Feb. 9, 1937. W. F. BIRD 2,070,251

IMPREGNATED PILE FABRIC AND METHOD OF MAKING SAME

Filed Aug. 15, 1936 3 Sheets-Sheet 1

FIG. I.

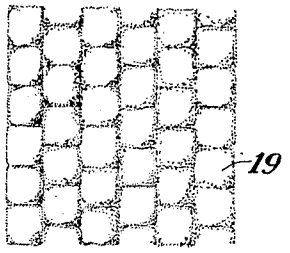


FIG. II.

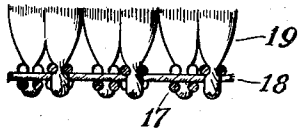


FIG. III.

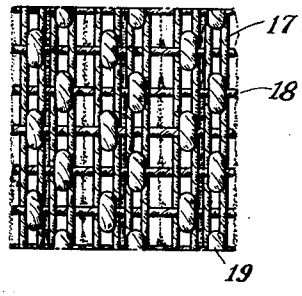


FIG. IV.

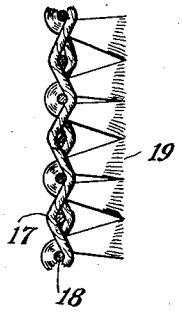
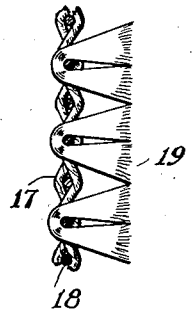


FIG. V.



INVENTOR

WHITWORTH FONTAINE BIRD.

BY Paul J Schmitz

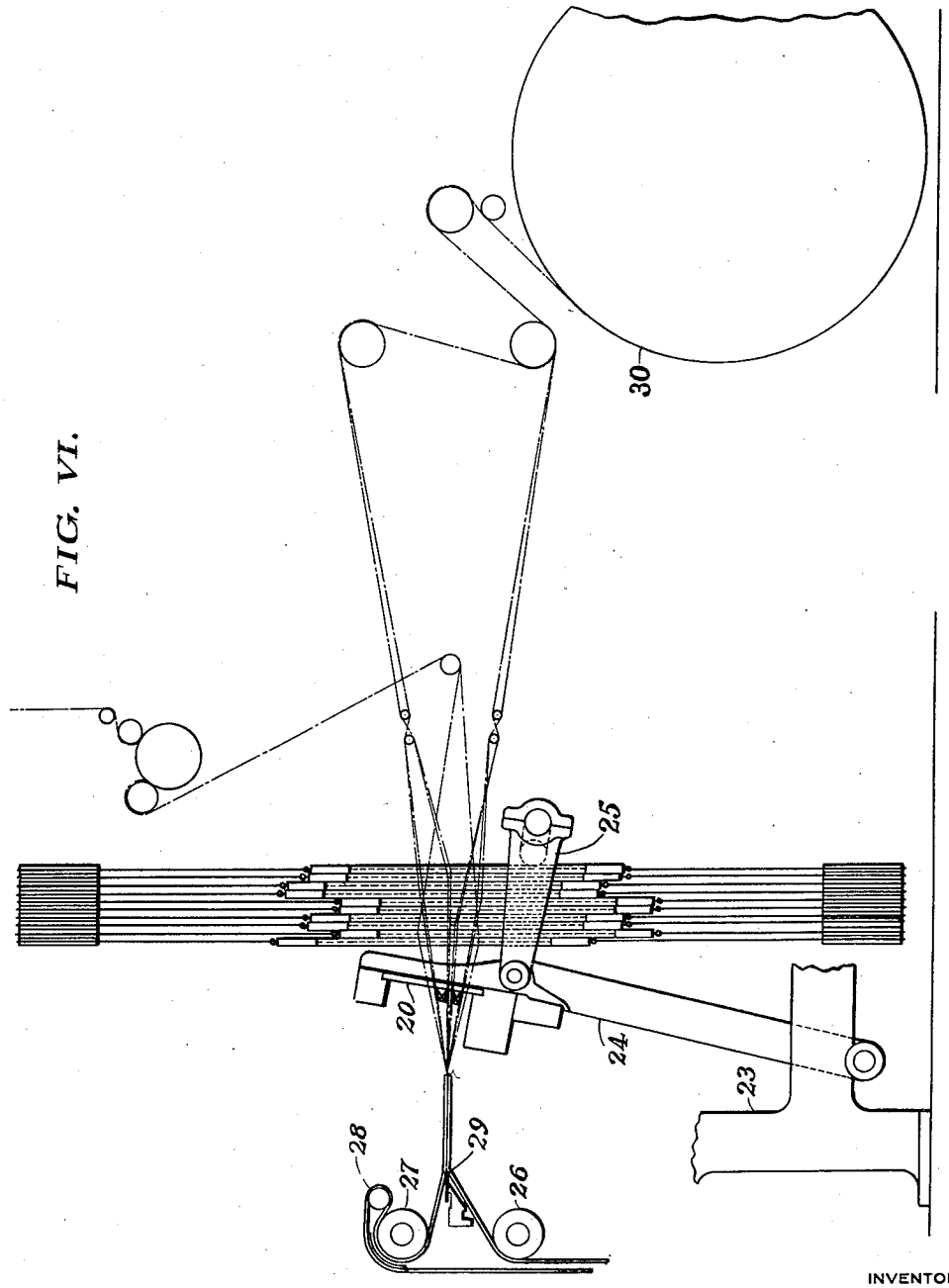
ATTORNEY

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IMPREGNATED PILE FABRIC AND METHOD OF MAKING SAME

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FIG. VI.



INVENTOR

WHITWORTH FONTAINE BIRD.

BY Paul J. Schmitz

ATTORNEY

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IMPREGNATED PILE FABRIC AND METHOD OF MAKING SAME

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FIG. VII.

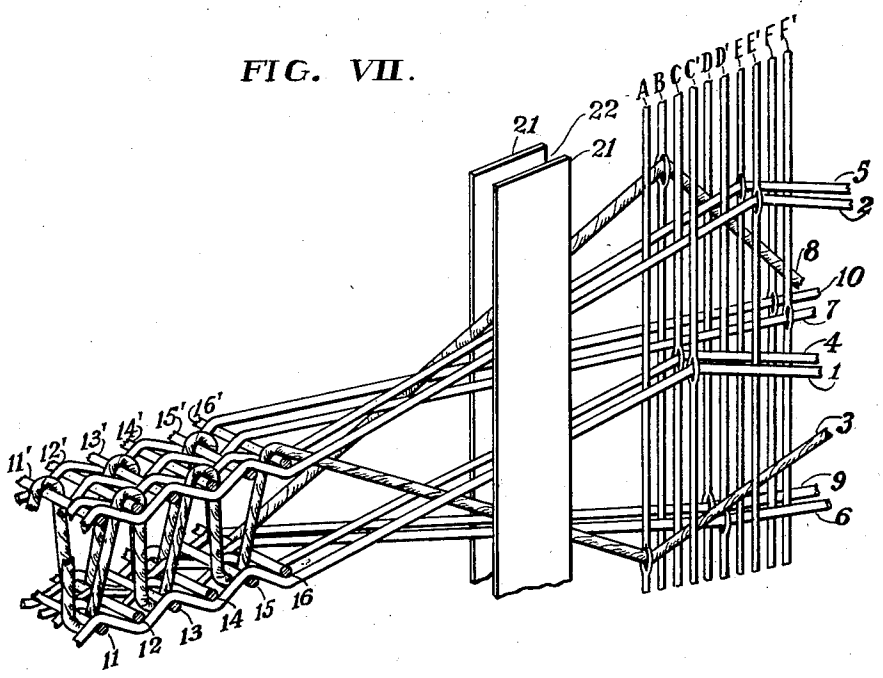
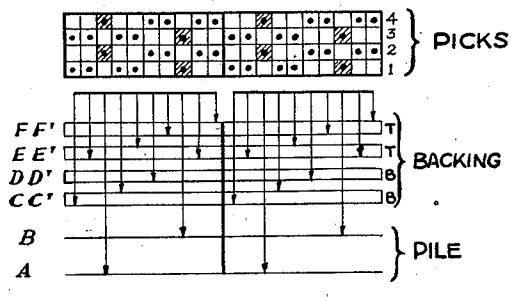


FIG. VIII.



INVENTOR

WHITWORTH FONTAINE BIRD.

BY Paul J Schmitz

ATTORNEY

Patented Feb. 9, 1937 2,070,251

UNITED STATES PATENT OFFICE

2,070,251

IMPREGNATED PILE FABRIC AND METHOD OF MAKING SAME

Whitworth Fontaine Bird, Springfield, Pa., assignor to Collins & Aikman Corporation, Philadelphia, Pa., a corporation of Delaware

Application August 15, 1936, Serial No. 96,258

12 Claims. (Cl. 28—1)

My invention is directed to an impregnated cut pile fabric woven on the double plush principle and it includes, by means of grouping the warps, the effecting of a greater coverage by the pile tufts than was heretofore practicable, as well as a method and fabric especially adapted to be impregnated with an adhesive pile tuft anchorage medium while maintaining a substantial permeability to air or porosity of the fabric. This result is accomplished without using pile warps of a size less than those used in prior fabrics, by grouping the pile warps and decreasing the number of reed dents. A plurality of pile warps of each fabric, along with the binder warp threads, are drawn through each dent or space between the wires of a loom reed. This application is a continuation in part of my co-pending application Serial Number 695,532 filed October 27, 1933.

Pile fabrics and particularly those having pile of animal fibre yarn or mixtures of animal fibre yarn, cotton and/or artificial silk, are highly desirable for upholstery which is subject to rough and hard treatment, as for example, use in automobiles. The use of long pile, while advantageous in concealing and protecting the backing threads, has been found to be objectionable because of the tendency of such long pile to crush when subjected to atmospheric or other dampness or crushing. The crushing may be overcome or minimized by shortening the length of the pile, but such shortening results in the "grinning through" of the backing, and reducing the security of the anchorage of the pile tufts, in fabrics made in accordance with prior practice and with commercially available fibre yarns.

An object of my invention is to provide a cut pile fabric in which the pile tufts are firmly anchored in position and a good pile coverage is obtained on the face of the fabric with a short pile tuft.

It is a further object of my invention to produce an impregnated cut pile fabric, having substantial body because of a greater face density per unit of area and structure than is present in prior fabrics and in which the interstices are so located and of such size that the fabric can maintain porosity after impregnation with a binder material such as rubber latex of sufficient dry rubber content and viscosity to provide adequate pile anchorage.

It is a further object of my invention to produce a pile fabric having a visually uniform face, by weaving on the double plush principle on a loom containing a reed by drawing through each of the reed dents a plurality of pile warp threads, each having a diameter larger than the maximum diameter of pile warp threads, which, with the customary knots therein, can be drawn in practical weaving through reed dents having one-half the width of said reed dents and associating a plurality of pairs of upper ground warps and a plurality of pairs of lower ground warps, and subsequently impregnating the fabric locally.

More particularly, my invention is designed to provide a fabric especially suitable for automobile upholstery, in which fabric the pile tufts are aligned warp-wise in groups, said groups comprising a plurality of longitudinal rows of pile tufts aligned so that adjacent tufts in the same group affect each other to produce, along with the tufts in other groups, excellent and uniform pile coverage and at the same time, a fabric permeable to air. The pile tufts are each so supported at the sides and at the ends and are so positioned and are of such size and number per unit of area as to give complete coverage of the ground, notwithstanding the shortness of the pile. Consequently, the grounds may be woven close together and but little additional pile yarn is required, notwithstanding the greatly improved pile coverage. When the pile warps are cut, the V-pile tufts are so short that they do not readily crush or lay over, even while damp, and the shortness of the pile permits satisfactory penetration of the dye to the bottoms of the pile tufts.

I preferably employ in the practice of my invention backing yarns having a diameter less than the diameter of the pile yarns supported thereby so that the ground is completely concealed by the tufts formed by the cut pile yarns, even when such tufts are cut very short and close to the ground. The pile yarns passing through each dent of a reed form V-pile on every pick in each dent group of each fabric, but the tufts formed on adjacent picks in the same dent group of a fabric are staggered relatively one to another and separated from one another by at least two ground warps so that every tuft is not only supported on each side thereof by a ground warp passing over the pick under which the tuft is looped but is also supported at the ends thereof by picks of weft.

The character of the use to which such fabrics are put requires that the yarn used therein, both for the backing and pile, be of substantial diameter and strength, and this, as well as manufacturing economy, has made it necessary to use in practice a relatively small number of wefts or picks per inch, say between 25 and 40. To increase the number of pile tufts per unit of area by

materially increasing the number of picks per inch is therefore impracticable as well as uneconomical, as the number of picks determines the rate of weaving.

It has been a prior practice in weaving double cut pile fabrics to invoke the use of a reed having approximately 1250 reed dents to weave a fabric approximately 56 inches wide and to draw a single pile warp through each dent. The use of a reed that is much finer than this for increasing the number of pile ends per unit of area widthwise of the fabric is likewise impracticable because the use of such finer reed necessitates the use of a finer pile yarn and to use such finer pile yarns decreases the pile coverage because of the disproportionate decrease in the number of pile fibers in a given area of fabric. This decrease, is as the square of the yarn diameter. Moreover, the fine pile warp yarns, in conjunction with the usual number of picks result in the production of an unbalanced and ribby fabric, and in the production of fabrics of inadequate body. I have found that if the number of dents in the reed be decreased to below approximately 900 that two pile yarns may be passed through a single dent along with the backing warps and the warp threads so grouped in the finished fabric as to produce a pile fabric having an increased number of pile tufts so grouped that they give excellent pile face coverage.

I have found that in my invention, the proper balance between the size of the weft threads and the size of the backing warps and pile warps has been maintained without increasing the number of reed dents or decreasing the free area thereof, available for passage of warp threads or increasing the number or decreasing the size of the picks.

The use of a reed with a lower number of dents with the same percentage of free area, invokes the use of heavier reed wires with a resulting more definite alignment of the warps of a dent group in the woven fabric. This grouping of the pile tufts in longitudinal rows occasions crowding of the pile tips and causes that portion of the tufts near the center of the group to exert a slight pressure on adjacent tufts and hence the fibres of the pile tips assume a slightly abnormal inclined position, thus effectively concealing backing threads and the interstices created by the loom reed during the beating up operation. The abnormality of position of the pile fibres is not sufficient to be detected by the eye from the face side of the fabric. I thus have a pile fabric which embodies a great number of pile tufts of substantial size and a backing in which the interstices are larger than in prior fabrics, having adequate pile coverage.

In a preferred application of my invention, I utilize a loom having a reed with relatively wide spaces between the reed wires, such spaces occupying approximately 67% of the width of the reed, thus allowing for wires of sufficient strength and rigidity to beat up the relatively heavy upholstery fabric resulting from the use of weft yarns approximating ⅛'s (cotton count) or the equivalent thereof and of binder warps with a complimentary range of sizes. A suitable fabric within the scope of my invention has been woven with a reed containing 868 dents in 56 inches width, said fabric having 2/30's backing warps, pile warps 2/24's containing animal fibre, and composed of ⅛'s (cotton count) weft yarn inserted 30 to the inch. A reed having twice my number of dents would be wholly unsatisfactory, as such pile yarn could not successfully be woven through it.

As the size of yarn, such as used for the cut pile of automobile upholstery is decreased, the cost per pound increases. It is thus seen that I have introduced features of economy as well as improvements in my fabric. The use of a reed of 1600 or more dents would accordingly be uneconomical as well as result in an inferior product. The increased number of warps and tufts in this fabric over the number in prior fabrics results in more weft undulations and obviously a more elastic fabric weftwise.

In accordance with my invention in the embodiment illustrated in the accompanying drawings,

Fig. I is a diagrammatic plan view of the top of a portion of pile fabric according to my invention.

Fig. II is a diagrammatic sectional view in elevation and illustrates the grouping of the pile tufts.

Fig. III is a diagrammatic plan view of the back of the fabric shown in Figs. I and II.

Figs. IV and V are diagrammatic views looking weftwise of the fabric and clearly show the staggered arrangement of tufts.

Fig. VI is a side elevation of a portion of a loom on which my invention may be practiced in part.

Fig. VII is a detail of a portion of the fabric and illustrates a single dent grouping.

Fig. VIII is a weave and shedding diagram illustrating the drawing in of two dent groups and the positions of the warps during a weaving cycle.

Referring to the drawings, the backing warps, wefts and tufts are generally depicted as **17**, **18** and **19**, respectively. In the practice of my invention, I utilize a double shuttle loom on which is mounted a reed **20** containing reed wires **21** forming spaces as **22** for the passage of the warp threads. Fig. VI depicts a portion of a multi-shed loom having a frame **23** on which is pivoted an oscillating lay **24** driven by a crank and pitmen **25**. Seperating rolls **26**, **27** reversing roll **28** as well as the cutter **29**, cut and separate the double pile fabric all in a known manner.

The ground warps are drawn from warp beam **30** and the pile warps from a separate beam not shown. Harness frames A—F' (Fig. VII) open and close the warp sheds as hereinafter more fully described.

In weaving fabric in accordance with my invention, each reed dent contains a similar arrangement of warps, comprising (Fig. VII) two pairs of ground warps, **2** and **5**, and **7** and **10**, for the upper fabric, two pairs of ground warps, **1** and **4**, and **6** and **9**, for the lower fabric, and two pile warps, **3** and **8**. The ground warps, **2** and **5**, in each dent weave together as a pair to form flats and oppositely to the ground warps, **7** and **10**, in each dent which likewise weave together as a pair to form flats. Similarly, the ground, **1** and **4**, in each dent weave together as a pair to form flats and oppositely to the ground warps, **6** and **9**, in each dent which likewise weave together as a pair to form flats. The adjacent pairs in adjoining reed dents weave oppositely to one another.

The pile warps, **3**, are shedded to interlace in the upper ground while the pile warps **8** are being shedded to interlace the lower ground in one rotation of the loom crank shaft, are at all times spaced from one another by at least four

ground warps during weaving and the pile loops at any pick are also spaced from one another by four ground warps. On the next revolution of the crank shaft, the pile warps 3 are shedded to interlace them in the lower ground and the pile warps 8 are interlaced to shed them in the upper ground, and so on.

The pile threads which later form cut tufts are arranged throughout the weaving cycle relative to one another and to the other warp threads in such a manner that pile yarns of large diameter may be used without excessive crowding. In Fig. VII, the pile warps, 3 and 8, are shown crossing one another. At their point of crossing, there are no other warps in the plane of the crossing and hence no crowding. If a slub or imperfection on a pile yarn be present, the other pile yarn will yield and breakage due to slubs and the like being caught in the reed wires is substantially eliminated.

Fig. VIII of the drawings illustrates the position of the warp yarns and their relationship to the harness. The backing warps are raised in pairs and the pile yarns are moved oppositely to one another. Beginning on the left side of the diagram, the first arrow depicts the bottom backing 1 as being connected to the C harness and is in the up position as indicated by the dot. The small blocks represent 4 picks of weft and show the arrangement of warps 1–10 on each pick. The arrows represent the warps and relationship to the individual heddles, the first arrow representing warp 1, the second warp 2, etc.

Pairs of picks, 11, 11', 12, 12', 13, 13', etc., are laid during each revolution of the loom crank shaft in the upper and lower sheds. The picks are so interlaced with the grounds that in each ground, a pile warp of each dent group is looped over every pick. The loop formed on one pick by a pile warp in any dent group lies between and is supported by one of the pairs of ground warps, whereas the loop formed on the next pick by the other pile warp in such dent group lies between and is supported by the other pair of ground warps. The legs of each pile group are supported by sections of adjacent wefts having no pile thereon, hence each loop is supported at both sides and at both ends. Since the pile ends in each dent are not drawn adjacent to each other, a staggered formation of tufts, each of substantial area, and a more desirable face appearance is obtained. The pile may be held against being pushed out by impregnating the ground with a solidifiable binder material, examples of which are latex, either vulcanized or unvulcanized, pyroxylin and the like. These substances may be generally defined as normally insoluble.

Prior to impregnation and after the fabric is removed from the loom, it may be scoured to remove the water-repellent oils, naturally carried thereby or artificially incorporated therein, and any excess water incorporated therein as a result of the scouring may be removed by a suction or blowing apparatus. This latter step removes any water which may have collected in the relatively large interstices and as just sufficient adhesive is applied through the back of the fabric to securely anchor the tufts and to thoroughly permeate and surround the fibres of the backing yarns and that portion of the tufts which lie in the plane of the backing yarns, a porous somewhat tightly woven fabric will result. The grouping is invaluable as it causes the binder warps to hold in the tufts more firmly and the problem of tuft dislodgment prior to impregnating is substantially reduced. As previously set forth, although the free area or the total area of the interstices may be less than that of prior fabrics, the location and size of said interstices are such that they are less liable to be filled with the impregnating material.

The tips of the pile bights passing as they do around a single weft thread over which the warps pass in flats, project below the backing and the anchoring material. The tips of the pile bights may be scraped and all excess adhesive thereby removed. This scraping operation may be done with the impregnating blade concurrently with or immediately following impregnation and is so effective that the presence of adhesive in the fabric is in most cases difficult to determine by anyone except an expert. If latex, for example, be used as the adhesive, the percentage of dry weight of rubber in the adhesive compound can be varied as can the amount of adhesive in the dry finished fabric. There must be sufficient adhesive material deposited and sufficient concentration and viscosity of the compound to securely anchor the pile tufts with a fiber lock to the backing threads without the adhesive contacting the pile face. I have found that by the removal of the water-repellent oils that the anchoring power of the adhesive is so increased that a substantially shorter tuft may be used than in prior fabrics. This, together with the fact that there is an increase in the number of pile fibres of a unit area of fabric over the number of pile fibres in a similar area of prior fabrics, results in a very superior product being obtained as substantially all the adhesive material is within the threads as opposed to on the threads.

If the interstices formed by the reed wires are of sufficient size, it may not be necessary to completely remove the water-repellent oil and mere wetting or even dry impregnation may suffice. The size of the interstices in the finished fabric is, of course, influenced by the tension of the warps during weaving and other factors.

When the pile warps used are the maximum size that can be successfully passed through the dents during weaving, allowing for normal imperfections in the yarn, a very dense faced but permeable impregnated fabric may be produced.

Having described my invention, I claim:

1. An impregnated single weft plane porous cut pile fabric having a visually uniform face coverage which consists of warp and weft backing threads, pile tufts, the tips of which are free of impregnating material, attached to the backing in weft-wise spaced groups, each group having a plurality of rows of pile tufts, said tufts in one row being staggered with respect to the tufts in another row in the same group, each tuft being associated with a pair of backing warps which interlace on opposite sides of the tuft with the weft in flats, a normally insoluble adhesive material impregnated and diffused well into the backing and that portion of the tuft which lies in the same plane with the backing but not filling the interstices between the groups.

2. An impregnated single weft plane porous cut pile fabric having a visually uniform face coverage which consists of warp and weft backing threads, which are substantially free of water-repellent oils, pile tufts, the tips of which are free of impregnating material, attached to the backing in weft-wise spaced groups, each group having a plurality of rows of pile tufts, said tufts in one row being staggered with respect to

the tufts in another row in the same group, each tuft being associated with a pair of backing warps which interlace on opposite sides of the tuft with the weft in flats, a normally insoluble adhesive material impregnated and diffused well into the backing and that portion of the tuft which lies in the same plane with the backing but not filling the interstices between the groups.

3. An impregnated single weft plane porous cut pile fabric having a visually uniform face coverage which consists of warp and weft backing threads, pile tufts, the tips of which are free of impregnating material, looped around a single backing thread and attached to the backing in weft-wise spaced groups, each group having a plurality of rows of pile tufts, said tufts in one row being staggered with respect to the tufts in another row in the same group, each tuft being associated with a pair of backing warps which interlace on opposite sides of the tuft with the weft in flats, a normally insoluble adhesive material impregnated and diffused well into the backing and that portion of the tuft which lies in the same plane with the backing but not filling the interstices between the groups.

4. An impregnated single weft plane porous cut pile fabric having a visually uniform face coverage which consists of warp and weft backing threads, pile tufts, the tips of which are free of impregnating material, attached to the backing in weft-wise spaced groups, each group having a plurality of rows of pile tufts, each tuft being associated with a pair of backing warps which interlace on opposite sides of the tuft with the weft in flats, a normally insoluble adhesive material impregnated and diffused well into the backing and that portion of the tuft which lies in the same plane with the backing but not filling the interstices between the groups.

5. An impregnated weft plane porous cut pile fabric having a visually uniform face coverage which consists of warp and weft backing threads, pile tufts, the tips of which are free of impregnating material, attached to the backing in weft-wise spaced groups, each group having a plurality of rows of pile tufts, a normally insoluble adhesive material impregnated and diffused well into the backing and that portion of the tuft which lies in the same plane with the backing but not filling the interstices between the groups.

6. An impregnated single weft plane porous cut pile fabric having a visually uniform face coverage which consists of warp and weft backing threads, which are substantially free of water repellent oils, pile tufts, the tips of which are free of impregnating material, attached to the backing in weft-wise spaced groups, each group having a plurality of rows of pile tufts, a normally insoluble adhesive material impregnating the backing and that portion of the tuft which lies in the same plane with the backing but not filling the interstices between the groups.

7. In the weaving of pile fabrics on the double plush principle on a loom having a reed containing dents, the steps for obtaining maximum pile coverage which consist in drawing through each of the dents a plurality of pile warp threads each having a diameter larger than the maximum diameter of pile warp threads which, with the customary knots therein, would pass in practical weaving through reed dents having one-half the width of said reed dents, drawing through each of said reed dents a plurality of pairs of upper ground warp threads and a plurality of pairs of lower ground warp threads, shedding said warp threads to form upper and lower ground sheds and laying picks in the upper and lower ground sheds to form upper and lower grounds spaced apart and having a pile loop on every pick in every dent group in both the upper and lower fabric, the pile tufts on adjacent picks in every dent group of each fabric being staggered relatively to one another and separated by a plurality of ground warps.

8. In the weaving of pile fabrics on the double plush principle on a loom having a reed containing dents, the steps for obtaining maximum pile coverage which consist in drawing through each of the dents a plurality of pile warp threads each having a diameter larger than the maximum diameter of pile warp threads which, with the customary knots therein, would pass in practical weaving through reed dents having one-half the width of said reed dents, drawing through each of said reed dents a plurality of pairs of upper ground warp threads and a plurality of pairs of lower ground warp threads, shedding said warp threads to form upper and lower ground sheds and laying picks in the upper and lower ground sheds to form upper and lower grounds spaced apart and having a pile loop on every pick in every dent group in both the upper and lower fabric, the pile tufts on adjacent picks in every dent group of each fabric being staggered relatively to one another and separated by a plurality of ground warps, and impregnating the backing and that portion of the tufts which is in the plane of the backing with a normally insoluble adhesive which does not fill the interstices between the tufts and threads or materially change the textile appearance of the back of the fabric.

9. In the weaving of pile fabrics on the double plush principle, the steps which comprise guiding a plurality of groups of warp threads through reed dents separated from one another by wires, each of said groups comprising at least four pairs of ground warp threads and at least two pile warp threads, each having a diameter larger than the maximum diameter of pile warp thread which, with the customary knots therein, would pass in practical weaving through a reed dent having one-half the width of a reed dent aforesaid, the warp threads of each of said ground pairs working together to form a flat, shedding two of said pairs of ground warp threads oppositely to one another to form an upper ground and shedding the other two pairs of ground warp threads oppositely to one another to form a lower ground, shedding one of said pile warp threads first between the warp threads of a pair forming said lower ground and then between the warp threads of a pair forming the upper ground, shedding the other of said pile warp threads oppositely to said first named pile warp threads and first between warp threads of a pair forming the upper ground and then between warp threads of a pair forming the lower ground, and so on, and laying a pick between the warp threads forming the upper ground and laying a pick between the warp threads forming the lower ground after each shedding of such warp threads.

10. In the weaving of pile fabrics on the double plush principle, the steps which comprise guiding a plurality of groups of warp threads through reed dents separated from one another by wires, each of said groups comprising at least four pairs of ground warp threads and at least two pile warp threads, each having a diameter larger than the maximum diameter of pile warp thread which, with the customary knots therein, would pass in

practical weaving through a reed dent having one-half the width of a reed dent aforesaid, the warp threads of each of said ground pairs working together to form a flat, shedding two of said pairs of ground warp threads oppositely to one another to form an upper ground and shedding the other two pairs of ground warp threads oppositely to one another to form a lower ground, shedding one of said pile warp threads first between the warp threads of a pair forming said lower ground and then between the warp threads of a pair forming the upper ground, shedding the other of said pile warp threads oppositely to said first named pile warp threads and first between warp threads of a pair forming the upper ground and then between warp threads of a pair forming the lower ground, and so on, and laying a pick between the warp threads forming the upper ground and laying a pick between the warp threads forming the lower ground after each shedding of such warp threads and then impregnating the backing and that portion of the tuft which is in the plane of the backing with a normally insoluble adhesive which does not fill the interstices between the tufts and threads or materially change the textile appearance of the back of the fabric.

11. In the weaving of double pile fabrics on a loom having a reed containing dents, the steps for increasing the pile coverage which consist in drawing through each of the reed dents a plurality of pile warp threads each having a diameter larger than the maximum diameter of pile warp threads which, with the customary knots therein, would pass in practical weaving through reed dents having one-half the width of said reed dents, drawing through each of said reed dents two pairs of similarly acting ground warp threads for each of said pile warp threads, interlacing said warp threads with weft threads to form spaced grounds connected by the pile warp threads, and cutting the pile warp threads to form tufts from each pile warp thread on both grounds.

12. In the weaving of double pile fabrics on a loom having a reed containing dents, the steps for increasing the pile coverage which consist in drawing through each of the reed dents a plurality of pile warp threads each having a diameter larger than the maximum diameter of pile warp threads which, with the customary knots therein, would pass in practical weaving through reed dents having one-half the width of said reed dents, drawing through each of said reed dents two pairs of similarly acting ground warp threads for each of said pile warp threads, interlacing said warp threads with weft threads to form spaced grounds connected by the pile warp threads, cutting the pile warp threads to form tufts from each pile warp thread on both grounds, and impregnating the backing and that portion of the tuft which is in the plane of the backing with a normally insoluble adhesive which does not fill the interstices between the tufts and threads or materially change the textile appearance of the back of the fabric.

WHITWORTH FONTAINE BIRD.