This invention relates to apparatus for polishing stone. It is an object of this invention to provide a novel apparatus for polishing stone in which the abrasive is conducted by water to the polishing wheel and in which the waste abrasive is recovered, classified and selectively recirculated for re-use.

Another object of this invention is to provide in a stone polishing apparatus a novel arrangement for automatically classifying and recirculating unused or only partially used abrasive for re-use.

Another object of this invention is to provide in a polishing apparatus a novel arrangement for feeding the abrasive by water to the polishing wheel which insures an even mixture of the abrasive and a selective proportioning of the abrasive and water in the stream to the polishing wheel.

A further object of this invention is to provide a stone polishing assembly having two polishing compartments at either of which the polishing wheel can be selectively positioned for speeding up the polishing process.

Other and further objects and advantages of the invention will be apparent from the following description of a preferred embodiment, illustrated herein to demonstrate the principles and mode of operation of the invention.

In the drawings:

Figure 1 is a perspective view of the polishing apparatus of the present invention;
Figure 2 is a fragmentary perspective view illustrating a portion of the collecting tank for waste abrasive and a portion of the apparatus for recovering such abrasive from the collecting tank;
Figure 3 is a top view of the polishing box and collecting tank assembly forming part of the present invention;
Figure 4 is a longitudinal sectional view of the Fig. 3 assembly, taken along the line 4-4 in Fig. 3;
Figure 5 is a transverse sectional view of the Fig. 3 assembly taken along the line 5-5 in Fig. 3;
Figure 6 is a vertical section through the spindle for driving the polishing wheel;
Figure 7 is a section along the line 7-7 in Fig. 6;
Figure 8 is a fragmentary perspective view showing the safety catch on the polishing wheel assembly;
Figure 9 is a fragmentary view, partly in section, showing the foot valve employed in the abrasive recirculating system of the present invention;
Figure 10 is an enlarged perspective view of one of the separable stone-supporting blocks positioned in the polishing compartment for supporting the stone while it is being polished; and
Figure 11 is a longitudinal section through a portion of the collecting tank, taken along the line 11-11 in Fig. 3.

Referring to the drawings, the present invention includes a polishing box assembly having two polishing compartments or bins 11 and 12, which are generally rectangular in configuration. The polishing bins are separated by a central slab 13 of concrete having a flat upper surface. On either side of this concrete slab the respective inner side walls 14 and 15 of the polishing bins incline downwardly toward the drain troughs 16 and 17, which run centrally along the bottom of the polishing bins. On the other sides of the drain troughs there are provided the respective outer inclined side walls 18 and 19, which terminate at their upper, outer edges in the vertical outer side walls 20 and 21 of the polishing box assembly. The vertical end walls 22, 23 of the polishing box assembly terminate at their inner sides in downwardly inclined portions 24, 25, 26, 27 which extend down to the drain troughs 16 and 17. A pair of separable, separable blocks 28 and 29 extend transversely across the interior of the polishing compartment 12 for supporting the stone to be polished in that bin. Each of these blocks is shaped as shown in Fig. 10, with a flat horizontal upper face 140 for supporting the stone to be polished at a level below that of the upper face of the central slab 13, and inclined bottom side faces 141 and 142 shaped to seat respectively on the inclined side walls of the polishing compartment. Similarly in the other polishing bin 11 there are provided a pair of separable, transverse, horizontal blocks 30 and 31 for supporting the stone to be polished in that bin.

A perforated sprinkler pipe 32 extends around the inside of the polishing box assembly near the top thereof. This sprinkler pipe is provided with similarly perforated extensions 33 and 34, which extend along the top of the central slab 13, and downwardly inclined perforated extensions 35, 36, 37 and 38, which overlie the junctures between the end walls and inclined inner side walls of the respective bins. These perforated sprinkler pipes furnish continuous streams of water around both bins, which flow down the inclined side and end walls of the bins and serve to wash down into the drain troughs any abrasive which might be deposited on any of these walls of the bins.

As best seen in Fig. 4, the drain trough 16 inclines downwardly in a direction away from the end wall 22. This is also true of the other drain trough 17, which empties through trough 130 into the lower end of the trough 16 leading to the collecting tank 39. By virtue of this construction, it will be evident that the mixture of water and abrasive in the drain troughs 16 and 17 flows downward into the collecting tank, from which it is recirculated by mechanism which will be described hereinafter.

The collecting tank 39 includes means for classifying and segregating the abrasive according to size, so that abrasive of a particular size may be selectively re-used, when desired, in subsequent polishing operations. At predetermined locations in the collecting tank 39 away from its inlet end at trough 16, the tank is provided with transverse partitions 131—139 at spaced intervals (Figs. 3 and 11). These partitions extend upwardly from the bottom of tank 39 completely through the central slab and are of successively shorter heights, so that the partition 131 adjacent the inlet end of the collecting tank has its top edge about two inches higher than the following partition 132, and the third partition 133 is similarly shorter than partition 132. These partitions divide the collecting tank 39 into successive separate compartments, with the heavier abrasive dropping into the first compartments and the lighter, finer abrasive settling in the following compartments toward the discharge end of collecting tank 39.

Mounted at either end of the central slab 13 of the polishing box assembly are vertical uprights 40 and 41, which support a horizontal beam 42 in spaced relation above the top of the central slab 13. Mounted on this horizontal beam is a bracket 43 which carries a motor 44 for driving the polishing wheel. The motor shaft carries a pulley 45 which drives a pulley 46 through belts 47. The pulley 46 is mounted on a vertical shaft 48 which has an upper bearing in the cross beam 42 and a
lower bearing in the base 49, which is mounted on the central slab 13. A pulley 50 is keyed to the shaft 48 to be slidable therealong and to be driven for rotation thereby. Pulley 50 drives the pulley 51 through belts 52. The pulley 51 is mounted on a vertical countershaft 53, which is rotatably journalled in a bracket having outwardly extending arms 54 and 55. The pulley 51 in turn drives the pulley 56 through belts 57. Pulley 56 is mounted on the spindle 58 which drives the grinding wheel 59. Spindle 58 is mounted for rotation within a tubular housing 60 carried on the outer end of a bracket 61 which extends outward from spaced sleeves 62, 63, which are both mounted on the countershaft 53.

Countershaft 53 will be mounted on the lower end of the bracket arms 54, 55 extend outwardly from a tubular housing member 64. This housing member 64 is slidable along a vertical guide shaft 65. Rearwardly extending arms on the housing member 64 terminate in sleeves 66, 67 slidable along the shaft 48. For raising and lowering the housing member 64, there is provided a raising motor 68 which drives gear 69 meshing with a larger gear 70. The latter gear is mounted on a lead screw 71 which is threadedly received in an extension 72 of the housing member 64. When the motor is selectively energized in the "forward" or "reverse" direction, the housing member 64 is raised or lowered for raising or lowering the grinding wheel 59. It is to be understood that the pulley 50 is raised or lowered simultaneously with the housing member 64 so as to maintain the pulleys 50 and 51 at the same level and in driving relation.

At its upper end the guide shaft 65 carries a bracket arm 88 on which the drive motor 68 is mounted and which terminates in a tubular sleeve 89 mounted rotatably on the shaft 48. At its lower end the guide shaft 65 carries a bracket arm 90 which terminates in a sleeve 91 rotatable about the base 49. With this construction, the entire supporting structure for the polishing wheel can be swung about the shaft 48 for shifting the polishing wheel from one polishing bin to the other.

As best seen in Fig. 6, the tubular housing 60 for the spindle carries the top gland plate 100 which locates a first set of ball bearings 101 disposed between the stationary spindle housing 60 and the rotary spindle 58 located therein. In like manner, a lower gland plate 102 is attached to the lower end of the spindle housing 60 and locates a second set of ball bearings 103 acting between the spindle and the spindle housing.

A clutch acts between the pulley 56 and the spindle 58 to provide a releasable driving connection therebetween. In the present instance this clutch is in the form of a lower coupling member 104 and an upper coupling member 105 secured to the top of the spindle 58. As best seen in Fig. 6, the lower coupling member 104 is shaped to permit the spindle 58 to extend loosely upward through it. When the upper coupling member 105 is lowered into engagement with the lower coupling member 104, the rigid water pipe 87, which extends downward through the spindle, so as to permit the pipe 87 to remain stationary while the spindle rotates. Toward the lower end of the spindle there is provided a compression coil spring 106a acting between the bottom face of the lower gland plate 102 and a collar and gland plate assembly 107, 108. A set of ball bearings 109 is interposed between the collar 107 and the upper end of the motor 68 to permit rotation of the spindle relative to the collar 107. A spacing collar 110 locates this ball bearing assembly on the spindle and extends downward therefrom. The collar 107 is formed with an intumescence transverse neck 107a which abuts against the upper end of the bearing assembly 109. An oil seal 111 is interposed between the lower end of the bearing assembly 109 and the gland plate 108 attached to the bottom of collar 107. A spring guard 112, suitably attached to the lower face of the gland plate 102, surrounds the assembly of coil spring 106a collar 107 and bearings 109, and is keyed to the collar 107 in a manner preventing rotation of the collar but permitting the collar to move vertically. With this assembly, the spindle 58 is normally urged by the spring 106a downward into driving engagement with the pulley 56, and the spindle is free to rotate while collar 107 remains stationary within the spring guard 112.

Attached to the lower end of the spindle is a universal mounting for the polishing wheel 59. As best seen in Fig. 6, this universal mounting includes a first yoke 113 suitably attached to the lower end of the spindle 58 and having its upper side abutting against the lower edge of the spacing collar 110. Yoke 113 is formed with an upper tubular neck 114 extending around the spindle 58 and a pair of opposed arms 115, 116 depending therefrom. Aligned horizontal pins 117, 118 extend transversely through the yoke arms 115, 116 and at their inner ends releasably carry the inner tubular member 119 which carries the polishing wheel. The pins are each formed with reduced neck portions 120, 121, each positioned to be engaged by a respective pivoted latch 122 (Fig. 8) for releasably locking the pins 117, 118 in the in line of the spindle 58. The lower end of the tubular member 119 also releasably carries another aligned pin of similar horizontal pins 123, 124, extending at right angles to the pins 117, 118, and extending outward through holes formed in the top collar 125 on the polishing wheel 59. A similar pair of pivoted latches 126 is provided for engaging the reduced neck portions 127 and 128 on the pins 123, 124 to releasably maintain the polishing wheel 59 attached to the inner tubular member 119. A set of ball bearings 129 is disposed between the yoke member 113 of the universal mounting and the pipe 87, to permit the universal mounting and the polishing wheel to rotate while the pipe 87 remains stationary.

Turning now to the abrasive recirculating aspects of the illustrated assembly, a flexible conduit 73 extends into the abrasive and water sludge in the collecting tank 39 and at its upper end communicates with a foot valve 74, shown in detail in Fig. 9. A conduit 75 leads from the foot valve 74 to a pump 76a, which has a reciprocating piston driven by the pump motor 77. When the pump piston moves in the upstream, it draws a quantity of abrasive sludge from the collecting tank 39 through the flexible conduit 73 and past the lower flapper 130 in the foot valve 74 (Fig. 9) into the conduit 75. On the downstream side of the pump, the fluid pressure closes the lower flapper 130 to shut off the communication between the conduits 75 and 73, and opens the upper flapper 131 to establish communication between conduit 75 and the conduit 76 leading to an inlet at the top of the retaining tank 92, which is supported on the cross arm 42. Thus, a steady stream of the pump piston the abrasive sludge in conduit 75 is forced down past the foot valve 74 and up into the conduit 76 leading to the retaining tank 92. On each successive reciprocation of the pump, a quantity of abrasive sludge is pumped from the collecting tank 39 up to the retaining tank 92.

Conduit 76 has its line of center located over the abrasive collecting tank 39, as shown in Fig. 3. The flexible conduit 73 may be positioned in communication with any desired one of the abrasive compartments between the transverse partitions in the collecting tank 39 for the selective recirculation of the desired type of abrasive.

A water inlet pipe 78 extends downward into the retaining tank 92 and terminates in a pair of perforated, arcuate discharge pipes 79 located at the bottom of the retaining tank. The water discharged through these perforated discharge pipes 79 agitates the mixture of abrasive and water in the retaining tank: A hand valve
80 is provided for controlling the discharge of water from the pipes 79 so as to maintain the desired mixture of water and abrasive in the retaining tank. Flexible overflow conduits 81, 82 communicate with the interior of the retaining tank adjacent the top thereof and extend downward into the polishing bins for discharging the overflow back into the troughs 16, 17.

From the bottom of the retaining tank 92 a swivel joint 83 extends into communication with a flexible conduit 84 leading to the spindle for the polishing wheel 59. A water inlet pipe 85 communicates with the swivel joint 83 beyond the retaining tank and provides a stream of water which acts to push the abrasive mixture coming from the retaining tank down through the conduit 84. A water valve 86 controls the discharge of water from the pipe 85. At its lower end the conduit 84 communicates with the previously-described rigid pipe 87 which extends downward through the spindle 58 for the polishing wheel 59. As best seen in Fig. 6, the pipe 87 terminates at its lower end at the center of the polishing wheel 59 and discharges abrasive onto the surface to be polished by the wheel 59. This abrasive-treating pipe 87 is maintained stationary since if it did rotate the resulting centrifugal force would prevent the free flow of the abrasive.

In using the foregoing apparatus, the stone to be polished in the bin 11 is deposited on the supporting ledges 30, 31 therein and the polishing wheel 59 is lowered into engagement with the upper surface of the stone. Silicon carbide abrasive from the retaining tank 92 is fed down through the conduit 84 and discharge pipe 87 onto the stone at the center of the polishing wheel. Through the rotation of the polishing wheel the abrasive is distributed evenly over the stone beneath the scrolls on the underside of the polishing wheel. From past experience it is known that about 50% of the abrasive is retained under the polishing wheel, while the remainder of the abrasive is gradually thrown out from beneath the polishing wheel due to centrifugal force. This waste abrasive is deposited on the inclined walls of the polishing bin 11, from which it is washed down into the trough 16 by the sprinkler pipes 32—36.

The abrasive and water sludge then flows down the trough into the collecting tank 39, where it is separated according to size and from which abrasive of the desired size is automatically pumped back-up to the retaining tank 92, as described, to be used again.

While the stone in the polishing bin 11 is thus being polished, another stone may be put in place in the other polishing bin 12. After completion of the polishing operation in the bin 11, the polishing wheel 59 is raised from the polishing stone and its supporting brackets are swung manually about 90 degrees to position the polishing wheel over the stone in place in the other polishing bin 12. Then, while the polishing operation of the stone in bin 11 is going on, the finished stone in bin 11 is removed and another stone to be polished is put in place. Thus, it will be seen that a considerable saving of time in the polishing process is effected by the use according to the present invention of the double pin polishing box assembly and the polishing wheel which may be selectively positioned at either bin.

While in the foregoing description there is disclosed a specific preferred form of the present invention, it is to be understood that various omissions and refinements departing from the described embodiment of the invention may be adopted without departing from the spirit and scope of our invention.

We claim:

1. A polishing apparatus comprising a polishing bin having a downwardly sloping bottom wall defining a drain trough, means in said bin for supporting a stone to be polished, a polishing wheel supported to be positioned at any desired location within said polishing bin, an abrasive retaining tank mounted above said bin, an abrasive feed conduit communicating at one end with the bottom of said retaining tank and terminating at the other end adjacent said polishing wheel for gravity feeding of abrasive thereto, abrasive recirculating means for recirculating abrasive from said bin back to the retaining tank comprising, a grading tank disposed below said bin and communicating with said trough to receive a stream of abrasive sludge therefrom, sprinkler means in said bin for washing the abrasive sludge therefrom into said grading tank, pump means for withdrawing abrasive from said grading tank and for delivering the abrasive to the top of said retaining tank, a perforated conduit disposed around the bottom of the retaining tank, conduit means for feeding a controlled amount of water through said perforated conduit to flow upwardly in said retaining tank to agitate and maintain the abrasive in suspension therein, an overflow conduit communicating with the abrasive tank above the bottom thereof and discharging into said bin to convey the excess water and the very fine particles of abrasive and stone to said bin, and a waste conduit communicating with said grading tank for conveying therefrom the excess water and the very fine particles of abrasive and stone.

2. The combination of claim 1 wherein said sprinkler means in said bin includes a perforated conduit extending substantially completely around the periphery of said bin, and means for supplying water to said last mentioned perforated conduit.

3. A polishing apparatus comprising a polishing bin having a downwardly sloping bottom wall defining a drain trough, means in said bin for supporting a stone to be polished, a polishing wheel supported to be positioned at any desired location within said polishing bin, an abrasive retaining tank mounted above said bin, an abrasive feed conduit communicating at one end with the bottom of said retaining tank and terminating at the other end adjacent said polishing wheel for gravity feeding of abrasive thereto, abrasive recirculating means for recirculating abrasive from said bin back to said retaining tank comprising, a grading tank disposed below said bin and communicating with said trough to receive a stream of abrasive sludge therefrom, sprinkler means in said bin for washing the abrasive sludge therefrom into said grading tank, pump means for withdrawing abrasive from said grading tank and for delivering the abrasive to the top of said retaining tank, including a valve body mounted adjacent said grading tank and defining a valve chamber therewith, said chamber having an inlet passage arranged for communication with said grading tank, a fluid supply conduit communicating with said valve chamber at one end thereof and with the top of said abrasive retaining tank adjacent the other end thereof, a first check valve controlling flow from said grading tank to said chamber and arranged with a check to prevent return flow from the chamber through the inlet passage, a second check valve controlling flow from the chamber through the supply conduit and arranged to close to prevent return flow from the supply conduit, a pump conduit communicating with said chamber between said check valves and extending upwardly from the valve body, and a reciprocating pump communicating with said pump conduit adapted to draw abrasive sludge from the grading tank into the pump conduit and discharge the abrasive sludge from the pump conduit through said supply conduit, said pump being disposed above said check valve a distance such that the displacement of the pump during each stroke thereof is less than the volume of said pump conduit between the pump and the first check valve whereby the abrasive sludge does not flow through the pump as the pump operates to deliver abrasive material from the grading tank to the retaining tank.

4. A polishing apparatus comprising a polishing bin having a downwardly sloping bottom wall defining a drain trough, means in said bin for supporting a stone to be polished, a polishing wheel supported to be posi-
tioned at any desired location within said polishing bin, an abrasive retaining tank mounted above said bin, an abrasive feed conduit communicating at one end with the bottom of said retaining tank and terminating at the other end adjacent said polishing wheel for gravity feeding of abrasive thereto, abrasive recirculating means for recirculating abrasive from said bin back to said retaining tank comprising, a grading tank disposed below said bin and communicating with said trough to receive a stream of abrasive sludge therefrom, sprinkler means in said bin for washing the abrasive sludge therefrom into said grading tank, pump means for withdrawing abrasive from said grading tank and for delivering the abrasive to the top of said retaining tank, including a valve body mounted adjacent said grading tank and defining a valve chamber therein, said chamber having an inlet passage arranged for communication with said grading tank, a fluid supply conduit communicating with said valve chamber at one end thereof and with the top of said abrasive retaining tank adjacent the other end thereof, a first check valve controlling flow from said inlet passage to said chamber and arranged to close to prevent return flow from the chamber through the inlet passage, a second check valve controlling flow from the chamber through the supply conduit and arranged to close to prevent return flow from the supply conduit, a pump conduit communicating with said chamber between said check valves and extending upwardly from the valve body, a reciprocable pump communicating with said pump conduit adapted to draw abrasive sludge from the grading tank into the pump conduit and discharge the abrasive sludge from the pump conduit through said supply conduit, said pump being disposed above said check valve a distance such that the displacement of the pump during each stroke thereof is less than the volume of said pump conduit between the pump and the first check valve whereby the abrasive sludge does not flow through the pump as the pump operates to deliver abrasive material from the grading tank to the retaining tank, means for introducing a stream of water into said retaining tank to flow upwardly therein and maintain the abrasive in suspension, and an overflow conduit communicating with said retaining tank above the bottom thereof for passing excess liquid therefrom to thereby maintain a substantially constant liquid level in the retaining tank.

A polishing apparatus comprising a polishing bin having a downwardly sloping bottom wall defining a drain trough, means in said bin for supporting a stone to be polished, a polishing wheel supported to be positioned at any desired location within said polishing bin, an abrasive retaining tank mounted above said bin, an abrasive feed conduit communicating at one end with the bottom of said retaining tank and terminating at the other end adjacent said polishing wheel for gravity feeding of abrasive thereto, abrasive recirculating means for recirculating abrasive from said bin back to said retaining tank comprising, a grading tank disposed below said bin and communicating with said trough to receive a stream of abrasive sludge therefrom, sprinkler means in said bin for washing the abrasive sludge therefrom into said grading tank, pump means for withdrawing abrasive from said grading tank and for delivering the abrasive to the top of said retaining tank, including a valve body mounted adjacent said grading tank and defining a valve chamber therein, said chamber having an inlet passage arranged for communication with said grading tank, a fluid supply conduit communicating with said valve chamber at one end thereof and with the top of said abrasive retaining tank adjacent the other end thereof, a first check valve controlling flow from said inlet passage to said chamber and arranged to close to prevent return flow from the chamber through the inlet passage, a second check valve controlling flow from the chamber through the supply conduit and arranged to close to prevent return flow from the supply conduit, a pump conduit communicating with said chamber between said check valves and extending upwardly from the valve body, a reciprocable pump communicating with said pump conduit adapted to draw abrasive sludge from the grading tank into the pump conduit and discharge the abrasive sludge from the pump conduit through said supply conduit, said pump being disposed above said check valve a distance such that the displacement of the pump during each stroke thereof is less than the volume of said pump conduit between the pump and the first check valve whereby the abrasive sludge does not flow through the pump as the pump operates to deliver abrasive material from the grading tank to the retaining tank, means for introducing a stream of water into said retaining tank to flow upwardly therein and maintain the abrasive in suspension, an overflow conduit communicating with said retaining tank above the bottom thereof for passing excess liquid therefrom to thereby maintain a substantially constant liquid level in the retaining tank, means for introducing a stream of water into said feed conduit in the direction of flow of abrasive material therefrom, and means for regulating the rate of flow of water into said feed conduit to thereby regulate the rate of flow of abrasive to said polishing wheel.

References Cited in the file of this patent

UNITED STATES PATENTS

<table>
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<tr>
<th>Patent Number</th>
<th>Inventor</th>
<th>Date</th>
</tr>
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<tbody>
<tr>
<td>2,771,718</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

306,772 Pratt et al. Oct. 21, 1884
457,496 Stinebring Aug. 11, 1891
461,221 Kann Oct. 13, 1891
639,955 Warner Dec. 26, 1899
796,841 Gray Aug. 8, 1905
946,616 Pembroke Jan. 18, 1910
1,081,762 McLean Dec. 16, 1913
1,089,894 Bechtel Mar. 10, 1914
1,223,461 Willis Apr. 24, 1917
1,311,518 Hitchcock July 29, 1919
1,396,286 Ross Nov. 8, 1921
1,619,344 Hill Mar. 1, 1927
1,622,091 Cruckshank Mar. 22, 1927
1,740,154 Chase Dec. 17, 1929
1,925,751 Diffenderfer Sept. 5, 1933
1,955,981 McClymont Apr. 17, 1934
2,083,773 Burroughs June 15, 1937