March 19, 1963 G. W. POWELL ET AL 3,081,580

ABRASIVE BLASTING APPARATUS

Filed Jan. 4, 1961 2 Sheets-Sheet 1

Fig. 1.

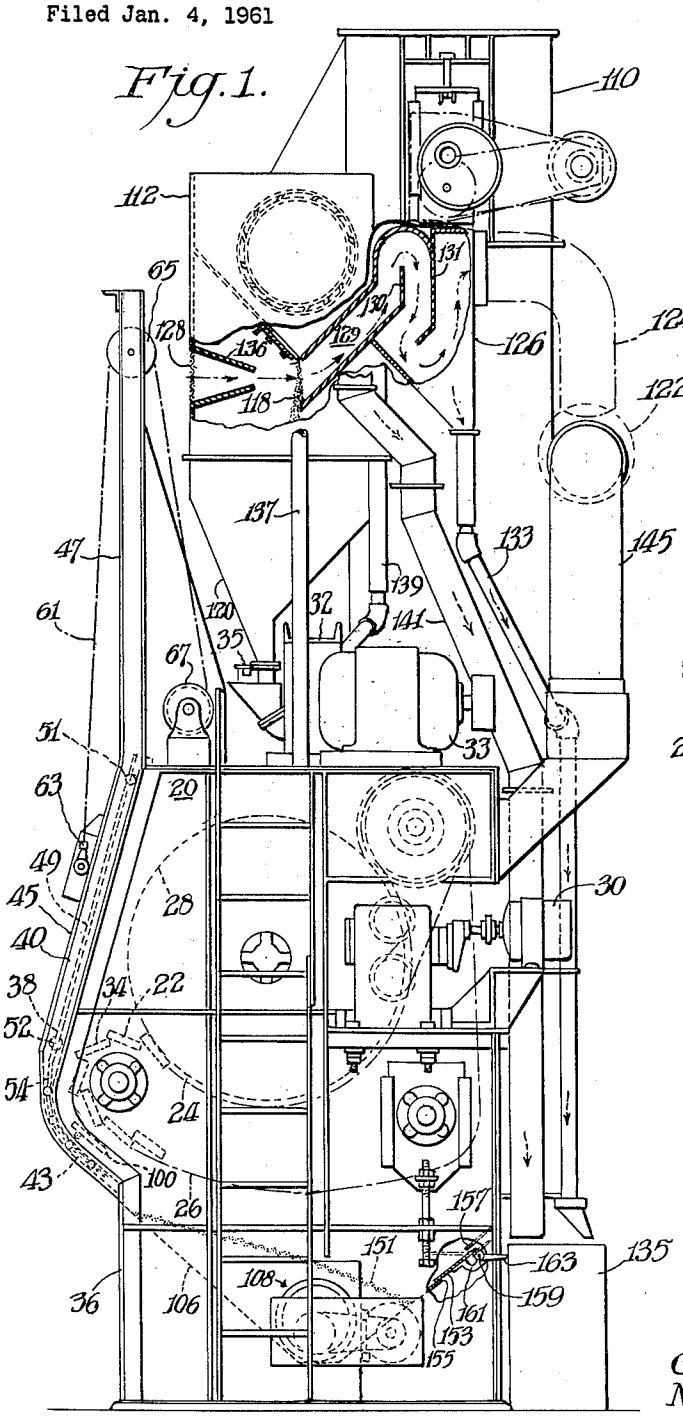


Fig. 7.

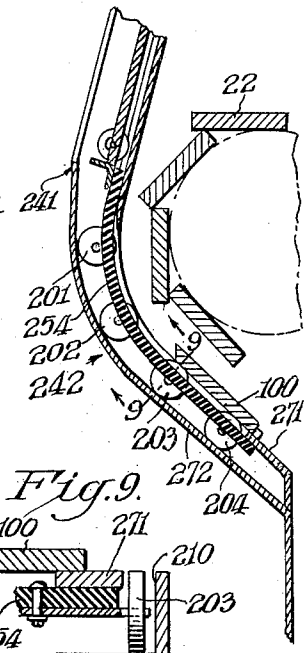
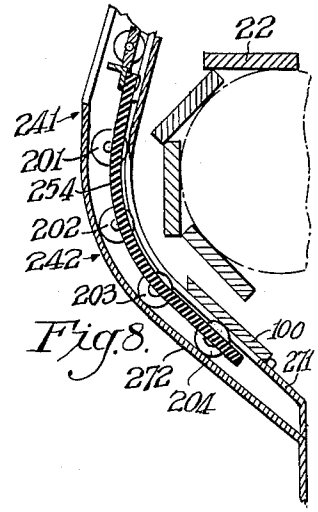


Fig. 9.

Fig. 8.



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Fig. 5.

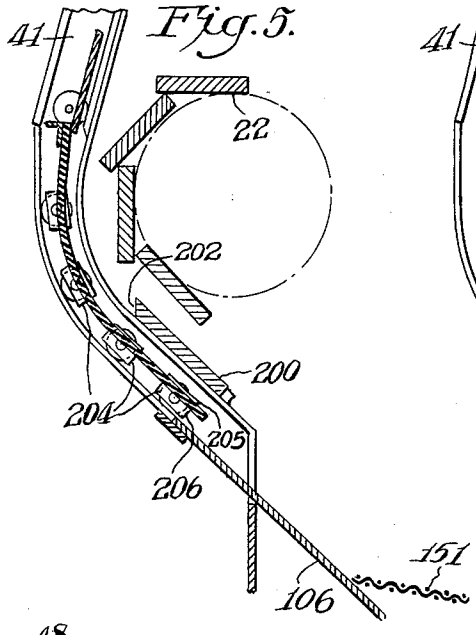


Fig. 6.

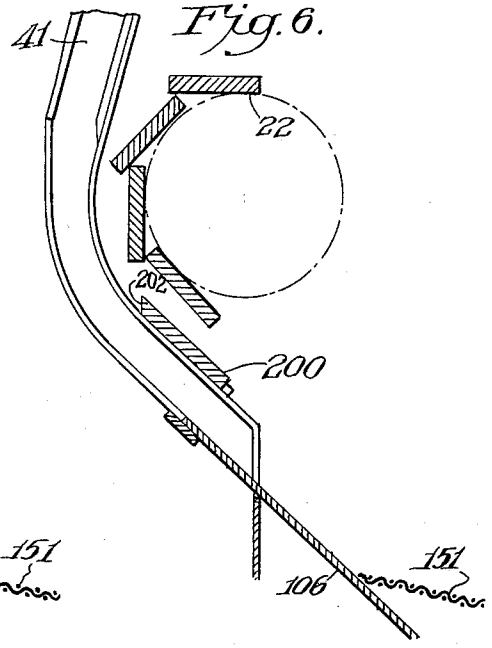


Fig. 2.

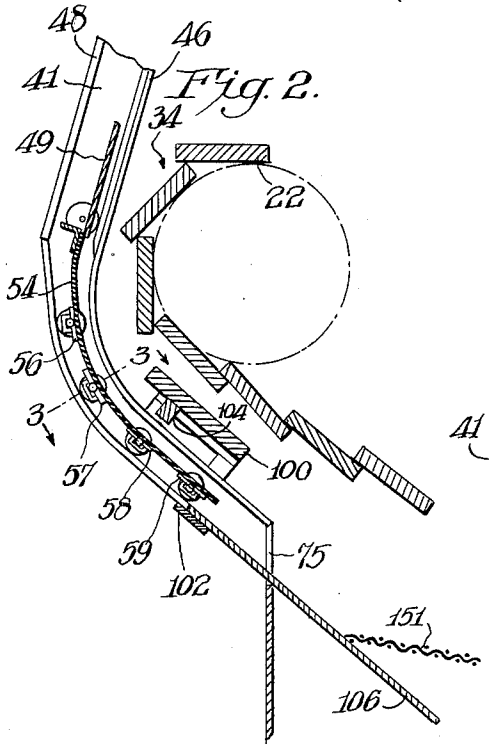


Fig. 4.

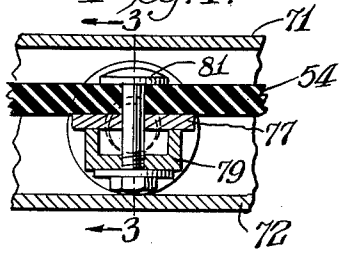
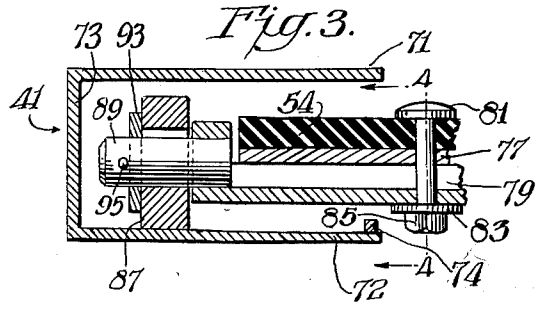


Fig. 3.



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ABRASIVE BLASTING APPARATUS

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Filed Jan. 4, 1961, Ser. No. 80,587
5 Claims. (Cl. 51—13)

The present invention relates to apparatus for subjecting work pieces to a blast of abrasive particles, and particularly to such apparatus in which the work pieces are tumbled in a trough-shaped conveyor to expose all their surfaces for such blasting.

Among the objects of the present invention is the provision of novel apparatus of the above kind to enable efficient operation with fewer maintenance difficulties.

Further objects of the present invention include the provision of abrasive blasting apparatus which is simpler to manufacture and use.

The above, as well as additional objects of the present invention, will be more clearly understood from the following description of several of its exemplifications, reference being made to the accompanying drawings wherein:

FIG. 1 is a partly broken away side view of one form of abrasive blasting apparatus illustrative of the present invention;

FIG. 2 is an enlarged sectional view of a portion of the apparatus of FIG. 1, showing some features of its construction.

FIG. 3 is a fragmentary sectional view of the construction of FIGS. 1 and 2, taken along the line 3—3 of FIG. 2;

FIG. 4 is a sectional view taken along the line 4—4 of FIG. 3;

FIG. 5 is a view similar to FIG. 1 showing a modified form of construction;

FIG. 6 is a view of the construction of FIG. 5, showing the operation of the apparatus in one phase of its working cycle;

FIGS. 7 and 8 are views similar to FIGS. 5 and 6 respectively, illustrating a still further embodiment of the present invention; and

FIG. 9 is a sectional view along the line 9—9 of FIG. 7.

A very popular form of blasting apparatus is the batch treatment type one form of which is shown in U.S. Patent No. 2,716,310, granted August 30, 1955. Such an apparatus has a conveyor arranged to move through a path that forms a laterally tilted trough in which the work pieces are held and tumbled while they are blasted, and a housing around the conveyor keeps the blastant particles confined against escape into the surroundings. A doorway is provided through which to load and unload the work pieces and by inclining the doorway so that it faces upwardly above the conevyor, heavy work pieces can be loaded by an overhead crane if desired. Also the lower portion of the doorway is desirably tilted so as to face downwardly, thereby allowing work pieces to drop directly from the conveyor when they are to be unloaded.

The doorway should be very carefully sealed inasmuch as the escape of flying particles can be hazardous to adjacent personnel, and in addition walking on a floor upon which such ball-like particles have dropped is likely to cause a fall.

According to the present invention apparatus of the above type has the upwardly inclined loading doorway provided with a sliding door and with a door track that extends along the inclined sides of the doorway, the door being a single rigid panel slidably fitted in the track, the lower portion of the doorway is inclined to face downwardly and is provided with a second sliding door depending from the bottom edge of the first sliding door to complete the closure for the doorway, the second door being a flexible panel slidably fitted in a lower trackway extension of the upper trackway, and having a plurality of closely spaced transverse stiffeners, sealing elements on the sides of the upper door and upper trackway cooperating to minimize the escape of projected particles around the upper door, the lower trackway having connected outer and inner plates on each side of the lower door, the inner plates being spaced from the adjacent outer plates by a distance greater than the thickness of the lower door to guide that door, and the sides of the lower door being free of sealing structure.

The stiffeners can have rollers at each end so that they roll in the trackway. In addition although the stiffeners can be affixed to either the inner or outer surfaces of the lower door, it is preferable to have the stiffeners on the outer surface so as to leave the inner surface without any obstructions upon which blastant particles could collect. Particles so collected will drop off when the door is opened and will then be free to fall out through the lower doorway. Stiffeners on the other surface are also protected by the door against much of the abrasion flying blastant particles cause.

The trackway for the upper door is also advantageously made to extend vertically upward from the top of the inclined upper doorway, as described in copending application Serial No. 829,078, filed July 23, 1959, now Patent No. 3,048,947, issued August 14, 1962.

Another feature of the present invention is the provision of a fixed deflector plate within the housing immediately below the outer edge of the conveyor, this plate being over the lower portion of the lower doorway and being inclined to direct inwardly beyond the doorway any particles falling on this plate from the conveyor, and the deflector plate extending outwardly not quite as far as said conveyor edge to keep from interfering with the free dropping of work pieces but to knock off the conveyor any work pieces that tend to be carried onto its lower flight.

The apparatus of the present invention can also have the housing tapered to provide a hopper-shaped lower portion into which the spent blastant particles drop and collect, with a coarse screen mounted across the hopper-shaped portion at an intermediate level, the screen being inclined to cause any coarse material collecting on it to drop to a low point adjacent the housing wall, and an access door is positioned in said wall alongside the low point for reaching in and removing the collected coarse material. The access door can be at an inclined section of the hopper-shaped portion, and can overlap the internal surface of the entire periphery of an access opening. The access door can also be hinged for swinging inwardly. For keeping the blastant particles from interfering with the operation of the access door, a baffle plate can be positioned within the housing above the upper edge of the access door to deflect the particles away from that edge. In addition, the access door can be hinged adjacent its upper edge so that it swings up and prevents abrasive particles from falling through the access opening when the door is open.

Turning now to the drawings, the apparatus of FIG. 1 includes a housing generally indicated at 20, within which is suitably supported an endless conveyor belt 22 so that it has an upper flight 24 and a lower flight 26. The upper flight is held by rotatable guide discs 28 so that it takes the shape of a trough inclined sideways, as shown in the above U.S. Patent No. 2,716,310. The conveyor belt is actuated by a driving motor 30 so that the upper flight 24 moves from the low side of the trough to the high side when work pieces are to be subjected to the blasting treatment. A throwing wheel 32 or a set of such wheels,

actuated by one or more motors 33 mounted on the housing roof above the trough, projects the abrasive blastant particles on the work pieces as they are caused to tumble on the upper flight during its upward travel. When the work pieces are to be unloaded the blastant projection is stopped as by a shut-off valve 35 in a conduit that supplies the blastant particles to the wheel, and the conveyor belt 22 is actuated to move in the reverse direction. This reverse movement carries the work pieces up over the lower edge 34 of the trough so that they will drop off the conveyor belt.

Below this lower trough edge the housing 20 has its front wall 36 recessed somewhat so as to allow the unloaded work pieces to drop down in front and outside the housing where they can be collected in a tote box or other suitable container, not shown. Above the front housing wall 36 the housing is provided with a door assembly slidably mounted in side tracks 40, 41. The lowest portion 43 of the tracks is inclined so as to provide a doorway that faces downwardly and through which the unloading work pieces can be discharged. The trackway curves back from this lowest portion to an intermediate section 45 which is inclined to provide an upper trackway that faces upwardly. Through the doorway formed by trackway section 45, work pieces can be loaded onto the conveyor. The tracks continue on to an uppermost section 47 which in the construction of FIG. 1 is vertically positioned so as to keep from obstructing the space above the housing.

The door assembly consists of an upper rigid one-piece door panel 49 carrying rollers 51, 52 at its upper and lower ends in each of the tracks. From the lower end of this panel a flexible door panel 54 depends. This flexible panel is conveniently made of natural rubber or synthetic rubber, plastics or even with mesh as in U.S. Patent 2,716,310, or other flexible material, and can be stiffened by transverse stiffeners 56, 57, 58, and 59 spaced from each other to keep the side edges of the lower door from being pulled out of the trackways. To this end the stiffeners are provided with rollers on each end and these rollers fit in the trackways, as more fully shown in FIGS. 2, 3 and 4.

The door assembly is operated by a pair of cables 61 each having one end secured to a lifting bracket 63 on the respective sides of the upper door panel, the other ends of the cables being threaded through reversing pulleys 65 and onto a hoisting drum 67. This drum can be electrically operated to wind up the cable and thereby lift the door assembly so as to expose the lower and upper doorways at 43 and 45. A one-way drive such as a worm gear type speed reducer in the drive connection from the motor will keep the door from dropping when the lifting action is terminated. A magnetic brake in the drive connection will also guard against such undesired dropping. Reversing the motor or disconnecting the one-way drive will permit the door assembly to descend into position to close both doorways. In order to permit the rigid upper door panel 49 to move across the angle between the intermediate trackway section 45 and the upper trackway section 47, the trackways which are composed of inner and outer plates 46, 48 connected together, can have their outer plates 48 of reduced width in these sections so as to only receive the rollers 51, 52 projecting from the panel without enclosing any part of the panel itself. This is shown in more detail in earlier application Serial No. 829,078 (Patent No. 3,048,947), and permits the portion of the rigid panel between the rollers to be elevated out from the trackways as the door moves through the angular trackway section.

If desired, the uppermost trackway portion 47 can be tilted to form an undeviated extension of trackway section 45 in which event no special provision need be made to permit the rigid panel to move along that trackway.

In order to keep the blastant particles from escaping out of the housing, the upper door panel is provided with seals such as shown more fully in the above earlier filed application. The lower door panel 54 is not exposed to the direct re-bounding of projected blastant particles and accordingly does not need elaborate sealing. The mere lateral extension of the lower panel so that its side edges are received within the tracksways, which are channel-shaped in transverse section, will direct into the track channels those blastant particles moving laterally along the lower door panel. These particles will then roll down the inclined track channels into the lower portion of the housing. This is more clearly shown in FIG. 3 where the trackway 41 is illustrated as having an inner plate 71 and an outer plate 72 connected by a web 73.

The spacing between plates 71 and 72 is greater than the thickness of the flexible door panel 54 and this panel has its side edges received in this spacing. Because of the downward and inward tilting of the trackways at the lower door panel, any particles that move laterally past the flexible door panel 54 will fall onto plate 72 and will drop along the inner surface of that plate to the bottom 75 of the trackway. At this bottom the trackway channel opens into the interior of the housing so that the falling particles are returned to the interior where they can be collected and recycled in the conventional manner. A bead 74 can also be provided on the inner surface of plate 72 near its open edge to further assure against the escape of particles.

FIGS. 3 and 4 also show the stiffener construction of FIGS. 1 and 2 in greater detail. Each stiffener is here illustrated as composed of a bar 77 and a reenforcing channel 79, each extending transversely across the entire curtain width and both held together and to the curtain by a set of bolts 81. The bolt heads are preferably oriented so as to be against the inner surface of the curtain, the bolts penetrating through aligned openings in the curtain, stiffener bar and reenforcing channel. A washer 83 and a nut 85 can be used to secure the bolt in place and at the same time provide for simple panel replacements when this becomes necessary. Alternatively the bolts can be replaced by rivets or the like, or the flexible door panel can be cemented or vulcanized to the stiffener bars. Having threaded bolts so located that the threads are on the outside of the door panel also minimizes the working of particles into the threads so as to cause them to become jammed.

The rollers for the lower door panel, as indicated at 87, are conveniently journalled on extension studs 89 welded, or otherwise secured to the ends of reenforcing channel 79. Adequate clearance is desirable in the journalled mounting of these rollers to reduce the possibility of jamming by blastant particles or the like. Any suitable roller-retaining construction can be used and in FIG. 3 this is shown as a combination of a washer 93 and a retaining pin 95 that is fitted through a transverse passageway in the stud.

The construction of FIGS. 1 and 2 also includes a deflector plate 100 fixed in place across the interior of the lower trackway just below the conveyor edge 34. The deflector plate should be sturdy enough to resist impacts from heavy work pieces and is mounted so as to form a deflector for abrasive particles that drop down through the slats of the conveyor at edge 34. For this purpose the deflector plate is inclined with its lower edge extending interiorly of the bottom 102 of the trackway. The upper edge of the deflector plate is in turn recessed slightly below the outermost edge of the conveyor so that work pieces dropping freely off the conveyor do not touch the deflector plate. Under some circumstances work pieces tend to become pinched between the adjacent slats of the conveyor and tend to be carried around along the lower flight of the conveyor rather than to drop free of its outermost edge. Such pinched work pieces are liberated by the deflector plate and thereby kept from following the

lower flight into the interior of the housing bottom. When such pinched pieces reach the deflector plate they are pulled off the conveyor and will then drop along with the freely falling work pieces. It has been found that the positioning of the upper edge of the deflector plate so that it has a clearance of approximately a half inch from the lower flight of the conveyor will assure proper unloading without any tendency for the work pieces to become jammed or caught between the lower flight and the deflector plate itself.

Where the work pieces to be treated in the apparatus are particularly heavy, the deflector plate can have a reenforcing rib welded or otherwise secured thereto, as indicated at **104**, near its upper edge. It is also a good idea to have the bottom of the trackway **102** reenforced as by a strengthening strip welded across the entire bottom, as illustrated.

The lower portion of the housing **20** in FIGS. 1 and 2 tapers down to provide a hopper **106** through which the blastant particles are guided to a recycling mechanism which may, for example include a screw conveyor **108** located at the bottom of the hopper. The screw conveyor, or for that matter a vibrating conveyor, can be used to propel the particles to one side of the housing where they can be lifted by a bucket elevator **110** in the conventional fashion, and dropped into a separator **112** mounted on the top of the housing. The separator can be the usual combination of scalping drum and rotating screen as shown for example in U.S. Patent 2,771,189, granted November 20, 1956, and is arranged to cause the recycled blastant particles along with any fine materials that accompany them, to drop through a moving air stream, as indicated at **118**, so that the fine materials are swept to one side along with the air stream. The heavier particles drop into storage bin **120** which in turn feeds the throwing wheel. The air stream is provided by a source of suction shown as duct **122** with a branched connection **124** leading through a baffle chamber **126** and to a screened opening **128** on one face of the lower portion of the separator. Suction in source **124** sucks air in from screen opening **128** through abrasive stream **118**. Air as well as lighter particles such as sand and fines continue through duct **129**. A deflector baffle **130** directs air upwardly, and the duct being curved on top, the particles are swept around as in a cyclone collector. The particles follow along another baffle **131** and are deflected off its lower end into expansion chamber **126**, where the heavier of the swept along particles fall into spout **133**, and the lighter particles are carried by the air to pipe **124** and on to a filtered or unfiltered discharge outlet for the air. The particles dropped into conduit **133** discharge at some convenient place where a collector such as a discharge bin **135** can be conveniently located, and removed when necessary.

For the more complete removal of high concentrations of lighter particles, as where large amounts of sand are introduced into the machine by the work pieces, this separator can be equipped with a nozzle **136** inserted in screen opening **128** and tapered in such a manner as to increase the speed with which the sucked in air moves across the dropping particle stream **118**.

The nozzle can also have its outer end connected to a blower or other source of air under pressure to also increase the speed of air travel across the dropping particle stream. Where the nozzle **136** is so supplied with air under pressure, it need not be tapered. To supply air under pressure, a manifold can be fitted to cover opening **128**, and a supply duct connected to the manifold adjacent one edge of the opening. A relatively small supply duct connected to such a manifold for example, adjacent a short end of a rectangular opening **128** having a relatively large width, will adequately supply pressurized air through the manifold over the entire width of the opening, if the duct is directed at right angles to the axis of the opening so that the pressurized narrow air stream changes direction to go through the opening.

As in application Serial No. 22,588, filed April 15, 1960, an overflow conduit **137** can also be provided at the remote end of the separator to carry particles that reach that end so as to indicate that the separator is operating at full capacity. Another conduit **139** can be located with its upper end near the top of storage bin **120** so as to indicate by overflow of the particles when the storage bin is full. Both conduits can be arranged to have transparent sections or air gaps so that the movement of particles through them is readily observed. These conduits can lead directly to the screw conveyor or to the housing so that the particles passing through them are not removed from the system. A refuse conduit **141** is also conveniently provided for carrying off larger objects such as core wire, rods, etc., that the scalping drum separates from the falling particles.

Suction source **122** is also connected by duct **145** to the interior of the housing **20** so as to withdraw air-carrying dust and the like that is present in the housing as a result of the blasting operation.

Another feature of the construction of FIGS. 1 and 2 is an additional separator in the lower portion of the housing. In FIG. 1 a screen **151** is mounted across the hopper bottom **106** in a tilted position so as to catch large objects such as cores and wires, and keep them from going through the recycling system where they might cause jamming. The tilting of the screen **151** causes such large articles to drop to the lowermost portion of this screen where the articles collect. Just above this lowermost portion an access door **153** is provided in the inclined bottom of the housing so that an operator can reach in and remove the objects collected by screen **151**. The access door is shown as fitted across the interior of an opening **155** and overlapping the entire periphery of the opening so as to keep blastant particles from dropping through the opening both when the access door is open and when it is shut. Additional protection against the dropping of particles is provided by a baffle **157** above and spaced from the upper portion of the access door to keep falling particles from becoming caught on the upper edge of that door when the door is closed. The access door is also shown as hinged at **159** adjacent its upper edge by means of an arm **161** secured to the door and extending out through the opening. The arm terminates in a handle **163** by which the door can be operated.

Grasping the handle **163** and lowering it causes the access door to be raised. At the same time it is a simple matter to reach in through the doorway thus opened and pull out the objects on the bottom of screen **151** while the access door is held open. With this arrangement it is a simple matter to clean out objects collected by screen **151**, whether the machine is in operation or not, and even while blasting is going on, care being taken for the operator reaching in to wear suitable gloves to protect his hands against flying blastant. Because of the presence of the lower screen **151**, the scalping drum portion of the separator **112** can be made smaller so that the entire height of the apparatus can be reduced.

FIGS. 5 and 6 show a modified form of apparatus more suitable for machines handling smaller work pieces. Here the deflector plate is illustrated at **200** and does not have a reenforcing rib. It is also mounted directly against the inner walls of the trackway and has its upper edge provided with a vertical end face **202** so as to reduce impact effects on work pieces that engage it. The stiffeners **204** are here also shown as having a stiffener member **205** on the inner face of the flexible door with another stiffener member **206** on the outer face. FIG. 5 shows the door assembly when in closed position, and FIG. 6 shows a corresponding arrangement when the door assembly is open.

FIGS. 7, 8 and 9 show a still further modified form of

construction where the flexible door panel can be so arranged as to seal itself against the trackways without requiring any sealing flanges or ribs such as those used in the upper door panel. As will be noted in FIG. 7, the trackway 241 had its lower portion 242 arranged so that the outer plate 272 approaches inner plate 271 more and more closely as the lower door moves down this trackway portion. Rollers 201, 202, 203 and 204 are so arranged on their stiffeners that when the lower panel is closed their centers are equidistant from the outer track plate 272 and they hold the flexible door panel so that it is parallel with and resting against inner plate 271.

In this arrangement the panel itself has a varying spacing from the centers of the successive rollers. As is clear from the figures, the door panel is a substantial distance inwardly spaced from the center of roller 201, that is, it is on the side of the roller center close to inner track plate 271. At roller 202 the door panel is a lesser distance inwardly spaced from the roller center. At roller 203 it is still less displaced and at roller 204 it can be substantially at the roller center. This variation in spacing corresponds to the taper in the width between the inner and outer plates of trackway section 242 so that when the lower door panel is brought sufficiently far down in this trackway section this entire panel will uniformly have its side edges brought directly against the inner trackway plates 271. On the other hand, when the door assembly is lifted, only a small amount of travel will cause the entire lower door panel to be pulled away from its engagement with the inner track plates 271, as shown in FIG. 8. There will accordingly be very little rubbing of the door panel against the trackways while at the same time there will be a good sealing action when the door assembly is closed.

As shown in FIG. 9, the size of the rollers 201–204 may be such that a slot 210 should be cut out of the inner trackway plate 271 to permit the rollers to travel in the desired paths.

If desired the upper door panel can also be fitted in the same manner as the lower panel of FIGS. 7 and 8. The inner track plates 46 can then be provided with suitably located depressions at the location of all the upper panel rollers when the upper panel is in closed position. If these depressions cause the lower panel to rub too much against the inner plates as the lower door panel rollers move across them, the lower panel rollers can be made to hold their panel further away from the trackway plates 46, or the lower panel rollers can be arranged so that they do not move into the depressions, as by having the lower panel rollers wider than the depressions, or offset from the upper panel rollers so that they do not follow in the same path.

Obviously many other modifications and variations of the present invention are possible in the light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed:

1. In an apparatus for tumbling a batch of work pieces comprising a trough-shaped conveyor on which the work pieces are tumbled, a housing enclosing said conveyor, a loading and unloading doorway for said housing, abrasive particle blasting means extending into said housing for projecting abrasive against the work pieces, the improvement of a doorway in which the upper portion thereof is inclined to face upwardly, a door track that extends along the sides of the doorway, a roller supported door in the track, said door having a rigid upper panel portion, the lower portion of said doorway being inclined to face downwardly, said door having a lower flexible panel depending from the bottom edge of the upper door panel to complete the closure for the doorway, a plurality of closely spaced transverse stiffeners extending across the lower flexible door panel, and sealing elements on the sides of the upper door panel portion and that upper portion of the track accommodating the upper door panel cooperating to minimize the escape of projected particles around the upper door panel, the lower portion of the track accommodating the lower flexible panel having connected outer and inner plates on each side of the lower door panel, the inner plates lying in spaced relationship from the adjacent outer plates by a distance greater than the thickness of the lower door panel to guide that door panel.

2. The apparatus of claim 1 in which each stiffener is equipped with rollers at each end.

3. The apparatus of claim 1 in which the stiffeners are secured against the outer face of the lower door.

4. The apparatus according to claim 1 wherein the door track that extends along the inclined sides of the doorway extends vertically upwardly from the top of the doorway, and rollers affixed to both sides of the upper door panel portion which ride in said door track guide the upper panel door portion into and out of the vertical extension of said door track.

5. The apparatus according to claim 1 wherein a fixed deflector plate is fitted to the housing, which plate extends across the entire doorway width below the outer edge of said conveyor and immediately adjacent the conveyor, said deflector plate being inclined to direct inwardly beyond the doorway any particles falling on this plate from the conveyor.

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