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(54) **Dust removing system**

System zur Entfernung von Staub

Système d'enlevage de poussière

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- **PATENT ABSTRACTS OF JAPAN vol. 17, no. 355 (C-1079), 6 July 1993 & JP 05 049826 A (SEIDENSHA), 2 March 1993**

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Description

[0001] This invention relates to a dust removing system.

[0002] In film industry or paper industry, a dust removing system which can remove adhesive dust, dust stuck in a base member, sticky dust such as feather-like fiber at an edge portion of a base member of, for example, paper or films as well as dust on surface of a base member of such as paper or films is required. In anticipation of an increase of recycled paper hereafter, a problem of paper powder is predicted to be bigger in the paper industry, and a providing of a dust removing system is thought to be unessential. A conventional dust removing system is disclosed in EP 0 640 411. The dust removing system disclosed here has a casing having an air discharging chamber and an air sucking chamber and provided with a first jetting nozzle and a second jetting nozzle on the underside thereof. The first jetting nozzle and the second jetting nozzle blow supersonic jets such that these approach each other. A sucking nozzle is located between the first jetting nozzle and the second jetting nozzle to allow the working air to be sucked into the casing.

[0003] Another conventional dust removing system for adhesive dust is, as shown in Fig. 11, provided with a dust removing head 103 comprising a rotating brushroll 101 which slides on a travelling work 105 (a base member) and an air sucking chamber 102 possessing said brushroll 101 therein. Dust removing systems of that kind are, for example, disclosed in the patent specifications US 4,996,746 (Flat cleaning apparatus for a card) and CH 654753 (Method and apparatus for cleaning the periphery of a cylindrical filter element).

[0004] However the conventional dust removing system as described above has defects described below.

(1) Because the air sucking chamber 102 is too big to slow down a velocity of air flow inside the air sucking chamber 102, dust 104 is easy to be collected inside the dust removing head 103, and when the dust removing system is stopped working, the dust 104 falls therefrom and pollutes the work 105 and circumferential systems.

(2) Because sucking force of said dust removing system is weak, the dust 104 adhered to the brushroll 101 is not removed effectively, and the dust 104 on the brushroll 101 adheres to the work 105 again. To this extent, Japanese patent 05049826 discloses the possibility to provide a vacuum nozzle for sucking and removing the dirt sticking to the brushroll.

(3) An air flow of the conventional dust removing system has little dust removing effect, and a bristle of the brushroll 101 which contacts to the work 105 to remove adhesive dust 104 need to be thick and hard. Consequently, the work 105 is possible to be scratched by the bristle.

(4) A force of sucking dust of said conventional dust removing system is basically insufficient (the velocity of air flow is below 10m/s), and dust can not be removed efficiently.

[0005] It is therefore an object of the present invention to provide a dust removing system wherein the foregoing problems are solved and adhesive dust is removed from the work certainly without scratching the work and the dust removing head is prevented to be polluted with dust.

[0006] These objects are solved according to the present invention by a dust removing system including the features of claim 1.

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

Figure 1 is a sectional view of a principal portion of an embodiment of a dust removing system which is not part of the invention;
Figure 2 is a schematic top plan view of a dust removing system under operating situation;
Figure 3 is an enlarged explanatory view of a principal portion of a function of the dust removing system;
Figure 4 is an enlarged explanatory view of a principal portion of a function of the dust removing system;
Figure 5 is an enlarged explanatory view of a principal portion of a function of the dust removing system;
Figure 6 is a sectional view of a principal portion of another embodiment of a dust removing system which is not part of the invention;
Figure 7 is an explanatory view of a principal portion of a function of the embodiment of Figure 6;
Figure 8 is an explanatory view of a function of a comparative example for the present invention;
Figure 9 is a sectional view of a principal portion of a further embodiment of a dust removing system which is not part of the invention;
Figure 10 is a sectional view of a principal portion of an embodiment of a dust removing system according to the present invention; and
Figure 11 is a sectional view of a principal portion of a conventional dust removing system.

[0008] Embodiments of dust removing systems and a preferred embodiment of the present invention will now be described with reference to the accompanying drawings.

[0009] Figure 1 and Figure 2 are showing an embodiment of a dust removing system, and this dust removing system is possessed with a dust removing head 1, a blower unit (not shown) and a traveler means (not

shown) which makes work 2 traverse toward arrow A as the work 2 is arranged to be close to the head 1.

[0010] The dust removing head 1 is comprising an air sucking chamber 4 having an air sucking opening 3 which opens at a position near the work 2, a rotating brushroll 5 disposed inside the air sucking chamber 4 slidable on the work 2, and a nozzle 6 which sucks and removes dust R adhered to the rotating brushroll 5.

[0011] To be concrete, the dust removing head 1 possesses a casing 7 which is long in a width direction of the work 2, and inside the casing 7 the air sucking chamber 4 is formed corresponding to a substantially whole longitudinal length of the casing 7. On an under surface of the casing 7, the slit-like air sucking opening 3 having a longitudinal length L longer than a width Wa of the work 2 is formed. (See Figure 2)

[0012] One end of an air sucking passage not shown in the attached drawings is connected to the air sucking chamber 4, and a blower unit which sucks air in the air sucking chamber 4 is connected to other end of the air sucking passage. By sucking force of the blower unit, air inside the air sucking chamber 4 is sucked into the blower unit through the air sucking passage, and air outside the system is sucked through a space between the air sucking opening 3 and the work 2 into the air sucking chamber 4.

[0013] As shown in Figure 1, the rotating brushroll 5 is provided to be rotatable on axis M which is parallel to the slitted air sucking opening 3 inside the air sucking chamber 4 of the casing 7, and the brushroll 5 is rotated by a rotation driving means not shown in the attached drawings toward arrow F in Figure 1. With this rotating brushroll 5, the dust R adhered to a surface of the work 2 is wiped off.

[0014] Nozzle 6 is stuck to an under surface of a partition wall 8 which is provided above the brushroll 5 in the air sucking chamber 4. The nozzle 6 has a slit hole 10 extended corresponding to a whole axial length of the brushroll 5. Specifically, as shown in Figure 3, the nozzle 6 is possessed with a pair of blade portions 21 having concave face portions 20 which are formed on edges of end portions of outer faces thereof. Tip portions of the blade portions 21 are tip thin portions 22. Between inner faces of the pair of blade portions 21 opposing each other, a slit hole 10 extended corresponding to the whole axial length of the axis M of the brushroll 5 is formed. An end of nozzle 6 extended corresponding to the whole axial length of the axis M is arranged to be close to or contact with a circumferential face of the brushroll 5. A plurality of air passage slits 9 are provided on the partition wall 8 in the air sucking chamber 4, and one of said air passage slits 9 communicates the slit hole 10 of the nozzle 6.

[0015] As the dust removing system is constructed above, when air is sucked from the slit hole 10 of the nozzle 6 toward arrow C, air around the concave face portions 20 of the end portion of the nozzle 6 flows at high speed downwardly along the concave face portions 20 as broken lines show in Figure 3, and the air reaches at a slightly deep position of the brush bristle 12 before sucked into the slit hole 10. Therefore dust R adhered to the brush bristle 12 of the rotating brushroll 5 can be completely removed.

[0016] Next, referring back to Figure 1, a diameter D of the rotating brushroll 5 and an inner width W parallel to a traveling direction of the work 2 of the air sucking chamber 4 are arranged to be D≦ W≦ (D+20mm). Therefore a space between the rotating brushroll 5 and an inner wall surface of the air sucking chamber 4 is possible to be smaller, and air inside the air sucking chamber 4 can flows at high speed, hereby dust R sucked in the air sucking chamber 4 can quickly flow into the air sucking passage, and the dust R can be prevented not to remain in the air sucking chamber 4, and readhering of the dust R to the work 2 can be also prevented.

[0017] Further preferably, the diameter D and the inner width W are arranged to be (D+3mm) ≦ W≦ (D+10mm), and the air inside the air sucking chamber 4 flows still more smoothly and at higher speed than the case arranged to be D≦ W≦ (D+20mm), therefore a possibility of the dust R remaining in the air sucking chamber 4 can be prevented. If D > W, the brushroll 5 contacts the inner wall surface of the air sucking chamber 4, and no space exist between the brushroll 5 and the inner wall surface of the air sucking chamber 4. Therefore a velocity of the air flow inside the air sucking chamber 4 is considerably lowered and power of sucking dust R of the dust removing head 1 will lose. If W > (D+20mm), a space between the brushroll 5 and the inner wall surface of the air sucking chamber 4 becomes too large, and a velocity of the air flow inside the air sucking chamber 4 becomes lower.

[0018] Air passes between divisional walls 11 which form an air sucking opening 3 and a work 2 is arranged to be at a velocity V of 50 to 60 m/s. Therefore dust R is removed from the work 2 still more effectively and is sucked into the air sucking chamber 4 for certain. Furthermore dust R adhered to a work 2 which is difficult to be exfoliated depending on quality of a material of the work 2 by a conventional dust removing system is possible to be removed with the dust removing system of the present invention in some cases. When a velocity of air flow V is arranged to be below 50 m/s, dust R swept out by the brushroll 5 is possible to go outside through a space between partition walls 11 and a surface of the work 2. Even if a velocity of air flow V is more than 60 m/s, an efficiency of removing dust R does not change very much.

[0019] A rotating brushroll 5 is arranged to rotate within a range of 1600 to 3000 r.p.m.. Therefore dust R adhered to the work 2 is effectively removed and a possibility of the work 2 to be scratched by the brushroll 5 can be prevented. If rotation of the brushroll 5 is below a range of 1600 r.p.m., dust R stuck strongly to the work 2 may not be removed in some cases. If rotation of the brushroll 5 is above a range of 3000 r.p.m., a surface of

work 2 is possible to be scratched and damaged by the brushroll 5.

[0020] As shown in Figure 4, a length B of bristle end portions 12a among brush bristles 12 of said rotating brushroll 5 contactable to the surface of the work 2 and a thickness T of said work 2 are arranged to be $0 \leqq B \leqq T$. Therefore while this dust removing system is working, as shown in Figure 5, each of the brush end portions 12a slides surely on the surface of the work 2 in a condition that the brush bristle 12 is slightly bent and is moderately stored elastic energy. For this reason dust adhered to the work 2 is removed still more surely, and the work 2 can be prevented to be damaged. If a length B of the bristle end portion 12a is arranged to be $0 > B$, i. e. if the bristle end portion 12a is arranged not to touch the surface of the work 2, the brushroll 5 will not have a function of removing dust. If $B > T$, the brush bristle 12 bends largely and hits and scratches the surface of the work 2 hardly.

[0021] As the dust removing system is described in the foregoing, dust R adhered to the work 2 is removed surely and efficiently by the rotating brushroll 5 of the present dust removing system. Moreover dust R adhered to the brushroll 5 is removed by applying the nozzle 6, and the dust R adhered to the work 2 again which is removed once from the work 2 is possible to be prevented. Especially, for example, sticky dust, dust stuck in the work 2, fluff of the end rim of the work 2 (in case the work 2 is paper) are removed effectively.

[0022] The dust removing head 1 of the dust removing system can be prevented to be dirty. That is to say, a space between the rotating brushroll 5 and an inner wall surface of an air sucking chamber 4 becomes smaller than that of the conventional dust removing system, and air inside the air sucking chamber 4 flows at high speed and dust R sucked in the air sucking chamber 4 can quickly flow into the air sucking passage. Therefore the dust R is prevented not to remain in the air sucking chamber 4 after an operation of the dust removing system. That is to say, the dust R is prevented not to remain in the rotating brushroll 5 and the inner wall surface of the air sucking chamber 4. Therefore the dust removing head 1 can be used for a long term without cleaning, and a frequency of cleaning and exchanging of the brushroll 5 can be decreased. In consequence, maintenance of the dust removing system would be easy and a running cost would be decreased at the same time.

[0023] The brush bristle 5 can be made of, for example, polyamide resin, acrylic resin, metal, conductive fiber, but it is possible to be made of other materials. The work 2 which dust is removed therefrom can be, for example, paper, film or other materials.

[0024] Next, Figure 6 shows another embodiment of a dust removing system. This dust removing system possesses first and second air discharging chambers 15, 16 arranged on an upstream side H and a downstream side J of an air sucking opening 3 of an air sucking chamber 4 and are provided with first and second ultrasonic nozzles 13, 14 which respectively change air to air knife K including ultrasonic pressure wave P and blow the air knife K against said work 2.

[0025] Divisional walls 11 divide inside a casing 7 of a dust removing head 1 into the air sucking chamber 4 and the first and second discharging chambers 15, 16 on the upstream side H and the downstream side J of said air discharging chamber 4. Structures of rest of parts of this embodiment are almost same as those shown in Figure 1 to 5.

[0026] The first and second air discharging chambers 15, 16 are provided with air from a blower unit not shown in the attached drawings through an air discharging passage not shown in the attached drawings. The air passes the first and second ultrasonic nozzle 13, 14, and becomes air knife K including ultrasonic pressure wave P and blown against a work 2. After that the air knife K is sucked in the air sucking chamber 4 together with the dust R, and the air goes back to said blower unit through an air sucking passage.

[0027] Referring to Figure 8, when air which simply blows at a high speed is arranged to blow from an air discharging chamber 201 against a surface of a work 2 and is arranged to be sucked into an air sucking chamber 203, a part of dust R is separated from a surface of the work 2 by, so called, an air knife operation of the air flow, however a boundary layer 25 where air flows at a low speed therein is formed over the surface of the work 2, and most of the dust R is shut in said boundary layer 25, therefore the removing dust R from the work 2 becomes difficult.

[0028] With the dust removing system of the present invention as shown in Figure 7, an ultrasonic pressure wave P destroys a boundary layer 25 and an air knife K directly hits a surface of a work 2 and dust R can be exfoliated effectively. Therefore two kinds of dust removing operation which are of the brushroll 5 and of the air knife K including the ultrasonic pressure wave P, the dust R adhered to the work 2 can be removed still more surely. Especially, for example, adhesive dust, dust stuck in the work 2, fluff on an end rim of the work 2 (if the work 2 is paper) are removed effectively.

[0029] Figure 9 shows further embodiment of a dust removing system. The dust removing system possesses an air sucking chamber 17 arranged on a downstream side J of an air sucking chamber 4, and first and second air discharging chambers 15, 16 arranged on the downstream side J of said air sucking chamber 4 and provided with first and second ultrasonic nozzles 13, 14 which blow air knife K including ultrasonic pressure wave P against a work 2 on an upstream side H and a downstream side J of said air sucking chamber 17.

[0030] Therefore inside a casing 7 of the dust removing head 1, the air sucking chamber 4, the air sucking chamber 17 possessing an air sucking opening 19 which opens downwardly at the downstream side J of the air sucking chamber 4, a communicating chamber 18 communicating both the air sucking chambers 4 and

17, and said first and second air discharging chambers 15, 16 are provided. Structures of rest of parts of this embodiment are almost same as those in Figure 1 to 7.

[0031] As the dust removing system is constructed as described above, after exfoliated adhesive dust R stuck to the work 2 with the brushroll 5 in the air sucking chamber 4 on the upstream side H of the air sucking chamber 4, the air knife K including the ultrasonic pressure wave P blown from the first and second ultrasonic nozzles 13, 14 on the downstream side J of the air sucking chamber 4 is possible to strongly suck and remove dust R remained in the work 2. The dust R adhered to the work 2 is removed by two steps of dust removing operations which are operations of the brushroll 5 and the air knife K on the downstream side of the air sucking chamber 4 including the ultrasonic pressure wave P. The dust can be removed still more surely by two steps of the dust removing operation.

[0032] Figure 10 shows a dust removing system according to the present invention. A casing 7 is possessed with partition walls 11 wherein (for example) blade edge portions 30 having triangular cross sections are obliquely formed on lower end edges thereof (as shown in Figure 10), and a gap between the lower end edge of the partition wall 11 (i.e. the blade edge portion 30) and (an outer circumferential face of) the brushroll 5 is reduced. Therefore a velocity of air flows in the gap between the lower end edge of the partition wall 11 (i.e. the blade edge portion 30) and the outer circumferential face of the brushroll 5 is increased, and fine dust R separated from the surface of the work 2 can be sucked into the air sucking chamber 4 for certain.

[0033] While a preferred embodiment of the present invention has been described in this specification, it is to be understood illustrative and not restrictive, because various changes are possible within the invention as specified in the appended claims.

Claims

1. A dust removing system comprising:

an air sucking chamber (4) having an air sucking opening (3) which opens at a position near a work (2);
a rotating brushroll (5) arranged inside said air sucking chamber (4) slidable on said work (2);
a nozzle (6) which is arranged inside said air sucking chamber (4) for sucking and removing dust (R) adhering to the rotating brushroll (5), arranged to be close to or contact with said rotating brushroll (5); **characterized in that** the dust removing system is provided with a pair of blade portions (21), each of which is possessing a concave face portion (20) on a tip end portion of an outer face thereof, and a slit hole (10) formed between inner faces of said blade portions (21) opposite each other and extended corresponding to a whole axial length of the brushroll (5).

Patentansprüche

1. Staubbeseitigungssystem mit:

einer Luftsaugkammer (4) mit einer Luftsaugöffnung (3), welche sich an einer Stelle in der Nähe eines Werkstücks (2) öffnet;

einer sich drehenden Bürstenwalze (5), welche innerhalb der Luftsaugkammer (4) gleitbar auf dem Werkstück (2) angeordnet ist; und

einer Düse (6), welche innerhalb der Luftsaugkammer (4) zum Ansaugen und Beseitigen von Staub (R) angeordnet ist, welcher der sich drehenden Bürstenwalze (5) anhaftet, und welche nahe an oder in Kontakt mit der sich drehenden Bürstenwalze (5) angeordnet ist;

dadurch gekennzeichnet, dass
das Staubbeseitigungssystem mit einem Paar von Schaufelabschnitten (21) versehen ist, wobei jeder Schaufelabschnitt einen konkaven Flächenabschnitt (20) an einem vorderen Endabschnitt einer Außenfläche aufweist, und dass eine Schlitzöffnung (10) zwischen Innenflächen der Schaufelabschnitte (21) ausgeformt ist, welche einander gegenüberliegen, welche Schlitzöffnung (10) sich entlang einer gesamten axialen Länge der Bürstenwalze (5) erstreckt.

Revendications

1. Système d'enlèvement de poussière comprenant :

une chambre d'aspiration d'air (4) comportant une ouverture d'aspiration d'air (3) qui s'ouvre à une position proche d'une pièce d'ouvrage (2),
une brosse cylindrique rotative (5) agencée à l'intérieur de ladite chambre d'aspiration d'air (4) pouvant glisser sur ladite pièce d'ouvrage (2),
une buse (6) qui est agencée à l'intérieur de ladite chambre d'aspiration d'air (4) destinée à aspirer et enlever la poussière (R) adhérant à la brosse cylindrique rotative (5), agencée pour être proche de ladite brosse cylindrique rotative (5) ou bien en contact avec celle-ci, **caractérisé en ce que** le système d'enlèvement de poussière est muni d'une paire de parties de lames (21), dont chacune possède une partie

de face concave (20) sur une partie d'extrémité en pointe d'une face extérieure de celle-ci, et un trou en fente (10) formé entre des faces intérieures desdites parties de lames (21) opposées l'une à l'autre et étendu de façon correspondante à une longueur axiale entière de la brosse cylindrique (5).

Fig. 1

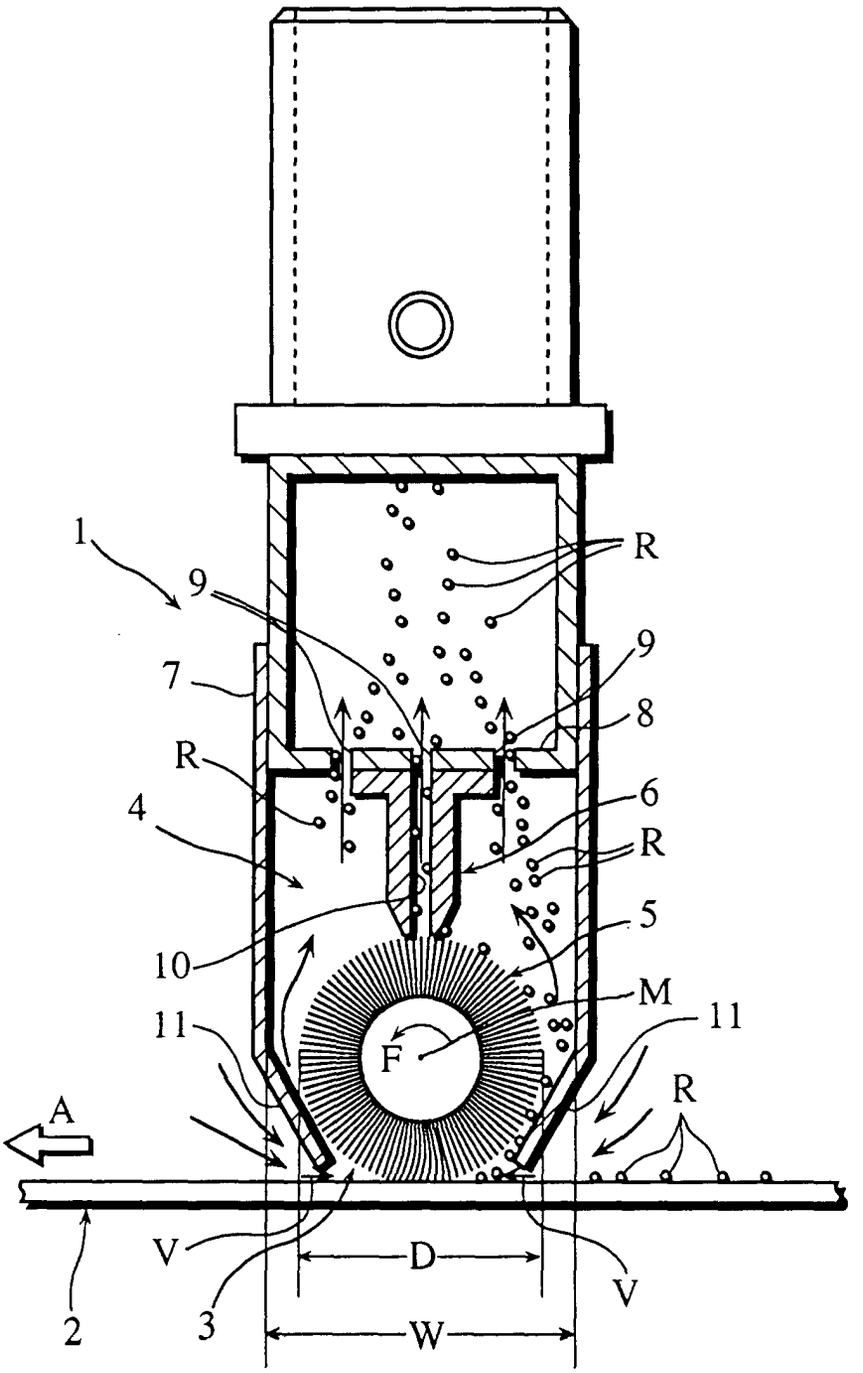


Fig. 2

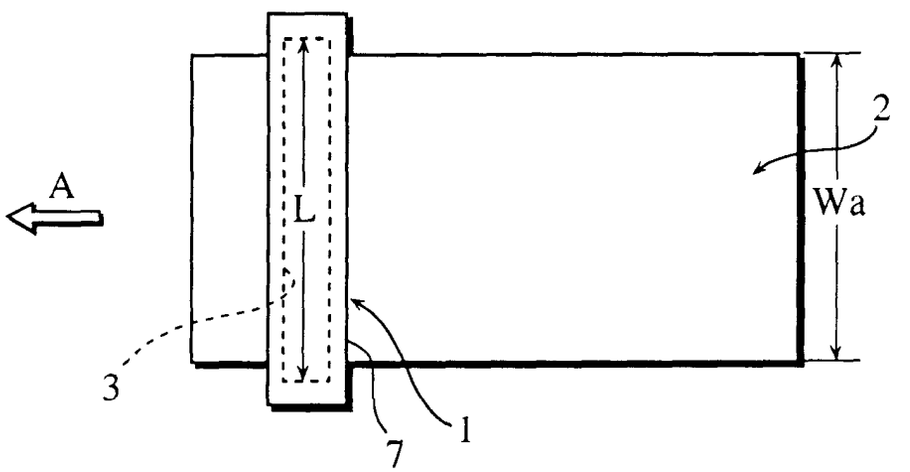


Fig. 3

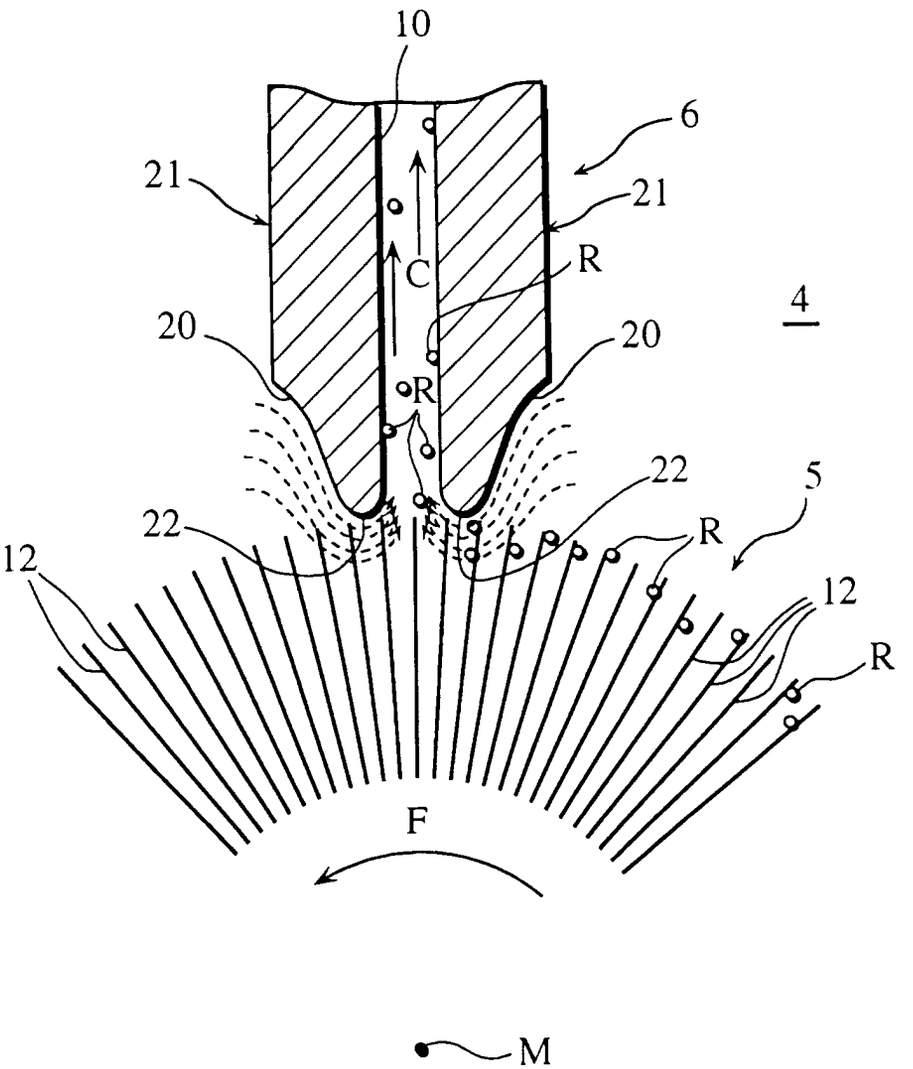


Fig. 4

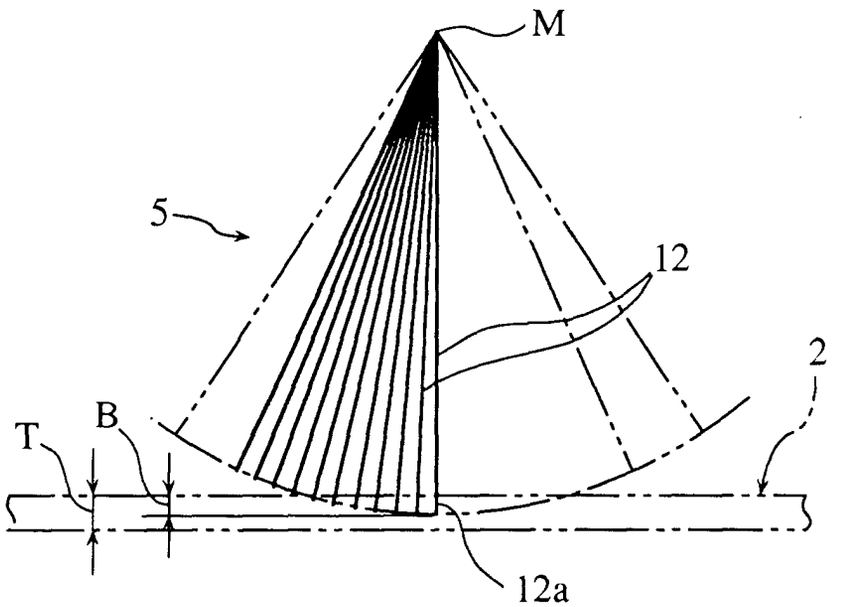
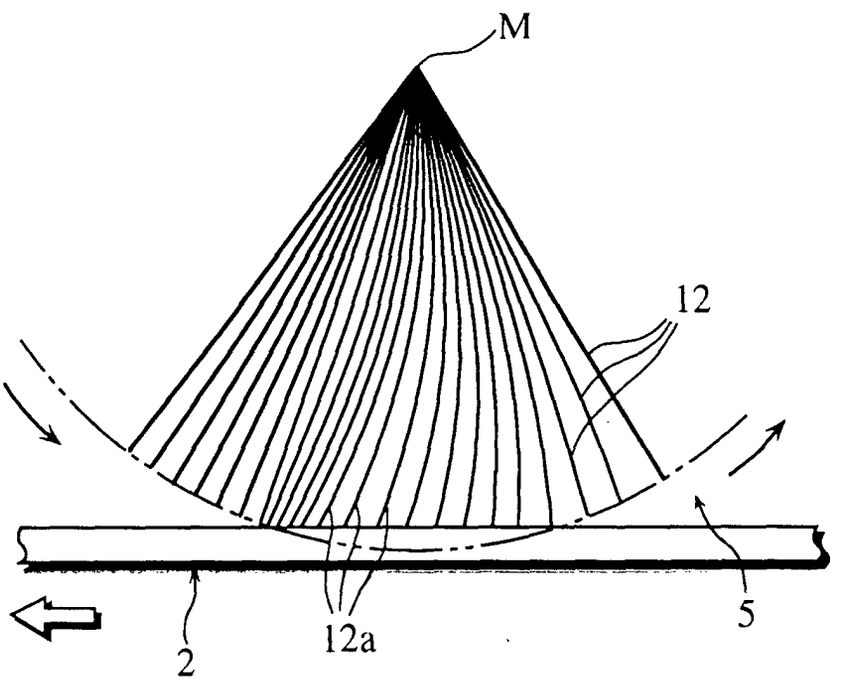


Fig. 5



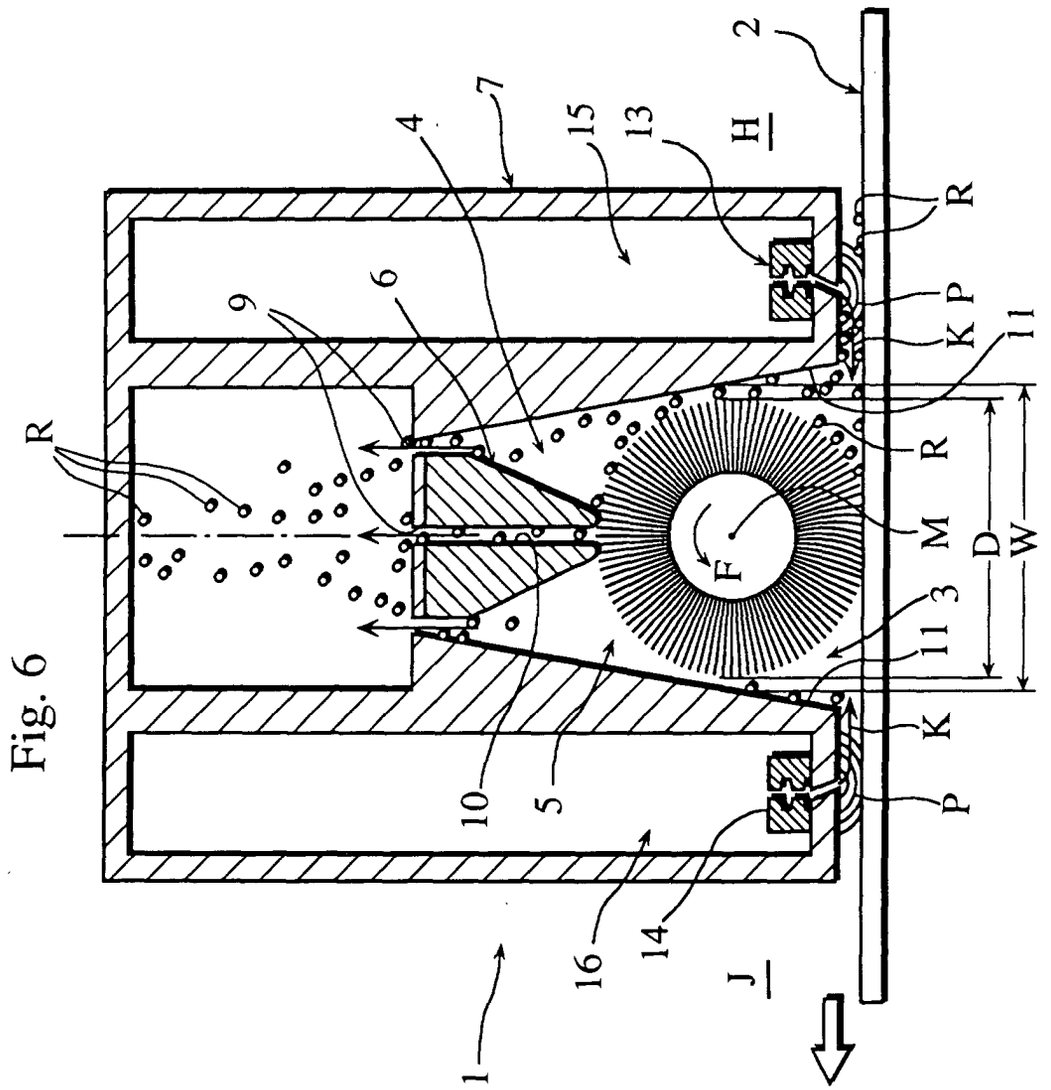


Fig. 6

Fig. 7

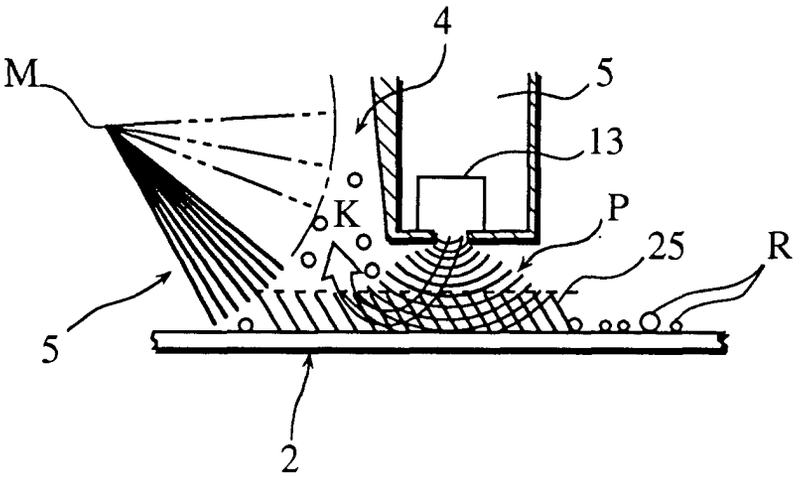
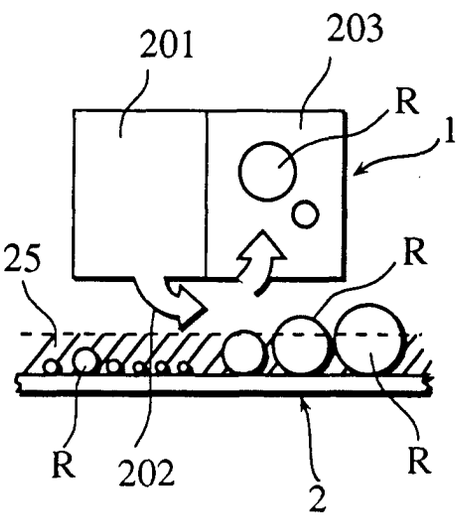


Fig. 8



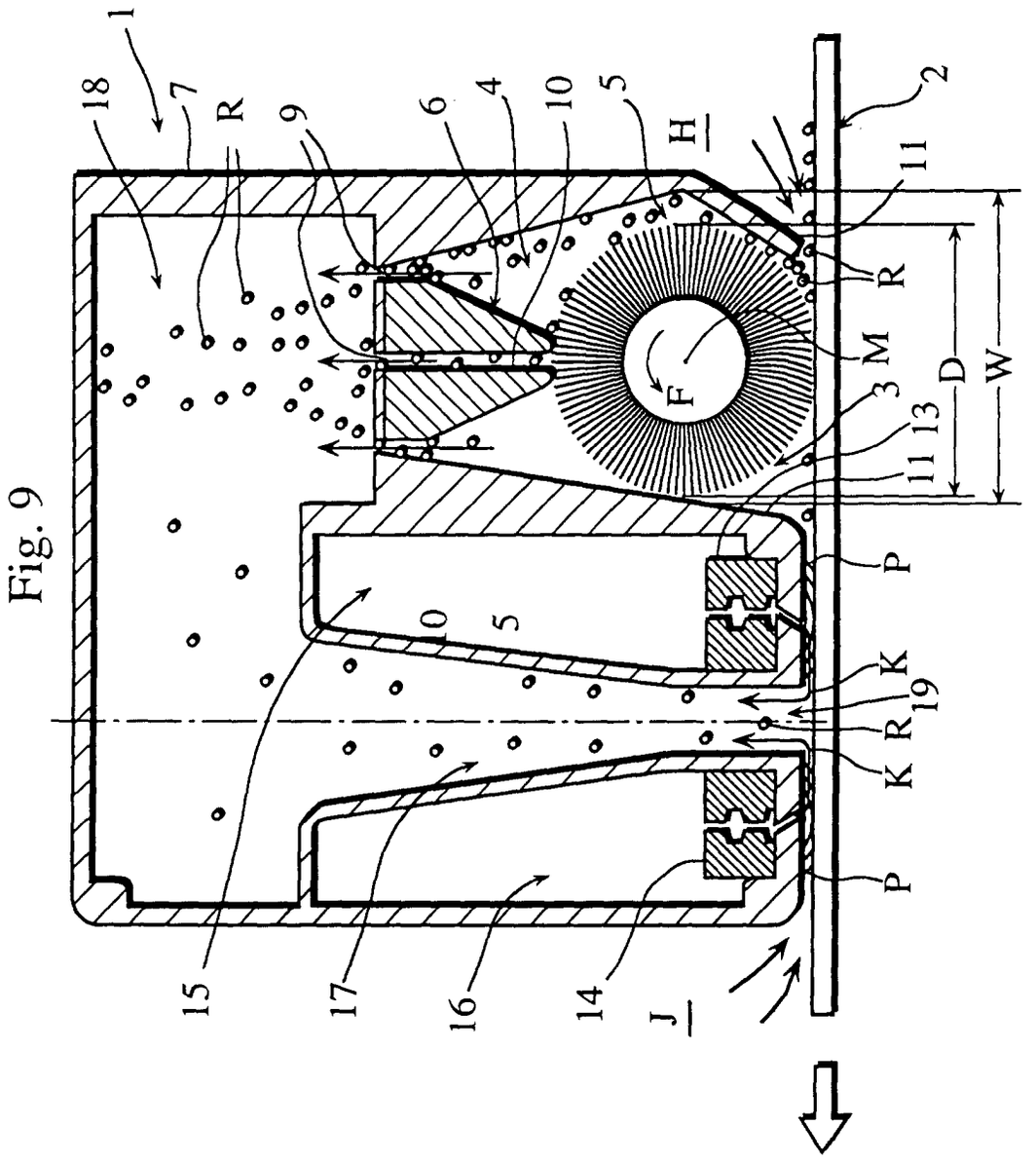


Fig. 9

Fig. 10

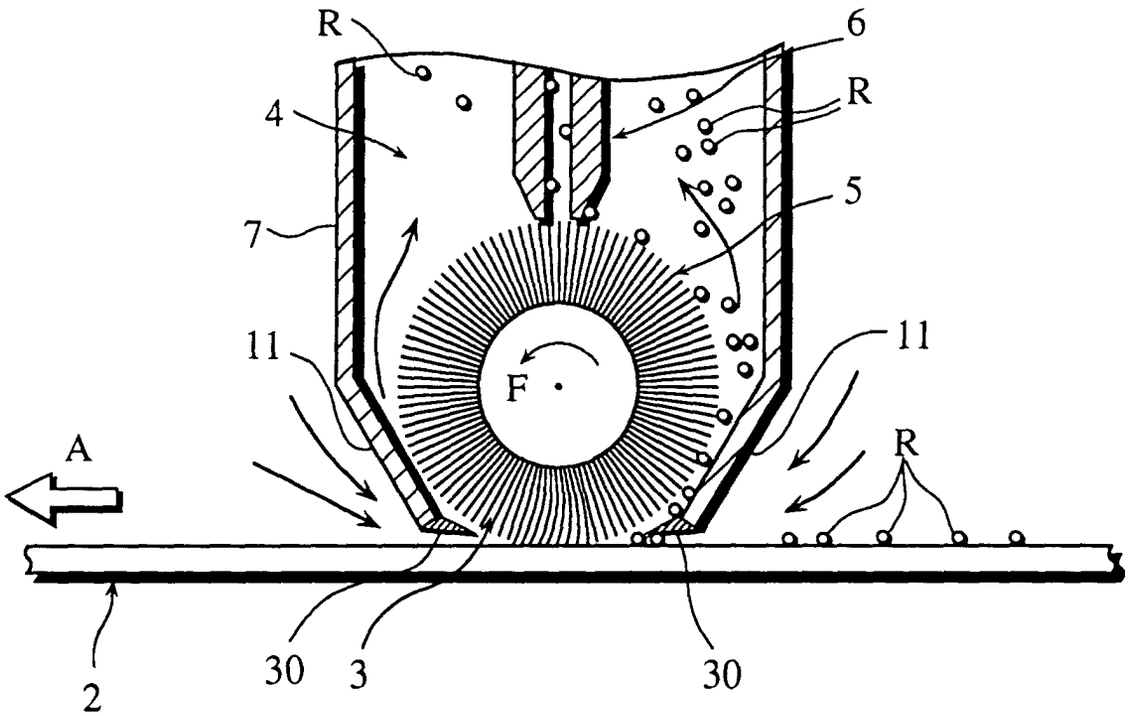


Fig. 11 PRIOR ART