

April 20, 1937.

J. T. CALLAHAN

2,077,514

ELASTIC FABRIC AND METHOD OF MAKING THE SAME

Filed March 16, 1934

2 Sheets-Sheet 1

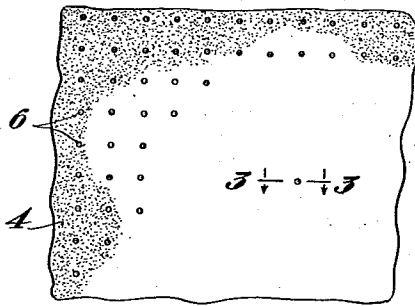


Fig. 1

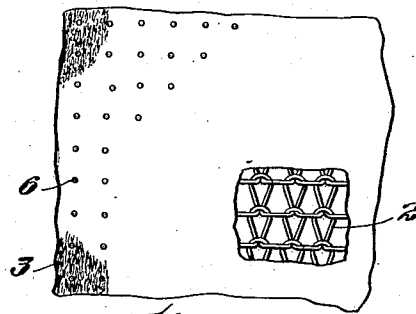


Fig. 2

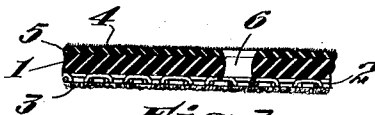


Fig. 3

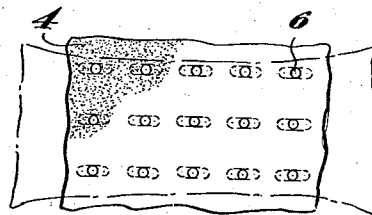


Fig. 4

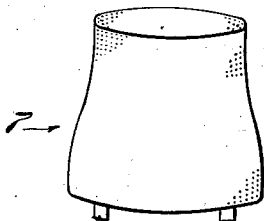


Fig. 5



Fig. 6

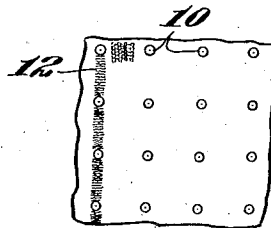


Fig. 7

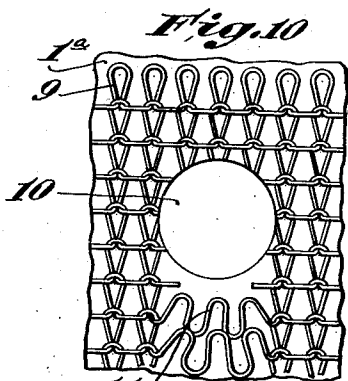


Fig. 8

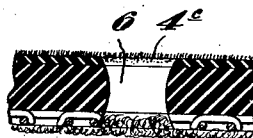


Fig. 9

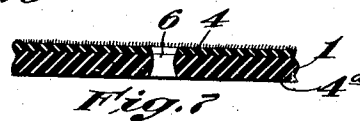


Fig. 10



Fig. 11



Fig. 12

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ELASTIC FABRIC AND METHOD OF MAKING THE SAME

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2 Sheets-Sheet 2

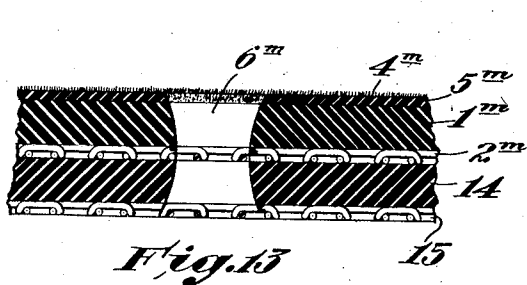


Fig. 13

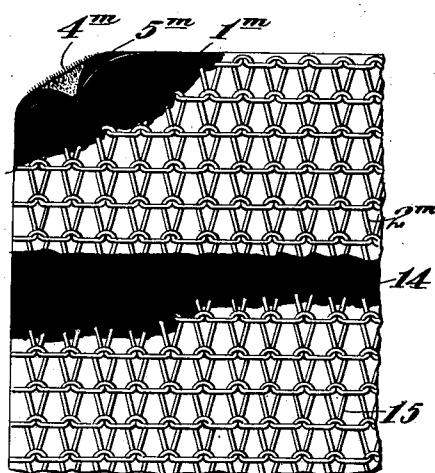


Fig. 14

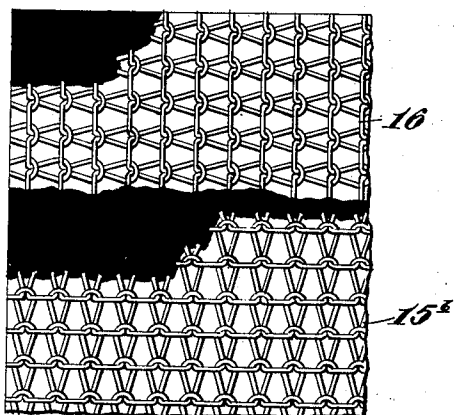


Fig. 16

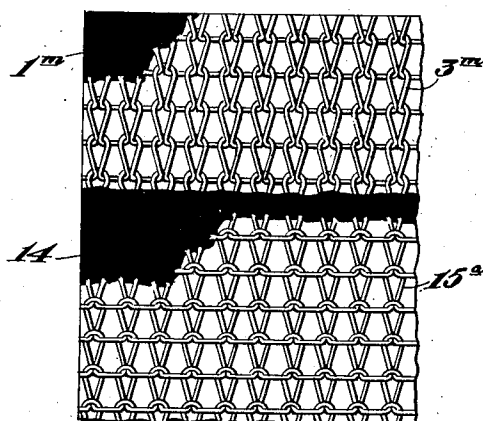


Fig. 15

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UNITED STATES PATENT OFFICE

2,077,514

ELASTIC FABRIC AND METHOD OF MAKING
THE SAMEJohn T. Callahan, Waban, Mass., assignor to
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Application March 16, 1934, Serial No. 715,851

15 Claims. (Cl. 154—2)

This invention pertains to elastic fabric of the kind in which textile material is combined with sheet rubber, and to a method of making such a fabric, and in the specific embodiment herein illustrated relates to porous or perforated fabric desirable for use in the manufacture of garments such, for example, as reducing girdles, corsets, sport vests, jackets, etc.;—bandages, pads, gloves, hat or shoe parts, or wherever it is desired to have the garment or garment-part fit the wearer snugly and smoothly but where for comfort it is usually desirable to provide for ventilation and the escape of moisture. The present application is a continuation-in-part of my application Serial No. 691,945, filed October 3, 1933, upon which Patent No. 1,995,734 issued March 26, 1935.

While it is possible by known methods of textile manufacture, for example, by weaving or knitting, to produce elastic and porous material in which individually elastic yarns or threads of rubber are substituted for some at least of the usual textile yarns, or by the incorporation of tensioned elastic rubber strands with and in addition to the usual textile strands during weaving or knitting,—the elastic material thus produced is unduly expensive for many of the purposes for which elastic fabrics are desirable and loses its elasticity after a short period of use so that garments made therefrom do not long hold their original shape. For this reason, the material most commonly employed for such purposes consists of rubber sheeting having one or both sides united to and covered by textile fabric of a type which is capable of stretching to a substantial extent, at least in one direction, such composite fabrics being durable and retaining their elasticity for a long time. Knitted fabric is almost universally employed as the textile layer in such composite elastic material by reason of its relatively high elasticity as compared with usual types of woven fabric. While rubber sheeting alone, that is to say, unassociated with textile material, might perhaps be used for some purposes in garment manufacture, it is desirable, and substantially necessary, for most purposes to associate textile fabric with the sheet rubber. Such a textile fabric gives added strength to resist abnormal stresses and to furnish a secure anchorage for attachments, such as garters or the like. Furthermore, many wearers find unprotected rubber to be hot, sticky, irritating, and uncomfortable in direct contact with the skin and for this reason prefer to have the inner surface of the sheet rubber covered with textile material of a

soft and non-irritating character. Moreover, an extended outer or exposed surface of rubber alone, even though colored in light shades, does not harmonize well with the daintiness of texture of other articles of modern types of underwear, and tends to adhere to other garments with which it contacts, and for these reasons it is customary to cover the outer side of the sheet rubber with a textile material.

Many garments are made from combined rubber and textile material without any provision whatever for ventilation or the escape of moisture, but they are not comfortable, sanitary or hygienic. It is possible to provide a reasonable degree of porosity by providing perforations in the composite fabric, for example, by punching out small portions at regular intervals, thus forming multitudinous perforations or openings adapted to permit a reasonable degree of ventilation and escape of moisture. However, experiments have shown that;—(owing to the fact that the only textile material commonly employed for the purpose and possessing the desired elasticity is knitted fabric having the inherent structural characteristic of running, forming "ladders" of dropped stitches whenever one or more of its constituent loops is ruptured) the composite rubber and textile material, when perforated as above suggested, is subject, when stretched during use, to the formation of longitudinally extending runs starting at the perforations, such runs, when the stretching stress is removed, form outstanding wales or ribs in the surface of the fabric which detract from its appearance, giving it a worn and unsightly effect.

Among the objects of the present invention are to provide a very durable elastic fabric useful for the manufacture of garments, for example, of the type above referred to, and particularly a fabric of the composite sheet rubber and textile type and of such construction as to provide the desired elasticity, durability, strength and pleasing external appearance, and comfort to the wearer, and more specifically to provide such a fabric having capacity to furnish the desired ventilation and escape for moisture, while at the same time to avoid the production of runs or ravel ribs on the exterior surface of the material which detract from its original finished appearance.

In accordance with one embodiment of my invention, I reinforce the sheet rubber, to insure the desired strength, by adhesively uniting a web of elastic textile fabric to the inner surface of the rubber, preferably employing a textile fabric which is or may be napped to give a soft, fluffy

inner surface for direct contact with the wearer's skin, such a surface being very absorbent. To impart the desired finish to the outer surface of the rubber, I adhesively unite a layer of "flock", that is to say, finely divided and very short fibrous material, for example cotton, wool, silk, rayon, etc., such layer being applied in any usual manner known to those skilled in the art. After the composite fabric has thus been formed, and preferably before the rubber constituents of the fabric have been cured, the fabric is perforated by punching or otherwise, and afterward cured.

For some uses it is undesirable to provide the inner face of the fabric with a napped surface and to avoid the formation of visible runs or ravel-ribs at this inner surface, when the latter is unnapped, I may, in accordance with another embodiment of the invention, associate a second layer of rubber and another textile web with the first (the second web thus constituting the inner face of the composite fabric). When the fabric is thus constituted it is found that the inner textile web which is disposed between two layers of rubber, appears to take almost the entire strain as the fabric is stretched, perhaps due to the fact that this inner web is symmetrically anchored between the two substantially equal layers of rubber, and thus the web which forms the inner surface of the material is not exposed to sufficient strain to develop runs at the perforations. Thus while the inner face of the fabric may be substantially smooth (unnapped) and though it is perforated, yet it does not develop objectionable runs or ravel-ribs during use.

In the accompanying drawings, wherein I have illustrated certain embodiments of the invention by way of example,

Fig. 1 is a fragmentary elevation illustrating the outer side of my improved composite fabric;

Fig. 2 is a similar view showing the inside of the improved fabric in accordance with one mode of construction, and showing a portion of the unnapped textile web highly magnified;

Fig. 3 is a fragmentary section to large scale substantially on the line 3—3 of Fig. 1;

Fig. 4 is a fragmentary view showing the appearance of the outside of the fabric and indicating the normal shape of the perforations and also their shape when the fabric is stretched;

Fig. 5 is an elevation to small scale illustrating a garment such as may be made from the improved fabric;

Fig. 6 is a fragmentary view similar to Fig. 3, but to even larger scale, illustrating the effect of punching the composite fabric before its rubber constituents have been cured;

Fig. 7 is a fragmentary section similar to Fig. 3, illustrating a modification;

Fig. 8 is a view similar to Fig. 7 illustrating a further modification;

Fig. 9 is a fragmentary section illustrating a still further modification;

Fig. 10 is a fragmentary front elevation to large scale illustrating a composite fabric of usual construction having the outer surface of the rubber covered with knitted textile fabric, and indicating the effect of stretching such a fabric after it has been perforated;

Fig. 11 is a view similar to Fig. 10, but to smaller scale, indicating the resultant surface appearance of the fabric after the stretching stress has ceased and the fabric has resumed its normal unstretched condition;

Fig. 12 is a view similar to Fig. 8, but showing the use of a sponge rubber layer;

Fig. 13 is a view similar to Fig. 3, but disclosing another embodiment of the invention;

Fig. 14 is a fragmentary elevation of the fabric of Fig. 13, viewed from the inner face;

Fig. 15 is a view similar to Fig. 14, illustrating a slight modification of the fabric of the latter, and

Fig. 16 is a view similar to Fig. 14, showing a further modification.

Referring to the drawings, my improved fabric preferably comprises a sheet rubber core 1 which may be of any desired thickness or gauge in accordance with the purpose for which the fabric is to be employed. This rubber sheet may be prepared in accordance with any of the usual methods and by any of the accepted formulas, and may be colored or tinted to suit the requirements of the trade.

To that side of the sheet rubber which is to form the inner or body-contacting surface of the garment, when made, I preferably adhesively secure, by methods well known to the manufacturer of rubber fabrics, a web 2 of highly elastic textile material. For this purpose I have found that a knitted fabric is well adapted, although I contemplate that other elastic textile webs may be employed instead of a knitted web, if preferred. Specifically, I have in mind the possibility of weaving a highly elastic textile fabric which would be suitable for this purpose.

Preferably, before association with the rubber sheet, that surface of the textile web which is to be exposed, is napped in accordance with well known textile practices to provide a fluffy or brushed fibrous surface 3, but I contemplate the possibility of attaching the textile web to the rubber sheet before this napping process has been carried out and afterward napping the textile layer to produce the fibrous surface. Such a fibrous inner surface is very desirable by reason of its highly absorbent qualities, and because it provides a soft and silky surface for contact with the wearer's skin. Nevertheless, I contemplate the possibility of leaving this textile web unnapped. Preferably the rubber sheet or core 1 is uncured or only partially cured before attachment of the textile web thereto. After the textile web has thus been combined with the rubber sheet, I adhesively secure to the opposite face of the rubber sheet, (that is to say, that face which will be the outer face of the garment) a layer 4 of "flock". By "flock" I mean finely divided fibrous material such as is produced by cutting cotton, wool, silk, rayon, etc., so as to provide fiber of extremely short but substantially uniform lengths or by grinding the same or similar materials almost to the condition of dust. Preferably, this "flock" is treated in some appropriate manner, for example, by impregnation with paraffin, insoluble soap, cellulose compound, resin, or the like, to make it waterproof or moisture-repellent before or after application to the fabric. This layer of flock is so applied and adhesively secured to the rubber sheet, for example, by the employment of an adhesive layer 5, preferably a rubber compound, that in general one end of each flock fiber is individually embedded in the adhesive layer while the other end of each fiber is free, the fibers standing on end so to speak, as illustrated in Fig. 7, and collectively covering the adhesive layer and imparting a villous surface effect.

After the layer 4 of flock has been applied to

the outer surface of the rubber sheet, the composite fabric thus resulting is subjected to a punching or other equivalent process thereby to produce a multitude of small holes or perforations 6 extending completely through the thickness of the composite fabric, that is to say, through the layer 4 of flock, the rubber core 1 and the textile web 2. To provide the desired porosity, such perforations may for example, be of the order of $3/64$ of an inch in diameter and spaced on centers from $1/4$ to $1/2$ inch apart, but any other desired size of opening and any selected spacing and distribution of openings may be employed as circumstances seem to warrant. Moreover, for use in garments of the type referred to, the composite fabric may be of the order of 50 gauge, but this invention is not limited to any particular thickness of material.

After the sheet has thus been perforated, it is cured and is then ready for use in making up garments, such for example, as the reducing girdle 7 illustrated in Fig. 5. When thus made up into a garment, the outer or exposed surface presents a pleasing appearance quite different from that of plain rubber, due to the layer of flock, the appearance of this layer varying with the material used as a flocking substance,—in some instances appearing much like suede leather and in others having a silky velvety appearance of a highly ornamental character. Alternatively, as shown in Fig. 12, instead of providing a solid layer of rubber which must subsequently be perforated, I contemplate the use of a sponge rubber layer 14 of so porous a character as to provide the desired escape for moisture without necessitating the perforating operation.

When a garment made of this material is subjected to lateral stretch the perforations 6 stretch laterally as indicated in dotted lines in Fig. 4, becoming more or less elliptical in contour, but when the strain is removed these openings resume their normal circular shape. Even though the openings be stretched to a size just short of that which would result in tearing the fabric, they resume their normal shape when the stress ceases, and the surface appearance of the material is not injuriously affected. In other words, stretching the material, even to an abnormal degree, does not appreciably injure or deface its outer surface, so that the layer of flock may well be designated a stretchable, non-ravelling textile layer.

Preferably, as above noted, the perforations are formed before the rubber constituents of the material, that is to say, the rubber core 1 and the rubber adhesive layer or layers, if any,—used in attaching the surface layers, have been cured, since I find from examination of the finished fabric that when thus perforated before curing, portions 4^c of the flocking material are carried down during the punching operation into the mouths of the perforations and become embedded in the walls of such perforations and some of the fibrous elements 8 of the napped textile web are likewise bent over and embedded in the walls of the perforations. When the fabric is subsequently cured, these fibrous elements of the flocking material and of the web are firmly anchored in the walls of the perforations, thus giving a more finished appearance to the fabric, and in the case of the flocking material, at least, assisting to prevent moisture, which escapes through the perforations, from detaching the flock adjacent to the perforations, which would result in a defaced fabric. On the other hand, the embedding of the

nap fibers of the textile web in the walls of the openings, tends to prevent the ready formation of runs, or ravelling of the knitted textile web. Preferably, the punching is done by protruding a hollow punch through the fabric from the flocked surface inwardly through the core 1 and fabric 2, since the perforations thus made are more uniform at the outer or flocked side of the material, but acceptable results may be obtained if the fabric is punched from the back or napped side. For rapid work, gang punches are employed, and such punches may be mounted on reciprocating platens or on rollers, as preferred.

In Fig. 10 I have illustrated the usual effect of stretching a composite fabric comprising rubber having an outer surface of knitted material and which has been perforated. In this instance, the fabric comprises the rubber sheet 1^a having the knitted material 9 adhesively secured thereto and having perforations such as the opening 10 extending through the knitted fabric and through the rubber. When such a fabric is laterally stretched, the knitted loops which have been cut in forming the perforations tend to run and form a "ladder" 11 extending downwardly below each perforation. If the strain be prolonged these ladders may run down the fabric as far as the next perforation. When the strain is removed and the fabric resumes its normal condition, these ladder loops bunch up and form run ribs 12 (Fig. 11) which project from the outer face of the fabric below each opening. Since such run ribs are not uniform, but are fibrous and ragged, their presence greatly detracts from the appearance of the fabric, making it appear to be worn and old even though it may not have been in use for any substantial length of time.

In accordance with my present invention no such effect is produced by stretching my improved fabric, the outer surface of which retains its normal appearance throughout a long period of wear.

For certain purposes I find it unnecessary to employ the inner textile web 2, and thus as illustrated in Fig. 7 I may employ the rubber core 1 having its inner surface 4^a uncovered but having its outer surface provided with a layer of flock 4 adhesively secured thereto in the same manner as above described. This fabric is provided with perforations 6 to give the desired porous characteristics.

In Fig. 8 I have illustrated a further modification in which the rubber core 1 is furnished with the textile web 4^b at its inner side, and with the flock layer 4 at its outer side, but in this instance the textile web 4^b is not napped. In Fig. 9 I have illustrated a still further modification in which the core 1 is provided with a layer 4 of flock on its outer surface and with a similar layer 4 of flock at its inner surface.

In the construction illustrated in Figs. 13 and 14, the rubber core layer 1^m, the elastic web 2^m, the adhesive layer 5^m and the layer of flock 4^m are in general similar to the elements 1, 2, 5 and 4 respectively of the fabric of Fig. 3. However, in the fabric of Figs. 13 and 14 the web 2^m, instead of being napped, is embedded in and adhesively united to one face of a second core layer 14 of rubber, this layer preferably being of substantially the same thickness and elasticity as the layer 1^m. The exposed or outer face of this second layer 14 of rubber is adhesively united to a second textile web 15. This latter web is also of elastic material, usually of knitted fabric preferably disposed with the courses of knitted loops substantially parallel to those of the web 2^m. In

order that the web 15 may be further relieved of injurious stress I may, if desired, make the web 2^m of a slightly less elastic material than the web 15 and the web 2^m may be regarded as a reinforcing element which acts to limit the ultimate stretch of the composite fabric to an extent such that the web 15 can not be over stressed. However, in most instances I find that it is sufficient to make the webs 2^m and 15 alike.

10 Preferably, the two textile webs are similarly disposed in the fabric, that is to say, corresponding faces of the two webs are directed toward the same outer face of the composite material as shown in Fig. 14. The fabric of Figs. 13 and 14 is furnished with perforations 6^m extending throughout its entire thickness, such perforations being disposed in any desired relative arrangement and spacing, and of any suitable size and shape.

The several layers 1^m, 2^m, 14 and 15 of Figs. 13 and 14 may be assembled and adhesively united in any suitable manner, the layers 1^m and 14 preferably being initially unvulcanized. After these several layers have been assembled, the layer of flock 4^m is adhesively secured to the outer surface of the rubber layer 1^m in accordance with any convenient procedure, and the openings or perforations 6^m are then punched through the fabric substantially following the procedure outlined in describing the fabric of Figs. 1, 2 and 3. After these openings have been punched, the fabric is then vulcanized or cured, but I contemplate that the perforations may be formed after curing if desired.

While the fabric of Figs. 13 and 14 has a substantially smooth inner surface, I find, as above stated, that the inner or reinforcing layer or web 2^m carries the strain when the fabric is stretched so that the inner surface-web 15, although perforated, does not show any substantial tendency to ravel at the perforations.

In Fig. 15 I have illustrated an arrangement in general similar to that of Figs. 13 and 14, with the exception that the inner web 15^a of knitted material is disposed in reversed relation to the web 2^m so that corresponding sides of these two textile webs are opposed to each other.

In Fig. 16 the two textile webs 16 and 15^b are so disposed as to reduce the elasticity of the web both in the horizontal and vertical direction. With this object in view, the courses of loops forming the web 15^b are substantially horizontal while those of web 16 are substantially vertical. Thus the web is substantially prevented from stretching except in a diagonal direction, an effect which may be desirable for certain specific purposes.

While for most purposes my improved fabric is desirably perforated, I contemplate that in its broader aspects the invention is inclusive of imperforate fabrics comprising a sheet rubber core having one face covered with an elastic textile web and having its other face provided with a layer of flock. Doubtless, other specific modifications of the invention will occur to those skilled in the art but all such modifications as fall within the scope of the appended claims are to be regarded as within the purview of this invention.

I claim:

1. A flexible composite elastic fabric of the order of 50 gauge comprising a relatively thick layer of sheet rubber having a layer of elastic textile fabric adhesively united to one of its faces and having a stretchable, non-raveling textile layer united to its opposite face by a relatively thin film of adhesive, the composite fabric being provided with a multitude of small openings

which pass through its several constituent layers.

2. A composite elastic fabric comprising a layer of sheet rubber having a multitude of ventilating openings passing through it, one face of the rubber layer being provided with a layer of flock adhesively united to the rubber, the flock extending into the mouths of the openings and being firmly anchored to the walls of the latter, the opposite face of the rubber layer having a napped elastic textile web adhesively united thereto, the nap of the textile web extending into the mouths of the openings and being anchored to the walls of the latter.

3. A composite porous and flexible elastic fabric suitable for use in the manufacture of undergarments, said fabric comprising a sheet of rubber and layers of non-ravelling textile material adhesively united to each face of the rubber, said textile material being of such character as to permit stretching of the rubber in response to applied stress, the composite fabric being provided with a multitude of ventilating openings passing through the rubber sheet and both layers of textile material.

4. A composite porous elastic fabric having one exposed surface coated with flock while its other exposed surface consists of an elastic textile web, the composite fabric comprising layers of rubber with a reinforcing layer interposed therebetween to limit the stretch of the fabric, the composite fabric being provided with a multitude of small openings which pass through its several constituent layers.

5. A composite porous elastic fabric comprising a pair of layers of rubber adhesively united to opposite sides of a textile web of reinforcing material, a layer of flock adhesively united to the outer face of one of the layers of rubber, and an unnapped web of knitted material adhesively united to the outer face of the other layer of rubber, the composite fabric being pierced with a multitude of small openings which pass through its several constituent layers.

6. A composite porous elastic fabric comprising an elastic textile web interposed between and adhesively united to two layers of elastic sheet rubber, the outer face of one sheet of rubber having a layer of flock adhesively united thereto and the outer face of the other layer of rubber having an elastic textile web adhesively united thereto, the composite fabric being provided with a multitude of small openings which pass through its several constituent layers.

7. A composite porous elastic fabric comprising a web of knitted material interposed between and adhesively united to two layers of sheet rubber of substantially the same thickness, the outer face of one sheet of rubber having a layer of flock adhesively united thereto and the outer face of the other layer of rubber having a web of knitted material adhesively united thereto, the courses of loops of the two knitted webs being substantially parallel to each other, the composite fabric being provided with a multitude of small openings which pass through its several constituent layers.

8. That method of making composite elastic sheet fabric which comprises as steps assembling and adhesively uniting two layers of sheet rubber and two elastic textile webs with one textile web interposed between the two rubber sheets and the other textile web in contact with the outer face of one of the rubber sheets, adhesively uniting a layer of flock to the exposed surface of the other rubber sheet, and punching a multi-

tude of small holes through the entire thickness of the composite fabric.

9. A composite porous elastic fabric comprising a web of knitted material interposed between and adhesively united to two layers of sheet rubber of substantially the same thickness, the outer face of one sheet of rubber having a layer of flock adhesively united thereto and the outer face of the other layer of rubber having a web of knitted material adhesively united thereto, the courses of loops of the two knitted webs being disposed at an angle to each other, the composite fabric being provided with a multitude of small openings which pass through its several constituent layers.

10. A composite porous elastic fabric comprising a web of knitted material interposed between and adhesively united to two layers of sheet rubber of substantially the same thickness, the outer face of one sheet of rubber having a layer of flock adhesively united thereto and the outer face of the other layer of rubber having a web of knitted material adhesively united thereto, the courses of loops of the two knitted webs being disposed in non-registering relation, the composite fabric being provided with a multitude of small openings which pass through its several constituent layers.

11. A composite porous elastic fabric comprising a web of knitted material interposed between and adhesively united to two layers of sheet rubber of substantially the same thickness, the outer face of one sheet of rubber having a layer of flock adhesively united thereto and the outer face of the other layer of rubber having a web of knitted material adhesively united thereto, the knitted webs being disposed in relatively reversed relation so that the like sides of the two webs are adjacent to each other, the composite fabric being provided with a multitude of small openings which pass through its several constituent layers.

12. A flexible porous elastic fabric of the order of 50 gauge for use in the manufacture of garments, said fabric comprising a sheet of rubber having secured to one face at least by means of a relatively thin film of adhesive a layer of flock

comprising textile fibers treated to make them moisture repellant, the fabric being perforated with a multitude of openings of the order of $\frac{3}{64}$ of an inch in diameter and spaced a distance of the order of $\frac{1}{4}$ of an inch apart in each direction, said openings passing through the rubber sheet and the layer of flock.

13. A flexible composite elastic fabric of the order of 50 gauge appropriate for use in the manufacture of undergarments, said fabric comprising a relatively thick layer of sheet rubber having a layer of elastic textile fabric adhesively united to one of its faces and having its opposite face coated with a relatively thin film of adhesive, and a non-raveling flock layer comprising a multitude of independent short fibers, each fiber having one end embedded in said adhesive film and having its other end free, the flock fibers standing on end and collectively imparting a villous surface effect to said opposite face of the fabric.

14. A flexible composite elastic fabric of the order of 50 gauge comprising a relatively thick layer of sheet rubber having a layer of elastic textile fabric adhesively united to one of its faces and having a stretchable non-raveling textile layer united to its opposite face by a relatively thin film of adhesive, the rubber layer being porous.

15. A flexible fabric of the order of 50 gauge or less, useful in the manufacture of garments or the like and having a villous surface on both faces, said fabric comprising a layer of relatively thick sheet gummed rubber coated upon one side at least with a relatively thin film of adhesive, and a flock layer comprising a multitude of independent short fibers each having one end embedded in said adhesive film and having its other end free, said fibers for the most part standing on end and being so closely disposed as substantially to cover and conceal the adhesive film, the rubber sheet having a multitude of ventilating openings passing through it, the flock fibers entering into the mouths of the openings and being firmly anchored to the walls of the latter.

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