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(54) METHOD AND SYSTEM FOR REMOVING DEBRIS

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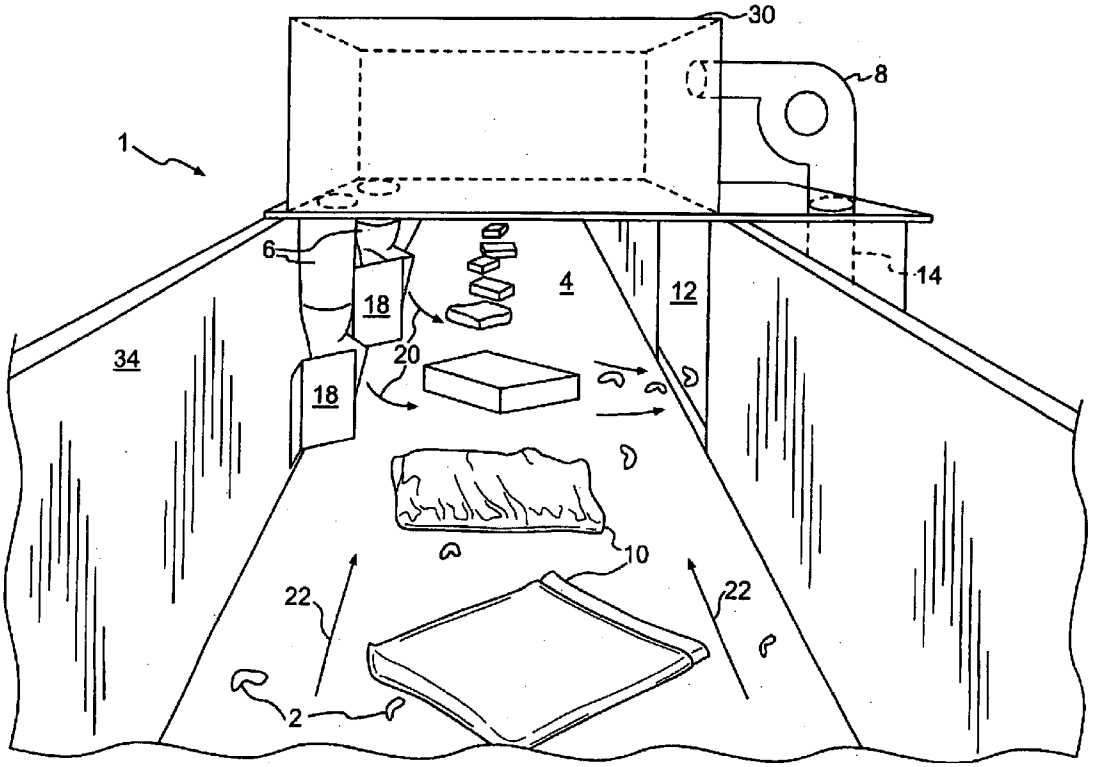
(57) **ABSTRACT**

A debris removal system for removing debris from a surface. The debris removal system may comprise a first air supply duct positioned adjacent to the surface, a debris collection chute positioned adjacent to the surface and on the side opposite the first air supply duct, and a blower configured to intake air from the debris collection chute and exhaust air to the first air supply duct. The first air supply duct may be configured to direct airflow across the surface and the debris collection chute is configured to collect debris. The first air supply duct may direct airflow across the surface to move debris from the surface to the debris collection chute.



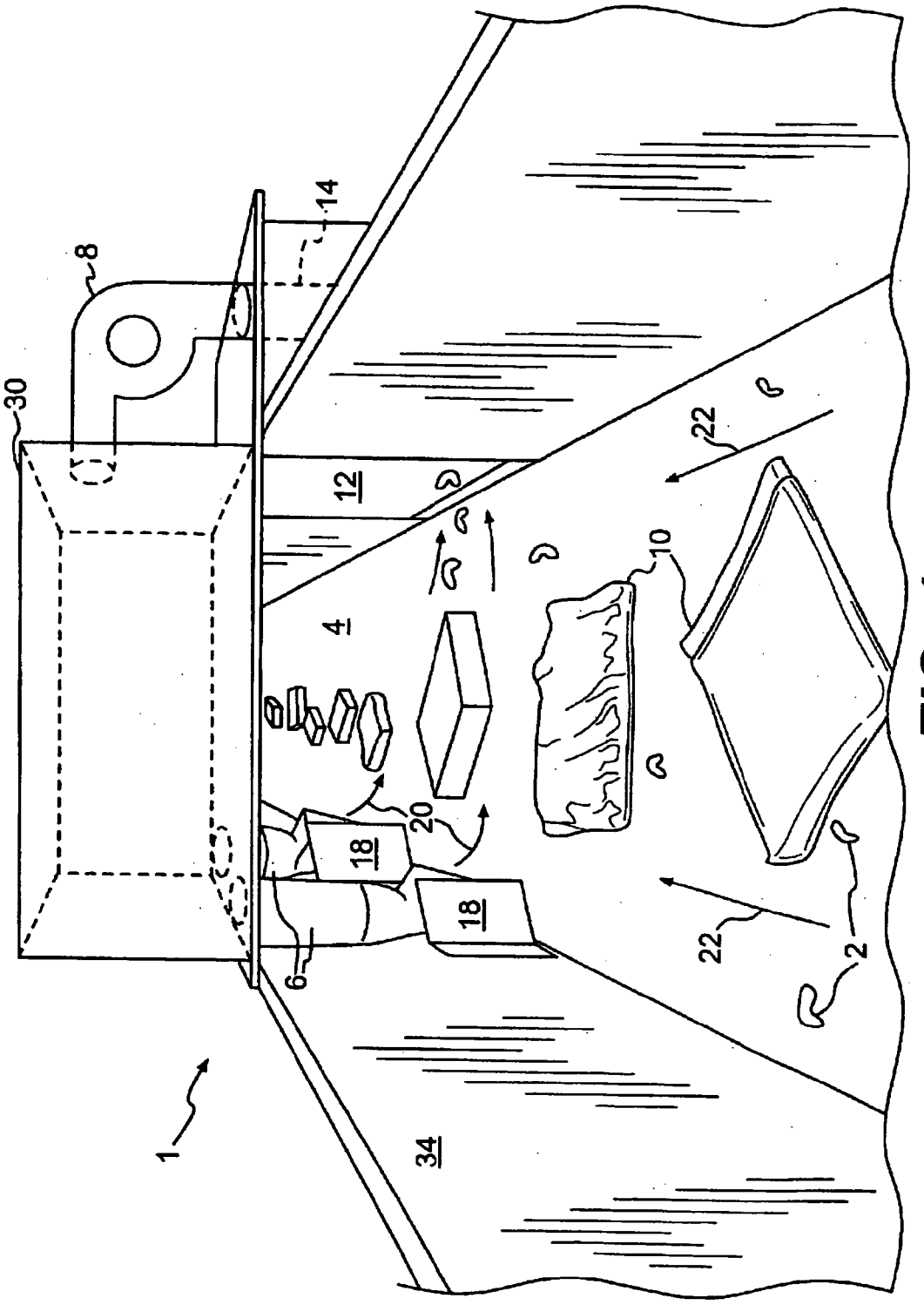


FIG. 1

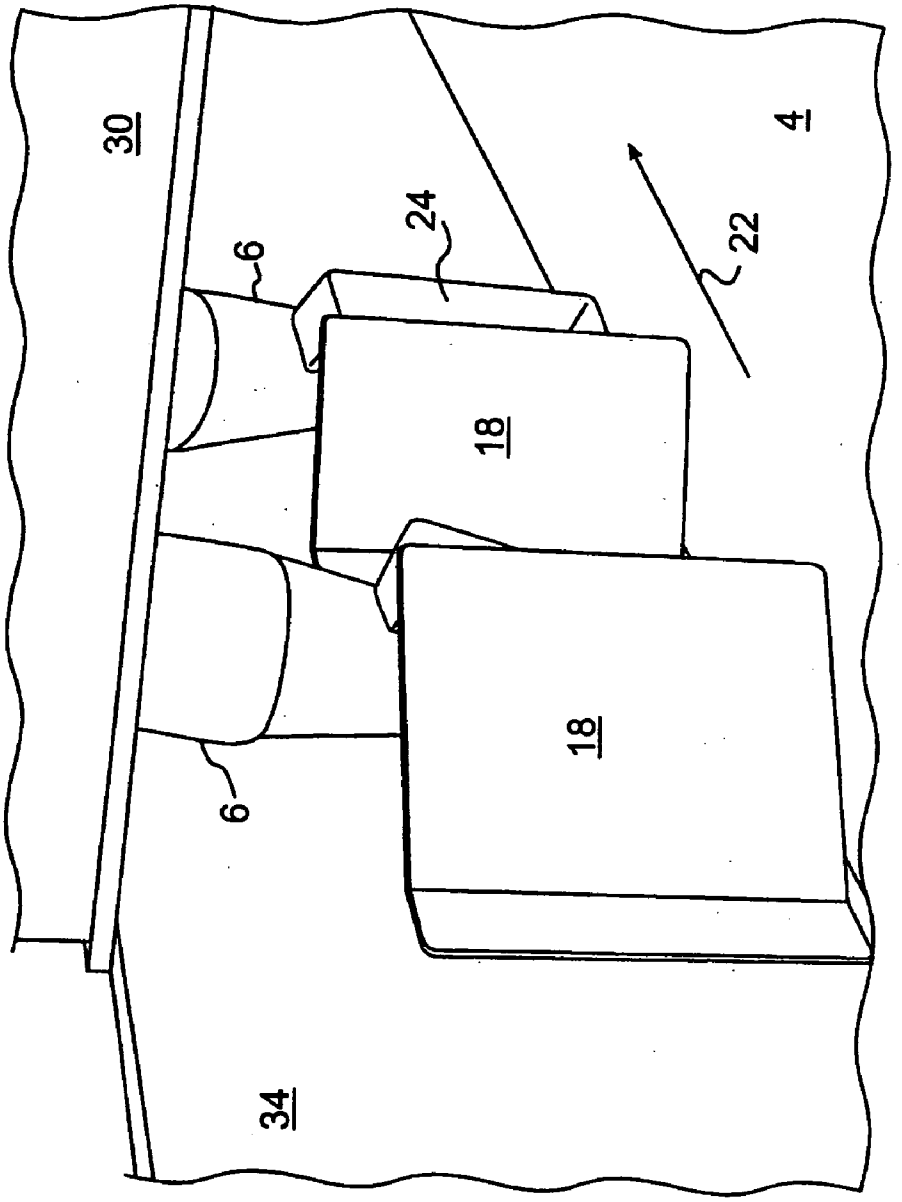


FIG. 2

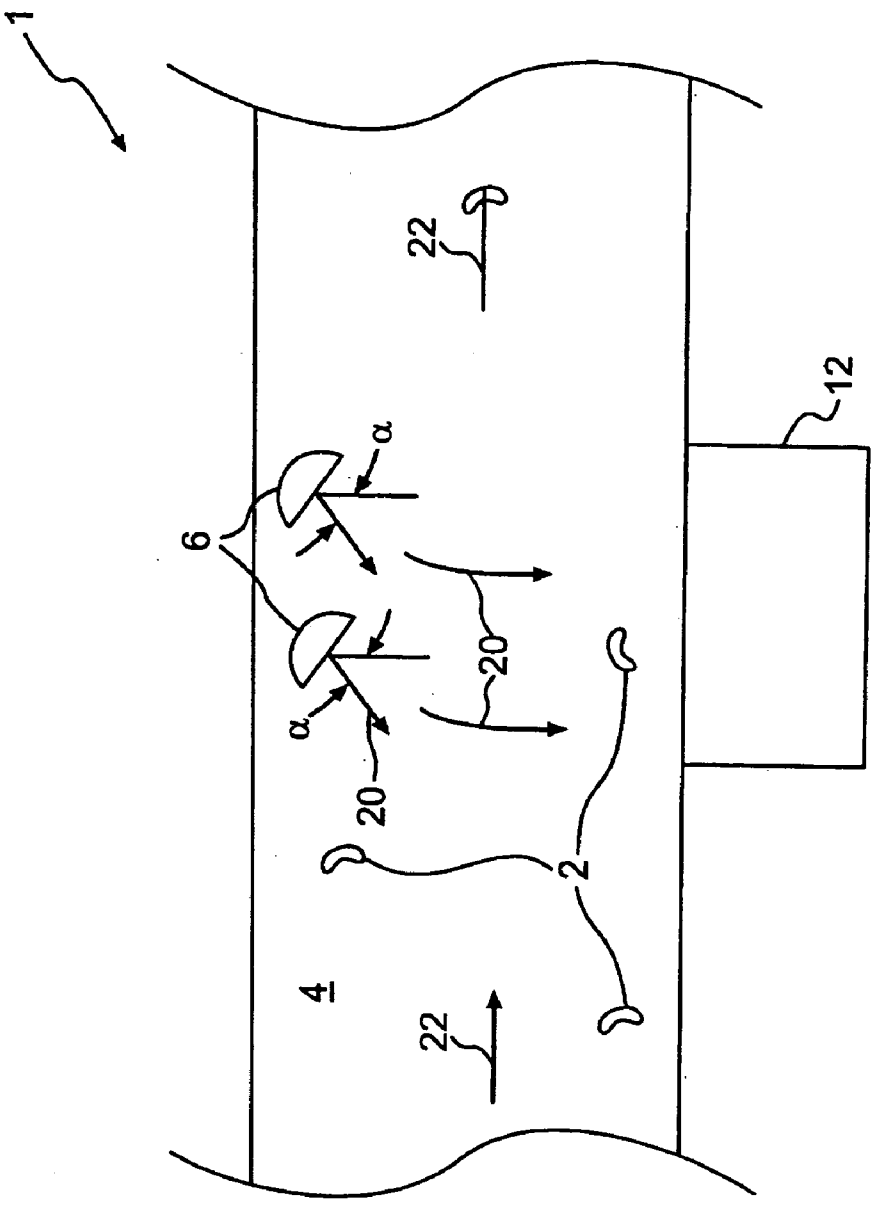


FIG. 3

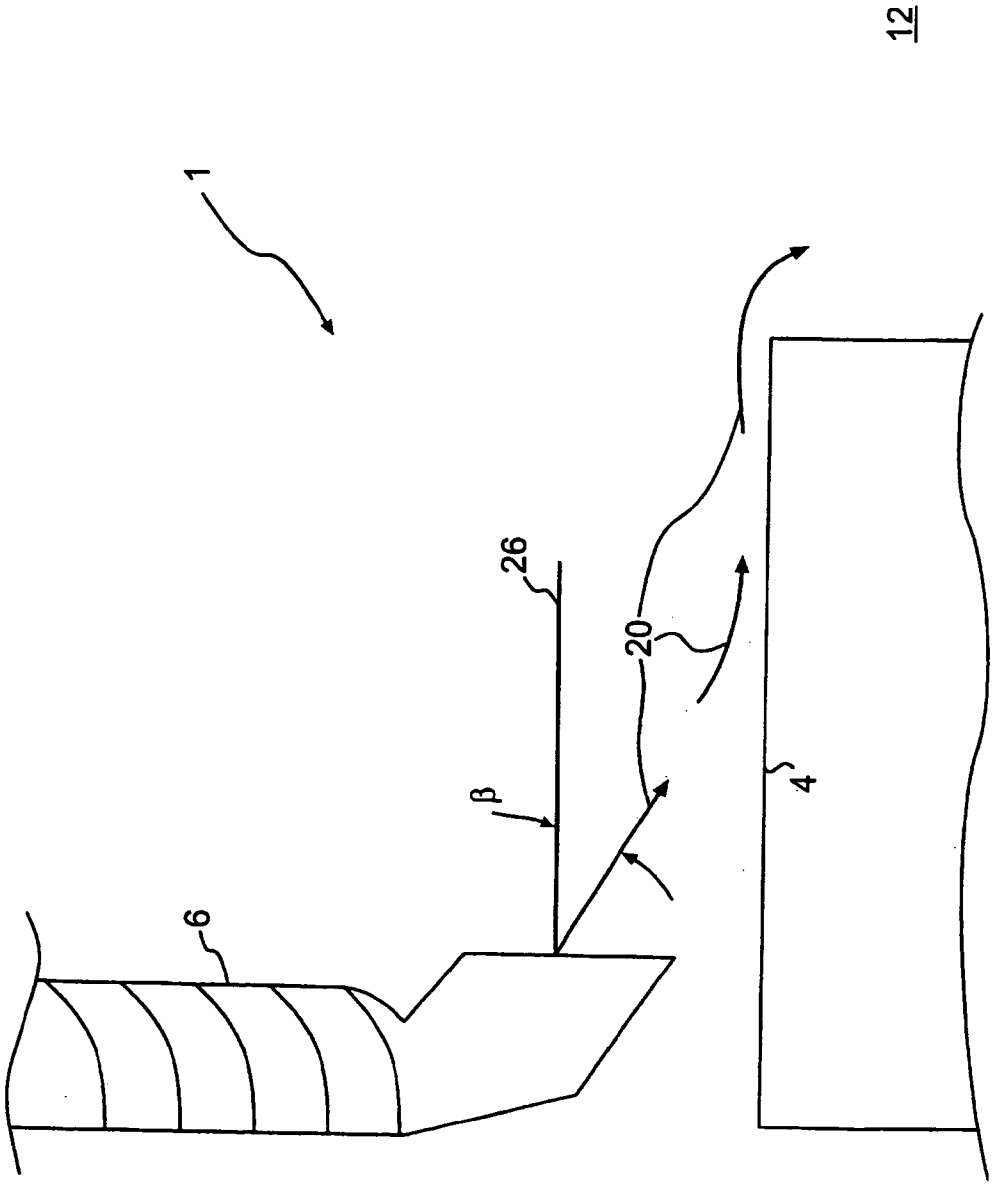


FIG. 4

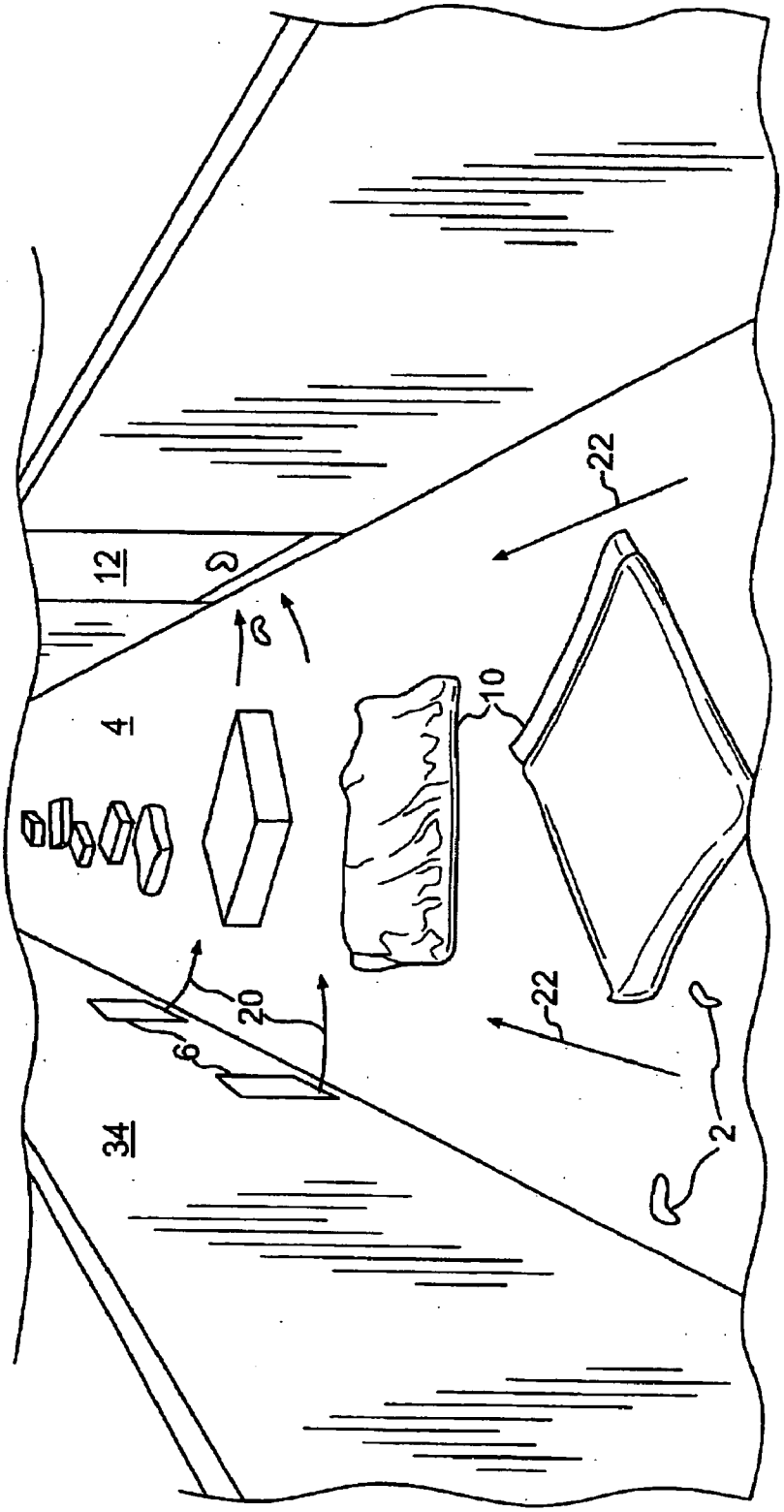


FIG. 5

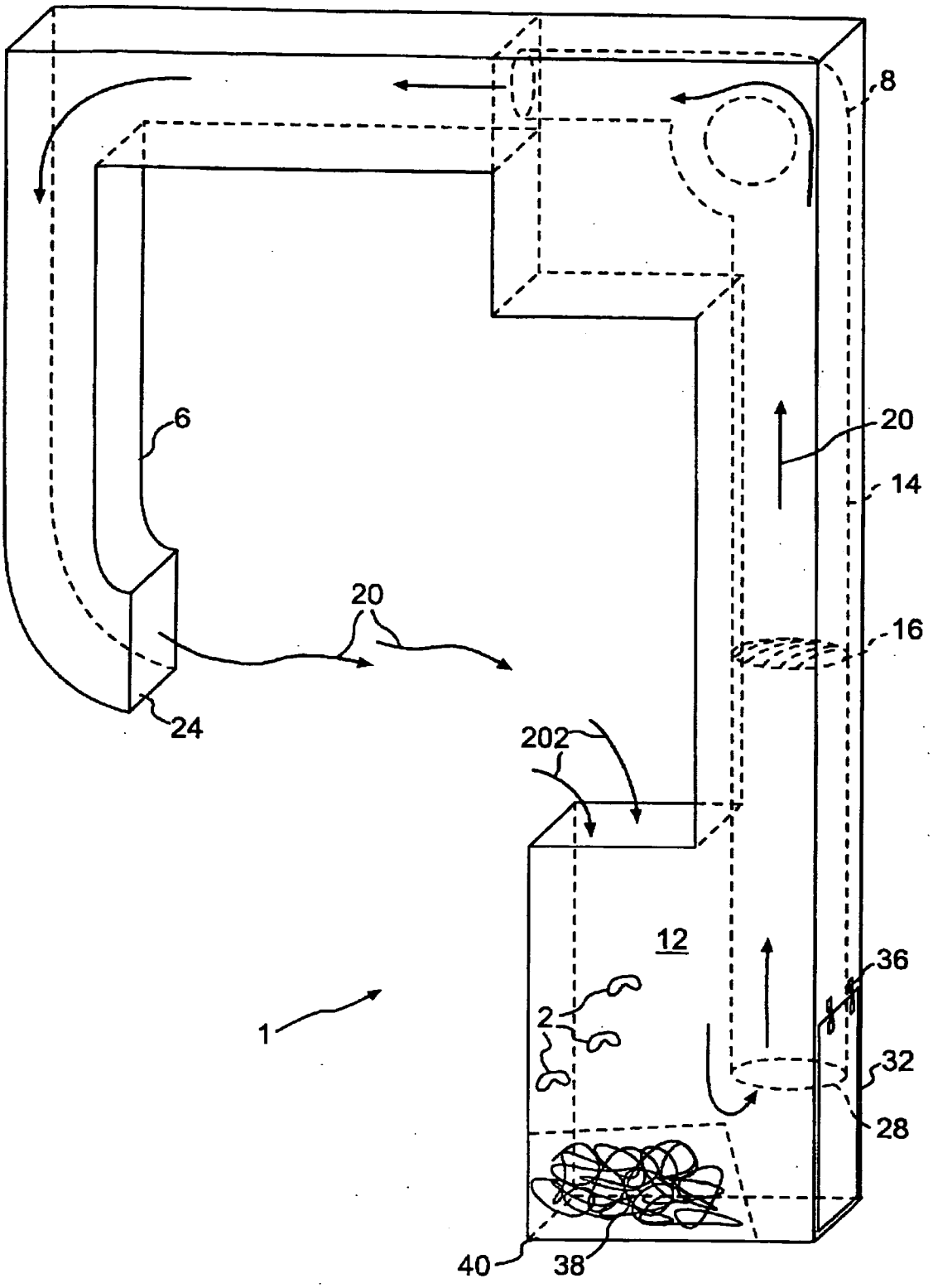


FIG. 6

METHOD AND SYSTEM FOR REMOVING DEBRIS

RELATED APPLICATION

[0001] The present application is related to and claims priority of U.S. Provisional Application No. 60/539,998 filed on Jan. 30, 2004, in the name of Jeffery A. FOX et al and titled METHOD AND SYSTEM FOR DEBRIS REMOVAL, the contents of which are fully incorporated herein by reference.

DESCRIPTION OF THE INVENTION

[0002] Background of the Invention

[0003] This invention relates to a method and system for removing debris from a surface. In a particular embodiment, the invention relates to a method and system for removing dust and debris from a conveyor belt used for transferring products, such as a package, during mail processing.

[0004] Systems designed for automatically processing packages (or parcels) are conventionally known. For example, the Singulator-Scan-Induction Unit ("SSIU") is a system that automatically processes packages in some Bulk Mail Centers ("BMCs") of the United States Postal Service ("USPS"). Additionally, BMCs or other facilities may use the Automated Package Processing System ("APPS").

[0005] In processing packages for delivery, both the SSIU and APPS use optical character recognition and bar code reading technologies to read the package information—such as the sender or delivery address—for proper sorting. The SSIU and APPS also use mechanical conveyors and belts to handle and sort the packages. During this mechanical handling, some packages may break open and debris such as packaging Styrofoam or loose paper may enter the system. Once the debris enters the system, it may interfere with the proper optical reading of the package information, block photodetectors, or create no-reads, thus resulting in unnecessary delays and decreased mail processing efficiency. Additionally, paper dust, which is prevalent in mail facilities, can coat mirrors and camera lenses resulting in decreased readability and increased maintenance hours of the SSIU and APPS.

[0006] For these and other reasons, there is a need for a system to remove debris from the mail stream.

[0007] The present invention improves package processing efficiency and reduces packaging processing delays by removing some of the unwanted debris present in the mail stream.

SUMMARY OF THE INVENTION

[0008] In the following description, certain aspects and embodiments of the present invention will become evident, It should be understood that the invention, in its broadest sense, could be practiced without having one or more features of these aspects and embodiments. In other words, these aspects and embodiments are merely exemplary.

[0009] Consistent with the invention, a system for removing debris from a surface is provided. The system comprises a first air supply duct positioned adjacent to the surface, a debris collection chute positioned adjacent to the surface and on the side opposite the first air supply duct, and a blower configured to intake air from the debris collection chute and exhaust air to the first air supply duct. In this aspect, the first air supply duct is configured to direct airflow across the surface and the debris collection chute is configured to collect debris. The first air supply duct directs airflow across the surface to move debris from the surface to the debris collection chute.

[0010] Consistent with the system, as described above, the first air supply duct may be positioned above the surface, instead of adjacent to the surface. In this aspect, the system may further comprise a deflector positioned upstream of the first air supply duct and configured to prevent objects on the surface from contacting the first air supply duct.

[0011] Also consistent with the invention, the system further comprises an air intake duct connected to the blower and configured to intake air from the debris collection chute. The system may further comprise a filter attached to the air intake duct, wherein the filter is configured to prevent debris and dust from entering the blower. In a particular embodiment, the opening of the air intake duct is positioned above and to one side of the collected debris in the debris collection chute.

[0012] The reader should understand that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The accompanying drawings are incorporated in and constitute a part of this specification. The drawings illustrate exemplary embodiments and, together with the description, serve to explain some principles of the invention. In the drawings,

[0014] **FIG. 1** is a perspective view of a debris removal system consistent with exemplary aspects of the invention;

[0015] **FIG. 2** is a perspective view of deflectors and air supply ducts in accordance with the embodiment of **FIG. 1**;

[0016] **FIG. 3** is a top view in accordance with the embodiment of **FIG. 1**;

[0017] **FIG. 4** is a front-side view in accordance with the embodiment of **FIG. 1**;

[0018] **FIG. 5**. is a perspective view of another debris removal system consistent with exemplary aspects of the invention; and

[0019] **FIG. 6** is a perspective view of yet another debris removal system consistent with exemplary aspects of the invention.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0020] Reference will now be made in detail to the exemplary embodiments, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[0021] Consistent with the invention, a debris removal system **1** for removing unwanted debris **2** from a surface (for example, a belt of a conveyor **4**) is depicted in **FIGS. 1-6**. System **1** is designed to remove debris **2** from the belt of a

conveyor **4** using a blower **8**, which circulates airflow **20** from air supply ducts **6** across the belt of a conveyor **4** and into a debris collection chute **12**. As used herein "across" means in a lateral direction from one edge of the belt of a conveyor to the opposite edge.

[**0022**] System **1** may be implemented in a U.S. Postal Service ("USPS") Bulk Mail Center ("BMC") for use with Singulator-Scan-Induction Units ("SSIU") or Automated Package Processing Systems ("APPS"). SSIUs and APPS use optical character recognition for reading information from packages **10**, and unwanted debris **2** (for example, packaging material such as Styrofoam) may interfere with the optical reading of packages **10** or block photodetectors during sorting, which may result in unnecessary delays.

[**0023**] In accordance with the embodiment of **FIG. 1**, packages **10** and unwanted debris **2** move on the belt of a conveyor **4** in the direction **22**. As packages **10** and debris **2** pass near air supply ducts **6**, airflow **20** moves the unwanted debris **2** into debris collection chute **12**. Heavier packages **10** are not effected by airflow **20**.

[**0024**] In the embodiment of **FIG. 1**, blower **8** takes in air from debris collection chute **12** and exhausts air to a plenum **30**, where the air then flows to air supply ducts **6**. In this particular embodiment, plenum **30** is positioned above the belt of a conveyor **4**. This is advantageous, if space limitations, for example, preclude positioning plenum **30** below the belt of a conveyor **4**.

[**0025**] In the embodiment of **FIG. 1**, air supply ducts **6** are positioned above the belt of a conveyor **4**. If air supply ducts **6** cannot be positioned adjacent to the belt of a conveyor **4**, due to limited space, for example, air supply ducts **6** may be positioned above the belt of a conveyor **4**. Placing air supply ducts **6** above the belt of a conveyor **4**, however, may result in packages **10** hitting and possibly damaging air supply ducts **6**. To minimize the possibility of damaging air supply ducts **6**, a deflector **18** may be placed "upstream" of air supply ducts **6**, as depicted in **FIGS. 1 and 2**. As used herein "upstream" is a direction opposite the direction of travel of the belt of a conveyor. Deflectors **18** are configured to laterally move any packages **10**—which may otherwise contact air supply ducts **6**—away from air supply ducts **6** while keeping packages **10** on the belt of a conveyor **4**.

[**0026**] The embodiment of **FIG. 2** depicts using two air supply ducts **6**, although any number of air supply ducts **6** may be used in system **1**.

[**0027**] **FIG. 3** provides a top plan view of air supply ducts **6**, the belt of a conveyor **4**, and the debris collection chute **12** of the embodiment of **FIG. 1**. In this particular embodiment, air supply ducts **6** direct airflow **20** across and "upstream" with respect to the belt of a conveyor **4**. Because packages **10** and debris **2** move on the belt of a conveyor **4** in direction **22**, system **1** may be more effective at removing debris **2** if air supply ducts **6** direct airflow **20** at an angle α away from a direction perpendicular to direction **22**. Depending on the speed of the belt of a conveyor **4** and other factors, angle α may be anywhere between 0° and 90°. However, angle α must be chosen to ensure that the airflow **20** moves the debris **2** into the debris collection chute **12**.

[**0028**] **FIG. 4** provides a front-side view of air supply ducts **6**, the belt of a conveyor **4**, and debris collection chute **12** of the embodiment of **FIG. 1**. In this particular embodiment, air supply ducts **6** direct airflow **20** down towards the belt of a conveyor **4** and also across the belt of a conveyor **4** at an angle β from the horizontal plane **26**. Directing airflow **20** at angle β may more effectively move debris **2** from the belt of a conveyor **4** to debris collection chute **12**.

[**0029**] **FIG. 5** depicts another embodiment of system **1**. In this particular embodiment, air supply ducts **6** are positioned adjacent to the belt of a conveyor **4** and terminate at the surface of wall **34** facing the belt of a conveyor **4**. Positioning air supply ducts **6** adjacent to the belt of a conveyor **4**, instead of over the belt of a conveyor **4**, may eliminate the need for installing deflectors **18** to protect the air supply ducts **6**. Further, installing air supply ducts **6** in this manner does not create a bottleneck for packages **10** as they travel along the belt of a conveyor **4**. Positioning air supply ducts **6** adjacent to the belt of a conveyor **4** or placing air supply ducts **6** within wall **34** of an SSIU, for example, may be impractical due to space restrictions.

[**0030**] **FIG. 6** depicts yet another embodiment of system **1**. In this embodiment, a door **32** is provided with hinges **36** that permits access to the collected debris **38** from the bottom **40** of debris collection chute **12** for removal. Further, in this embodiment, system **1** is provided with an air intake duct **14**. The opening **28** to air intake duct **14** is positioned a few inches above and to one side of collected debris **38** from the bottom **40** of debris collection chute **12**. Positioning opening **28** in this manner may improve system **1** operation by providing improved airflow **20** from the opening **24** of air supply duct **6** to debris collection chute **12** while preventing any debris **2** from entering intake duct **14** and blower **8**. However, opening **28** of air intake duct **14** may positioned elsewhere. For example, opening **28** of air intake duct may be positioned either above or below the surface from which the debris is removed. Additionally, air intake duct **14** may include a screen or filter **16**, which further prevents any debris **2** from entering blower **8**.

[**0031**] Consistent with the system, as described above, the air intake duct may be provided with two or more openings (not shown). In an embodiment where the air intake duct is provided with two openings, one opening may be configured to intake air from outside the debris removal system and one opening may be configured to intake air from the debris collection chute.

[**0032**] It will be apparent to those skilled in the art that various modifications and variations can be made to the structure and methodology of the present invention without departing from the scope or spirit of the invention. Thus, it should be understood that the invention is not limited to the examples discussed in the specification. Rather, the present invention is intended to cover modifications and variations of this invention.

What is claimed is:

1. A system for removing debris from a surface, comprising:

a first air supply duct positioned above the surface, wherein the first air supply duct is configured to direct airflow across the surface;

a debris collection chute positioned adjacent to the surface and on the side opposite the first air supply duct, wherein the debris collection chute is configured to collect debris; and

a blower configured to intake air from the debris collection chute and exhaust air to the first air supply duct,

wherein the first air supply duct directs airflow across the surface to move debris from the surface to the debris collection chute.

2. The system of claim 1, further comprising a deflector positioned upstream of the first air supply duct and configured to prevent objects on the surface from contacting the first air supply duct.

3. The system of claim 1, further comprising an air intake duct connected to the blower and configured to intake air from the debris collection chute.

4. The system of claim 3, further comprising a filter within the air intake duct,

wherein the filter is configured to prevent debris from entering the blower.

5. The system of claim 4, further comprising a filter within the air intake duct,

wherein the filter is configured to remove dust from the air stream.

6. The system of claim 3, where there are two openings of the air intake duct, one being configured to intake air outside the debris removal system and a second being configured to intake air from the debris collection chute.

7. The system of claim 3, wherein the opening of the air intake duct is positioned below the surface in the debris collection chute.

8. The system of claim 3, wherein the opening of the air intake duct is positioned above the surface in the debris collection chute.

9. The system of claim 3, wherein there are two openings of the air intake duct, one being positioned below the surface and a second being positioned above the surface in the debris collection chute.

10. The system of claim 1, further comprising an air intake duct connected to the blower and configured to intake air from outside the debris removal system.

11. The system of claim 9, wherein one opening of the intake duct is configured to intake air from outside the debris removal system and the second opening is configured to intake air from the debris collection chute.

12. The system of claim 1, further comprising a second air supply duct positioned on the same side of the surface as the first air supply duct,

wherein the second air supply duct is configured to direct airflow across the surface.

13. The system of claim 12, further comprising a deflector positioned upstream of the air supply duct and configured to prevent objects from contacting the air supply duct.

14. The system of claim 12, further comprising a second deflector positioned upstream of the second air supply duct and configured to prevent objects from contacting the second air supply duct.

15. The system of claim 1, wherein the first air supply duct directs airflow down towards the surface and across the surface at an angle from the horizontal plane.

16. The system of claim 12, wherein the second air supply duct directs airflow down towards the surface and across the surface at an angle from the horizontal plane.

17. The system of claim 1, wherein the first air supply duct directs airflow opposite the direction of travel of the surface.

18. The system of claim 12, wherein the second air supply duct directs airflow opposite the direction of travel of the surface.

19. The system of claim 1, further comprising a door configured to access debris in the debris collection chute.

20. A method for removing debris, comprising:

directing airflow across the surface via a first air supply duct positioned above the surface to move the debris from the surface to a debris collection chute;

collecting debris in the debris collection chute; and

circulating air from the debris collection chute to the first air supply duct.

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