

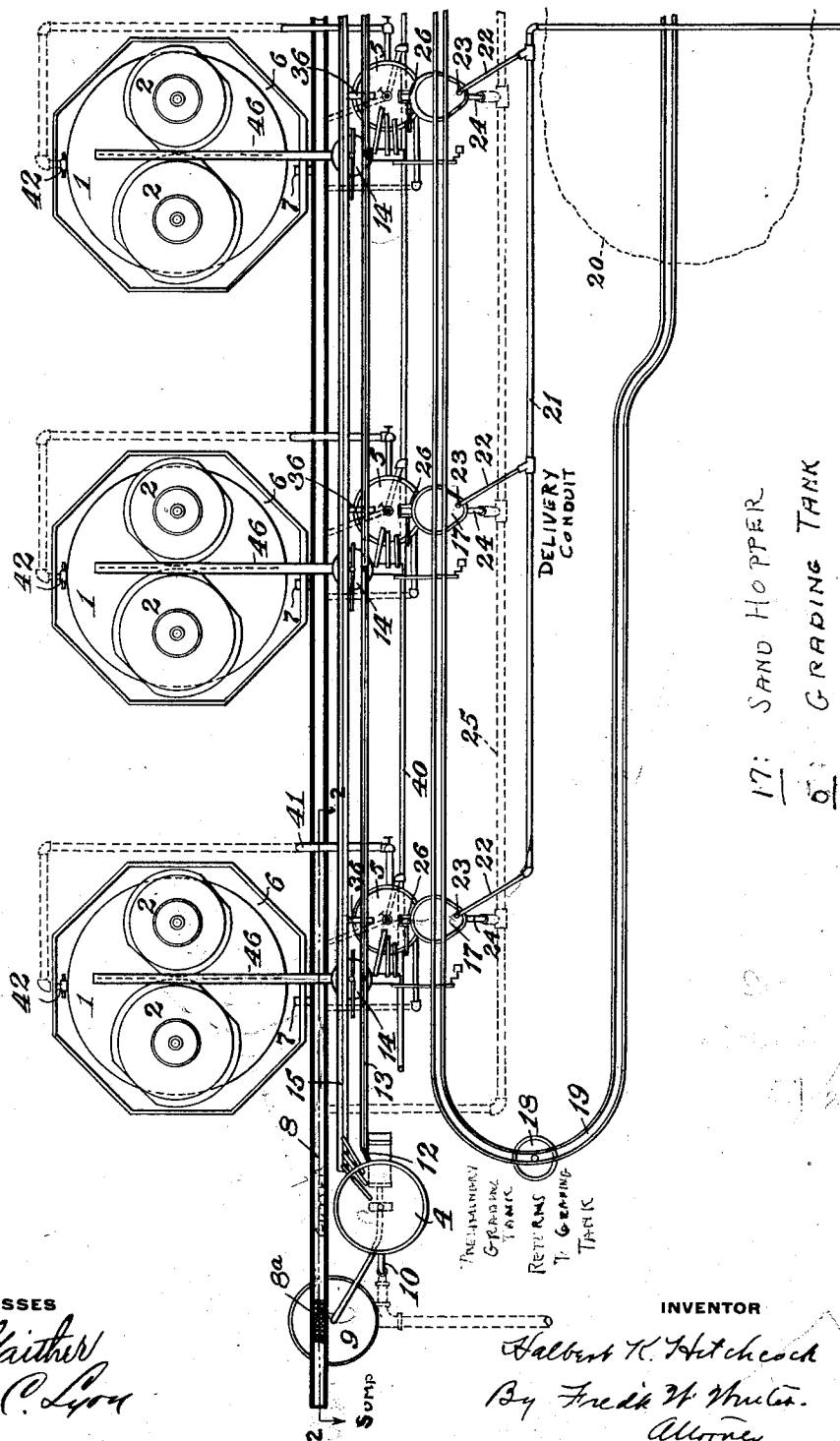
H. K. HITCHCOCK.
 APPARATUS FOR APPLYING ABRASIVES TO GRINDING APPARATUS.
 APPLICATION FILED JULY 31, 1911.

1,056,415.

Patented Mar. 18, 1913.

5 SHEETS—SHEET 1.

FIG. 1.



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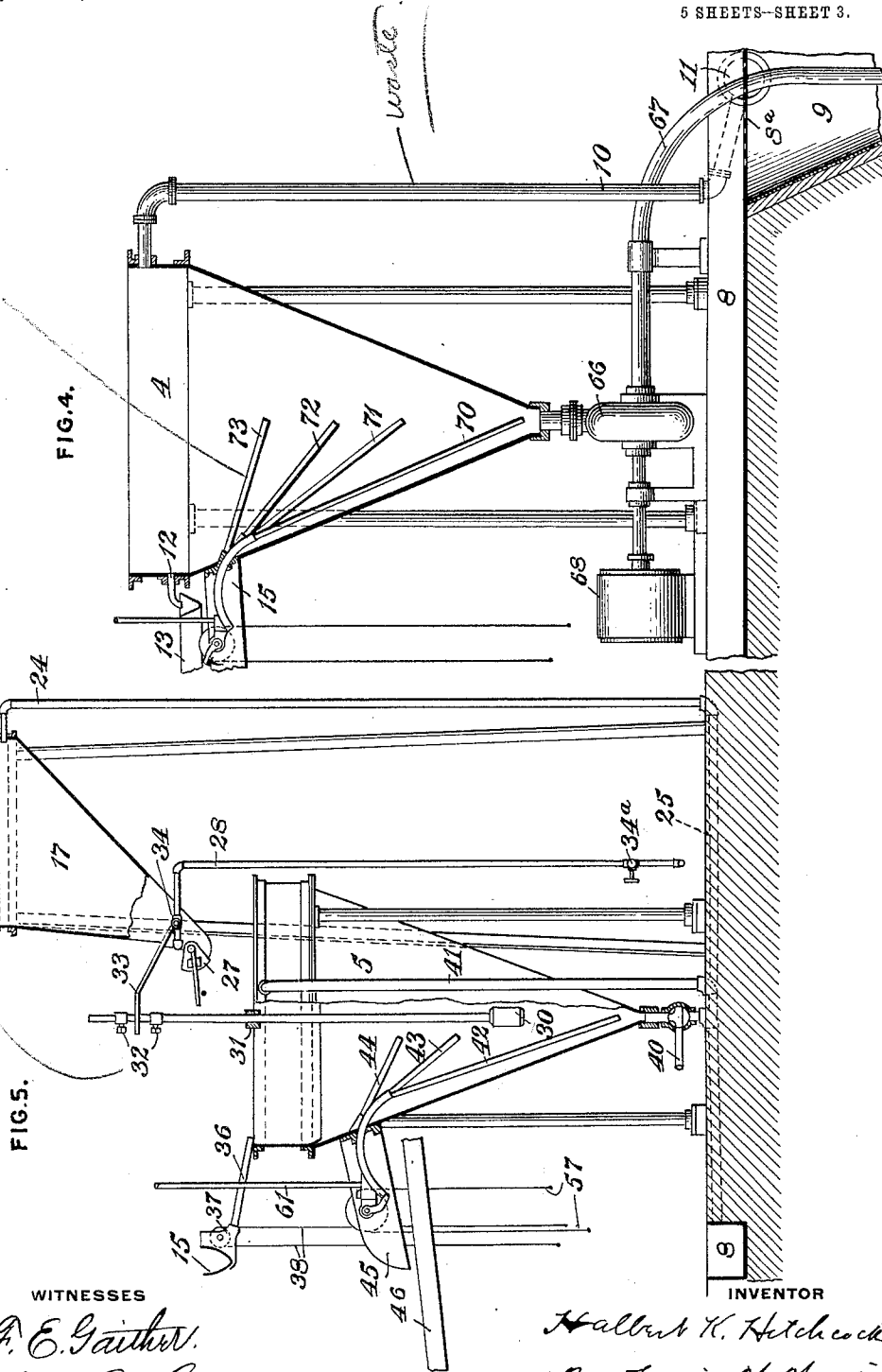
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5 SHEETS—SHEET 3.

*different grades of abrasives
 are fed out thru 70 & 73 down
 to pressure from piece*

*to open and close
 supply of sand
 by 22*



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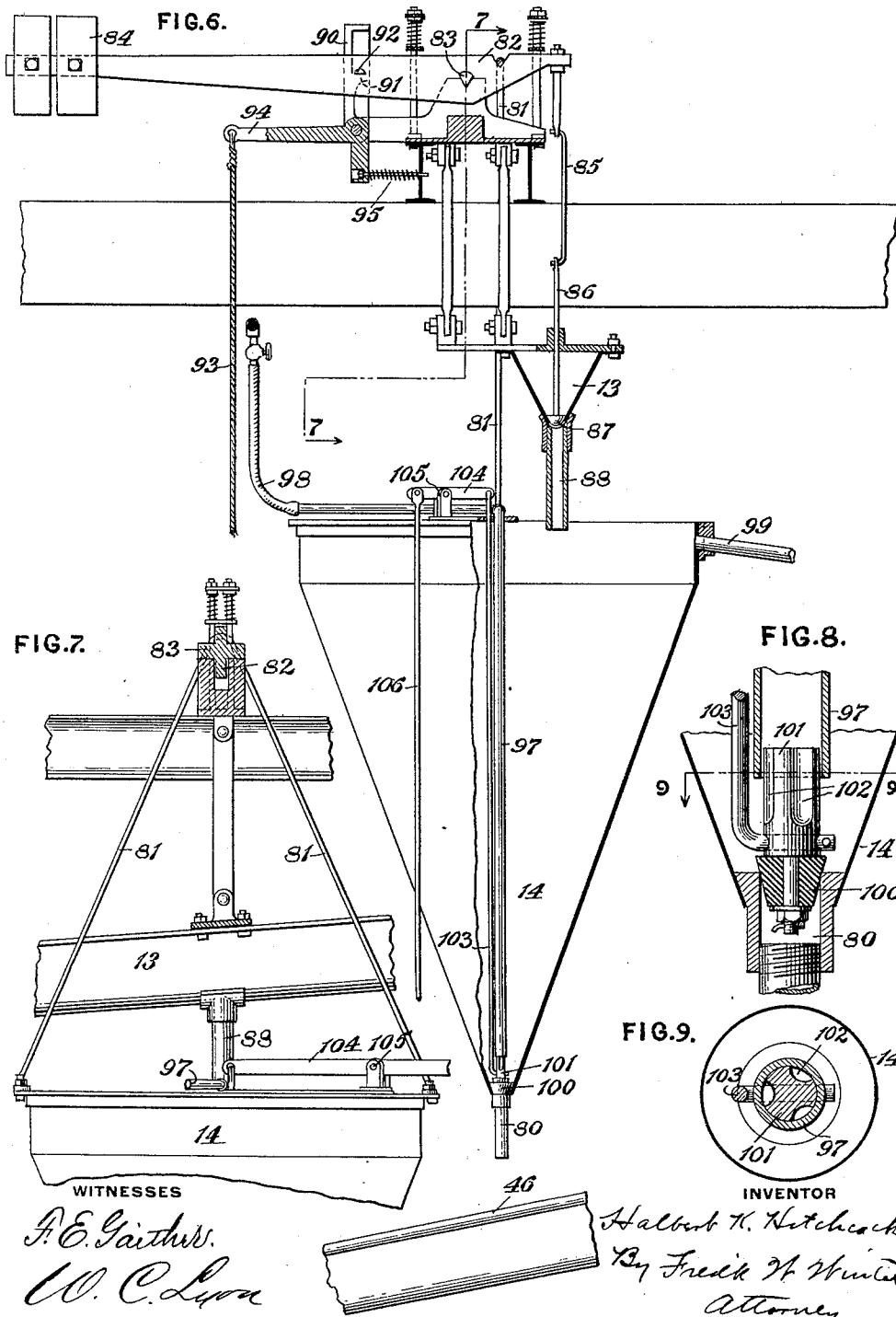
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5 SHEETS-SHEET 4.

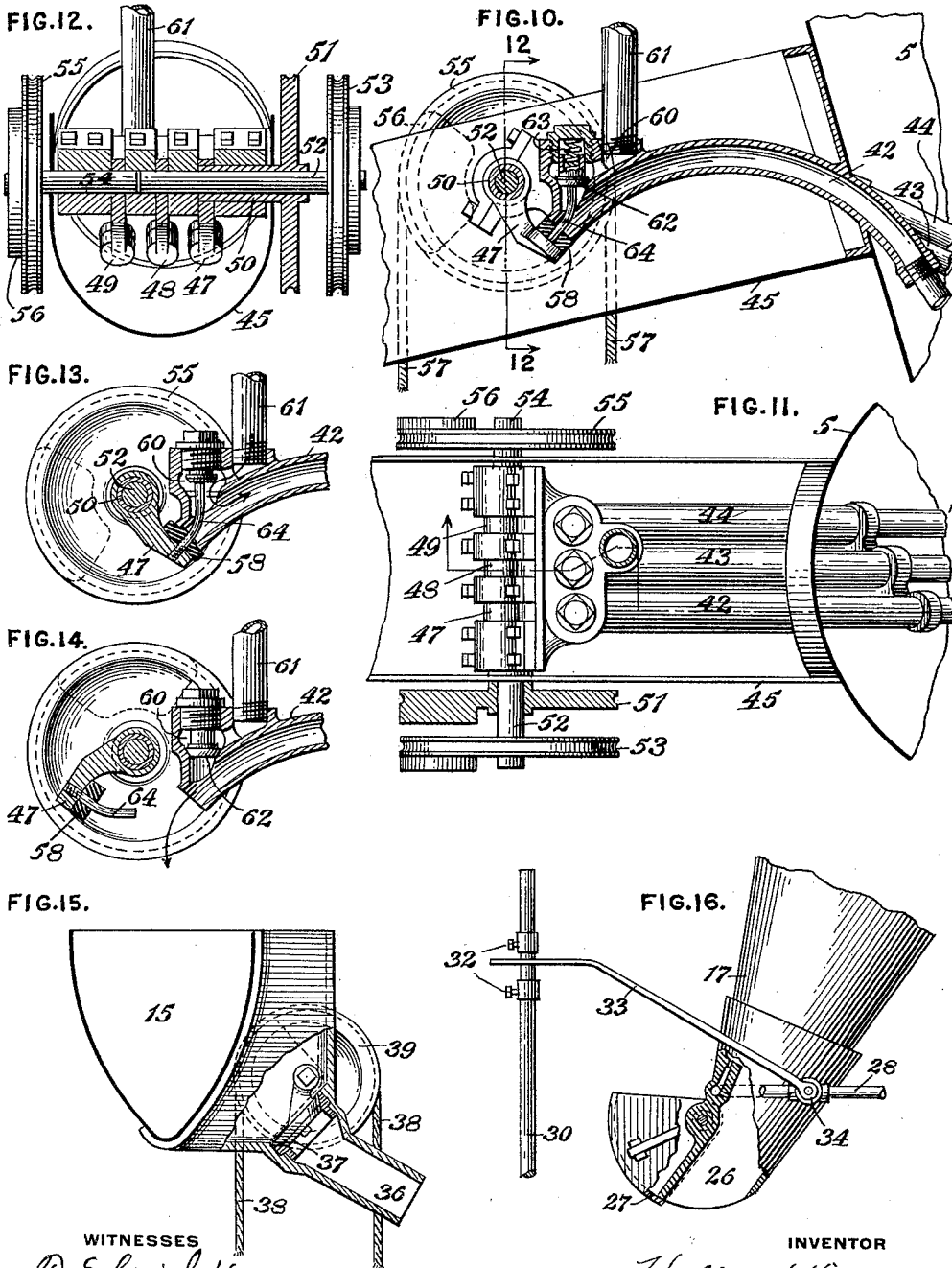


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5 SHEETS—SHEET 5.



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HALBERT K. HITCHCOCK, OF TARENTUM, PENNSYLVANIA.

APPARATUS FOR APPLYING ABRASIVES TO GRINDING APPARATUS.

1,056,415.

Specification of Letters Patent.

Patented Mar. 18, 1913.

Application filed July 31, 1911. Serial No. 641,483.

To all whom it may concern:

Be it known that I, HALBERT K. HITCHCOCK, a resident of Tarentum, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Apparatus for Applying Abrasives to Grinding Apparatus, of which the following is a specification.

This invention relates to apparatus for handling, grading and applying finely divided material mixed in water, such as sand or other abrading material for use with grinding machines.

In the grinding and smoothing of material requiring a fine surface such as plate glass, marble and granite, it is desirable after the abrasives have passed between the material to be ground and the runners or rubbing bed, that the finer particles be separated from the coarser ones and saved to be used in the finishing operation, and the coarser particles returned to the grinder to assist in the roughing operations.

The object of the present invention is to provide apparatus for grading and applying such materials wherein the supply to and withdrawal of the material from the grading vessel goes on simultaneously, the finer material being held back during the roughing operation for the subsequent smoothing and finishing operation.

Further objects of the invention are to provide apparatus whereby the proper ratio of the water to the sand or other abrading material may be regulated; and providing apparatus which is simpler and less expensive than that heretofore suggested, and to provide for starting the finishing operation at any time and bringing it to a speedy close by a series of steps or jumps from a coarse to a fine grade, as will be fully described hereafter.

In the accompanying drawings, Figure 1 is a diagrammatic plan view of the apparatus; Fig. 2 is a vertical elevation on the line 2—2, Fig. 1, looking in the direction of the arrows; Fig. 3 is a vertical elevation at right angles to that of Fig. 2 on the line 3—3, Fig. 2, looking in the direction of the arrows; Fig. 4 is a vertical sectional view through the preliminary grading vessel or cone; Fig. 5 is in part a side elevation and in part a vertical section through the sand receiving reservoir or hopper and the grad-

ing vessel or cone used in connection therewith; Fig. 6 is in part a vertical section and in part an elevation of the fine sand cone and parts connected thereto; Fig. 7 is a detail view showing the suspending means of the fine sand cone at right angles to the position seen in Fig. 6, being a section on the line 7—7, Fig. 6; Fig. 8 is an enlarged sectional view of the valve controlling the outlet from the fine sand cone; Fig. 9 is a horizontal section on the line 9—9, Fig. 8; Fig. 10 is a vertical sectional view through the discharge mechanism from the secondary grading cone; Fig. 11 is a plan view of the same; Fig. 12 is a transverse vertical section through the valves on the line 12—12, Fig. 10; Figs. 13 and 14 are detail views showing different positions of a valve; Fig. 15 is a detail sectional view through one of the troughs and spout connected thereto; and Fig. 16 is a detail view showing means for controlling the flow of sand from the receiving hopper or reservoir.

In my Patent No. 934,441 issued September 21, 1909, is described and claimed a certain process for grading fine material in suspension, and in my Patent No. 934,612, September 21, 1909, I have illustrated and described certain apparatus for grading material, conducting the same to a grinding apparatus and then returning it for re-grading. The operation of the apparatus for grading or separating the material into grades of the present application has certain general resemblances and follows the same broad principle as that described in my Patent No. 934,441 above identified.

In the use of the apparatus illustrated in Patent No. 934,612, part of the material after being graded is deposited in tanks or bins from which it is taken to the grinding machines as necessary or desired, and upon the return from the grinding machines is re-graded and again deposited in such tanks or bins. The material is not continuously mixed with the liquid in which the grading is effected, nor is there a continuous cycle, that is, a withdrawal of material from the grading apparatus simultaneously with its introduction thereto, but rather an interrupted or intermittent cycle. Consequently, the apparatus was comparatively large and expensive.

The present invention has for its purpose

to provide simpler and less expensive apparatus in which a continuous uninterrupted cycle with the abrading material in suspension or mixed with the liquid is carried on, so that the material can be handled at less cost and with less labor than with the apparatus shown in my prior patent.

In the drawings I have illustrated apparatus and herein will describe the same for grading abrading material and applying the same for glass grinding operations, but it will be understood that certain features of the invention are applicable to grading materials and applying them to other purposes.

As illustrated, a series of grinding tables 1 each provided with a pair of runners 2 of the usual form, are served from a single preliminary grading vessel or cone indicated at 4, while each of the individual tables is provided with its own individual grading vessel or cone 5, which is hereinafter designated the secondary grader to distinguish it from the preliminary grading cone 4. These graders are arranged to re-grade the used and new material so as to retain all of the material coarser than a given size. The grinding tables 1 may be of any kind or type but are shown of a conventional type largely used for grinding plate glass. These are so well understood that specific description thereof is unnecessary. The gutter 6 around each of these tables is connected by cross gutter 7 with the main gutter 8 which conveys the water and used abrading material over a screen 8^a to the pit or sump 9 from which it is pumped to the large grading vessel or cone 4 and re-graded. The very fine or scummy material from grader 4 escapes through overflow pipe 10 and thence through conduit 11 to the sewer, the conduit 11 also carrying the overflow from the sump 9. The finest grade of sand from grader 4 escapes through outlet 12 near the top of the cone to trough 13, whence it is distributed to the several fine sand cones 14, one preferably located at each grinding table. The coarser grades of sand from the cone 4 are discharged into the trough 15 and are thereby conveyed to the secondary grading cones 5 at the several tables, and from the latter delivered again to the grinding tables after being properly graded as will hereinafter be more fully apparent.

The fresh abrading material or sand is taken from any suitable source and deposited in reservoirs or hoppers 17, one located at each grading table. The drawings indicate two modes of delivering the sand into such hoppers; one being by clam shell bucket 18 running on the telfer 19 and receiving the supply from sand pile 20; the other being by a conduit 21 with branches 22 extending over the hoppers 17 and provided with controlling valves 23 and serv-

ing to deliver the sand to said hoppers in suspension in water. The surplus of water escapes through overflow pipes 24 to a conduit 25 which discharges into the main gutter 8 or other suitable place.

The hopper 17 and the means for discharging the sand therefrom may be of various constructions and kinds, but preferably is of the form illustrated, described and claimed in my application for patent filed concurrently herewith, Serial No. 641,482 and in which the sand is removed from the hopper by admitting water into the lower part thereof. As shown, the discharge orifice 26 in the lower end of the hopper is closed by means of the valve 27 and the water is introduced into the lower end of the hopper through pipe 28. Preferably the admission of the water into the said hopper from below is controlled automatically by the density of the mixture of water and sand in the grading cone 5. To this end there projects into the said grading cone a hydrometer 30 (see Figs. 3 and 5) guided in a suitable guide 31 and provided near its upper end with adjustable stops 32 between which is located the end of lever 33 connected to an ordinary control cock 34 in the water supply pipe 28. These parts are so arranged that when the mixture in the cone 5 is sufficiently dense, the hydrometer is elevated and through the stop 32 and lever arm 33 closes valve 34, thereby stopping the delivery of more sand to cone 5. When the density of the mixture in the cone is reduced sufficiently, the hydrometer drops and the upper collar 32 contacts with the lever arm 33 and opens the valve 34 to admit water into the reservoir 17 and restarts the delivery of sand from said hopper. In this way an automatic regulation of the density of the mixture in the grading cone is effected during the roughing or facing operation. Each of cones 5 also receives the coarser portion of the material which comes from the tables, through the regrading cone 4. This material is received from trough 15 which, opposite each of the secondary grading cones 5, is provided with a spout 36 arranged to discharge into the cone 5. Each of these spouts is controlled by a valve 37 operated by a rope or the like 38 running on sheave 39 connected to the axis on which the valve is mounted, so that the supply of sand coming through trough 15 to each one of the grading cones 5 can be controlled at will.

Each of the grading vessels 5 is preferably of the shape shown on the drawing, that is, of inverted cone shape, and is adapted to receive the material mixed with water from above. The grading is preferably effected by maintaining in such cone an upward flow of water whereby the material is divided into various strata depending upon

the ratio of the weight of the different particles of material to the resistance offered to falling down in the upward current of water, all as described in my Patent No. 934,441 above identified. The upward flow of water is provided through the lower end of the cone by means of supply pipe 40. The action of the upward flow of water in the conical vessel separates the material into various grades, the coarsest being at the bottom and successive layers decreasing in coarseness toward the top. The very fine or scummy material, as well as surplus water, escapes through overflow pipe 41 which connects at 42 with the gutter 6 of the grinding table.

In order to separately withdraw the grades from the grading vessel, there are projected into said vessel a series of pipes 42, 43 and 44, in number depending upon the number of grades to be separately withdrawn. The lower inner ends of these pipes are at different heights in the grading vessel and each ends approximately in the strata or zone of the grade which it is desired to withdraw through that pipe. All of these pipes extend through the side of the cone at substantially the same level and the outer ends bend downwardly somewhat as shown in Figs. 2 and 5, and all are arranged to discharge into the spout 45 which in turn discharges into the trough 46 which projects over the grinding table, preferably between the runners as shown, and is perforated to discharge the mixture of sand and water onto the table. The discharge ends of these pipes are controlled by independent valves, the valves being numbered respectively 47, 48 and 49, Figs. 10, 11, 12. The valve 47 is secured to a tubular shaft 50 provided with operating sheave 51; the valve 48 is connected to shaft 52 which extends through hollow shaft 50 and is provided with operating sheave 53; and the valve 49 is secured to shaft 54 provided with operating sheave 55. Each of these operating sheaves is weighted, as at 56, so that when closed the weight keeps the valve closed against the head or pressure of the mixture in the tank, and when opened this weight keeps the valve open. Each sheave is provided with a rope or similar device 57 for operating the same. Each of the valves is provided with a soft packing or face 58 adapted to seat against the open end of the pipe and close the same. The mixture of sand and water is forced out of the pipes when they are open by the pressure of the head in the cone 5, but this pressure is not so great but that when the valve closes the end of the pipe the outflow immediately ceases, but as soon as a valve is opened the flow through the open pipe is set up. As soon as the valve is again closed, the sand which is in the pipe drops out of the same

back into the cone 5, due to the fact that there is no upward flow of water in the pipe, so that the sand gradually drops down until it escapes through the inner open end of the pipe. Consequently, these pipes will not ordinarily clog, but on the contrary while no mixture is being withdrawn there-through, they are filled with nearly clear water. In case sand or anything else should clog in any of these pipes from any cause, I have provided the following arrangement for clearing the same: The outer ends of the withdrawal pipes are connected to a suitable chamber 60 which is supplied with water under pressure through pipe 61. From chamber 60 there are ports leading into the outer ends of all of the withdrawal pipes, each of which ports is controlled by a check valve 62 controlled by spring 63 to normally close communication from chamber 60 to the end of the withdrawal pipe. To unseat the valve 62 and open communication from chamber 60 to the withdrawal pipe, the flap valve 47 is provided with a projection or prong 64 of sufficient length to contact with the check valve 62 and lift it from its seat when the rubber facing or packing 58 is compressed. The normal condition of the closed valve is shown in Fig. 10 with the projection or prong 64 barely contacting with valve 62 but without lifting the same from its seat. Should, for any cause, one of the withdrawal pipes become clogged, the rope 57 is pulled upon in such a direction as to forcibly compress the packing 58, as shown in Fig. 13, which permits the prong 64 to lift the valve 62 from its seat. Water under pressure from the supply pipe 61 now flows inwardly and downwardly through the clogged pipe and washes out of the same the clogging material. Fig. 14 illustrates the position of the valve when open to permit material to be withdrawn from the cone 5.

Each of the valves 47, 48 and 49 is independently controlled and this permits the withdrawal of the several grades separately and independently and to any extent or degree. In other words, it is not necessary to withdraw all of the grades lying between any two planes before taking out or beginning to take out the upper or finer grade. This enables the finishing operation to be brought to a speedy conclusion, whereas with the prior apparatus where the different grades were withdrawn through a common outlet, it was necessary to entirely withdraw all of the grades before the finest could be taken out. When the material in any layer is withdrawn that immediately above drops down to take the place of the withdrawn layer, and as the withdrawal continues through any one pipe the material being withdrawn gradually becomes finer and finer. The withdrawal through any one pipe can be stopped whenever desired, and

any one of the higher pipes opened. This enables the material to be withdrawn in a series of steps or jumps and enables the finishing operation to be started at any time and to be brought to a speedy conclusion.

In the application of abrading material, and particularly for grinding and smoothing plate glass, it is advantageous to vary the amount of water mixed with the sand of various grades. With the coarser grades a small ratio of water can profitably be used, while with the finer grades the ratio of water preferably should increase. In my patent hereinbefore described, this regulation of the ratio of water to the sand for the different grades was secured by means of a float located in a suitable vessel and controlling the valve which controlled the amount of water entering the grading cone. In the apparatus illustrated in this application, this regulation is automatically effected without such float and regulating valve by properly proportioning the shape or lines of cone 5 and properly locating the points of withdrawal of the different grades therefrom; that is to say, the different heights at which the withdrawal pipes terminate in said cone. By properly designing the shape of the cone and having the several withdrawal pipes project down into the cone to exactly the right points, I am enabled to automatically and properly regulate the ratio of water to the sand, so as to secure the increasing ratio of water to the sand for the finer grades. This considerably simplifies the apparatus over that illustrated in my prior patents.

The large or preliminary grading cone 4, receives the mixture of water and sand as it comes back from the tables from the sump or pit 9. This mixture is discharged upwardly into the said cone through its lower end by means of a rotary pump 66, shown as of the centrifugal type having connected to its inlet a conduit 67 which dips down in the pit 9 and having its discharge arranged to project the mixture up into cone 4. This pump can be operated in any suitable way, such for instance as by the electric motor 68.

The cone 4 in its general construction is similar to the cone 5 and has the same general arrangement of pipes and controlling valves as already described for withdrawing the material therefrom and its action is preferably the same as that described in my Patent No. 934,441 in connection with Fig. 3. As shown, there are in this cone four discharge pipes 70, 71, 72 and 73 for withdrawing the coarser grades of material and an upper discharge pipe 12 for withdrawing the finest grade and delivering the same to the trough 13 which conveys it to the fine sand cone as heretofore described. All of the other discharge pipes discharge into the

trough 15 which conveys the mixture to the several cones 5. Therefore, after grading the material into five grades in cone 4, four of those grades are again mixed in trough 15 and are re-graded in the cones 5. The purpose of taking out of the cone 4 the several independent grades through pipes 70, 71, 72 and 73 is to remove as quickly as possible all of the coarser material and thus insure having the uppermost grade which escapes through outlet 12, very carefully selected. As a consequence, a very careful grading or selection of the upper or fine material is secured. Each of the fine sand cones 14, therefore, receives its supply from the stop stratum of the preliminary re-grading cone 4. The sand from these fine sand cones is withdrawn only at the end of the grinding operation so as to effect the final or finishing grinding. Each of these cones is arranged to automatically control the delivery of the fine sand thereinto, and to discharge said sand through an outlet 80 in its bottom directly into the trough 46.

For the purpose of regulating the supply of sand into the cone 14, the following arrangement is provided:—The cone is suspended by means of a bail or stirrup 81 from the short end of lever 82 fulcrumed at 83, and having on its long arm adjustable counterweights 84. The short arm of the lever has connected thereto a link 85 attached to the stem 86 of a valve 87 which controls the discharge spout 88 from trough 13. Until the mixture in the cone 14 acquires the proper density, the cone together with connected parts, is overbalanced by the weights 84, in which condition the weights 84 are depressed from the position shown in Fig. 6. The short end of lever 82 is elevated and valve 87 lifted to open the inlet to discharge spout 88 so that the mixture of fine sand and water flows into the cone 14. As soon as the mixture in the cone 14 has reached the desired density, it overbalances the counter weights 84, lifts the latter and depresses the short end of lever 82, thereby forcing valve 87 downwardly to close the inlet to spout 88 and shutting off the supply of fine sand and water to the cone 14. It is understood, of course, that the trough 13 is stationary. When the cone 14 drops as described, the lever 82 is locked in the position shown in Fig. 6 by means of a dog 90 provided with a lug or shoulder 91 adapted to engage a lug 92 on the lever and prevent counterweights 84 from dropping until dog 90 is released, which can be done by means of the rope 93 attached to an arm 94 on the said dog. A spring 95 normally holds the dog against the stop 92. This holds the valve 87 closed until the fine sand cone has been emptied to the desired degree. When the latter occurs, a workman pulls on the rope

93, withdraws dog 90 from lever 82, which permits counterweights 84 to again lift the cone and valve 87.

The fine sand in the cone 14 is graded therein by an upward current of water which is introduced into the bottom of the cone through the pipe 97 which projects down centrally in the cone and is open at its lower end, this pipe having a supply connection 98. The surplus water escapes through the overflow 99. The effect of this is to further grade the fine sand in the cone 14, bringing the coarser sand at the bottom and gradually increasing in fineness toward the top so that when withdrawn through the bottom discharge orifice, the finishing sand gradually becomes finer and finer.

The discharge orifice 80 of the fine sand cone is controlled by a valve 100 which is secured to a stem 101 guided in the lower end of tube 97, said stem being fluted or grooved, as at 102, so that it cannot stop the flow of water from the pipe 97. Connected to the valve stem 101 is a rod 103, extending upwardly above the cone and connected to one end of lever 104, fulcrumed at 105, and having connected to its opposite end an operating rod 106. By pulling down on the latter, the valve 101 is lifted to open the discharge orifice, and the fine sand and water will then escape from the cone 14.

In the use of the apparatus the sand is deposited in hopper 17, is washed out of the same by opening valve 34, and passes, mixed with water, into the grading tank or cone 5 where it meets an upward current of water of gradually diminishing velocity toward the top, and settles down in the water in said tank until it reaches a state of equilibrium, which depends upon the size and physical characteristics of the particles of sand, so that they are thereby divided or separated into several grades or sizes. The grades are withdrawn and conducted separately to the grinding table by opening the appropriate valve 47, 48 or 49, controlling the several withdrawal pipes from said cone. The sand and water from the grinding table escapes into gutter 8 and passes then to sump 9. On the grinding table more or less of the sand is pulverized to a degree of fineness which incapacitates it for further service as an abrasive. The sand mixed with water, is drawn from sump or pit 9 and discharged upwardly into the preliminary grading tank or cone 4. The stream of water carrying the same up into the cone gradually diminishes in velocity upwardly and the different particles of sand seek their strata of equilibrium, the same as in the tank or cone 5, and being thereby separated into a series of grades or sizes. The very fine particles, too fine to be of use,—scum, dirt and other impurities, wash out through the overflow 10 to the sewer. The

coarser grades of material are withdrawn from this tank through discharge pipes 70, 71, 72 and 73, being returned to the grading tank 5, while the finest grade is deposited in the finishing cone 14, to be withdrawn therefrom whenever the grinding operation has reached the stage for the final or finishing operation. During the coarse grinding or roughing, the coarser grades (or even the coarsest grade only) are taken from the vessel or cone 5 to the table, and simultaneously the material from all the grades, except the finest in cone 4, are returned to the cone 5 for re-grading, and fresh material is also supplied to the cone 5 from reservoir 17, this supply being controlled by the density of the mixture in the cone 5. When the roughing or facing operation is substantially completed, the supply of material to the cone 5 is cut off by closing valves 34^a and 37. The operation then continues with the withdrawal from the cone 5 of the several grades in succession, or by steps or jumps, as above described and to the extent desired or necessary, the material becoming finer and finer, and after this has been carried far enough, further withdrawal from cone 5 ceases and the finishing or smoothing is completed by withdrawing entirely from the fine sand cone 14, when, again, the material withdrawn gradually increases in fineness from the bottom to the top. During the rough grinding there is a continuous circulation of the abrading material in water, from cone 5 to the grinding table, thence to pump 9, thence into cone 4, and thence by trough 15 back to cone 5. The portion of material too fine for further use is washed by the overflow into the sewer and the finest usable grade is conveyed to the fine sand cone 14 for the finishing operation. Simultaneously therewith fresh material is being added to cone 5 to make up for the fine material washed into the sewer and that taken to the fine sand cone. During the roughing or facing operation when the sand is being admitted into the tank 5 from the hopper 17 and the trough 15, it is possible to shut off the inflow of water through the pipe 40, in which case the heavier particles of sand on account of their greater weight in proportion to their resistance to the water, fall rapidly to the bottom of the cone 5 and are withdrawn through pipe 42. The finer particles of sand, requiring a much longer time to fall down into the liquid, have a tendency to remain in suspension higher in the cone, and as long as the coarse sand is withdrawn through the pipe 42 as rapidly as it is accumulated in the bottom of the cone 5 fairly satisfactory results may be obtained, but I prefer to introduce through the pipe 40 enough water to more than equal the volume of mixture being withdrawn through pipe 42 which causes a

continuous upward flow of water in the cone 5 and prevents any of the finer particles of sand coming down and being mixed with the coarser grades which are being withdrawn through the pipe 42, as would be the case were the water shut off from the pipe 40 or when the volume of water introduced through the pipe 40 is less than the volume of water being discharged through the pipe 42.

With this apparatus there is a continuous and uninterrupted cycle of the abrading material, constantly or practically constantly, in a state of suspension, or at least mixed with water. No storage place is necessary or required and therefore, the labor of handling is reduced practically to a minimum, and the apparatus is of less size and less expensive than where storage must be provided for. The apparatus is so designed that the graded material is withdrawn from the grading tanks and is discharged into said tanks simultaneously, *i. e.* both operations going on at the same time, but without interfering with the accuracy of the grading. This does away with the necessity of storage places or tanks, and permits the use of very much smaller and less expensive tanks or cones than with my prior form of apparatus.

What I claim is:

1. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising in combination, grinding mechanism, a preliminary grading tank, a secondary grading tank in position to discharge to the grinding mechanism, means for producing in both of said grading tanks a downward flow or travel of the material relative to the liquid, and a conduit for withdrawing liquid and material from the lower strata of the preliminary grader and conducting the same to and discharging the same directly into the secondary grader.

2. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising in combination, grinding mechanism, a preliminary grading tank arranged to receive the material from the grinding mechanism, a secondary grading tank in position to discharge to the grinding mechanism, means for producing in both of said grading tanks an upward flow of liquid, and a conduit arranged to withdraw liquid and material from the lower strata of the preliminary grader and conducting the same to and discharging the same into the secondary grader.

3. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising in combination, grinding mechanism, a preliminary grading tank arranged to receive the material from the grinding mechanism, a secondary grading tank in position to discharge to the grinding

mechanism, means for producing a downward travel of the material relative to the liquid in both of said tanks, a conduit for conducting liquid and material from the preliminary grading tank and discharging the same into the secondary grading tank, and means for independently withdrawing the liquid and material from the different strata of said secondary grading tank.

4. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising in combination, grinding mechanism, a preliminary grading tank arranged to receive the material from the grinding mechanism, a secondary grading tank in position to discharge to the grinding mechanism, means for producing a downward flow or travel of the material relative to the liquid in both of said tanks, means for independently and separately withdrawing material from different strata in both of said tanks, and a conduit for conducting material from the preliminary grading tank and discharging the same directly into the secondary grading tank.

5. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising in combination, grinding mechanism, a pair of grading tanks in position to discharge to the grinding mechanism, a preliminary grading tank arranged to receive the material from the grinding mechanism and having means for producing a flow of liquid upwardly therein, and means for conveying the liquid and abrading material from one level of the preliminary grading tank to one of the tanks in position to discharge to the grinding mechanism and for conveying the liquid and abrading material from a different level of the preliminary grading tank to the other of said pairs of tanks.

6. In apparatus for applying abrading material to grinding and smoothing mechanism, the combination of grinding mechanism, a preliminary grading tank, a secondary grading tank, each provided with means for independently discharging material therefrom at different levels, a conduit for conducting the liquid and material from the grinding mechanism to the preliminary grading tank, a conduit for conducting the liquid and material from the preliminary grading tank and depositing the same directly in the secondary grading tank, and means for delivering material separately from different levels from the second grading tank to the grinding mechanism.

7. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising in combination grinding mechanism, a preliminary grading tank and a second grading tank each provided with means for independently discharging material therefrom from different levels, a fin-

ishing tank, a conduit for conducting the liquid and abrading material from the grinding mechanism to the preliminary grading tank, a conduit for conducting the liquid and material from the upper portion of the preliminary grading tank to the finishing tank, and another conduit for conducting the liquid and material from the lower strata of the preliminary grading tank to the secondary grading tank, and conduits for conducting the material from the finishing tank and second grading tank to the grinding mechanism.

8. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising in combination, grinding mechanism, a preliminary tank arranged to receive the material from the grinding mechanism, a secondary tank in position to discharge to the grinding mechanism, means for maintaining the material in suspension in liquid in both of said tanks, and a conduit for withdrawing liquid and material from the preliminary tank and conducting the same to and discharging the same directly into the secondary tank.

9. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising in combination, grinding mechanism, a preliminary grading tank arranged to receive the material from the grinding mechanism, a secondary grading tank in position to discharge to the grinding mechanism, means for maintaining the material in suspension in liquid in both of said tanks, a conduit for conducting liquid and material from the preliminary grading tank and discharging the same into the secondary grading tank, and means for independently withdrawing the liquid and material from the different strata of said secondary grading tank.

10. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising in combination grinding mechanism, a preliminary grading tank arranged to receive the material from the grinding mechanism, a secondary grading tank in position to discharge to the grinding mechanism, means for maintaining the material in suspension in liquid in both of said tanks, means for independently and separately withdrawing liquid and material from different strata in said tanks, and a conduit for conducting liquid and material from the preliminary grading tank and discharging the same into the secondary grading tank.

11. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising a tank in position to discharge to said mechanism, a hopper provided with a valve controlled outlet in its bottom arranged to discharge to said tank, and means controlled by the density of the

mixture in said tank for controlling the discharge from said hopper to said tank.

12. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising a tank in position to discharge to said mechanism, a hopper provided with a valve controlled outlet in its bottom in position to discharge to said tank, and a water supply arranged to introduce a stream into the bottom of said hopper to thereby remove the material therefrom.

13. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising a tank in position to discharge to said mechanism, a hopper provided in its bottom with a discharge orifice in position to discharge to said tank, a valve controlled water supply to the bottom of said hopper, and means controlled by the density of the mixture in the tank and acting on said valve to control the supply of water to the bottom of said hopper.

14. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising in combination, a tank in position to discharge to said mechanism, a hopper provided with a discharge opening in position to discharge to said tank, a valve controlled water supply to said hopper, a hydrometer in said tank, and connections therefrom to said valve for cutting off the water supply to said hopper upon a predetermined density of mixture in said tank.

15. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising in combination, grinding mechanism, a grading tank, means for maintaining the material in suspension in a liquid in said tank, and means for independently and separately withdrawing material from different levels in said tank and conducting the same to said grinding mechanism.

16. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising in combination, grinding mechanism, a grading tank, means for maintaining the material in suspension in a liquid in said tank, means for separately and independently withdrawing material from different levels in said tank and conducting the same to said grinding mechanism, and means for conducting the used material mixed with the liquid from the grinding mechanism to said tank.

17. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising in combination, grinding mechanism, a grading tank, means for maintaining the material in suspension in a liquid in said tank, a plurality of withdrawal pipes terminating at different levels in said tank, a valve controlling each of said withdrawal pipes whereby material can be separately and independently withdrawn from different

levels in said tank, and a conduit receiving the material from each of said withdrawal pipes and arranged to conduct the same to the grinding mechanism.

18. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising in combination, grinding mechanism, a grading tank, means for maintaining the material in suspension in a liquid in said tank, a plurality of withdrawal pipes terminating at different levels in said tank, a valve controlling each of said withdrawal pipes whereby the material can be separately and independently withdrawn from different levels in said tank, a conduit receiving the material from each of said withdrawal pipes and arranged to conduct the same to the grinding mechanism, and means for returning the used material mixed with the liquid from the grinding mechanism to the grading tank.

19. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising in combination, grinding mechanism, a grading tank, means for maintaining the material in suspension in a liquid and material from the grinding mechanism and discharging the same into the grading tank, and means and a conduit arranged to simultaneously conduct the graded material directly from the grading tank to the grinding mechanism.

20. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising in combination, grinding mechanism, a grading tank, means for maintaining the material in suspension in a liquid in said grading tank, a conduit and means for returning the material from the grinding mechanism and discharging the same into said grading tank, and means acting simultaneously with the introduction of the material into said tank for separately and independently withdrawing material from different levels therein and conducting the same to the grinding mechanism.

21. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising a tank in position to discharge to said mechanism, a conduit for introduc-

ing liquid containing divided material thereinto, means controlled by the weight of the mixture in the tank for cutting off the supply thereto when a predetermined density of mixture in the tank is secured, and manual operated means for maintaining at will the apparatus in condition with the supply cut off.

22. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising a grading tank in position to discharge to said mechanism, a conduit for introducing a liquid containing divided material in suspension thereinto, means controlled by the weight of the mixture in the tank for cutting off the supply thereto, and a lock arranged to hold the apparatus in position with the supply to said tank cut off.

23. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising in combination, a grading tank in position to discharge to said mechanism, means for introducing a liquid containing divided material in suspension into said tank, and a liquid supply pipe extending downwardly into said tank and discharging at the bottom thereof, and an overflow pipe from the upper portion of said tank.

24. Apparatus for applying abrading material to grinding and smoothing mechanism, comprising in combination, a grading tank in position to discharge to said mechanism and having a discharge opening in its bottom, a conduit for introducing a liquid containing divided material in suspension into said tank, an overflow pipe from the upper portion of said tank, a liquid supply pipe extending downwardly into said tank and opening thereinto near its bottom, a valve controlling the discharge opening of said tank and having a stem guided in said liquid supply pipe, and means for operating said valve.

In testimony whereof, I have hereunto set my hand.

HALBERT K. HITCHCOCK.

Witnesses:

MABEL S. THOMPSON,
W. C. LYON.