

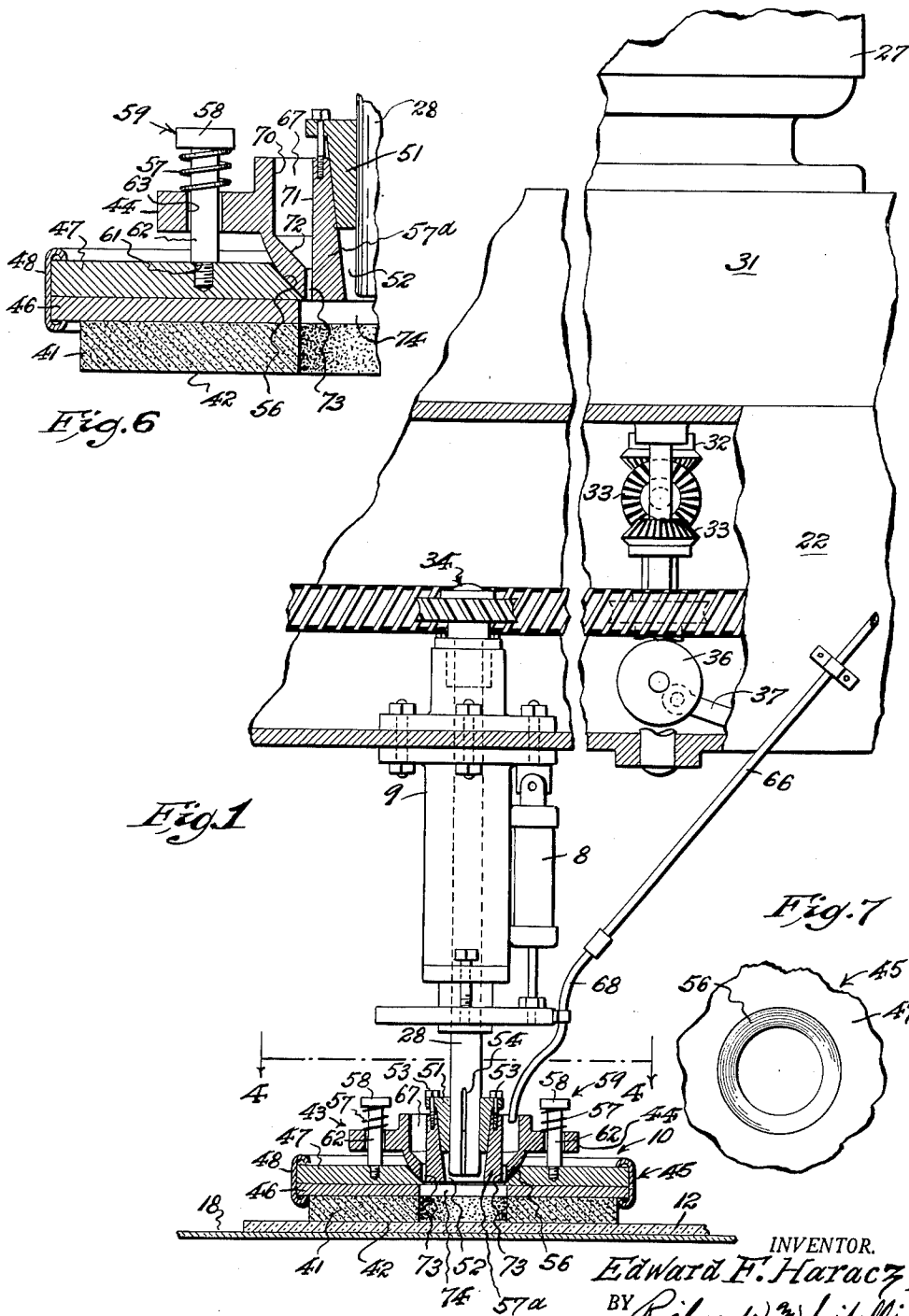
Feb. 6, 1962

E. F. HARACZ
POLISHING SURFACES

3,019,564

Filed April 29, 1959

3 Sheets-Sheet 1



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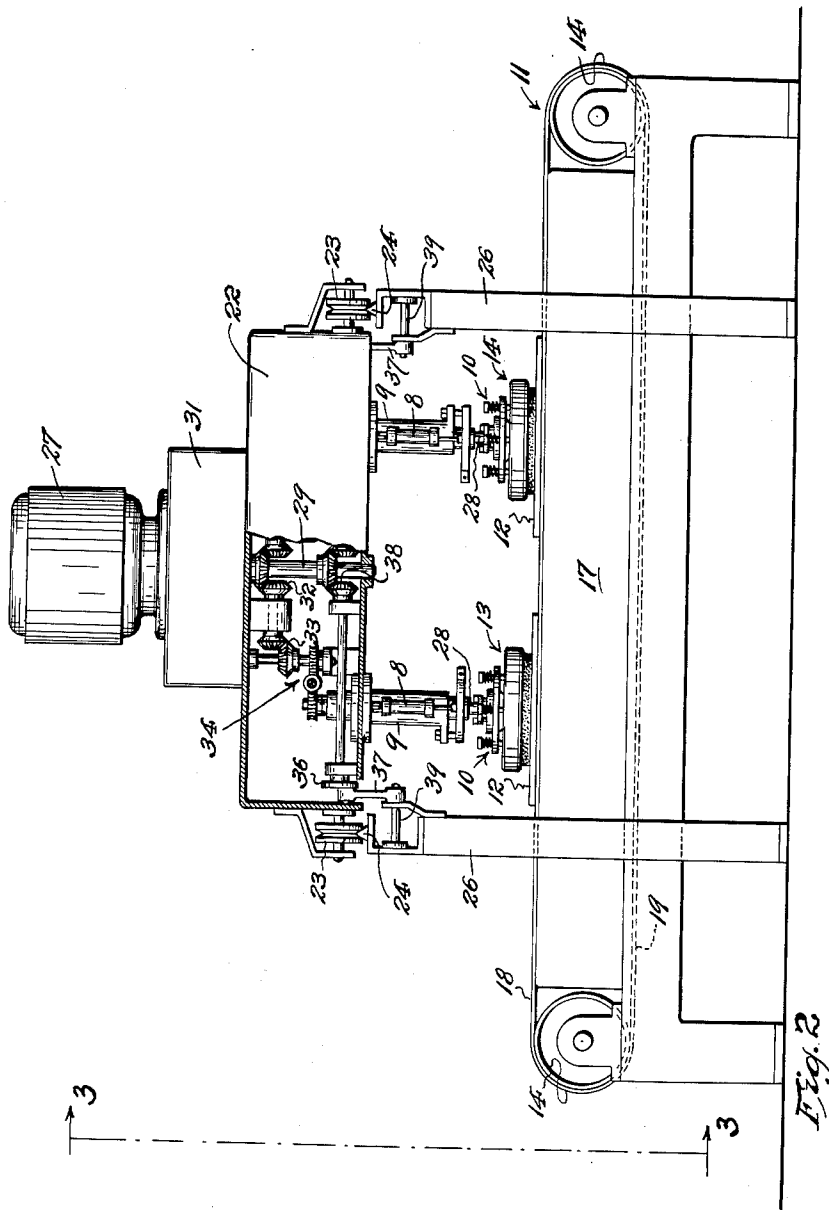
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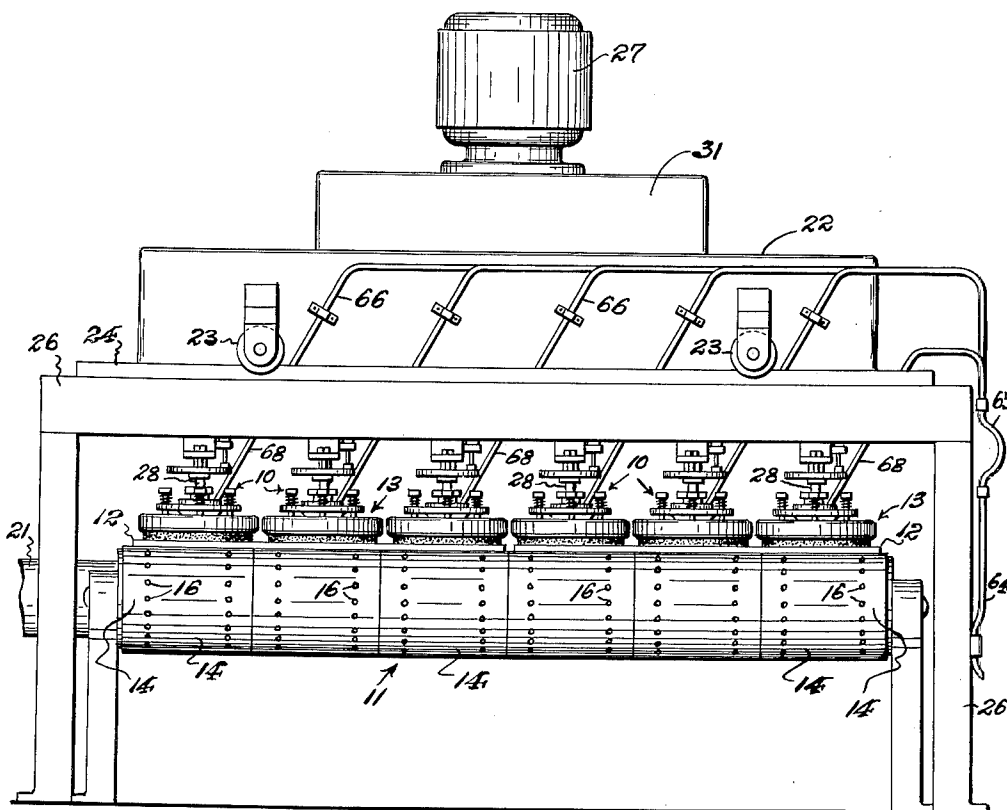


Fig. 3

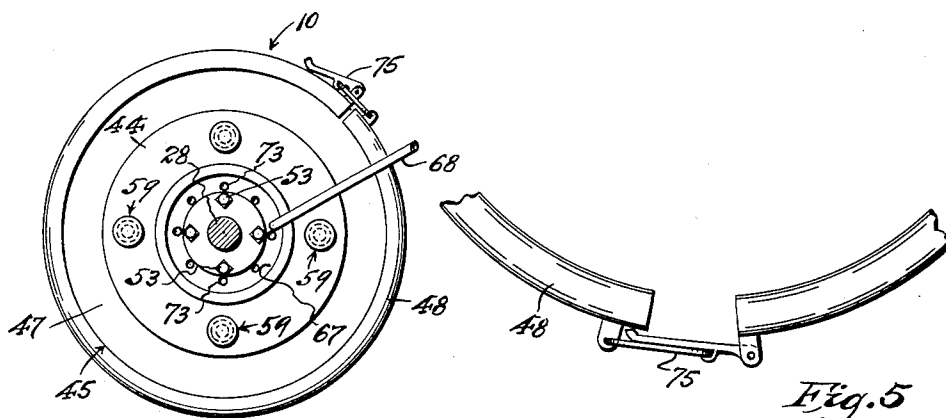


Fig. 4

Fig. 5

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3,019,564

POLISHING SURFACES

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This invention relates to the polishing of surfaces, such as for example a glass surface. More particularly, the invention relates to machines adapted to polish surfaces by rotating an abrasive laden polishing pad or pads on the surface to be polished.

Polishing machines commonly have a conveyor which is adapted to continuously advance the work pieces, e.g. glass plates, over a horizontal course, and a plurality of polishing heads which work polishing composition over the surfaces as the work pieces pass under the heads on the conveyor. The polishing heads have pads which press the polishing composition against the glass and the heads are rotated and also reciprocated horizontally so that the polishing composition is wiped substantially uniformly over the surface of the glass and the desired abrading action is obtained.

The plates which are polished are commonly of limited length so that leading ends of the plates or work pieces frequently pass under the polishing heads. Accordingly, the machines are desirably adapted to have the leading edges of the work pieces move under the polishing heads without having to interrupt operation of the machine. Commonly, the machines are provided with means for raising and lowering the polishing heads so that, if desired, the heads can be raised to permit the leading edge of work pieces to be started under the heads. This manner of operation is, however, inconvenient and machines are commonly provided which are intended to have work pieces moved under the heads without raising and lowering the heads or otherwise interrupting operation of the machine. Machines commonly used heretofore and intended to operate in this manner, i.e. without interrupting operation to raise and lower the heads, have the disadvantage that as the rotating pads of the polishing heads move onto the work piece, the surface adjacent the leading edge is frequently scored and hence defaced so as to spoil the work piece. The present invention is concerned with this operating characteristic of the presently commonly employed machines and aims to improve the machine in this respect.

Another aspect of the commonly used machines with which the invention is concerned is the manner in which polishing composition is fed to the polishing head. Commonly, a drive shafted for each head is disposed axially of the head and polishing composition is fed through the drive shaft and falls by gravity through a centrally disposed opening in the polishing pad and onto the work piece where it is picked up and wiped over the work piece by the polishing pad. As will be readily understood, this method of feeding the polishing composition has the disadvantage that it complicates the design of the polishing head since the composition must be passed to the center of the drive shaft and then through the shaft. As indicated, the invention is concerned with improving the manner of feeding abrasive to the polishing heads.

Still another aspect of the polishing machines with which the invention is concerned is the mounting of the polishing pads on the head. Commonly, the polishing heads include a foundation plate which is secured to the head drive shaft for rotation therewith, and a polishing pad back-up member on which the pad is mounted and which in turn is yieldingly or resiliently mounted on the foundation plate so that the back-up member can move in response to uneven pressure of the work piece against the polishing pad and assume a position such that it squarely abuts with the working surface. It is frequently

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necessary to replace polishing pads, and with the heretofore commonly used machines the replacement requires releasing the resilient mounting of the back-up member on the foundation plate. This is undesirable since the more frequently the resilient mounting is effected, the more likely this mounting is to be unsatisfactory so as to result in uneven polishing and/or scoring of the work pieces adjacent the leading edges thereof. Also, the effecting of the resilient mounting is time consuming and hence adds to operating expense.

Particularly objects of the invention are to provide constructions which obviate the aforementioned undesirable operating characteristics of the commonly used machines. The manner in which these and other objects are attained according to the invention will be apparent from the following description of the invention considered together with the accompanying drawings, in which:

FIG. 1 is a view of a portion of the machine shown in FIG. 2 and showing in cross-section details of the polishing head construction of the invention;

FIG. 2 is a side elevation of a machine equipped with polishing heads according to the invention;

FIG. 3 is an end elevation of the machine shown in FIG. 2 and is taken along line 3—3 in FIG. 2;

FIG. 4 is a plan view of the polishing head shown in FIG. 1 as seen from line 4—4 in FIG. 1;

FIG. 5 is an enlarged view of a portion of the clamping ring used to secure parts of the polishing head together;

FIG. 6 is an enlarged view of a portion of the polishing head as shown in FIG. 1; and

FIG. 7 is a plan view of an element of the polishing head shown in FIG. 1.

According to the invention, the polishing head can comprise a horizontally disposed polishing pad having a radially extending working face for application against a work piece which is disposed substantially horizontally beneath the polishing head. The polishing pad is mounted on the underside of a polishing pad support which is disposed over the pad and is adapted to be engaged by a drive means for rotating the head. The polishing pad support can comprise a pad back-up member to which the pad is secured and a foundation plate adapted to be engaged by drive means. The back-up member and the foundation plate are disposed in superposed relationship and means are included which provide a plug and socket universal engagement of the foundation plate and back-up member. Additionally, holding means are provided for securing the back-up member to the foundation plate for rotation therewith and for holding the plug and socket in engagement and permitting universal movement of the plug and socket. By operation of the holding means, the back-up member and polishing pad unit is movable in response to uneven pressure of a work piece against the polishing pad working face to cause the polishing pad working face to squarely abut with the work piece.

Desirably, the holding means joining the foundation plate and back-up member is in the form of headed bolts which have their shank ends threaded into the back-up member, and extend through the foundation plate so that their heads are disposed across the foundation plate from the back-up member and are spaced from the foundation plate. A spring is disposed coaxially of each bolt intermediate the head and foundation plate and the springs urge the foundation plate and back-up member together to hold the plug and socket in engagement. The holes in the foundation plate through which the bolts extend are of larger diameter than the bolt shank portions disposed in the holes and thus some movement of the back-up member relative to the foundation plate is permitted.

The mounting of the pad on the polishing head as described above improves operation of the polishing ma-

chines in the respect that it permits moving of the leading edges under the polishing pads without scoring of the surfaces to be polished.

Another feature of the polishing head according to the invention is the employment of an annular trough disposed in the upper portion of the polishing pad support for supplying polishing composition to the polishing pad. The employment of an annular trough dispenses with the necessity of feeding the composition axially through the polishing head. It has been found, surprisingly, that notwithstanding the rotation of the head an annular trough can be used satisfactorily provided a particular construction of the trough is employed. Thus, according to the invention, the trough is formed by an inner wall, an outer wall and a bottom wall and the bottom wall slopes inwardly and downwardly from adjacent the outer wall to adjacent the inner wall. Through discharge passageways for delivering the polishing composition to the work piece extend through the support from the trough bottom wall adjacent the trough inner wall to an under portion of the polishing pad support. An opening is disposed in the polishing pad for communicating the trough discharge passageways with a work piece disposed beneath the pad.

In a preferred construction, the discharge passageways from the annular trough are disposed axially of the polishing head. When the parts are pitched inwardly from the trough bottom, the polishing composition tends to flow up the passageways, and if the passageways are pitched outwardly, the polishing composition is thrown against the axially extending sides of the polishing pad rather than dropping onto the work piece. Accordingly, axially or vertically extending passageways are preferred.

Replacement of polishing pads is facilitated according to the invention by forming the back-up member of a polishing head including a back-up member resiliently mounted on a foundation plate, of a first plate on which the polishing pad is mounted, a second plate which is resiliently mounted on the foundation plate by suitable holding means, and a releasable clamping means securing the first and second plates of the back-up member together. Thus, after loosening the clamping means, the polishing pad, and the plate to which it is secured, can be removed for replacement without altering the connection by the holding means of the foundation plate and the plate of the back-up member to which the foundation plate is secured by the holding means.

The polishing machine shown in the drawing comprises a conveyor 11 for advancing glass plates 12 under the two rows 13 and 14 of polishing heads 10. The conveyor 11 is advantageously of the suction type described and claimed in U.S. Patent 2,877,607 of Edward Haracz issued March 17, 1959. Thus, the conveyor 11 includes a series of endless belts 14 in which there are disposed perforations 16, and a suction box 17 is arranged between the conveyor upper course 18 and lower course 19. An air duct 21 (FIG. 3) communicates the suction box 17 with a means (not shown) for drawing a vacuum on the suction box. The resulting suction on the plates 12 disposed on the upper course of the conveyor aids to hold the plates in place as they are moved under the polishing heads.

The polishing heads 13 depend from car 22 which is provided with wheels 23, the wheels being positioned to travel along tracks 24 which are mounted on the frame 26. The car and track arrangement is provided to permit imparting a reciprocating motion to the heads 10 relative to the plates 12. Means are also provided for rotating the heads 10.

A motor 27 mounted atop the car 22 provides power for reciprocating and rotating the heads. Rotary motion is delivered to the drive shafts 28 of the polishing heads 10 from the delivery shaft 29 of speed reduction unit 31 of the motor 27, through a gear train formed of bevel gears 32 and 33, and the worm and wheels 34. Reciprocating motion is imparted to the car 22 by eccentric wheel

36. One end of a connecting rod 37 is connected to the eccentric wheel 36 and the other end of the connecting rod is connected to the frame 26 at pin 39. Rotation of the eccentric wheel reciprocates the car 22 and the eccentric wheel is rotated by gearing in the form of bevel gears 38 which connected the eccentric wheel to be driven by motor 27.

The polishing heads 10 are positioned at the lower end of depending structures 9 which house the drive shafts 28 and include the air cylinders 8 which are provided to permit raising and lowering the heads 10. As thus far described the machine shown in the drawing is of the type commonly used heretofore to polish surfaces of plates. The plates can be glass or other material such as for example metal or plastic.

The improved polishing head construction of the invention can be best seen in FIGS. 1 and 6. The polishing head 10 comprises a polishing pad 41 which has a radially extending working face 42 for application against a work piece in the form of a plate 12 which can be glass or other material which it is desired to polish or otherwise treat by wiping an abrasive or other material over the surface thereof. Preferably, the polishing pads are circular. Square pads can be used but pads of such form have the disadvantage that a scissoring action occurs between the pads and leading edges of the work pieces and this action frequently results in chipping of the leading edges.

The polishing head includes a polishing pad support 43 which is made up of a foundation plate 44 and polishing pad back-up plate member 45, which is superposed over the foundation plate 44. The back-up member 45 is of two piece construction and includes a first plate 46 on which the pad is mounted and a second plate 47 which is joined to the foundation plate 44 by holding means shortly to be described. A clamp 48, described in more detail hereinafter, secures the first plate 46 and second plate 47 together.

The foundation plate 44 is engaged by the drive shaft 28 so that the polishing head 10 is rotated by the shaft. Thus, a tapered bushing 51 is wedged into an opening 52 between the shaft 28 and foundation plate 44 by bolts 53 and a key 54 is provided to insure positive engagement of the shaft and bushing.

A feature of the invention is the manner in which the back-up member 45 is mounted on the foundation plate. The back-up member 45 is formed with an axially disposed socket or recess 56 which provides a socket for receiving a depending portion or plug 57a of the foundation plate 44. The plug and socket are of circular form, as is indicated in FIG. 7 by the plan view there shown of the socket or recess 56. Thus, a universal connection of the foundation plate 44 and polishing pad back-up member 45 is provided. Advantageously, the engaging surface of the plug 57a is arcuate and the engaging surface of the back-up member recess 56 is a chamfer.

The engaging surfaces of the plug and socket connection of the foundation plate 44 and back-up member 45 are held in engagement by springs 57 which work between the foundation plate 44 and the heads 58 of bolts 59. The bolts 59 are threaded into the back-up member, extend through the foundation plate and beyond so that the heads are disposed across the foundation plate from the back-up member and are spaced therefrom. The springs 57 being positioned between the foundation plate 44 and bolt heads 58 urge engagement of the plug and socket connection. Desirable, the shank ends of the bolts 58 which are threaded into the back-up member 45 are of relatively small diameter so that a radially extending shoulder 61 (see FIG. 6) is formed along the bolt shank 62 and the shoulder abuts with the back-up member 45. This construction results in the spring length being fixed and thus precludes variation of this dimension as between different bolts and polishing heads. The openings 63 (see FIG. 6) in the foundation plate for the

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bolt shanks 62 are of greater diameter than the bolt shanks so that movement of the back-up member relative to the foundation plate is not restrained by the openings 63.

The operation of the polishing head mounting will be apparent from FIG. 1. Thus, in the event of the pressure applied against the polishing pad by the work piece 12 being uneven, the back-up member will shift position relative to the foundation plate so that the polishing pad squarely abuts the work and the pressure is equalized. The tightness of engagement between the plug 57a and socket 56 is determined by the characteristics of the springs 57 and suitable engagement is obtained by selection of the springs.

The mounting of the back-up member 45 on the foundation plate 44 also serves to connect these elements together so that the rotary motion of the foundation plate is imparted to the back-up member.

The above-described mounting of the polishing head 10 on the machine has the advantage that polishing pads readily adjust to squarely abut the work piece so that uniform polishing is obtained, and, further, the machines can be operated in the manner that the polishing heads are not raised to start a work piece under the heads and the work pieces are not scored.

A feature of the polishing head 10 is the manner in which the abrasive is fed to the polishing pads 41. According to the invention, polishing composition which can be a cerium oxide or rouge water slurry passes through line 64 (FIG. 3), flexible connection 65 and on to lines 66 which direct it to the annular troughs 67 of the polishing heads 10. Desirable, a short piece of flexible tubing 68 extends from lines 66 into the troughs 67. The polishing composition is discharged into these troughs and passes to the work piece underlying the heads in a manner shortly to be described.

The polishing pad support, which in the embodiment shown in the drawings, comprises the foundation plate 44 and back-up member 45, includes an upper axially extending portion suitable for engagement by a drive means in the form of shaft 28 and the annular trough is disposed in the upper portion of the polishing pad support so that it is coaxial with the rotation axis of the polishing head and is adjacent the portion of the polishing pad support which receives the drive means, i.e. the trough 67 is disposed so that it is coaxial with and adjacent the polishing head drive shaft 28.

The form of the trough 67 is distinctive and it has been found that this general form is necessary to satisfactory operation of the annular feeding of the polishing composition. Thus, as can be seen in FIG. 6, the trough includes an outer wall 70, inner wall 71 and a bottom wall 72 which slopes downwardly and inwardly from adjacent the outer wall to adjacent the inner wall. Polishing composition leaves the trough 67 by way of the discharge passageways 73, and the location and direction of these is also important. Thus, for satisfactory operation the passageways 73 should be disposed as close to the axis of rotation of the polishing head as is convenient and should be vertical. Further, the passageways should be short in length.

It was found that annular troughs as described above except of rectangular cross-section and having the discharge passageways opening into the trough adjacent the trough out wall, did not operate satisfactorily.

An opening 74 extends axially through the back-up member 45 and polishing pad 44 and communicates the passageways 73 with a work piece underlying the polishing pad. Thus, polishing composition from the passageways 73 passes through the opening 74 to the work piece 12.

Variations in the dimensions of the polishing head elements are of course possible and consideration of the manner of operation of the polishing head and the annular feed thereof will indicate interdependence of certain

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dimensions. Thus to provide for suitable feed of the composition to the work, special consideration must be given to the r.p.m. of the head 10, the radial location of the passageways 73, the diameter of the opening 74 and the length of the reciprocating stroke of the polishing head. These dimensions as well as others, will depend on particular applications and can be tailored thereto by those skilled in the art. In one application, the polishing of glass with a cerium oxide water slurry polishing composition as is commonly used in polishing glass, suitable dimensions for the operation are an r.p.m. of about 185; a reciprocating rate of 10-24 cycles per minute and stroke, in terms of length of path through which the polishing head axis moves, of about 2-10"; a polishing pad inner diameter of $4\frac{1}{2}$ " and outer diameter of $14\frac{1}{2}$ "; an annular trough (as shown in the drawing) of inner diameter $3\frac{3}{8}$ " and outer diameter $5\frac{1}{2}$ " and having $8, \frac{5}{16}$ " discharge passageways at equally spaced intervals and of length $\frac{5}{8}$ ".

Another feature of the polishing head of the invention is the construction of the back-up member 45. According to the invention, this back-up member comprises a first plate 46 to which the polishing pad is secured by known means, and a second plate 47 which is secured to the foundation plate 44. These first and second plates are circular and provide a circular periphery of the back-up member, and the plates are secured together by a C-belt clamp 48 which extends about the circular periphery and has its ends joined together by a releasable buckle 75. The closed position of the buckle is indicated in FIG. 4 and the open position is indicated in FIG. 5. When in the open position, the C-belt clamp 48 expands and the plates 46 and 47 become disengaged so that the first plate 46 to which the polishing pad is secured can be removed. The described two piece construction of the polishing pad back-up plate 45 facilitates replacement of polishing pads as it permits replacement of the pads without altering the mounting of the back-up plate 45, i.e. the said second plate 47 of the back-up plate 45, on the foundation plate 44.

Various modifications of the construction shown in the drawings can be made to provide other embodiments of the invention and the appended claims are intended to include all such other embodiments.

What is claimed is:

1. A polishing head for a polishing machine of the type which includes a drive shaft for rotating the head, said head comprising first and second annular plates of circular peripheral shape having plane parallel faces, a polishing pad secured to the first plate, means securing the second plate to the drive shaft for rotating the head, and releasable clamping means securing the first and second plates together, whereby the first plate and polishing pad are removable from the second plate, said releasable clamping means comprising a belt clamp having a C-shaped cross-section, the said clamp extending about the circular periphery of the first and second plates with one edge of the clamp engaging one plane face of the first plate and another edge of the clamp engaging one plane face of the second plate, and a releasable buckle securing the ends of the clamp together, the said buckle in the releasable position permitting expansion of the clamp and disengagement thereof from the first and second plates.

2. A polishing head for a polishing machine of the type which includes a drive shaft for rotating the head, said head comprising a first annular plate having plane surfaces, a second annular-like plate having plane surfaces and a central bowl-like curvilinear vertical opening, said second plate being superimposed over said first plate, releasable clamping means securing the first and second plates together, a foundation member having an upwardly tapering centrally disposed surface, a downwardly tapering bushing member fixedly disposed between said drive shaft and said foundation member at its said inner surface

whereby rotative force is applied by said shaft to said foundation member, means for articulating said foundation member and said second plate, said articulating means comprising a downwardly extending curvilinear surface on said foundation member cooperating with said central curvilinear vertical opening in said second plate, and means for movably securing said second plate and said foundation plate, said movable securing means comprising headed bolts passing between openings in said foundation plate and fixedly secured to said second plate, and spring means between said bolt heads and said foundation plate whereby the latter is held yieldably secured to said second plate.

3. The head as recited in claim 2, wherein said foundation plate has an annular trough comprising an inner surface, an outer surface and a bottom surface, said bottom surface sloping inwardly and downwardly, a plurality of downwardly extending discharge passageways located between said inner and outer surfaces, said discharge pas-

sageways communicating with the central opening defined by the opening in the first annular plate.

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