Aug. 29, 1972 W. M. MURPHY ET AL 3,687,730

DOCTOR CLEANING METHODS AND APPARATUS WITH SCANNING SUCTION PORT

Filed March 15, 1971 2 Sheets-Sheet 1

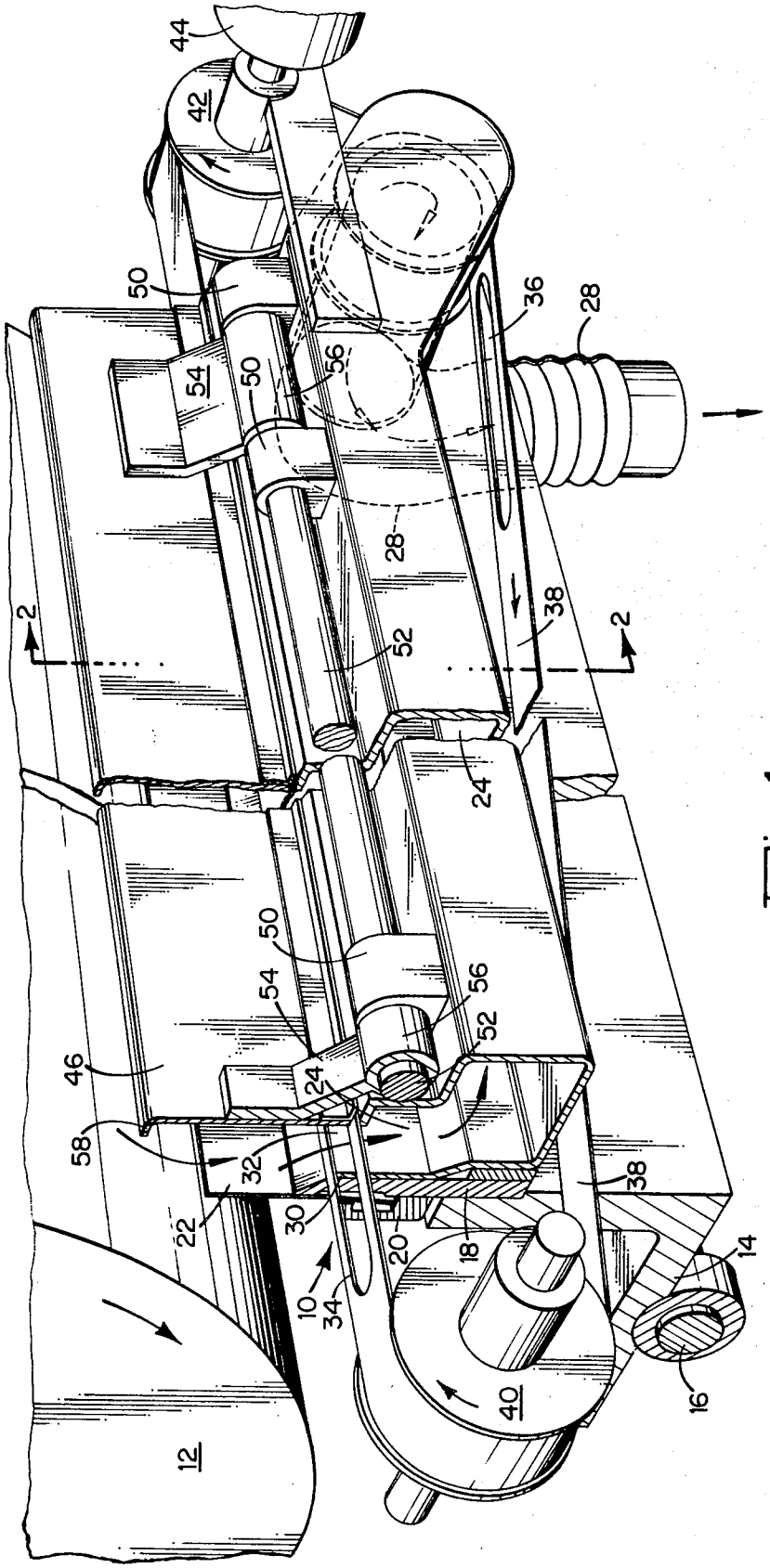


Fig. 1.

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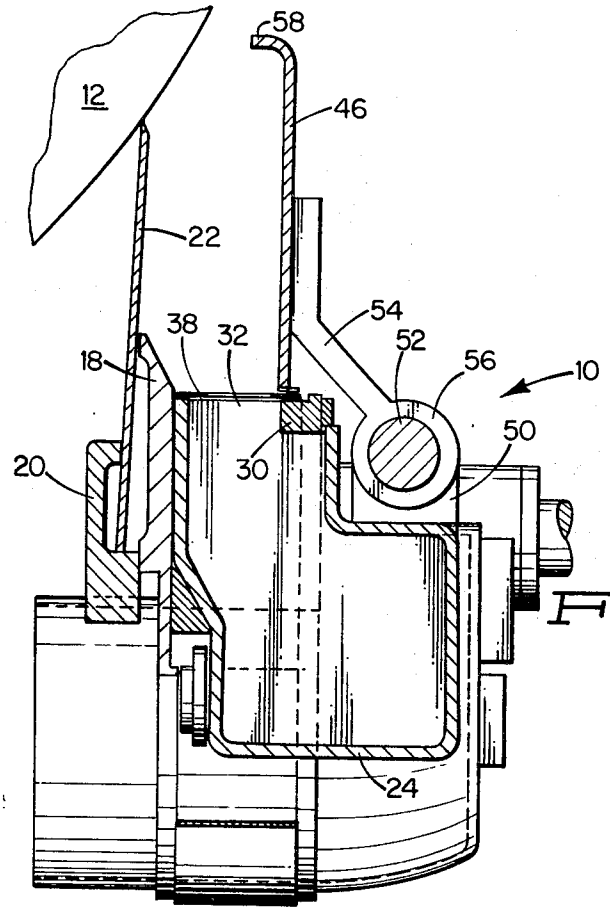


Fig. 2.

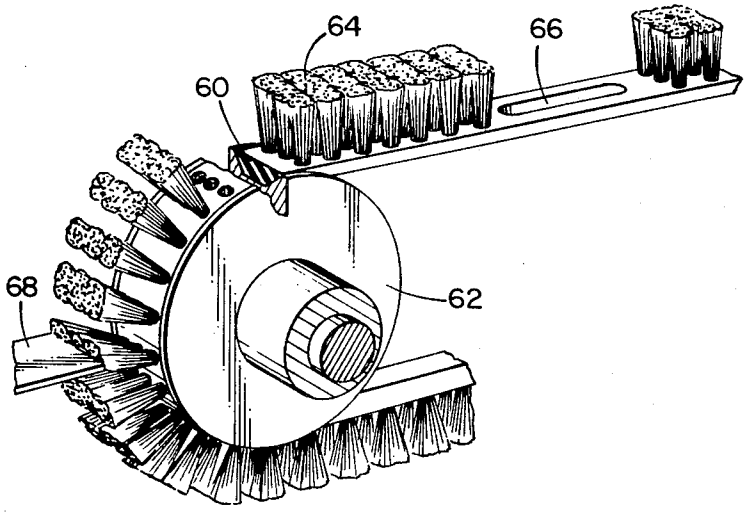


Fig. 3.

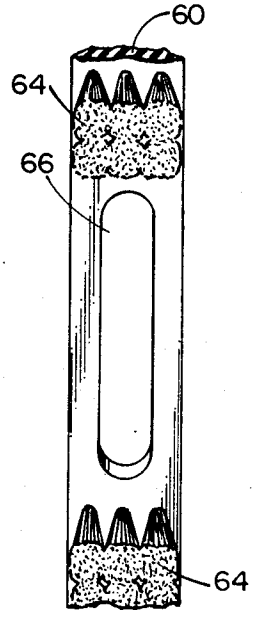


Fig. 4.

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DOCTOR CLEANING METHODS AND APPARATUS WITH SCANNING SUCTION PORT

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Int. Cl. B08b 5/04; D21g 3/00
U.S. Cl. 134—21 19 Claims

ABSTRACT OF THE DISCLOSURE

The cleaning apparatus comprises a suction chamber having an open mouth extending along the length of a doctor and a driven endless belt which is guided across the suction chamber mouth in sealing relationship thereto. The belt has one or more openings whose total effective area is small compared to the effective area of the chamber mouth. A high suction port is thus established which scans the doctor to inhale fines collected on the doctor. In a second disclosed embodiment, a belt as described has also sweeping means extending therefrom for sweeping from the doctor deposited matter too large or too heavy to be inhaled through the opening or openings in the belt.

BACKGROUND OF THE INVENTION

This invention relates to apparatus for cleaning doctors, especially doctors of the type used in papermaking systems to clean fines such as dust, lint, fuzz, and small broke from dryer rolls. It is well known that to consistently produce paper of high quality, the dryer rolls must be kept very clean, and that to attain this high state of cleanliness, the doctor itself must be kept relatively free from accumulations of such fines.

It is common practice today to clean such dryer roll doctors manually with a vacuum hose. This can only be done when the papermaking system is "down," i.e., turned off. Such manual cleaning operations are costly, especially in terms of system "down time." In some applications wherein the doctor is in a relatively inaccessible location, manual cleaning of the doctor may be extremely difficult, if not impossible.

Attempts have been made to develop automatic cleaning equipment to obviate the described manual operations. A Canadian Pat. No. 508,476 suggests the use of a vacuum cleaner having a hose with a nozzle which is reciprocated across the doctor by a driven double-helical cam mechanism. Such an arrangement has a number of serious drawbacks which include the following: (1) the drive mechanism is very uneconomical in terms of cost of fabrication and consumption of space; (2) the drive mechanism is very susceptible of being clogged by the matter which is to be removed; (3) the apparatus has an inefficient air flow pattern; (4) the hoses all require a substantial amount of operating space, limiting use of such apparatus to applications wherein large amounts of operating space are available; and (5) the hoses are susceptible of being cut (e.g., by a broke paper web) and have a limited life.

Another approach is expounded by British Pat. No. 1,209,359 which discloses a mesh-like conveyor belt driven over a plurality of side-by-side suction nozzles, the suction nozzles causing broke to adhere to the belt for transport to the end of the doctor. This latter method suffers from producing relatively low suction for a given suction pump capacity.

OBJECTS OF THE INVENTION

It is an object of this invention to provide automatic, real-time doctor cleaning apparatus and methods which

do not suffer from any of the aforementioned disadvantages of the prior art apparatus and methods.

More particularly, it is an object to provide doctor cleaning apparatus and methods which are especially useful for removing from dryer roll doctors and the like fines and small broke, and which is compact, durable, reliable, and relatively economical to manufacture, and which are not readily susceptible of being jammed by large broke.

It is another object to provide doctor cleaning apparatus and methods which result in extremely high cleaning efficiencies due to the production of a very high suction for a given vacuum pump capacity and a controlled air flow.

It is yet another object to provide doctor cleaning apparatus and methods which involve removing fines by suction inhalation and larger broke by sweeping.

Further objects and advantages of the invention will in part be obvious and will in part become apparent as the following description proceeds. The features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the invention, reference may be had to the following detailed description taken in connection with the accompanying drawings wherein:

FIG. 1 is a fragmentary perspective view, partly broken away, showing doctor cleaning apparatus representing a preferred embodiment of the invention which is incorporated in a roll doctor assembly;

FIG. 2 is a fragmentary sectional view taken along lines 2—2 in FIG. 1;

FIG. 3 is a schematic fragmentary perspective view, partly broken away, of a belt representing an alternative to the belt shown in the FIGS. 1–2 embodiment; and

FIG. 4 is a fragmentary top view of the belt shown in FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

This invention concerns apparatus for removing loose matter which has been deposited upon a doctor for doctoring a moving work surface. The invention finds particular utility when implemented for use with a doctor such as a dryer roll doctor in a papermaking system. In this application cleaning apparatus in accordance with this invention is effective to efficiently remove fines such as dust, fuzz, lint, small broke, and other loose matter which has accumulated on the doctor.

FIGS. 1–2 illustrate a doctor assembly **10** for cleaning a roll **12** which may, for example, be a Yankee dryer roll in a papermaking system. The doctor assembly **10** includes a doctor comprising a doctor back **14** supported for rotation on a shaft **16**. The doctor back **14** supports a blade holder comprising a top plate **18** and a bottom plate **20**. The blade holder supports a doctor blade **22** for engagement with the outer surface of roll **12**.

In the illustrated application the doctor functions to clean from the roll **12** paper dust, fuzz, lint, and other loose matter which has been deposited on the roll **12**. Any loose matter, even fine dust and lint, if not removed from the roll **12**, is apt to aggregate and produce imperfections in the end product which may degrade the value thereof.

It is well known that if the fines and other matter which accumulate on the doctor are not removed, the likelihood that such matter will escape the doctor and be picked up by the web is much greater. It is an object of this invention to provide apparatus for cleaning the

doctor assembly to remove such deposits of dust, lint, fuzz and other matter. In accordance with this invention a high strength suction port is established which is caused to scan the doctor assembly to periodically remove any such accumulated matter from each point on the doctor.

More particularly, in accordance with a preferred embodiment of this invention shown in FIGS. 1–2, we provide cleaning apparatus including a suction chamber **24** for connection to a source of vacuum (not shown). The suction chamber is illustrated as comprising essentially a box having an opening at one end which receives a vacuum pipe **28** connecting the chamber **24** with the vacuum source. The chamber **24** has a forward wall **30** defining an open mouth **32** which extends substantially along the full length of the doctor and, as shown, is disposed adjacent thereto.

In order to greatly increase the effective strength of the suction applied to points along the length of the doctor, a scanning suction port is established. In accordance with this invention, the scanning suction port comprises openings **34, 36** in a flexible air-impervious endless belt **38** which is driven such that the openings **34, 36** are caused in sequence to traverse the mouth **32** from one end to the other. In the illustrated embodiment the belt transport is continuous and unidirectional and is provided in part by a pair of guide reels **40, 42** disposed at opposite ends of the doctor. The reels **40, 42** guide the belt **38** along the face of the forward wall **30** on its operative traverse of the doctor and along a return path behind the suction chamber **24**. Guide reel **42** may, as illustrated, be driven by a motor **44**; guide reel **40** is here shown as being an idler.

As shown clearly in FIG. 2, the belt **38** is wider than the mouth **32** in the forward wall **30** and is so constructed and guided that when a vacuum exists in the chamber **24**, the belt **38** is in sealing engagement with the front surface of the forward wall **30**. The belt **38** may be composed of any of a great variety of flexible, air-impervious materials such as spring steel, or other suitable metals, rubber, glass-reinforced plastic, and the like.

The openings **34, 36** in the belt **38** are caused to each have an effective area which is small compared to the effective area of the mouth **32** of the suction chamber **24**, but larger than matter desired to be drawn into the chamber **24** and thereby removed from the doctor. By causing the effective area of each of the openings to be small compared to the effective area of the mouth **32**, the velocity of air drawn through the mouth **32** when a predetermined vacuum exists in the chamber **24** is substantially greater than would be the velocity of air drawn into the chamber through the mouth **32** absent the belt **38**. Apparatus constructed to implement the invention was found to work very satisfactorily with a ratio of areas of the mouth **32** to one of the belt openings **34, 36** of approximately 25 to 1; however, other ratios selected according to the teachings of this invention may be used with success. The velocity of air drawn into the suction chamber through the scanning openings **34, 36** is increased above what it would be if the mouth were open at all times by substantially the said ratio of areas. Using this information as a guide, the desired suction air velocity can be predetermined, within the limitations set by the suction pump capacity, by selecting the relative effective areas of the suction chamber mouth **32** and each of the openings **34, 36** in the belt **38**. In applications wherein it is desired to remove relatively large fines, it may be desirable to trade off effective suction strength (for a given suction pump capacity) for a larger belt opening area.

In the FIGS. 1–2 embodiment, the belt **38** is illustrated as having two openings **34, 36** so arranged so as to sequentially but not simultaneously traverse the suction chamber mouth **32**. It may be desirable in some applications to have more than one opening traversing the mouth **32** at a given time. However, consonant with the teachings of this invention the total effective area of all the openings traversing the doctor at a given time must be maintained small compared to the effecive area of the mouth **32** in order to effect the described high velocity air flow through the openings which is an important object of this invention.

It is not uncommon for a paper web to break as it is passing over the dryer roll **12**. In such event, the broken web, commonly termed "broke" is apt to jam in the doctor assembly. In accordance with another aspect of this invention, means are provided for deflecting such broke from the doctor assembly, and in particular from the doctor cleaning apparatus which might be jammed or otherwise damaged by such broke. As explained in detail below, by this invention, the same broke deflection means also acts to guide the flow of air drawn into the suction chamber such that entrainment of matter in the air flow is maximized.

In the illustrated FIGS. 1–2 embodiment the broke deflection and air guide means is illustrated as comprising a hood **46** supported by support means so as to extend from above the mouth **32** into contiguity with the surface of roll **12** (see especially FIG. 2). The support means is depicted as comprising pivotal mounting apparatus including a number of supports **50** which support a shaft **52**. A plurality of brackets **54** are affixed at one end to the hood **46** and at the other end have a sleeve **56** which is received on the shaft **52** for rotation thereon.

As suggested above, the hood **46** has a dual function. First, it acts to deflect broke which might otherwise jam in the doctor assembly, particularly in the doctor cleaning apparatus. Any broke that might enter beneath the hood **46** can easily be reached and removed by pivoting the hood **46** out of the way. Secondly, the air drawn into the suction chamber through the scanning suction ports (the openings **34, 36** in the belt **38**) is caused, to a substantial extent, to flow under the lip **58** of the hood **46** and over matter accumulated on the doctor, particularly the doctor blade **22**, in a direction transverse to the doctor, thus maximizing entrainment of matter in the air flow into the suction chamber **24**. Absent the hood **46**, a substantial amount of the air drawn into the suction chamber would enter from above the belt **38**, and would entrain very little of the matter desired to be inhaled into the suction chamber **24**.

FIGS. 3–4 illustrate another embodiment of the invention wherein a belt **60** having the general functions and operation of the belt **38** in the FIGS. 1–2 embodiment has also affixed thereto at spaced points along the belt sweeping means for removing from the doctor matter not susceptible of being drawn through the suction port or ports. More particularly, the FIGS. 3–4 belt **60** is illustrated as being composed of molded synthetic material such as rubber and having a generally V-shaped cross-section such that it may be transported by a pair of pulleys, one of which is shown at **62**. One of the pulleys **62** may be driven as depicted in the FIGS. 1–2 embodiment. The belt **60** defines one or more openings **66** having the same function and general specifications as the openings **34, 36** in the belt **38** in the FIGS. 1–2 embodiment

In the illustrated FIGS. 3–4 embodiment the sweeping means is shown as comprising a collection of brush bristles **64** carried by the belt **60**. Preferably, the bristles are captured in the belt **60** during the belt molding process. The operation of the FIGS. 3–4 embodiment is substantially as described above; however, the provision of sweeping means provides an additional function of removing matter from the doctor which is too large or too heavy to be inhaled through the scanning suction port or ports.

As shown in FIG. 3, a doctor blade **68** is disposed at the end of the doctor assembly in interfering relationship with the bristles **64** on the belt **60**, serving to clean matter from the bristles **64**. Rather than using a blade which acts to deflect and scrape the bristles **64**, a vacuum nozzle or a shower of steam, air, or water or any other suitable cleaning means, may be employed to remove matter

carried by the sweeping means. Rather than using bristles as the sweeping means, other sweeping means may be carried by the belt so as to extend into adjacency with the doctor to remove matter not susceptible of being inhaled into the suction chamber. In an application such as is shown in FIGS. 1–2 wherein bristles are used as the sweeping means, the bristles may be constructed and arranged to substantially fill the cavity formed between the hood **46** and the doctor to thereby gain access to all matter accumulated on the doctor.

The invention is not limited to the particular details of construction of the embodiments depicted, and it is contemplated that various and other modifications and applications will occur to those skilled in the art.

Therefore, because certain changes may be made in the above-described apparatus without departing from the true spirit and scope of the invention herein involved, it is intended that the subject matter of the above depiction shall be interpreted as illustrative and not in a limiting sense.

We claim:

1. For use with a doctor for doctoring a moving work surface, apparatus for removing air-entrainable matter deposited on the doctor, comprising:

suction chamber means for connection to a source of vacuum, said chamber means defining open mouth means extending along the length of the doctor and disposed adjacent thereto;

flexible air-impervious belt means having an opening therein;

guide means for guiding said belt means over said mouth means of said chamber means such that said belt means substantially seals said mouth means when a vacuum exists in said chamber means;

said opening in said belt means having an effective area which is small compared to the effective area of said mouth means but larger than matter desired to be drawn into said chamber and thereby removed from the doctor, whereby the velocity of air drawn through said mouth of said chamber means when a predetermined vacuum is present in said chamber means is substantially greater than would be the velocity of air drawn into said chamber means through said mouth means absent said belt means;

drive means for driving said belt means across said mouth means such that said opening is caused to scan said mouth means whereby to establish a scanning high suction port for inhaling and thereby removing loose matter collected on the doctor.

2. The apparatus defined by claim **1** including hood means supported by support means to extend from above said mouth means into contiguity with the surface being doctored such that air drawn into said opening in said belt means is caused to flow over the doctor and over matter accumulated thereon in a direction transverse to the doctor, said hood means maximizing entrainment of matter in the air flow and blocking access of large broke to said belt means.

3. The apparatus defined by claim **2** wherein said support means comprises a pivotal mount for said hood means.

4. The apparatus defined by claim **1** wherein said belt means is composed of spring steel.

5. The apparatus defined by claim **1** wherein said belt means is composed of rubber.

6. The apparatus defined by claim **1** wherein said belt is composed of glass-reinforced plastic.

7. For use with a doctor for doctoring a moving work surface such as a drying drum in a papermaking system, cleaning apparatus for removing dust, fuzz, and other air-entrainable matter deposited on the doctor, comprising:

a suction chamber for connection to a source of vacuum, said chamber defining an open mouth extending substantially along the full length of the doctor and disposed adjacent thereto;

a flexible air-impervious endless belt having an opening therein, said belt being wider than said mouth of said chamber;

guide means for guiding said belt over said mouth of said chamber such that said belt substantially seals said mouth when a vacuum exists in said chamber;

said opening in said belt having an effective area which is small compared to the effective area of said mouth but larger than matter desired to be drawn into said chamber and thereby removed from the doctor, whereby the velocity of air drawn through said mouth of said chamber when a predetermined vacuum is present in said chamber is substantially greater than would be the velocity of air drawn into said chamber through said mouth absent said belt;

drive means for driving said belt continuously and unidirectionally across said mouth such that said opening is caused to repetitively scan the full length of said mouth whereby to establish a scanning high suction port for inhaling and thereby removing loose matter collected on the doctor.

8. The apparatus defined by claim **7** including hood means supported by support means to extend from above said mouth into contiguity with the surface being doctored such that air drawn into said opening in said belt is caused to flow over the doctor and over matter accumulated thereon in a direction transverse to the doctor, said hood means maximizing entrainment of matter in the air flow and blocking access of large broke to said belt.

9. The apparatus defined by claim **8** wherein said support means comprises a pivotal mount for said hood means.

10. The apparatus defined by claim **9** wherein said belt means is composed of spring steel.

11. The apparatus defined by claim **9** wherein said belt means is composed of rubber.

12. The apparatus defined by claim **9** wherein said belt is composed of glass-reinforced plastic.

13. For use with a doctor for doctoring a moving work surface, cleaning apparatus for removing matter deposited on the doctor, comprising:

suction chamber means for connection to a source of vacuum, said chamber means defining open mouth means extending along the length of the doctor and disposed adjacent thereto;

flexible air-impervious belt means having an opening therein;

sweeping means affixed to said belt means and extending into contiguity with the doctor;

guide means for guiding said belt means over said mouth means of said chamber means such that said belt means substantially seals said mouth means when a vacuum exists in said chamber means;

said opening in said belt means having an effective area which is very small compared to the effective area of said mouth means but larger than matter desired to be drawn into said chamber and thereby removed from the doctor, whereby the velocity of air drawn through said mouth of said chamber means when a predetermined vacuum is present in said chamber means is substantially greater than would be the velocity of air drawn into said chamber means through said mouth means absent said belt means;

drive means for driving said belt means across said mouth means such that said opening is caused to scan substantially the full length of said mouth means whereby to establish a scanning suction port for inhaling and thereby removing small air-entrainable matter from the doctor, said sweeping means removing from the doctor matter not susceptible of being inhaled through said suction port.

14. The apparatus defined by claim 13 wherein said sweeping means comprises a collection of brush bristles carried by said belt means.

15. The apparatus defined by claim 14 wherein said belt means is of a molded construction and wherein said brush bristles are captured in said belt means during the belt molding process.

16. The apparatus defined by claim 15 including hood means supported by support means to extend from above said mouth means into contiguity with the surface being doctored such that air drawn into said opening in said belt means is caused to flow over the doctor and over matter accumulated thereon in a direction transverse to the doctor, said hood means maximizing entrainment of matter in the air flow and blocking access of large broke to said belt means.

17. The apparatus defined by claim 18 wherein said support means comprises a pivotal mount for said hood means.

18. Method for removing loose matter from a doctor, comprising:

providing a suction chamber having an open mouth extending lengthwise of the doctor and disposed adjacent thereto;

transporting a flexible belt along the length of the chamber mouth and in substantial sealing relationship therewith, the belt having an opening with an effective area which is small compared to the effective area of the chamber mouth but larger than matter desired to be drawn into the chamber and thereby removed from the doctor, the velocity of air drawn through the mouth of the chamber when a predetermined vacuum exists in the chamber being substantially greater than would be the velocity of air drawn into the chamber mouth absent the belt, whereby to establish a scanning high suction port for inhaling and thereby removing loose matter collected on the doctor.

19. Method for removing dust, fuzz, lint and other fines from a doctor for doctoring a drying drum in a papermaking system, comprising:

providing a suction chamber having an open mouth extending along the length of the doctor and disposed adjacent thereto;

transporting a flexible endless belt continuously and unidirectionally along the length of the chamber mouth and in sealing relationship therewith, the belt having an opening with an effective area which is small compared to the effective area of the chamber mouth but larger than matter desired to be drawn into the chamber and thereby removed from the doctor, the velocity of air drawn through the mouth of the chamber when a predetermined vacuum exists in the chamber being substantially greater than would be the velocity of air drawn into the mouth absent the belt, whereby to establish a scanning high suction port for inhaling and thereby removing fines collected on the doctor.

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U.S. Cl. X.R.

15—256.53, 308, 312 R; 162—199, 272; 134—6

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(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,687,730 Dated August 29, 1972

Inventor(s) WILLIAM M. MURPHY/NORMAN J. BEAUCHEMIN

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 6, line 71, after "scanning" insert --high--;
Column 7, claim 17, line 1, "claim 18" should be
--claim 16--.

Signed and sealed this 6th day of February 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents