

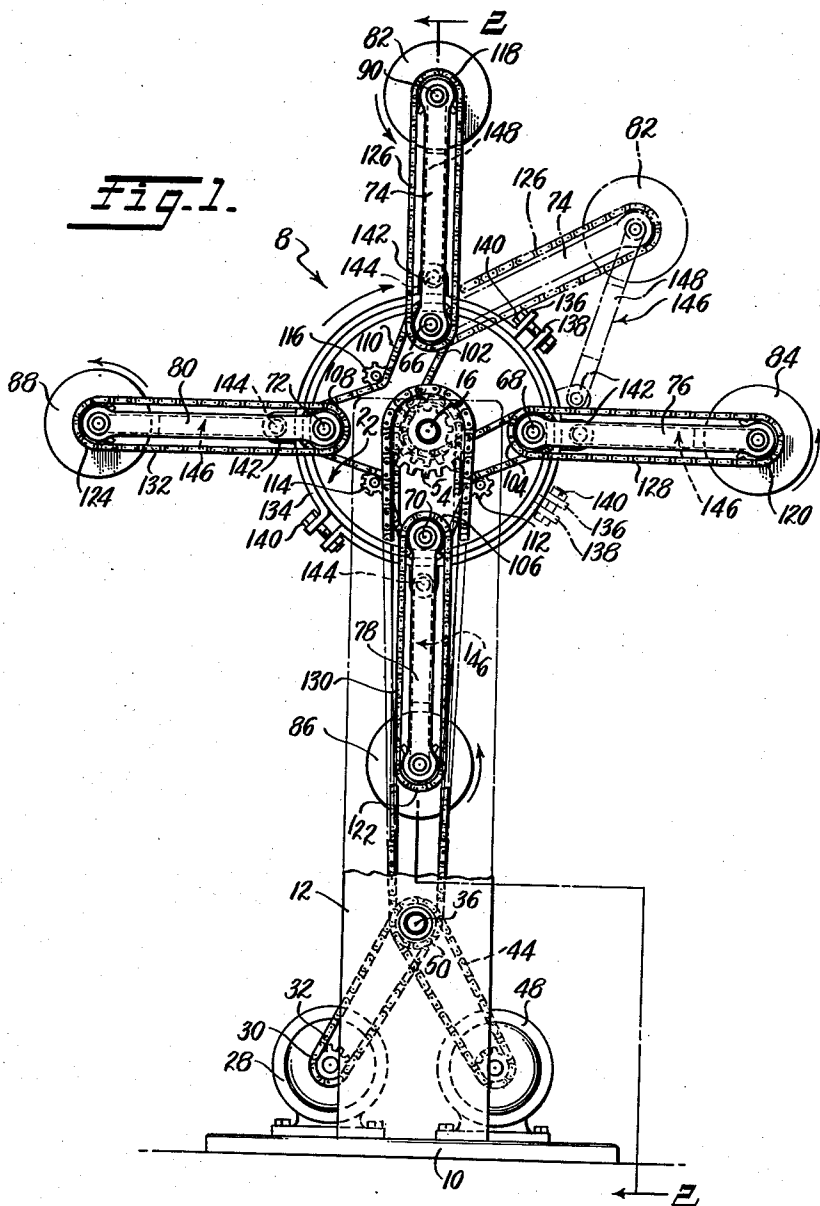
June 25, 1963

N. E. PRICE
PROCESS AND APPARATUS FOR SHAPING AND
POLISHING GEM STONE PARTICLES

3,094,818

Filed Nov. 2, 1960

3 Sheets-Sheet 1



INVENTOR.

Noble E. Price

BY

Robert E. Price
ATTORNEY

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3 Sheets-Sheet 2

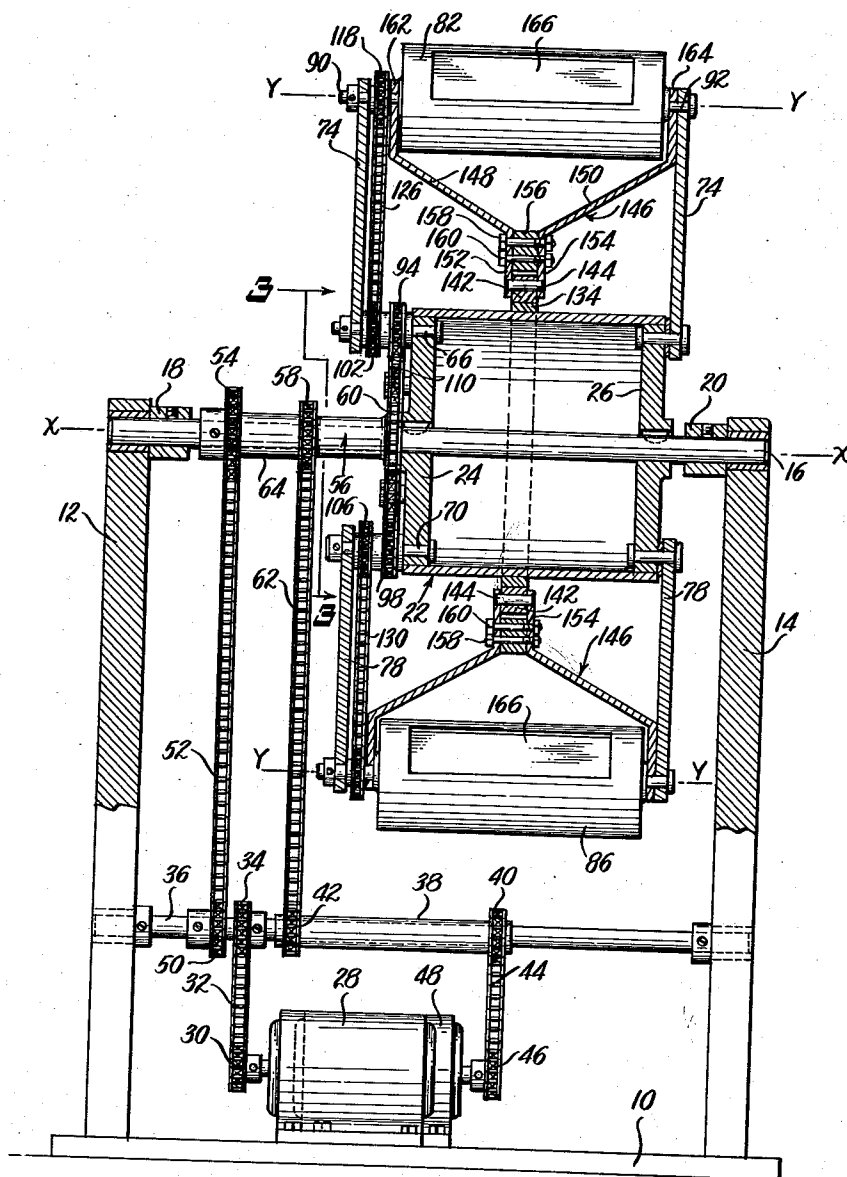


Fig. 2.

INVENTOR.
Noble E. Price
BY *[Signature]*
ATTORNEY

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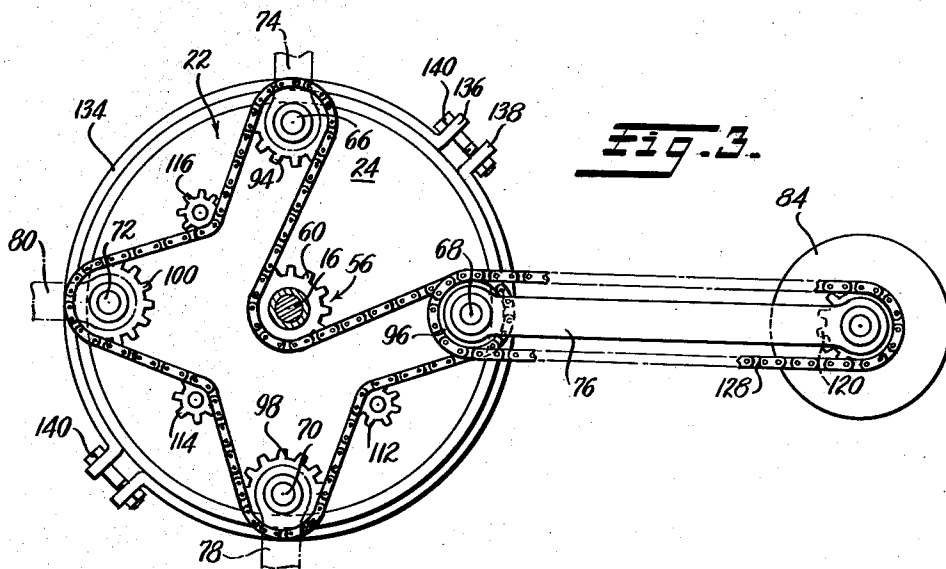


Fig. 3.

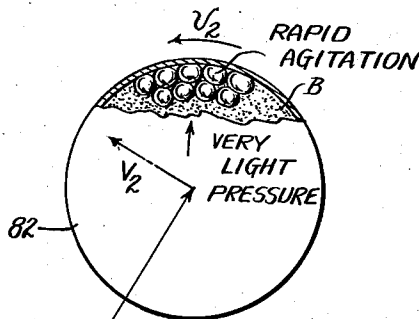
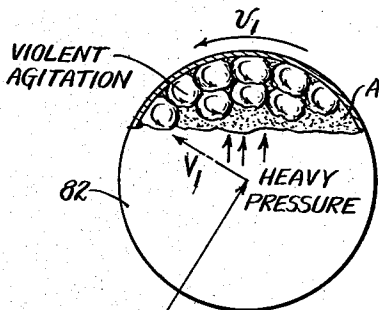


Fig. 4.

Fig. 5.

INVENTOR.
Noble E. Price
BY *Robert N. Haley*
ATTORNEY

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3,094,818

PROCESS AND APPARATUS FOR SHAPING AND POLISHING GEM STONE PARTICLES

Noble E. Price, R.R. 3, Pana, Ill.

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11 Claims. (Cl. 51-164)

This invention relates to a process and apparatus for shaping and polishing gems and semiprecious stones and more particularly relates to a process for shaping and polishing a multitude of gem or semiprecious stone particles together with apparatus therefor which includes structure that enables the operational steps of shaping and polishing the particles to be accomplished by a single machine within a relative short time interval.

In the gem and semiprecious stone art, it is frequently desirable to shape and polish a multitude of gem stone particles of diverse form and size. Ordinarily, such particles will be in the form of broken pieces of gem stones or sawed preforms. In the former case, the gem stone particles will have jagged edges and sharp corners which must be removed or smoothed in a shaping or grinding operational step of the process before the gem stone particles are subjected to a polishing operational step which results in the gem stone particles having a final desired finished form. In the latter case, the gem stone particles will possess saw marks and rough edges, perhaps as well as grinding wheel marks, and these marks and edges must be removed and/or smoothed by the shaping operational step prior to effecting the polishing operational step in the process of bringing the gem stone particles to the final desired finished form.

It is to be understood that the shaping or grinding of the gem stone particles, as stated above, constitutes an operational step of the process which is distinctly different from the operational step of polishing the gem stone particles, as will hereinafter appear.

Conventional processes and apparatuses for effecting the shaping and subsequent polishing of gem stone particles to finished form normally depend primarily on the effect of gravity to produce the pressure needed, wherein the gem stone particles together with an abrasive are placed in a rotating drum having a rotational speed which is just sufficient to produce a cascading or tumbling action upon the gem stone particles so that the particles tumble down over each other in a cascading action and merely rub together and effect an abrading action due to the presence of the abrasive material with the pressure force between the gem stone particles and the abrasive material being maintained substantially constant. Such conventional processes and apparatuses are extremely time-consuming and render the process quite costly.

In the operational step of shaping, reshaping or grinding a multitude of gem stone particles in accordance with the improved process and apparatus of this invention, there is employed an abrasive agent with the effect that the desired result is accomplished through the action of a pressure force and abrasive action which is created and applied to the gem stone particles and the abrasive agent together with the agitation or movement of the gem stone particles relative to each other in a manner which effects a rubbing action therebetween in the presence of the abrasive agent, while in the operational step of polishing the multitude of gem stone particles to the final desired finished form it is desirable to arrest the abrasive action between the particles while maintaining the agitation or

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rubbing movement of the particles relative to each other with the pressure force acting thereon being maintained at a value which effectively enmasses the multitude of particles so that the particles are rolled together in a mass as rapidly and yet as easily as possible.

The present invention has for its primary objective the provision of a process and apparatus for shaping and polishing gem stone particles to final desired finished form which takes into account the essential difference between the operational step of shaping and the operational step of polishing and which utilizes, in the shaping operational step, the effect of a pressure force acting on the various gem stone particles as well as an abrasive action and agitation between the gem stone particles due to the rubbing together or movement of the gem stone particles relative to each other and which is effective and capable of varying the degree of pressure force and abrasive action to such extent as to substantially eliminate the abrasive action between the particles, reduce the pressure force effect to an amount which merely enmasses the particles while maintaining sufficient agitation or rubbing movement between the particles in the mass during the operational step of polishing the gem stone particles to final desired finished form. By being able to independently control the effective pressure force and abrasive action between the operational steps of shaping and polishing the gem stone particles, as described above, a considerable saving in time is attained by the process and apparatus of this invention over the conventional type of processes and apparatuses, as stated above.

Accordingly, a principal objective of this invention is to provide an improved process of shaping and polishing gem stone particles.

Another object of this invention is to provide an improved process of shaping and polishing gem stone particles which enables the desired final finished form of the gem stone to be attained within a time interval which is substantially shorter than the time interval generally needed in conventional type processes.

It is also an object of this invention to provide an improved process of shaping and polishing gem stone particles to final desired finished form which utilizes the effective force of pressure between the various gem stone particles in a manner to vary such pressure force between the operational step of shaping the gem stone particles and the operational step of polishing the gem stone particles to desired final finished form.

It is also a further object of this invention to provide an improved process of shaping and polishing gem stone particles to final desired finished form which utilizes in the shaping operational step the effective force of pressure between the various gem stone particles together with an abrasive action due to the movement of the gem stone particles relative to each other and which varies both the pressure force and abrasive action to such extent that in the operational step of polishing the gem stone particles to final finished form that the abrasive action is substantially eliminated.

It is also a still further object of this invention to provide an improved process of shaping and polishing a multitude of gem stone particles to final desired finished form which utilizes in the operational step of shaping the particles an effective force of pressure which is applied to the particles together with the agitation or movement of the particles relative to each other in a manner to create an abrasive action and which, in the operational step of polishing the particles to the final desired finished form,

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varies the pressure force and abrasive action to such extent as to substantially eliminate the abrasive action between the particles, reduce the pressure force effect thereon to an amount which will only maintain the multitude of particles in a mass while maintaining sufficient agitation or rubbing movement therebetween in the mass state to effectively polish the gem stone particles to the final desired finished form.

An additional object of this invention is to provide an improved apparatus for shaping and polishing gem stone particles.

Another additional object of this invention is to provide an improved apparatus for shaping and polishing gem stone particles with structure which enables the apparatus to shape and polish the gem stone particles to final finished form within a time interval which is substantially less than the time interval normally required by conventional type apparatus.

A further additional object of this invention is to provide an improved apparatus for shaping and polishing a multitude of gem stone particles to final desired finished form which includes structure for creating and varying an effective pressure force on and an abrasive action between the multitude of particles during the shaping and polishing thereof.

It is also an additional object of this invention to provide an improved apparatus for shaping and polishing a multitude of gem stone particles to final desired finished form which includes structure for rotating and revolving the particles in a manner to create an effective pressure force on and an abrasive action between the particles during the shaping of the particles and which varies the pressure force relative to the abrasive action during the polishing thereof.

It is a still further additional object of this invention to provide an improved apparatus for shaping and polishing a multitude of gem stone particles to final desired finished form which includes structure which, in the shaping of the particles, creates an effective pressure force on the particles by revolving the particles about a first axis while creating an abrasive action between the particles due to the agitation or movement thereof relative to each other by rotating the particles about a second axis which is spaced from the first axis and which, in the polishing of the particles is capable of varying the pressure force, abrasive action and the agitation or rubbing relative movement of the particles by varying the revolutions and rotation of the particles and the spacing between the first and second axis so that the abrasive action between the particles is substantially eliminated, the pressure force is only sufficient to maintain the particles in an enmassed state while maintaining sufficient agitation or rubbing movement therebetween to effect the desired polish thereto.

In order to accomplish the desired objects as stated above the improved process and apparatus for shaping and polishing gem stone particles in accordance with the present invention includes an epicyclically rotating container for receiving the gem stone particles and such abrasive as necessary, means for variably rotating the container about its own axis at a desired selected speed of rotation, means for variably revolving the container about another main axis which is displaced from the axis of the container at a desired selected speed of revolution which, if desired, may be varied relative to the rotational speed of the container about its own axis, and means for varying the physical displacement of the axis of the container relative to the main axis. In this manner it is possible to variably control both the effect of the pressure force and the abrasive action, independently of each other, as stated above, to enable the gem stone particles to be shaped and polished to desired final finished form in a minimum time interval and in a single apparatus.

Other objects, advantages and important features of the invention will be apparent from a study of the speci-

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cation following, taken with the drawing, which together describe, disclose and illustrate an embodiment of the invention and what is now considered and believed to be the best mode of practicing the principles thereof. Still other embodiments may be suggested to those having the benefit of the teachings herein, and such other embodiments are intended to be reserved especially as they fall within the scope and breadth of the subjoined claims.

In the drawing:

FIGURE 1 is an end elevational view of an apparatus for shaping and polishing gem stone particles to final desired finished form with a portion thereof being broken away to better illustrate certain structural details thereof;

FIGURE 2 is a side elevational view of the apparatus illustrated in FIG. 1 taken along the line 2—2 looking in the direction of the arrows;

FIGURE 3 is an enlarged partial transverse elevational view taken along the line 3—3 of FIG. 2 looking in the direction of the arrows and illustrating a drive train assembly for driving several gem stone particle receiving containers of the apparatus illustrated in FIGS. 1 and 2;

FIGURE 4 is a diagrammatic view illustrating the movement of gem stone particles in a container of the apparatus shown in FIGS. 1 and 2 during an operational step of shaping the particles in a process prior to polishing the gem stone particles to final desired finished form, and

FIGURE 5 is a diagrammatic view, similar to FIG. 4, but illustrating the movement of gem stone particles in a container during the operational step of polishing same to final desired finished form.

Attention is now directed to FIGS. 1 and 2 of the drawing wherein there is illustrated an apparatus 8 for shaping and polishing gem stone particles G to final desired finished form which comprises a base 10 and suitable framework including standards 12 and 14 rotatably supporting a horizontally disposed shaft 16. Suitable locating means 18 and 20, such as collars, may be fixed to the shaft 16 at locations thereon so as to bear against the standards 12 and 14 in a manner to axially locate the shaft 16 as desired.

A drum or spider 22 is mounted for rotation with the shaft 16 about an axis X—X through the medium of a splined or keyed connection between drum end walls 24 and 26 and the shaft 16. For the purpose of rotating the shaft 16 about the axis X—X, a variable speed electric motor 28 may be used, such motor having a sprocket 30 fixed to the drive shaft thereof and connected, through a chain 32, or the like, to a sprocket 34 on a countershaft 36. The countershaft 36 is suitably journaled in the frame of the machine and rotatably carried thereby is a quill shaft 38 provided with sprockets 40 and 42. The sprocket 40 is connected through a flexible drive member 44 in the form of a chain, or the like, to a sprocket 46 carried by the drive shaft of a second variable speed electric motor 48.

The countershaft 36 also carries a sprocket 50 having a connection through a chain or belt 52 with a sprocket 54 fixed to the shaft 16 so that the shaft 16 and consequently the drum 22 are rotated about the axis X—X at a speed proportional to the speed of rotation of the motor 28. The purpose of the motor 48 is to drive a sprocket cluster 56 which comprises a pair of sprockets 58 and 60 joined together and freely journaled on the shaft 16. The quill shaft sprocket 42 is connected, via a chain 62, to the cluster sprocket 58 and the sprocket cluster 56 is axially located on the shaft 16 by means 64, such as a suitable spacing collar.

The drum end walls 24 and 26 carry axially aligned and spaced apart cooperable pair of stub shafts 66, 68, 70 and 72 disposed in circumferentially spaced relationship with the stub shafts of each pair pivotally carrying the radial inner end portions of cooperable pairs of arms 74, 76, 78 and 80. The radial outer end portions of each pair of the arms 74, 76, 78 and 80 rotatably carry cylin-

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dricl containers 82, 84, 86 and 88 preferably through stub axles 90 and 92, note FIG. 2, which are fixed to the ends of the respective containers. As is also shown in FIG. 2, one of each pair of the stub shafts 66, 68, 70 and 72 at the end wall 24 of the drum 22 have sprockets 94, 96, 98 and 100 mounted thereon inboard from the adjacent arms 74, 76, 78 and 80 and disposed intermediate such adjacent arms and the drum end wall 24. The stub shafts 66, 68, 70 and 72 also carry additional sprockets 102, 104, 106 and 108 which are mounted thereon inboard of the adjacent arms 74, 76, 78 and 80. The inboard sprockets 94, 96, 98 and 100 are drivingly interconnected with the quill shaft sprocket 60 by an endless, flexible drive element 110 trained thereover and, as shown in FIG. 3, the drum end wall 24 rotatably mounts idler members 112, 114 and 116 which engage with the drive member 110 as illustrated. Also, the stub shaft cluster sprockets 94—102, 96—104, 98—106 and 100—108 are drivingly connected to container drive sprockets 118, 120, 122 and 124 each of which are fixed for rotation with the respective stub axle 90 through chains 126, 128, 130 and 132 or the like.

From the above it is believed to be understood that by reason of the electric motor 28, the drive connection defined by the sprocket 30, the chain 32, the sprocket 34, the counter shaft 36, the sprocket 50, the chain 52, the sprocket 54, the shaft 16, the drum 22, the stub shafts 66, 68, 70 and 72, the arms 74, 76, 78 and 80 and the stub axles 90 and 92 that the containers 82, 84, 86 and 88 are each revolved about a first axis which is common to the axis X—X of rotation for the shaft 16 and the drum 22. Also, each of the containers 82, 84, 86 and 88 rotate about respective axes Y—Y, each of which is spaced from and disposed substantially parallel to the axis X—X and which is common to the respective stub axles 90 and 92 for each of the containers by reason of the driving connection between each of the containers 82, 84, 86 and 88 and the electric motor 48 which is defined by the sprocket 46, the chain 44, the sprocket 40, the quill shaft 38, the sprocket 42, the chain 62, the sprockets 58 and 60 of the sprocket cluster 56, the chain 110, the inboard cluster sprockets 94—102, 96—104, 98—106 and 100—108, the stub shafts 66, 68, 70 and 72, the chains 126, 128, 130 and 132, the drive sprockets 118, 120, 122 and 124 and the respective stub axles 90. In this manner the containers 82, 84, 86 and 88 are each revolved about the first axis X—X and also rotated about the respective axes Y—Y and it should be noted that the variable electric motors 28 and 48 enable both the rotation and the revolution of the container to be varied.

Extending around the body of the drum 22 is a split ring or band 134 provided with spaced, upstanding ear portions 136 and 138 at the free end portions thereof, note particularly FIG. 3, which are normally urged together to clamp upon the drum 22 by means 140 in the form of a suitable screw thread member or the like. The split ring 134 carries a plurality of circumferentially spaced, radially outwardly projecting upstanding lug portions 142, equal in number to the number of containers provided, and each such lug portion 142 pivotally carries, by means 144, such as a pin or the like, the radial inner end of an adjacent corresponding yoke-like member 146. Each yoke-like member 146 may conveniently take the form of a pair of angulated legs 148 and 150 having parallel radial inner end portions 152 and 154 which straddle the adjacent respective lug portion 142 with the legs 148 and 150 being maintained in proper spaced relationship by a spacer block 156 sandwiched therebetween by fasteners 158 and 160. The intermediate portions of the legs 148 and 150 are divergently angulated with the radial outer terminal end portions 162 and 164 extending adjacent the opposite ends of the corresponding container to rotatably receive the stub axles 90 and 92 which are associated respectively therewith.

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From the above, it will be apparent that the speed of revolution of the containers 82, 84, 86 and 88 and the rotation of the drum 22 about the axis X—X is variably controlled by the motor 28 while the speed of rotation of the containers 82, 84, 86 and 88 about the axes Y—Y is variably controlled by the motor 48. At the same time, the radial distance between the axes of rotation Y—Y and the axis of revolution X—X of the containers 82, 84, 86 and 88 may also be varied by loosening the split ring 134 and rotating same relative to the drum 22 and then clamping same in the new position, as illustrated in dotted lines in FIG. 1 for the uppermost container 82. An access panel or door 166 is provided for each of the containers 82, 84, 86 and 88 through which the gem stone particles G may be inserted, removed and replaced.

As mentioned hereinbefore, the apparatus is capable of performing the operational steps of grinding or shaping as well as polishing the gem stone particles G to final desired finished form. These two operational steps of the process are diagrammatically illustrated respectively in FIGS. 4 and 5 of the drawing. In the operational step of shaping the gem stone particles G as illustrated in FIG. 4, it will be noted that the radial spacing R between the axes of rotation X—X and the axis of revolution Y—Y of the containers is greater than the radial spacing r therebetween as shown in FIG. 5 wherein the operational step of polishing the gem stone particles G to final desired finish is being carried out. The reason for the differential radii R and r is that during the shaping operational step, as in FIG. 4, it is desirable to provide a far greater pressure force effect between the particles G being shaped than during the polishing operational step thereof. The force exerted to produce this pressure will be a function both of the speed of revolution V—1 of the containers about the axis X—X and also the radial spacing R between the axes X—X and Y—Y. At the same time, the rotational speed or spinning velocity v —1 of each of the containers about the respective axes Y—Y must be great enough to rapidly agitate or cause the particles G to rub together to create an abrasive action therebetween.

In the polishing operational step on the other hand, it is desirable that a pressure force which is only sufficient to enmasse the multitude of particles G be effected and that the abrasive action therebetween be eliminated while at the same time, maintaining a high degree of agitation or rolling of the particles G relative to each other. The higher degree of agitation or relative rolling of the particles will result in the more rapid polishing of the particles. Therefore, in the case of the operational step of polishing, as shown in FIG. 5, the moment arm r and the speed of revolution V—2 of the containers are so adjusted as to just cause the particles G to enmasse while utilizing a high rotational speed and spinning velocity v —2. This will permit very rapid polishing of the particle G and completely eliminates any tumbling or cascading action which is undesirable and detrimental in the operational step of polishing the gem stone particles G to final desired finished form. That is to say, when polishing, V—2 and r are such that the mass of the particles G is just past the factor of gravitational pull while the particles are grouped at the top point of travel of the container while at the same time, v —2 is as great as possible while still maintaining the particles enmassed, as shown in FIG. 5.

Naturally, a coarse grit A is used as an abrasive during the rougher operational step of shaping the gem stone particles G than is used during the operational step of polishing the particles G to final desired finished form. Following conventional practice, the material B used during the polishing operational step will normally be some form of rouge or polishing agent.

It has been found by actual practice that in employing the improved process and apparatus of this invention

in connection with the actual operational steps of shaping and polishing a multitude of gem stone particles G to final desired finished form that a good starting abrasive agent would be No. 80 grit, followed by further shaping With No. 220 grit abrasive, and the particles are finally subjected, as far as shaping is concerned, to the action of No. 400 grit abrasive. Normally, the roughest work will necessitate operation at or near the maximum radius R, and near maximum speed of revolution V-1 although it will be appreciated that these factors will vary in accordance with the brittleness and toughness of the particles being processed, which properties may vary widely. Generally speaking during the operational step of shaping, the two speeds V-1 and v-1 as well as the spacing R will be decreased as finer and finer abrasives are used. In the operational step of polishing the gem stone particles G to final desired finished form the apparatus is adjusted with the spacing r decreased relative to the spacing R, the speed of revolution V-2 decreased relative to V-1 and the rotational speed v-2 increased relative to v-1 and the containers revolved and rotated in a manner so that the pressure force created thereby is effective only to enmasse the gem stone particles G in a body, as illustrated in FIG. 5, and effectively rolled together in a mass as rapidly and yet as easily as possible with less pressure force than in the shaping operational step so that the abrasive action therebetween is substantially eliminated and arrested while there is maintained sufficient agitation and relative rolling action between the particles to effect the polishing of the particles G to the final desired finished form.

A typical example of a complete process which employs the apparatus in accordance with this invention will now be described and such process includes the taking of a multitude of broken particles of gem stone material or sawed preforms thereof which will constitute the material which is to be processed. In either instance, the gem stone particles are of very irregular configuration and in the case of the broken particles the particles are the result of crushing larger particles into smaller particles which are suitable in size for use as ornamental jewelry and in the case of preformed particles the particles have been previously rough shaped by any one of a number of manual methods. The gem stone particles are placed into the containers of the apparatus and are first shaped or ground for the purpose of removing saw marks and/or rough edges together with scratches which may have occurred from a grinding wheel in bringing the gem stone particles to a rough form prior to the shaping and polishing thereof to the final desired finished form. A relatively coarse grit such as No. 80 is placed into the containers with the raw stock gem stone particles for the purpose of first smoothing or removing the most pronounced irregularities which may be present thereon. The apparatus is then actuated so that the containers revolve about the axis X-X, rotate about the axes Y-Y with the axes being spaced apart by distance R and in this initial operation the apparatus is operated at a maximum working potential so that the speeds V-1 and v-1 are relatively high and in the case of a hard durable or tough gem stone particles such as jade or agates the initial shaping operation will consume approximately 10-15 minutes in time with the revolution of the containers being as high as 300 r.p.m., the spacing R a maximum and the rotation of the containers v-1 near the maximum. At the end of the time interval, the gem stone particles are smoothed and possess a shape as desired. The containers and particles are washed to thoroughly remove all of the rough grit No. 80 and when the particles and containers have been cleaned, the particles are replaced into the clean containers along with a relatively finer abrasive such as No. 220 in order to remove any scratches which may have been left on the particles by the coarser No. 80 grit and the apparatus is again actuated with the spacing R de-

creased and the speeds V-1 and v-1 also decreased but with the multitude of particles being maintained in the enmassed state so that there is agitation and relative movement between the particles together with sufficient pressure force thereon to remove any scratches or pits left by the coarse No. 80 grit. In each of the operational steps employed in shaping the raw stock of the gem stone particles to prepare the particles for the polishing thereof to final desired finished form there is added sufficient grit to remove any scratches or pits left by the previous grit employed and to only use sufficient grit to accomplish the intended purpose with the complete wearing out of the grit so that there is a minimum waste of both abrasive and gem material. The apparatus normally operates for a time interval which is usually comparable to the time interval used when the particles are subjected to the coarse No. 80 grit and again both the containers and gem stone particles are thoroughly washed and a still finer No. 400 grit may be employed with the pressure force still further reduced while maintaining the agitation and abrasive action at a fairly high level which will remove any scratches or pits left by the fine No. 220 grit. Again the operation of the apparatus in conjunction with the employment of the finer No. 400 grit will consume approximately the equivalent amount of time as in the former instances.

In preparing the gem stone particles for the operational step of polishing to final desired finished form the complete surface area of each particle must be thoroughly smoothed before the polishing operational step is possible and a high degree of polish may be acquired only after the complete surface area has been so smoothed and the abrasive action which occurs between the gem stone particles has been arrested. As described above, the abrasive action is arrested and the gem stone particles are polished in a relatively short time interval by maintaining a high rate of agitation or movement of the gem stone particles relative to each other in the presence of a polishing agent while reducing the pressure force to an amount which will merely maintain the multitude of particles in the enmassed state. In preparing the particles for the polishing operational step the containers and particles are washed free of all abrasive material and are placed into the containers with a mixture of oxide polishing agent such as tin oxide, cerium oxide, levigated alumina powder, rouges, etc. and the apparatus actuated and it has been found that the operational step of polishing requires a greater time interval than was necessary for any of the previous shaping operations wherein the abrasive grit materials were employed.

At this time it is to be pointed out that it is not possible to recite any specific time intervals, speeds of revolution and rotation and spacing distance in regard to the operation of the apparatus since there are so many variables encountered in the process of shaping and polishing a multitude of gem stone particles such as the inherent physical properties thereof which differ materially between the various gems, minerals or stones which may be polished for use as ornamental jewelry and also the possibility that the particles will include certain impurities or other related ores and minerals which may adhere thereto.

Following is a table which shows various different types of gem stone material which has been successfully shaped and polished in accordance with the process and apparatus of this invention and the table contains data relating to the spacing between the axes X-X and Y-Y, the speed of revolution for the containers in revolutions per minute about the axis X-X, the rotation of the containers per minute about the respective axes Y-Y and the approximate time for completing the operational steps of shaping and polishing the respective gem stone material to final desired finished form.

Material	Relative hardness	Physical Characteristics	Radial Spacing, inches	Revolutions per Minute	Rotations Per Minute	Time to Finish, hours
Agate-----	7.5	tough-----	10	200	300 plus	2
Do-----	7	less tough-----	10	150	300	2
Do-----	6.5	brittle-----	10	100	200 plus	2
Jade-----	7	very tough-----	10	175	400	2-3
Quartz-----	7	brittle-----	10	100	250 plus	2
Garnet-----	7	tough-----	10	100	350	2
Obsidian-----	5	brittle-----	10	100	250	2
Opal-----	5.5	very brittle-----	10	100	100	1-2
Rhodonite-----	5.5	brittle-----	10	100	150 plus	2
Turquoise-----	3	brittle or sectile-----	10	100	150	2
Chrysocolla-----	2-4	sectile-----	10	100	100	2

In the apparatus, machines, methods and processes heretofore employed in the polishing of gem stone particles which have above been referred to as the tumbler type of process and apparatus wherein the particles are merely tumbled in a manner which cascades the particles over each other, a time interval comparison between the process and apparatus of this invention and the conventional rough tumble type of processes and apparatuses would indicate that in the shaping operational step wherein the abrasive grit No. 80 is employed in the conventional type of rough tumble process that there will be consumed from 100-200 hours of continuous operating time as compared to from 15 minutes to 1 hour by the process of this invention to impart a comparable smoothness or shape to similar gem particles. Similarly, the time consumed by the conventional tumble type process and apparatus in further smoothing and removing the scratches or pits left by the abrasive material No. 80 by employing the finer No. 180 abrasive material usually consumes more than 100 hours of operating time as compared to less than 1 hour when the process and apparatus of this invention is employed to acquire a smoothness which corresponds to the smoothness which is acquired by the conventional tumble type of process and apparatus on like gem stone material. Also, in the final operational step of polishing the gem stone particles to final desired finished form the conventional type of processes and apparatuses usually require from 50-100 hours of continuous running while the like result on similar particles may be accomplished by the process and apparatus of this invention in less than 2 hours of operating time.

From the above description and disclosure it is believed to be understood that this invention provides an improved process and apparatus for shaping and polishing a multitude of gem stone particles to final desired finished form which is highly effective for all types of gem or semi-precious stone materials and which will enable the final desired finished form to be acquired within a time interval which is substantially less than the time interval required by conventional type of tumbler processes and apparatuses in acquiring a finished form which would correspond to the form acquired by the use of the process and apparatus of this invention on like gem stone material.

While the invention has been described and disclosed in terms of certain embodiments which it has assumed in practice, the scope of the invention should not be deemed to be limited by the precise embodiments herein shown, illustrated, described and disclosed and it is to be understood that other such embodiments are intended to be reserved, especially as they fall within the scope of the claims herein subjoined.

I claim as my invention:

1. Apparatus for processing a multitude of gem stone particles, said apparatus comprising a frame structure, a horizontal shaft journaled on said frame structure, means for mounting a drum to said shaft for rotation therewith, means for driving said shaft at selectively variable speeds, a pair of elongated arms pivotally connected adjacent one end portion thereof to axially spaced and aligned portions of said drum, said arms rotatably carrying adjacent the opposite end portions thereof a cylindrical container having the longitudinal axis thereof dis-

posed in radially spaced substantially parallel relationship relative to said shaft, means for rotating said container at selectively variable speeds about the longitudinal axis thereof in a direction which is opposite to the direction of rotation of said shaft and said drum, a yoke-like member having one end portion anchored to said drum and pivotally connected at the other end portion thereof to each of said arms, and means for selectively anchoring said yoke-like member at circumferentially spaced locations on said drum to vary the radial spacing between the longitudinal axis of said container and said shaft.

2. Apparatus for variably rubbing a plurality of gem stone particles together and variably effecting pressure therebetween to effect both shaping and polishing thereof, said apparatus comprising a container for such particles, combined drive and carrier means mounting said container for epicyclic movement about a sun axis, said means comprising mechanism for varying the revolutionary speed of said container about the sun axis and for varying the rotational speed of said container about its own axis and for varying the radial spacing between the stated axes.

3. Apparatus for shaping and polishing gem stone particles, said apparatus comprising frame structure, a spider rotatably carried by said frame structure, a work container rotatably carried by said spider with the axis of rotation of said container being disposed in spaced relationship relative to the axis of rotation of said spider, means for rotatably driving said spider and said container independently of one another at selectively variable speeds, and means for varying the distance between said axes of rotation.

4. Apparatus for processing gem stone particles, said apparatus comprising a frame structure having a rotatable spider mounted thereon, means for rotating said spider at various selected speeds about an axis, a plurality of circumferentially spaced containers carried by said spider in radial spaced relationship relative to said axis, means for selectively varying the radial spaced relationship between the containers and the axis, and means for rotating each of said containers at various selected speeds about a respective axis thereof with the respective axes of the containers being disposed substantially parallel to the axis of rotation of said spider.

5. Apparatus for first shaping and then polishing a multitude of gem stone particles, said apparatus comprising means for revolving a mass of such particles about a first axis, means for rotating such mass about a second axis spaced from the first axis, means for varying the revolutionary and rotational speed of such particles, and means for varying the spacing between the axes.

6. Apparatus for first shaping and then polishing a multitude of gem stone particles, said apparatus comprising means for revolving a mass of such particles about a first axis, means for rotating such mass about a second axis spaced from the first axis, and means for varying the spacing between the axes.

7. In an apparatus for first shaping and then polishing a multitude of gem stone particles having a container for carrying such particles, the improvement comprising in combination with said container, means for creating a pressure force on, an abrasive action between and an agitation of such particles during the shaping thereof and

for varying the amount of pressure force, abrasive action and agitation from the shaping of such particles to the polishing thereof by decreasing the pressure force thereon and substantially eliminating the abrasive action therebetween while maintaining the agitation of such particles, said means comprising mechanism for variably revolving said container about a first axis while variably rotating the container about a second axis spaced from the first axis and for varying the spacing between the axes.

8. Apparatus for shaping and polishing a multitude of gem stone particles to final desired finished form, said apparatus comprising at least one container for carrying such particles, means for revolving said container about a first axis, means for rotating said container about a second axis spaced from the first axis, means for varying the rotational speed of the container, and means for varying the spacing between the said axes.

9. Apparatus for shaping and polishing a multitude of gem stone particles to final desired finished form, said apparatus comprising means for revolving a mass of such particles about an axis, means for disposing such mass of such particles a given distance from said axis, and means for varying the revolutionary speed of such mass of particles about said axis and for varying the distance that such mass of particles may be disposed from the axis.

10. The method of first shaping and then polishing gem stone particles which comprises the steps of confining a plurality of such particles in a common container together with coarse abrasive, revolving said container in one direction about a first axis while rotating said container in an opposite direction about a second axis which is radially spaced from the first axis while controlling the radial spacing between the axes and the speed of revolution of the container about the first axis so as to create heavy pressure between adjacent stones while simultaneously controlling the speed of rotation about the second

axis to cause the particles to rapidly rub together to effect shaping thereof, washing the particles and the container of coarse abrasive and replacing such coarse abrasive with a polishing agent and then reducing the radial spacing between the first and the second axes and controlling the speed of revolution about said first axis to cause the stones to overcome gravitational effect and be enmassed adjacent the outermost confining portion of the container, while simultaneously controlling the speed of rotation of the container about the second axis to rapidly agitate the particles in the enmassed state to effect the polishing thereof.

11. A process for first shaping and then polishing gem stone particles to final desired finished form comprising placing a multitude of gem stone particles into a container, shaping the gem stone particles by creating and maintaining a pressure force on the particles to enmasse the multitude of particles within the container and effecting abrasive action and agitation between the enmassed particles by revolving the container at a given speed about a first axis while rotating the container at a given speed about a second axis which is spaced at a given distance from the first axis, and then polishing the enmassed particles to final desired finished form by retaining the particles enmassed and eliminating the abrasive action while maintaining the agitation therebetween by varying the speed of revolution of the container, the speed of rotation of the container and the distance between the first and the second axes by decreasing the speed of revolution of the container, decreasing the distance between the first and the second axes and increasing the speed of rotation of the container.

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