This invention relates to a machine adapted for continuous operation for the making of cemented pile fabrics such as carpets, rugs, upholstery and similar material.

The present application is a division of my application Serial No. 211,660, "Pile fabric and method and apparatus for making the same," filed August 2, 1927.

Among the objects of my invention are to provide a form of machine adapted for continuous operation, by means of which a pile fabric product may be continuously made in any desired length and at a rate of operation materially higher than that possible with looms for the making of pile fabrics.

Another object of the present invention is to provide a form of machine adapted for continuous operation to fold or pleat a pile element material, such as a batt, between a series of fixed "wires" or separators in such a manner that the base portions of the folds or pleats lie in a substantially continuous surface, the various operations to which the folded or pleated pile element material is subsequently subjected in attaching the pile element material to a backing being performed successively on the machine while the pile element material is rigidly held in place between the "wires" or separators.

Another object of the invention is to provide a form of machine particularly adapted for folding or pleating a pile element material, such as a batt, between spacing elements or "wires" arranged in fixed relation in a closed curve, such as upon the surface of a drum or cylindrical member, so as to permit continuous operation and the carrying out of various steps to permanently attach the pile element material to a backing while the pile element material is rigidly held in place in the folded or pleated relation.

Another object of the invention is to provide a form of machine adapted for continuous operation which comprises a rotatable drum or cylinder upon the surface of which spacing elements or "wires" are rigidly attached axially of the drum, or in other words along the elements of the cylindrical surface; and which comprises a form of inserting mechanism adapted to operate in synchronism with the drum so as to fold or pleat the pile element material between successive spacing elements or "wires," as the drum is rotated, and which further comprises a coating mechanism operatively connected to the drum or cylindrical member to coat the exposed surface or bases of the folds or pleats with a suitable cementing material and means in conjunction with the drum or cylindrical member for applying a flexible backing member to the coated surface of the rigidly held folds or pleats and for permanently attaching the flexible member, so that the flexible member together with the upstanding folds or pleats attached thereto may be directly withdrawn from between the spacing elements or "wires" for the carrying out of various finishing operations to produce the desired pile fabric product.

Another object of the invention is to provide a form of machine adapted for continuously carrying out the combination of steps for the forming of pile upstanding from a backing, which is adapted or the use of unspun fibres, for rubberizing appropriate portions of the pile elements, for drying moisture or solvent from the rubberizing material, for doubling or connecting the rubberized elements to a fabric base, and for vulcanizing the rubber cement material and withdrawing the material from the machine in one continuous cycle of operations, involving continuous feeding of pile-element material, backing and rubberizing material to the machine, and continuously removing the product for finishing operations.

Another object of the invention is the provision of a form of machine having means for forming pile element material into a series of loops or folds between "wires" or spacing elements at a high rate of speed, the spacing elements or "wires" being permanently attached to a continuously moving element, such as a massive cylindrical drum, and for securing accurate alignment between the inserting elements, or mechanism, and the spacing elements.

Another object of the invention is to provide means for relating or registering the
inserting elements with successive "wires" or spacing elements on the moving cylindrical member at a high rate of speed without correspondingly moving the inserting mechanism as a whole to produce successive action of folding or pleating between the "wires".

Another object of the invention is to provide a plurality of means for holding the loops or pleats already formed in place between the "wires" and to provide successive operation of the parts of the inserting mechanism in contacting and withdrawing the parts from the loops or pleats, in a manner such that the parts shall not interfere with or displace the formed portions of the pleats or loops held in place between the "wires" or spacing elements.

Another object of the invention is to provide a form of machine for the purposes set forth having a continuously moving element carrying "wires" or spacing elements between which folds or pleats are inserted in a manner so as to be capable of direct withdrawal without displacing the "wires" and vulcanizing means associated therewith for vulcanizing a rubber cement material applied to the exposed surface of the folds or pleats to permanently attach a backing material to the coated surface, and means associated with the vulcanizing elements to permit their application in such a manner as to resiliently limit the applied pressure during vulcanization.

Another object of the invention is to provide means whereby the vulcanizing elements may be alternately applied to and withdrawn from the material held between the "wires" or spacing elements upon the continuously moving drum so as to successively and progressively vulcanize the rubber cement material during the operation of the drum.

With these and other objects in view, the invention comprises various features hereinafter more fully described and particularly defined in the claims.

The invention is illustrated in the preferred form in the accompanying drawings, in which:

Fig. 1 is a sectional view in elevation of a form of machine for the making of cemented pile fabric by a continuous operation; and

Fig. 2 is a flow chart illustrating the preferred sequence of steps in the making of the cemented pile fabric product.

In carrying out my invention, the raw stock to be used for forming the pile, consisting of hair, wool, jute, or other fibres, or mixtures thereof, is preferably first prepared by passing it through a picker, or lumper, as the nature of the stock may require, to more or less separate the fibres, and to remove foreign material. The stock is then put on a garnett or a carding machine, with the object of disintegrating the fibrous masses remaining in the stock and to form the fibres into a lap or batt of a substantially uniform thickness. The fibres are preferably arranged on an endless carrier in such a manner that the greater portion of the fibres will be arranged longitudinally of the batt, which produces a better and more economical use of the stock in the piling or loop-forming machine. It is to be understood, however, that satisfactory results may be obtained without laying or arranging the fibres longitudinally, as would result, for example, by the use of a Blamire lapper, which folds the web initially formed at the doffer of the carding machine into folds transverse to the longitudinal direction of the lap. I prefer, however, to lay the fibres in a general direction longitudinally of the batt, as may be accomplished by providing a wider and thicker batt than that desired, to be used, and then drafting or drawing it between rollers and at the same time narrowing the batt until the desired width and thickness thereof are produced. By means of this drawing or drafting action, the fibres will be arranged substantially in parallelism, whereby the loss of material resulting from arrangement of fibres transversely to the batt is reduced to a minimum. The thickness of the batt should be regulated in accordance with the pile density desired in the finished product and in accordance with the character of the fibres used, as will be apparent to those skilled in the art.

Referring more particularly to the drawings, the various steps of the method and apparatus for carrying out my invention may now be described.

After a batt 10 of the desired thickness and width has been formed, as above described, it is preferably carried, by means of an apron or conveyor belt 12, moving at an appropriate speed, to a chase 11 to be operated upon by a loop-forming or pleating mechanism 15 of suitable form. The machine of my invention consists primarily of a drum 14, having a width preferably somewhat greater than that of the pile fabric which is to be made, which is suitably mounted in bearings and is preferably driven at a low constant speed. The drum may be driven by any suitable means, although I preferably employ a worm wheel, which is attached to the circumference of the drum, and which is engaged by a driving worm, as indicated in Fig. 1.

Mounted on or attached to the cylindrical surface of the drum are a multiplicity of thin plates or so-called "wires" 16 which are preferably arranged parallel to the axis of the drum and are spaced apart at the desired equal intervals so as to provide the desired number of loops per inch in the final prod-
These "wires" or separators are preferably rigidly fastened to the drum and correspond in function substantially to that of the loose wires of a loom, which are used to form a pile in the ordinary woven pile fabric. The "wires" have been illustrated in the drawings, for the sake of simplicity, as being arranged radially to the drum, whereby the fibres in the loops or pleats formed in the batt or pile element material employed will be mainly in a direction substantially at right angles to the surface of the batt or pile element material formed by the base of the loops.

It is to be understood, however, that the "wires" or plate members of the chase may be sloped or inclined to the radial direction of the drum, so that the looped fibres, or the pile in the final product may have a definite angular direction or "lay". A lay of about 30° with the vertical may be employed, for example, and the plates or "wires" may be arranged at an angle sloping in the direction of movement of the batt or pile element material, in which case the loop-forming or pleating mechanism, hereinafter described, must be inclined at substantially the same angle in a direction toward the conveyor belt 12. By sloping the mechanism and wires in this direction, the drag on the fibres is increased, resulting in an increased action in the arranging of the fibres in parallelism, and the bunching effect on the "wires" which takes place when the "wires" are sloped in the opposite direction is thus avoided.

The loop-forming or pleating mechanism 18 is preferably arranged immediately above the drum 14, and comprises a loop-forming blade 20 adapted to pass centrally between the "wires" 16 on the drum, forcing the batt or pile element material into the space between the "wires" or separators to a distance depending on the adjustment of the loop-forming mechanism, the travel of the piling or loop-forming blade being adjusted to provide the desired depth of the loop-sections or pleats.

In order to hold the batt or pile element material in place during the operation of the piling blade, so as not to displace the loops or pleats already formed, a holding means for the last-formed loop or pleat is provided, which preferably comprises two presser-feet for holding each side of the loop or pleat in contact with the adjacent "wires" or separators, and a holding blade adapted to pass into the space between the sides of the loop or pleat to hold the remaining portion thereof in place. The means which I employ preferably comprises a presser foot 22 adapted to hold one side of the base portion of the loop against the adjacent "wire" or separator. An auxiliary blade or holding blade 24 is next forced downwardly into the last-formed loop into the position previously occupied by the loop-forming blade. In order to rigidly hold the remaining side of the base portion of the loop, a second presser foot 26 is provided which is moved downwardly to engage the other side or base portion of the loop above the adjacent "wire" or separator, whereby the last-formed loop is held rigidly in place, permitting a new loop to be formed without disturbing the previously formed loops. In the formation of the new loop, the loop-forming blade 20 descends on the adjacent batt section between the next two "wires" or separators, forcing a portion of the batt into the space between them, forming a fold or pleat or new loop. In the loop-forming mechanism as illustrated in Fig. 1 of the drawings, the holding blade or secondary piling blade is made integral with the presser foot 26, although it is to be understood that these may be made separate and separately operated, if desired.

The presser feet 22 and 26, the loop-holding blade 24 and loop-forming blade 20 are preferably held in a frame 28, in which they are actuated by suitable means. In the form illustrated in Fig. 1 of the drawings, the frame 28 is pivoted at 30 on a bracket 32 which may be attached or held in place in any suitable manner.

In order to operate the loop-forcing mechanism, a cam 34, mounted in any suitable way, may be operatively connected to the cylinder or drum 14 so as to be rotated in timed relation therewith. For this purpose, a gear 36 may be mounted on the cam shaft and a chain passing over the gear and connected to a corresponding gear mounted on the drum 14 may be used, although any other suitable driving means may be employed.

Operatively connected to the cam 34 is a lever 40 which is pivoted at 42 on an arm 43 of the bracket 32, and is connected to the frame 28 by means of a pin and slot connection 48, 44, the slot 44 being formed in the arm 46 of the lever 40, and the pin 48 being connected to a sliding member 50, which is arranged to move in the frame 28 between guides 52 and 54. As shown in the drawings, the piling blade 20 is rigidly connected to the slidable member 50, and the presser foot 26 is mounted so as to be movable with respect to the member 50, being preferably held in spring-pressed engagement with a portion of the member 50 by a spring 56, the presser foot 22 being similarly mounted with respect to the holding blade 24, being resiliently held by means of a spring 58 engaging a lug 60 on the holding blade or auxiliary piling blade, and adapted to force the presser foot 22 downwardly.

A spring 62 is employed for forcing the pin 48 in a direction to move the loop-form-
ing mechanism forwardly when it is released from engagement with the last-formed loop, so as to bring it in a position for forming the next pleat or new loop in the batt or pile element material when the drum has been brought into the required relative position for operation.

In the operation of the loop-forming or pleating mechanism, the presser foot 22 first descends on one side of the base portion of the loop or fold which has just been formed, and is held in pressure engagement therewith by means of the spring 58. After the presser foot 22 has been seated, the auxiliary piling blade or loop-holding blade 24 is forced downwardly in the space between the sideway the last-formed loop held between the adjacent “wires” until the blade reaches the extreme end portion of the loop, or the portion which forms the exposed ends of the final product when it is withdrawn from the drum 14. At the same time that the holding blade 24 is moved into position, the presser foot 26, which is integral therewith, moves into engagement with the other side of the loop above the corresponding “wire,” and is held in pressure engagement therewith by means of the spring member 56. In the subsequent downward movement of the loop-forming blade 20, which is actuated and moved into loop-forming position by the corresponding downward movement of the arm 46, being actuated by the cam 34 operating against the other arm of the lever 40, the pin 48 moves forwardly in the slot 44 compressing the spring 62 thereon, the loop-forming blade 20 being forced downwardly against the adjacent portion of the batt 10, dragging the batt portion into the space between the next set of “wires” or separators. During this movement it is apparent that the loop-forming blade 20 will pass over substantially one-half of the length of a loop section, dragging the loop over the edge of the next “wire” on the drum, whereby the fibres are dragged more or less into parallelism, in a direction corresponding to the original longitudinal direction of the batt, and are thus arranged in position at substantially right angles to the exposed surface of the batt.

During the time that the loop is being formed, the cylinder is being rotated at a constant speed and the pile forming elements and holding means for the loops move around the pivot 30, remaining in contact with the “wires” until the cam 34 is rotated into the position in which the lever 40 is released, the arm 46 being then returned or moved upwardly in a clockwise direction around the pivot 30 to its original position, thus raising the part 50 in its guides 52 and 54 and withdrawing the loop-forming and holding blades and the presser feet out of contact with the batt or pile element material, into the position shown in Fig. 1 of the drawings. In the withdrawing operation the loop-forming blade 20 is first withdrawn, then the presser foot 26 is released from one side of the base of the loop or pleat, then the blade 24 is raised from between the sides of the loop or pleat, and finally the presser foot 22 is moved out of engagement with the other side of the base of the loop or pleat. As soon as the presser foot 22 moves out of engagement with the batt or pile element material, the spring 62 operates to return the pin 48, in the slot 44, into its original or initial position, moving the member 50 and the associated portions 70 of the mechanism into its original position, as above explained, so as to be ready to form the new loop or pleat in the batt or pile element material when the cam 34 operates again to bring the loop-forming mechanism into engagement with the batt or pile element material.

After forming the looped or folded portions in the batt or pile element material between and over the “wires” of the drum 14, in the manner described, a cement coating is applied to the exposed surface of the batt or pile element material so as to form a continuous even coating on the fibres. The coating of cement material is preferably applied by means of a roller 64, which is preferably fed with a solution of vulcanizable rubber cement 63 from a tank 66.

It is to be understood, however, that the cementing material may be spread onto the base of the loops by means of a scraper, or a brush, or by other suitable mechanical means operatively associated with the drum 14 in place of the roller 64 to obtain a uniform surface. By the use of a solvent material the rubber cement penetrates to a certain extent into the base of the fibres, thus embedding not only the fibres of the outer exposed surface of the batt or pile element material, but also impregnating the inner or interior fibres in the base portion of the loops. The amount of rubber cement employed and the fluidity of the rubber solution should be controlled so as to prevent penetration to a depth beyond the curved portion of the fibres, so as to attain a maximum binding action with a minimum amount of rubber solution. By the use of a minimum amount of rubber solution the fibre portions of the loops upstanding from the base will contain substantially no cement material, and after the rubber cement material has been vulcanized and the finishing operations have been completed, the upstanding pile in the final cemented pile fabric product will be substantially free from adhering cement portions, the cement coating forming substantially an even layer over the backing material.

After the rubber cement coating has been
applied to the base of the pleats or loop sections, the excess solvent or volatile material in the coating is preferably removed by means of blasts of air, which may be heated if desired, from one or more nozzles 70. In order to assist in the removal of excess solvent or other volatile material, a heating means, such as hot air jets 68 may be applied to the interior of the drum.

After the rubber cement coating has been dried sufficiently, a suitable textile fabric, or other flexible material, is applied to the cemented surface of the folded or looped batt or pile element material. I preferably employ for this purpose a burlap or other cheap textile material, although other more expensive fabric or other material may be used, the choice of material depending on the purpose for which the resultant product is to be used, as will be apparent to those skilled in the art. If an upholstery material is to be formed, for example, I may employ a fine canvas or linen, and the fibres which are used in this case should be correspondingly of fine quality. The material 72 to be used as a backing is preferably first coated with a thin coating 73 of a vulcanizable rubber cement material, which is preferably applied by means of a roller 74 connected to a tank 75 in a manner similar to that employed for coating the exposed surface of the looped material.

After the textile backing has been coated and suitably dried, it is preferentially united to the coated batt surface by passing it over a suitable roller 78 into pressure engagement with the looped fibre surface, and the cement material is then preferably vulcanized to form a substantially integral medium between the base of the fibres and the textile material applied thereto.

The step of vulcanizing may be carried out by the use of steam heated molds 80, 82 and 83, for example, and the process may be made a continuous one by means of the form of apparatus shown in the drawings. This device preferably comprises a weighted member 84 suspended, for example, on the axis of the cylinder or drum 14, and having its center of gravity below the line of support or axis of the drum. The molds or vulcanizing members 80, 82 and 83, are preferably applied to the uncoated surface of the flexible backing member 72, and, in order to apply the molds to the material with a suitable pressure during the vulcanizing step, a series of piston-cylinder units 86, 88, which are actuated to apply pressure, are preferably employed, a pressure fluid being used for releasing the pressure and permitting return of the molds to the initial position after being moved through a predetermined distance in pressure contact with the drum. The molds or vulcanizing members may be connected to the piston-cylinder units in any suitable manner, as for example, by means of a yoke mounted on each piston rod extending axially within the drum beyond its end portions, the yoke being connected at its ends to the corresponding mold. It is obvious also that, if desired, pairs of piston-cylinder units may be mounted outside of the drum near its ends, so as to be directly connected with the corresponding molds, this construction being more particularly adapted for larger size units; for example, two piston-cylinder units 86, one on each side of the drum, might be directly connected with the vulcanizing member 80, another pair of piston-cylinder units 88 might be similarly directly connected to the mold or vulcanizing member 82, and a third pair of piston-cylinder units might be directly connected to the mold or vulcanizing member 83, the usual connection being provided for operating the pairs of piston-cylinder units simultaneously, as will be apparent to those skilled in the art.

The operation of the vulcanizing molds is substantially as follows:

After the molds have traveled in contact with the united backing and coated looped batt through a predetermined distance, which may be regulated as desired, depending upon the set of the ports 92 and 94, a pressure fluid from the central chamber 90 passes through the port 92 and through port 94 which is then in registration therewith, and passes through the passageway 96, for example, into the cylinder of the piston-cylinder unit 86, and exerts a pressure on the cylinder head against the spring 87, whereby the mold 80 is released from pressure engagement with the corresponding surface of the product. In a similar way, the molds 82 and 83 are released simultaneously with the release of the mold 80.

The center of gravity of the element 84, to which the molds and cylinder units are attached, having been displaced to the right during the counter-clockwise rotation of the drum, the weight element 84 returns to the position shown in Fig. 1 of the drawings, in which the center of gravity of the combined elements is directly below the axis of the drum. When this position is reached, the pressure fluid in the cylinders exhausts into the chamber 98 through the passage 100, and the molds 80, 82 and 83 are then again brought into pressure contact with the surface of the drum by means of the springs 87, 89, and the corresponding spring forcing the mold 80 to the surface of the drum. A new section of the coated material is thus brought under the vulcanizers, and the vulcanization of the material then proceeds until the operation, as above described, is repeated, whereby the product is gradually fed around the cylinder or drum 14 in a continuous movement and is then drawn out of
the “wires” or chase continuously by any suitable form of mechanism.

Before being drawn out of the chase, the material on the drum is preferably cooled by means of a cold air blast or other suitable cooling means 102, the material being then stripped from the chase by passing over a roller 104 or other suitable means, into engagement with a shearing device or cutter 106 for cutting the exposed tops of the loops, thus releasing the individual fibres in the material and producing a pile surface.

The material may then be steamed, if desired, and is then preferably tigerey by means of a brush 108 to remove dead stock or loose fibres and to straighten the fibres of the pile. The material may then be put through a finishing operation including a re-shearing of the pile by means of a cutter or shearing device 110 to produce a uniform height, or a level pile surface, and thereafter the material may be brushed or cleaned and rolled or cut into any desired lengths.

The preferred sequence of steps of my method is indicated in the flow chart in Fig. 2 of the drawings, but it is to be understood that certain of these steps or operations may be omitted if desired, and that the various steps may be modified as will be apparent to those skilled in the art, without departing from the invention, and I do not desire to be limited therefore, to the exact steps or sequence of steps, as described, except as hereinafter specifically claimed.

It is also to be understood that I do not desire to be limited to the form of loop-forming mechanism as illustrated in Fig. 1 of the drawings, but that this mechanism may be varied as will be apparent to those skilled in the art. I desire, therefore, to be limited only to the construction defined in the annexed claims.

Having thus described my invention, what I claim is:

1. In a machine of the kind described, a curved element, a series of fixed spacing elements arranged upon said curved element, means for forming a succession of folds or pleats between said fixed spacing elements, means for uniformly moving the said spacing elements along a predetermined path, and means coordinating with said forming means for permanently attaching a flexible backing material to the said folds or pleats during movement thereof along the said path and while rigidly held in place between the said spacing elements.

2. A machine for the production of a pile fabric material which comprises a plurality of spacing elements rigidly mounted in fixed inter-relation upon a body having a continuous surface forming a closed curve, means for uniformly operating the said body to move the said spacing elements in a cycle through the said closed curve, means mounted in operative relation with said body to fold or pleat a pile element material between successive spacing elements so as to expose portions of the folds or pleats in a substantially continuous surface and means for cementing a flexible backing to the said surface of the folds or pleats.

3. A machine for the continuous production of a pile fabric material which comprises a plurality of spacing elements rigidly mounted in fixed inter-relation upon a body having a continuous surface forming a closed path, means for uniformly operating the said body so as to move the said spacing elements at a uniform rate along the said path, means mounted in operative relation with said body to fold or pleat a pile element material between the said spacing elements to form a series of folds or pleats extending into the spaces between successive spacing elements, the base portions of which are exposed in a substantially continuous surface extending over a portion of the said path, means for cementing a flexible backing to the said surface of the folds or pleats, and means for withdrawing the cemented product from the said spacing elements without disturbing or displacing any of the said spacing elements.

4. A machine for the production of a pile fabric material by a continuous operation which comprises a plurality of spacing elements rigidly mounted in fixed relation upon a surface forming a closed curve, means for uniformly moving the said spacing elements through a cycle along the said curve, inserting means associated with said spacing elements for folding a pile element material between successive elements, means for operating the said inserting means as to maintain operative registration between the inserting means and the successive spacing elements, means for cementing a flexible backing to the said folds or pleats while they are rigidly held in position between said
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spacing elements, and means for withdrawing the cemented product from the said spacing elements.

7. A machine for the production of a pile fabricated material adapted for continuous operation which comprises a body having a surface lying in a closed path, a plurality of spacing elements rigidly mounted on the said surface, means for uniformly moving the said body to move the said spacing elements along the said closed path, inserting means associated with the said body for folding or pleating a pile element material between successive spacing elements, means for so operating the said inserting means in conjunction with the said body as to insure successive registration of the inserting means with consecutive spaces between the said spacing elements, and means for cementing a flexible backing to the folded or pleated pile element material.

8. A machine for the production of a pile element material by a continuous operation, which comprises a cylindrical drum, a series of spacing elements mounted in fixed inter-relation on said drum, means for uniformly rotating the said drum, a pleating mechanism operatively connected with the said drum, means for successively operating the said pleating mechanism to form a series of loops or pleats in a pile element material by inserting the pile element material into the spaces between successive spacing elements on the said drum, means for cementing a flexible backing to the pleated pile element material, and means associated with the said drum for continuously withdrawing the cemented product at a fixed point from between the said spacing elements.

9. A machine for the production of a pile element material by a continuous operation which comprises a cylindrical drum, a series of "wires" mounted in fixed inter-relation upon the surface of the said drum, means for uniformly rotating the said drum upon its axis, a loop-forming mechanism operatively associated with said drum, means for successively operating the said loop-forming mechanism to form a series of folds or pleats in a pile element material by inserting the said material into the spaces between successive "wires" on the said drum, the said folds or pleats being formed so as to leave an exposed surface extending around the greater portion of the said cylindrical drum, means for cementing a flexible backing to the exposed surface of the said folds or pleats, and means for withdrawing the cemented product from the said drum without disturbing or displacing any of the said "wires".

10. A machine for the production of a pile element material by a continuous operation, which comprises a cylindrical drum, a series of "wires" mounted upon the surface of the drum and arranged parallel to the axis of the drum, a loop-forming mechanism operatively associated with said drum having loop-holding and loop-forming elements, means for operating the said loop-forming element to move the same into and out of the spaces between the "wires" to form a series of loops or pleats in the material treated, means for operating the said loop-holding element to hold a section of the said material in place while each loop or pleat is formed and means for cementing a flexible backing to the folded or pleated material to form a cemented product.

11. A machine for the production of a pile element material by a continuous operation which comprises a cylindrical drum, a series of "wires" rigidly mounted in fixed inter-relation on the surface of said drum, means for uniformly rotating the said drum, a pleating mechanism operatively connected with the said drum, means for feeding a pile element material to the said drum to be operated upon by the said pleating mechanism, means for successively operating the said pleating mechanism to form a series of pleats in the pile element material by inserting the said material into the spaces between successive "wires" on the said drum, means for coating the exposed surface of the pleats with a cementing material, and means for cementing a flexible backing material to the pleated pile element material while the said material is rigidly held in place between said "wires".

12. A machine for the production of a pile element material by a continuous operation which comprises a cylindrical drum of large diameter, a series of "wires" mounted radially to and circumferentially of said drum in parallelism to the axis thereof, the said drum being of sufficient diameter with relation to the height of said "wires" so that the "wires" are substantially in parallelism with each other, a worm and worm wheel operatively connected to the said drum for uniformly rotating the same, a pleating mechanism operatively associated with the said drum for interdependent operation in a manner to maintain registration of the operative elements of said pleating mechanism with the spaces between successive "wires" to successively form a series of loops or pleats in the pile element material treated, the said loops being rigidly positioned in the spaces between successive "wires" on the drum, and means for cementing a flexible backing to the pleated pile element material, while rigidly held in place, to form a cemented product.

13. A machine for the production of a pile element material by a continuous operation, which comprises a cylindrical drum of large diameter, means for mounting the drum for axial rotation, a series of "wires"...
mounted radially on the surface of the drum and in parallelism with the axis thereof, a worm wheel connected with said drum, a worm cooperating with said worm wheel for uniformly rotating the said drum, a pleating mechanism operatively connected with said drum comprising a loop-forming element mounted in parallelism with the axis of the drum and presser feet for holding the base portions of the last formed loop during the formation of a new loop in the pleating element material operated upon, means for feeding a pleating element material onto the said "wires" to be operated upon by said pleating mechanism to form a series of loops or pleats in the spaces between successive "wires", means for coating the base portions of the loops with a cement material, means for passing a flexible backing into contact with the coated portion of said pleating element material, and means for attaching the said flexible backing to the said pleating element material while the loops or pleats are rigidly held in place between the said "wires".

14. A machine for the production of a pleating element material adapted for continuous operation, which comprises a cylindrical drum of large diameter, means for mounting the drum to be axially rotated, a series of "wires" mounted radially on the surface of the drum in parallelism with the axis thereof, a worm wheel connected with said drum, and a worm cooperating with said worm wheel for uniformly rotating the said drum, a pleating mechanism operatively connected with said drum and comprising a loop-forming element, a loop-holding element and presser feet for holding the base portions of the last formed loop during the formation of a new loop in the pleating element material operated upon, means for operating the said pleating mechanism in synchronized inter-dependent movement with the rotation of the drum, means for feeding a pleating element material onto the said "wires" to be operated upon by said pleating mechanism to form a series of loops or pleats therein having the base portions exposed in a substantially continuous surface by the insertion of the pleating element material into the spaces between successive "wires" on the said drum, means for coating the said exposed base portions of the loops with a cement material, means for passing a flexible backing into contact with the coated portion of said pleating element material, means for permanently attaching the said flexible backing to the said pleating element material while the loops or pleats are rigidly held in place between the said "wires" and means for continuously withdrawing the cemented product from between the said "wires" of the drum at a fixed point relative to said drum.

15. In a machine of the kind described, means for forming a succession of folds or pleats upon a curved surface so as to leave a portion of the folds or pleats exposed in a substantially continuous surface, means for passing a flexible backing material into contact with the exposed surface of the folds or pleats, and means for permanently attaching the said backing material to the said folds or pleats comprising a vulcanizing press operatively adapted to be held in pressure contact with the said backing material to produce vulcanization while the said folds or pleats are rigidly held in place upon the said curved surface.

16. In a machine of the kind described, means for forming a succession of folds or pleats between spacing elements upon a curved surface so as to leave the base portions of the said folds or pleats exposed in a substantially continuous surface, means for applying a vulcanizable cement material to the said exposed base portions of the folds or pleats, means for passing a flexible backing into contact with the coated surface of the folds or pleats, and a vulcanizing press operatively associated with said curved surface, and adapted to be resiliently held in pressure contact with, and moved with, the said spacing elements while the said folds or pleats are rigidly held in place, so as to produce vulcanization of the said cement material and to permanently attach the said flexible backing in place without disturbance of the folds or pleats.

17. In a machine of the kind described, means for forming a succession of folds or pleats between spacing elements upon a moveable curved surface so as to leave portions of the folds or pleats exposed in a substantially continuous surface, means for passing a flexible backing material into contact with the exposed surface of the folds or pleats, means for interspersing a vulcanizable cement material between the said backing and said exposed surface of the folds or pleats, and a vulcanizing press adapted to be resiliently held in pressure contact with the said curved surface and moved therewith to produce vulcanization of said cement material without disturbance of the folds or pleats, and to permanently attach the said backing material to the said folds or pleats.

18. A machine for the production of a pleating element material by a continuous operation, which comprises a cylindrical drum, a series of "wires" mounted upon the surface of said drum and arranged substantially parallel to the axis thereof, means for uniformly rotating the said drum, a pleating mechanism operatively connected with said drum, means for operating the said pleating mechanism in conjunction with the said drum to maintain registration of the loop-forming elements and associated parts of the pleating mechanism with the spaces
between successive "wires" during the continuous operation of the drum, means for passing a pile element material onto the surface of the said "wires" to be operated upon by said pleating mechanism to form a series of loops or pleats in the pile element material by insertion into the spaces between successive "wires", means for coating the exposed base portions of the said loops or pleats with a vulcanizable cement material, means for passing a flexible backing into contact with the coated portion of the said loops or pleats, and a power-operated vulcanizing press operatively associated with said drum so as to be resiliently moved into pressure contact with the said backing material against the said "wires" during a predetermined portion of the path of rotation of the said drum to effect vulcanization of the said cement material and to permanently attach the said loops or pleats to the said drum flexible backing, means for disengaging the said power operated vulcanizing press from the said backing material and adjacent "wires" at a predetermined portion of the cycle of rotation of the said drum, and means associated with said drum for continuously withdrawing the cemented product from between the said "wires" after the vulcanization has been effected.

19. In a machine of the kind described, a rotatable cylinder having a series of "wires" arranged on the surface thereof to provide spaces for the formation of a series of loops or pleats in a batt, means for feeding a batt into contact with the said "wires" of the cylinder, means for forcing portions of the batt between said "wires" and means for holding the portion of the batt containing the already formed loops in place while the next succeeding loop is formed whereby a substantially continuous surface comprising the exposed bases of the loops or pleats is formed on the "wires" of said cylinder, means associated with the said cylinder for coating the said exposed surface with a vulcanizable rubber cement, means associated with the coated surface for removing solvent or other volatile material from the said cement, means for passing a flexible backing material into contact with the said coated surface, a vulcanizing press associated with said cylinder for vulcanizing the said rubber cement to form a substantially integral surface between the said flexible backing and the fibres of the batt, and means for progressively passing the said press into engagement with the said backing during a predetermined movement of the said cylinder and means for removing the resultant sheet or mat from between the "wires" after the vulcanizing of the said cement material has been completed.

20. A machine for the production of a pile element material by a continuous operation, which comprises a cylindrical drum, a series of "wires" mounted upon the surface of said drum and arranged substantially parallel to the axis thereof, means for uniformly rotating the said drum, a pleating mechanism operatively connected with said drum, means for operating the said pleating mechanism in conjunction with the said drum to maintain registration of the loop-forming elements and associated parts of the pleating mechanism with the spaces between successive "wires" during the continuous operation of the drum, means for passing a pile element material onto the surface of the said "wires" to be operated upon by said pleating mechanism to form a series of loops or pleats in the pile element material by insertion into the spaces between successive "wires", means for passing a flexible backing into contact with said loops or pleats, means for interdispersing a vulcanizable cement material between the said backing and the portions of the said loops or pleats to be attached thereto, a vulcanizing press operatively associated with said drum, resilient means for moving the said vulcanizing press into pressure engagement with said backing during a predetermined arc of rotation of the said drum, a power operated piston-cylinder unit associated with said vulcanizing press for disengaging the press at a predetermined point in the rotation of said cylinder, control means for controlling admission and exhaust of pressure fluid to said cylinder to operate the piston therein, means for automatically operating the said control means at predetermined points in the rotation of said drum to effect vulcanization of the said cement material and permanently attach the said loops or pleats to the said flexible backing, and means associated with said drum for continuously withdrawing the cemented product from between the said "wires" after said vulcanization has been effected.

21. A machine for the production of a pile element material by a continuous operation, which comprises a cylindrical drum, a series of spacing elements mounted in fixed interrelation on said drum, means for uniformly rotating said drum, a cam-operated inserting mechanism operatively connected with said drum so as to be operated in synchronism therewith to fold or pleat a pile element material between successive spacing elements as the said drum is rotated, and means operatively associated with said drum for cementing a flexible backing material to the said folds or pleats by means of a vulcanizable rubber cement comprising steam-heated molds suspended from the said drum and operable by means of piston-cylinder units, actuated by pressure fluid to control the application of said molds to the said backing material on the said drum, and means for
controlling the return of the molds to their initial position on the drum after being moved through a predetermined distance in pressure contact with the drum.

22. Apparatus of the character described which comprises means for bending fibres into a series of rows having curved portions exposed in a substantially continuous surface, means for applying a flexible backing to the fibres at the bent portion thereof with a vulcanizable rubber cement, and means for vulcanizing the said cement while the fibres are maintained in the bent relation to permanently hold the fibres in place on the backing.

23. Apparatus of the character described for the making of cemented pile fabric which comprises means for forming a pile element material into a series of transverse loops having the base portions of the loop sections exposed in a substantially continuous surface, means for coating the exposed surface containing the said base portions with a rubber cement, means for applying a flexible backing to the cemented portion of the fibres, and means for vulcanizing the said cement while the said loops are rigidly held in place.

24. Apparatus of the character described for the making of a cemented pile fabric which comprises means for folding a pile element material into a series of continuous loop sections, means for rigidly holding the said sections in close proximity to each other, means for coating a surface of the loop sections, means coordinated therewith for applying a backing of flexible material to the coated portion of the fibres, and coordinated means for cutting the unattached ends of the loop sections so as to form a continuous pile surface in which the fibres are attached only at their base portions.

25. Apparatus of the character described for the making of a cemented pile fabric which comprises means for folding a pile element material into a series of continuous transverse loop sections, the bases and tops of the looped portions forming substantially two parallel surfaces, means for rigidly holding the said loop sections in close proximity to each other, means for coating one surface of the loop sections with a vulcanizable cement so as to form a continuous coated section, means for applying a backing of flexible material to the coated section of the fibres, means for vulcanizing the said cement coating while the said loop sections are rigidly held in place, and means for cutting the unattached ends of the loop sections so as to form a continuous pile surface in which the fibres are attached only at their base portions.

26. Apparatus of the character described, which comprises a series of spacing elements for holding a looped pile element material in a series of rows, a loop-forming mechanism for forming loops with the base portions exposed in one surface of the said spacing elements, means for applying a flexible backing to the said loops exposed in a substantially continuous surface, means for coating the exposed surface of the loop sections with a flexible cementing material, and means for vulcanizing the said cement while the said loops are maintained in the said spacing elements to permanently hold the loops in place on the backing.

27. Apparatus of the character described, which comprises a form for rigidly holding a looped pile element material in a series of rows having the base portions of the loops exposed in a substantially continuous surface, a loop-forming mechanism for forming loops in the said form in a series of rows with the base portions exposed, means for applying a flexible backing to the exposed portions of the loops by means of a cement material, means for drawing the looped material out of the said form and means for cutting the said loops to form a pile fabric.

28. Apparatus of the character described, which comprises means for forming a succession of folds or pleats between spacing elements upon a curved surface so as to leave portions of the said folds or pleats exposed in a substantially continuous surface and to permit removal from one side of the said curved surface without disturbance of the said spacing elements, means for passing a flexible backing material into contact with the exposed surface of the folds or pleats, and means for permanently attaching the said backing material to the said folds or pleats, comprising a vulcanizing press adapted to be held in contact with the said backing material to produce vulcanization while the said folds or pleats are rigidly held in place between the said spacing elements.

29. Apparatus of the character described, in combination, a series of spacing elements, a loop-forming element, means for causing relative reciprocation between the said loop-forming element and said spacing elements, to effect engagement of the loop-forming element between said spacing elements, means for causing the loop-forming element and spacing elements to travel along together during the loop-forming movement, and means for automatically effecting relative movement between the said spacing elements and the loop-forming element to attain the desired relative position of the parts for forming a new loop.

30. Apparatus of the character described, which comprises a loop-forming mechanism having an inserting element, means for actuating the said inserting element in a forward and return movement along a predetermined path to permit the formation of loops along said path, and means interde-
Apparatus of the character described, in combination, a series of spacing elements, a loop-forming element, means for reciprocating the loop-forming element and spacing elements to travel along together during the loop-forming movement, and means for automatically effecting relative movement between the said spacing elements and the loop-forming element to attain the desired relative position of the parts for forming a new loop.

32. Apparatus of the character described, in combination, a series of spacing elements mounted in fixed relation to each other, means for moving the said spacing elements along a predetermined path, a loop-forming element, means for causing relative reciprocation between the said loop-forming element and the said spacing elements to effect engagement of the loop-forming element between said spacing elements for forming successive loops, and means for causing the loop-forming element to travel with the spacing elements during the loop-forming movement.

33. Apparatus of the character described, in combination, a series of spacing elements mounted in fixed relation to each other, means for moving the said spacing elements along a predetermined path, a loop-forming element, means for periodically reciprocating the loop-forming element into the spaces between the said spacing elements for forming successive loops, and means for causing the loop-forming element to travel with the spacing elements during the loop-forming movement.

34. Apparatus of the character described, in combination, a series of spacing elements mounted in fixed relation to each other, means for uniformly moving the said spacing elements, a loop-forming element, means for periodically reciprocating the loop-forming element into the spaces between the said spacing elements for forming successive loops, means for causing the loop-forming element to travel with the spacing elements during the loop-forming movement, and means for effecting transverse movement of said loop-forming element relative to said spacing elements between successive loop-forming movements.

35. Apparatus of the character described, comprising a plurality of spacing elements, a loop-forming element, means for reciprocating the said loop-forming element into the spaces between adjacent spacing elements to form successive loops in a material operated upon, means for positively moving the said spacing elements in a predetermined path, means for causing the said loop-forming element to travel with the said spacing elements during the loop-forming operation, and means for bringing the said loop-forming element to its initial position after each movement of travel thereof with the spacing elements.

36. Apparatus of the character described, comprising in combination, a series of parallel spacing elements mounted in fixed relative position with respect to each other, a loop-forming element, means for progressively moving the said loop-forming element into the spaces between adjacent spacing elements to form successive loops in a material operated upon, means for moving the said spacing elements in a predetermined path, means for causing the said spacing elements and said loop-forming element to travel along together during each loop-forming movement, and means for periodically effecting relative transverse movement between said spacing elements and said loop-forming element to put them into the required relative position for the formation of a new loop.

37. Apparatus of the character described, which comprises a plurality of spacing elements, a loop-forming mechanism in relatively fixed position having a movable loop-forming element, means for uniformly moving the said spacing elements in a predetermined path for the formation of loops in a material operated upon between the spacing elements, means for periodically moving the said loop-forming element into the spaces between the said spacing elements, means for causing movement of the said loop-forming element with the said spacing elements during the formation of each loop, means for withdrawing and returning the loop-forming element to its original position in the loop-forming mechanism after each loop-forming operation, a holding means operative with said loop-forming element to hold a section of material in place during each loop-forming operation, and means for co-ordinating the operation of the loop-forming mechanism and operative parts thereof with the movement of said spacing elements along said path.

38. Apparatus of the character described, comprising a series of spacing elements in fixed relation to each other, means for continuously moving the said spacing elements in a predetermined path, and means for inserting a pile element material into the spaces between the said spacing elements, said means being pivoted at a fixed point independently of said spacing elements to swing and permit movement of the said inserting means with the spacing elements during the time that the inserting means re...
mains inserted between two of the said spacing elements.

39. Apparatus of the character described, comprising a plurality of substantially equally spaced spacing elements, means for moving the said spacing elements along a predetermined path, a loop-forming mechanism having inserting and holding means mounted independently of the said spacing elements and adapted to be pivotally swung during the loop-forming operation along the path of said spacing elements so as to be relatively stationary with respect thereto during said loop-forming operation, and means for co-ordinating the inserting movement of said inserting means with the swinging movement of said loop-forming mechanism and with the movement of said spacing elements to permit continuously forming new loops during the movement of said spacing elements.

40. Apparatus of the character described, comprising a series of parallel spacing elements in relatively fixed positions, means for moving the said spacing elements along a predetermined path, means for inserting a pile element material into the spaces between said spacing elements, said inserting means including an inserting element and means for holding the pile element material in place while a portion thereof is being inserted into the said spaces, cam means for operating the said inserting element and said holding means, means permitting the said inserting element and said holding means to swing about a fixed point so as to permit movement with the said spacing elements during the time that the pile element material is being inserted, and means for returning the said inserting element and holding means to their initial position after each inserting movement, whereby the inserting action takes place progressively between the consecutive spaces of the said spacing elements.

41. In a machine of the kind described, an inserting mechanism pivoted about a fixed point, said inserting mechanism comprising an inserting element, a holding blade and a presser foot adapted to move radially independently of each other, means for moving the said inserting element, holding blade and presser foot at predetermined times, and means for returning the said inserting element, holding blade, and presser foot to their initial position after each inserting and holding operation.

42. Apparatus of the character described, a cylinder, a series of "wires" mounted thereon, arranged substantially parallel to the axis of the cylinder and adjacent "wires" being in substantially parallel relation with each other, means for rotating the cylinder, a loop-forming element, means for successively moving the loop-forming element into and out of the spaces between the "wires" to form a series of loops in the material operated upon and means for holding a section of the said material in place while each loop is formed.

48. Apparatus of the character described, comprising a cylindrical drum having fixed spacing elements thereon, means for uniformly rotating the drum to move said spacing elements uniformly in a circular path, an inserting mechanism comprising an inserting blade and means for holding the pile element material in position during the inserting movement of said inserting blade, means for reciprocally moving the said inserting blade into the spaces between said spacing elements, means for pivoting the said inserting blade so as to permit a swinging movement thereof during the time that it is engaged between two spacing elements, means for positively returning the said inserting blade after each swinging movement in one direction so as to permit its insertion into the space between the next adjacent spacing elements and means for coordinating the movements of said inserting blade with the rotary movement of the said drum.

In testimony whereof, I affix my signature.

PAUL S. SMITH.
CERTIFICATE OF CORRECTION.

Patent No. 1,822,510.  Granted September 8, 1931, to

PAUL S. SMITH.

It is hereby certified that error appears in the printed specification of the
above numbered patent requiring correction as follows:  Page 6, line 49, claim
1, for "or" read for; and that the said Letters Patent should be read with this
correction therein that the same may conform to the record of the case in the
Patent Office.

Signed and sealed this 6th day of October, A. D. 1931.

M. J. Moore,
Acting Commissioner of Patents.