Sept. 18, 1951 M. T. HOFFMAN 2,567,938

APPARATUS FOR DRY CLEANING AND DEGREASING OF FIBROUS MATERIAL

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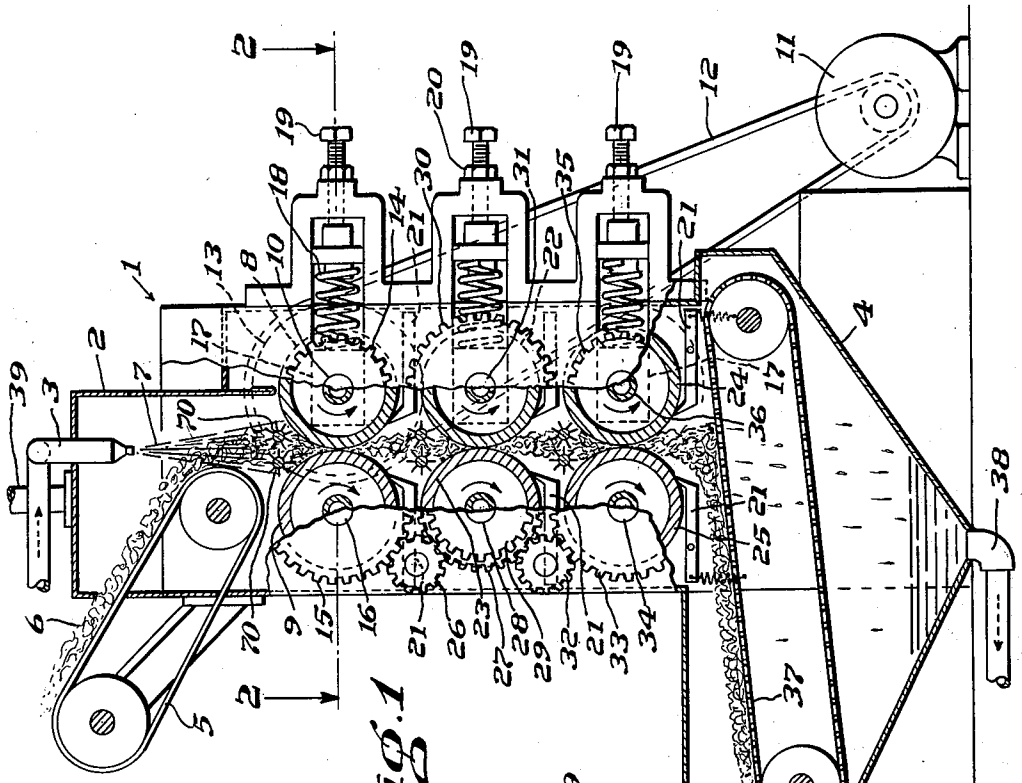


Fig. 1

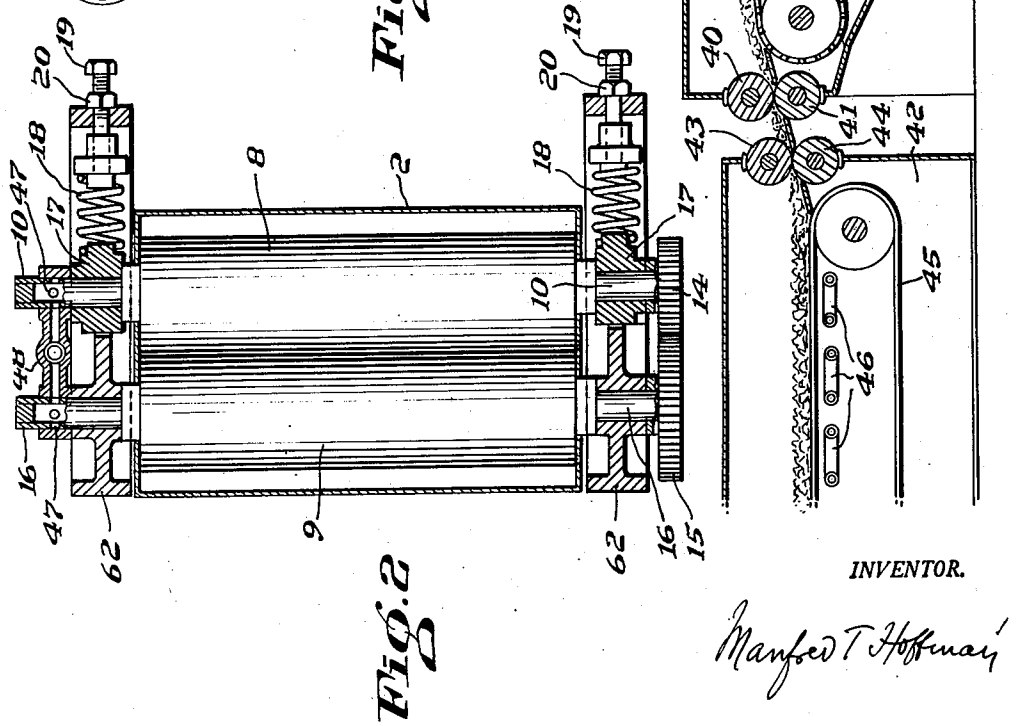


Fig. 2

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Fig. 3

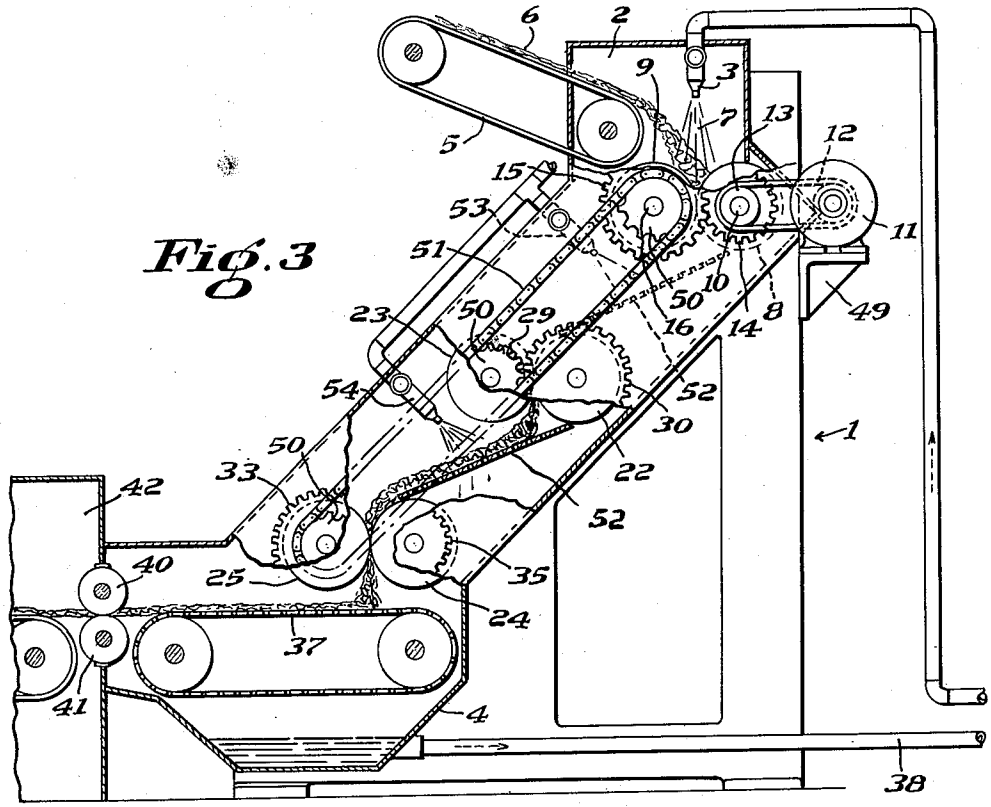
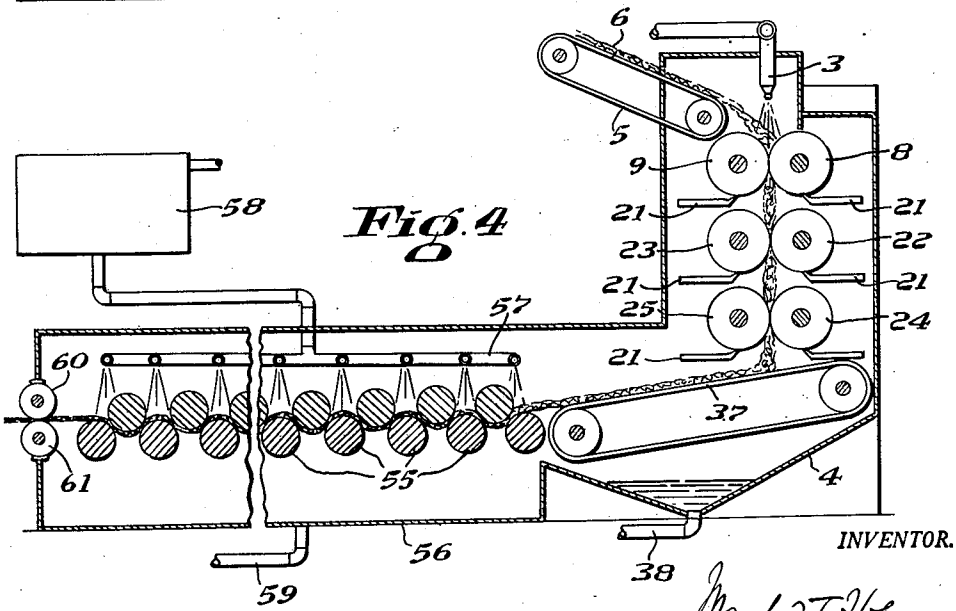


Fig. 4



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Patented Sept. 18, 1951 2,567,938

UNITED STATES PATENT OFFICE

2,567,938

APPARATUS FOR DRY-CLEANING AND DEGREASING OF FIBROUS MATERIAL

Manfred T. Hoffman, Newburyport, Mass.

Application February 4, 1947, Serial No. 726,428

3 Claims. (Cl. 68—205)

1

This is a continuation in part of my copending application Ser. No. 548,620, filed August 8, 1944, for "Apparatus for Dry Cleaning," now Patent 2,479,358.

The present invention relates to apparatus for dry cleaning and degreasing of fibrous material. The term fibrous material is intended to include wool, hair, furs and skins and any other materials of animal origin which consist of animal fibers, or comprise such fibers.

One object of the present invention is to provide a novel apparatus for dry cleaning of fibrous materials in a continuous operation as distinguished from the batch method in which limited quantities of material are immersed and treated in successive operations in a bath of dry-cleaning agent.

Another object of the present invention is to provide means for dry cleaning the fibrous material which are, in essence, automatic, thus minimizing the requirement of hand labor and being easier to control than the means which were used heretofore for dry cleaning of fibrous material.

Still another object of the invention is to provide a novel apparatus for dry cleaning of fibrous materials which is effective for simultaneously removing impurities and foreign matter such as, for instance, grease, paint, pitch or tar.

Still another object of the present invention is to provide apparatus for dry cleaning fibers in a continuous operation which requires less floor space and is easier to manufacture than the type of apparatus which is shown in my Patent 2,479,358.

Other objects of the present invention will become apparent as this description proceeds.

In the apparatus of the present invention the material to be dry cleaned and degreased is moved in a wet state through a cleaning zone and, while being moved through said zone, subjected to a rubbing action having the same direction as the direction of the movement of the material through said cleaning zone. Any suitable dry cleaning agent or mixtures thereof may be used for wetting the material to be dry cleaned as, for instance, trichlorethylene, carbon tetrachloride or tetrachlorethylene. The fibers to be treated may be in the form of an elognated layer which may consist of uncarded, unwoven fibers as, for instance, raw wool. The above referred-to rubbing action which has the same direction as the direction of movement of the material through the cleaning zone may be achieved by a pair of rotatable rolls adapted to engage opposite surfaces of a layer of fibrous material and being positively rotated at unequal surface speeds.

The invention will be better understood by referring to the following specification and to the appended drawings, wherein:

Fig. 1 is a side elevation of, and partly a vertical section through, a preferred embodiment of a dry cleaning apparatus;

Fig. 2 is a section along line 2—2 of Fig. 1 showing a front view of cleaning rolls of the apparatus shown in Fig. 1 and also showing other parts which are associated with said rolls;

Fig. 3 is a side elevation of, and partly a vertical section through, a modification of the apparatus which is shown in Fig. 1; and

Fig. 4 is a diagrammatic side elevation of still another apparatus for dry cleaning fibrous material.

The same reference signs have been used in all figures to designate like parts.

The apparatus which is shown in the drawing is intended to be used in combination with a system for continuously and automatically purifying the dry cleaning agent and recirculating the same. That system has been fully described in my above referred-to Patent 2,479,358 and has, therefore, been omitted from the present drawings.

Referring now to Fig. 1 of the accompanying drawing, the cleaning apparatus has generally been indicated by the reference sign 1. Cleaning apparatus 1 is aranged in a substantially gastight chamber 2. Cleaning agent is supplied to the top of the cleaning chamber 2 by a system of pipes or spray nozzles 3. The cleaning agent, upon having passed through chamber 2, is collected in a funnel-shaped basin 4 forming the bottom of chamber 2. Apron 5 feeds the top portion of chamber 2 continuously with fibrous material 6 to be cleaned, for instance, raw wool. The jets 7 of dry cleaning agent coming from nozzles 3 are aimed at the fibrous material as it leaves apron 5 and drops between the nip formed between a pair of rotatable rolls 8 and 9. The shaft 10 of roll 8 is driven by motor 11 by means of a belt 12 and pulley 13 arranged on shaft 10. Spur gear 14 on shaft 10 meshes with spur gear 15 on shaft 16 of roll 9. The diameters of rolls 8 and 9 may be equal, but the diameters of spur gears 14 and 15 are so selected that rolls 8 and 9 are rotated at different surface speeds. By reason of this difference in surface speed the fibrous material is subjected, while being moved through a cleaning zone, to a rubbing action which has the same direction as the direction of movement of the material through said zone.

In my above referred-to Patent 2,479,358 I have mainly described means for subjecting the material to be dry cleaned to a rubbing action in a direction transversal of the direction of movement of the material through a cleaning zone. I have found, however, that in certain cases it is preferable to effect, and easier to achieve, a rubbing action in the direction of the movement of the material through the cleaning zone.

As may best be seen from Fig. 2 shaft 10 rests in

bearings 17 which are acted upon by helical springs 18. The amount of pressure which springs 18 exert upon bearings 17 and consequently upon the roll 8 may be adjusted by means of screw-threaded bolts 19 held in position by nuts 20. The amount of pressure which should preferably be exerted by the springs 18 depends upon the material which is to be treated as well as upon the nature and the amount of impurities which are contained therein, and for this reason provision has been made of means for varying the amount of pressure by which cooperating pairs of rolls 8, 9 are pressed against each other. The surfaces of cooperating pairs of rolls 8, 9 are smooth and highly polished and the pressure which tends to keep them in linear engagement is preferably high. Wool to be dry cleaned and degreased is not harmed even if the pressure of springs 18 or of weights which are used in their place is very high.

Paint, grease and other impurities which have not been completely dissolved by the dry cleaning agent will have a tendency to adhere to the surfaces of the rolls 8 and 9, from where such substances may be removed by means of scraper blades 21. These scrapers have been shown in Fig. 1 in a more or less diagrammatic way and I prefer that particular scraper design which has been shown in my Patent 2,479,358. If the scraper blades are arranged as shown in Fig. 1, it may be necessary or desirable to arrange a tray (not shown in the drawing) below of each scraper blade in order to prevent impurities dropping from the scraper blades to soil the fibers which were previously cleaned.

In addition to rolls 8 and 9 chamber 2 houses a cooperating pair of rolls 22 and 23 and a cooperating pair of bottom rolls 24 and 25. Spur gear 15 engages a small gear 26 which, in turn, engages spur gear 27 on shaft 28 of roll 23. Spur gear 29, which is likewise mounted on shaft 28, engages spur gear 30 which is mounted on shaft 31 of roll 22. Spur gear 27 meshes with a small gear 32 which, in turn, meshes with spur gear 33 which is mounted on the shaft 34 of roll 25. Spur gear 33 engages spur gear 35 which is mounted on the shaft 36 of roll 24. Thus all pairs of cooperating rolls 8, 9; 22, 23 and 24, 25 are operated positively by means of a common motor 11. The left bank of rolls 9, 23 and 25 is carried by shafts the bearings of which are rigidly mounted in a frame structure 62 or form part of such a structure, while the right bank of rolls 8, 22 and 24 is supported by shafts the bearings of which are movable relative to the frame structure 62 and are acted upon by separate springs 18, thus making it possible for each shaft of the right bank of rolls to move relative to the other shafts of said bank of rolls. It will be noted that the entire transmission system for operating rolls 8, 9; 22, 23 and 24, 25 is located outside of the chamber 2 wherein said rolls are housed. The ratios between the different spur gears which form the transmission system is selected in such a way that rolls 22 and 23, and 24 and 25, respectively, are rotated at different surface speeds, thus subjecting the material while being moved through the bites formed between these two pairs of rolls to a rubbing action having the same direction as the direction of movement of the material. The ratio of the different spur gears which form the transmission system is selected in such a way that pairs of cooperating rolls 22, 23, and 24, 25, respectively, which are situated more remotely from the feed end rolls 8, 9, are rotated at relatively higher surface speeds. Thus, the surface speeds of rolls 22 and 23 are higher than the surface speeds of rolls 8 and 9 and, in turn, the surface speeds of rolls 24 and 25 are higher than the surface speeds of rolls 22 and 23. By reason of the aforementioned grading of the surface speeds of pairs of cooperating rolls the capacity of conveying fibrous material is increased from the feed end of the machine toward its delivery end, thus precluding plugging of the machine by lumps of fibers which may drop down from a pair of cooperating rolls located on a higher level to a pair of cooperating rolls located on a lower level. The aforementioned grading of the surface speeds of cooperating pairs of rolls results in that a drawing action in the direction of its travel through the machine is being exerted upon fibrous material which is in the form of a more or less coherent layer. Such drawing action tends to facilitate the removal of foreign matter from relatively coherent fibrous layers. The lowermost pair of cooperating rolls 24, 25 delivers the cleaned fibers upon a perforated conveyor belt 37 which permits dry cleaning fluid to drop into funnel shaped basin 4 forming the bottom of chamber 2, from where it is removed through drain pipe 38. The cleaning fluid escaping through drain pipe 38 is transferred to a purification apparatus (not shown), and then recirculated, i. e. reintroduced into chamber 2 by means of the system of spray nozzles 3. Fumes of the dry cleaning agent which rise to the top of chamber 2 are collected by means of a system of pipes indicated at 39 and liquefied in a condenser (not shown), whereupon the dry cleaning agent may be reused in the process of cleaning fibrous material. The fibrous material, before issuing from chamber 2, is caused to pass through a pair of squeeze rolls 40, 41 for extracting excess dry cleaning fluid which is removed through funnel shaped basin 4 and drain pipe 38. Squeeze rolls 40, 41 are rotated to advance the cleaned fibrous material out of chamber 2 and are constructed and arranged to form a part of a substantially gastight seal of that chamber.

The apparatus shown in Fig. 1 includes a chamber 42 for effecting, by the action of heat, a more complete extraction, i. e. evaporation, of dry cleaning fluid than is possible by the mechanical action of squeeze rolls. Chamber 42 is provided both at its feed end and its delivery end with substantially gastight arrangements of squeeze rolls of which only the squeeze rolls 43 and 44, located at the feed end of chamber 42, are shown in the drawing. Within chamber 42 there extends an endless apron 45 adapted to convey fibrous material through said chamber. Below apron 45 are located heating devices 46 which cause evaporation of dry cleaning fluid still contained in the cleaned fibers. Solvent expelled from the fibers through the action of heat may be collected in a condenser (not shown) and, upon its liquefication, be reused in the dry cleaning process. After the fibers are cleaned they may be subjected to carbonizing, and ought to be subjected to crushing and dusting operations to remove unsoluble foreign matter, such as burrs and shives, excrements, sand, dust, etc. which still may have remained therein.

In certain cases it may be desirable to heat the working rolls 8, 9; 22, 23 and 24, 25, and this can best be achieved by steam or by hot air. As shown in Fig. 2, the shaft 10 of roll 8 and the shaft 16 of roll 9 may be hollow for the purpose

of admitting a heating medium into the rolls. Shafts 10 and 16 are provided with ports 47 which permit a heating medium, such as steam or hot air, to enter from a heating fluid distribution system 48 into the rolls 8 and 9. A similar arrangement may be provided, if desired, for removing heating fluid from the rolls 8 and 9, thus permitting the heating medium to be circulated through said rolls.

It is not absolutely necessary, yet it may be desirable in certain circumstances to provide, in addition to the worker rolls 8, 9; 22, 23 and 24, 25, feed rolls 70 for feeding the material to be dry cleaned to the bite formed between each cooperating pair of worker rolls.

The arrangement shown in Fig. 3 is very similar to that shown in Fig. 1. The main difference between both apparatus consists in that in the arrangement shown in Fig. 1 the fibers travel in a vertical direction through a cleaning zone, whereas the path of travel of the fibers through the cleaning zone in the apparatus shown in Fig. 3 is inclined rather than vertical.

Referring now to Fig. 3 of the drawing, the cleaning apparatus 1 comprises a cleaning chamber 2 which is adapted to be supplied by means of apron 5 with fibrous material 6 to be cleaned. The fibers 6 are wetted by jets 7 of dry cleaning fluid coming from a system of spray nozzles 3. Excess dry cleaning fluid is collected in funnel shaped basin 4 and removed through drain pipe 38. The apparatus comprises three pairs of cooperating rolls 8, 9; 22, 23 and 24, 25. Bracket 49 carries a motor 11 driving shaft 10 of roll 8 by means of a belt 12 and a pulley 13 mounted on shaft 10. Shafts 10 and 16 of rolls 8 and 9, respectively, are provided with spur gears 14 and 15 which are in engagement and cause rolls 8 and 9 to be rotated at different surface speeds. In a simliar way, shafts of rolls 22 and 23 are provided with spur gears 30 and 29 which cause rolls 22 and 23 to be rotated at different surface speeds. Finally, the shafts of rolls 24 and 25 are provided with spur gears 35 and 33 which cause rolls 24 and 25 to be rotated at different surface speeds. Rolls 23 and 25 are operated by means of a transmission system comprising three sprocket wheels 50 and one or more endless chains 51 in cooperative engagement therewith. Fibrous material upon having been rubbed between rolls 8 and 9 drops upon an inclined perforated surface 52 from where it is fed to the bite formed between rolls 22 and 23. If the fibrous material is sufficiently coherent it will travel along a stationary surface, such as the perforated surface 52, even though such surface is much less inclined than 90 degrees, since the pull exerted by the action of the pair of cooperating rolls 22 and 23 will compel such a travel. If the fibrous material is relatively uncoherent it will be necessary that the angle of inclination of the perforated surface 52 be nearer to 90 degrees than shown in the drawing; or the perforated surface 52 may be substituted by an endless, preferably perforated, conveyer belt or wire apron adapted to convey fibers issuing from rolls 8 and 9 to the bite formed between rolls 22 and 23. A second inclined surface which, if desired, may likewise be substituted by an endless conveyer belt, is arranged for conveying fibers issuing rom rolls 22 and 23 to the bite formed between rolls 24 and 25. The cleaned fibers issuing from rolls 24 and 25 are deposited on the endless conveyer belt 37 which carries them to the nip formed between squeeze rolls 40 and 41. Squeeze rolls 40 and 41 form part of a substantially gastight seal separating cleaning chamber 2 from a drying chamber 42 wherein the portion of the cleaning fluid still remaining in the fibers is caused to evaporate by the action of heat.

It may be desirable to further wet the fibers with fresh cleaning fluid upon their having passed the first pair of cooperating rolls 8 and 9. To this end, the apparatus which is shown in Fig. 3 is provided with a system of pipes or spray nozzles 53 which aim sprays or jets of dry cleaning agent against the fibers while in transit from the bite formed between rolls 8 and 9 to the bite formed between the rolls 22 and 23. Another system of spray nozzles 54 aims sprays or jets of dry cleaning fluid against the fibers while in transit from the bite formed between rolls 22 and 23 to the bite formed between rolls 24 and 25.

If desired, the apparatus shown in Fig. 1 may be provided with additional systems of spray nozzles similar to the systems of spray nozzles 53 and 54 shown in Fig. 3.

The apparatus shown in Fig. 3 requires somewhat more floor space than the apparatus shown in Fig. 1, yet it enables a more perfect cleaning of fibrous material. In the structure which is shown in Fig. 1, dry cleaning fluid containing a relatively high amount of partially or completely dissolved foreign matter will flow down to the material in the process of being deposited on conveyor belt 37, thus limiting the final degree of cleanliness which may be attained. In the slanting type of apparatus shown in Fig. 3, the dry cleaning fluid which is being supplied by the system of nozzles 3 is used for pre-cleaning the fibrous material and then prevented from coming further into contact with it, i. e. it is caused to flow directly to the basin 4. The dry cleaning fluid coming from the system of nozzles 53 will be able to effect a relatively high degree of cleanliness since it is not mixed in the cleaning zone with the relatively dirty dry cleaning fluid used for precleaning the fibers prior and during their passage between rolls 8 and 9. The unclean dry cleaning fluid originally supplied by the system of nozzles 53 is drained off to basin 4 before the fibers on the lower slanting surface 52 are subjected to jets or sprays of dry cleaning fluid coming from the system of pipes or nozzles 54. Thus the apparatus shown in Fig. 3 permits to achieve progressive degrees of cleanliness at a relatively rapid rate. If the degree of cleanliness which can be attained with an apparatus of the type shown in Fig. 1 is not sufficient for the purpose in hand, a composite apparatus of the kind shown in Fig. 4 may be used which comprises a substantially vertical precleaning arrangement and a substantially horizontal finishing arrangement.

Referring now to Fig. 4, the right hand side of that figure shows diagrammatically a number of rolls which are arranged and supposed to operate in the same way as the rolls in the structure shown in Fig. 1, i. e. the rolls 8, 9; 22, 23 and 24, 25 which are shown in Fig. 4 are provided with means not shown in the drawing whereby they are rotated positively at different surface speeds, thereby subjecting any fibrous material which is passed through the bites between said rolls to a rubbing action in the direction of the movement of the fibers through chamber 2. The endless conveyer 37 receives the fibers upon their passage through rolls 24 and 25 and conveys the fibers to another group of cleaning rolls which has generally been indicated by the reference sign 55. Rolls 55 are housed in a substantially gastight extension 56 of chamber 2. The upper bank of

rolls 55 is engageable with the upper, and the lower bank of rolls 55 is engageable with the lower, surface of the layer of fibers issuing from conveyer 37. The rolls of said two banks of rolls are out of registry so as to cause alternate flexings of any layer of fibers which is being passed therebetween. Rolls 55 are provided with a shifting device for oscillating the rolls of one bank of rolls relative to the rolls of the other bank of rolls to exert transverse rubbing pressure by the rolls on the fibrous layer in opposite directions. A suitable shifting device for such an arrangement of cleaning rolls has been more fully described in my Patent 2,479,358. The wetting device 57 which is fed from tank 53 comprises a plurality of spray nozzles which are adapted to apply clean dry cleaning fluid to the layer of fibers at the gaps formed between consecutive rolls of the upper bank of rolls to flush out any dirt left after the dry cleaning between the vertical rolls. Cleaning fluid which drops to the bottom of chamber 56 is removed by a drain pipe 59. Rolls 60 and 61 form part of a substantially gastight seal of chamber 56 permitting the continuous removal of cleaned fibers.

If desired, cleaning rolls 55 may be arranged in registry rather than out of registry, as shown on the drawing. Moreover, cooperating pairs of rolls 55 may be positively operated at different surface speeds instead of being oscillated in a transversal direction, thus substituting longitudinal rubbing pressure for transversal rubbing pressure.

It will be seen from the foregoing that the apparatus which is shown in Fig. 4 comprises means for advancing a layer of fibers consecutively through two cleaning zones in one of which the layer is precleaned and subjected to a rubbing action having the same direction as the direction of the movement of the layer, while in the other cleaning zone the layer is subjected to a finishing cleaning action which may include a rubbing action transversely to the direction in which it is being advanced. This change of the direction of the rubbing action in different cleaning zones is conducive to a more complete removal of impurities from the fibers though it is only needed in cases where the fibers are extremely soiled or dirty. During the finishing cleaning action fresh dry cleaning fluid flushes off any residues of impurities which may have still adhered to the fibers prior to their passage through extension chamber 56.

Referring again to Fig. 1, owing to the action of springs 18 pairs of cooperating rolls 8, 9; 22, 23; 24, 25 may separate to a certain extent when pressed apart by fibrous material which is being passed therebetween. For this reason it is necessary to provide the apparatus with a special kind of gears, well known in the art, which do not get out of mesh on the occurrence of displacements of the rolls 8, 9; 22, 23 and 24, 25 as caused by the passage of fibrous materials of uneven thickness therebetween.

The number of worker rolls 8, 9; 22, 23; 24, 25 which it is desirable to provide depends upon several factors such as, for instance, the kind of material which it is desired to process, the nature and the amount of foreign matter contained therein which is sought to be removed therefrom, and the speed at which the processing is to be effected.

While Fig. 1 shows a layer 6 of loose fibers on the conveyer belt 5, the same machine may also be used to treat one or more thicknesses of fabric, or furs, or skins, or hat bodies upon being hardened or partly fulled, or any other fibrous matter adapted to be dry cleaned.

It will be understood that by illustrating herein preferred forms of apparatus for practicing the process of the invention, I do not intend to limit my invention thereto. While I have described and illustrated herein only preferred embodiments of the several mechanisms of the invention, these may take other form than as specifically shown and described herein. It will be apparent to those skilled in the art that various changes and modifications may be made without departing from the spirit of the invention or from the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. An apparatus for cleaning fibrous material with a dry cleaning agent comprising two banks of spaced rotatable rolls having smooth and highly polished surfaces, the rolls forming one bank being adapted to engage cooperatively the rolls forming the other bank, a plurality of pairs of said cooperatively engaging rolls being arranged at different levels, said cooperatively engaging rolls being adapted to engage opposite surfaces of a layer of fibrous material and to advance the layer through the nips formed between cooperatively engaging rolls, each pair of cooperatively engaging rolls arranged at a relatively higher level being adapted to feed said layer directly into the nip formed between a pair of cooperatively engaging rolls arranged immediately below, a feeding device adapted to feed fibrous material to the nip formed between a pair of cooperatively engaging rolls arranged above the level of at least one other pair of cooperatively engaging rolls, a wetting device adapted to supply cleaning agent to the fibrous material prior to its passage through said nip, and operating means for the rolls of both banks comprising gear means for positively rotating each of the rolls constituting a pair of cooperatively engaging rolls at unequal surface speeds for exerting a rubbing action upon the layer of fibrous material arranged therebetween.

2. An apparatus for cleaning fibrous material with a dry cleaning agent comprising two banks of spaced rotatable rolls having smooth and highly polished surfaces, the rolls forming one bank being adapted to engage cooperatively the rolls forming the other bank, a plurality of pairs of said cooperatively engaging rolls being arranged at different levels, said cooperatively engaging rolls being adapted to engage opposite surfaces of a layer of fibrous material and to advance the layer through the nips formed between cooperatively engaging rolls, each pair of cooperatively engaging rolls arranged at a relatively higher level being adapted to feed said layer directly into the nip formed between a pair of cooperatively engaging rolls arranged immediately below, a feeding device adapted to feed fibrous material to the nip formed between a pair of cooperatively engaging rolls arranged above the level of at least one other pair of cooperatively engaging rolls, a wetting device adapted to supply cleaning agent to the fibrous material prior to its passage through said nip, and operating means for the rolls of both banks comprising gear means for positively rotating each of the rolls constituting a pair of cooperatively engaging rolls at unequal surface speeds for exerting a rubbing action upon the layer of fibrous material arranged therebetween, said operating means including gear

means for rotating at least one pair of cooperatively engaging rolls situated at a relatively low level at relatively higher surface speeds than one pair of cooperatively engaging rolls situated at a relatively higher level.

3. An apparatus for dry cleaning fibrous material with a dry cleaning agent comprising two banks of spaced rotatable rolls having smooth and highly polished surfaces, the rolls forming one bank being adapted to engage cooperatively the rolls forming the other bank, the rolls of each bank being arranged in registry one above the other in a vertical direction and adapted to engage opposite surfaces of a layer of fibrous material and to advance said layer through the nips formed between pairs of cooperating rolls, each said pairs of cooperating rolls situated above the lowest of said pairs of cooperating rolls being adapted to feed said layer of fibrous material directly into the nip formed between one of said pairs of cooperating rolls situated immediately below, a feeding device adapted to feed fibrous material to the nip formed between the top pair of said pairs of cooperating rolls, a wetting device adapted to supply cleaning agent to the fibrous material prior to its passage through said nip, and common operating means for the rolls of both said banks including gear means for positively rotating each of the rolls constituting one of said pairs of cooperating rolls at unequal surface speeds for exerting a rubbing action upon the layer of fibrous material arranged therebetween.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
4,164	Hoskins	Aug. 26, 1845
198,557	Bachelder	Dec. 25, 1877
266,248	Worrall	Oct. 17, 1882
599,070	Turner	Feb. 15, 1898
796,530	Quackenbos	Aug. 8, 1905
851,539	Malard	Apr. 23, 1907
899,440	Shuman	Sept. 22, 1908
969,952	Harris	Sept. 13, 1910
1,400,159	Hawley	Dec. 13, 1921
1,432,318	Brandwood et al.	Oct. 17, 1922
1,527,369	Meyer	Feb. 24, 1925
1,626,439	Voegeli	Apr. 26, 1927
1,764,809	Smith	June 17, 1930
1,788,840	Mantius	Jan. 13, 1931
1,790,392	Skelton	Jan. 27, 1931
2,025,768	Nieman	Dec. 31, 1935
2,223,858	Schellenberg	Dec. 3, 1940
2,223,860	Schellenberg	Dec. 3, 1940
2,284,503	Williams	May 26, 1942
2,368,916	Drum	Feb. 6, 1945
2,479,358	Hoffman	Aug. 16, 1949