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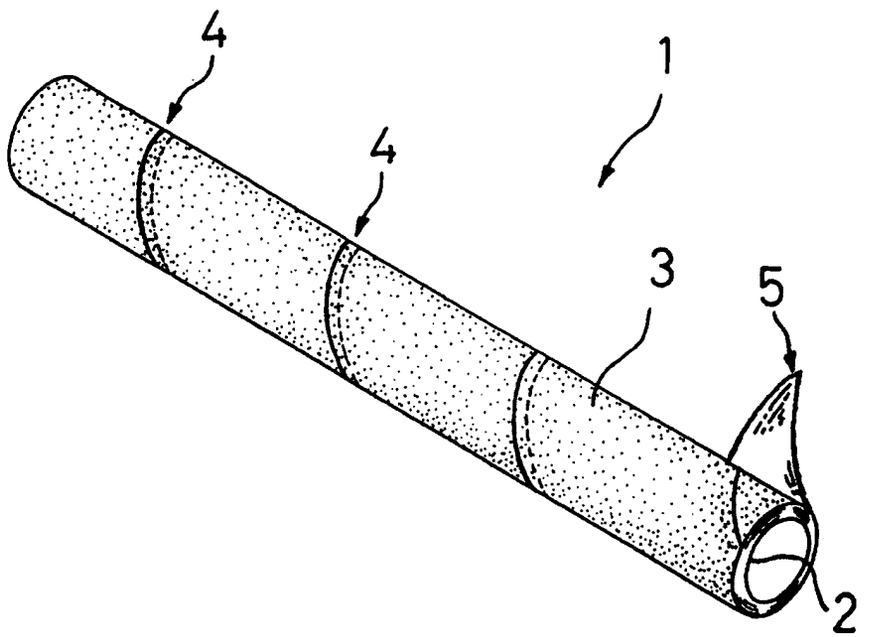
(54) Adhesive roll cleaner

(57) An adhesive roll cleaner (1) having single-sided adhesive sheets (3) helically wound around a core tube (2) with the adhesive side out, wherein the adhesive sheets (3) each have a tear strength of 500 mN or higher as measured with an Elmendorf tear tester according to JIS P8116(ISO 1974).

Fig. 1



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Description

[0001] The present invention relates to a roll type adhesive cleaner used to clean floors or rugs.

[0002] Cleaning tools having a roll type adhesive cleaner attached to a roll holder are known for removing dust such as hairs and fluffy debris clinging to piled surfaces of clothing, carpets, rugs, etc. The roll type adhesive cleaner is a single-sided adhesive sheet of continuous length circumferentially wound around a core into a roll. An adhesive cleaner of this type needs peeling off a dust-soiled part of the adhesive sheet to expose a fresh adhesive surface. When peeling, the soiled adhesive sheet is peeled apart over the whole width, folded with the soiled side inward, and torn off over the whole width by the hand. Therefore, the adhesive sheet must have low tear strength. Further, it is difficult and troublesome to tear the adhesive sheet neatly over the total width. Adhesive roll cleaners having cut adhesive sheets wound around a core into a roll are also known, which have been developed aiming at ease in removing a soiled adhesive sheet. Of this type of adhesive roll cleaners those having adhesive strips independently helically wound around a core are advantageous in that a user can easily remove a soiled adhesive sheet simply by picking up a sharp-pointed tip of the strip and helically unwinding. The adhesive sheet used in the adhesive roll cleaners of this kind has low tear strength similarly to the circumferential winding type.

[0003] If, as illustrated in Fig. 8, a long hair 31 circumferentially clings to an adhesive roll cleaner 30, cases are sometimes met with in which a soiled adhesive sheet 32 is torn at the hair 31 remaining clinging when it is peeled. If this happens, the peeling operation must be repeated to completely remove the soiled adhesive sheet. This inconvenience is common to general rolls of circumferentially wound adhesive sheet of continuous length and rolls of separate adhesive sheets wound either circumferentially or helically. In particular, since the helically wound adhesive sheet is peelable at a higher speed due to the ease in helically unwinding, it has a higher probability of being torn apart by a clinging long hair. The tendency of the adhesive sheet's being torn apart by a hair is especially conspicuous with a compact adhesive roll having a small roll diameter because of a possibly increased number of turns of a hair around the roll.

[0004] In an attempt to efficiently produce adhesive roll cleaners having a variable roll width (working width), JP-A-11-216096 proposes a method comprising winding continuous single-sided adhesive tapes helically around a core tube in an edge-to-edge configuration with the adhesive-coated surface outside. The adhesive roll cleaner produced by the method still has a possibility of an adhesive sheet's being torn apart when peeled off with a long hair circumferentially clinging thereto. Further, it is not easy to pick up the end of a soiled adhesive sheet to start peeling because there is no level difference (overlap) between adjacent turns. Furthermore, if a continuous adhesive tape should wobble from some cause when winding edge-to-edge, there will be produced gaps or laps between adjacent turns. In other words, it is difficult to edge-to-edge wind adhesive tapes in a stable manner.

[0005] An object of the present invention is to provide an adhesive roll cleaner which traps fibrous dust such as hairs, lint and fluff on piled surfaces such as rugs and carpets and, when soiled, is easily stripped of its uppermost soiled adhesive sheet to expose a fresh adhesive surface without tearing the soiled adhesive sheet due to the trapped dust, particularly circumferentially clinging hairs.

[0006] The above object is accomplished by an adhesive roll cleaner having single-sided adhesive sheets helically wound around a core tube with the adhesive side out, wherein the adhesive sheets each have a tear strength of 500 mN or higher as measured with an Elmendorf tear tester (hereinafter sometimes referred to as an Elmendorf tear strength) according to JIS P8116 (ISO 1974).

[0007] The present invention will be more particularly described with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view showing an embodiment of the adhesive roll cleaner according to the present invention;
Fig. 2 is a perspective view showing another embodiment of the adhesive roll cleaner according to the present invention;
Fig. 3 illustrates a method of measuring an unwinding peel strength;
Fig. 4 also illustrates the method of measuring an unwinding peel strength;
Fig. 5 shows an application of the adhesive roll cleaner shown in Fig. 1;
Fig. 6 shows another application of the adhesive roll cleaner shown in Fig. 1;
Fig. 7 is a side sectional view of Fig. 6; and
Fig. 8 is a perspective of a conventional adhesive roll cleaner.

[0008] The present invention will be described in detail based on its preferred embodiments with reference to the accompanying drawings. Fig. 1 is a perspective of an embodiment of the adhesive roll cleaner according to the present invention. The adhesive roll cleaner 1 is composed of a cylindrical core tube 2 and adhesive sheets 3 helically wound around the core tube 2. The adhesive sheet 3 is made of a base sheet having an adhesive applied all over one side thereof, which is referred to as a single-sided adhesive sheet. The other side of the adhesive sheet 3 has a release

finish against the tack. The adhesive sheet 3 is a wide strip having a prescribed width and wound around the core tube 2 with its adhesive side out. The width of the adhesive sheet 3 preferably ranges from 40 to 75 mm, particularly 45 to 65 mm, from the standpoint of ease in peeling off when soiled, and good productivity of the adhesive roll cleaner 1, while depending on a particular use of the adhesive roll cleaner 1.

[0009] The adhesive roll cleaner 1 is made up of n independent adhesive sheets 3 individually wound to form n layers. The adhesive sheet in direct contact with the core tube 2 (the undermost adhesive sheet) is adhered to the core tube 2 with a double-sided adhesive tape so that all the n adhesive sheets 3 may be made effective use of without waste. Taking convenience of use into consideration, the core tube 2 preferably has an inner diameter of 22 to 50 mm and a thickness of 1 to 2 mm. The adhesive sheets 3 are preferably wound around such a core tube to make a roll whose outer diameter is in a range of from 23 to 100 mm, particularly from 23 to 60 mm, throughout the use of the adhesive roll cleaner 1. From the standpoint of convenience of use, the width of the adhesive roll cleaner 1 is preferably 80 to 250 mm, still preferably 100 to 200 mm.

[0010] Each adhesive sheet 3 is lap-wound around the core tube 2 so that one of the edges thereof overlaps the other for each turn to form laps 4 of prescribed width. The laps 4 provide a level difference on both edges of each adhesive sheet 3, which makes it easy for a user to pick up the tip 5 of each adhesive sheet 3 in peeling off the sheet. In an adhesive roll cleaner of the type having adhesive sheets helically wound in an edge-to-edge configuration, it is not easy for a user to pick up the tip of each adhesive sheet because of the absence of such a level difference. An adhesive roll cleaner of the type in which an adhesive sheet is helically wound with a prescribed gap between adjacent turns is also known. This type of an adhesive roll cleaner has a level difference on both edges of the adhesive sheet like the adhesive roll cleaner of the present embodiment and therefore assures ease in picking up the tip of a soiled adhesive sheet to be peeled off. However, since dust is caught on the gaps, too, the dust remains in a helical pattern after a soiled adhesive sheet is peeled off. The width of the lap 4 in the present embodiment is decided from the balance between ease in picking the tip of the adhesive sheet 3 and effective utilization of the adhesive area. It is preferably 1 to 10 mm, still preferably 2 to 5 mm.

[0011] The adhesive sheets 3 are lap-wound in such a manner that the laps 4 of adjacent layers may not superpose on each other. With this configuration, when a user peels off a soiled adhesive sheet 3 to expose a fresh adhesive surface, the underlying adhesive sheet is effectively prevented from accompanying the sheet to be peeled (double peeling). To prevent double peeling more effectively, it is preferred that the tip of an adhesive sheet 3 be 30 to 60 mm, particularly 40 to 60 mm, distant from the tip of the underlying adhesive sheet as measured in the circumferential direction of the roll.

[0012] To prevent double-peeling still more effectively, it is preferred to form a low-adhesive area which is less tacky than the adhesive area or a non-adhesive area which has no adhesive applied on one or both lateral sides of the adhesive surface of the adhesive sheet 3 either continuously or discontinuously. The width of the low- or non-adhesive area is preferably 2 to 15 mm, still preferably 3 to 10 mm, for preventing double peeling while securing a sufficient effective cleaning area and also for assuring easy peelability even with a hair wound around (particularly effective where an about 10 cm long hair is clinging around). In the case of an adhesive roll cleaner having laps of prescribed width, the adhesive sheet preferably has a low- or non-adhesive area A on one lateral side thereof (the other side B being adhesive) as shown in Fig. 2, whereby double peeling due to adhesion between the upper adhesive sheet 3 and the underlying adhesive sheet 3' can be prevented effectively.

[0013] The adhesive sheet 3 has a tear strength of 500 mN or higher as measured with an Elmendorf tear tester according to JIS P8116(ISO 1974) (hereinafter referred to as "the specific tear strength"). The adhesive sheet having the specific tear strength is effectively prevented from being torn when soiled and peeled off even with a long hair or the like clinging therearound in the circumferential direction of the adhesive roll cleaner 1, and it is easy to expose a new adhesive surface. An Elmendorf tear strength of 800 mN or higher, especially 1100 mN or higher, is more effective to prevent tear of the adhesive sheet 3 due to a clinging hair. The upper limit of the tear strength is not particularly limited. The higher the tear strength, the more preventive for the adhesive sheet 3 from being torn due to a clinging hair. From the economical consideration, however, a preferred upper limit of the tear strength is about 100 N.

[0014] For effective prevention of the adhesive sheet 3 from being torn due to a clinging hair, it is preferred for the adhesive sheet 3 to have the specific tear strength in the direction perpendicular to the longitudinal direction of the adhesive sheet, i.e., the width direction of the adhesive sheet 3. The longitudinal direction of the adhesive sheet 3 as referred to in the present invention is the direction along the winding direction of the adhesive sheet 3.

[0015] The specific tear strength can be secured by, for example, appropriately selecting the materials and basis weights of the base sheet and the adhesive constituting the adhesive sheet 3. Materials of the base sheet include paper, plastic films, nonwoven fabric and like sheeting. Paper is preferred of them from the viewpoint of workability in applying an adhesive and helically winding the adhesive sheets 3 and the production cost.

[0016] In order for the adhesive shect having a paper base sheet to have the specific tear strength, the paper base sheet preferably has an Elmendorf tear strength of 350 mN or higher, particularly 500 mN or higher, especially 900 mN or higher, measured according to JIS P8116(ISO 1974). There is not a particular upper limit of the tear strength of the

base sheet. It is preferred for effectively preventing tear of the adhesive sheet 3 due to a clinging hair that the base sheet exhibits the above-recited tear strength particularly in the direction perpendicular to the longitudinal direction of the base sheet, i.e., the width direction of the base sheet.

[0017] The Elmendorf tear strength of the base sheet and the adhesive sheet are measured as follows.

(1) Method of measuring Elmendorf tear strength of base sheet

(a) Preparation of specimen and method of measurement

[0018] The procedure of JIS P8116(ISO 1974) is followed. In this particular measurement the tear strength of a base sheet in the width direction (CD) is measured. A plurality of test specimens 63 mm wide (in CD) and 75 mm long (in MD) cut out of a sample are stacked, with the release-finished side and the non-finished side facing each other, to give a measurement within an effective measurement range, which is between scale readings 0 gf and 100 gf, desirably 25 gf and 100 gf, on an Elmendorf tear tester. The stack of the specimens is secured between two clamps with the width direction (CD) of the specimens vertical and the longitudinal direction (MD) horizontal. A 20 mm long initial tear is vertically made at the middle of the MD from the lower edge of the stack by the cutter attached with the tester. The tester is operated according to JIS P8116(ISO 1974). On confirming complete vertical tear propagation in the CD, the load (gf) required for tearing is read. The measurement was quadruplicated for the same sample to ensure reproducibility.

(b) Data analysis

[0019] The resulting data are converted to an Elmendorf tear strength F of a stack of 16 specimens as specified in JIS P8116(ISO 1974) according to the following formula:

$$\text{Tear strength } F \text{ (mN)} = W \text{ (gf)}/n \times 16 \times g \text{ (m/s}^2\text{)}$$

where W (gf) is the reading of an Elmendorf tear tester; n is the number of specimens stacked; and g is an acceleration of gravity (=9.8 (m/s^2))

[0020] An average of the quadruplicate measurements is taken as the tear strength of the sample. Since the tear strength is a 16-specimens-equivalent value, it is believed that a difference of the number of specimens stacked for each sample has no influence on the results.

[0021] JIS P8116(ISO 1974) specifies a 63 mm wide specimen in the measurement of tear strength. In case the width of an actual specimen is less than 63 mm, the data obtained are normalized to a 63 mm width. More specifically, JIS P8116(ISO 1974) specifies that a 20 mm long initial tear be made in a 63 mm wide specimen so that the tear length may be 43 mm. If the width of an actual specimen is 50 mm for example, the actual tear length is (50-20) mm, i.e., 30 mm. Then, the tear strength as defined in JIS P8116(ISO 1974) is obtained by multiplying the measured tear strength by 43/30.

(2) Method of measuring Elmendorf tear strength of adhesive sheet

[0022] The tear strength of an adhesive sheet is measured in accordance with JIS 8116(ISO 1974) similarly to the base sheet. The number of specimens to be stacked and the manner of stacking the specimens are the same as for the base sheet. Where an adhesive sheet has an adhesive applied in a pattern as in Examples hereinafter given, specimens should be cut out so that at least the 43 mm width of the total 63 mm width (CD) other than the 20 mm width where an initial tear is made must be coated with the adhesive. Because of the adhesive applied, the specimens as such will stick to each other when stacked with the adhesive side and the releasable side facing each other. Because JIS P8116(ISO 1974) specifies that the stacked specimens must not stick together, the specimens need pretreatment for eliminating the tackiness of the adhesive. This can be done by uniformly applying silicone powder (KMP590, Lot 712180 from Shin-Etsu Chemical Co., Ltd.) to the adhesive surface with a 30 mm wide brush. Surface unevenness due to coating with silicone powder is suppressed to some extent by use of a brush. The amount of silicone powder to be applied is such that the adhesive-coated side of the adhesive sheet gets tack-free as ascertained by applying finger pressure. As the pretreatment is intended to eliminate the tack of the adhesive sheet, any other commercially available powder may be used for the pretreatment. Such a powder that results in increased surface unevenness when applied with a finger should be avoided.

[0023] The tear strength of paper can be heightened by, for example, (i) increasing the total number of fibers participating in breakage of the sheet or (2) selecting the kind of the pulp (e.g., length or thickness of the fibers). In the

method (1), the total number of fibers participating in breakage of the sheet is decided by the basis weight of paper and flexibility of the sheet. Paper with a larger basis weight or paper with higher flexibility has a greater total number of fibers participating in the sheet breakage and exhibits a higher tear strength. Methods for increasing flexibility of paper include Clupak processing and creping. In the method (2), paper comprising pulp fibers having a long fiber length, pulp fibers having a thick diameter, pulp fibers having a considerably thick fiber wall, or like pulp fibers in a larger proportion exhibits higher tear strength. The work of tearing paper involves the work of drawing fibers from paper and work of breaking the fibers. The work necessary to draw the fibers is far greater than the work necessary to break the fibers. Accordingly, soft wood pulp having a long fiber length is preferred. Of soft wood pulp kinds, those with a longer fiber length are more effective to increase the tear strength. Tear strength of paper can also be improved by making paper from wood pulp mixed with other fibers such as glass fiber or by adding an elastic polymer such as synthetic rubber. However, use of pulp fiber having a long fiber length or an increase of the basis weight results in increased paper stiffness, and it would follow that the resulting adhesive sheet 3 is difficult to wind helically around the core tube 2. From these considerations it is preferred that paper to be used as a base sheet be soft paper having flexibility particularly in the winding direction, i.e., the longitudinal direction of the adhesive sheet. Such paper includes the above-described Clupak-processed extensible paper. Paper used as a base sheet preferably has a basis weight of 40 to 200 g/m^2, particularly 50 to 100 g/m^2.

[0024] Tear strength of paper can also be enhanced by laminating with a synthetic resin film either by extrusion or bonding. In this case, the thickness (e.g., 25 μm or greater) of the resin film or the kind of the laminating resin should be selected appropriately.

[0025] The adhesives which can be applied to the base sheet include hot melt-adhesives, solvent type adhesives, and aqueous adhesives. The hot melt adhesives include styrene adhesives and olefin adhesives. The solvent type adhesives include styrene type, olefin type and acrylic type adhesives. The aqueous adhesives include acrylic adhesives. The adhesive is preferably applied to a coating weight of 5 to 50 g/m^2, particularly 10 to 50 g/m^2, for securely catching and holding dust such as hairs and bread crumb.

[0026] Release agents which can be used for release finish include long-chain alkyl acrylate copolymers, long-chain alkyl vinyl ester copolymers, long-chain alkyl vinyl ether copolymers, long-chain alkyl acrylamide copolymers, maleic acid long-chain alkyl derivative copolymers, long-chain alkyl allyl ester copolymers, a long-chain alkyl ester of cellulose or polyvinyl alcohol (PVA) obtained by reacting $C_{17}H_{35}COCl$ on the hydroxyl group of the polymer, a long-chain alkyl carbamate of cellulose or PVA obtained by reacting $C_{18}H_{37}NCO$ on the hydroxyl group of the polymer, polyethyleneimine derivatives, long-chain alkylamides obtained by copolymerizing maleic anhydride and vinyl acetate and reacting the copolymer with $C_{18}H_{37}NH_2$ (long-chain alkylamine) and a maleic anhydride unit, perfluoroalkyl-containing compounds, silicone compounds, chromium-containing compounds, long-chain alkyl compound/polymer blends, long-chain alkyl-free low-adhesive polymers (e.g., acrylonitrile-1,1-dichloroethene copolymers, acrylonitrile-ethyl acrylate copolymers, and a combination of an acrylonitrile-acrylic ester (or methacrylic acid) copolymer and an aldehyde resin), and titanium compounds. Of these release agents the long-chain alkyl-free low-adhesive polymers and the titanium compounds are effective only on acrylic or silicone type adhesives.

[0027] The unwinding peel strength (hereinafter defined) of these release agents can be adjusted by controlling the surface energy. The surface energy of the long-chain alkyl-containing release agents can be adjusted by the proportion of the long-chain alkyl-containing monomer unit in the total polymer. The surface energy of the perfluoroalkyl-containing compounds can be adjusted by the fluorine content. The unwinding peel strength is also adjustable by the amount of the release agent to be used. In the case of adhesive sheets using kraft paper as a base sheet, the release agent is preferably chosen with due considerations for adhesion to kraft paper and the composition of the adhesive. Silicone release agents are usually used for polyethylene-laminated paper. Solvent type silicone release agents are frequently used so as to prevent the release agent from migrating to the adhesive layer. The unwinding peel strength of silicone release agents can be controlled by adjusting the amount of the release agent to be applied, altering the composition of the organic groups bonded to the silicon atoms (for example, a methyl group is changed to other alkyl groups), or adjusting the degree of polymerization.

[0028] It is preferred for the adhesive sheet 3 as wounded around the core tube 2 to have an unwinding peel strength of 100 to 2000 mN/50 mm, particularly 200 to 1200 mN/50 mm, as measured between an adhesive side entirely coated with an adhesive and its reverse (releasable side). Within the preferred unwinding peel strength range, an adhesive sheet 3 in a state helically wound around a relatively small-diametered core tube is prevented from lifting from an underlying adhesive sheet 3. Within the preferred unwinding peel strength range, an adhesive sheet 3 to be peeled off is prevented from causing material failure of the underlying adhesive sheet 3 due to delamination, and ease of peeling is assured. With the formulation of the release agent and the kind or formulation of the adhesive being unchanged, the unwinding peel strength increases with an increase in amount of the adhesive applied and decreases with a decrease in amount of the adhesive applied. With the kind and. the amount of the adhesive being unchanged, the unwinding peel strength can be adjusted by modifying the release agent formulation.

[0029] The unwinding peel strength is measured as follows.

(a) Preparation of specimen

[0030] An adhesive sheet is cut to prepare a 50 mm wide (CD) and 280 mm long (MD, winding direction) piece 30 as illustrated in Fig. 3. Where an adhesive sheet has a adhesive applied in a pattern, the piece 30 should be cut out from the portion all over coated with the adhesive. A 50 mm wide (CD) and 130 mm long (MD) piece is cut out of the same adhesive sheet and stuck to a 100 mm wide and 130 mm long stainless steel support 31 with its release side out (not shown). A length of 110 mm of the piece 30 is stuck, on its adhesive side, to the piece on the support 31 with the end of the former even with one end of the latter as shown in Fig. 3. A load is applied to the stuck area by giving two double strokes of a 1 kg rubber roller to prepare a specimen. Seven specimens are prepared for each sample. The specimens prepared are conditioned at 23°C and 50% RH for 1 hour before measurement.

(b) Method of measurement

[0031] An unwinding peel strength of the specimen is measured with a tensile tester in 180° peeling at a pulling speed of 6.5 m/min. To realize such high-speed peeling, a tensile tester (Tensilon) supplied by Orientec Co., Ltd. fitted with a positioning actuator 32 supplied by Koganei Corp. is used as shown in Fig. 4. The starting position and the stopping position of the actuator 32 are inputted in the actuator 32. The starting position is such that the contact between the two adhesive sheets over 110 mm is maintained, and the stopping position is such that the upper adhesive sheet 30 is completely peeled off the lower adhesive sheet 33. These positions are decided from the timing for operating the actuator 32 after operating the load cell 34 of the tensile tester. The decision for positioning may vary according to an operator but does not affect the measurement data. The support 31 having the specimen (the adhesive sheets 30 and 33) on is attached to the load cell 34, and the free end of the adhesive sheet 30, which is above the actuator 32, is secured between the clamps of the actuator 32. After the load cell 34 is moved upward at a speed of 500 mm/min, the actuator 32 is moved downward at a speed of 6m/min to thereby produce a pulling speed of 6.5 m/min. The reading of the load cell 34 after the operation of the. actuator 32 is taken as an unwinding peel strength. The measurement was repeated 7 times by using the 7 specimens for each sample.

(c) Data analysis

[0032] The load on the load cell steeply rises for the movement of the load cell immediately after the actuator operates and then almost plateaus. The plateau shows amplitude of about ±100 mN. The average of five highest peaks of the amplitude is obtained for each specimen, and the average of the seven specimens was taken as an unwinding peel strength of the sample.

[0033] The adhesive sheet 3 preferably has a bending length of 70 mm or less, particularly 50 mm or less, measured with its adhesive side up by means of a cantilever tester in accordance with JIS L1085(ISO 9073-7), except that the inclination angle of a specimen with the horizontal, at which the bending length is measured, is changed from 41.5° as specified by JIS L1085(ISO 9073-7) to 45° (hereinafter sometimes referred to as a cantilever bending length). The above recited bending length is favorable to a user in peeling a soiled adhesive sheet 3 to expose a new adhesive surface and to a manufacturer in helically winding an adhesive sheet 3 around a relatively small-diametered core tube without causing the adhesive sheet to float or lift. The recited bending length is particularly preferred in using a core tube having a diameter of 30 mm or smaller. A bending length falling in the above range can be achieved by using a base sheet with relatively low stiffness. Considering that a base sheet should have a relatively high tear strength as stated above, it should be noted, however, that too low stiffness of a base sheet, which conflicts with tear strength, is not advantageous. The bending length of the base sheet itself is preferably 85 mm or less, still preferably 70 mm or less.

[0034] While it is sufficient that the above-recited bending length of the adhesive sheet 3 is exhibited in either CD or MD, it is preferred that the recited bending length be exhibited in the MD to further improve the workability in helical winding. In this regard, Clupak-processed extensible paper is a preferred base sheet in that it has a smaller bending length in the MD and a larger tear strength in the CD as a result of its processing.

[0035] The adhesive sheet 3 preferably has a rolling ball tack of 11 to 30, particularly 12 to 25, especially 14 to 25, on its adhesive side as measured in accordance with JIS Z0237-2000. With this tack, the adhesive sheet 3 shows sufficient dust holding power and is free from such an inconvenience that the tack reduces on adhesion of a small amount of dust. With a rolling ball tack of 11 or greater, even though the roll cleaner 1 has a reduced outer diameter to have a reduced lateral surface area, it sustains cleaning performance over a sufficient area of an object such as floor to be cleaned. With a rolling ball tack of 30 or smaller, the adhesive roll cleaner 1 assures satisfactory manageability in use. If the rolling ball tack of the adhesive sheet exceeds 30, the adhesive roll cleaner 1 can pluck piles to damage carpets, etc. when used as attached to a direct contact type cleaning tool as shown in Fig. 5 (hereinafter described), or the adhesive roll cleaner 1 tends to be so sticky to user's hand, etc. to impair manageability when used as attached to an indirect contact type cleaning tool as shown in Figs. 6 and 7.

[0036] The rolling ball tack according to JIS Z0237 is measured with a ball rolling tool as follows. A specimen cut out of an adhesive sheet sample is set (the adhesive side up) on an inclined plate of the ball rolling tool, and balls of increasing sizes are rolled one by one at a specified position above the specimen. Balls of 31 sizes from 1/16 to 16/16 except 5/64, 7/64, 9/64, 15/64, and 17/64 of nominal diameter specified in JIS B1501 (a 32 multiple of the nominal size is called a ball number) are used (first rolling). The biggest ball adhered on the specimen, a ball one size bigger than that biggest one, and a ball one size smaller than that biggest one are again rolled (second rolling) to confirm that the biggest ball adhered on the specimen in the first rolling is really the biggest one meeting the specification of measurement. The tack of the specimen is represented by the ball number of the biggest ball adhered on the specimen. An average of triplicate runs is taken as the rolling ball tack of the sample according to JIS Z0237.

[0037] The kind and the amount of the adhesive applied to the base sheet are selected so that the rolling ball tack may fall within the above-recited range. Use of styrene-based hot-melt adhesives will make it easy to obtain a rolling ball tack within that range.

[0038] The styrene-based hot-melt adhesives preferably comprise a base polymer, a tackifier, a softener, and an antioxidant. The base polymer includes styrene-butadiene rubber (SBR), a styrene-butadiene-styrene block copolymer (SBS), a styrene-isoprene-styrene block copolymer (SIS), a styrene-ethylene-butylene-styrene block copolymer (SEBS), and a styrene-ethylene-propylene-styrene block copolymer (SEPS). The base polymer is usually used in an amount of 10 to 100 parts by weight per 100 parts by weight of the total of the tackifier and the softener.

[0039] The tackifier includes C_5 monomer-based petroleum resins, C_9 monomer-based petroleum resins, dicyclopentadiene-based petroleum resins, rosin-based petroleum resins, polyterpene resins, and terpene phenol resins. The tackifier is usually used in an amount of 50 to 90 parts by weight per 100 parts by weight of the total of the tackifier and the softener.

[0040] The softener includes process oil, mineral oil, various plasticizers, polybutene, and liquid tackifying resins, each having a softening point of 10°C or lower and an average molecular weight of 200 to 700. It is usually used in an amount of 10 to 50 parts by weight per 100 parts by weight of the total of the tackifier and the softener.

[0041] The antioxidant includes phenol antioxidants, amine antioxidants, phosphorus antioxidants, and benzimidazole antioxidants. It is usually used in an amount of 0.5 to 3 parts by weight per 100 parts by weight of the total of the tackifier and the softener.

[0042] The hot-melt adhesive can contain other components commonly used in adhesives.

[0043] It is preferred for the adhesive sheet 3 be white for visualizing collected dust so that a user may judge whether the adhesive sheet should be peeled off. To this effect, non-white paper having a release finish as a base sheet may be coated with a white coating on the side to be coated with an adhesive, or bleached white paper having a release finish is used as a base sheet. Use of bleached white paper is desirable for production simplification.

[0044] The adhesive roll cleaner according to the present embodiment can be used as attached to a conventional J-roller holder as shown in Fig. 5 (direct contact type) or a cleaning tool shown in Figs. 6 and 7 (indirect contact type). The cleaning tool 10 of Figs. 6 and 7 has a brush roll 16 and a driving roll 18 which are disposed in parallel to each other and rotatably supported by a frame 15, and an adhesive roll 21 which bridges between the brush roll 16 and the driving roll 18, wherein the adhesive roll cleaner according to the present embodiment is used as the adhesive roll 21. The cleaning tool 10 will be described in more detail.

[0045] The cleaning tool 10 comprises a handle 11, a supporting arm 13 which is laterally pivotably connected to the tip of the handle 11 via a joint 12, and the flame 15 which is pivotably connected to the side arms 13A of the supporting arm 13 through pivots 14 so as to swing back and forth.

[0046] The brush roll 16 is rotatable on its rotating shaft 17 and supported in front of the flame 15. The driving roll 18 is rotatable on its rotating shaft 19 and supported in the rear of the flame 15. The brush roll 16 and the driving roll 18 are in parallel to each other. The brush roll 16 is composed of a tire 16B and bristle 16A having a long diameter than the tire 16B. The driving roll 18 has an elastic surface. For example, a silicone roll is used as the driving roll 18. The driving roll 18 may have ribs on its surface.

[0047] The adhesive roll 21 is disposed to bridge between the brush roll 16 and the driving roll 18 and rotates on its axis accompanying the rotation of the brush roll 16 and the driving roll 18. There is an opening in the upper part of the frame 15, through which the adhesive roll 21 is loaded and unloaded. The opening is covered with a removable transparent cover 22.

[0048] A dust scooper 23 is supported at the back of the brush roll 16 in the flame 15. The dust scooper 23 has a bottom 23A which is brought into contact with a floor (carpets and rugs) and a scoop 23B having a curved or flat surface which faces the brush roll 16 with or without a gap. The dust scooper 23 has a flat projection 23C on both ends thereof and is vertically movably attached to both sides of the flame 15 with the projections 23C engaged with each rectangular hole 24 of the flame 15 which slants backward from the vertical. The dust scooper 23 is adapted to move upward with the projections 23C sliding up in the rectangular holes 24 and move downward by its own weight so that the bottom 23A and the front edge of the scoop 23B always come into contact with a floor. As a result, all the dust scraped by the bristle 16A of the brush roll 16 can be guided to the adhesive roll 21 by the scoop 23B without fail.

[0049] Cleaning operation with the cleaning tool 10 is carried out as follows. (1) A force is applied in the axial direction of the handle 11 to move the cleaning tool 10 forward on a floor to thereby rotate the tire 16B of the brush roll 16 and the contact roll 18. The adhesive roll cleaner 21 in contact with the driving roll 18 also rotates. (2) Dust is scraped off the floor by the bristle 16A of the brush roll 16, guided by the scoop 23B of the dust scooper 23 to the adhesive roll 21, and adhered to the rotating adhesive roll 21. (3) The dust adhered to the rotating adhesive roll 21 is carried to the driving roll 18, pressed by the driving roll 18 and secured to the adhesive surface of the adhesive roll 21. (4) After the adhesive surface of the adhesive roll 21 is saturated with dust, which can be visually confirmed through the transparent cover 22, the cover 22 is opened to taken out the adhesive roll 21. The outermost soiled adhesive sheet is peeled off to expose a fresh adhesive surface. The adhesive roll is again set on the brush roll 16 and the driving roll 18, and the cover 22 is closed. Because the cleaning tool 10 is capable of moving back and forth, the dust caught on the driving roll 18 is picked up by the adhesive roll 21 when moving backward. The rear edge of the bottom 23A of the dust scooper 23 is rounded so as to prevent the rear edge from being caught up by the pile of a carpeted floor, etc.

[0050] The present invention is not limited to the above-described embodiments. For example, while in the embodiments described the adhesive sheet 3 is wound around the core tube 2 with laps 4 between adjacent turns, it may be wound with gaps between adjacent turns or in an edge-to-edge configuration. As previously stated, the most preferred winding configuration is lap-winding, though.

[0051] The present invention will now be illustrated in greater detail with reference to Examples. The following Examples are presented as being exemplary of the present invention and should not be construed as limiting.

EXAMPLE 1

[0052] Bleached kraft paper of continuous length (purchased from Chuetsu Pulp & Paper Co., Ltd.; basis weight: 50g/m^2; Elmendorf tear strength in CD: 372 mN; cantilever bending length in MD: 63 mm) was laminated with polyethylene (15 μm), and a silicone release agent was applied to the polyethylene side to prepare a base sheet. The non-finished side of the base sheet was coated with 36 g/m^2 of a styrene-isoprene-styrene block copolymer (SIS) hot-melt adhesive to obtain a single-sided adhesive sheet. The adhesive was applied in a 45 mm wide stripe pattern leaving a 5 mm width between adjacent stripes uncoated. The resulting adhesive sheet had a cantilever bending length of 30 mm in MD as measured on a specimen cut out of the adhesive-coated area. The adhesive sheet has an Elmendorf tear strength of 540 mN in the CD as measured on specimens cut out of the adhesive-coated area so that at least the area torn by the tear tester was in the adhesive-coated area. The sheet was slit into 50 mm wide strips each having a 5 mm wide non-adhesive area on one side thereof, and the resulting adhesive strips were each taken up into roll. Twenty adhesive strips were successively helically wound around a paper core tube having an inner diameter of 1 inch and a thickness of 1.2 mm with the adhesive side out in such a manner that the non-adhesive area overlaps the adhesive area to form 3 mm wide laps between adjacent turns. The resulting roll, the outer diameter of which reached 35 mm, was cut to lengths of 195 mm to obtain adhesive roll cleaners (roll width: 195 mm) shown in Fig. 2.

EXAMPLE 2

[0053] A side of bleached kraft paper of continuous length (purchased from Oji Paper Co., Ltd.; basis weight: 70 g/m^2; Elmendorf tear strength in CD: 810 mN; cantilever bending length in MD: 71 mm) was given a release finish in the same manner as in Example 1, and the opposite side of the paper was coated with an SIS adhesive in the same manner as in Example 1. The resulting adhesive-coated sheet had a cantilever bending length of 53 mm in MD and an Elmendorf tear strength of 1035 mN in the CD as measured in the same manner as in Example 1. The sheet was processed in the same manner as in Example 1 to obtain adhesive roll cleaners shown in Fig. 2.

EXAMPLE 3

[0054] An adhesive-coated sheet and adhesive roll cleaners were prepared in the same manner as in Example 2, except for changing a release agent formulation so as to give a higher unwinding peel strength than the release agent used in Example 2. The adhesive-coated sheet had a cantilever bending length of 53 mm in MD and an Elmendorf tear strength of 1035 mN in the CD as measured in the same manner as in Example 1.

EXAMPLE 4

[0055] Bleached kraft extensible paper of continuous length (purchased from Oji Paper Co., Ltd.; basis weight: 75 g/m^2; Elmendorf tear strength in CD: 1362 mN; cantilever bending length in MD: 60 mm) was given release finish in the same manner as in Example 1 to prepare a base sheet. The non-finished side of the base sheet was coated with 30 g/m^2 of an SIS hot-melt adhesive in a 55 mm wide stripe pattern leaving a 5 mm width between adjacent stripes

uncoated. The resulting adhesive sheet had a cantilever bending length of 37 mm in MD as measured on a specimen cut out of the adhesive-coated area. The adhesive sheet has an Elmendorf tear strength of 1385 mN in the CD as measured on specimens cut out of the adhesive-coated area so that at least the area torn by the tear tester was in the adhesive-coated area. The sheet was slit into 60 mm wide strips each having a 5 mm wide non-adhesive area on one side thereof, and the resulting adhesive strips were each taken up into roll. Adhesive roll cleaners shown in Fig. 2 were produced by using the adhesive strips in the same manner as in Example 1.

COMPARATIVE EXAMPLE 1

[0056] A side of glassine paper of continuous length (basis weight: 38 g/m^2) was given a release finish in the same manner as in Example 1 to prepare a base sheet. An SIS adhesive was applied to the non-finished side to a coating weight of 40 g/m^2 in the same pattern as in Example 1. The resulting adhesive sheet had a cantilever bending length less than 15 mm in MD and an Elmendorf tear strength of 290 mN in the CD as measured in the same manner as in Example 1. The sheet was processed in the same manner as in Example 1 to obtain adhesive roll cleaners shown in Fig. 2.

COMPARATIVE EXAMPLE 2

[0057] A commercially available adhesive roll, Lint Pic-up Adhesive Roller from Helmac Products Co. was examined. The adhesive roll has a width of 8 inch and is made up of 36 adhesive strips of 78 mm in width each helically wound around a paper core tube having an inner diameter of 1.5 inch and a thickness of 1 mm with their adhesive side out and 5 mm wide gaps between adjacent turns to build up a roll of 47 mm in outer diameter. The adhesive sheet had a cantilever bending length of 38 mm in MD and an Elmendorf tear strength of 370 mN in CD.

Evaluation of performance:

[0058] The unwinding peel strength and the rolling ball tack of each adhesive roll cleaner of Examples and Comparative Examples were measured according to the methods previously described. Further, the winding capabilities of the adhesive sheet were rated according to the following standard. Furthermore, hair collecting performance of each adhesive roll cleaner as attached to an indirect contact cleaning tool and peelability of the adhesive sheet with hairs clinging thereto were evaluated in accordance with the methods described below. The results obtained are shown in Table 1.

Standard of rating winding capabilities:

[0059]

A: The adhesive sheet was wound stably.
B: Floating or lifting of the adhesive sheet occurred.
C: The adhesive sheet was incapable of winding.

Hair collecting performance with indirect contact type cleaning tool:

[0060] A 50 cm by 50 cm cut pile rug (San Harmony, available from Sangetsu Co., Ltd.; made of 85% acrylic fiber and 15% nylon fiber; pile length: 8 mm; gauge: 1/10"; stitch per inch: 14.5) was cleaned with a vacuum cleaner having a rotating brush in a "carpet mode". Ten human hairs of 10 cm in length were scattered uniformly over the vacuumed rug. The adhesive roll cleaner having absolutely no dust on was loaded on the cleaning tool shown in Figs. 6 and 7 (an indirect contact type in which the adhesive sheet does not come into direct contact with a surface to be cleaned), and the rug was rubbed with the cleaning tool back and forth 5 times (5 double strokes). A percentage of the number of the hairs caught on the adhesive sheet to the total number of scattered hairs (10) was calculated as a measure of hair collecting performance. The test was carried out three times to obtain an average percentage. The adhesive. roll cleaner of Comparative Example 2 is too small to load on the cleaning tool shown in Figs. 6 and 7. Thus, a modified roll cleaner was prepared by the following manner. First, the adhesive sheet was unwound from the roll cleaner of Comparative Example 2 and then slit into a 50 mm wide strip. Then, the strip was wound in the same manner as in Example 1 around a paper core having an inner diameter of 1 inch to obtain a modified roll cleaner having an outer diameter of 35 mm and a width of 195 mm.

Peelability of adhesive sheet with clinging hairs:

[0061] Ten human straight hairs of 10 cm in length and 70 to 100 μm in diameter were circumferentially wound around the adhesive roll at 15 mm intervals in the width direction of the roll. The adhesive roll cleaner was attached to a J-roll holder (supporting axis diameter: 24 mm) shown in Fig. 4. The rug which is the same as used in evaluating hair collecting performance was rubbed with the cleaning tool back and forth 5 times (5 double strokes). Then, the winding end of the outermost adhesive strip was picked up between fingers, and the sheet was peeled off at a speed of 70 to 120 mm/sec. Where the adhesive roll cleaner is not of helical wound type, either of lateral side comer was picked up. The same test was repeated but by using 20 cm long hairs. The peelability of the adhesive sheet was rated based on the following standard.

A: The adhesive strip was easily peeled without being torn.
B: The adhesive strip was partially torn by the hairs along its width direction once or twice but peeled with no problem.
C: The adhesive strip was torn by the hairs along its width direction once or twice but was peelable.
D: The adhesive strip was torn by the hairs many times and was difficult to peel.

TABLE 1

			Example 1	Example 2	Example 3	Example 4	Comparative Example 1	Comparative Example 2
Base Sheet Material	Kind		bleached kraft paper			bleached extensible paper	glassine paper	-
	Basis Weight (g/m^2)		50	70		75	38	-
Adhesive Sheet	Adhesive Coating Weight (g/m^2)		36	36		30	40	-
	Basis Weight (g/m^2)		106	125		122	72	87
	Tear Strength (mN)		540	1035		1385	290	370
	Bending Length (mm)		30	53		37	<15	38
	Unwinding Peel Strength (mN/50 mm)		570	360	1050	500	600	150
	Rolling Ball Tack		20	20		20	20	4
Adhesive Roll	Winding Capabilities		A	B	A	A	A	A
	Hair Collecting Performance (%)		100	100	100	100	100	20
	Peelability with Clinging Hair Length of:	10 cm	B	B	B	A	D	Hair did not cling.
		20 cm	C	B	B	A	D	D

[0062] As is apparent from the results shown in Table 1, the adhesive sheet of the adhesive roll cleaners of Examples is effectively prevented from being torn by clinging hairs when peeled off to expose a fresh adhesive surface. The adhesive tape of Comparative Example 2 (commercially available product) failed to hold 10 cm long hairs due to its weak adhesiveness, which was verified by its rolling ball tack as low as 4. Assuming that the adhesive tape of Comparative Example 2 exhibited a rolling ball tack of 10 or greater, the peelability would be rated "D".

[0063] As demonstrated, the adhesive roll cleaner of the present invention is capable of securely catch up fibrous dust, such as hairs lint and fluff, and is easily stripped of its soiled uppermost adhesive sheet to expose an intact adhesive sheet without causing the adhesive sheet from being torn when peeled.

[0064] The invention having been thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

[0065] This application claims the priority of Japanese Patent Application Nos. 2001-320446 filed October 18, 2001 and 2002-266600 filed September 12, 2002, which are incorporated therein by reference.

Claims

1. An adhesive roll cleaner having single-sided adhesive sheets helically wound around a core tube with the adhesive side out, wherein said adhesive sheets each have a tear strength of 500 mN or higher as measured with an Elmendorf tear tester according to JIS P8116(ISO 1974).

2. The adhesive roll cleaner according to claim 1, wherein said adhesive sheets each have a bending length of 70 mm or shorter as measured with a cantilever tester according to JIS L1085(ISO 9073-7).

3. The adhesive roll cleaner according to claim 1 or 2, wherein said adhesive sheets as wounded around said core tube each have an unwinding peel strength of 100 to 2000 mN/50 mm as measured between the releasable side and the adhesive side thereof.

4. The adhesive roll cleaner according to claim 1,2 or 3, which is adapted to be loaded in a cleaning tool comprising a brush roll and a driving roll disposed in parallel with each other and rotatably supported by a frame, wherein said adhesive roll is disposed to bridge between said brush roll and said driving roll.

Fig. 1

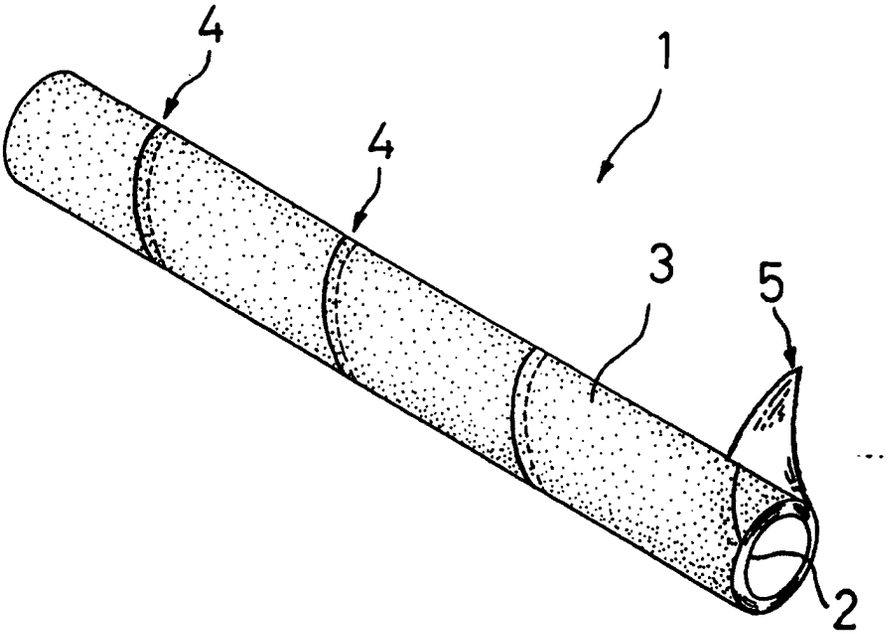

Fig. 2

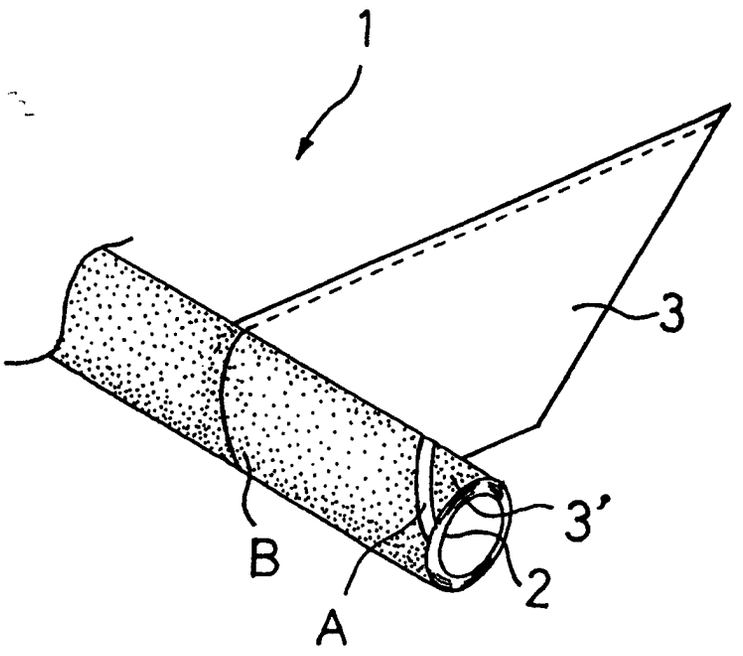

Fig. 3

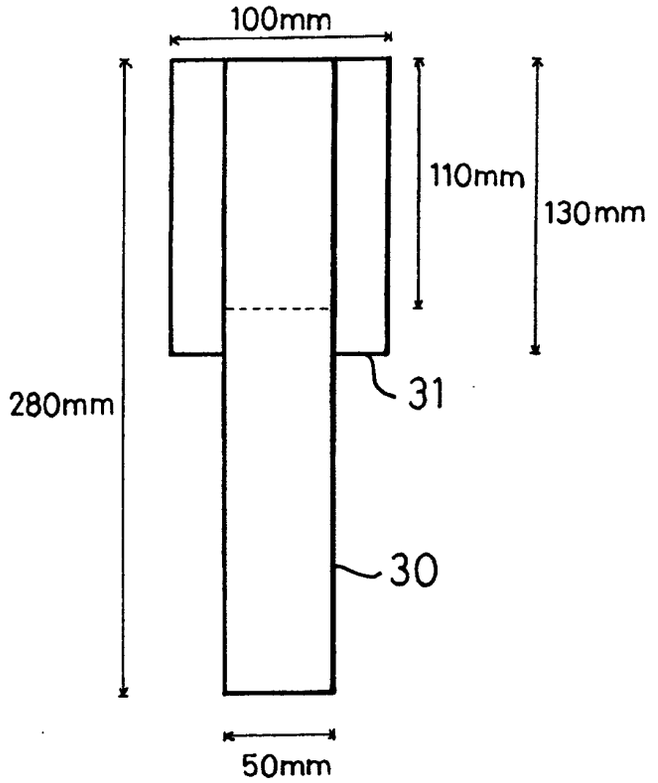

Fig. 4

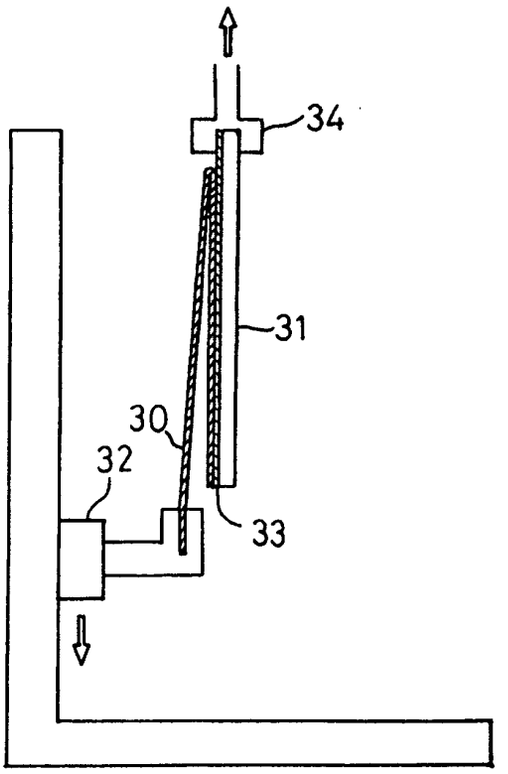

Fig. 5

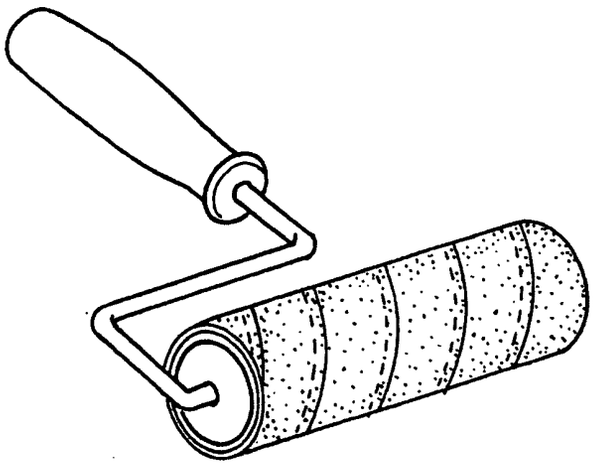

Fig. 6

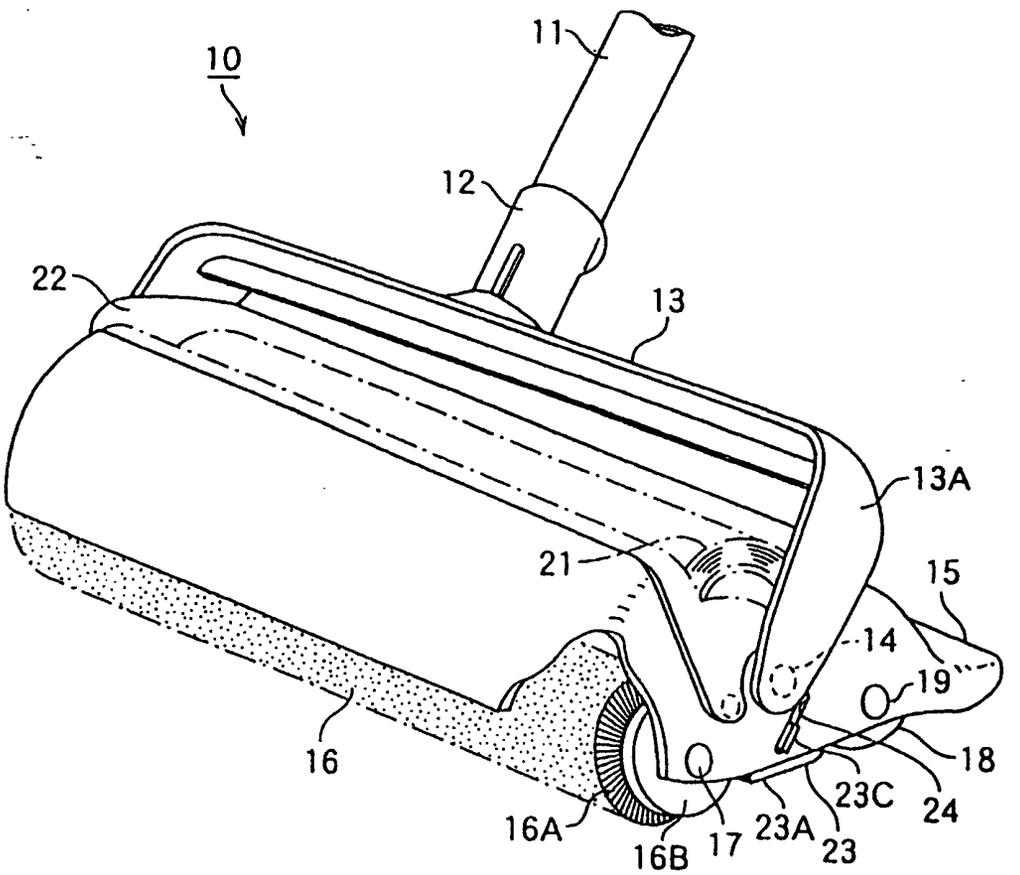

Fig. 7

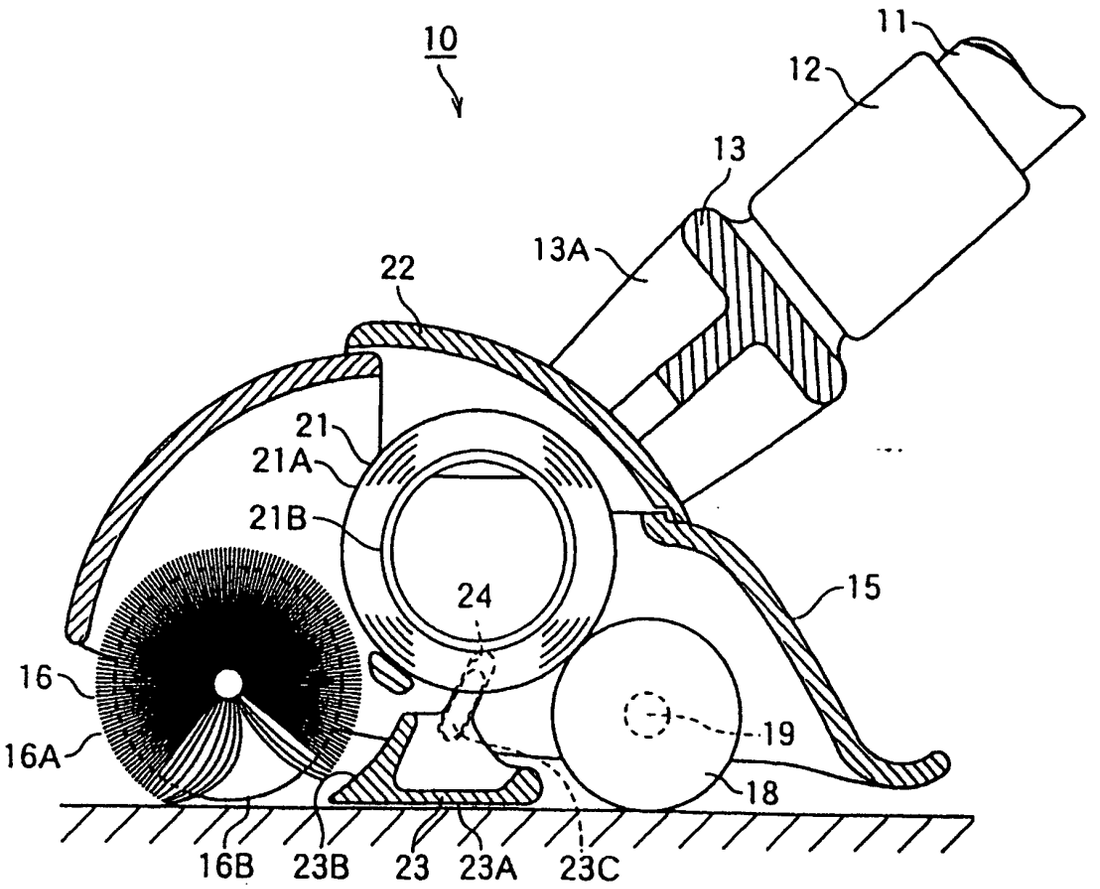
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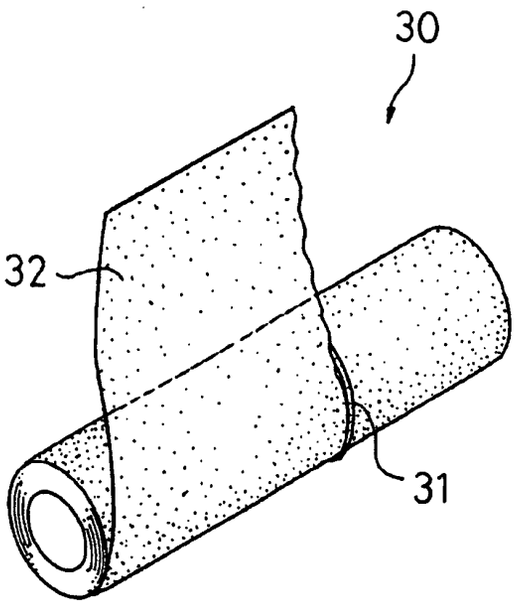
Fig. 8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