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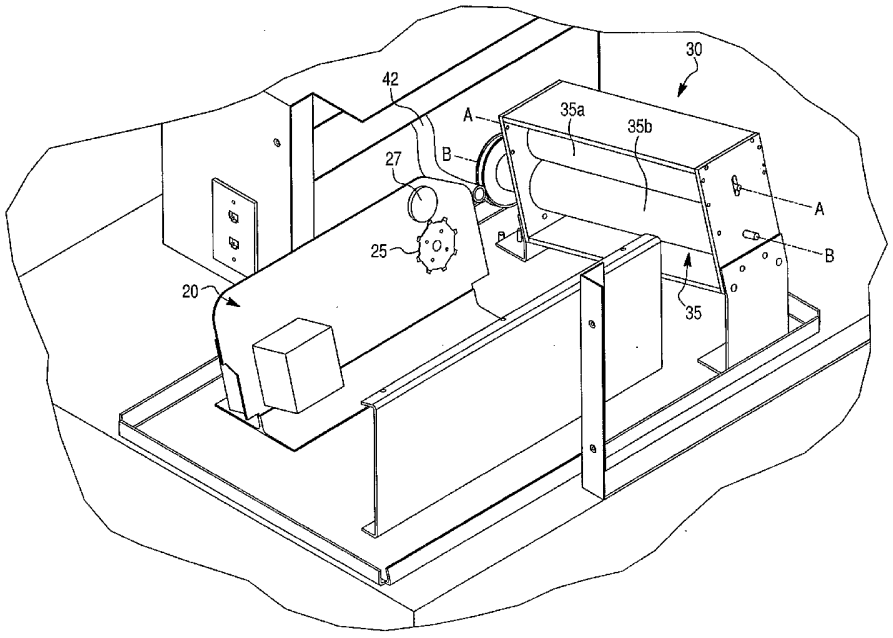
(54) **Title:** APPARATUS FOR SCREENING MAIL FOR HAZARDOUS SUBSTANCES



(57) **Abstract:** A screening apparatus includes an access device configured to create an opening in a mail item and a pressurizing device configured to increase an internal pressure of the mail item so that the pressure is released through the opening. The screening apparatus also includes a sampling device configured to receive a sample of an interior environment of the mail item when the pressure is released through the opening and a detection device configured to analyze the sample to detect the presence of a hazardous agent.

WO 2006/025868 A1

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APPARATUS FOR SCREENING MAIL FOR HAZARDOUS SUBSTANCES

BACKGROUND

[0001] The present invention relates to a mail screening apparatus and, more particularly, to a mail screening apparatus that can be used to screen mail for hazardous agents.

[0002] Individuals bent on harming others and disrupting society have demonstrated that hazardous biological agents, such as anthrax in micron-sized particles, can be spread in envelopes or parcels delivered through the postal system. The particles are dispersed when mail is sorted by mail personnel or equipment or when the envelope or parcel is opened by the recipient. For example, in October 2001, anthrax was discovered in mail processed by the United States Postal Service in Washington, D.C. The resulting contamination caused serious illness to postal employees and at least one death. The incident also disrupted the flow of mail, caused economic loss, resulted in the closure of postal facilities and offices of the United States Congress, and generated fear among postal/mailroom workers and the general population.

[0003] Existing mail screening systems typically sound an alarm once a dangerous level of anthrax is detected in mail. The suspect mail is then quarantined to limit contamination and protect mail handlers and recipients. However, existing mail screening systems are not sufficiently accurate. For example, conventional mail screening systems may result in an unacceptably high number of false positives (i.e., falsely indicating the presence of a dangerous level of a biological agent) and false negatives (i.e., falsely indicating the absence of a dangerous level of a biological agent). A false positive could cause unnecessary expense and disruption including building closure, medical quarantine, medical treatment, and public panic. Conversely, a false negative could result in failure to detect and contain contamination, which could lead to widespread contamination and serious illness and/or death to those infected by the biological agent. Additionally, decontamination costs could be exceedingly high.

[0004] Another disadvantage of conventional mail screening systems is that such systems are too slow to enable rapid and cost-effective management of a potential

anthrax release. For example, existing systems do not enable near-real time detection and may require more than an hour to obtain and analyze a sample for the presence of anthrax.

[0005] Another disadvantage of conventional mail screening systems is that such systems remove an excessive amount of material from or otherwise deface a mail item to obtain a sample of the contents of the mail item. Thus, the confidentiality and appearance of the screened mail are compromised. For example, some mail screening systems remove the corners of an envelope, cut visible holes in the envelope, or completely slice open the envelope to collect a sufficient sample size. Such systems may also force air across the envelope or subject the envelope to vibration to capture the sample, which may contaminate the sample. Additionally, conventional systems have a limited ability to screen mail of various sizes. For example, such systems may be able to screen envelopes but not thicker parcels or boxes.

[0006] Moreover, existing mail screening systems are not equipped to detect threats other than anthrax, such as other biological agents, chemical agents, explosive agents, radioactive agents, and narcotic agents. A need to detect various types of threats exists. For example, a postal attack in Belgium in June 2003 involved a chemical agent and resulted in hospitalization of several individuals. The contaminant included a yellow powder that was an arsenic derivative typically used in nerve agents.

SUMMARY OF THE INVENTION

[0007] An embodiment of the present invention relates to a screening apparatus. The screening apparatus includes an access device configured to create an opening in a mail item and a pressurizing device configured to increase an internal pressure of the mail item so that the pressure is released through the opening. The screening apparatus also includes a sampling device configured to receive a sample of an interior environment of the mail item when the pressure is released through the opening and a detection device configured to analyze the sample to detect the presence of a hazardous agent.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate an example of the invention and together with the description serve to explain the principles of the invention.

[0009] Figure 1 is a perspective view of an embodiment of a screening apparatus according to the present invention.

[0010] Figure 2 is a front perspective view of the screening apparatus of Fig. 1 with lower doors in an open position.

[0011] Figure 3 is a perspective view of detail A in Fig. 1 with some cover panels removed.

[0012] Figure 4 is a front elevation view of a cutting device and a guide roller of the screening apparatus of Fig. 1.

[0013] Figure 5 is a front elevation view of the cutting device and guide roller of Fig. 4 showing processing of a mail item.

[0014] Figure 6 is a top plan view of the mail item of Fig. 5.

[0015] Figure 7 is a perspective view of detail A in Fig. 1 with additional cover panels removed.

DETAILED DESCRIPTION

[0016] Referring to Figures 1 through 3, the screening apparatus 10 generally includes an access device 20, a pressurizing device 30, a sampling device 40, and a detection device 50.

[0017] The access device 20 is configured to receive a mail item 15, such as an envelope, and to deliver the mail item 15 to the pressurizing device 30. The mail item 15 can be introduced to the access device 20 automatically. For example, the access device 20 can include an intake device 23 (shown in Fig. 1) having a conveyor mechanism 23a configured to feed the mail item 15 into the access device 20. The mail item 15 can be placed flat on the intake device 23 and advanced through the access device 20 by the conveyor mechanism 23a.

[0018] The access device 20 can also be configured to create an opening 15a in the mail item 15 (shown in Fig. 6). The opening 15a provides access to an interior

environment of the mail item 15 so that a sample of the interior environment (or contents) can be forced through the opening 15a by the pressurizing device 30. The sample can then be collected by the sampling device 40 and analyzed by the detection device 50. Alternatively, the access device 20 can be configured so that the access device 20 does not cut or open the mail item 15 in any manner. When the access device 20 does not cut or open the mail item 15, the sample can be extracted through pre-existing openings in the mail item 15, such as unsealed corner portions of an envelope.

[0019] If an opening 15a is desired, the access device 20 can include a cutting tool 25 (shown in Figs. 4 and 7) for creating the opening 15a. The cutting tool 25 can have various configurations. For example, the cutting tool 25 can comprise a circular disk having a plurality of blades 25a (e.g., eight blades 25a) disposed along a periphery of the disk, as shown in Fig. 4. The blades 25a can have a width W and can be disposed so that a center point of each blade 25a is located at an angle θ from a center point of a consecutive blade 25a. The width W can be, for example, approximately 0.14 inches, and the angle θ can be approximately 45 degrees. Each blade 25a can create an opening 15a, such as a slit, on a face of the mail item 15. As shown in Fig. 6, the opening 15a is very narrow. Thus, the blades 25a can create openings 15a in the mail item 15 without removing a substantial amount of material from the mail item 15.

[0020] The access device 20 can also include a guide roller 27 (shown in Figs. 4 and 7) to control and facilitate movement of the mail item 15 through the access device 20. The guide roller 27 can be disposed above the cutting tool 25 so that the mail item 15 is received between the cutting tool 25 and the guide roller 27, as shown in Fig. 5. The guide roller 27 maintains a distance D between the guide roller 27 and an edge of the cutting tool 25 to control formation of the opening 15a and to enable the access device 20 to receive mail items 15 of varying thickness. For example, a mail item 15 can have a thickness of approximately 1/4 inch or less. If the distance D is too great, the opening 15a may not be large enough to force a sample of the contents of the mail item 15 through the opening 15a. Conversely, if the distance D is too small, the cutting tool 25 may tear the mail item 15 or remove a noticeable amount of

material from the mail item 15. The distance D may be, for example, approximately 0.005 inches.

[0021] The pressurizing device 30 is configured to receive the mail item 15 from the access device 20 and to compress the mail item 15 to force a sample of the contents through the opening 15a (or through pre-existing openings). For example, the pressurizing device 30 can be disposed adjacent to the access device 20 so that the conveyor mechanism 23a automatically feeds the mail item 15 into the pressurizing device 30. The pressurizing device 30 includes a compression member 35 (shown in Fig. 7) configured to continuously compress the mail item 15 to increase the internal pressure of the mail item 15 as the mail item 15 moves through the compression member 35. For example, the compression member 35 can include a first roller 35a and a second roller 35b, as shown in Fig. 7. The first roller 35a can be disposed above the second roller 35b so that a central axis A-A of the first roller 35a is substantially parallel to a central axis B-B of the second roller 35b. The first and second rollers 35a, 35b can be disposed substantially transverse to a direction of advancement of the mail item 15. Thus, the mail item 15 can be received between the first and second rollers 35a, 35b. As the first and second rollers 35a, 35b rotate, the mail item 15 advances through the compression member 35 so that the first and second rollers 35a, 35b compress a first portion (or first end) of the mail item 15, then compress a middle portion of the mail item 15, and then compress a second portion (or second end) of the mail item 15.

[0022] The first and second rollers 35a, 35b can be moveable relative to one another to enable the compression member 35 to receive mail items 15 of varying thickness. Additionally, a length of the first and second rollers 35a, 35b can be selected so that the compression member 35 can receive mail items of varying dimensions. For example, the mail item 15 can have a length of up to approximately 12 inches and a width of up to approximately 12 inches. The pressurizing device 30 can also be configured to automatically deposit the compressed mail item 15 into a storage bin 27, such as a mail cart, stored within the screening apparatus 10 and accessible via a door 5, as shown in Fig. 2. For example, the storage bin 27 can be disposed below an end

of the pressurizing device 30 so that the mail item falls into the storage bin 27 when the mail item 15 exits the compression member 35.

[0023] In operation, the sample of the contents of the mail item 15 is extracted as the mail item 15 traverses the pressurizing device 30. For example, pressure can build up within the mail item 15 as the mail item 15 advances through the compression member 35 and undergoes compression. When a sufficient amount of pressure has developed, the pressure bursts through the opening 15a (or through pre-existing openings) thereby releasing a sample of the contents of the mail item 15. The sample is then available for collection by the sampling device 40.

[0024] The opening 15a is configured to enable adequate pressure to develop and to allow a sample of sufficient size to be released. For example, the opening 15a can comprise a substantially straight cut, slit, or perforation or a plurality of cuts, slits, or perforations disposed in a substantially straight line, as shown in Fig. 6. A length L_o of each opening 15a must be large enough to release a sufficient sample size but small enough to allow pressure to develop within the mail item 15. For example, the length L_o of an opening 15a may be in a range of approximately 1/8 to 1/4 inch.

[0025] Similarly, the openings 15a must be sufficiently spaced apart to allow adequate pressure to develop within the mail item 15. For example, a distance D_o between an end of a first opening 15a and a beginning of a subsequent opening 15a may be in a range of approximately 1 to 1.5 inches. Thus, the relationship between the length L_o and the distance D_o can determine whether a sufficient sample is released. For example, a ratio of the length L_o and the distance D_o may be approximately 1:12 to 1:4 (preferably 1:8 to 1:6).

[0026] Additionally, although the openings 15a shown in Fig. 6 are disposed below an edge of the first mail item 15, it will be recognized that the openings 15a could be located at various locations on the mail item 15. In this manner, the access device 20 can create an opening 15a so that a sufficient sample size is released without significantly defacing the mail item 15 or compromising the confidentiality of the mail item 15. Moreover, the openings 15a are a discrete visual mark on the mail item 15 that can be used to verify that the mail item 15 has been screened.

[0027] The sampling device 40 is configured to collect (or receive) the sample when the pressure within the mail item 15 is released through the opening 15a (or through pre-existing openings). For example, the sampling device 40 can include an air collection hose 42 (shown in Figs. 3 and 7) with an intake opening disposed between the access device 20 and the pressurizing device 30. The air collection hose 42 can be operatively connected to a vacuum device so that a suction force is created at the intake opening. When the pressure is released through the opening 15a (as discussed above) the suction force draws the sample into the air collection hose 42. The sampling device 40 can be controlled to maintain a desired air flow rate. For example, the air flow rate can be approximately 450 liters per minute.

[0028] Once the sample is collected, the sample can optionally be converted to a liquid sample using a conversion device, such as a Spincon® concentratr. The sample is automatically delivered to the detection device 50 using a pumping device. In this manner, the sampling device 40 can obtain a sample of the contents of the mail item 15 without subjecting the mail item 15 to vibration and without forcing air over the mail item. Thus, the potential for contamination of the sample is reduced.

[0029] The screening apparatus 10 can also include a second access device 60 (shown in Fig. 1) configured to create an opening in a mail item 17 when the mail item 17 is too large to be processed through the access device 20 and the pressurizing device 30. Thus, the second access device 60 can be used to create an opening in a mail item 17 having a thickness greater than 1/4 inch, such as a box or a package. For example, the mail item 17 can have a length of up to approximately 13 inches, a width of up to approximately 13 inches, and a height of up to approximately 13 inches.

[0030] The second access device 60 can be configured for manual operation. For example, the mail item 17 can be placed into a manual screening area 62 of the screening apparatus 10 by an operator The manual screening area 62 can be an open area within the screening apparatus 10 large enough to receive the mail item 17, as shown in Fig. 1 The operator manually opens the mail item 17 and can examine the contents of the mail item 17 for sealed items, such as letters or other closed items. A sample of the interior of the mail item 17 can be obtained using the sampling device 40, which can include a second air collection hose 47 (shown in Fig. 2). The operator

collects the sample by manually maneuvering the hose 47 near and/or within the interior of the mail item 17. As discussed above, the sampling device 40 evacuates the sample and delivers the sample to the detection device 50. The operator then reseals the mail item 17 and moves the mail item 17 into a package cabinet 65 through an aperture 67. The mail item 17 is stored in the package cabinet 65 until processing of the sample by the detection device 50 is complete (or until a full screening cycle is complete). In this manner, the screening apparatus 10 can be used to screen both large and small mail items.

[0031] The detection device 50 is configured to analyze samples of the contents of the mail items 15, 17 to determine whether a hazardous agent is present in the samples. The detection device 50 can include, for example, portable detectors, such as Smiths APD 2000 and Saber 2000; an ion scan mobility system; and/or a polymerase chain reaction (PCR) instrument, such as GeneXpert or Bio-Seeq. If a PCR instrument is used (to screen for a biological agent), particles in the sample are first concentrated into a liquid sample and then transferred to a disposable cartridge. The cartridge is analyzed using PCR technology to detect the presence of the biological agents. Through the completely automated PCR process, one molecule of Deoxyribonucleic Acid (DNA) is replicated up to approximately a billion-fold, which provides sufficient genetic material for detection and positive identification. The time for a result from a PCR test can be, for example, approximately thirty minutes, compared to several days for a conventional lab culture. Additionally, PCR technology possesses excellent sensitivity and has the ability to detect a single bacterial cell.

[0032] If the detection device 50 obtains a negative result (i.e., indicates the absence of a dangerous level of a hazardous agent), the mail items 15, 17 can be unloaded from the screening apparatus 10 and re-introduced into the general mail population and flow. If the detection device 50 obtains a positive result (i.e., indicates the presence of a dangerous level of a hazardous agent), an alarm can sound and a paging device can be activated to notify essential personnel. The screening apparatus 10 can then be secured and the suspect mail items 15, 17 quarantined. Upon quarantine, first responder personnel can, for example, visually inspect each mail item for unusual

markings or other indications that a particular mail item is the source of the hazardous agent. Additionally, due to cross contamination, mail items other than the source item are likely to have traces of the hazardous agent. Thus, the entire batch of quarantined mail items can be treated as dangerous.

[0033] The detection device 50 can be configured to detect a biological agent, such as anthrax. Additionally, it will be recognized that the capabilities of the detection device 50 can be expanded to detect hazardous agents other than anthrax. For example, the detection device 50 could be configured to detect other biological agents; chemical agents, including nerve and blister agents such as Tabun, Sarin, Soman, Cyclosarin, Agent VX and Vx, and Nitrogen Mustard; radioactive agents; narcotic agents; and explosive agents, such as RDX, PETN, TNT, Semtex, NG, and Ammonium Nitrate.

[0034] When the detection device 50 is configured to detect explosive agents, the screening apparatus 10 can further include a pre-screening X-ray device to detect the explosive agent (or explosive device) in a mail item 15, 17 before the mail item 15, 17 is processed through the screening device 10. The X-ray device can be, for example, Smiths Heimmann Model 7555. Thus, potential detonation of the explosive agent during processing in the screening apparatus 10 is avoided. For example, the X-ray device can be disposed prior to the intake device 23 so that the mail items 15, 17 can be x-rayed before being introduced into the access device 20 or the second access device 60. If the presence of an explosive agent is detected by the X-ray device, an alarm can sound and the screening apparatus 10 can be secured so that the suspect mail item 15, 17 is not introduced into the access device 20 or the second access device 60. In this manner, the potential for detonation of the explosive agent during processing in the access device 20, the second access device 60, or the pressurizing device 30 is reduced.

[0035] The screening apparatus 10 can also include a protective enclosure 70 that can be configured to be maintained at a negative pressure. For example, the protective enclosure 70 can include an exhaust system disposed in an upper portion 10a of the screening apparatus 10. The exhaust system can comprise an air handler including a filter to capture aerosolized contamination and to prevent such

contamination from being released into the environment surrounding the screening apparatus 10. For example, the filter can comprise a high efficiency particulate air filter and/or a carbon filter. When the access device 20, the pressurizing device 30, the sampling device 40, the detection device 50, the second access device 60, and/or the sealed package cabinet 65 are disposed within the protective enclosure 70, the potential for contamination external to the screening apparatus 10 is reduced.

[0036] In operation, multiple mail items 15, 17 can be processed during one cycle of the screening apparatus 10. Cycle process time (i.e., a time from mail loading to mail unloading) can be, for example, approximately one hour. The mail items 15, 17 are loaded into the screening device 10. For example, an operator can manually place a mail item 17 into the manual screening area 62 of the second access device 60. The operator manually opens the mail item 17 and evacuates a sample from the interior of the mail item 17 using the air collection hose 47. The sampling device 40 delivers the collected sample to the detection device 50 via a suction and/or a pumping force. The operator then reseals the mail item 17 and stores the mail item 17 in the sealed package cabinet 65 for storage during the remainder of the cycle. Another mail item 17 can then be placed into the manual screening area 62 for manual processing.

[0037] Similarly, mail items 15 can be placed on the intake device 23 and automatically fed into the access device 20. The access device 20 receives the mail items 15 one at a time, optionally creates openings 15a in each mail item 15, and feeds each mail item 15 into the pressurizing device 30. The pressurizing device 30 compresses each mail item 15 so that a sample of the contents of the mail item 15 is released through the openings 15a (or through pre-existing openings). The sampling device 40 collects and delivers the samples to the detection device 50 via a suction and/or a pumping force. When the mail items 15 exit the pressurizing device 30, the mail items 15 are automatically deposited in the storage cart 27 for storage during the remainder of the cycle. Additionally, to reduce or prevent contamination of the environment external to the screening apparatus 10, the cycle steps discussed above can be performed under negative pressure maintained by the protective enclosure 70.

[0038] A cycle of the screening apparatus 10 can screen a low to moderate volume of mail. For example, the screening apparatus 10 can be configured to process

approximately 2,000 to 5,000 envelopes up to 1/4 inch thick in approximately one hour. The screening apparatus 10 can also include a user-friendly touch screen interface 80 (shown in Figs. 1 and 2) with push button operation so that an operator can control the cycle. The screening apparatus 10 can be sized so that the screening apparatus 10 can be used on-site at various facilities, such as mail centers, hospitals, factories, commercial offices, and government offices. For example, the screening apparatus 10 can have a rectangular footprint of approximately 3 feet by 6 feet. The screening apparatus 10 can also include rolling members, such as conventional stem or plat casters, for mobility.

[0039] Thus, according to embodiments of the present invention, a screening apparatus 10 can provide accurate, rapid, safe, on-site testing for hazardous agents transmitted through mail items.

[0040] Modifications and other embodiments of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. It is intended that the specification and examples be considered as exemplary only, the scope of the invention being limited only by the appended claims.

WHAT IS CLAIMED IS:

1. A screening apparatus, comprising:

a first access device configured to create an opening in a first mail item;

a pressurizing device configured to increase an internal pressure of the first mail item so that the pressure is released through the opening;

a sampling device configured to receive a first sample of an interior environment of the first mail item when the internal pressure of the first mail item is released through the opening; and

a detection device configured to analyze the first sample to determine whether a hazardous agent is present in the first sample.

2. The screening apparatus of claim 1, further comprising a second access device configured to create an opening in a second mail item, wherein the second mail item is thicker than the first mail item.

3. The screening apparatus of claim 2, wherein the first mail item has a thickness of approximately 1/4 inch or less.

4. The screening apparatus of claim 2, wherein the second mail item has a thickness of approximately greater than 1/4 inch.

5. The screening apparatus of claim 2, wherein the second mail item comprises a box.

6. The screening apparatus of claim 2, wherein the first access device is configured to operate automatically and the second access device is configured to be operated manually.

7. The screening apparatus of claim 2, wherein the sampling device is configured to receive a second sample of an interior environment of the second mail item and the detection device is configured to analyze the second sample to detect the presence of a hazardous agent in the second sample.

8. The screening apparatus of claim 7, wherein the sampling device includes an air collection device configured to obtain the second sample.

9. The screening apparatus of claim 1, wherein the first access device includes a cutting tool.

10. The screening apparatus of claim 9, wherein the cutting tool includes at least one blade.

11. The screening apparatus of claim 9, wherein the cutting tool comprises a circular disk including a plurality of blades disposed along a periphery of the circular disk.

12. The screening apparatus of claim 9, wherein the cutting tool is configured to produce an opening in the first mail item without removing a noticeable amount of material from the first mail item.

13. The screening apparatus of claim 9, wherein the first access devices includes a guide roller disposed above the cutting tool and is configured so that the first mail item can be received between the guide roller and the cutting tool.

14. The screening apparatus of claim 13, wherein a distance between a surface of the guide roller and an edge of the cutting tool is approximately 0.005 inch.

15. The screening apparatus of claim 1, wherein the first access device is configured to automatically feed the first mail item into the pressurizing device.

16. The screening apparatus of claim 1, wherein the opening comprises at least one perforation.

17. The screening apparatus of claim 1, wherein the opening comprises at least one slit.

18. The screening apparatus of claim 1, wherein the opening comprises a substantially straight cut.

19. The screening apparatus of claim 1, wherein the opening is disposed below an edge of the first mail item.

20. The screening apparatus of claim 1, wherein the opening includes a plurality of slits.

21. The screening apparatus of claim 20, wherein the slits are disposed in a substantially straight line and are spaced apart from one another.

22. The screening apparatus of claim 21, wherein a ratio of a length of a slit to a distance between the slit and a consecutive slit is 1:12 to 1:4.

23. The screening apparatus of claim 1, wherein the pressurizing device includes a first roller and a second roller.

24. The screening apparatus of claim 23, wherein the first roller is disposed above the second roller.

25. The screening apparatus of claim 23, wherein a central axis of the first roller is parallel to a central axis of the second roller.

26. The screening apparatus of claim 23, wherein the first and second rollers are disposed transverse to a direction of advancement of the first mail item.

27. The screening apparatus of claim 23, wherein the first roller is moveable relative to the second roller

28. The screening apparatus of claim 23, wherein the first and second rollers are configured to continuously compress the first mail item as the first mail item moves between the first and second rollers.

29. The screening apparatus of claim 23, wherein the first roller is spring loaded.

30. The screening apparatus of claim 1, wherein the pressurizing device is configured to receive an item having a thickness of 1/4 inch or less.

31. The screening apparatus of claim 1, wherein the pressurizing device is configured to automatically deposit the first mail item into a storage bin.

32. The screening apparatus of claim 1, wherein the sampling device includes a vacuum device configured to produce a suction force near the first mail item as the first mail item moves through the pressurizing device.

33. The screening apparatus of claim 1, wherein the sampling device includes a suction hose having an opening disposed between the first access device and the pressurizing device.

34. The screening apparatus of claim 1, wherein the sampling device is configured to automatically deliver the first sample to the detection device.

35. The screening apparatus of claim 1, wherein the sampling device is configured to capture the first sample using only a suction force.

36. The screening apparatus of claim 1, wherein the detection device is configured to detect a biological agent.

37. The screening apparatus of claim 36, wherein the biological agent comprises anthrax.

38. The screening apparatus of claim 1, wherein the detection device is configured to detect a chemical agent.

39. The screening apparatus of claim 1, wherein the detection device is configured to detect a radioactive agent.

40. The screening apparatus of claim 1, wherein the detection device is configured to detect an explosive agent.

41. The screening apparatus of claim 1, wherein the detection device is configured to detect a narcotic agent.

42. The screening apparatus of claim 1, wherein the detection device comprises a polymerase chain reaction system.

43. The screening apparatus of claim 1, wherein the detection device comprises an ion scan mobility system.

44. The screening apparatus of claim 1, wherein the detection device comprises an X-ray device.

45. The screening apparatus of claim 1, further comprising a mail intake device configured to automatically feed the first mail item into the first access device.

46. The screening apparatus of claim 1, further comprising a protective enclosure, wherein the first access device, the pressurizing device, the sampling device, and the detection device are disposed within the protective enclosure.

47. The screening apparatus of claim 46, wherein the protective enclosure includes an area configured to store boxes.

48. The screening apparatus of claim 46, wherein the protective enclosure is configured to be maintained at a negative pressure.

49. The screening apparatus of claim 46, wherein the protective enclosure includes an exhaust system comprising a filter.

50. The screening apparatus of claim 49, wherein the filter comprises a high efficiency particulate air filter.

51. The screening apparatus of claim 49, wherein the filter comprises a carbon filter.

52. The screening apparatus of claim 1, wherein the screening apparatus is configured to process at least two thousand mail items per hour.

53. The screening apparatus of claim 1, wherein the first mail item is an envelope.

54. The screening apparatus of claim 1, wherein a thickness of the first mail item is approximately 1/4 inch or less.

55. The screening apparatus of claim 1, wherein a length of the first mail item is approximately 12 inches or less.

56. The screening apparatus of claim 1, wherein a width of the mail item is approximately 12 inches or less.

57. The screening apparatus of claim 1, wherein the hazardous agent comprises a biological agent.

58. The screening apparatus of claim 57, wherein the biological agent comprises anthrax.

59. The screening apparatus of claim 1, wherein the hazardous agent comprises a chemical agent.

60. The screening apparatus of claim 1, wherein the hazardous agent comprises a radioactive agent.

61. The screening apparatus of claim 1, wherein the hazardous agent comprises an explosive agent.

62. The screening apparatus of claim 1, wherein the hazardous agent comprises a narcotic agent.

63. A method of screening mail for hazardous agents, comprising:

creating an opening in a first mail item;

compressing the first mail item to increase an internal pressure of the first mail item so that the pressure is released through the opening;

collecting a sample of an interior environment of the first mail item when the pressure is released through the opening;

analyzing the sample of the interior environment of the first mail item to detect the presence of a hazardous agent.

64. The method of claim 63, further comprising the steps of creating an opening a second mail item and collecting a sample from an interior environment of the second mail item, wherein the second mail item is thicker than the first mail item.

65. The method of claim 64, wherein the step of analyzing the sample of the interior environment of the first mail item includes analyzing the sample of the interior environment of the second mail item.

66. The method of claim 64, wherein the step of creating an opening in the second mail item includes first X-raying the second mail item to determine whether the second mail item contains an explosive device.

67. The method of claim 64, wherein the step of creating an opening in the first mail item is automated and the step of creating an opening in the second mail item is performed manually.

68. The method of claim 64, wherein the method is performed within a protective enclosure configured to be maintained at a negative pressure.

69. The method of claim 68, wherein the protective enclosure includes an area configured to store boxes.

70. The method of claim 64, wherein the first mail item has a thickness of approximately 1/4 inch or less.

71. The method of claim 64, wherein the second mail item has a thickness of approximately greater than 1/4 inch.

72. The method of claim 64, wherein the second mail item comprises a box.

73. The method of claim 63, wherein the step of creating an opening in the first mail item includes making at least one cut in the first mail item.

74. The method of claim 73, wherein the cut is formed in a substantially straight line.

75. The method of claim 73, wherein the cut is formed without removing a noticeable amount of material from the first mail item.

76. The method of claim 63, wherein the step of compressing the first mail item includes compressing a first portion of the first mail item, then compressing a middle portion of the first mail item, and then compressing a second portion of the first mail item.

77. The method of claim 63, wherein the step of compressing the first mail item includes passing the first mail item through a set of rollers.

78. The method of claim 63, wherein the step of collecting a sample includes producing a suction force near the first mail item as the first mail item is being compressed.

79. The method of claim 63, wherein the step of analyzing the sample includes performing a polymerase chain reaction analysis.

80. The method of claim 63, wherein the step of analyzing the sample includes performing an ion scan mobility analysis.

81. The method of claim 63, wherein the hazardous agent comprises a biological agent.

82. The method of claim 57, wherein the biological agent comprises anthrax.

83. The method of claim 63, wherein the hazardous agent comprises a chemical agent.

84. The method of claim 63, wherein the hazardous agent comprises a radioactive agent.

85. The method of claim 63, wherein the hazardous agent comprises an explosive agent.

86. The method of claim 63, wherein the hazardous agent comprises a narcotic agent.

87. The method of claim 63, wherein at least one of the step of creating an opening in the first mail item, the step of compressing the first mail item, the step of collecting a sample of an interior environment of the first mail item, and the step of analyzing the sample is automated.

88. The method of claim 63, wherein the steps of creating an opening in the first mail item, compressing the first mail item to increase an internal pressure of the first mail item, collecting a sample of an interior environment of the first mail item, and analyzing the sample to detect the presence of a hazardous agent are performed within a protective enclosure configured to be maintained at a negative pressure.

89. An apparatus for accessing an interior of a mail item, comprising:

a cutting tool having at least one blade; and

a guide roller disposed below the cutting tool and configured so that the mail item can be received between the cutting tool and the guide roller;

wherein the cutting tool is configured to produce an opening in the mail item, and

wherein the opening comprises a plurality of slits disposed in a substantially straight line along an entire length of the mail item.

90. The apparatus of claim 89, wherein the slits are located below an edge of the mail item.

91. The apparatus of claim 89, wherein a distance between a surface of the guide roller and an edge of the cutting tool is approximately 0.005 inch.

92. The apparatus of claim 89, wherein a ratio of a length of a slit to a distance between the slit and a consecutive slit is 1:12 to 1:4.

93. A device for detecting contaminants in mail, comprising an access device configured to produce a plurality of slits on a face of a mail item so that a portion of material contained in the mail item can be forced through at least one of the slits, wherein each slit comprises a narrow opening.

94. A screening apparatus, comprising:

an access device configured to create an opening in a mail item;

a pressurizing device configured to compress the mail item to force a portion of material contained in the mail item through the opening; and

a detection device configured to collect and analyze the portion of material to determine whether a hazardous agent is present in the portion of material.

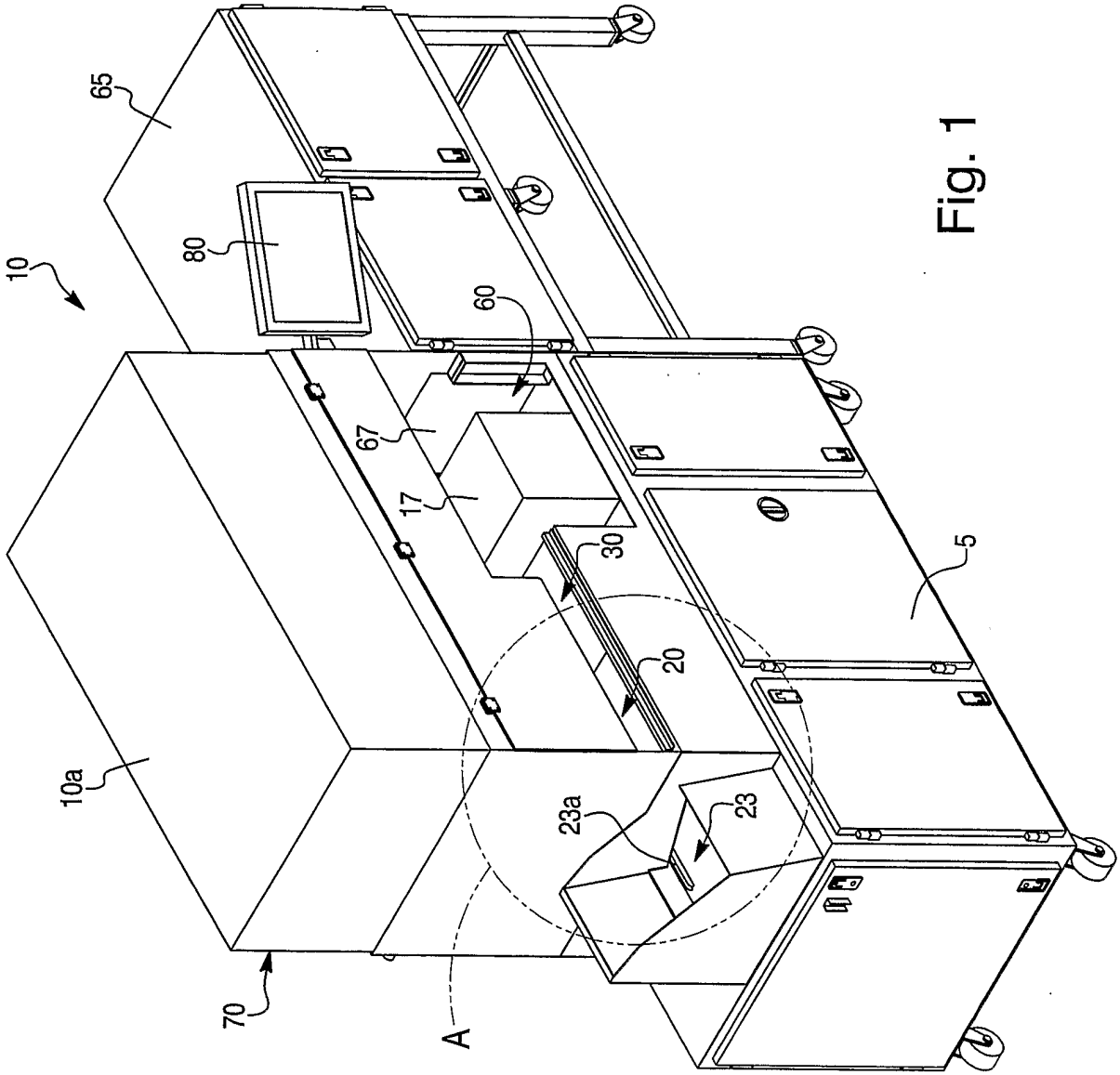


Fig. 1

Fig. 2

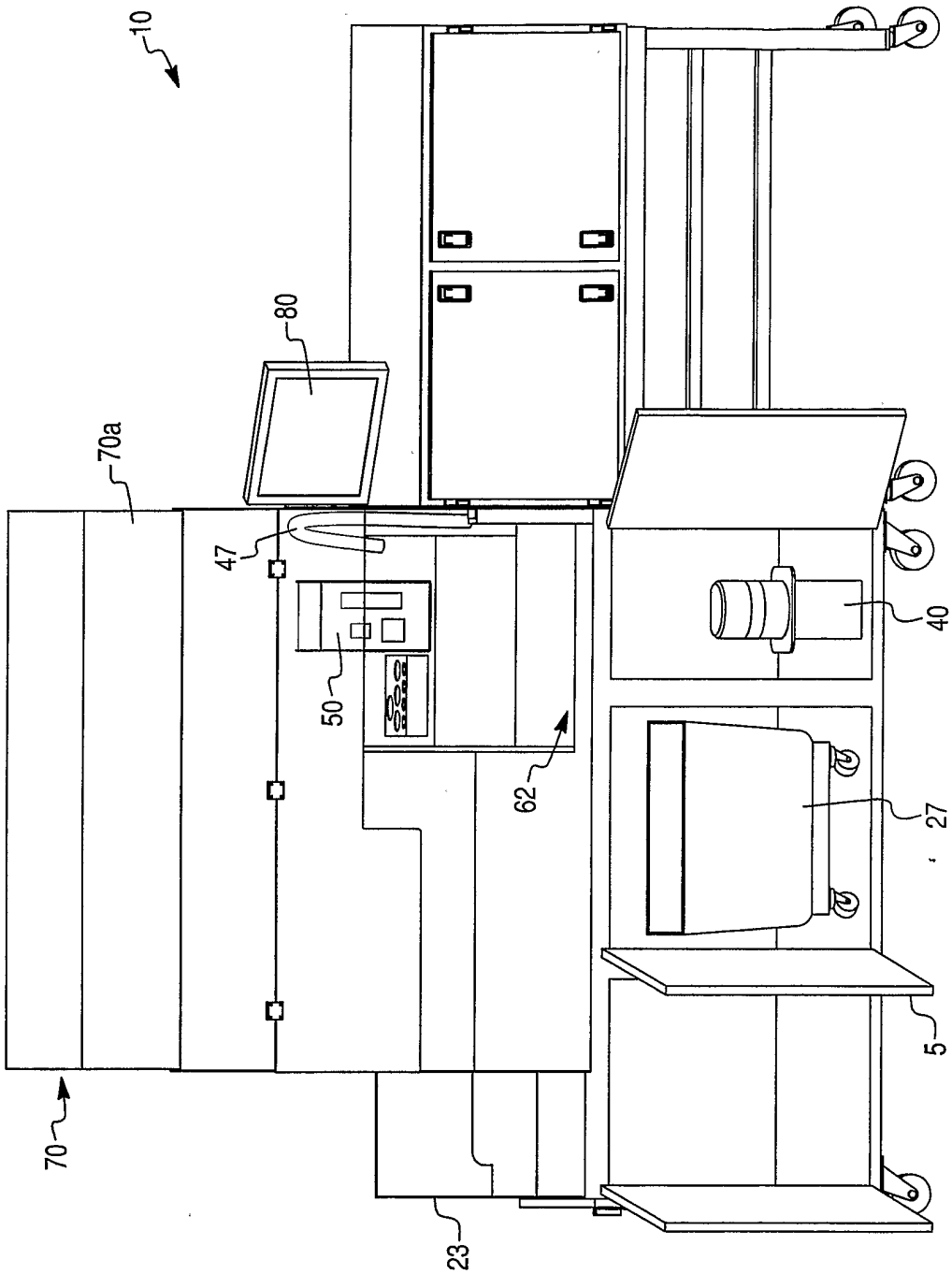


Fig. 3

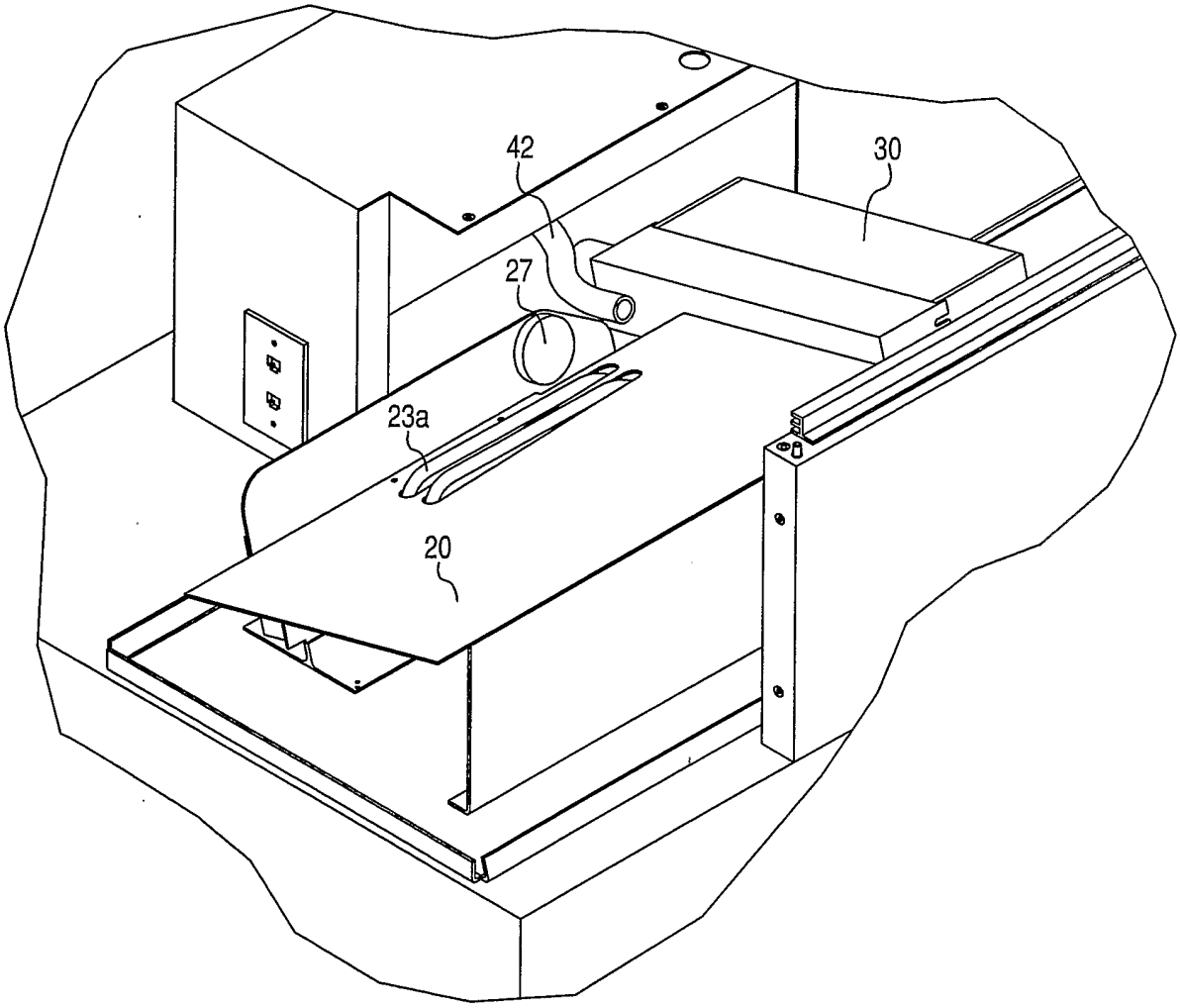


Fig. 4

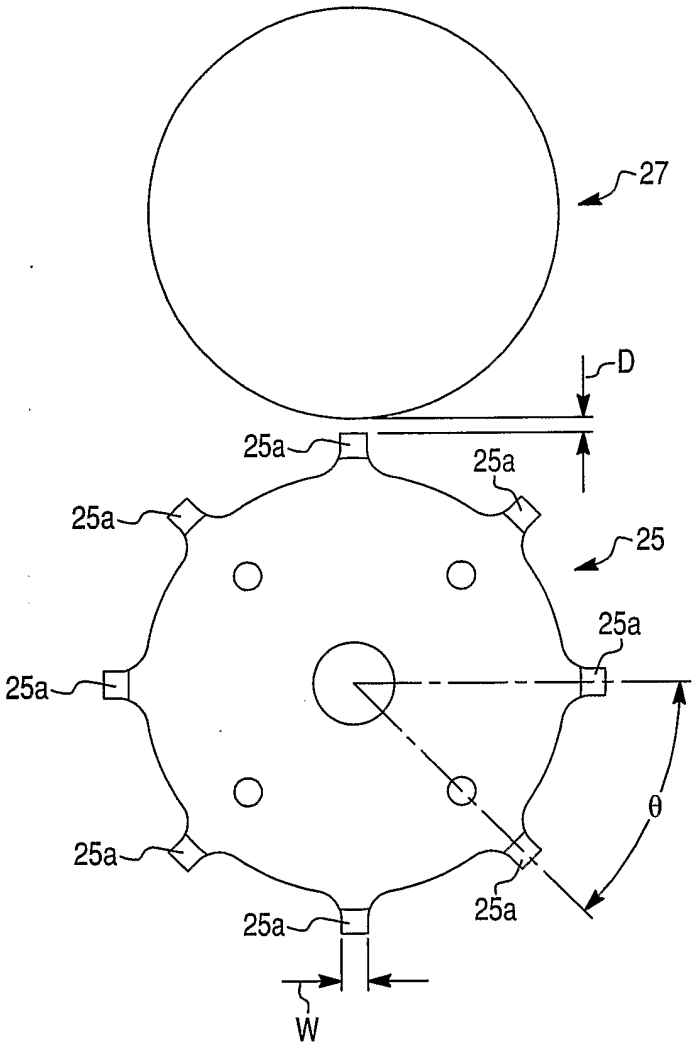


Fig. 5

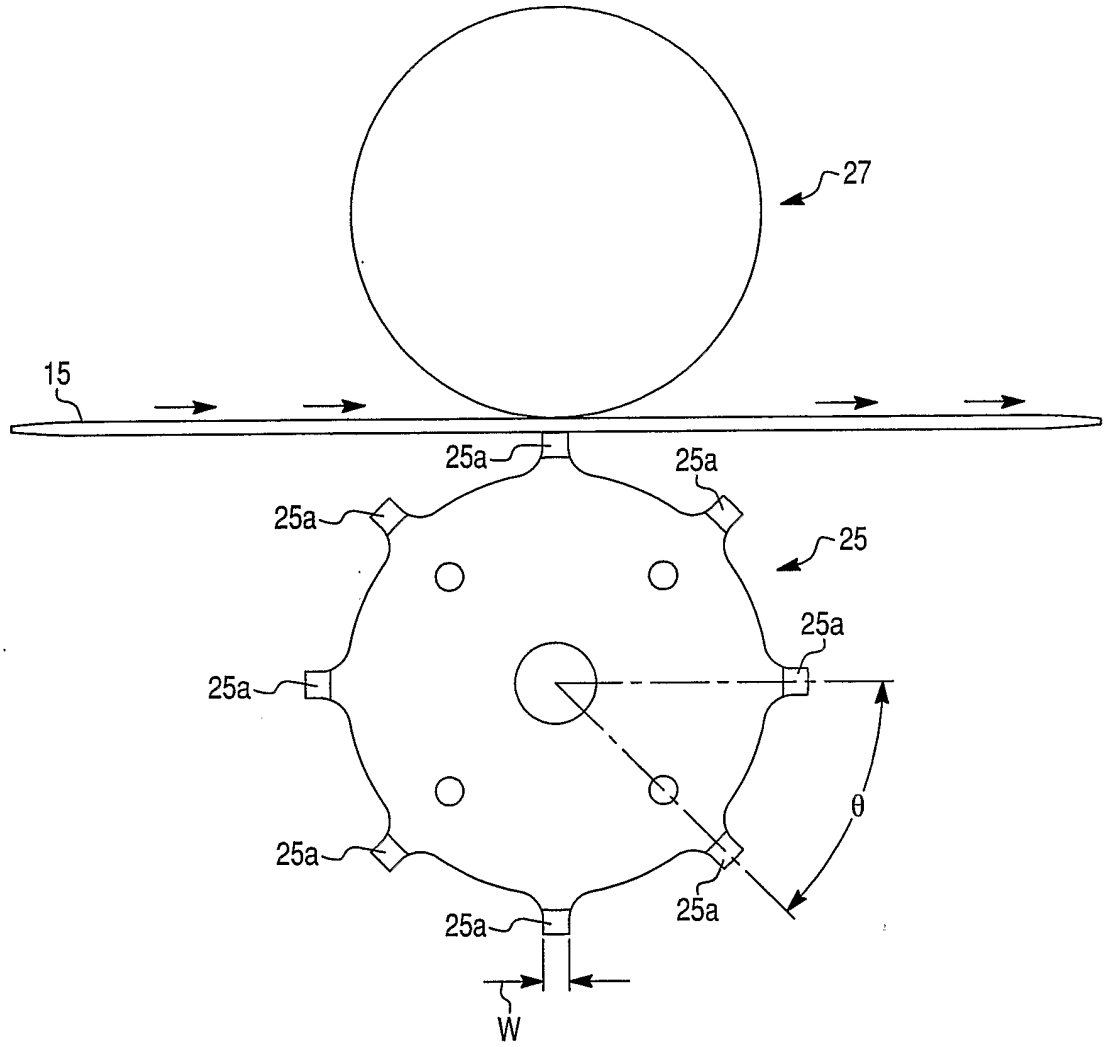
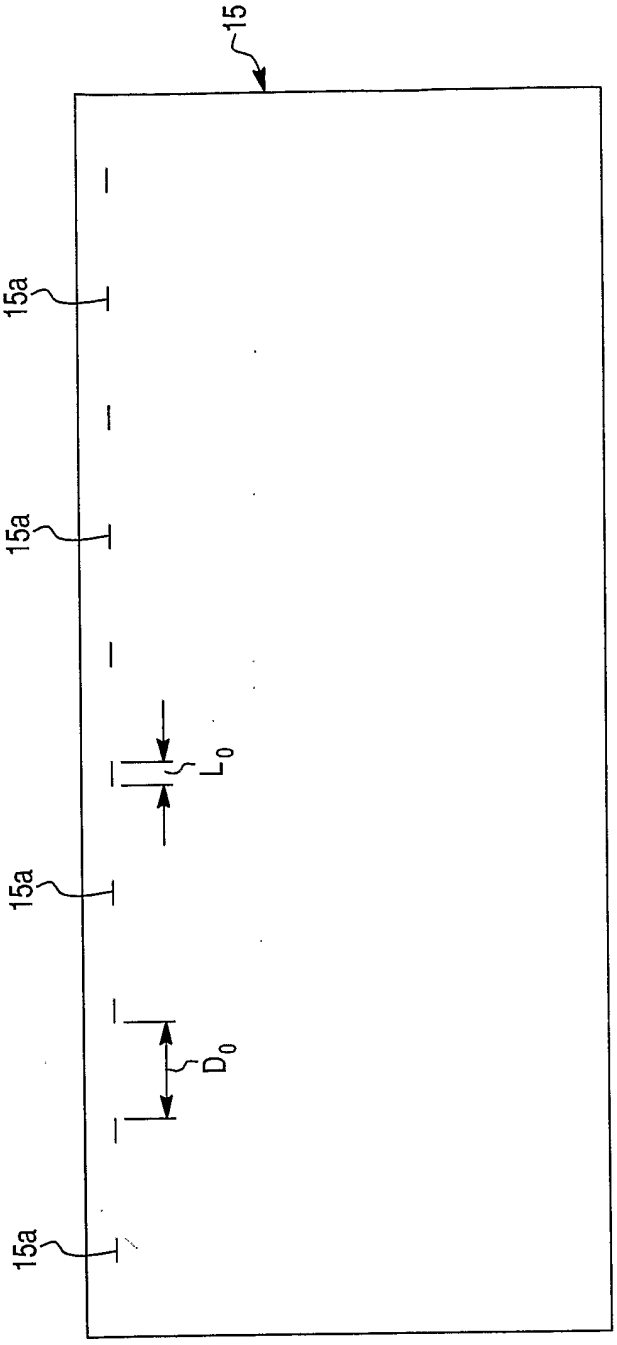


Fig. 6



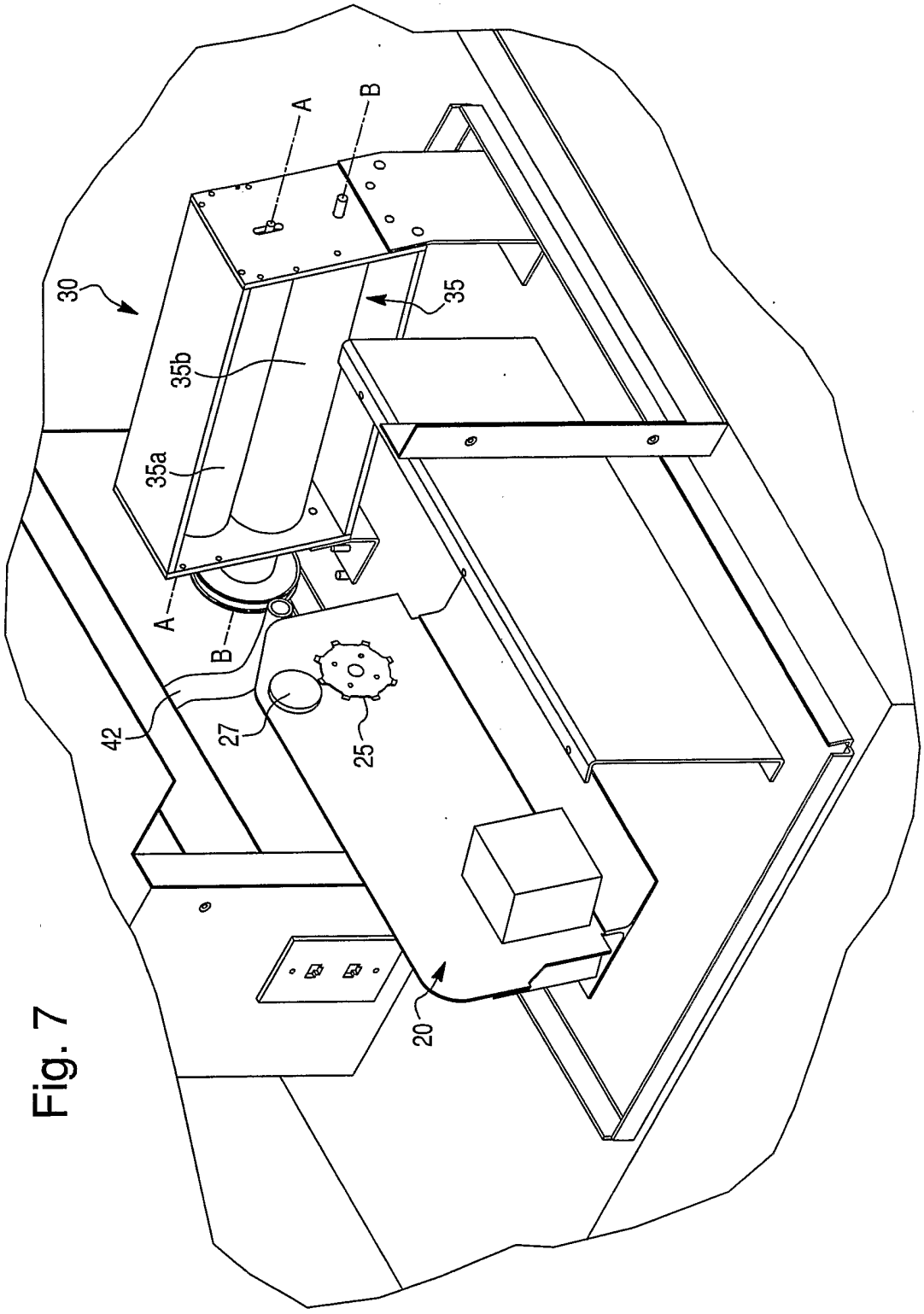


Fig. 7

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2005/010128

A. CLASSIFICATION OF SUBJECT MATTER
B07C5/04 G01N1/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B07C G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 03/089156 A (THE JOHNS HOPKINS UNIVERSITY; HARSHBARGER, STUART, D; ARABIAN, ADAM, K) 30 October 2003 (2003-10-30) paragraphs '0006!, '0017! - '0019! paragraph '0037! - paragraph '0044! paragraph '0057! - paragraph '0061! figures 1,4-6	1-94
X	US 2003/115931 A1 (STEMMLE DENIS J ET AL) 26 June 2003 (2003-06-26) paragraph '0020! - paragraph '0022! paragraph '0028! - paragraph '0038! figures 3-12	1,63,94

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
10 January 2006	18/01/2006

Name and mailing address of the ISA	Authorized officer
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
A	US 2002/124664 A1 (CALL CHARLES J ET AL) 12 September 2002 (2002-09-12) paragraph '0108! - paragraph '0111! paragraph '0116! paragraph '0129! - paragraph '0135! figures 1-5	1-94
X	US 2003/136203 A1 (YOON SUNG HOON) 24 July 2003 (2003-07-24) paragraph '0108! - paragraph '0122! figures 1-11	1,63,94

INTERNATIONAL SEARCH REPORT

Information on patent family members

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PCT/US2005/010128

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US 2003115931 A1	26-06-2003	AU 2002367170 A1	15-07-2003
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US 2003136203 A1	24-07-2003	NONE	