May 6, 1952 C. C. ALVORD 2,595,559

PLURAL LIQUID UNIT FOR GRINDING MACHINES

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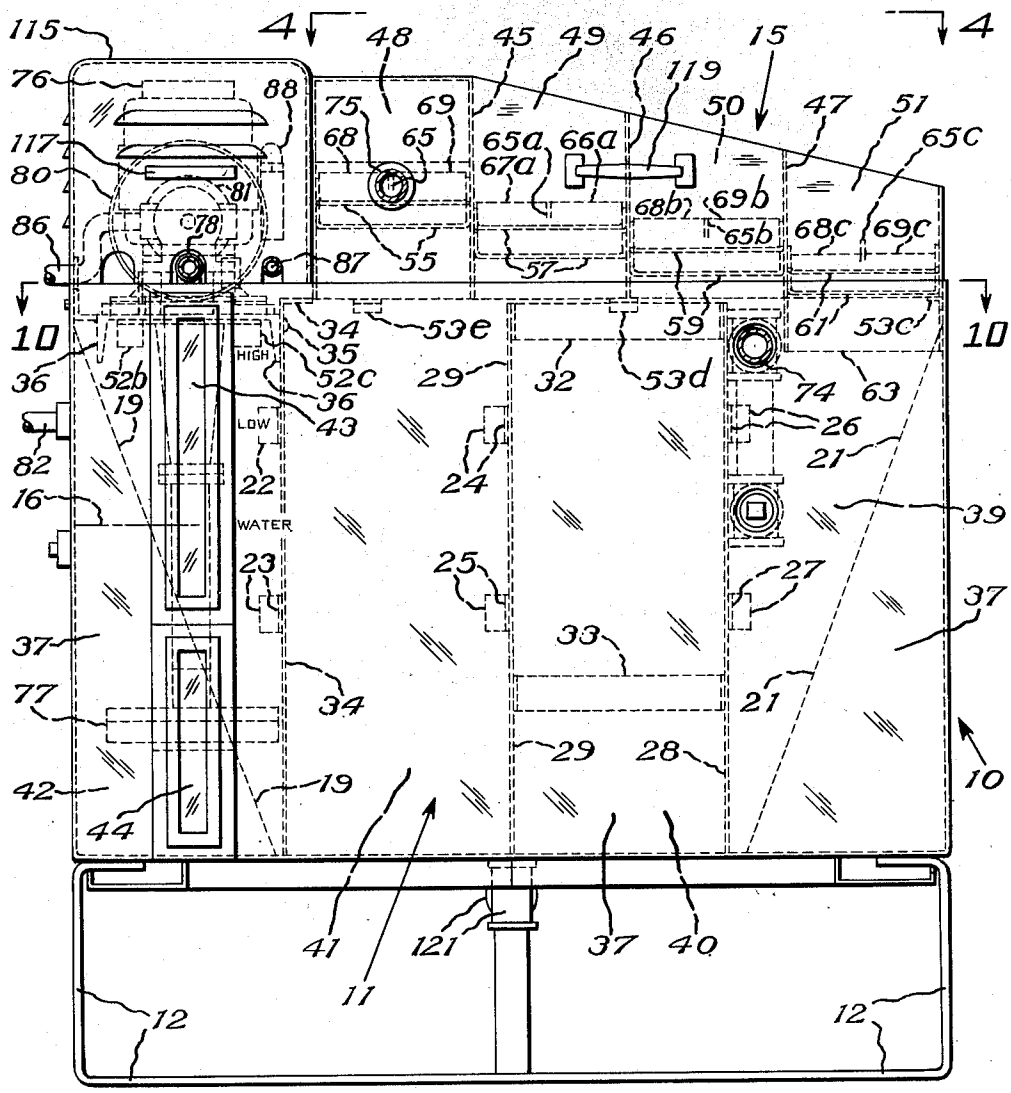


FIG. 1

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PLURAL LIQUID UNIT FOR GRINDING MACHINES

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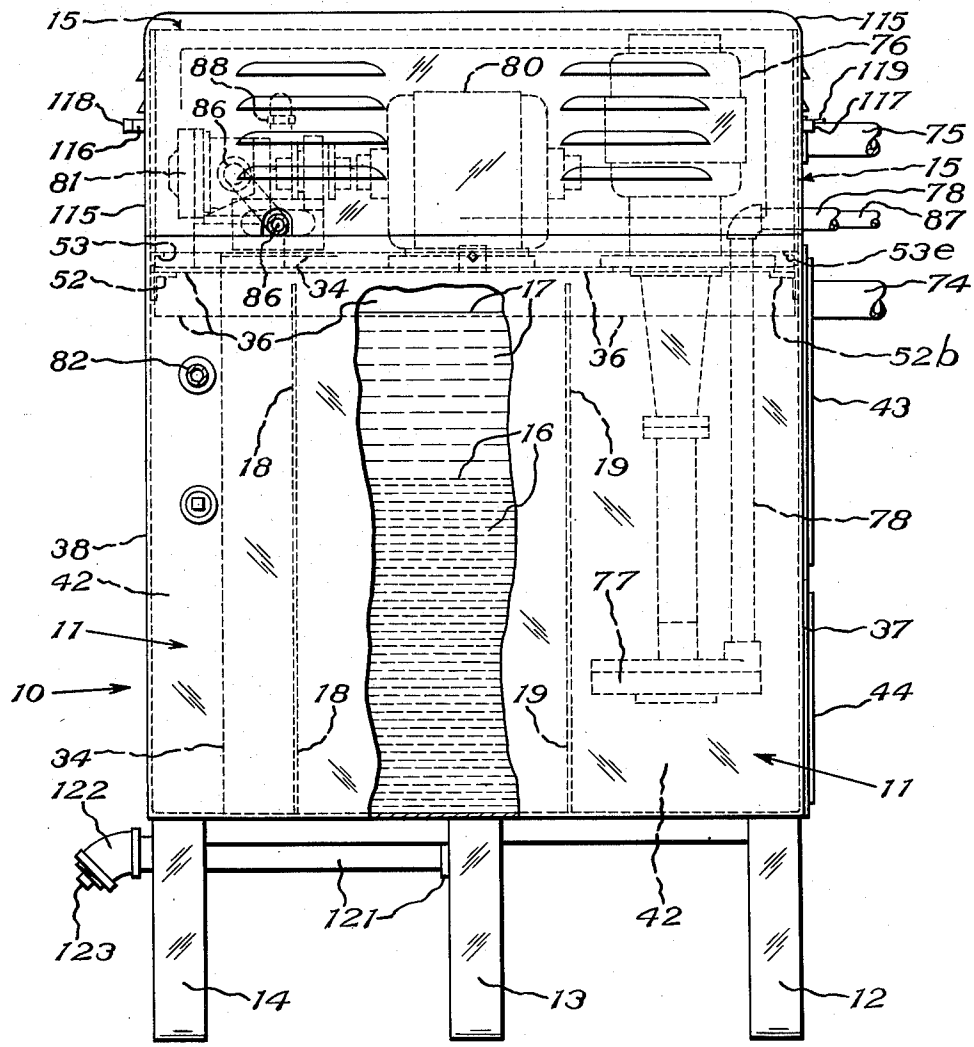


FIG. 2

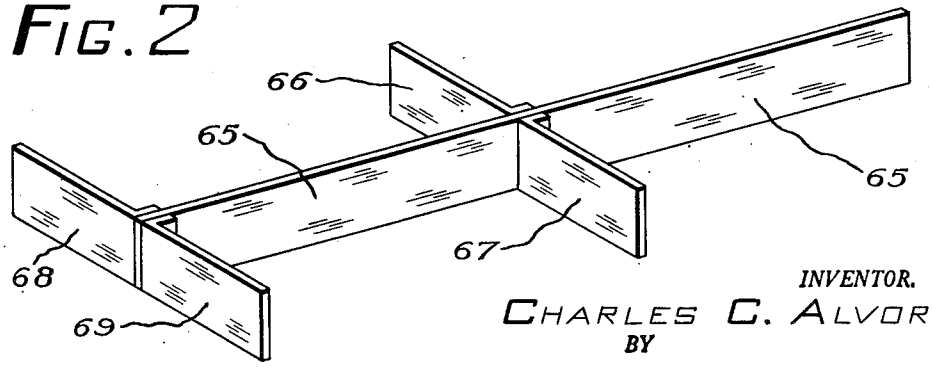


FIG. 3

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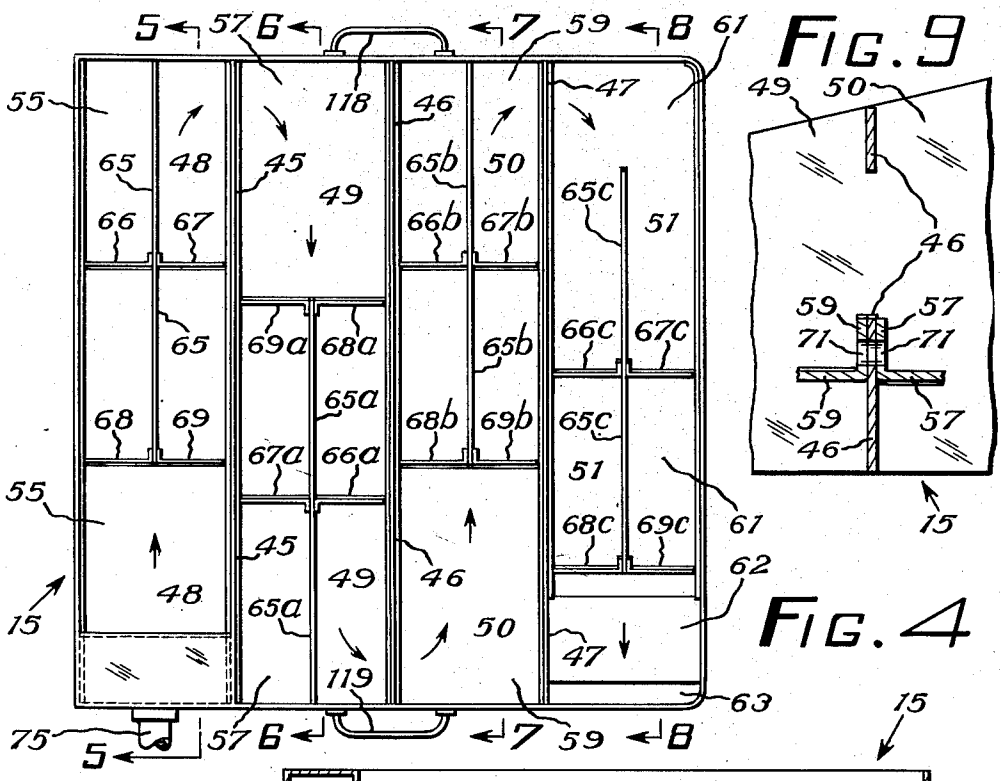


FIG. 9

FIG. 4

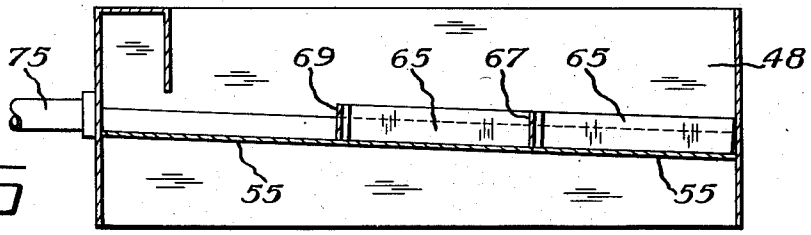


FIG. 5

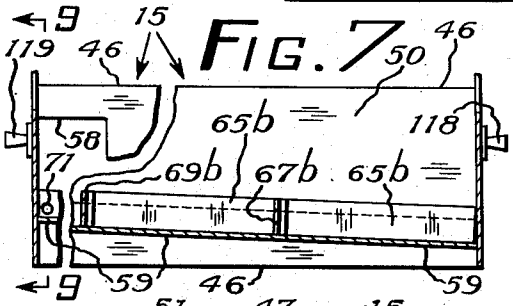


FIG. 7

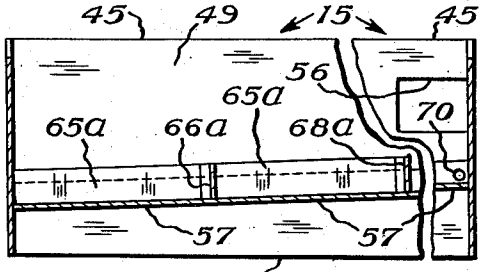


FIG. 8

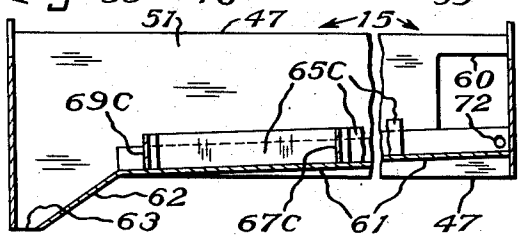


FIG. 6

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PLURAL LIQUID UNIT FOR GRINDING MACHINES

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FIG. 10

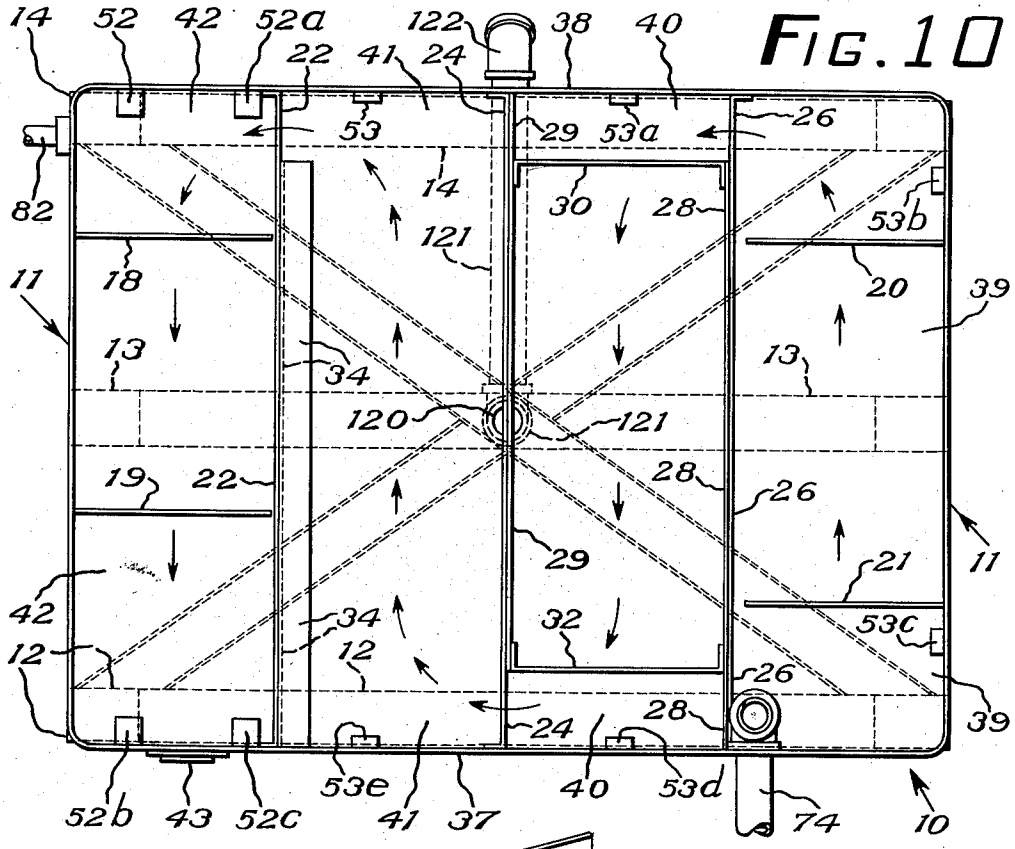
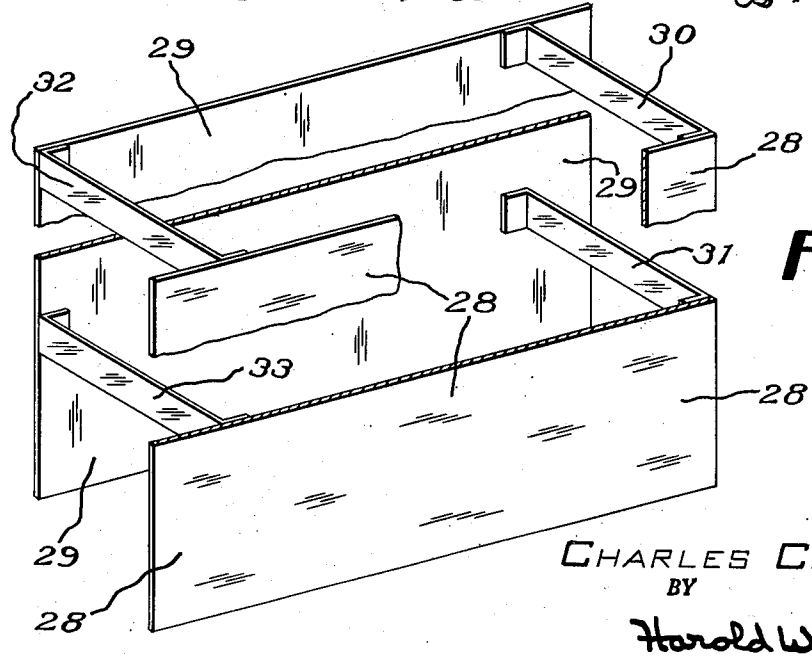


FIG. 11



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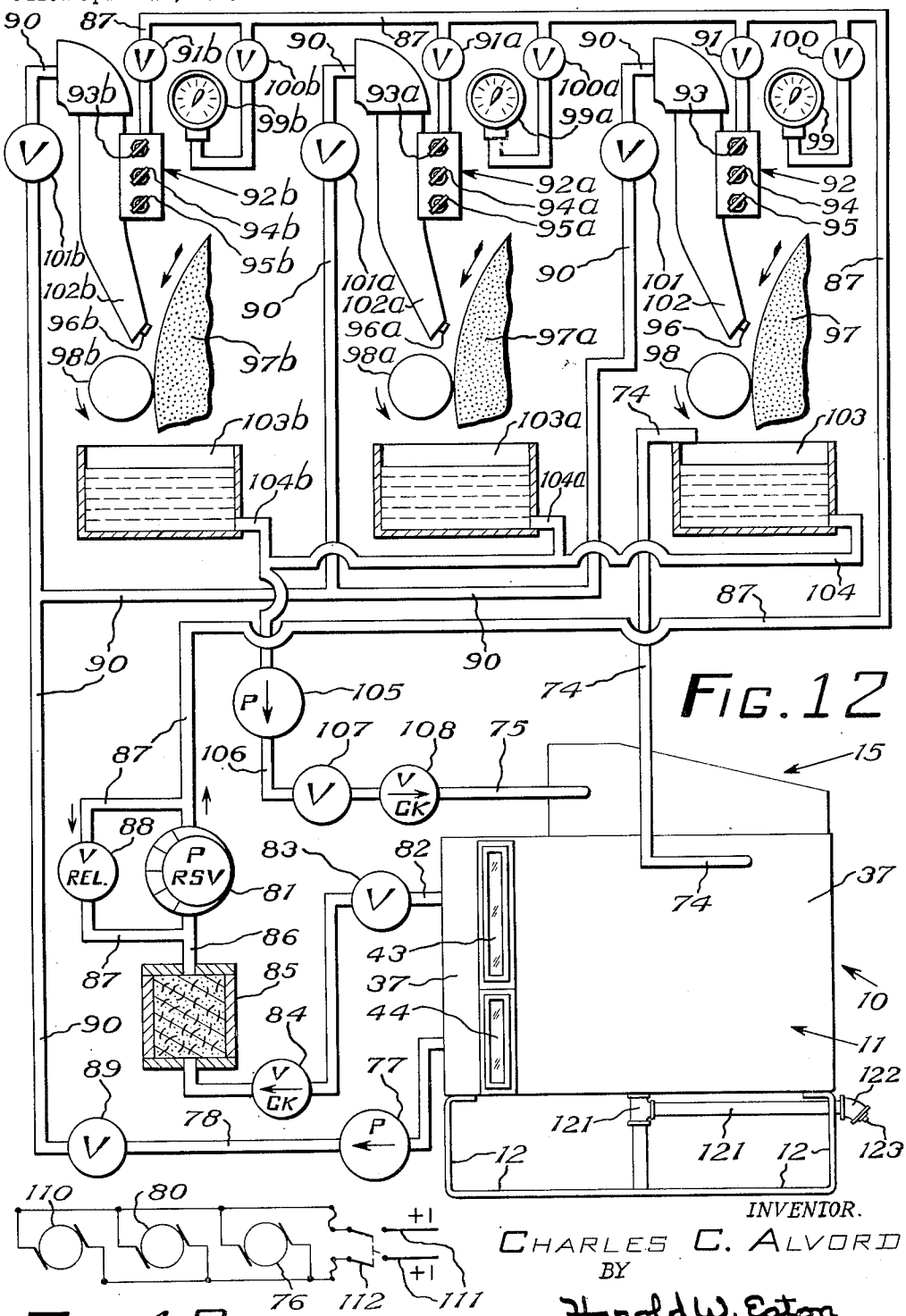


FIG. 12

FIG. 13

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Patented May 6, 1952

2,595,559

UNITED STATES PATENT OFFICE

2,595,559

PLURAL LIQUID UNIT FOR GRINDING MACHINES

Charles C. Alvord, Worcester, Mass., assignor to Norton Company, Worcester, Mass., a corporation of Massachusetts

Application April 28, 1949, Serial No. 90,171

9 Claims. (Cl. 210—52)

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The invention relates to grinding machines and more particularly to an apparatus for applying a cooling fluid to grinding wheels and to the work piece being ground.

In order to provide a clearer understanding of some of the objects and features of this invention, it has been found that by supplying a grinding fluid at a relatively high pressure and relatively small volume to the place of contact between the grinding wheel and the work piece being ground and to supply a coolant fluid to the work piece being ground to cool the same, a more efficient higher rate of grinding operation may be obtained. It has been found that by such a plural fluid apparatus that the grinding wheel surface stands up longer, requires less frequent truing operations and can take much heavier cuts at increased rate of feeds than previously. Such a grinding method and apparatus is disclosed in the prior United States Patent to H. W. Wagner and G. J. Wickstrom No. 2,434,679 dated January 20, 1948 and also in the pending application by H. W. Wagner and G. J. Wickstrom Serial No. 2,505 filed January 15, 1948, now Patent Number 2,475,811, July 16, 1949.

One of the objects of this invention is to provide a simple and thoroughly practical plural fluid supplying apparatus for a grinding machine. Another object of the invention is to provide a unitary plural fluid supplying apparatus which may be of a suitable size and capacity for separately supplying a grinding fluid at a relatively high pressure and relatively low volume and to supply a coolant fluid at a relatively low pressure and relatively large volume to one or a plurality of grinding machines. Another object of the invention is to provide a unitary plural fluid supply apparatus which may be readily applied to either a new grinding machine as manufacture, or may be supplied for converting a grinding machine or machines in the field for a plural fluid grinding method.

Another object of the invention is to provide a compact unitary plural fluid unit which serves to settle-out swarf from the refuse fluid returning from the grinding machine and to facilitate a separation of the grinding fluid from the cooling fluid so that they may be again reconveyed to the grinding machine or machines for further grinding operations.

Another object of the invention is to employ a grinding fluid which is insoluble in the cooling fluid and which readily separates therefrom during gravity flow through the unit at substantially normal room temperature. Another object is to

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provide a unit sufficiently large in size to contain a large volume of both a grinding fluid and a cooling fluid so that the fluids in the unit remain at substantially normal room temperature during operation.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts, as will be exemplified in the structure to be hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings in which is shown one of various possible embodiments of the mechanical features of this invention,

Fig. 1 is an end elevation of the unitary plural fluid unit for grinding machines;

Fig. 2 is a front elevation of the unitary plural fluid unit, partly broken away to show the levels of the two fluids in the unit;

Fig. 3 is a fragmentary perspective view of the trays used in the upper portion of the unit;

Fig. 4 is a fragmentary plan view of the unit, as shown in Fig. 1;

Fig. 5 is a cross sectional view, taken approximately on the line 5—5 of Fig. 4;

Fig. 6 is a similar cross sectional view, taken approximately on the line 6—6 of Fig. 4, partly broken away;

Fig. 7 is a similar cross sectional view, taken approximately on the line 7—7 of Fig. 4, partly broken away;

Fig. 8 is a similar cross sectional view, taken approximately on the line 8—8 of Fig. 4, partly broken away;

Fig. 9 is a fragmentary sectional view, on an enlarged scale, taken approximately on the line 9—9 of Fig. 7;

Fig. 10 is a plan view of the lower or tank section of the unit, with the upper portion or pan thereof removed;

Fig. 11 is a fragmentary perspective view of some of the partitions and spaces used in the lower portion or tank of the unit;

Fig. 12 is a piping diagram, showing the unit connected for supplying a grinding fluid and a cooling fluid to a plurality of grinding machines; and

Fig. 13 is an elementary electrical wiring diagram of the controls for the fluid pump driving motor.

A unitary plural fluid unit 10 is illustrated in the drawings comprising a fluid tank 11 which is supported by a plurality of spaced brackets 12, 13 and 14. The tank 11 serves as a support for a setting tank 15. The tank 11 serves to

contain a supply of cooling fluid 16 and grinding fluid 17. The grinding fluid 17 serves to promote grinding and is hereinafter termed grinding fluid, and may be an oil, such as a mineral, animal, or vegetable oil, preferably treated to embody one or more ingredients, such as sulphur or chlorine compounds, to improve the grinding action. Oils of this nature may be loaded, in a known manner, with such sulphur compounds or chlorine compounds or both, for example sulphur chloride. The oil which is preferably used with this apparatus is a grinding oil of the insoluble type meaning that it is not soluble in water.

The grinding fluid is insoluble in the cooling fluid and is preferably such that it readily separates from the cooling fluid during gravity flow through the unit at substantially normal room temperature. The liquid supplied for cooling the work piece is preferably water.

The tank 11 is preferably formed as a rectangular sheet metal welded-up structure having triangularly shaped reinforcing brackets or plates 18, 19, 20 and 21 which are welded to opposite sides of the tank and also to the bottom thereof. A plurality of transversely extending brackets 22, 23, 24, 25, 26 and 27 are welded to the front and back faces of the tank. These brackets have two functions, namely to reinforce and strengthen the front and back surfaces of the tank and also serve to position and locate partitions within the tank to be hereinafter described.

A pair of partitions 28 and 29 are welded together in spaced relationship with each other by means of brackets 30, 31, 32 and 33 (Fig. 11). It should be noted that in Fig. 10 the partition 28 extends from the side face 37 of the tank 11 to the transverse bracket 30 so that fluid may pass around the upper end of the partition 28 as shown in Fig. 10. Similarly the partition 29 extends from the opposite side face 38 of the tank 11 to the brackets 32 so that there is an open space between the lower end of the partition 29 and the side face 37 so that fluid may pass therethrough. The partitions 28 and 29 being of a unitary construction are arranged so that they fit between the transverse brackets 24—25 and 26—27 respectively so that the partition unit may be readily removed for cleaning out the tank 11.

Another partition 34 (Figs. 1 and 10) is supported against the transverse brackets 22 and 23 and is held in position thereagainst by a plurality of screws 35 which are screw threaded into a transversely extending inverted channel iron 36 bolted to the upper portion of the tank 11. It should be noted in Fig. 10 that the partition 34 extends from the side face 37 of the tank 11 to a point spaced from the side face 38 of the tank 11 so that fluid may flow around the upper end of the partition 34 (Fig. 10). The partitions 28, 29 and 34 serve to divide the tank 11 into a plurality of chambers 39, 40, 41 and 42. Due to the fact that the partitions do not extend across the entire width of the tank, fluid may flow in a tortuous path from the chamber 39 around the upper end of the partition 28, through the chamber 40, around the lower end of the partition 29, through the chamber 41, and around the end of the partition 34 into the chamber 42. This relatively long path of travel of fluid entering at the lower end of the chamber 39, as shown in Fig. 10, serves to facilitate gravity separation of the oil or grinding fluid 17 from the water or coolant fluid 16 as shown in Fig. 2. To facilitate visible indication of the level of the grinding

fluid 17 and coolant fluid 16 in the tank 11, a pair of vertically extending glass or other transparent panels 43 and 44 are provided in the side face 37 of the tank 11.

The channel iron 36 preferably is supported on a plurality of angle-iron brackets 52, 52*a*, 52*b*, and 52*c* (Fig. 10). A plurality of screws or bolts not shown serve to detachably secure the channel iron 36 to the brackets 52, 52*a*, 52*b* and 52*c*, so that the channel iron 36 and the mechanisms supported thereon to be hereinafter described may be readily removed from the tank 11 when desired.

The pan 15 is preferably shaped to fit within the upper portion of the tank 11 and is supported upon a plurality of angle-iron brackets 53, 53*a*, 53*b*, 53*c*, 53*d* and 53*e*. It will be readily apparent that the pan 15 may be readily removed from the tank 11 when desired to facilitate cleaning out the tank when necessary.

It is desirable to provide a relatively long path of flow for the refuse fluid (swarf grinding fluid and cooling fluid) returning from the grinding machine so that the swarf may be settled out and the grinding and cooling fluids separated from each other before dropping into the tank 11. This operation may be accomplished by providing a relatively long pan but in order to minimize the amount of floor space required for the unit a relatively compact pan is provided which is arranged so that the fluid flows in a tortuous path so that a relatively long flow thereof may be obtained in a comparatively compact area. This is preferably accomplished by providing the pan 15 with a plurality of transversely extending partitions 45, 46 and 47 (Figs. 1 and 4). These partitions extend across the entire width of the pan and are welded in place to the sides of the pan. The partitions 45, 46 and 47 divide the pan 15 into a plurality of transversely extending compartments 48, 49, 50 and 51 which are connected in a manner to be hereinafter described at alternately opposite ends so as to provide a tortuous path of flow for the fluid. The bottoms of the compartments 48, 49, 50 and 51 are preferably arranged so as to form a continuous sloping surface so that fluid may flow through the compartments by gravity. As shown in Fig. 5, the compartment 48 is provided with a sheet metal bottom plate 55 which slopes toward the right (Fig. 5) and is welded to one side of the pan 15 and to the partition 45. Fluid passing through the compartment 48 moves in a direction toward the right (Fig. 5) and passes through a port or aperture 56 in the partition 45 (Fig. 6) into the compartment 49. The compartment 49 is similarly provided with a sloping bottom plate 57 which slopes toward the left (Fig. 6) and is welded to the partitions 45 and 46. Fluid entering the compartment 49 through the port or aperture 56 flows toward the left (Fig. 6) and through a port or aperture 58 in the partition 46 into the compartment 50. The compartment 50 is provided with a bottom plate 59 which slopes toward the right (Fig. 7) and is welded to the partitions 46 and 47. Fluid from the compartment 50 flows through a port or aperture 60 in the partition 47 into the compartment 51. The compartment 51 is provided with a bottom plate 61 which slopes toward the left (Fig. 8) and is welded to the partition 47 and the side of the pan 15. The bottom plate 61 has a gradual slope toward the left except as it approaches the left hand end of the compartment 51 (Fig. 8). At this point the bottom plate 61 drops abruptly as indicated by the portion 62 to convey fluid to an aperture 63 from which the

fluid (grinding fluid and cooling fluid) drops into the chamber 39 of the tank 11. It will be readily apparent from the arrows (Fig. 4) that the fluid passing through the pan 15 moves through a relatively long tortuous path.

In order to facilitate settling-out swarf from the fluid and to agitate the fluid as it passes through the compartments 48, 49, 50 and 51, it is desirable to provide a plurality of obstructions such as dams or shallow partitions which serve to produce an agitating effect on the fluid as it passes through the pan 15. This agitation of the fluid serves to facilitate the settling-out of swarf (metal particles, abrasive grit, etc.) and also serves to accelerate the separation of the grinding liquid from the cooling liquid. As illustrated in Figs. 3 and 4, the compartment 48 is provided with a readily removable tray comprising a longitudinally extending vertical strip 65 to which is welded opposed strips or dams 68 and 69. This tray unit is arranged to fit loosely within the compartment 48 so that it may be readily removed when it is desired to clean out the pan 15.

A similar tray is provided for the compartment 49 comprising a longitudinally extending strip 65*a* having opposed strips or dams 66*a* and 67*a* which are welded to opposite sides thereof, and spaced therefrom strips or dams 68*a* and 69*a*. This unit like the one previously described fits loosely within the compartment 49 so that it may be readily removed therefrom when desired.

A similar tray is provided for the compartment 50 comprising a longitudinally extending strip 65*b* having opposed strips or dams 66*b* and 67*b* welded thereto and spaced therefrom strips or dams 68*b* and 69*b*. A similar tray is provided for the compartment 51 comprising a longitudinally extending strip 65*c* having welded thereto opposed strips or dams 66*c* and 67*c*, and spaced therefrom opposed strips or dams 68*c* and 69*c*.

It should be noted that the ports or passages 56, 58 and 60 in the partitions 45, 46 and 47 are spaced from the bottoms of the compartments so that the lower portion of these partitions serve as additional dams or obstructions to the flow of fluid through the pan 15.

It will be readily apparent from the foregoing disclosure that when fluid is passed through a pipe 75 from the grinding machine, it will flow by gravity in the path of the arrows as indicated in Fig. 4. Each of the strips or dams above described serve to retard the flow of fluid through the compartments 48, 49, 50 and 51 so as to accelerate the settling-out and collecting of swarf from the fluid in the pan and also serve to agitate the fluid to facilitate a separation of the grinding fluid from the cooling fluid before the fluids pass through the aperture 63 (Fig. 8) into the tank 11.

A plurality of holes 70, 71 and 72 are provided in the partitions 45, 46 and 47 respectively. These holes are slightly above the bottom of each respective compartment and serve to facilitate flushing out the pan when it is desired to clean the same.

It is desirable from time to time during use of this plural fluid unit to clean out the accumulation of swarf in the pan 15. This is preferably accomplished by removing trays from each of the compartments 48, 49, 50 and 51, then scooping out the bulk of the swarf accumulated therein, after which the tray may be readily flushed out with a hose to clean the same if desired.

The tank 11 is provided with an overflow pipe 74 to prevent excessive filling of the tank 11 with fluid.

It is desirable to provide a circulating means for the grinding fluid and the cooling fluid so that they may be separately pumped from the tank 11 to one or more grinding machines. As illustrated in Fig. 2, a motor driven pump unit comprising an electric motor 76 and a pump 77 is supported on the channel iron 36. The pump 77 is located in the coolant fluid chamber 42 of the tank 11, and is positioned in the lower part of the compartment where it will draw coolant fluid therefrom. Coolant fluid 16 from the compartment is passed through a pipe 78 and is conveyed in a manner to be hereinafter described to the work piece being ground.

The channel iron 36 also supports a motor driven pump unit comprising an electric motor 80 and a pump 81 which draws grinding fluid 17 from the upper portion of the tank 11. It is desirable to provide a filter for the grinding fluid to remove any stray particles of grit either metallic or abrasive therefrom before the fluid is conveyed to the grinding machine. As illustrated in Figs. 2 and 12, grinding fluid 17 from the upper portion of the tank 11 passes through a pipe 82, through a valve 83, through a check valve 84 and through a fluid filter 85, through the pipe 86 to the grinding fluid pump 81. The pump 81 serves to force grinding fluid at a relatively high pressure and a relatively low volume through the pipe 87 in a manner to be hereinafter described. An adjustable pressure relief valve 88 is provided in the pipe line 87 whereby excess fluid under pressure may be returned to the tank side of the pump so as to facilitate maintaining a predetermined pressure of the grinding fluid.

Grinding fluid passing through the pipe 87 may be conveyed to one or more grinding machines. The pipe 87 is connected by a valve 91 with a manifold 92 having a plurality of independent control valves 93, 94 and 95 for controlling the passage of grinding fluid at a relatively high pressure and a relatively low volume through a plurality of spaced nozzles or jets 96 (only one of which has been illustrated in the drawings). This nozzle or jet construction may be substantially identical with that shown in the above mentioned prior patent and pending application. The jets or nozzles 96 are preferably arranged so that fluid at a relatively high pressure and a relatively low volume is passed onto the grinding wheel 97 at a point adjacent to the place of contact between the grinding wheel 97 and the work piece 98 being ground to facilitate the grinding operation. If desired the system may be provided with a pressure gage 99 which is connected by means of a valve 100 with the pipe 87 so that the grinding fluid pressure may be readily checked when desired.

If it is desired to connect the plural fluid unit to more than one machine, fluid passing through the pipe 87 may similarly pass through a valve 91*a* to a manifold 92*a* and through a plurality of manually operable control valves 93*a*, 94*a* and 95*a* to a plurality of jets 96*a* so as to convey grinding fluid at the desired pressure and quantity to the grinding wheel 97*a* at the place of contact between the grinding wheel 97*a* and the work piece 98*a*.

Similarly the pipe 87 may be connected to supply a third grinding machine in which case grinding fluid passing therethrough passes through a valve 91*b*, through a manifold 92*b* and through a plurality of manually operable control valves 93*b*, 94*b* and 95*b* to a plurality of jets or nozzles 96*b* to convey grinding fluid at the desired pressure to the operative face of the grinding

wheel 97b at the place of contact between the grinding wheel 97b and the work piece 98b. If desired each of these additional grinding machines may be provided with separate pressure indicators or gages 99a and 99b which are connected by valves 100a and 100b with the pipe 87 so that the grinding fluid pressure supplied to each machine may be readily checked when desired.

Cooling fluid from the pump 77 passing through the pipe 90 at a relatively low pressure and a relatively large volume is conveyed through a valve 101 to a coolant nozzle 102 which is arranged to convey a relatively large volume of coolant fluid to the surface of the work piece 98 being ground. Similarly coolant fluid passing through the pipe 90 may pass through a valve 101a to a coolant nozzle 102a to supply a relatively large volume of coolant fluid to the surface of the work piece 98a being ground. Coolant fluid in the pipe 90 may be also conveyed to a third grinding machine through a valve 101b to a coolant nozzle 102b to supply coolant fluid in a relatively large volume to the surface of the work piece 98b being ground.

By providing a plural fluid unit 10 of a suitable size and capacity, either one or a plurality of grinding machines may be supplied with the required amount of grinding fluid and cooling fluid to perform the desired grinding operation.

Grinding fluid and cooling fluid together with swarf from the grinding operation drain into reservoirs 103, 103a and 103b on each of the grinding machines. Fluid may be pumped from the reservoirs 103, 103a and 103b through a plurality of pipes 104, 104a and 104b by means of a fluid pump 105 which is driven by an electric motor 110. The pump 105 passes refuse fluid through a pipe 106, through a valve 107, through a check valve 108 which connects with the pipe 75 to convey the refuse fluid and swarf to the pan 15. As previously described, as fluid is passed through the tortuous path formed within the pan 15 swarf is settled-out therefrom and the grinding fluid is separated from the collant fluid due to the differing specific gravities thereof. The grinding fluid and cooling fluid then passes from the pan 15 through the aperture 63 into the chamber 39 in the tank 11 (Fig. 10) and flows through a tortuous path as indicated by the arrows in Fig. 10 into the chamber 42 where the fluid is separated as indicated in Fig. 2 and ready to be circulated to the one or more grinding machines as previously described.

The electric motors 76, 80 and 110 for driving the pumps 77, 81 and 105 respectively receive power from a suitable source such as indicated by the power lines 111 (Fig. 13). A main switch 112 serves to close the circuit and to simultaneously start the three pump motors 76, 80 and 110.

A sheet metal hood 115 surrounds the motors 76 and 80 and the pump 81. This hood is preferably readily removable from the tank 11 by means of a pair of handles 116 and 117. In order to facilitate cleaning out the tank 11 when desired, the pan 15 is preferably made so that it may be readily removed therefrom by means of a pair of opposed handles 118 and 119 to facilitate access to the tank 11. If it is desired to clean out the tank 11, the pan 15 is first removed after which the partition assembly 28—29 may be readily removed and the partition 34 removed by first removing the screws 35 after which any accumulation of swarf or sludge may be removed from the bottom of the tank 11. In case it is desired to flush out the tank 11 after cleaning, the bottom of the tank is provided with a central port 120 (Fig. 10) which is connected by a pipe 121 with a pipe elbow 122 having a drain plug 123 (Figs. 2 and 10). By removing the plug 123, the tank 11 may be readily flushed and drained through the pipe 121 and the elbow 122.

The operation of this improved plural fluid grinding apparatus will be readily appreciated from the foregoing disclosure. The desired amount of coolant fluid such as water may be put into the tank 11 in any suitable manner or may be poured into the compartment 48 and caused to pass through the tortuous path above described and through the aperture 63 into the tank 11. Similarly the desired amount of grinding fluid, such as suitable oil or oil compounds, may be conveyed to the tank 11 directly or in a manner above described namely through the pan 15 into the tank 11. The main switch 112 may then be closed to start the pump driving motors 76, 80 and 110 which serve in a manner above described to pump grinding fluid at a relatively high pressure and a relatively low volume to one or more grinding machines as desired. The coolant pump 77 serves to convey coolant fluid at a relatively low pressure and a relatively large volume to one or more machines as desired to facilitate the grinding operation. Similarly the fluid pump 105 which is started simultaneously with the other pumps serves to return the refuse fluid from the grinding machine reservoirs 103, 103a and 103b to the plural fluid unit 10 where the swarf is settled-out and the grinding fluid separated from the coolant fluid in its passage through the pan 15 in a manner above described and then passes into the tank 11 where the two fluids separate due to their different specific gravities so that the coolant fluid accumulates at the bottom of the tank and the grinding fluid floats on top thereof. This cleaned grinding fluid and cooling fluid is then ready for being reconveyed to the grinding machine for further grinding operations.

It will thus be seen that there has been provided by this invention apparatus in which the various objects hereinabove set forth together with many thoroughly practical advantages are successfully achieved. As many possible embodiments may be made of the above invention and as many changes might be made in the embodiment above set forth, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. A plural liquid unit for grinding machines having a tank having an open top arranged to contain a grinding liquid and a cooling liquid each of which has a different specific gravity so that the cooling liquid settles in the bottom of the tank while the grinding liquid separates into a layer in the upper portion of the tank, a pump chamber in said tank, independent motor driven pumps for separately pumping grinding liquid from the upper portion of said chamber and cooling liquid from the lower portion of said chamber, a pan removably mounted on top of said tank to receive refuse liquid from a grinding machine consisting of a mixture of grinding liquid-coolant liquid and swarf, said pan being shaped to mate with the open top of said tank, a plurality of transverse partitions in said pan arranged to form a relatively long path for the gravity flow of refuse liquid therethrough to facilitate settling-out and collecting swarf in

said pan and to facilitate separation of the grinding and cooling liquids before flowing into said tank, and having a discharge aperture in said pan at the end of the long path to convey liquid into said tank.

2. In a plural liquid unit, as claimed in claim 1, in combination with the parts and features therein specified in which the partitions are provided with passages through alternate ends, said passages being arranged to form a relatively long tortuous gravity flow of liquid through the pan, and a plurality of transverse baffles between said partitions to agitate said liquid so as to facilitate settling-out swarf and to facilitate separation of the grinding and cooling liquids before flowing into said tank.

3. In a plural liquid unit, as claimed in claim 1, in combination with the parts and features therein specified in which the partitions are provided with passages through alternate ends, said passages being arranged to form a relatively long tortuous gravity flow of liquid through the pan, a bottom for said pan betwen said partitions which slopes gradually from the liquid entry to the discharge to facilitate gravity flow of liquid therethrough, a readily removable baffle assembly between each of said adjacent partitions including a longitudinally extending baffle plate having a plurality of spaced transversely extending baffles to agitate the refuse liquid from one or more grinding machines to facilitate settling-out swarf and to facilitate separation of the grinding and cooling liquids, and having a passage in the bottom of said pan located at the end of the tortuous liquid path for conveying the separated liquids into said tank.

4. In a plural liquid unit, as claimed in claim 1, in combination with the parts and features therein specified in which the partitions are provided with passages through alternate ends, said passages being spaced from the bottom of said pan and arranged to serve as baffles for refuse liquid flowing therethrough, and a readily removable baffle assembly in each of the compartments between the partitions including a longitudinally extending baffle plate having a plurality of spaced transversely extending baffles, said assemblies serving to facilitate settling and collecting swarf in said pan and being removable to facilitate cleaning swarf from said pan when desired.

5. In a plural liquid unit, as claimed in claim 1, in combination with the parts and features therein specified of a plurality of removably spaced partitions to form a plurality of spaced compartments in said tank, each of said partitions being shorter than the width of the tank, and being arranged to form opening at opposite ends thereof to form a tortuous path for liquid in said tank to facilitate completion of the separation of the grinding liquid from the cooling liquid.

6. A plural liquid unit for grinding machines having a tank having an open top arranged to contain a grinding liquid and a cooling liquid each of which has a different specific gravity so that the cooling liquid settles in the bottom of the tank while the grinding liquid separates into a layer in the upper portion of the tank, a pump chamber in said tank, a pair of motor driven liquid pumps for separately pumping grinding liquid from the upper portion of said chamber at a relatively high pressure to the surface of the grinding wheel for promoting grinding and small volume and for pumping coolant liquid from the lower portion of said chamber at a relatively low pressure and large volume to the workpiece being ground to cool the workpiece, a pan mounted on said tank to receive refuse liquid from a grinding machine consisting of a mixture of grinding liquid-coolant liquid and swarf, said pan being shaped to mate with the open top of said tank, a plurality of spaced lugs within said tank to support said pan, and a plurality of transverse partitions arranged to form a relatively long tortuous path for the gravity flow of refuse liquid therethrough to facilitate settling-out and collecting swarf in said pan and to facilitate separation of the grinding and cooling liquids before they flow into said tank.

7. A plural liquid unit for grinding machines having a pan to receive refuse liquid from one or more grinding machines including a grinding liquid-cooling liquid and swarf, a plurality of transverse partitions in said pan forming a plurality of adjacent transversely extending compartments, said partitions being provided with a passage through alternate ends to form a tortuous path for liquid flowing in one direction through said pan, the bottom of said compartments sloping progressively to facilitate continuous flow of liquid therethrough by gravity, a plurality of baffles extending transversely across said compartments, said baffles and passages serving to retard the flow of liquid so as to cause an agitating action of the liquid as it flows through said compartments to facilitate settling-out and collecting swarf in said pan and to facilitate separation of the grinding and cooling liquids, a relatively large tank having an aperture on the top shaped to mate with and support below said pan, said pan having an opening in the bottom of said pan whereby the separated liquids flow into said tank, and a plurality of removably spaced partitions in said tank, each of said partitions being shorter than the width of the tank and arranged to form a tortuous path for liquid flow in the opposite direction within said tank, and a pump compartment adjacent to one end of said tank whereby the separated grinding liquid and cooling liquid may be separately pumped to one or more grinding machines.

8. A plural liquid unit for grinding machines having a tank which is open at the top and arranged to contain a grinding liquid and a cooling liquid each of which has a different specific gravity so that the cooling liquid settles in the bottom of the tank while the grinding liquid separates into a layer in the upper portion of the tank, a pump chamber at one end of said tank, independent motor driven liquid pumps in said unit for separately pumping grinding liquid from the upper portion of the chamber at a relatively high pressure and low volume to the surface of the grinding wheel for promoting grinding and for pumping coolant liquid from the lower portion of said chamber at a relatively low pressure and large volume to the workpiece being ground to cool the workpiece, a pan mounted on top of said tank which is shaped to mate with the open top of said tank and to receive refuse liquid consisting of a mixture of grinding liquid-cooling liquid and swarf from a plurality of grinding machines, a plurality of transverse partitions in said pan arranged to form a relatively long tortuous path for gravity flow of refuse liquid therethrough in one direction, a plurality of transverse baffles between said partitions to agitate said liquid as it flows therethrough to facilitate settling-out and collecting swarf in said pan and to facilitate separation of the grinding and

cooling liquids, the bottom of said pan being provided with an aperture at the end of the tortuous path to allow the separated grinding and cooling liquids to flow into said tank, and a plurality of partitions in said tank which are arranged so that the liquids flow in a tortuous path in the opposite direction into said pump chamber for recirculation to said grinding machines.

9. A central unitary plural liquid unit for separately supplying a grinding liquid and a cooling liquid to a plurality of grinding machines having an open top tank arranged to contain a grinding liquid and a cooling liquid each of which has a different specific gravity, a plurality of spaced partitions in said tank arranged to form a tortuous path for liquid flow in one direction, a pump compartment adjacent one end of said tank, independent liquid pumps for separately pumping grinding liquid and cooling liquid to a plurality of grinding machines, a pan which is shaped to mate with the open top of said tank for receiving refuse liquid consisting of a mixture of grinding liquid-cooling liquid and swarf from said grinding machines, and means including a plurality of partitions and baffles in said pan to

produce a gravity flow of liquid therethrough in the opposite direction in a tortuous path to facilitate settling-out and collecting swarf in said pan and to facilitate separation of the grinding and cooling liquids before passing into said tank.

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