

[54] **BOX FOR POWDER COATING**

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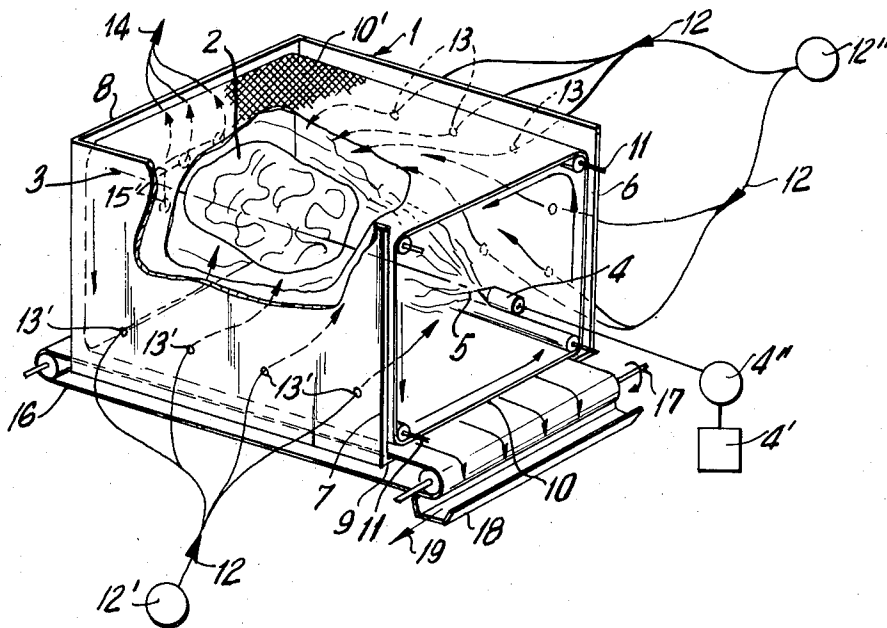
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[57] **ABSTRACT**

The box is used for powder coating of a workpiece,

such as for coating a workpiece with synthetic resin powder. The box has a front wall, side walls, a rear wall, a base and a top wall, and a nozzle in the front wall directs an air-powder stream substantially centrally and horizontally of the box toward a workpiece in the box positioned on the axis of the air powder stream, to provide a powder cloud surrounding the workpiece. Air inlet means, such as slots or nozzles, in the side walls provide rinsing air flows directed substantially tangentially of the powder cloud to impart thereto a rotary motion about the axis of the air-powder stream and counteracting the force of gravity on the powder cloud. Air outlet apertures are formed in the rear wall substantially symmetrical with the axis of the air powder stream. An endless air-permeable belt extends along the inner surfaces of the side walls, base and top wall and is driven to move in a direction transversely of the axis of the air-powder stream. The endless belt receives powder carried toward the side walls, base and top wall and delivers this powder to the rinsing air flows for return to the powder cloud. One or more endless conveyors are positioned adjacent the base of the box to receive powder falling onto the base and to remove the received powder to prevent powder accumulation. The powder-air flow is focused in the direction of the axis of the air-powder stream by virtue of the mentioned rotary motion which has the characteristics of a well-known cyclone.

**10 Claims, 5 Drawing Figures**





**BOX FOR POWDER COATING****FIELD OF THE INVENTION**

The subject of the invention is a box for powder coating, such as used for coating workpieces with synthetic resin powder or similar material. Subsequently the powder is sintered on the workpiece so that there will be produced on the workpiece a uniform coating of synthetic resin.

**BACKGROUND OF THE INVENTION**

Boxes for powder coating as known up to now are equipped with a powder-air distributor by means of which there is introduced a powder-air flow or a gas flow which generates a powder cloud in the box for powder coating, the cloud being intended for being precipitated on the workpiece.

The known boxes for powder coating involve the great inconvenience that only a small quantity of powder is precipitated on the workpiece and that most of the powder has to be removed again from the box.

In practical operation there is ordinarily obtained an efficiency rate ranging from 20 to 40 percent.

Furthermore, there has to be taken into account the great disadvantage that, in consequence of the precipitation of powder in the powder box, there is often the risk of detonations or explosions. The boxes for powder coating known up to now have an additional inconvenience in so far as it happens sometimes that only slight detonations take place at the workpiece, which generate explosions of chain-reaction in the entire box, whereby the powder located at the walls and at the base is whirled and a considerable explosion will happen which may destroy the powder box.

Moreover it has been tried to avoid powder residue in the box by means for constructing slots at the base which permit the powder to fall into collection-tanks or conveyor-devices so that the powder can be conveyed outwards.

So far all these measures have been unable to improve the effectiveness of the boxes for powder coating and until now the output has been low.

**SUMMARY OF THE INVENTION**

The present invention has the objective to increase the powder output and to reduce the risk of powder explosions and primarily the explosions of chain-reaction.

In addition the invention has the objective to provide that the powder cloud, which develops in the box, is kept in a more stable position at the workpiece and that, in this way, there is secured a longer stay period of the cloud at the workpiece.

Furthermore, the powder cloud in the box is confined by imparting thereto a rotary motion opposing the force of gravity of the powder, this rotary motion being provided by rinsing air flows directed tangentially to the powder cloud and transversely of the axis of the air-powder stream.

In accordance with the invention, the powder cloud, formed in the box around the workpiece due to the air-powder stream, is supported by rinsing air flows which are directed around the workpiece from rinsing air slots or nozzles in the side walls of the box. These rinsing air slots or nozzles are so arranged as to impart a rotary motion to the powder cloud counteracting the force of gravity on the powder. An endless perforated belt extends around the inner surfaces of the side walls, base

and top wall of the box, traveling in a direction transversely of the axis of the air-powder stream, this belt acting like a cyclic conveyor. Powder directed toward the walls of the box impinges on the endless belt and is returned again to the powder cloud by the rinsing air flows. Discharge of the rinsing air from the powder-air flow is effected primarily along the axis of the air-powder stream and through the rear wall of the box, behind the workpiece. Powder accumulating on the base outside the belt, through gravity, is removed by a conveyor device or devices.

The measures stated above offer the great advantage that any quantity of powder which reaches the walls is carried away again and again by the perforated belt-conveyor and will be conveyed again to the powder cloud at the workpiece, wherever possible in its cyclic motion around the workpiece. There are avoided in this way powder explosions as well as explosions of chain reaction as a result of powder concentrations at the walls. There is the additional advantage that the workpiece is coated with powder in a more uniform way and this leads to an increase in the powder exploitation i.e., in the powder efficiency.

The powder accumulating at the base behind the cyclic conveyor is carried away by means of conveying equipment such as belt conveyors and similar devices so that powder accumulation is completely avoided in the box.

The belt rotating along the lateral walls is able to cover at least part of the lateral walls.

It is also possible to proceed in such a manner that two belts are provided in the box and are driven in a counter-rotating manner. It is thus possible to coat even very complicated workpieces uniformly with powder.

The rinsing air slots are so directed that the rinsing air flows extend substantially tangentially to the powder cloud, to impart to the powder cloud a rotary motion counteracting the force of gravity thereon. The direction of motion of the belt is transversely of the axis of the air-powder stream. The rinsing air slots or nozzles can be provided in such a manner that the direction of rinsing air flows can be varied. This offers the advantage of being able to coat complicated workpieces with powder taking into consideration their particular shapes. The rinsing air slots are fitted in such a way that there can be produced a cyclone effect around the workpiece in the box comparable to the effect of the classic cyclones. There is thus generated a focusing of the powder air flow in the direction of the main axis of the workpiece.

As far as the effect of the cyclones is concerned, it is generally known that, starting from a comparatively large diameter intake

rotary motion, the diameter of the cyclones continually decreases so that, in the present invention, the air can be discharged after having passed completely by the workpiece. The rinsing air flows directed into the box can also be directed upwardly from bottom to top, at a few degrees to the vertical, in order to counteract the force of gravity on the powder.

As far as the cyclic conveyor is concerned, it is advisable to utilize an airpermeable belt so that the rinsing air is able to pass through the belt and to blow any pow-

der off the belt. It is preferable that the rinsing air flow is regulable.

It is possible to distribute the rinsing air inlet devices among the sidewalls and the front wall in such a way that the required air flow in the box is obtained by focusing around the workpiece.

In addition to mechanical conveyor devices at the base of the box for removal of excessive powder, excess powder can also be removed by air.

This method of proceeding offers the advantage that the base of the box is completely cleansed of excess powder.

As far as mechanical conveyor devices are concerned, it is also possible to utilize two counterrotating belts.

For an understanding of the principles of the invention, reference is made to the following description of typical embodiments thereof as schematically illustrated in the accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings

FIG. 1 shows a perspective, isometric schematic representation of a powder box, with its cover or top wall removed, and which is partly cut open with workpiece and the other devices.

FIG. 2 is a schematic side view of the powder box of FIG. 1.

FIG. 3 is a schematic line drawing of a workpiece and of an air flow of the nature of a cyclone flow.

FIG. 4 is a schematic front view of a powder box, with counterrotating belt conveyors for the purpose of removing excessive powder.

FIG. 5 is a schematic representation of the air flow when the rinsing air flows are directed upwardly from the bottom of the box toward the top in opposition to the force of gravity on the powder.

#### DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 shows a powder box 1 containing a workpiece 2 which is placed in the center line 3. There is placed in this center line also the powder air distributor 4 which is connected to an air-powder compressor 4'' receiving powder from a powder supply box 4'. By means of powder air distributor 4, it is possible to generate a powder cloud 5 in box 1 around the workpiece 2.

The cyclic conveyor 10 rotates on the rollers 11, like a rotating belt in the direction of the arrows across the sidewalls 6, 7, 8 and the base 9. As indicated at 10' in FIG. 1, cyclic conveyor 10 is an endless belt having a perforated construction, such as a mesh construction.

The rinsing air flow is supplied by compressors 12' and 12'' and enters the box 1, in the direction of arrows 12, through holes 13 in the front and side walls of the box. The rinsing air flows produce a swirling motion of the powder cloud 5 around the workpiece 2, and the swirling powder cloud remains in contact with the workpiece for a longer time than in the case of the usual type of powder boxes. The rinsing air and that portion of the excess powder not directed towards the side and top walls, and not falling by gravity onto the bottom wall, are able to leave box 1 through the holes 15 in the rear wall, near the center line 3 of workpiece 2, as indicated by the arrows 14.

Any excess powder falling by gravity onto the bottom wall is carried to the trough 18 by the belt conveyor 16

which is fitted below the cyclic conveyor 10 and driven by axle 17 and this excess powder can be removed in the direction, of arrow 19.

It is apparent from FIG. 2 that, in box 1, the workpiece 2 is placed in center line 3 and it is enveloped in a powder cloud 5 from the powder air distributor 4 just as it is the case of FIG. 1.

When the rinsing air flow 21 is directed tangentially to powder cloud 2 by nozzles 21', it will generate a cyclone flow 22 around workpiece 2, this cyclone flow being discharged from box 1 through aperture 23 in the rear wall near the center line 3. This design offers the advantage that it is possible to obtain a higher degree of focusing of the powder air flow around the workpiece 2.

Furthermore FIG. 2 shows that the powder tends to drop in the direction 20 to the base 9 of box 1. Part of the powder is carried by the cyclic conveyor 10 upwards and conducted in front of the inject nozzles 21.

FIG. 3 schematically represents a workpiece 24 in which a rinsing air flow into the box and around the workpiece develops a cyclone air flow 25. It is a typical feature of cyclone air flow that the inlet turbulence 27 has a larger diameter than the output turbulence 28. This results in a maximum focusing of the powder air flow.

FIG. 4 shows a front view of a powder box where, in box 1, the cyclic conveyor 10 likewise rotates on rollers 11 and where the workpiece 2 is positioned in box 1 in the center line 3. Rinsing air enters box 1 in the direction of arrows 29 and 30 and whirls over workpiece 2 as has been described above.

Excess powder is removed at base 31 by a belt conveyor which consists of two counterrotating parts 32 and 33. The powder is discharged at slot 34 into a receiver 35 and carried off in the direction of arrow 36.

FIG. 5 is a schematic representation of workpiece 37 which is rinsed by rising air flows 38 and 39 whereby it is possible to discharge the rinsing air through holes 40 in a box wall at an upper level. In this case, the air flows 38 and 39 are operating in a direction opposing the force of gravity on the powder.

The invention solves likewise the problem of how to create a powder box in which the powder return is largely limited since the rotating perforated belt repeatedly carries the powder, dropping off the workpiece, to the air flow which is in action around the workpiece.

This avoids the troublesome return and preparation of the comparatively expensive powder.

The rinsing air is utilized to set up favorable conditions for the powder flow configuration around the workpiece and it is thus possible to turn the rinsing air to account. As far as the quantity of powder which remains to be removed from the box by means of the cross conveyor belt is concerned, it is indeed very small and, strictly speaking, the conveyor belt is used only for safety reasons in order to avoid agglomerations which might happen with heavy powder if the worst comes to the worst.

What is claimed is:

1. In a box for powder coating of a workpiece, of the type having a front wall, side walls, a rear wall, a base and a top wall, and nozzle means in the front wall operable to direct an air-powder stream, substantially centrally and horizontally of the box, toward a workpiece in the box, positioned on the axis of the air-powder stream, to provide a powder cloud surrounding the

5

workpiece, the improvement comprising, in combination, air inlet means in said side walls; means connected to said air inlet means and producing air flows directed through said air inlet means substantially tangentially of said powder cloud to impart thereto a supporting rotary motion maintaining said powder cloud about said axis and the workpiece and counteracting the force of gravity on said powder cloud; air outlet means in said rear wall substantially symmetrical with said axis for discharge of the air flows carrying excess powder from said powder cloud; conveyor means receiving powder carried toward the walls of said box and delivering the received powder to said rinsing air flows for return thereby to said powder cloud; and a conveyor device adjacent said base receiving any powder falling onto said base and removing the received powder to prevent powder accumulation onto said base.

2. In a box for powder coating of a workpiece, the improvement claimed in claim 1, in which said conveyor means comprises an endless belt moving adjacent the walls of said box.

3. In a box for powder coating of a workpiece, the improvement claimed in claim 2, in which said endless belt covers at least part of said side walls, base and top wall of said box.

4. In a box for powder coating of a workpiece, the improvement claimed in claim 2, in which said air inlet means comprises rinsing air slots directing the rinsing air to flow tangentially of said powder cloud at a selected angle of tangency.

5. In a box for powder coating of a workpiece, the im-

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provement claimed in claim 2, in which the direction of movement of said endless belt is transversely of said axis.

6. In a box for powder coating of a workpiece, the improvement claimed in claim 2, in which said air inlet means comprises rinsing air slots; said rinsing air slots providing rinsing air flows which are directed at a selected angle with respect to said axis.

7. In a box for powder coating of a workpiece, the improvement claimed in claim 2, in which said air inlet means comprises rinsing air slots directing the rinsing air flows in a direction to impart a rotary motion to said powder cloud about said axis and which rotary motion provides a cyclone effect around the workpiece and which is comparable to the effect of known cyclones to focus the air-powder flow in the direction of said axis.

8. In a box for powder coating of a workpiece, this improvement claimed in claim 2, in which said air inlet means direct said rinsing air flows upwardly at an angle to the vertical.

9. In a box for powder coating of a workpiece, the improvement claimed in claim 2, in which said endless belt is air-permeable.

10. In a box for powder coating of a workpiece, the improvement claimed in claim 2, in which said conveyor device comprises two counter-rotating endless belts constituting mechanical conveyor devices and spaced apart in end-to-end relation to provide a discharge slot for the excess powder.

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