

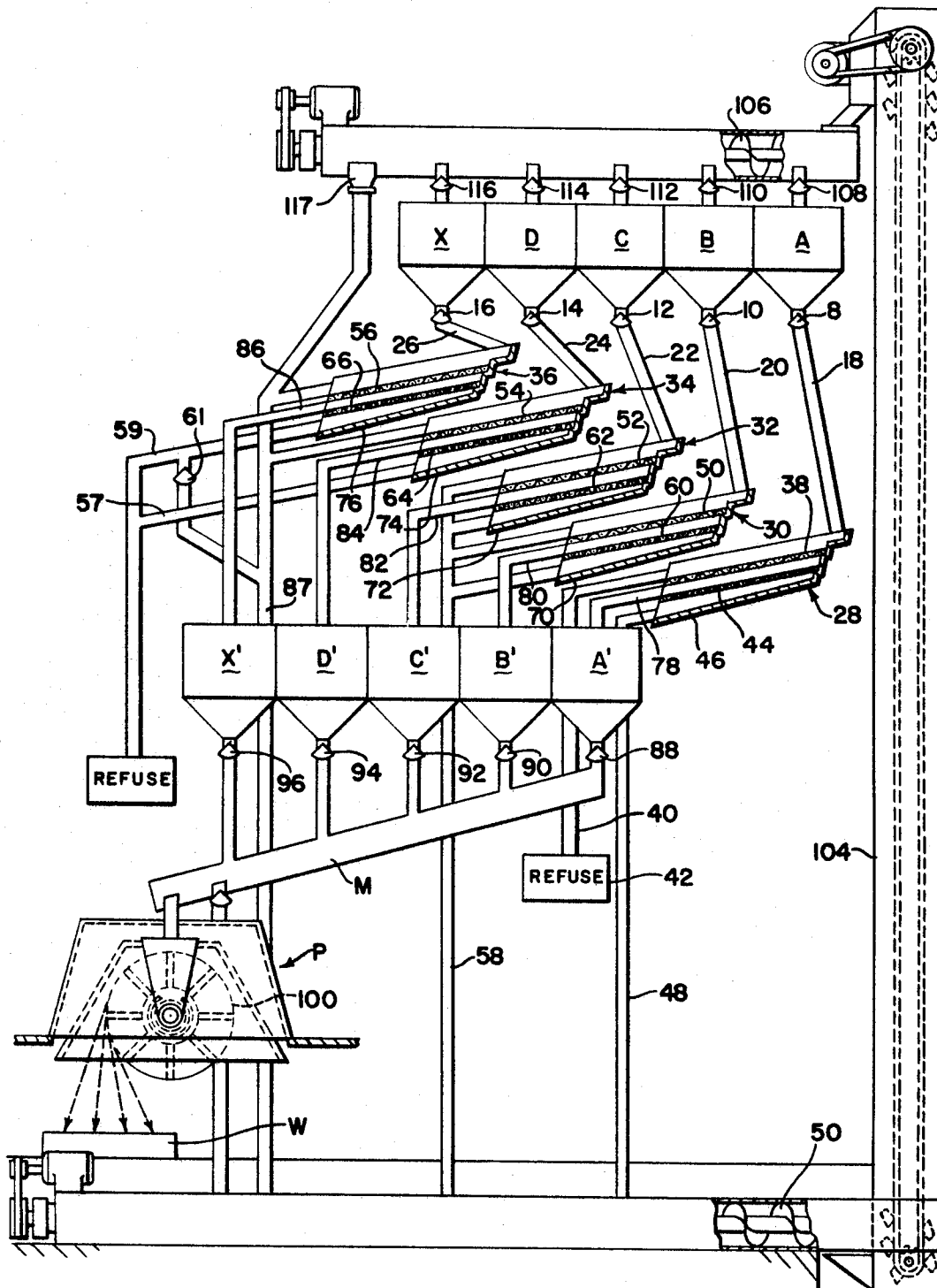
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T. R. VOGT

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PARTICLE SEGREGATING SYSTEM

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INVENTOR
THEODORE R. VOGT
BY *Fay & Fay*
ATTORNEYS

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PARTICLE SEGREGATING SYSTEM

Theodore R. Vogt, Rocky River, Ohio, assignor, by mesne assignments, to Textron, Inc., Providence, R.I. a corporation of Rhode Island

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ABSTRACT OF THE DISCLOSURE

An apparatus for segregating different size ranges of preclassified granular material for circulation through an abrasive blasting device. A plurality of containers for different size ranges with independently operable multideck screens and a plurality of secondary containers connected to the discharge end of the screening decks are connected by conduits so that secondary containers receive accurately classified materials in predetermined ranges of sizes. The secondary containers are connected in series for individual or preselected combination presentation to a centrifugal blasting device or the like. Provision for automatically segregating and discarding oversized and undersized particles is made. A recirculating device to accept used particles and return them to the first mentioned containers for subsequent reclassification through the system insures that after each blasting operation, the particles are returned to the first containers for proper reclassification and re-use.

This invention generally relates to an apparatus for classifying particulate material. More specifically the invention relates to an apparatus for segregating numerous different size ranges of preclassified material to obtain a corresponding number of different size ranges of finish classified material. Still more particularly the invention concerns an apparatus for selectively classifying a plurality of given size ranges of preclassified material to obtain a corresponding number of finish classified size ranges of ready to use material with a minimum of contamination of one size with another. The invention contemplates the foregoing particularly for use with a means for projecting the particles against a workpiece to impart surface properties thereto. The apparatus of this invention is particularly useful in connection with shot blasting or shot peening with metal abrasive particles either shot or grit, and is illustrated and described in connection with this use.

In connection with the rolling of steel sheet for example, it is necessary that the rolls be etched to alleviate many problems which would otherwise prevail. The degree or character of this etching is determined for the most part by the size of metal abrasive which is utilized for etching. Inasmuch as the surface condition of the roll which is used to roll steel determines in large part the surface condition of the steel itself it is apparent that a roll which is improperly etched will produce substandard sheet or roll stock.

A real problem exists in rolling mills in changing from one type of product to another since different rolls must be used and therefore the mill must necessarily prepare rolls having different surface conditions for different types of products. The primary method of etching the surface of these rolls is by shot blasting with metal abrasive particles. Accordingly the manufacturer must have available metal abrasives particles of various sizes to treat the various rolls. The basic problem which underlies most difficulties in this area is that for economic reasons the shot or grit must be reused. In use the material breaks down in size and one size becomes contaminated with another size, and if used in this condition would produce a defective roll.

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A conventional system for etched rolls generally uses four sizes of grit. This grit is purchased in SAE sizes and added to the machine as necessary. The largest size of grit is usually added and the size breakdown supplies the smaller sizes. These different sizes are obtained by classifying on a four or five deck screening machine. Due to the overlapping of sizes it is impossible to use the proper all pass or nominal screen on any but the largest size. The remaining sizes are for the most part random. Inasmuch as the different sizes of grit are not always used in the same sequence a different result is obtained each time a roll is blasted due to the overlapping of the size of grit.

In an attempt to overcome the problem of defective rolls due to the contamination of one size of metal abrasive with another size it is customary to use a size classification apparatus in combination with the shot blasting apparatus.

A conventional size classification device of this type amounts to a plurality of vibrating screen devices, placed one over the other, with the largest screen being placed on the top deck. The bottom plate or slick plate, receives all of the material which passes through the overlying screen decks. While this type of "over-under," or deck type screening device has been somewhat satisfactory it is inefficient in separating a large number of different sizes of material. This inefficiency and undesirability prevails for a number of reasons. Firstly all of the particles to be removed by a given screen in the deck must necessarily have passed through the preceding screen. This makes it necessary to handle an excessive amount of material merely for the purpose of isolating one or more given size ranges of material. Secondly it is found that the feed rates of screens, in terms of pounds, per hour, per square foot of screening area is much lower for the smaller sizes than for the larger sizes. As a matter of fact, it has been found that the feed rate increases exponentially with particle size. Accordingly, when using a multiple deck type screen to isolate a plurality of different size ranges of particles it is necessary to use a slow enough feed rate to accommodate the smallest size range. This clearly reduces the overall efficiency of the classification unit. Additionally, it is necessary to provide a screen having an area sufficient to accommodate the feed rate for the smallest particles since all of the decks in a given multiple deck type screen of in the same area.

Thirdly, it is clearly necessary to operate the entire multiple deck type size classification unit regardless of the number of different size ranges of particles which are to be isolated. It should also be noted that all of the decks operate at the same speed.

In view of the foregoing it is apparent that by using a multiple deck type screen, the overall feed rates are determined by the feed rate of the smallest screen size, the screen area is also determined by the feed rate of the smallest sized particles, thereby making it necessary to use an excessively large area for the larger sized particles. In addition, the overall efficiency and maintenance cost of the multiple deck type screens are excessively high.

In view of the foregoing it is an object of this invention to provide a size classification apparatus for a plurality of different size ranges of abrasive particles which is less costly than devices heretofore known.

Another object of this invention is to provide an apparatus for classifying a plurality of different sizes of metal abrasive particles with a greatly improved feed rate for any given size of particles.

A still further object of this invention is to provide an apparatus for classifying a plurality of different sizes of abrasive particles wherein the purge time is reduced to thereby allow a quicker change from one size particle to another.

A still further object of this invention is to provide an

apparatus for classifying a plurality of different size ranges of abrasive particles with a minimum of contamination of one size range with foreign sizes.

Another object of this invention is to provide an apparatus for classifying a plurality of different size ranges of abrasive particles wherein it is only necessary to operate a single classification device to isolate that particular size range being used.

Another object of this invention is to provide a size classification device for a plurality of different sizes of abrasive particles, to be used in combination with a shot or grit blasting device wherein the blasting apparatus may be changed from using one size range of particles to another size range of particles without risk of significant contamination by foreign sized particles.

These and other objects will become more apparent upon a consideration of the following specification and claims.

Applicant's new system of classifying particulate material is particularly adapted for classifying metal grit used for etching rolls and will be described in this connection.

In applicant's system a plurality of individual two deck screening devices are used. A different or individual screening device is used for each different size range of grit. Each size segregation, or screening device, carries an all pass screen on the top deck and a nominal sized screen on the lower deck. The material passing through the lower screen falls onto a slick plate. There is also a storage bin for preclassified or prescreened material mounted above and connected with each size segregation machine. When the system is used in connection with a roll etching apparatus the particular grit being used continuously returns to its proper prescreen, or preclassified bin, and then proceeds over its individual screening machine for deposit in a finish screened bin for reuse. Those sizes of grit which are excessively large or excessively small are isolated from the system and saved for future use.

By using this technique it should be noted that the optimum feed rate for each size of grit can be utilized. Accordingly the largest size of grit can be screened about four times as fast as the finer sizes, or conversely the larger sizes may be screened by using a screen area about $\frac{1}{4}$ of the size necessary for the smaller grit.

Reference is now made to the drawing, which shows an elevational view, partly in section, of a preferred embodiment of applicant's device illustrated in use with a roll etching blasting apparatus.

Referring more particularly to the drawing the apparatus includes a plurality of storage bins or hoppers, identified as A, B, C, and D to contain the prescreened or preclassified material. Also illustrated in the drawing is an additional bin identified as X which is used for an additional size of material or for experimental use. The bins A, B, C and D are illustrated as containing grit numbers 25, 40, 50, and 80 respectively, which it should be noted are in the order of decreasing particle size. Each of the bins A, B, C, D and X are of the V-bottom variety and open into flow control means 8, 10, 12, 14, and 16 respectively. The control means preferably bucket valves 8, 10, 12, 14, and 16 control the flow of the various sized shot through conduits 18, 20, 22, 24, and 26 respectively leading downwardly to the various two deck size classification devices, each being particularly adapted for use with the particular sized material contained in the corresponding bin.

Situated immediately below the screening devices are a second plurality of bins, identified as A', B', C', D', and X'.

Interposed between the preclassified bins A to D, and X, and the finish classified bins A' to D', and X', are a corresponding number of two deck screening machines identified as 28, 30, 32, 34, and 36 respectively.

Referring more particularly to the screening machine 28, it will be noted that an upper screen 38, identified as

a scalping screen, removes the particles which are excessive in size of any particles contained in the system. These particles pass over the scalping screen 38 downwardly through a conduit 40 into a pit or refuse bin 42. This material is generally saved for later use in some other type of operation.

Immediately below the screen 38 in the screening machine 28 is the deck screen 44 which is of a nominal size. The particles which pass the screen 44 fall onto a slick plate 46 and fall through a conduit 48 into a conventional auger mechanism 50 and are thereby retained in the system.

By retaining the particles which pass the nominal size screens 44 and 60 and returning them to the system, these particles are never allowed to contaminate the remaining particles inasmuch as the screening devices are interposed between the preclassified material. Further, by retaining this material in the system itself, it is not lost but used subsequently when a smaller screen, such as 62 or 64 is being used.

Each of the two deck screening machines 30, 32, 34, and 36 carries all pass screens 50, 52, 54, and 56 respectively on the upper deck thereof. On the lower deck of each screening machine 30, 32, 34, and 36 are nominal size screens 60, 62, 64, and 66 respectively corresponding to the size of particle in bins A', B', C', D', and X' respectively. Each of the screening machines 30, 32, 34, 36 also includes a slick plate or bottom plate, 70, 72, 74, and 76 respectively which receive the particles smaller than the aforementioned nominal sizes. Slick plates 70, and 72 empty into a downwardly leading conduit 58 which empties into the screw conveyor or auger 50 similarly to the conduit 58.

The particles passing through the nominal sized screens 64 and 66, falling on slick plates 74 and 76 respectively, are passed through conduits 57 and 59 respectively leading to the refuse for unusable fines. Alternatively a flow control means 61 may be placed in the conduit 59 to return these fines to the system through the conduit 87.

Those particles which pass the scalping screens 38, 50, 52, 54 and 56 but which are retained on the nominally sized screens 44, 60, 62, 64, and 66 respectively, are deposited into the bins A', B', C', D', and X', respectively through conduits 78, 80, 82, 84, and 86 respectively.

That material passing over scalping screens 54 and 56, obviously being larger in size than the predetermined size range to be used in D', and X', is returned to the system through a conduit 87.

Each of the bins A', B', C', D', and X', containing the finish classified material, opens to a flow control means, preferably bucket valves 88, 90, 92, 94 and 96 respectively. These flow control means are independently and selectively operable to control the flow of the various materials through the downwardly leading conduits communicating with the manifold generally indicated at M.

Conduit M leads to the inlet of a particle projecting apparatus such as a roll etching machine generally indicated as P.

The roll etching, or equivalent apparatus, is of a conventional design which includes a particle projecting wheel 100 which receives the shot or grit from the manifold M and projects it against the work piece, generally indicated at W as illustrated by the broken arrows. As the etching continues the grit used is collected and fed into the screw conveyor auger 50 which is driven by suitable motor means of a conventional character. The auger transfers the grit to a bucket elevator 104 which elevates the grit and deposits same into another screw conveyor or auger 106.

The point of discharge from the auger 106 is determined by the selectively operable bucket valves 108, 110, 112, 114 and 116 opening into bins A, B, C, D, and X respectively. To prevent any buildup of particles in the end of the auger 106 a continuously open overflow dis-

charge 117 is provided to release the material directly into conduit 87.

In a typical operation of this system the bins A', B', C', D', and X' would be charged with a quantity of shot or grit of the appropriate size range. If a grit number 50 were to be used, bucket valve 92 would be opened and the particle projecting apparatus would be started into operation along with auger 50, elevator 104 and auger 106. Also bucket valves 112 and 12 would be opened and screening devices 32 would be placed into operation. As the etching operation continued the particles would pass from the finish classified bin C' through the manifold through projecting apparatus P to workpiece W, through auger 50, up elevator 104, to auger 106, through valve 112, into bin C, through valve 12, and onto scalping screen 52. Scalping screen 52 would remove any particles, probably left from a prior use of the machine using a grit of larger size, and return same to the apparatus via auger 50 etc. Nominal size screen 62 would then isolate those particles having the predetermined size range prescribed for grit number 50 and transfer same to the bin C' via conduit 82. The fines, due to breakdown of the original particles, or remaining in the apparatus from prior use of grit numbers 80 or larger numbers, would drop to the slick plate 72 and would be returned to the system through conduit 58.

A similar sequence of operations would follow in connection with the uses of any other of the different sized particles, noting that the screening device 28 removes particles of a size larger than any of the sizes in use and screening device 36 removes fines of a size smaller than any of the particles in use.

For purposes of illustration and description the principles of the invention have been set forth in connection with but a single embodiment. It is not my intention that the illustrated embodiment, nor the terminology employed in describing the invention, be limiting inasmuch as variations in these may be made without departing from the spirit of the invention as set forth in the appended claims.

What I claim is:

1. A size classification system comprising:
 - a first series of containers for a plurality of different size ranges of preclassified abrasive particles;
 - a plurality of independently operable size classification devices;
 - each of said containers being interconnected to the input end of one of said size classification devices;
 - a second series of containers, each being operably interconnected to the discharge end of one of said size classification devices;
 - each of said size classification devices being operable to separate abrasive particles of a given predetermined size range from the remaining sizes present in said preclassified abrasive particles and including means to transfer said particles of predetermined size range to a given one of said second series of containers;
 - one of said size classification devices including apparatus operable to discharge from the system abrasive particles which are smaller in size than any of said predetermined size ranges;
 - one of said size classification devices including apparatus operable to discharge from the system abrasive particles which are larger in size than any of said predetermined size ranges; and
 - the remaining of said plurality of size classification devices including apparatus to retain in the system all particles of a size falling in any one of said predetermined range of sizes.
2. A size classification apparatus for segregating a plurality of different predetermined size ranges of particles from a corresponding plurality of different preclassified size ranges of particles which comprises:
 - a plurality of containers for said preclassified size ranges;

a corresponding plurality of independently operable size segregation devices;

means to transfer each different size range of preclassified particles to the input end of one of said size segregation devices, each of the size segregation devices containing apparatus to separate particles of a predetermined size range from the remaining sizes present in the corresponding preclassified particles;

means to transfer particles of said predetermined size range;

means on the segregation device which is interconnected to the container for the smallest of said preclassified size ranges for discharging from the apparatus those particles smaller in size than any of said predetermined size ranges;

means on the segregation device interconnected to the container for the largest of said preclassified size ranges to discharge from the apparatus those particles larger in size than any of said predetermined size ranges; and

means on the remaining size segregation devices to return to the system particles of a size falling within any of the predetermined size ranges.

3. The apparatus of claim 2 further characterized in that the containers for the preclassified ranges of particles and the container for the particles of the predetermined size ranges have independently and selectively operable discharge means.

4. An apparatus for selectively classifying a plurality of different size ranges of preclassified particles to produce a corresponding number of predetermined size ranges of finish-classified particles comprising:

- a plurality of containers for said different size ranges of preclassified particles;

- a plurality of independently operable size segregation devices operatively interconnected between a container for the preclassified material and a corresponding container for a given size of the finish-classified particle;

- the size segregation device interconnected with the container for the largest size range of preclassified particles and the size segregation device interconnected with the container for the smallest size range of the preclassified particles including means to discharge from the apparatus particles larger than included in the largest predetermined size range and smaller than included in the smallest predetermined size range, respectively; and

- the remaining size segregation devices including means to return to the system the particles of a size falling within any of the predetermined size ranges.

5. An apparatus for projecting a particulate material of a selected predetermined size range against a workpiece comprising in combination:

- an apparatus for selectively classifying a plurality of different size ranges of preclassified particles to produce a corresponding number of predetermined size ranges of finish-classified particles;

- said apparatus including first plurality of containers for said different size ranges of preclassified particles;

- a plurality of independently operable size segregation devices disposed below said first plurality of containers;

- means interconnecting each one of said first plurality of containers to the input end of one of the size segregation devices;

- each size segregation device including means for separating the predetermined size ranges of particles from the remaining particles present;

- means on said size segregation devices to transfer said predetermined size range of particles to a second plurality of containers;

- each of said first plurality of containers and each of

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said second plurality of containers having independently and selectively operable outlet means;
 each of said outlet means on said second plurality of containers opening into a manifold;
 said manifold being in fluid communication with a particle projecting means operative to project said particles of a predetermined size range against a work-piece; and
 means for conveying the projected particles to a selected one of said first plurality of containers.

6. The apparatus of claim 5 further characterized in that certain of the size segregation devices comprise:
 a two deck screen;
 the upper screen being operative to separate over-sized particles from the remaining particles;
 means for returning said over-sized particles of a size falling within any of the predetermined size ranges to said containers for preclassified particles;
 the second screen being operative to separate a predetermined size range of particles from the particles which are undersized with respect to said predetermined size; and
 a bottom plate disposed below said second screen to collect said undersized particles for return to said containers for the preclassified particles.

7. The apparatus of claim 6 further characterized in that the upper screen on the segregating device for the largest of said preclassified particle sizes is operative to isolate and discard particles of a size larger than included in the largest said predetermined size range of particles.

8. The apparatus of claim 7 further characterized in that the bottom plate of the size segregation device for the smallest of the said predetermined size ranges includes means to discard particles of a size smaller than any of said predetermined sizes.

9. An apparatus for selectively classifying a plurality of different size ranges of preclassified particles to produce a number of different sizes of predetermined size ranges of finish-classified particles comprising:
 a plurality of containers for said preclassified material;
 a plurality of independently operable size segregation devices operatively interconnected between a container for a given preclassified material and the size

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segregation device interconnected to the smallest size range of preclassified material including means to discharge from the apparatus particles which are larger than those included in the largest predetermined size range and smaller than included in the smallest predetermined size range respectively; and
 the remaining size segregation devices each including a two deck screen;
 the upper screen being operative to separate over-sized particles from the remaining particles;
 means for returning said over-sized particles of a size falling within any of the predetermined size ranges to said containers for preclassified particles;
 the second screen being operative to separate a predetermined size range of particles from the particles which are undersized with respect to said predetermined size; and
 a bottom plate disposed below said second screen to collect said undersized particles for return to said containers for the preclassified particles.

10. The apparatus of claim 9 further characterized in that the upper screen on the segregating device for the largest of said preclassified particle sizes is operative to isolate and discard particles of a size larger than included in the largest said predetermined size range of particles.

11. The apparatus of claim 10 further characterized in that the bottom plate of the size segregation device for the smallest of the said predetermined size ranges includes means to discard particles of a size smaller than any of said predetermined sizes.

References Cited

UNITED STATES PATENTS

671,317	4/1921	Edison	209—354 X
719,978	2/1903	Murvane	51—264
800,480	9/1905	Palmer	51—264 X
1,022,091	3/1927	Cruikshank	209—315 X
3,016,203	1/1962	Sears	209—315 X

HARRY B. THORNTON, *Primary Examiner*.
 R. HALPER, *Assistant Examiner*.