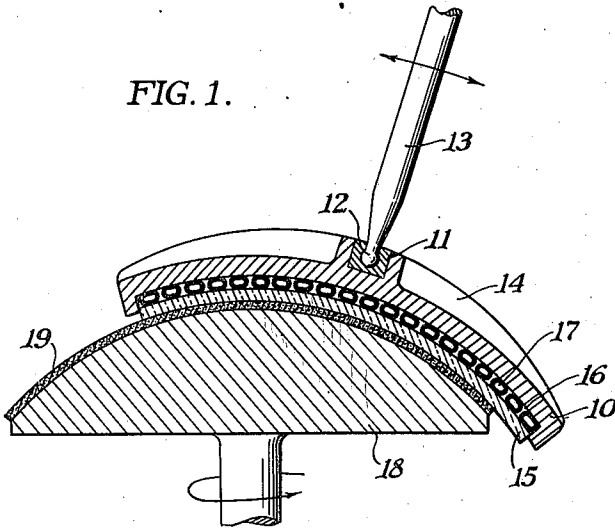


FIG. 2.

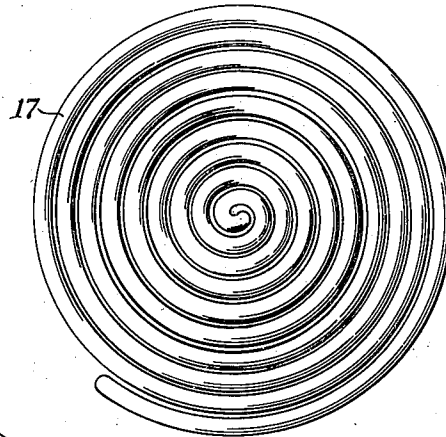
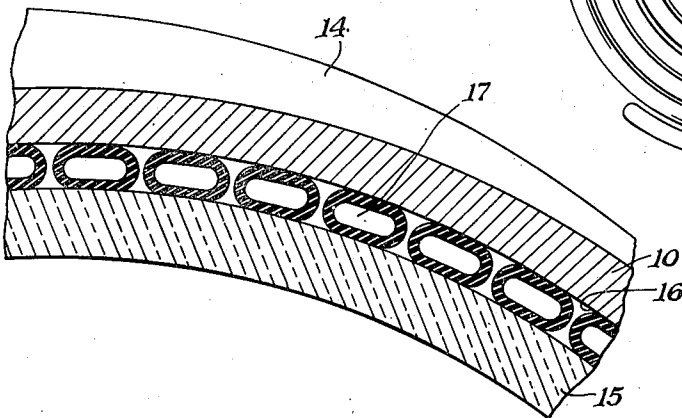


FIG. 3.



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ABRADING APPARATUS

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7 Claims. (Cl. 51-216)

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The present invention relates to an abrading apparatus and particularly to means for blocking work during the abrading thereof.

In the optical art, it is the usual practice to mount thin lenses or mirrors against a strong supporting tool by means of pitch or wax in order to hold them during the abrading operation of one surface. This is likely to cause some springing or distortion of the lens or mirror unless done very carefully. Even then, when large elements are being worked upon, e. g., 9-inch mirrors, etc., it has been found almost impossible to block the optical elements in this manner without incurring some undesirable distortion of the element. In addition, when pitch and wax are used in blocking optical elements, it is not unusual to have to wait as much as two hours, or more, for the pitch or wax to sufficiently cool and set before the abrading operation can be started. This time varies with the volume of the pitch or wax required for the blocking job and constitutes a considerable loss of time. Furthermore, in order that the supporting member will not be subject to flexure which would affect the uniformity of pressure applied to the work, it is imperative that this supporting member be absolutely rigid. For large pieces of work, the weight of the supporting member, in order to be sufficiently rigid, is inconveniently great and causes the driving means of the abrading apparatus to become overloaded.

The primary object of the present invention is to provide a blocking means for holding a piece of work during the abrading operation of one surface thereof which overcomes all of the above-mentioned disadvantages of the conventional blocking systems.

Specifically, the objects of the present invention are to provide a blocking means for an element being abraded by the use of which a uniform pressure is applied to the element during the abrading operation, so that the element is not distorted by non-uniformity of the applied pressure; to provide a blocking means which eliminates the use of pitch and wax and consequently the time wasted in waiting for these substances to set; to provide a blocking means which permits the use of a light-supporting member, or chuck, for the work; and to provide a blocking means which eliminates the need for skilled operators to carry out the blocking operation.

The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its

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methods of operation, together with additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawings, in which:

Fig. 1 is a vertical section showing a chuck or blocking means constructed in accordance with a preferred embodiment of my invention and particularly designed for holding a concave mirror during the abrading of the concave surface thereof;

Fig. 2 is a plan view of a preferred form of hydrostatic cushion forming a part of the present invention; and

Fig. 3 is an enlarged sectional detail of a portion of Fig. 1, and showing how the mirror is supported by the hydrostatic cushion located between the same and the bottom of the recess in the chuck.

Like reference characters refer to corresponding parts throughout the drawings.

Briefly, according to the present invention the element to be abraded is loosely confined in a recess in a chuck member atop a hydrostatic cushion seated between the same and the bottom of the recess. The element and/or cushion are held in the recess of the chuck by the abrading tool and by virtue of the hydrostatic nature of the cushion, a uniform fluid pressure is applied over the entire back of the optical element without permitting excessive displacement on one side when only a portion of the surface is in contact with the abrading tool, or for any other reason. The chuck need not be any thicker than is necessary to carry the applied load since moderate flexure of this member has no effect on the uniformity of the pressure applied to the piece of work by the cushion.

Coming now to the drawing wherein a preferred embodiment of the invention for blocking a concave optical mirror is shown, the present invention consists of a light-weight blocking chuck 10 having the usual socket member 11 formed in the back surface thereof into which the ball end 12 of an oscillating spindle 13 engages. This oscillating spindle is reciprocated in the direction shown by the arrows by means not shown to oscillate the work relative to the rotating abrading tool as is well known in the art. The backing chuck 10 may be relatively light compared to conventional equivalent structures and may include strengthening ribs 14, as shown, to reduce chances of flexure.

The concave mirror 15 to be abraded is loosely confined in a recess 16 in the face of the chuck

atop a hydrostatic cushion 17 located in the bottom of the recess. In the preferred form of the invention, the hydrostatic cushion 17 is loosely seated in the recess along with the mirror and the two are held in position in the recess by the engagement and pressure between the surface of the mirror being abraded and a rotating tool 18 having a polishing face 19 which is complementary to the surface to be abraded. The tool is rotated by any suitable means, not shown, and is well known; the pressure between the tool and work is applied through spindle 13 by the use of weights, springs, or other conventional means.

In its preferred form, the hydrostatic cushion consists of a spiral of thin rubber tubing filled with a liquid, as shown in Fig. 2. This cushion substantially covers the entire bottom of the recess 16 in the chuck and forms a support for substantially every point on the back of the mirror being abraded. The viscosity of the liquid is so chosen as to apply a uniform fluid pressure over the mirror without excessive displacement on one side when only a portion of the surface of the mirror is in contact with the polishing tool. For example, when the chuck moves to one of its extreme positions of oscillation, wherein the tool engages only a fraction of the surface of the mirror, the increased pressure on one side will cause the fluid in the cushion to shift to the side where the pressure is less until the pressure over the entire surface of the work and chuck is equalized. If the rubber tubing is thin, and the liquid used is not too viscous, the hydrostatic response of this cushion will be substantially immediate and continuous.

This arrangement of parts provides that the chuck need not be any thicker than is necessary to carry the applied load because moderate flexure of this member has no effect on the uniformity of the pressure applied to the work by the cushion. While I have shown the hydrostatic cushion as being of spiral form, it is pointed out that this is merely a matter of choice based on convenience of handling and fabrication. The cushion could just as well be of any other form, e. g., a single closed chamber, so long as every part of its interior is in fluid communication with every other part of the interior. By the same token, while I have found water to be a suitable fluid in synthetic rubber tubing in a chuck member for blocking 9-inch mirrors at a tool speed of approximately 60 R. P. M., it will be obvious that different fluids of varying viscosity, and tubing of other elastic material than synthetic rubber, may be found more suitable for other projects and operating speeds.

The continuous length of the tube in the disclosed cushion distributes the hydrostatic pressure uniformly. The viscosity of the fluid and the slight stiffness in the rubber tubing prevents all of the fluid from being forced to one side of the cushion, except when the system is not being rotated. It may prove advantageous to connect the inner and outer extremities of the spiral or to interconnect across some of the turns, if very small tubing is employed, in order to minimize weight. In the event that this form of chuck is used on a high-speed machine so that the centrifugal force set up in the fluid in the cushion would tend to upset the hydrostatic function thereof, then it is advisable to use air or some other suitable gas in the cushion. This substitution of fluids is recommended for the obvious reason that a gas will not be affected by

centrifugal forces set up by high-speed rotation of the chuck.

The present chuck is adaptable to easy blocking of the work, since all that is required is to slip the element and cushion into the recess 16 in proper superposed relation and to hold them in such position until the combination is slipped into operating relationship with the tool. If desired, the hydrostatic cushion may be glued, or otherwise fastened, to the bottom of the recess in the chuck so that it will not fall out with the work when the chuck is removed from operative relationship with respect to the tool. Referring to Fig. 1, it will be noticed that the side walls of the recess in the chuck are adapted to engage and confine the edges of the mirror to prevent the piece of work from sliding laterally from beneath the chuck as the latter is oscillated and the tool is rotated. While I have shown the recess equal in diameter to the mirror, so that the edges of the latter engage the side walls of the recess at all times, it is not necessary that this fit be a close one. The diameter of a recess can be somewhat larger than that of the work without affecting the operation of the arrangement, since there is no disadvantage encountered if the mirror slides and rotates relative to the chuck and the hydrostatic cushion during the abrading operation so long as the mirror is given sufficient oscillation relative to the tool to prevent undesirable repetitive spot abrasion.

From the above description it is believed that it will be obvious that the present invention provides a work blocking arrangement which is in advance over conventional arrangements in several respects. In addition to eliminating the need for skilled operators in blocking the work for the abrading operation, it saves all of the time heretofore required in waiting for the blocking pitch or wax to set and cool. It insures the application of a uniform pressure on all parts of the piece of work during the abrading operation and thus eliminates the possibility of the piece being distorted due to the non-uniformity of applied pressure arising because of improper blocking and/or movement of the work into overhanging relation with the tool during the abrading operation. While the arrangement is particularly desirable in the blocking of large pieces of work, since it permits the use of a much lighter blocking chuck, it will be readily appreciated that it is useful in blocking any type of work regardless of size and shape.

Although I have shown and described certain specific embodiments of my invention, I am aware that many modifications thereof are possible. My invention therefore is not to be restricted to the specific details of construction shown and described but is intended to cover all modifications coming within the scope of the appended claims.

Having thus described my invention what I claim as new and desire to secure by Letters Patent of the United States is:

1. An apparatus for blocking a piece of work for abrading a surface thereof comprising a chuck provided with a recess in which the piece of work is adapted to be seated with the surface to be abraded exposed and extending beyond the face of the chuck and with the edges of the work partially confined by the side walls thereof, and a hydrostatic cushion between the bottom of said recess and the piece of work seated therein.

2. A blocking apparatus according to claim 1 in which said hydrostatic cushion comprises a

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closed container made from an elastic material and filled with a fluid.

3. A blocking apparatus according to claim 1 in which said hydrostatic cushion comprises a closed chamber made from an elastic material and filled with a liquid.

4. A blocking apparatus according to claim 1 in which said hydrostatic cushion comprises a closed chamber made from an elastic material and filled with a gas.

5. A blocking apparatus according to claim 1 in which said hydrostatic cushion comprises a spiral rubber tube having closed ends and filled with a fluid.

6. In an apparatus for abrading the front surface of a preformed optical element, the combination of a chuck provided with a recess in which the element is adapted to be loosely confined as to both longitudinal and lateral movement and with front surface exposed, the bottom of said

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recess substantially complementary in shape to that of the rear surface of said element, a hydrostatic cushion loosely seated in the bottom of said recess beneath and engaging the rear surface of said element, said cushion being of such thickness as to space the element from the bottom of said recess and at the same time allow the element to seat therein sufficiently so that the edges of the element are confined by the side walls of said recess; said cushion and element held in place in said recess by an abrading tool held against the front surface of said element by pressure between the chuck and tool.

7. An abrading apparatus according to claim 6 in which said hydrostatic cushion is fastened to the bottom of said recess, whereby only the optical element is held in place in said recess by the tool.

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