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APPARATUS FOR TREATMENT OF PILE FABRICS

Original Filed July 7, 1958

2 Sheets-Sheet 1

Fig. 1.

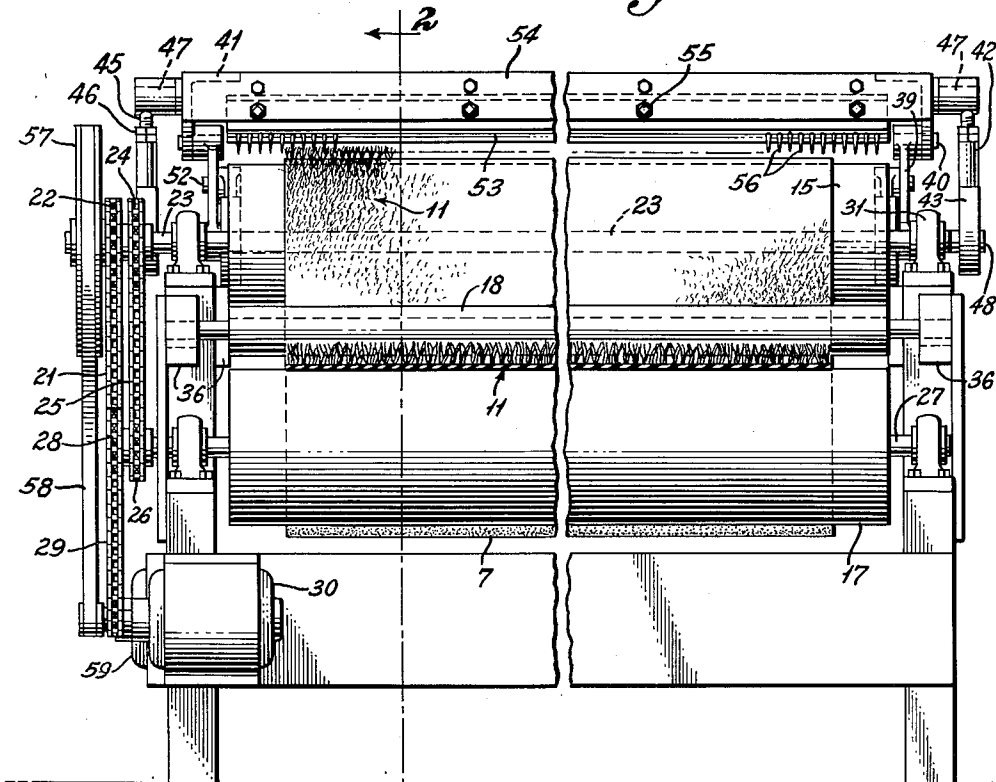


Fig. 3.

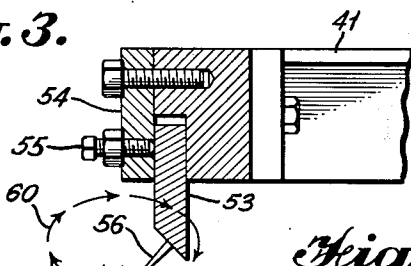
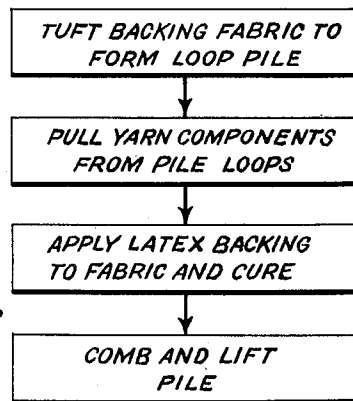
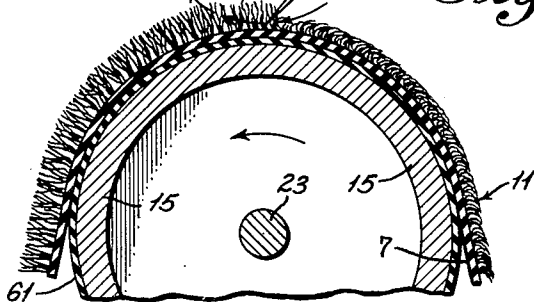


Fig. 5.



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2 Sheets-Sheet 2

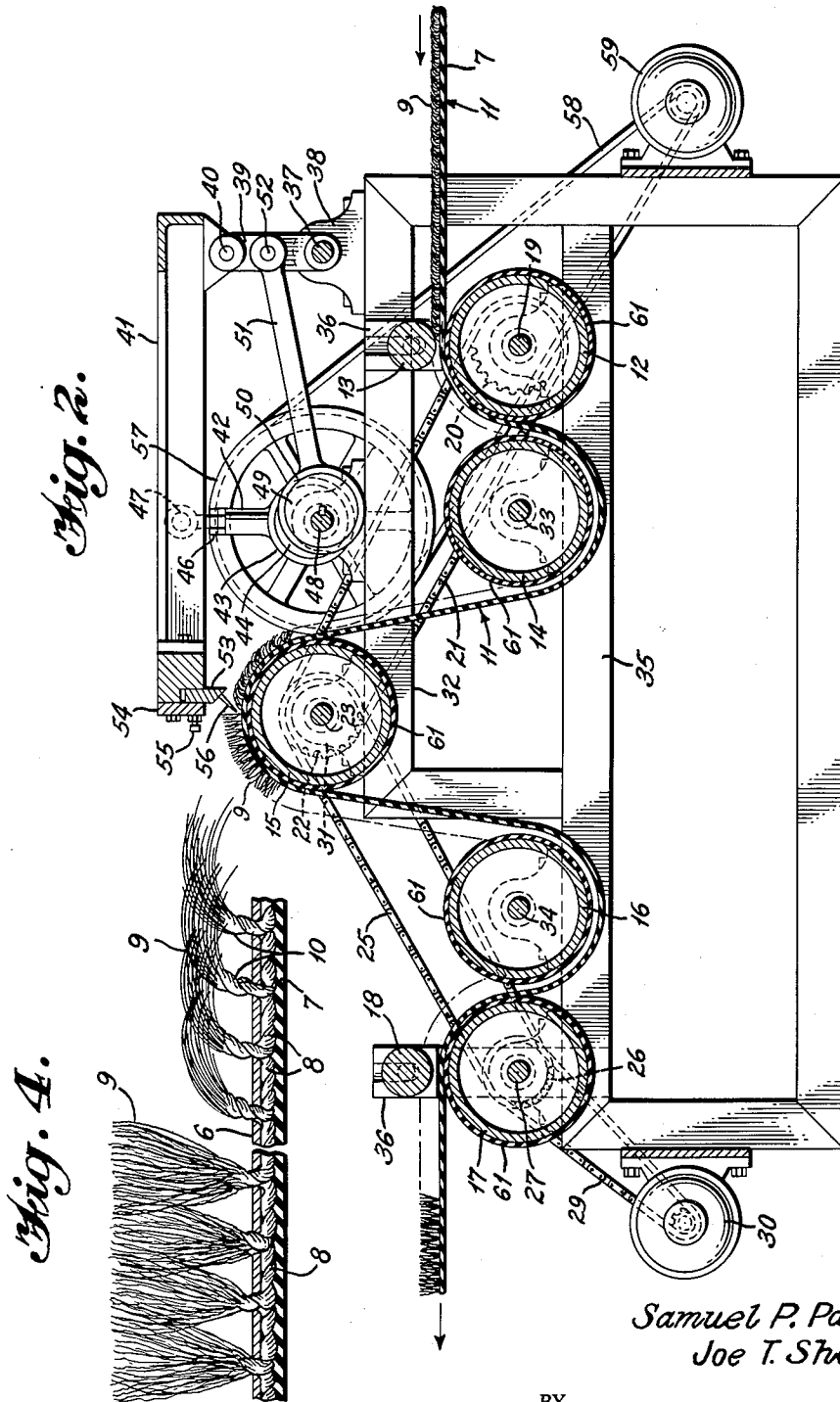


Fig. 2.

Fig. 4.

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APPARATUS FOR TREATMENT OF PILE FABRICS

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Continuation of application Ser. No. 747,065, July 7, 1958. This application Jan. 13, 1961, Ser. No. 82,646

14 Claims. (Cl. 26—2)

The present invention relates to apparatus for the treatment of pile fabrics. The invention is more particularly concerned with the treatment of tufted fabrics to produce and enhance the appearance of a deep, soft, fleecelike surface thereon.

A method is known for producing a tufted fabric having a deep fleecelike surface thereon. In that method a backing fabric is tufted with multiple component strands to form pile loops on one face of the backing fabric and to position longitudinally spaced portions of the strands on the opposite face of the backing fabric. The individual components of the strands may be continuous filaments or may be staple fibers of a length at least three times the height of the pile loops. Components are pulled from each pile loop to rob lengths of such components from at least one adjacent pile loop in the same longitudinal row of loops. This pulling action is continued until the pile loops have disappeared and been replaced by a fleecelike surface of individual strand components of average length several times greater than the original height of the pile loops.

The present invention represents an extension of and an improvement in the procedure described above. For many uses it is essential that the fabric produced by the foregoing procedure have a binder applied to the opposite or rear face of the fabric for the purpose of binding the strand components to each other and to the backing fabric. This binder is preferably a heat-curable binder and latex is commonly used. The binder cannot be applied until after the strand components have been pulled to form the fleecelike surface for the reason that the strand components must be free to move relative to each other during such pulling action. The binder is applied to the rear face of the backing fabric by any suitable coating apparatus, such as a roller coater, and it has been found that during the coating process the fibers forming the fleecelike surface become pressed down or matted to an objectionable extent. The coated fabric is then subjected to heat to cure the binder and the heat tends to "set" the fibers in the pressed-down state. The application of heat to cure the binder also appears to cause the fibers to revert toward their original twist, particularly near the backing fabric.

The primary object of the present invention is to provide apparatus for overcoming these objections and for greatly enhancing the appearance of the finished fabric.

Another important object of the invention is to provide simple but highly efficient apparatus for simultaneously severely combing and lifting the pile of the fleecelike surface of the fabric.

According to the present invention the fleecelike surface of a fabric having the binder cured on the opposite face thereof is subjected to a vigorous combing and pile-lifting action. A comb is caused to move transversely of its length in an elliptical or closed curvilinear path in such manner that the rigid teeth of the comb enter the fleecelike surface of the fabric while the teeth are moving generally longitudinally of their length. The points of the teeth very closely approach the backing fabric and the teeth then move generally transversely of their length to comb and lift the pile. In so doing, any twist which may exist in the fibers is removed and the pile is lifted

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to such an extent that its apparent depth is increased and its appearance enhanced.

The invention may be clearly understood from the following detailed description which has reference to the accompanying drawings, wherein:

FIGURE 1 is an elevational view of the front or delivery end of apparatus embodying the invention;

FIGURE 2 is a vertical sectional view taken in the direction of the arrows along the line 2—2 of FIGURE 1;

FIGURE 3 is an enlarged vertical sectional view showing the relationship of the comb and fabric supporting roller and also illustrating the path of the movement of the teeth of the comb;

FIGURE 4 is an enlarged sectional view of a piece of fabric, a portion only of which has been treated with the apparatus of FIGURES 1 to 3; and

FIGURE 5 is a flow chart diagrammatically illustrating the steps of producing and treating the fabric.

Referring first to FIGURE 5, a backing fabric of woven or non-woven material is tufted on any conventional multiple needle tufting machine to form loop pile on one face of the backing fabric and to position longitudinally spaced portions of the pile yarns or strands on the opposite face of the backing fabric. The tufting strands may be spun yarns or may be tow of continuous filaments, with or without definite twist. The use of yarns spun from staple fibers of synthetic material is preferred. The spun yarns must be composed of fibers of staple length at least three times, and preferably at least seven or eight times, the height of the pile loops. Yarns spun from fibers of staple length of from one and one-half to three inches will be found satisfactory when the height of the pile loops is from one-fourth of an inch or less to about three-fourths of an inch. Very coarse spun yarns are preferred. When tow is used to tuft the backing fabric, the tow should be of at least thirteen hundred and preferably four thousand to five thousand denier or more and should preferably be composed of at least one hundred and fifty filaments. Irrespective of whether spun yarns or tow are used as the tufting strands, the unit size of the strands should be equivalent to 4s (cotton count) or coarser and the twist multiplier should not exceed above five.

Prior to application of a binder to the thus tufted fabric, the pile loop surface of the fabric is subjected to a vigorous and very severe fiber pulling action. This pulling action, in the case of fabric tufted with spun yarns, results in pulling of the fibers out of the pile loops to random lengths. The fibers are pulled longitudinally of the spun yarns from two or more adjacent pile loops in the same longitudinal row of loops. The fiber pulling action is continued until the pile loops have disappeared and have been replaced by fibers of random lengths which form a deep, soft, fleecelike surface.

The fiber pulling action may be performed by conventional planetary nappers, either single action or double action, or by a napper of the type known as a box napper. The tufted fabric is usually passed through the napper a plurality of times.

It has been assumed in the foregoing description that the backing fabric has been tufted with spun yarns. The procedure is substantially the same when the backing fabric is tufted with tow. However, when tow is used, the napping action breaks the continuous filaments of the tow into random lengths while pulling the filaments.

A binder material, which may be latex, is then applied to the rear or opposite face of the napped fabric by means of any suitable coating apparatus, such as a roller coater. The coated fabric is then subjected to heat to cure the binder. During the coating and curing steps, the fibers assume a condition more or less diagrammatically illustrated at the right in FIGURE 4. In that figure

the backing fabric is designated by the reference numeral 6 and the cure binder is designated by the reference numeral 7. The longitudinally spaced portions of the pile yarns are illustrated at 8. The reference numeral 9 designates random lengths of individual fibers which have been pulled from the pile loops during the napping action. It will be seen that the fibers 9 have become somewhat pressed down or matted and that there is a certain amount of twist in the fibers as indicated at 10. The matting of the fibers 9 appears to result from the pressure necessarily applied to the fabric during the coating operation. The twist 10 may be residual twist which was not removed during the napping action or may be caused primarily by the heat used to cure the binder.

The curing of the binder 7 causes the individual fibers to be securely bonded to each other in the longitudinally spaced portions 8 and also to be firmly bonded to the rear face of the backing fabric 6. The fibers 9 can then be subjected to the severe combing action accomplished by the apparatus illustrated in FIGURES 1 to 3 without pulling an excessive number of the fibers 9 from the fabric. This combing action combs out the twist 10 and lifts the fibers 9 to place the fabric in the condition shown at the left in FIGURE 4. The appearance of the fabric is greatly improved by this combing and lifting operation and the apparent depth of the pile is greatly increased.

Referring now to FIGURES 1 to 3, a fabric 11 having a cured binder 7 on its lower surface is passed between a driven roller 12 and a weighted roller 13. The fabric 11 then passes beneath an idler roller 14 and over a driven working roller 15. The fabric then passes beneath an idler roller 16 and between a driven roller 17 and a weighted roller 18, from which point the fabric is fed to storage or other distribution. The roller 12 is fixed to a shaft 19 having a sprocket 20 thereon. The sprocket 20 is driven by a chain 21 from a sprocket 22 fixed to a shaft 23 which carries the working roller 15. Also fixed to the shaft 23 is a sprocket 24, which is driven by a chain 25 from a sprocket 26 secured to a shaft 27 of the roller 17. Also secured to the shaft 27 is a sprocket 28, driven by a chain 29 from any suitable source of power such as an electric motor 30.

The shaft 23 of the roller 15 is mounted in suitable bearings 31 on horizontal frame members 32. The idler rollers 14 and 16 are mounted on shafts 33 and 34, respectively. The shafts 19, 27, 33 and 34 are mounted in similar bearings on lower horizontal frame members 35. The weighted rollers 13 and 18 have reduced ends which are free to move vertically in guides 36.

The roller 17 is driven at a slightly higher surface speed than the roller 15. The roller 15 is in turn driven at a slightly higher surface speed than the roller 12. The fabric 11 thus has tension applied to it longitudinally as it passes over the working roller 15.

A shaft 37 extends parallel to the shaft 23 and is supported by bearings 38 secured to the horizontal frame members 32. The shaft 37 extends the full width of the machine and at each side of the machine there is oscillatably mounted on the shaft 37 a connecting link 39. A stub shaft 40 pivotally connects the upper end of each connecting link 39 with one end of a comb support 41. Each side of the comb support 41 is supported intermediate its ends by an arm 42 of an eccentric strap 43 on an eccentric 44. Each arm 42 is adjustable in length as indicated by the threaded portion 45 and the nuts 46. The upper end of each arm 42 is pivotally connected to a circular boss 47 secured to a side of the comb support 41.

The eccentrics 44 are keyed to a shaft 48. Also keyed to shaft 48 are eccentrics 49 provided with eccentric straps 50 and arms 51. The outer ends of the arms 51 are pivotally connected at 52 to the connecting links 39. Upon rotation of the shaft 48, the eccentrics 49 cause the connecting links 39 to oscillate about the shaft 37. The eccentrics 44 similarly cause the comb support 41 to oscillate about the stub shafts 40. The eccentrics 44 and 49 and

their associated straps and arms thus provide crank means for imparting a compound motion to the comb support 41. This motion is such that the free end of the comb support follows a curvilinear path which is oval or elliptical.

A rigid comb 53 is secured to the free end of the comb support 41 by means of a plate 54 and clamping bolts 55. The comb 53 is provided with a plurality of rigid pins or teeth 56 which are aligned in a row parallel to the shaft 23 of the roller 15.

The shaft 48 is driven by means of a pulley 57 and a belt 58 from any suitable power source such as an electric motor 59. The eccentricities of the eccentrics 44 and 49 and the angular orientation of those eccentricities are such that the points of the teeth 56 follow a curvilinear path which is generally elliptical or oval as indicated by the reference numeral 60 in FIGURE 3. The length of the arms 42 is appropriately adjusted so that the points of the teeth 56 enter the pile of fabric 11 passing over the roller 15 and very closely approach the woven backing fabric 6.

The teeth 56 point generally in the direction of movement of the comb 53 as the teeth enter the pile. It will be seen from inspection of FIGURE 3 that the points of the teeth 56 most nearly approach the roller 15 while the teeth are moving along one of the flatter sides of the oval path 60. It will thus be seen that the teeth 56 enter the pile while moving predominantly longitudinally of their length. The teeth then move almost horizontally while the points of the teeth pass nearest the roller 15 and then begin leaving the pile while moving predominately transversely of the length of the teeth. Such arrangement and movement of the teeth 56 provide a severe combing action accompanied by an actual lifting of the pile. The combing action serves to comb out the twist 10, illustrated in FIGURE 4, and to lift the pile into the condition shown at the left in FIGURE 4.

The teeth 56 must be rigid and sufficiently strong to dig into the twist 10 to comb out that twist. It is important that the teeth 56 be aligned in a single row to eliminate loading of the comb with lint, which would defeat the combing action. The spacing of the teeth 56 in the row also seems important to avoid the comb becoming loaded with lint. A distance of approximately one hundred and fifty thousandths of an inch between the points of the pins has been found satisfactory. The shaft 48 may be driven at approximately five hundred revolutions per minute to cause the teeth 56 to travel the path 60 that number of times per minute. The fabric 11 may be passed through the machine at about five feet per minute, which will cause the teeth 56 to travel one complete path 60 while the fabric 11 was being advanced approximately one-eighth of an inch. The rollers 12, 14, 15, 16 and 17 are provided with rubber covers, as indicated at 61.

We have illustrated and described what we now consider to be the preferred embodiment of our invention. It will be apparent, however, that various modifications may be resorted to without departing from the broader scope of the invention as defined by the claims.

This application is a continuation of our copending and now abandoned patent application Serial No. 747,065, filed July 7, 1958.

Having thus described our invention, we claim:

1. Apparatus for combing and lifting the pile on a pile fabric comprising a frame, a rotatable roller, means for advancing a pile fabric over said roller, a link pivotally mounted on a fixed pivotal axis parallel to said roller, a comb support pivotally mounted at one end of said link on a pivotal axis parallel to said roller, drive means connected to said link to oscillate the same about its fixed pivotal axis, drive means connected to said comb support to oscillate the same about its pivotal connection to said link to cause a portion of said comb support to follow a closed curvilinear path, a toothed comb mounted on said portion of said comb support parallel to said roller to

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move in said path, the teeth of said comb pointing generally in the direction of movement of said comb in approaching that point in its path at which said teeth most closely approach the surface of said roller.

2. Apparatus for combing and lifting the pile on a pile fabric comprising a frame, a rotatable roller, mechanism for advancing a pile fabric under longitudinal tension over said roller, a link pivotally mounted at one end on a fixed pivotal axis parallel to said roller, a comb support pivotally mounted at the opposite end of said connecting link on an axis parallel to said roller, crank means connected to said link to oscillate the same about its fixed pivotal axis, second crank means connected to said comb support to oscillate the same about its pivotal connection to said connecting link, means for driving said crank means, the throws and angular orientation of said crank means being arranged to cause a portion of said comb support to follow a closed curvilinear path, a toothed comb secured to said portion of said comb support in parallel relationship to said roller, the teeth of said comb pointing generally in the direction of movement of said comb in approaching that point in its path at which said teeth most closely approach the surface of said roller.

3. Apparatus for combing and lifting the pile on a pile fabric comprising a frame, a rotatable roller, means for advancing a pile fabric over said roller, a link pivotally mounted at one end on a fixed pivotal axis parallel to said roller, a comb support pivotally mounted to the opposite end of said link on a pivotal axis parallel to said roller, drive means connected to said link to oscillate the same about its fixed pivotal axis, drive means connected to said comb support to oscillate said comb support about its pivotal connection to said link to cause a portion of said comb support to follow a closed curvilinear path, a toothed comb rigidly secured to said portion of said comb support, said comb being disposed in parallel relationship to said roller, the teeth of said comb being aligned in a single row parallel to said roller, the aligned teeth of said comb pointing generally in the direction of movement of said comb in approaching that point in its path at which said aligned teeth most closely approach the surface of said roller.

4. Apparatus for combing and lifting the pile on a pile fabric comprising a frame, a rotatable roller, means for advancing a pile fabric over said roller, a link pivotally mounted at one end on a fixed pivotal axis parallel to said roller, a comb support pivotally mounted to the opposite end of said link on a pivotal axis parallel to said roller, drive means connected to said link to oscillate the same about its fixed pivotal axis, drive means connected to said comb support to oscillate the same about its pivotal connection to said link to cause a portion of said comb support to follow a generally elliptical path in which a portion of said comb support most closely approaches said roller at the middle of one of the flatter portions of said path, and a toothed comb secured to said portion of said comb support.

5. Apparatus for combing and lifting the pile on a pile fabric comprising a frame, a rotatable roller, means for advancing a pile fabric over said roller, a link pivotally mounted at one end on a fixed pivotal axis parallel to said roller, a comb support pivotally mounted to the opposite end of said link on a pivotal axis parallel to said roller, an eccentric connected to said link to oscillate the same about its fixed pivotal axis, a second eccentric connected to said comb support to oscillate the same about its pivotal connection to said link, means for driving said eccentrics to cause a portion of said comb support to follow a generally elliptical path, said portion of said comb support most closely approaching said roller at the middle of one of the flatter portions of said path, and a toothed comb secured to said portion of said comb support.

6. Apparatus for severely combing and lifting the pile on the face of a pile fabric having a deep, fleecelike surface thereon, comprising a rotatably mounted roller, fab-

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ric feed mechanism for advancing the fabric under longitudinal tension over said roller with the fleecelike surface facing outwardly, a toothed comb disposed parallel to said roller, mechanism for positively moving said comb transversely of its length through a generally elliptical path in which the comb most closely approaches said roller in one of the flatter portions of said path, the teeth on said comb pointing in the general direction of movement of said comb in approaching said one flatter portion of said path.

7. Apparatus for severely combing and lifting the pile on the face of a pile fabric having a deep, fleecelike surface thereon, comprising a frame, a rotatably mounted roller, fabric feed mechanism for advancing the fabric under longitudinal tension over said roller with the fleecelike surface facing outwardly, a toothed comb disposed parallel to said roller, mechanism for positively moving said comb transversely of its length through a generally oval path in which the comb most closely approaches said roller in one of the flatter portions of said path, the teeth on said comb aligned in a single row parallel to said roller and pointing in the general direction of movement of said comb in approaching said one flatter portion of said path.

8. Apparatus for combing and lifting the pile on a pile fabric comprising a frame, a roller rotatable in said frame, means for advancing a pile fabric over said roller, connecting link means pivotally mounted at one end to said frame on a pivotal axis parallel to said roller, a comb support pivotally mounted to the opposite end of said connecting link means on a pivotal axis parallel to said roller, first drive means connected to said connecting link means to oscillate the same about its pivotal axis with said frame, second drive means connected to said comb support to oscillate the same about its pivotal connection to said connecting link means to cause a portion of said comb support to follow a closed curvilinear path, a toothed comb secured to said portion of said comb support, said comb being disposed in parallel relationship to said roller, the teeth of said comb pointing generally in the direction of movement of said comb in approaching that point in its path at which said teeth most closely approach the surface of said roller, whereby said teeth enter the pile and comb and lift the same.

9. Apparatus for combing and lifting the pile on a pile fabric comprising a frame, a roller rotatable in said frame, mechanism for advancing a pile fabric under longitudinal tension over said roller, connecting link means pivotally mounted at one end to said frame on a pivotal axis parallel to said roller, a comb support pivotally mounted to the opposite end of said connecting link means on a pivotal axis parallel to said roller, first crank means connected to said connecting link means to oscillate the same about its pivotal axis with said frame, second crank means connected to said comb support to oscillate the same about its pivotal connection to said connecting link means, means for driving said crank means at the same angular speed, the throws and angular orientation of said crank means being arranged to cause a portion of said comb support to follow a closed curvilinear path, a toothed comb secured to said portion of said comb support, said comb being disposed in parallel relationship to said roller, the teeth of said comb pointing generally in the direction of movement of said comb in approaching that point in its path at which said teeth most closely approach the surface of said roller, whereby said teeth enter the pile of the fabric on said roller and comb and lift the pile.

10. Apparatus for combing and lifting the pile on a pile fabric comprising a frame, a roller rotatable in said frame, means for advancing a pile fabric over said roller, connecting link means pivotally mounted at one end to said frame on a pivotal axis parallel to said roller, a comb support pivotally mounted to the opposite end of said connecting link means on a pivotal axis parallel to said roller, first drive means connected to said connecting

link means to oscillate the same about its pivotal axis with said frame, second drive means connected to said comb support to oscillate the same about its pivotal connection to said connecting link means to cause a portion of said comb support to follow a closed curvilinear path, a toothed comb rigidly secured to said portion of said comb support, said comb being disposed in parallel relationship to said roller, the teeth of said comb being aligned in a single row parallel to said roller, said teeth pointing generally in the direction of movement of said comb in approaching that point in its path at which said teeth most closely approach the surface of said roller, whereby said teeth enter the pile and comb and lift the same.

11. Apparatus for combing and lifting the pile on a pile fabric comprising a frame, a roller rotatable in said frame, means for advancing a pile fabric over said roller, connecting link means pivotally mounted at one end to said frame on a pivotal axis parallel to said roller, a comb support pivotally mounted to the opposite end of said connecting link means on a pivotal axis parallel to said roller, first drive means connected to said connecting link means to oscillate the same about its pivotal axis with said frame, second drive means connected to said comb support to oscillate the same about its pivotal connection to said connecting link means to cause a portion of said comb support to follow a generally elliptical path in which a portion of said comb support most closely approaches said roller at the middle of one of the flatter portions of said path, a toothed comb secured to said portion of said comb support, said comb being disposed in parallel relationship to said roller, the teeth of said comb pointing generally in the direction of movement of said comb in approaching said one flatter portion of said path, whereby said teeth enter the pile and comb and lift the same.

12. Apparatus for combing and lifting the pile on a pile fabric comprising a frame, a roller rotatable in said frame, means for advancing a pile fabric over said roller, connecting link means pivotally mounted at one end to said frame on a pivotal axis parallel to said roller, a comb support pivotally mounted to the opposite end of said connecting link means on a pivotal axis parallel to said roller, first eccentric means connected to said connecting link means to oscillate the same about its pivotal axis with said frame, second eccentric means connected to said comb support to oscillate the same about its pivotal connection to said connecting link means, means for driving said eccentric means at the same angular speed, the throws and angular orientation of said eccentric means being arranged to cause a portion of said comb support to follow a generally elliptical path, said portion

of said comb support most closely approaching said roller at the middle of one of the flatter portions of said path, a toothed comb rigidly secured to said portion of said comb support, said comb being disposed in parallel relationship to said roller, the teeth of said comb pointing generally toward said roller and in the direction of movement of said comb in approaching said one flatter portion of said path whereby said teeth enter the pile and comb and lift the same.

13. Apparatus for severely combing and lifting the pile on the face of a pile fabric having a deep, fleecelike surface thereon, comprising a frame, a roller rotatably mounted in said frame, fabric feed mechanism for advancing the fabric under longitudinal tension over said roller with the fleecelike surface facing outwardly, a comb disposed parallel to said roller, mechanism for positively moving said comb transversely of its length through a generally elliptical path in which the comb most closely approaches said roller at the middle of one of the flatter portions of said path, and rigid teeth on said comb pointing in the general direction of movement of said comb in approaching said one flatter portion of said path, whereby said teeth enter the fleecelike surface of the fabric with a motion predominately longitudinally of the length of the teeth and leave said fleecelike surface with a motion predominately transversely of the length of the teeth.

14. Apparatus for severely combing and lifting the pile on the face of a pile fabric having a deep, fleecelike surface thereon, comprising a frame, a roller rotatably mounted in said frame, fabric feed mechanism for advancing the fabric under longitudinal tension over said roller with the fleecelike surface facing outwardly, a comb disposed parallel to said roller, mechanism for positively moving said comb transversely of its length through a generally oval path in which the comb most closely approaches said roller at the middle of one of the flatter portions of said path, and rigid teeth on said comb aligned in a single row parallel to said roller, said teeth pointing in the general direction of movement of said comb in approaching said one flatter portion of said path, whereby said teeth enter the fleecelike surface of the fabric with a motion predominately longitudinally of the length of the teeth and leave said fleecelike surface with a motion predominately transversely of the length of the teeth.

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