Sept. 13, 1938. L. A. RUNTON 2,129,707

PROCESS OF NAPPING TEXTILE FABRICS

Filed April 28, 1936 3 Sheets-Sheet 1

Fig. 1.

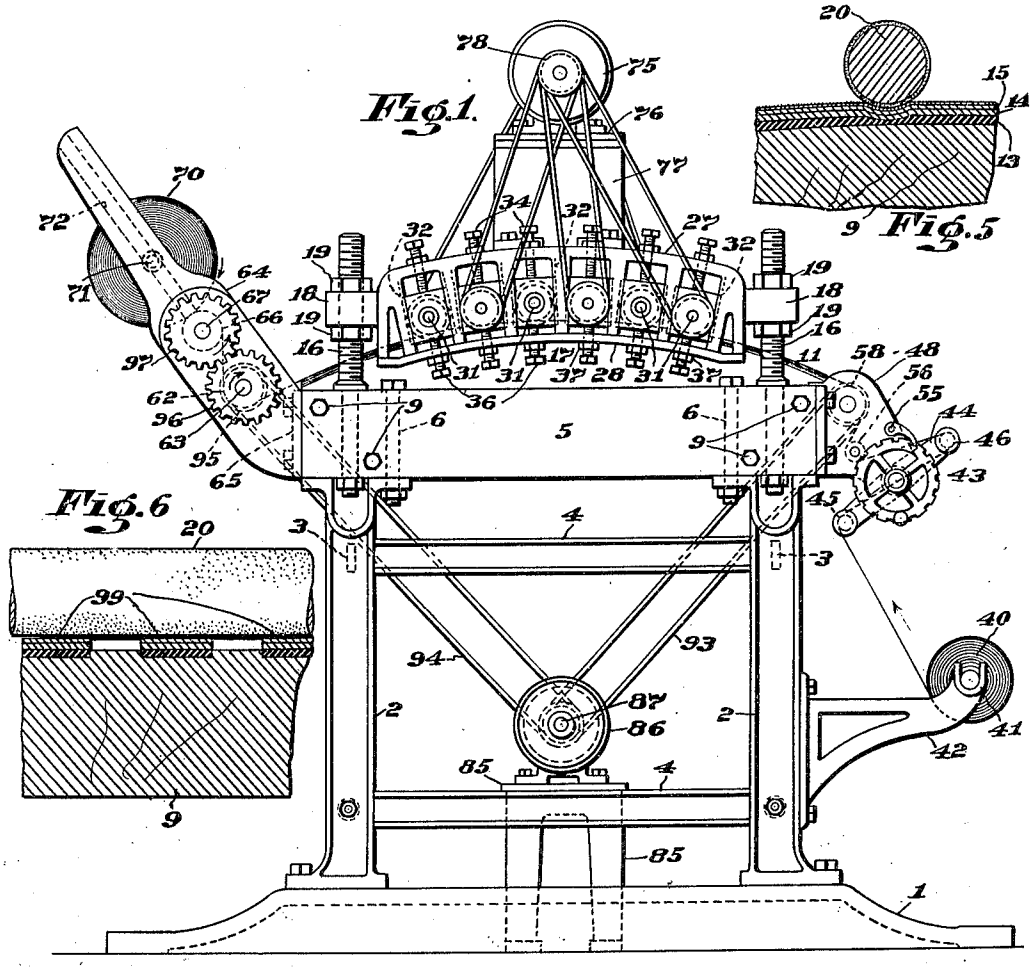
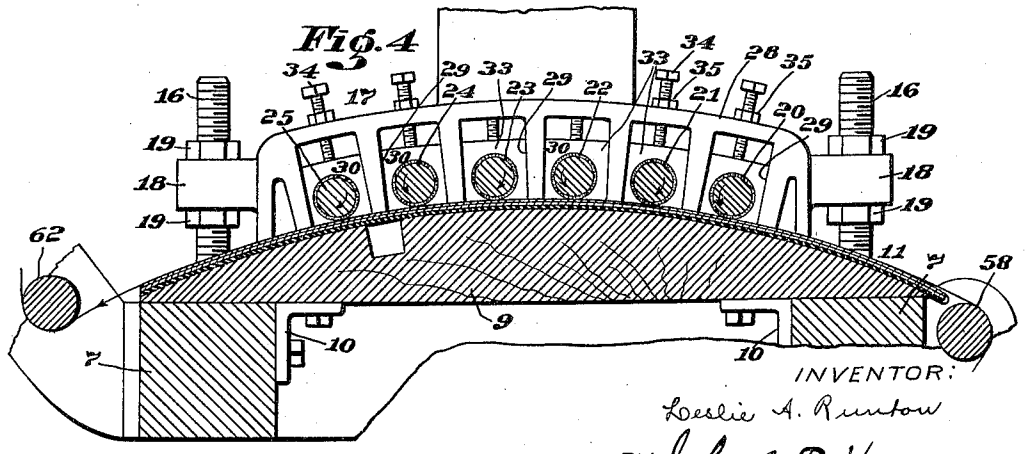


Fig. 5

Fig. 6

Fig. 4



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PROCESS OF NAPPING TEXTILE FABRICS

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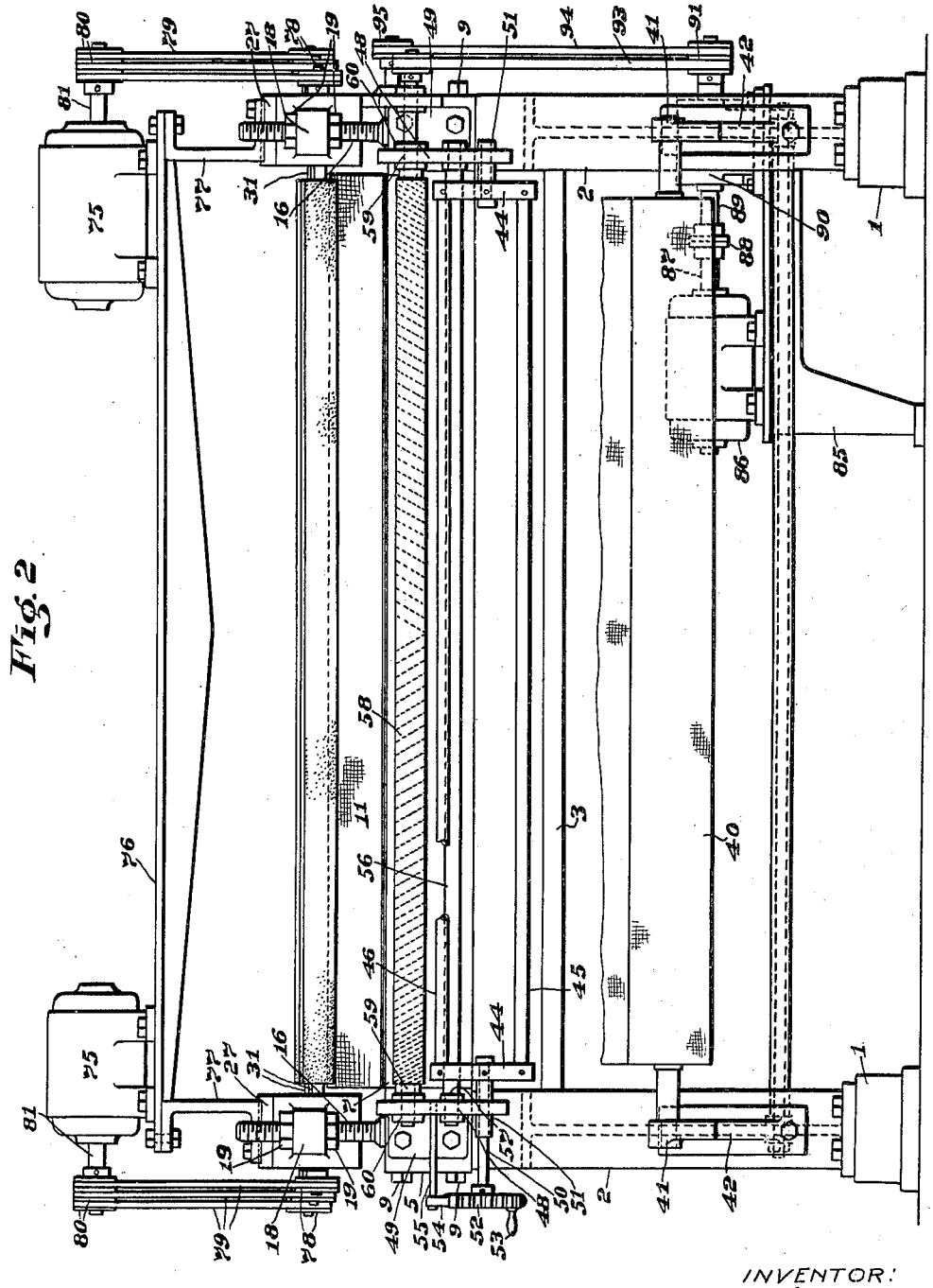


Fig. 2

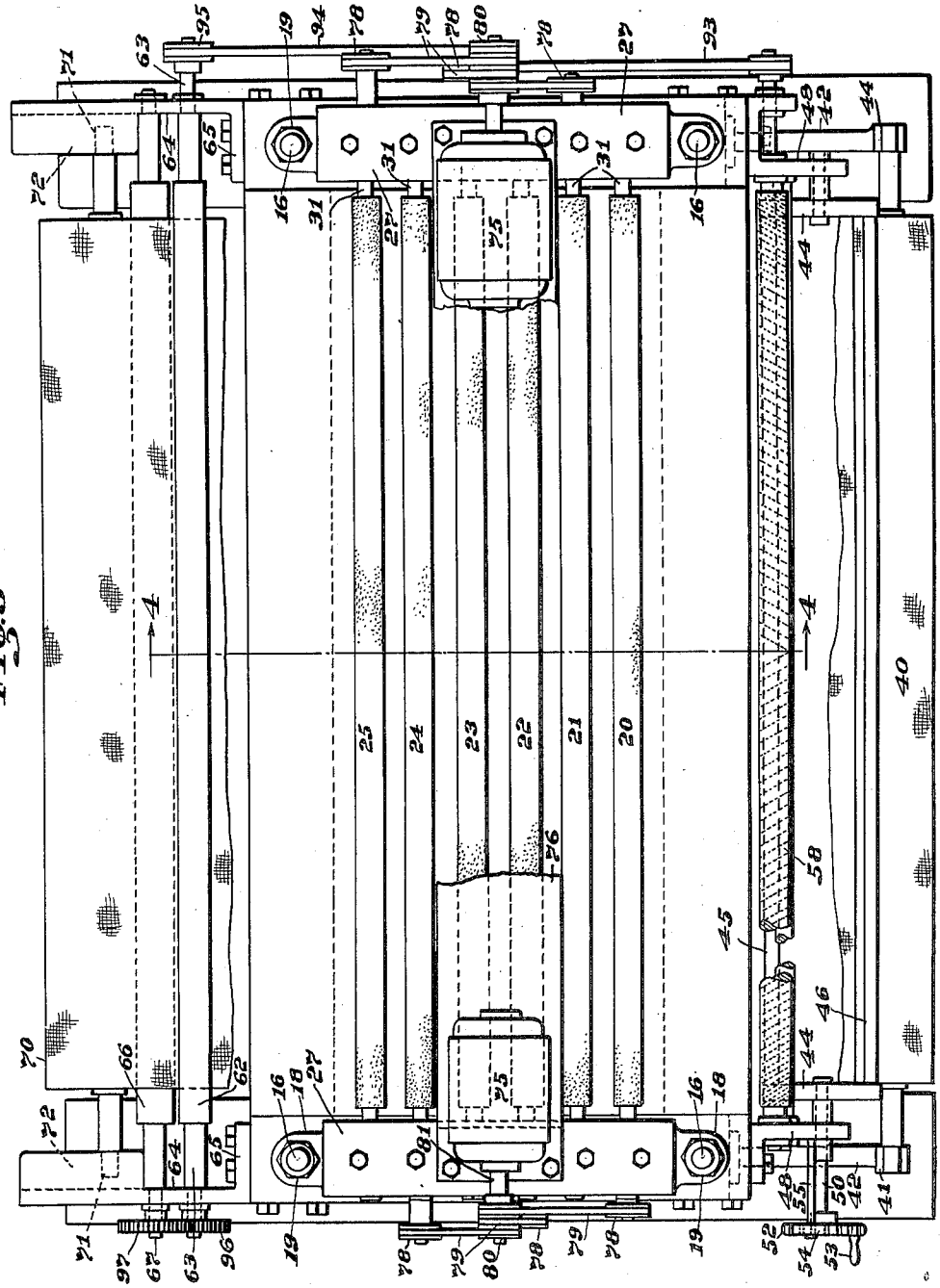
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PROCESS OF NAPPING TEXTILE FABRICS

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Fig. 3



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UNITED STATES PATENT OFFICE

2,129,707

PROCESS OF NAPPING TEXTILE FABRICS

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Application April 28, 1936, Serial No. 76,774

7 Claims. (Cl. 26—29)

The invention relates to an improved process of napping textile fabrics.

By textile fabrics is meant to include textile fabrics of all kinds, whether woven, braided, or knitted.

By napping is meant to include such lifting, or raising, of the surface fibres of the fabric as will enhance its handle, appearance, and light reflecting qualities; impart velvetlike softness of texture, with improved draping qualities, and suppleness.

The napping of textile fabrics has never been accomplished with complete success. Some fabrics might be napped very well, others indifferently, and some with no success. Soft, relatively thin fabrics, could not well be napped, previous operations tending to ripple the fabric, and the napping occurring only at the tops of the ripples, the effect being entirely unsatisfactory. Rayons could not well be napped. Print cloths, especially those employing the darker shades, could not well be napped for the reason that the dye paste so locked in the fibre as to prevent an easy napping. Soft knit cloths are also very resistant to napping owing to their softness, previous operations tending more to pluck pieces out of the knit fabric than to nap it.

The object of the invention is to obviate all of these difficulties and to put a napped or suede finish on all fabrics, some of which have heretofore never been napped at all because of difficulties above referred to; to impart a napped finish to relatively thin fabrics, to hard printed cretonne to canvase, or soft knitted goods; to take away the hard lustre of rayon fabrics and impart a soft velvety tone; to impart to a cheap, gaudy print, rich and mellow tones, the coarse boardy feel taken away, and for it substituted a velvety soft finish.

Further objects are:—

To make a finish unbroken, dense and level, with no loose or straggling fibres, and this without the necessity of any subsequent shearing operations;

To provide a quick, substantially one-step process, in which the fabric during the finishing will run continuously, unwinding from a take-off roll for finishing, and after finishing winding up on a wind-up roll;

To provide whereby the napped pile may be laid down and maintained in a particular direction if such be desired;

To provide an operation by which the surface fibres of the fabric may be cut irrespective of the direction of their lay, and this without weakening the body of the fabric; especially to avoid damage to piece goods by napping streaks into the fabric at which places the fabric is exceedingly tender and weak; and

To provide whereby variations may be obtained in the finish, depending upon the kind of fabric, and effect desired to be attained.

All these are within the objects of the invention.

As will later be more fully explained the actual cutting of the surface fibre to form the nap is effected by means of rolls covered with suitable elements for effecting the cutting operation, depending upon the fabric treated, and the effect desired to be obtained. The covering may be a strap of carborundum cloth, garnet, or glass, or, in other words, any suitable cutting abrasive. This is wound around the roll spirally to leave an even unbroken surface with abutting edges, and glued to the roll or otherwise secured thereto. In other cases, according to the fabric treated, a wire clothing as in a napper, may be employed; or the toothed wire like that in a carding engine.

Each cutting roll has length sufficient to enable the roll to process the body of the fabric between its selvedge edges which are best left unnapped. As compared with its length the cutting roll is of relatively small diameter. A roll of three to five inches diameter is preferably employed. In any event, the roll should be such that it will keep its shape and remain unbent during the cutting operation. The rolls are rotated at fairly high speed but the speed of their rotation will depend upon the diameter of the roll for the surface or peripheral speed of the roll is the factor to be considered and not the speed of rotation. In practice a roll three inches in diameter rotated at a speed of fourteen hundred revolutions a minute with a surface speed of 1,099 feet per minute has proven efficient. With a five inch roll in order to maintain substantially the same surface speed the roll would be rotated at a speed of approximately 800 revolutions a minute. The speed of rotation, and consequently the surface speed of the cutting roll, will depend more or less upon the fabric worked upon and the effect desired to be attained, keeping in mind that the operation is a cutting operation and not a grinding operation. The rolls are brought into contact with the surface of the fabric and when so engaged, cut the exposed thread surface and thus develop a cut pile, or velvet effect on the fabric.

Dependence is preferably made not upon one roll but upon a series of rolls all working upon

the fabric at the same time. These rolls may vary in the direction of their rotation, some rotating clockwise and others anti-clockwise. Preferably four or six cutting rolls are employed, following one another in relatively close sequence. The clothing, or cutting element, on these rolls may also vary, depending upon the effect desired to be attained.

The actual cutting operation would be of little avail unless the fabric is properly maintained during such operation. The action of the rolls tends to displace the fabric, and form air pockets, owing to the high rotative speed of the rolls. The fabric must be retained in such manner as to avoid any such displacement, or formation of air pockets. Proper maintenance of the fabric is primarily obtained by stretching the fabric held taut or tensely stretched over the face of a bed, or backing support, and preferably by stretching it over a curved bed, or backing support, against which the fabric will be held in constant contact. The bed or bed facing should, also, be so soft and resilient that the cutting rolls, when brought into contact with the fabric stretched over the bed, or bed facing, will form indentations in it.

The fabric thus held taut or tensely stretched over the bed, or backing support, is drawn past the cutting rolls during the cutting operation. The frictional resistance offered by the bed, or backing support, to drag of the fabric over it offers some assistance in preventing displacement of the fabric by the operation of the cutting rolls. This resistance, however, is not sufficient to injure the fabric by undue stretching. The essential factor depended upon for holding the fabric in place against displacement by the cutting roll during the operation thereof is the pulling of the fabric held taut or tensely stretched over the bed, or backing support, by means independent of the cutting or abrasive roll. This tends to stretch the fabric and make it resistant to displacement.

Hence it will be seen that the invention provides a process of napping textile fabrics which comprises subjecting the fabric to the action of a rotated abrasive roll, holding the fabric against the roll during the operation thereof by a backing support against which said roll has bearing through the interposed fabric, and during the operation of the roll drawing the fabric taut past said roll and backing support by means independent of the operation of said roll whereby displacement of the fabric by said roll during the operation thereof will be checked.

With the fabric thus held against displacement by the cutting roll during the operation thereof some further assistance in holding the fabric in place against displacement by the cutting roll during its cutting operation is afforded by providing the bed or backing support, against which the roll has bearing through the interposed fabric, with a resilient facing against which the roll may be brought to bear with intensity sufficient to imbed itself to a certain extent in the facing by forming some slight indentation therein. In such case while ordinarily, owing to the increased resistance thus obtained between the cutting roll and fabric, there would be all the more tendency to displace the fabric during the cutting operation, yet with the fabric held against displacement by means independent of the abrasive or cutting roll the upward thrust of the elastic support or backing against the fabric and roll offers some assistance in holding the fabric in place during the cutting.

For the purpose of further assisting in preventing displacement of the fabric during the cutting, and especially for the purpose of varying the direction of cut, the cutting rolls, in alternate arrangement, are preferably rotated in different directions, some clockwise and some anti-clockwise. The covering for the rolls is also preferably varied to obtain the best effects, although this depends upon the fabric treated and end to be attained. In some cases the first cutting roll may have a relatively coarse abrasive, or cutting element, which may gradually be finer, as the rolls progress.

The rate at which the fabric is advanced will depend upon the fabric worked upon and effect desired to be attained although with cutting rolls of larger diameter the fabric can be advanced faster than with rolls of lesser diameter for the reason that the larger diameter rolls have a wider bearing against the fabric at the point of cutting.

After the cutting the direction or lay of the nap or pile may be governed, if a laid nap is wanted, by brushing the nap which has first been subjected to a jet of steam shot through the fabric and brushed down by the last roll which may be covered with bristles. As the nap is brushed down the moisture from the steam, and the heat, set the lay of the pile.

With certain dyed fabrics heat changes may be effected in the color of the dyestuff by speeding up the rolls and developing a relatively high degree of frictional heat. A speed of 2000 revolutions per minute with a three inch diameter cutting roll coupled, with a high friction abrasive, will change the tones of a cheap, gaudy print to soft, rich, expensive looking, mellow tones, and take away the coarse boardy feel and handle of the fabric, and substitute for it a velvety soft handle.

The rolls cut with absolute precision, leaving an unbroken, dense, and level nap. All loose or straggling fibres, are cut off without necessitating any subsequent shearing operations.

The invention can further be understood in the light of the drawings which show the apparatus for practicing it, and in which it is physically embodied.

In the drawings:

Fig. 1 is a side elevation of the machine.

Fig. 2 is a front elevation.

Fig. 3 is a plan.

Fig. 4 is a section on the line 4—4 of Fig. 3.

Fig. 5 is a cross section illustrative of the working relation of the rolls to the pad.

Fig. 6 is a fragmentary plan of a modified form of the pad.

Referring to the drawings:—

The frame of the machine comprises spaced base members 1, 1, to which are secured upright corner posts 2, 2, 2, 2. These posts are connected by side bars 3, 3, and end bars 4, 4. Mounted upon the posts at the opposite ends of the machine, horizontally disposed, are crossheads 5, 5. Each of these crossheads is fixed by bolts 6 to the tops of the adjacent set of posts. Disposed in the same horizontal plane with the crossheads, but extending longitudinal of the machine, along the front and back, are beams 7, 7, each secured by bolts 8 to the respective crossheads.

Mounted upon the beams 7, 7, inside the crossheads 5, 5, is a pad support 9. This support rests upon the beams 7, 7 and is held against displacement by angle pieces 10 secured to the beams and pad support.

The pad support has the general form of a segment of a cylinder, its top surface being convex. Laid upon this top surface and securely fixed to the pad support is a resilient pad 11. This pad is preferably made up of a base layer of sponge rubber 13 about ½ inch in thickness. Above the sponge rubber is a layer of felt 14 about ¼ inch in thickness, and over the felt is stretched a canvas top 15. This canvas top may be any suitable tough canvas, or cloth, presenting a surface offering good frictional resistance. The several layers of the pad, and canvas, are secured to the pad support in any suitable manner. The fabric to be processed is drawn over this pad. The width of the pad is a little more than the width of the fabric to be processed, not including its selvedge edges, the desire being that the selvedge edges of the fabric shall extend beyond the sides of the pad so as not to be processed.

Bolted to the ends of the crossheads 5, 5, with upward extension therefrom are studs 16, 16, 16, 16. The upwardly extending portion of each stud is threaded. Secured to the studs, and adjustable thereon towards and away from the pad at the opposite side ends of the machine, are master roll carriers 17, 17. Each of these roll carriers is secured to adjacent studs by projecting ears 18, which slip down over the studs and are then fixed to the studs in any adjusted position by nuts 19 on the studs above and below the ears and with which ears the nuts have engagement. Thus mounted each roll carrier is adjustable as a whole towards and away from the pad, and may be fixed in any adjusted position.

Each master roll carrier 17 is carrier for a series of spaced rolls 20, 21, 22, 23, 24, 25, disposed to extend longitudinally over the face of the pad with axes parallel to the face of the pad. These rolls are cutter rolls, each being covered with clothing for cutting as previously explained. The roll 25, however, may be a finishing roll provided with bristles. Each master carrier has the general form of the convexity of the pad, with a top plate 27, a bottom plate 28, and various side forming partitions 29 which collectively provide a series of cages 30 for the ends to the shafts 31 of the respective rolls. Slidable up and down in ways 32 formed in the sides 29 of these cages are boxes 33 in which the end of the shaft 31 of each roll is disposed to turn, suitable ball bearings (not shown) being provided. Each roll is individually adjustable, movable towards or away from the pad 12 and maintained in any adjusted position. To this end the top plate 27 is provided with adjusting bolts 34 threaded to extend through the plate and bearing against the various boxes. Each bolt 34 is held in any adjusted position by means of a locking nut 35 threaded upon it which locks against the plate. Likewise the plate 28 is provided with a series of bolts 36 extended through it which bear against the under sides of the boxes. Each of these bolts is held in any adjusted position by a locking nut 37 threaded upon the bolts with bearing against the plate 28. Thus the rolls are supported in manner to be brought forcibly into engagement with the pad and there maintained in any adjusted position. It will also be observed that the inclination of the ways 32 for the various cages in which the roll boxes are slidable, is along the radii to the curve of the pad, assuming such radii to be extended.

Referring now to the various means which control the run of the fabric, or cloth, to be processed, 40 represents the take-off roll on which the fabric to be processed is wound. This roll is mounted to turn in the forked ends 41 of brackets 42 bolted to the posts 2, 2, at the front of the machine.

From the take-off roll the fabric runs upwardly to a tension device 43. This device comprises end pieces 44, 44 to which are fixed parallelly spaced tension bars 45, 46, the run of the fabric being over the tension bar 45, thence under the tension bar 46. The tension device is mounted upon and between spaced plates 48, 48 projecting forward from the fore ends of the crossheads 5, 5, and to these crossheads the plates are fixedly secured by providing the plates each with an angle 49 which is bolted to the end of the crosshead. The tension device is secured to the plates 48, 48 in such manner that it may turn thereon and the angularity of the tension bars to the run of the fabric changed for increasing or diminishing the tension. Accordingly, the end pieces 44, 44 of the tension device are provided with shafts 50 which extend through and turn within bearings 51 on the plates 48, 48. One of the shafts 50, extended beyond its bearing, bears a ratchet wheel 52 operated to turn by a handle 53, and held in any turned position by means of a dog 54 arranged upon a shaft 55 connecting with the adjacent plate 48, and by which means the tension device may be maintained in any adjusted position.

After passing around the tension bar 46 the fabric proceeds upwardly to pass beneath an idler roll 56 mounted to turn in bearings 57 on the plates 48, 48.

From the idler roll the fabric proceeds upwardly over a scroll roll 58 which operates to spread the fabric just before its initial entry onto the pad. The scroll roll 58 is borne by a shaft 59 mounted to turn in bearings 60 on the plates 48, 48.

From the scroll roll 58 the fabric passes over the pad beneath the cutting rolls.

After leaving the pad on the rear side of the machine the fabric passes beneath a roll 62 rotated in the direction of the arrow indicated upon it. The shaft 63 of this roll is journaled to turn in bracket forming arms 64, 64 each provided with an angle 65, and these angles are bolted, respectively, to the rear ends of the crossheads 5, 5.

From the roll 62 the fabric passes upwardly over a roll 66, rotating in the direction of the arrow indicated upon it. The shaft 67 of this roll is journaled to turn upon and between the bracket forming arms 64, 64.

From the roll 66 the fabric passes onto a wind-up roll 70 rotating in the direction of the arrow indicated upon it. The shaft 71 of this roll turns within ways 72, 72 formed on the interior sides of the bracket forming arms 64, 64. The rolls 62 and 66 are driven rolls, as will later be more fully explained. The wind-up roll 70, however, is driven by its frictional contact with the roll 66 so that as its diameter increases, as the fabric winds thereon, the ends of its shaft 71 will move along the ways 72, 72 in which they are contained, so providing for the enlargement of the roll.

Referring now to the mechanism for operating the various parts of the machine. The cutter rolls are operated by electric motors 75, 75. These motors are mounted upon an overhead platform 76 fixedly secured through interposed bar con-

nections 77 to the top plates 27 of the master roll carriers 17, 17 so as to be movable with the roll carriers. Each motor drives three rolls. The shafts 31 of the rolls, extending beyond the boxes 33 within which they are journaled to turn, are provided with pulleys 78 which connect through belt connections 79 with pulleys 80 on the shafts 81 of the respective motors. The arrangement is such that each motor will drive the set of rolls to which it is belted in a direction reverse to the direction of the rolls driven by the other motor, one set of rolls turning in direction clockwise and the other set turning in direction anti-clockwise. The motors are variable speed motors so that the rotary speed of the rolls may be varied as occasion requires.

Mounted on a stand 85 connected to a bottom end bar 4 of the machine is a variable speed motor 86 the shaft 87 of which is connected through a suitable coupling 88 to a shaft 89 journaled to turn on a bearing 90 on the end of the stand 85 on which the motor is mounted. The end of the shaft 89 projecting beyond its bearing bears pulleys 91, 92. The pulley 91 has belted connection 93 with the scroll roll 58 for driving this roll in a direction reverse to the direction the fabric is moving in the operation of the machine. The pulley 92 has belted connection 94 with a pulley 95 on the end of the shaft 63 of the roll 62 for turning this roll. The opposite end of the shaft 63, extending beyond its bearing, is provided with a gear 96 which meshes with a gear 97 on the end of the projecting shaft 67 to the roll 66, the two rolls 62 and 66 thus being positively driven from the motor 86.

The general operation is as follows: After the threading of the fabric through the various rolls with extension over the face of the pad as above outlined, the master roll carrier, through adjustment, is moved down until all the rolls are in proper coordination with the fabric on the pad, and the carriers are then set in the adjusted position thus obtained. Each individual roll is then adjusted by moving down the roll to have working contact with the fabric and this preferably with such degree of force as will cause some indentation in the pad. The amount of force any roll is pressed down depends somewhat on the fabric processed and effect desired to be attained.

The operation of the driven rolls 62 and 66, and the wind-up roll 70 is to draw the fabric over the face of the pad during the operation of the cutting rolls. The draw of the fabric will be retarded by the tension device 43 and scroll roll 58 and in consequence the fabric will be drawn tight against the convex surface of the pad.

The resilient pad admits of considerable variation in its form and structure. A pad made entirely of sponge rubber without any felt or cloth covering as before described, is most satisfactory.

In Fig. 6 a modification in the structure of the pad is shown in that instead of the pad being continuous, covering the entire top surface of the pad support, the pad is made in spaced sections 99, in the direction of the length of the fabric. With such a pad the cutting rolls will operate only at the points of the pads with the effect that the fabric is finished with strips of napped and unnapped sections.

In some cases it is desirable that the nap or pile be brushed and laid down. This effect may be obtained by providing one of the rolls, or the roll 25, with a clothing of bristles, and steaming the fabric by introducing live steam into a steam box 100 beneath the pad and from which the steam will pass through the pad onto the fabric at a point just forward of the brush. Steam is preferably introduced at a pressure of about 120 pounds.

A plurality of cutting rolls are preferably employed for the reason that while napping might be done by a single cutting roll, yet it would be for the most part impractical as compared with a plurality of rolls for the reason that the fabric would have to be advanced so much slower than the rate of its advance when a number of cutting rolls are employed, all operating at the same time. Moreover there is danger in running the fabric too slow and leaving it too long under the roll. It cannot be left too long under the roll else the surface will be ground off. The fabric must be advanced with speed, under which circumstances a proper napped finish cannot be obtained with a single cutting roll but only with a plurality of cuting rolls, preferably four to six, and these rotated preferably some in one direction and others in a reverse direction.

The frictional heat developed by rotating the cutting rolls at high speed will cause changes in dye colors.

The variety of abrasives will produce a variety of finishes.

The varying direction, downward pressure, and speed of the rolls, also makes for change of finishes. The pressure exerted by all the rolls should be an equal pressure in so far as possible, and this may be determined by the insertion of a steel gauge between the fabric and each roll. After this, further adjustment of the rolls, for obtaining a determinate finish, follows an examination of the fabric. If it is found that a sufficient cut is not being obtained to attain the required finish then the pressure on the rolls is increased, and this through adjustment of the master roll carriers, in order that all the rolls may be moved down together. Care should be taken to avoid too great a pressure which, instead of increasing the cutting, might result in a grinding operation, and even sever the fabric, but this danger is lessened owing to the character of the pad.

The following examples are illustrative:

For finishing a printed cotton cretonne, 6 oz. to the square yard. Alternate rolls covered with strips of carborundum cloth of 180 mesh; rolls of 3" diameter rotated at 1400 R. P. M. clockwise; the other rolls of like diameter, covered with carborundum cloth of 240 mesh rotating at 1220 R. P. M. anti-clockwise. Speed of fabric 2 yards per minute. Result: a smooth velvet handle; change of bright colors to more mellow tones with a brocade effect; the pattern outlines are blurred and not in black and white contrast.

For finishing a solid piece dyed 100% filament rayon fabric weighing about 5 to 6 oz. per square yard. All rolls of 3" diameter covered with carborundum of 260 mesh; rotating at 900 R. P. M. in alternate directions, some clockwise and others anti-clockwise. Speed of fabric 1½ yards per minute. Result: the hard shine, or lustre, is obliterated and a velvet nap surface substituted, with more mellow and subdued colors.

For finishing plain knitted fabric made on a 36 gauge machine from an 80/2's mercerized yarn, and which has been shrunk in a caustic bath. All rolls of 3" diameter covered with carborundum cloth of 200 mesh; alternate rolls rotating in opposite directions at 1000 R. P. M. Speed of fabric 3 yards per minute. Result: a fine chamoisette fabric especially adaptable for the making of cotton gloves.

In some cases, especially with the firmer woven fabrics, it is better to make the pad, or bed, for the rolls entirely of felt, in layer form, no rubber being used, the felt, however, having a canvas top the same as before.

The term "convex" occurring herein, and in the appended claims, as applied to the form of the pad, is used in the broad sense of meaning any bulging surface, whether distinctly spherical, or merely curved.

I claim:

1. The process of napping textile fabrics which comprises subjecting the fabric to the action of a rotated abrasive roll, holding the fabric against the roll during the operation thereof by a backing support against which said roll has bearing through the interposed fabric, and during the operation of the roll drawing the fabric held taut past said roll and backing support by means independent of the operation of said roll whereby displacement of the fabric by said roll during the operation thereof will be checked.

2. The process of napping textile fabrics which comprises subjecting the fabric to the action of a rotated abrasive roll, holding the fabric against the roll during the operation thereof by a stationary backing support against which said roll has bearing through the interposed fabric, and during the operation of the roll drawing the fabric held taut past said roll and backing support by means independent of the operation of said roll whereby displacement of the fabric by said roll during the operation thereof will be checked.

3. The process of napping textile fabrics which comprises subjecting the fabric to the action of a rotated abrasive roll, holding the fabric against the roll during the operation thereof by a resilient backing support against which said roll has bearing through the interposed fabric, and during the operation of the roll drawing the fabric held taut past said roll and backing support by means independent of the operation of said roll whereby displacement of the fabric by said roll during the operation thereof will be checked.

4. The process of napping textile fabrics which comprises subjecting the fabric to the action of a rotated abrasive roll, holding the fabric against the roll during the operation thereof by a resilient backing support against which said roll has bearing through the interposed fabric, bringing said roll and backing member into such juxtaposition that the roll will engage the fabric with pressure sufficient to indent said backing support, and during the operation of the roll drawing the fabric held taut past said roll and backing member by means independent of the operation of said roll whereby displacement of the fabric by said roll during the operation thereof will be checked.

5. The process of napping textile fabrics which comprises subjecting the fabric to the action of a plurality of rotated abrasive rolls successively arranged, holding the fabric against these rolls during the operation thereof by a backing support against which said roll has bearing through the interposed fabric, during the operation of the rolls drawing the fabric held taut past said rolls and backing support by means independent of the operation of said rolls whereby displacement of the fabric by said rolls during the operation thereof will be checked, and rotating certain of said rolls in direction opposite to the direction of rotation of other of said rolls.

6. The process of napping textile fabrics as specified in claim 1 which comprises subjecting the fabric to the action of a rotated abrasive roll, holding the fabric against the roll during the operation thereof by a backing support over which the fabric held taut is bent and against which said roll has bearing through the interposed fabric, and during the operation of the roll drawing the fabric held taut as aforesaid past said roll and backing support by means independent of the operation of said roll whereby displacement of the fabric by said roll during the operation thereof will be checked.

7. The process of napping textile fabrics as specified in claim 2 which comprises subjecting the fabric to the action of a rotated abrasive roll, holding the fabric against the roll during the operation thereof by a stationary backing support over which the fabric held taut is bent and against which said roll has bearing through the interposed fabric, and during the operation of the roll drawing the fabric held taut as aforesaid past said roll and backing support by means independent of the operation of said roll whereby displacement of the fabric by said roll during the operation thereof will be checked.

LESLIE A. RUNTON.