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(54) **APPARATUS FOR FORMING SHOT BALL**

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B24C 11/00	(2006.01)
B21F 1/00	(2006.01)
B24C 1/10	(2006.01)
B21K 1/02	(2006.01)

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CPC . ***B24C 11/00*** (2013.01); ***B21F 1/00*** (2013.01); ***B21K 1/02*** (2013.01); ***B24C 1/10*** (2013.01)

(58) **Field of Classification Search**

CPC B24C 1/10; B24C 11/00; B21F 1/00; B21K 1/02

USPC 72/426

See application file for complete search history.

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(57) **ABSTRACT**

The present invention provides an apparatus for forming a shot that can prevent a loss of shot in the process of forming and sorting the shot balls and can collect dust in a cyclone type that can strongly suppress generation of dust.

7 Claims, 6 Drawing Sheets

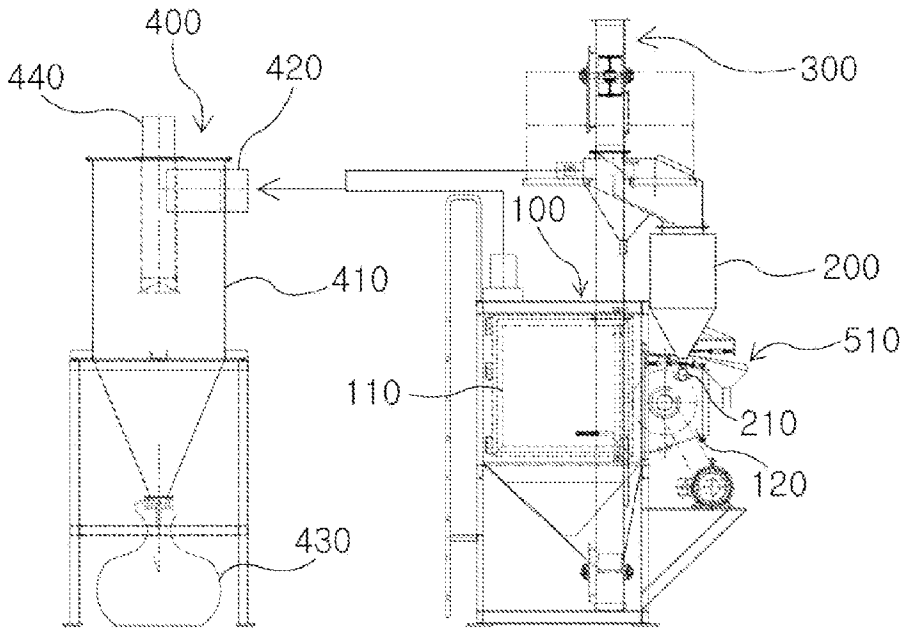


FIG. 1

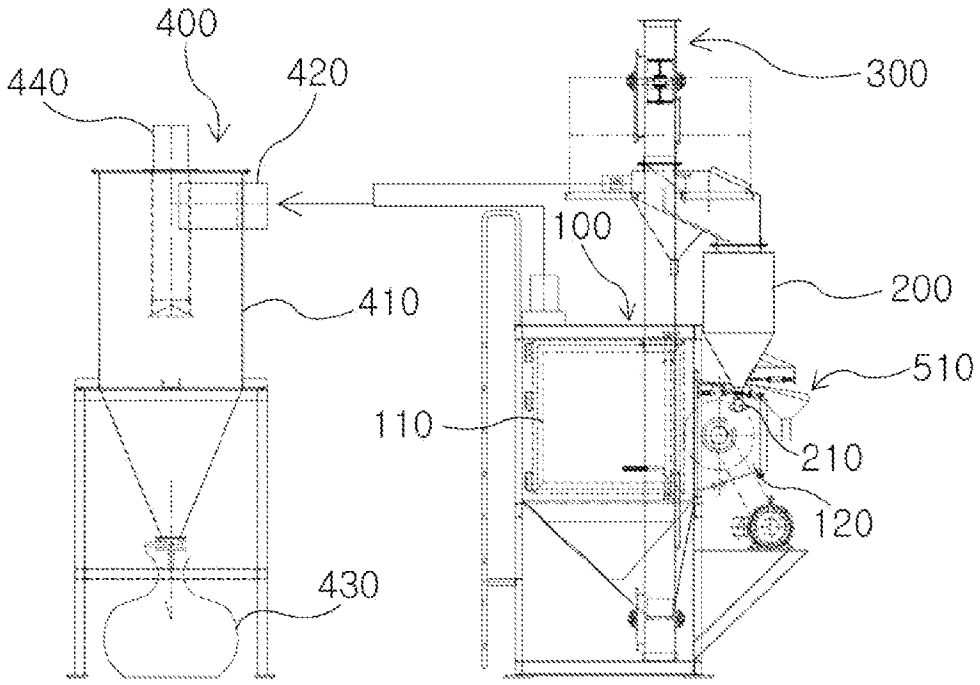


FIG. 2

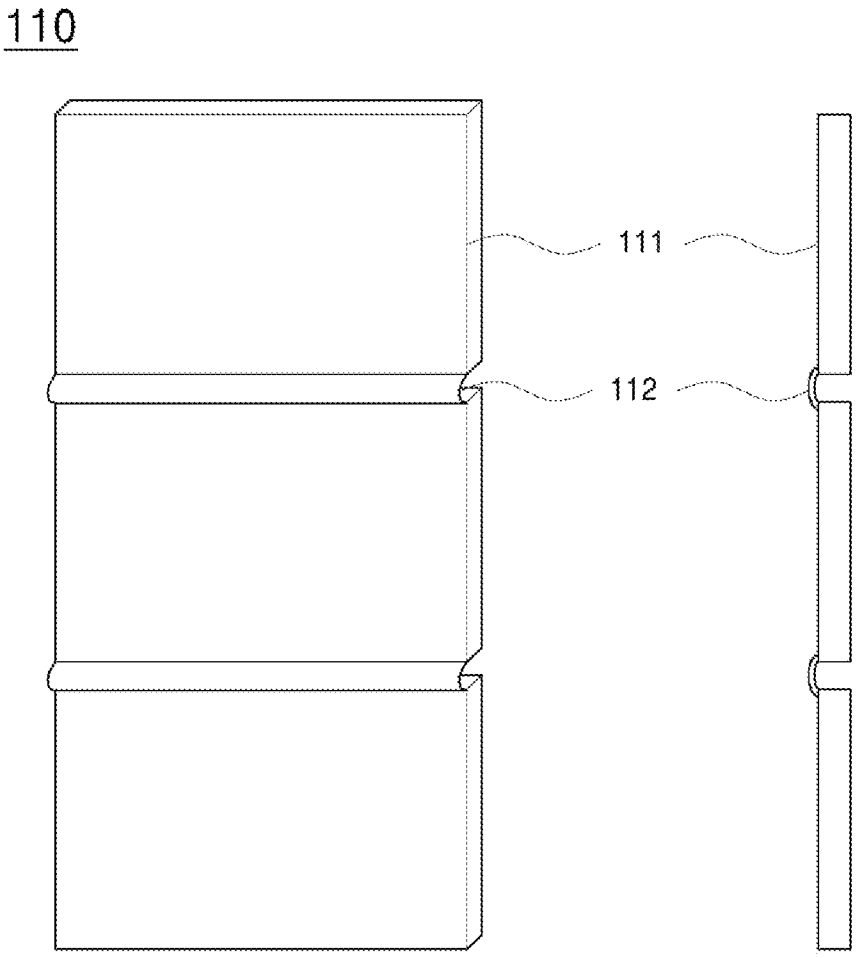


FIG. 3

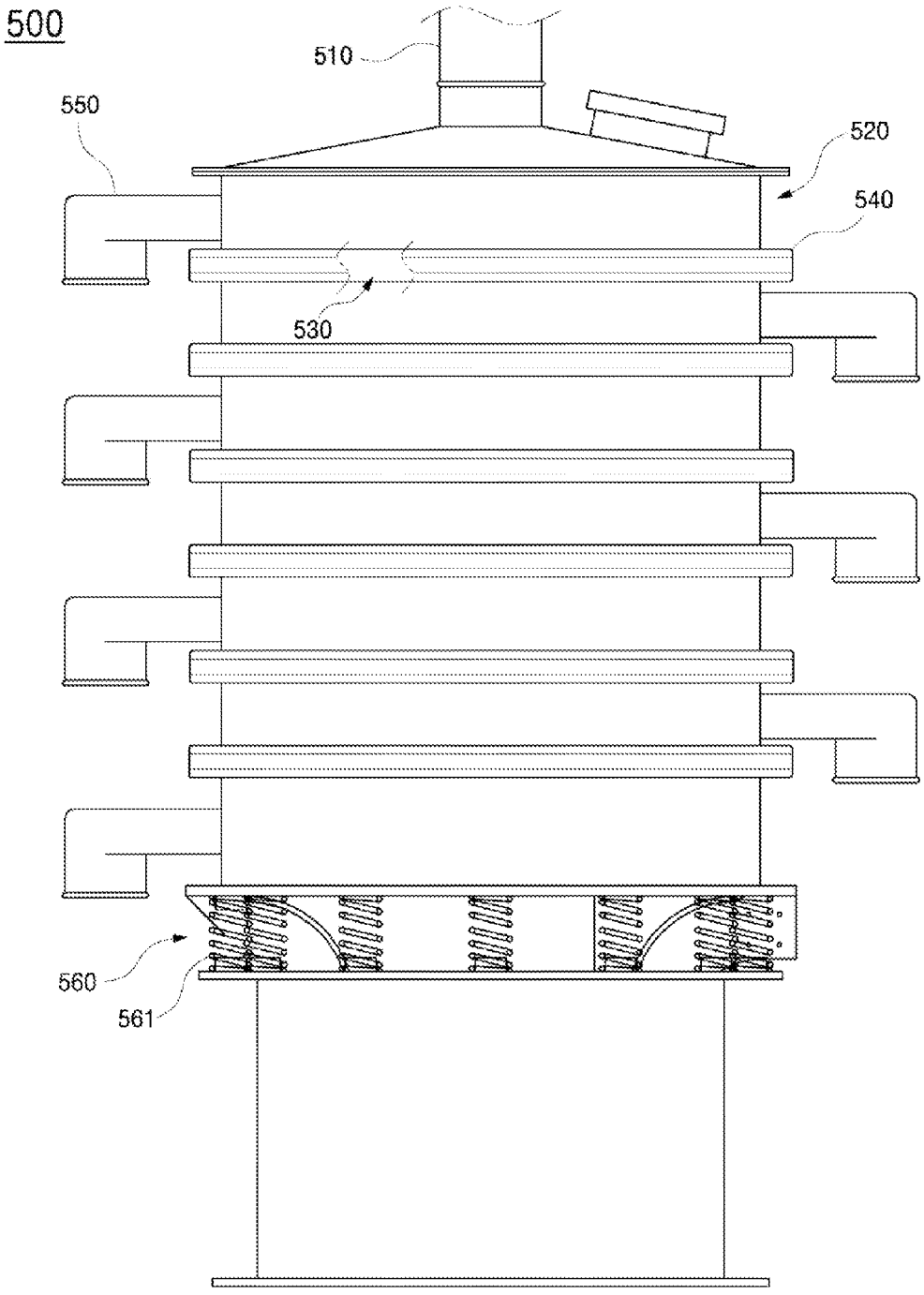


FIG. 4

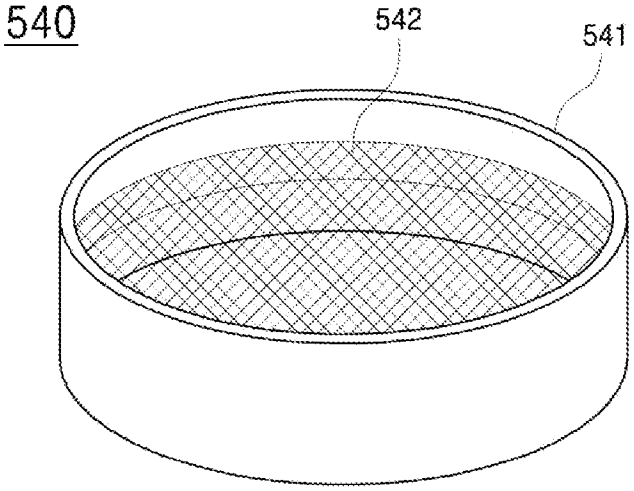


FIG. 5

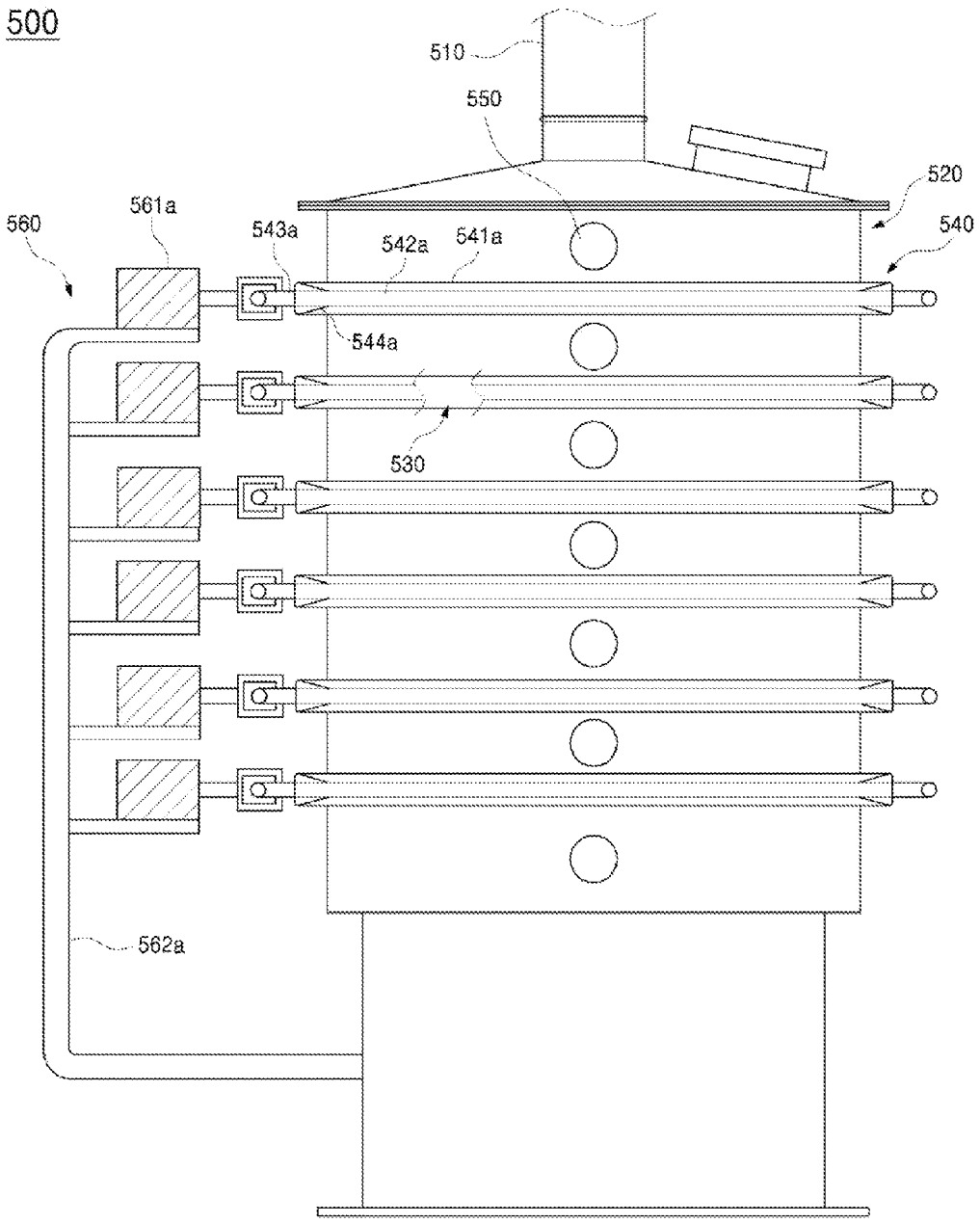
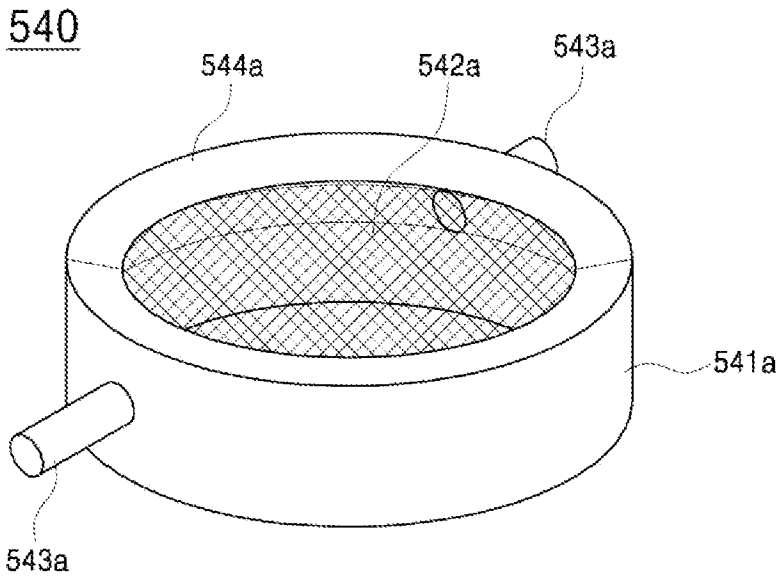


FIG. 6



APPARATUS FOR FORMING SHOT BALL

REFERENCE TO RELATED APPLICATIONS

This application claims the priority benefit of Korean Patent Application No. 10-2014-0100826 filed on Aug. 6, 2014, the entire contents of which are incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates to an apparatus for forming shot and, more particularly, to an apparatus for forming shot to be used in shot peening.

BACKGROUND OF THE INVENTION

Recently, various machining processes such as mechanical nontraditional machining, electric nontraditional machining, and chemical nontraditional machining have been studied in various ways to perform surface finishing on mechanical parts and increase their durability.

Examples of mechanical nontraditional machining include sandblasting and shot peening, both of which improve fatigue strength and surface hardness by generating work-hardening on the surface of a workpiece. In particular, shot peening can not only increase design ability by improving strength of a material, but maintain high toughness at the center portion of the material, so it is very useful for parts in a mechanical structure that receive fatigue loads, and is very important particularly for improving fatigue strength and lifespan.

In comparison to heat treatment or other machining methods, an advantage of shot peening is that it is possible to be performed without using a large energy source and thus pollution due to consumption of fuel is reduced. Further, strength increases after shot peening, so weight decreases, energy is saved, and air pollution is prevented.

Shot peening is used throughout industry including mechanical, aerial, automotive, shipbuilding, and civil engineering and construction fields, and particularly, the size, strength, and safety of products have been improved and the weight of products has been decreased with development of the technology, so shot peening is applied to various and wide fields.

Further, shot peening is particularly useful for increasing fatigue lifespan and fatigue strength of a coil spring, a leaf spring, a gear, a crankshaft, a connecting rod, an axle shaft, a universal joint, a piston, a cylinder block, a crank case, a torsion bar, a chain link, a milling cutter, a drill, a high-pressure steel pipe, a high-pressure container, jet engine blades, and blades of a helicopter. Furthermore, shot peening is useful for a notch of a part, a key groove, a welded portion, corrosion fatigue portion, a portion under high stress, a surface of a part after machining, a surface after grinding, a decarbonized portion after heat treatment, a friction portion, a distorted portion, and a surface after discharge machining.

Soft steel, hard steel, tooled steel, steel for a structures, spring steel, duralumin, an aluminum alloy, stainless steel, zinc, and emery are generally used for the material of shot balls.

Manufacturing methods for a steel shot ball include a casting method and a method that uses a cut wire, and both are used to create a stronger paint adhesion quality on a metal surface by making the metal surface rough using metallic particles like sand grains.

Shot and grit are types of shot peening balls generally used in industries using metal as a raw material, such as automotive, constructing, shipbuilding, forging, and steel industries, and are needed to satisfy various shapes and properties of metals. Accordingly, the inventor(s) has proposed a "Shaping apparatus for shot" and manufactured a shot in Korean Patent No. 10-0524536.

However, according to the shaping apparatus for shot, material is accumulated between projection sides in projection for rounding and there is a problem of inaccurate sorting and loss of shot in the process of sorting complete shot balls in accordance with diameters thereof.

Further, dust cannot be completely collected due to overload in the apparatus, so there is a need for an apparatus for forming shot equipped with a device that can strongly suppress generation of dust.

SUMMARY OF THE INVENTION

Accordingly, the present invention has been made keeping in mind the above problems occurring in the related art, and the present invention is intended to propose an apparatus for forming shot that can prevent a loss of shot in the process of forming and sorting shot balls and can collect dust using a cyclone type that strongly suppress generation of dust.

In order to achieve the above object, according to one aspect of the present invention, there is provided an apparatus for forming shot that includes: a tank for receiving cut-off pieces finely cut from a steel wire and dropping the cut-off pieces through a conveying channel formed at a side; a forming chamber disposed under the tank, communicating with the conveying channel, and including a projection side disposed on a first side therein and an impeller rounding cut-off pieces by projecting the cut-off pieces dropping through the conveying channel to the projection side using high-speed airflow; a conveyer having a first side disposed at a lower portion of the forming chamber and a second side communicating with an upper portion of the tank to convey cut-off pieces, which drop to the tank after hitting against the projection side; and a dust collector communicating with the forming chamber and collecting dust by absorbing dust and fragments produced in the forming chamber. The apparatus further includes a vibrator that is composed of: a supply channel formed at a second side of the tank and carries cut-off pieces that are finished being machined; a cylindrical body communicating with the supply channel at an upper portion and receiving cut-off pieces that drop; a plurality of insertion spaces formed with regular intervals in a depth direction of the body; sorting units separably inserted in the insertion spaces, respectively, and sorting cut-off pieces in accordance with diameters thereof; discharge ports formed between the insertion spaces to discharge the sorted cut-off pieces; and a vibrating unit disposed at a side of the body and vibrating the sorting units.

The projection side may be made of chrome steel and composed of a plurality of unit members spaced in a depth direction of the first side in the forming body, and anti-collection plates may be disposed in spaces between the unit members.

The dust collector may include: a cylindrical cyclone unit having an inverse conical lower portion; an inflow pipe connecting an upper portion of an outer side of the cyclone unit with the forming chamber; a storage communicating with a bottom of the cyclone unit and storing fragments turning and dropping along an inner side of the cyclone unit; and a discharge pipe communication with a top of the cyclone unit and discharging dust moved up in the cyclone unit.

The sorting units may each include a first rim separably inserted in a corresponding insertion space and a first filtering net disposed inside the first rim.

The vibrating unit may include: a vibration motor disposed under the body and vibrating the body up and down; and a plurality of springs disposed on a bottom of the body.

The sorting units may each include: a second rim separably inserted in a corresponding insertion space; a second filtering net disposed inside the second rim; rotational shafts connected with the second filtering net through both sides of the second rim; and fin stoppers formed at upper and lower portions of the second rim at an angle toward a center of the second rim.

The vibrating unit may include: driving motors coupled to predetermined rotational shafts and providing rotational vibration by turning the second filtering net forward and backward; and a bed supporting the driving motors.

According to the present invention, the following effects can be expected.

Since collection of shot in the apparatus in the forming process can be prevented, maintenance is simple and the maintenance cost can be reduced.

Since it is possible to prevent a loss of shot in the process of sorting and improve sorting performance, it is possible to increase production efficiency.

Since dust is collected in the cyclone type that strongly suppresses generation of dust, work environment is improved and work efficiency can be improved accordingly.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

FIG. **1** is a view showing an apparatus for forming a shot according to an embodiment of the present invention;

FIG. **2** is a view showing a projection side shown in FIG. **1**;

FIG. **3** is a view showing a first embodiment of a vibrator according to the present invention;

FIG. **4** is a view showing a sorting unit shown in FIG. **3**;

FIG. **5** is a view showing a second embodiment of a vibrator according to the present invention; and

FIG. **6** is a view showing a sorting unit shown in FIG. **5**.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, preferred embodiments of the present invention are described in detail with reference to the accompanying drawings.

The present invention provides an apparatus for forming a shot (steel ball) used as a shot peening ball in peening or blasting by rounding a cut-off piece, which is finely cut from a steel wire, with high precision. As shown in FIG. **1** showing the apparatus for forming a shot and FIG. **3** showing a first embodiment of a vibrator according to the present invention, the apparatus includes a tank, a forming chamber, a conveyer **300**, a dust collector **400**, and a vibrator **500** that sorts cut-off pieces in accordance with diameters after forming.

The tank **200**, which is formed in the shape of a hopper, receives cut-off pieces formed by finely cutting a steel wire and discharges the cut-off pieces down into the forming chamber **100** through a conveying channel **210** formed at a side of the bottom.

The forming chamber **100** is disposed under the tank **200**, with a side of the top communicating with the conveying channel **210**, and a projection side **110** and an impeller **120** are disposed in the forming chamber **100** and round the cut-off pieces dropped through the conveying channel **210**.

That is, the tank **20** is a container disposed over the forming chamber **100** including the impeller **120** to collect cut-off pieces and the conveying path **210** for guiding cut-off pieces to be dropped through it is formed at the lower portion of the tank **200**. The cut-off pieces are conveyed to the impeller **120** in the forming chamber **100** through the hopper of the impeller **120** connected with the conveying path **210** of the tank **200** and continuously projected to the projection side **110** by rotation of the impeller **120**, thereby being rounded.

In detail, the forming chamber, which is a box-shaped part where cut-off pieces are continuously projected, has a first side throughout which the projection side **110** made of chrome steel is formed and a second side where the impeller **120** for strongly guiding air flow to the projection side **110** is disposed.

As in FIG. **2** showing the projection side shown in FIG. **1**, the projection side **110** is made of chrome steel and composed of a plurality of unit members **111** spaced in the depth direction in the forming chamber **100**, and anti-collection plates **112** are disposed between the unit members **111**, so the problem that cut-off pieces are collected between the unit members **111** in the related art can be prevented.

The impeller **120**, which is a part generating lift by rotating large and wide blades such as a propeller, has a diameter of 360 to 550 mm and the blades are larger than the diameter of the impeller, so the effect of projecting cut-off pieces may be increased.

A space suitable for providing speed energy is defined between the projection side **110** and the impeller **120**, so cut-off pieces conveyed to the impeller **120** are continuously projected to the projection side **110** through the impeller **120** by rotation of the impeller **120**. Cut-off pieces hitting against the projection side **110** receive shock equal to the kinetic energy generated by their weight and projection speed, so the portions hitting against the projection side **110** are damaged, crushed, or cut off. When a cut-off piece hits against the projection side **110** and the hit portion is an edge of the cut wire, shock is applied for a short time in a narrow area, as compared with other portions that are hit, so shock force is large and the portion is more deformed. Accordingly, the cut-off piece is rounded in a spherical shape by repeating this process.

Next, the conveyer **300** has a first side disposed under the forming chamber **100** and a second side communicating with the top of the tank **200**, so it continuously conveys cut-off pieces (hereafter, referred to as "projection pieces" that are dropped after hitting against the projection side **110**.

The projection pieces conveyed by the conveyer **300** are continuously and repeatedly projected to the projection side **110**, so the more the cut-off pieces are projected, the more the shape of the cut-off pieces becomes close to a real sphere and the higher the fatigue strength, so the portion depressed by hitting is small. Further, the entire surface of the projection pieces receives uniform shock force, so precision is increased.

The dust collector **400** communicates with the forming chamber **110** and absorbs and collects dust and fragments produced in the forming chamber **100**. While cut-off pieces hitting against the projection side **110** are formed by breaking due to shock force, fine fragments are separated and dust is continuously produced. Further, the dust causes air pollution when it is exposed to the atmosphere, and causes malfunction by sticking in gaps in the apparatus or deteriorates precision of a forming process by sticking in the hit portions or the depressed portions of the cut-off pieces. Accordingly, the dust

collector **400** for absorbing dust in the forming chamber **100** in the process of projection is operated in a cyclone type in order to more effectively suppress generation of dust even under overload in the forming chamber **100**.

The collector **400** includes a cyclone unit **410**, an inflow pipe **420**, a storage **430**, and a discharge pipe **440**. The cyclone unit **410** has a cylindrical shape with an inverse conical lower portion and allows substances having predetermined weight or more to drop, such as fragments, and discharges dust having predetermined weight or less upward, in the dust flowing inside from above, by generating cyclonic airflow.

The inflow pipe **420** connects the upper portion of the cyclone unit **410** with the forming chamber **110** so that dust and fragments in the forming chamber **100** are absorbed into the cyclone unit **410**.

The storage **430** communicates with the bottom of the cyclone unit **410**, and stores fragments turning and moving down along the inner side of the cyclone unit **410**. The discharge pipe **440** is disposed through the top of the cyclone unit **410**, so the dust moved upward in the cyclone unit **410** is discharged.

The vibrator **500**, which is provided for sorting projection pieces rounded by hitting (hereafter, referred to as "shot") in accordance with diameters, includes a supply channel **510**, a body **520**, insertion spaces **530**, sorting units **540**, discharge ports **550**, and a vibrating unit **560**.

The supply channel **510** is formed at a second side of the tank **200** and carries shot conveyed in the tank **200** to the body **520**.

The body **520** is formed in the shape of a cylinder with the top communicating with the supply channel **510** to provide a space where shot drops.

The insertion spaces **530** are arranged in multiple steps with regular intervals in the depth direction of the body **520**. The sorting units **540** are separably inserted in the insertion spaces **530**, respectively, in order that dropping cut-off pieces can be sorted in accordance with their diameters.

The discharge ports **550** are disposed between the insertion spaces **530** of the body **520** to discharge sorted cut-off pieces to the outside of the body **520**. The discharge ports **550** may be sequentially formed in the depth direction of the body **520** along the outer side of the body **520** to prevent interference with each other.

The vibrating unit **560** is formed at a first side of the body **520** so that the sorting units **540** can sort shots in accordance with diameters by vibrating the sorting units **540**.

As a result, according to the vibrator **500**, the sorting units **540** in the insertion spaces **530** can sort shot such that shot balls having smaller diameters are sorted, as they goes in the depth direction of the body **520**, so it is possible to increase production efficiency by preventing a loss of shot.

The first embodiment of the vibrator **400** of the present invention having the basic configuration described above is described in detail hereafter.

As shown in FIG. **4** showing one of the sorting units **540** shown in FIG. **3**, the sorting unit **540** has a first rim that is separably inserted in the insertion space **530** and a first filtering net **542** inside the first rim **541**.

Further, as shown in FIG. **3**, the vibrating unit **560** includes a vibration motor (not shown) disposed under the body **520** and vibrating up/down the body **520** and a plurality of springs **561** disposed on the bottom of the body **520**. Accordingly, the vibration motor **520** vibrates up/down the body **520** and the springs **561** largely increase the amplitude, so up-down vibration can be efficiently applied to the sorting units **540**.

The second embodiment of the vibrator **500** according to the present invention is described hereafter in detail with reference to FIG. **5** showing the second embodiment of the vibrator **500** according to the present invention and FIG. **6** shown one of the sorting units **540** shown in FIG. **5**, including the previous figures.

The sorting unit **540** includes a second rim **541***a*, a second filtering net **542***a*, rotational shafts **543***a*, and fin stoppers **544***a*.

First, the second rim **541***a* is separably inserted in the insertion space **530** and the second filtering net **542***a* is disposed inside the second rim **541***a*.

The rotational shafts **543***a* are connected to the second filtering net **542***a* through both sides of the second rim **541***a* so that the second filtering net **542***a* can rotate inside the second rim **541***a*.

The fin stoppers **544***a* are made of an elastic material, formed at the upper and lower portions of the second rim **541***a* at an angle toward the center of the second rim **541***a*. Accordingly, the fin stoppers **544***a* limits the rotational angle second filtering net **542***a* rotating about the center of the rotational shafts **543***a*, so it is possible to prevent leakage of shot between the second rim **541***a* and the second filtering net **542***a*.

Further, the vibrating unit **560** includes driving motors **561***a* and a bed **562** and provides rotational vibration to the sorting units **540**.

The driving motors are coupled to predetermined rotational shafts **543***a* and repeatedly and finely turn the second filtering net **542***a* forward and backward, so fine rotational vibration is provided to the sorting units **540**. The bed **562***a* stably supports the driving motors **561***a* to prevent the driving motors **561***a* from moving due to vibration when they are operated.

As described above, it can be seen that the basic technical spirit of the present invention is to provide an apparatus for forming a shot ball that can prevent a loss of shot in the process of forming and sorting the shot balls and can collect dust in a cyclone type that can strongly suppress generation of dust.

The present invention may be modified in various ways by those skilled in the art without departing from the scope of the present invention and the scope of the present invention should be construed within claims to include various modifications.

What is claimed is:

1. An apparatus for forming a shot ball that includes:

a tank for receiving cut-off pieces finely cut from a steel wire and dropping the cut-off pieces through a conveying channel formed at a side;

a forming chamber disposed under the tank, communicating with the conveying channel, and including a projection side disposed on a first side therein and an impeller rounding cut-off pieces by projecting the cut-off pieces dropping through the conveying channel to the projection side using high-speed airflow;

a conveyer having a first side disposed at a lower portion of the forming chamber and a second side communicating with an upper portion of the tank to convey cut-off pieces, which drop after hitting against the projection side, to the tank; and

a dust collector communicating with the forming chamber and collecting dust by absorbing dust and fragments produced in the forming chamber,

the apparatus comprising a vibrator that is composed of:

a supply channel formed at a second side of the tank and carrying cut-off pieces that are finished being machined;

a cylindrical body communicating with the supply channel at an upper portion and receiving cut-off pieces that drop;

a plurality of insertion spaces formed with regular intervals in a depth direction of the body;

sorting units separably inserted in the insertion spaces, respectively, and sorting cut-off pieces in accordance with diameters thereof;

discharge ports formed between the insertion spaces to discharge the sorted cut-off pieces; and

a vibrating unit disposed at a side of the body and vibrating the sorting units.

2. The apparatus of claim **1**, wherein the projection side is made of chrome steel and composed of a plurality of unit members spaced in a depth direction of the first side in the forming body, and anti-collection plates are disposed in spaces between the unit members.

3. The apparatus of claim **1**, wherein the dust collector includes:

a cylindrical cyclone unit having an inverse conical lower portion;

an inflow pipe connecting an upper portion of an outer side of the cyclone unit with the forming chamber;

a storage communicating with a bottom of the cyclone unit and storing fragments turning and dropping along an inner side of the cyclone unit; and

a discharge pipe communicating with a top of the cyclone unit and discharging dust moved up in the cyclone unit.

4. The apparatus of claim **1**, wherein the sorting units each include a first rim separably inserted in a corresponding insertion space and a first filtering net disposed inside the first rim.

5. The apparatus of claim **4**, wherein the vibrating unit includes:

a vibration motor disposed under the body and vibrating the body up and down; and

a plurality of springs disposed on a bottom of the body.

6. The apparatus of claim **1**, wherein the sorting units each include:

a second rim separably inserted in a corresponding insertion space;

a second filtering net disposed inside the second rim;

rotational shafts connected with the second filtering net through both sides of the second rim; and

fin stoppers formed at upper and lower portions of the second rim at an angle toward a center of the second rim.

7. The apparatus of claim **6**, wherein the vibrating unit includes:

driving motors coupled to predetermined rotational shafts and providing rotational vibration by turning the second filtering net forward and backward; and

a bed supporting the driving motors.

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