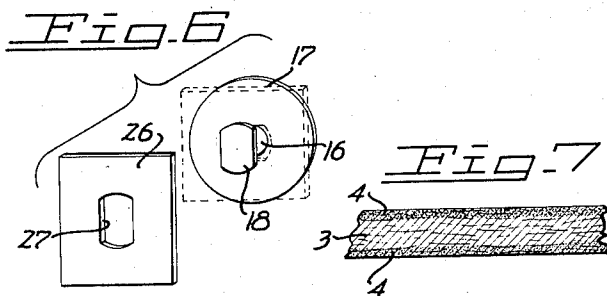
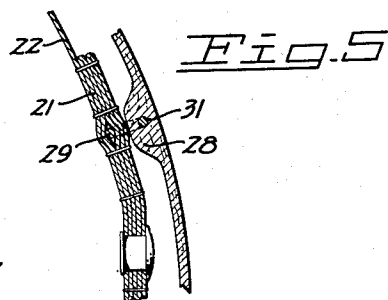
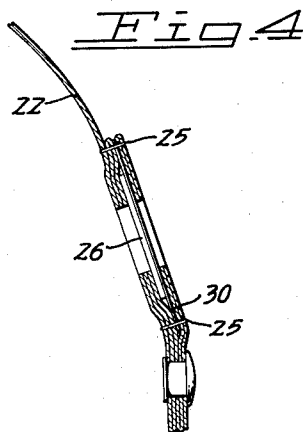
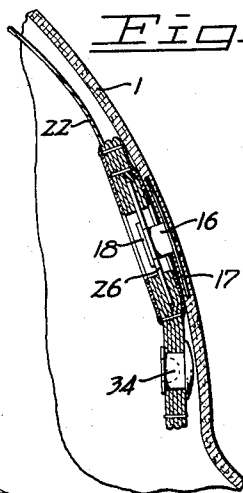
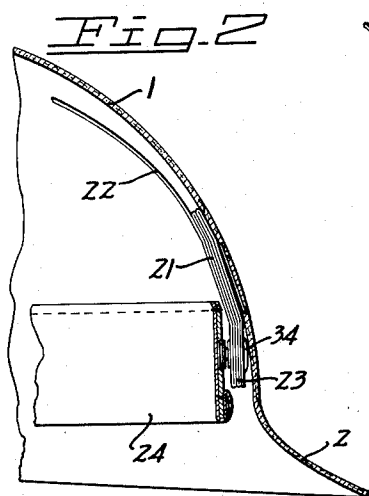
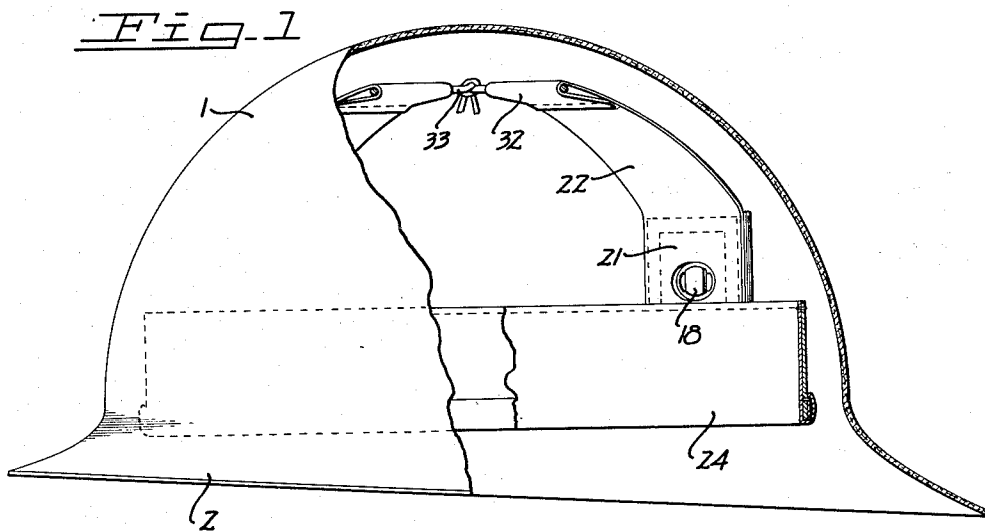


Sept. 15, 1942.

F. R. LUDWELL
PROTECTIVE HEADGEAR
Filed Oct. 18, 1939

2,295,855

2 Sheets-Sheet 1



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Sept. 15, 1942.

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2,295,855

PROTECTIVE HEADGEAR

Filed Oct. 18, 1939

2 Sheets-Sheet 2

Fig. 8

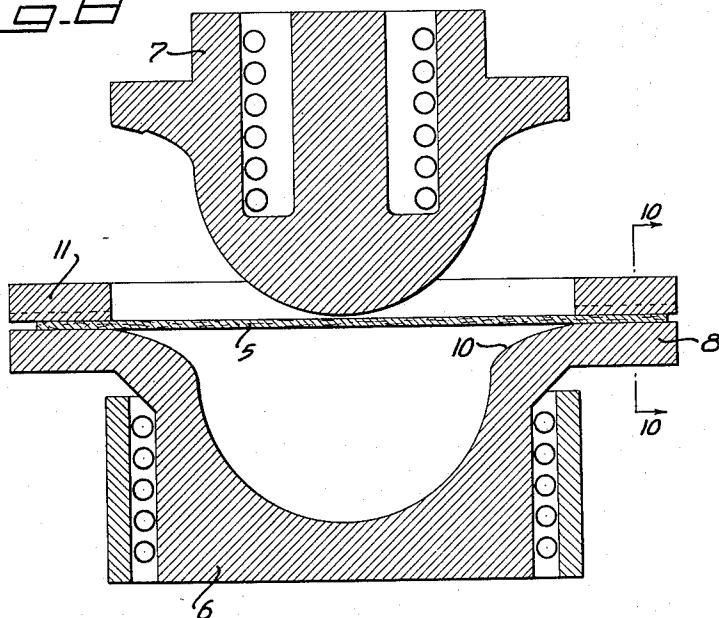


Fig. 9

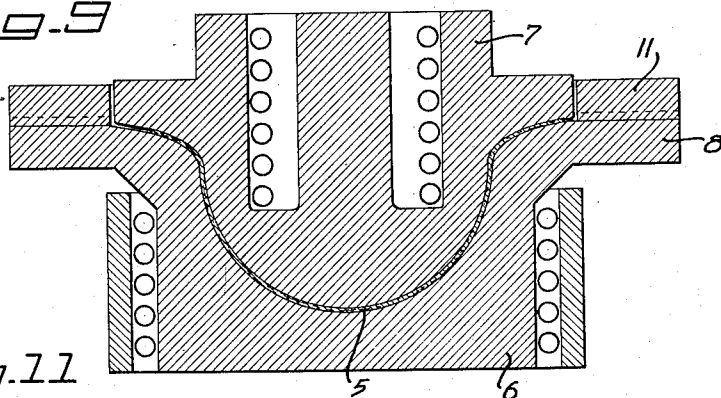


Fig.11

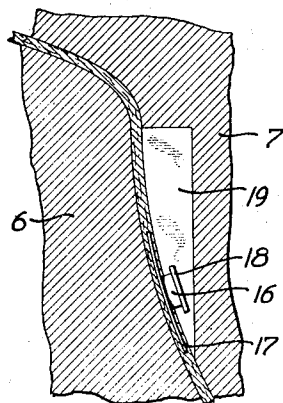


Fig. 12

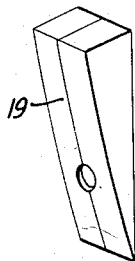
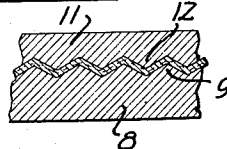


Fig. 10



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UNITED STATES PATENT OFFICE

2,295,855

PROTECTIVE HEADGEAR

Frederick R. Ludwell, San Francisco, Calif., assignor to E. D. Bullard Company, San Francisco, Calif., a corporation of California

Application October 18, 1939, Serial No. 299,999

18 Claims. (Cl. 2—3)

My invention relates to protective headgear for use by industrial workmen; and to an improved method of manufacturing the same.

It is among the objects of my invention to provide a press-formed protective headgear which is extremely tough and rigid, but at the same time light and comfortable to wear; and which is fully waterproof and an excellent electrical insulator.

Another object is to provide an improved means for mounting head straps and a sweat band within the crown of protective headgear, designed to simplify the manufacture and assembly of the parts, and to facilitate adjustment to the head size of a wearer.

Another object is to provide a protective hat and suspension therefor in which the suspension is mounted without requiring any opening to be made through the hat body to receive fastening elements; and in which no electrical conductor is exposed upon the exterior of the hat.

A further object is to provide a method of forming protective headgear wherein long, uneven strands of fibrous material are caused to be substantially uniformly distributed throughout the crown and brim portions of the headgear. The fibrous strands are laid in unoriented relation to each other, and are embedded in the plastic as the materials are pressed and vulcanized in hat form.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of my invention. It is to be understood that I do not limit myself to this disclosure of species of my invention, as I may adopt variant embodiments thereof within the scope of the claims.

In the drawings:

Figure 1 is a side elevation, partly in vertical section, of a protective hat embodying my invention.

Figure 2 is a fragmental sectional detail, partly in elevation, illustrating a preferred form of the suspension mounting.

Figure 3 is a fragmental sectional detail, drawn upon a larger scale, showing the suspension member and the mounting means therefor.

Figure 4 is a fragmental enlarged sectional detail of a modified form of suspension member.

Figure 5 is a fragmental enlarged sectional detail of another modified form of the suspension member and support therefor.

Figure 6 is an exploded view showing the supporting member and bearing plate of the suspension.

Figure 7 is an enlarged sectional view of the preferred hat-forming material.

Figure 8 is a vertical sectional view of portions of a die for pressing and vulcanizing the crown and brim portions of the protective headgear of my invention, the die parts being in open relation with a blank of the hat-forming material in place for pressing.

Figure 9 is a similar view, with the die sections in closed relation.

Figure 10 is a fragmental sectional detail view taken upon the line 10—10 of Figure 8 in the direction indicated and showing the fluted rim and ring portions of the forming die.

Figure 11 is an enlarged sectional detail showing the manner in which a supporting lug is inset in the die for embedding in the hat crown.

Figure 12 is an enlarged perspective detail of a supporting lug-setting block.

In terms of broad inclusion the protective headgear of my invention comprises a hat body pressed from a mass of long unwoven fibrous strands treated with vulcanizable plastic and subjected to conditions of pressure and temperature such as to produce a relatively light, thin, hat-shaped body in which the fibrous strands are substantially uniformly distributed and embedded in the plastic; the strands being disposed in unoriented relation to each other. Preferably the fibre strands are loosely felted in sheet form, the sheet being coated with thermosetting plastic such as a phenol condensation product in its fusible form. Blanks cut from the coated sheet material are pressed into hat form, and the plastic is converted to its hard infusible form by heat and pressure.

My invention also contemplates an improved hat suspension characterized by supporting elements fixed within the crown portion of the headgear coincidently with the forming thereof, and arranged to engage head straps and sweat band supporting tabs designed to facilitate assembly and adjustment to various head sizes, the straps and tabs preferably being fabricated as an integral part of their respective suspension mounting members.

In terms of greater detail, the protective headgear of my invention comprises a crown 1, preferably provided with a brim or visor 2, pressed from a mass of long unwoven fibrous strands 3 treated with formable plastic material 4. The treated mass is pressed and vulcanized into a rigid hat-shaped body by the application of pressure and heat.

Preferably I employ as the fibrous strand ma-

terial a loosely felted mat of long fibre hemp, such as sisal, blown or otherwise laid in loose unoriented relation to form a sheet of substantial thickness, say $\frac{1}{4}$ to $\frac{1}{2}$ inch thick. The sheet so formed is coated with a suitable formable plastic, preferably a thermo-setting phenol condensation product, deposited in a soluble and fusible form upon the mat, in any convenient manner, as by coating the sheet with an appropriate solution of the plastic material and then evaporating the solvent. The plastic is preferably confined to the surface portions of the mat, leaving a central core substantially free of plastic, as indicated in Figure 7 of the drawings. Such material is sold commercially under the name "Durez"; and that material, as such, is not claimed as a part of my invention.

Instead of using the prepared sheets of fibrous material pre-treated with formable plastic, the untreated fibre may be employed, and the plastic material may be mixed therewith directly in a hat-forming die. Also, the fibre may be blown or otherwise laid in a loosely felted mass in the approximate form of a hat, and then treated with plastic material either before or after it is placed in a die for final pressing and vulcanizing; or the plastic may be mixed with the fibre as it is being laid.

Hemp, and particularly sisal hemp, is especially desirable as the fibrous material because the strands are long and very strong, and may be easily handled. However, other materials such as strands of unknotted string, or strands of materials such as jute, hair, kapoc, palm fibre, spun glass, aluminum or other metallic wool, or similar fibrous or strand materials, may be used. The material should be substantially free of knots or snarls such as might prevent the material from flowing to an even thickness under pressure. Strands of a length ranging from $\frac{1}{2}$ inch to several inches are preferred, because they form a mat which is more readily handled; but strands of any length exceeding about $\frac{1}{4}$ inch may be used. No uniformity of length is required.

A plastic material of the thermal-setting type such as a phenol condensation product is preferred because it vulcanizes well; and, when set, is not further affected by heat. Also, this material is waterproof, and an excellent electrical insulator. Thermo-plastic materials, such as ethyl cellulose, may be used; but in that case, the reinforcing fibre should be mixed with the plastic material to provide a doughy mass which may be preformed into hat shape before pressing into final form. The term "vulcanize" is used herein in a broad sense, and includes the conversion of the plastic material to a tough, hard or infusible form by the action of pressure and heat alone, as well as by the chemical or catalytic action of a vulcanizing agent.

The preferred treated sheet material is cut to form oval shaped blanks 5 of appropriate size, say about 16 inches by 18 inches. Preferably, each blank is heated in an oven to 150° F.-250° F. before it is placed in a die for pressing, a temperature of about 200° F. being most desirable. This preliminary heating drives off any moisture or other volatile matter that may be present; and softens the sheet so that it may be more readily shaped. The heated blank is then centered over one section 6 of a die, and a companion die section 7 is moved to press the blank into hat shape. The die sections, both of which are heated in any conven-

ient manner, are preferably closed relatively slowly, say in about 15 seconds; and are separated slightly two or three times to permit escape of gas and vapor before the final shaping pressure is applied. The blank is then subjected to a pressure exceeding 4,000 pounds per square inch at a temperature of about 320° F. for six or seven minutes. The temperature for the preferred plastic material should not be less than about 310° F. nor more than about 330° F. to secure proper curing; but the critical temperature varies for different plastic materials, and a temperature closely approximating the critical temperature at which the plastic material is converted to its infusible form should be maintained. The pressure may be increased substantially, a pressure of about 4,500 pounds per square inch being preferred.

The heat and pressure causes the plastic material to flow through the mat of fibrous material and fully embed the individual fibres, and bond them together. Because of the loosely felted, unwoven character of the mat, the fibres will flow slightly in the die, and are pressed into a compact body.

The plastic material, while penetrating the mat and embedding the fibres forming the central core of the mat, collects in greatest concentration at the inner and outer surfaces of the hat body. This results in a center core portion which is materially less dense and brittle than the surface portions, and which acts as a relatively flexible cushion between the dense card surface portions of the hat body. The plastic produces a smooth glazed surface; and the unoriented fibres extend indiscriminately in all directions throughout the hat body so as to reinforce the same in all directions and preclude the formation of weakened lines along which cleavage may occur.

Since the periphery of the blank is substantially greater than the periphery of the finished hat, and segments cannot be cut from the blank without destroying the continuity and strength of the reinforcing mat, I prefer to arrange the die in such a manner that the edge portions of the blank are drawn into the die in crinkled or corrugated form. This may be accomplished by providing the die section 6 with a rim 8 having radial flutes 9. A ring 11 having corresponding ribs 12 is pressed lightly against the portion of the blank 5 overlying the rim 8. As the die section 7 is moved into the section 6, the edge portion of the blank is drawn from between the rim 8 and ring 11 in corrugations which take up the excess material and cause it to be uniformly distributed around the crown and brim portions of the hat without material overlapping of folds of the blank. The flutes 9 stop short of the area of the die corresponding to the edge of the brim 2; and, as the shaping pressure is applied, the edge of the blank is drawn past the inner ends of the flutes 9 and onto the smooth brim-forming portion 10 of the die.

Instead of forming the hat from a cut blank of sheet material directly in a single die, the material may be initially pressed to hat form in a preforming die at relatively low pressure and temperature. For example, the sheet material may be initially pressed in a preforming die at a temperature of about 150° F. to 250° F., and a pressure of about 500 to 2000 pounds per square inch. Such temperature and pressure does not convert the thermal-setting plastic to its final infusible form, and aids in securing a uniform

distribution of the fibrous strands throughout the body of the hat. The preformed body is then subjected to final treatment in a finish die at a temperature of about 310° F. to 330° F. and pressure exceeding 4,000 pounds per square inch. The final pressing and vulcanizing operation may be performed immediately after the preformed hat body is removed from the preforming die, thereby conserving its heat; or the preformed bodies may be stored and subjected to final treatment as required.

The hat body is provided with a suitable suspension including head straps and a sweat band for accommodating the hat to the head of a wearer. For this purpose I prefer to form the hat body with suspension supports 16 die-fixed upon the interior of the crown 1. The term "die-fixed" is used in a broad sense inclusive of any setting or forming of the lug upon the hat crown as an incident to the shaping operation, whether said lug be an integral part of the crown, or a separate member set in fixed position by the action of the die in forming the hat body. For example, the supports 16 may comprise a metal stem provided with a base plate 17 embedded in the wall of the crown 1, with the stem 16 projecting into the interior of the crown and provided with a head 18. The supports may be die-fixed in the wall of the crown 1 during the forming operation by inserting the heads 18 through openings in split die blocks 19 slidably set in the sides of the die section 7, as illustrated in Figure 11. The base plate 17 projects slightly outwardly from the die section, and a slight clearance is provided between the base and the die block 19 so that when pressure is applied, enough material is forced around the edges of the base plate to fix the support to the hat. No portion of the support 16 extends through the crown wall, and hence no opening is caused through which water may enter; and no electrical conductor is exposed upon the exterior of the hat.

When the die sections are separated after shaping a hat body, the die blocks 19 slide out of the pockets in the face of the die section in which they are normally set. The blocks 19 are then manually detached from the support 16, and another support 16 is placed in position on the block, and the block replaced in the die section preparatory for the next pressing operation.

The supports are engaged by suspension members 21 to which are connected head straps 22, and tabs 23 arranged to support a sweat band 24. In the preferred embodiment illustrated in Figures 1, 2 and 3, the suspension members 21 each comprise a plurality of folds of a heavy tape or other suitable material such as fabric or leather, doubled on itself to provide a heavy central portion. From one end of the central portion the tape is extended to form a head strap 22; and from the other end the tape is extended to form a tab 23.

A bearing plate 26 is secured between folds of the central portion of the member 21. Each plate 26 has an opening 27 arranged to engage a support 16, preferably in pivotal engagement therewith, openings being formed in the overlying folds of the tape to admit the support 16. Preferably the head 18 is longer than it is wide, and is positioned with its long dimension substantially vertically disposed. The opening 27 is of corresponding shape, but is positioned with its long dimension disposed transversely relative to the member 21. After the plate 26 is moved

over the head 18, the member 21 is swung through about 90°, thereby causing the plate to be locked onto the member 16 with a bearing portion of the plate bearing against the stem portion of the member 16.

The central portion of the suspension member 21 is preferably made relatively rigid, while the strap and tab portions 22 and 23 are left flexible. This may be accomplished by impregnating the folds of the central portion with a thermal-setting plastic and subjecting it to heat and pressure sufficient to convert the plastic to its infusible form. Alternatively, the bearing plate 26 may be attached to a piece of light metal 30 shaped to conform to the size and shape of the central portion of the member 21, and secured between overlying folds thereof by stitches 25 extending through the folds of the tape and through the thin metal plate, as shown in Figure 4 of the drawings.

Instead of a metal insert in the wall of the crown 1, the suspension supports may be formed as inwardly projecting lugs 28, as illustrated in Figure 5, and to which the suspension member 21 may be secured. Any suitable means may be employed for securing the suspension members to the lugs. For example, a link 29 may be secured to the central portion of each suspension member 21, and arranged to engage openings 31 formed in the lugs 28. In this case, as in the case of the metal inset supports 16, the suspension straps are supported from the interior of the hat without requiring any opening to be made through the crown wall, and without exposing any electrical conductor on the outside of the hat.

The upper ends of the head straps 22 are provided with loops 32. A cord 33 is passed through the loops of the several straps 22 and tied to secure the straps together at their upper ends. By varying the length of the loop formed by the cord 33, the head bands can be held in the relation best suited to the shape of the wearer's head.

The sweat band 24 is preferably a closed ring of relatively flexible material such as coated fabric, leather, Celluloid or other suitable material. The band 24 may be conveniently secured to the tabs 23 by snap fasteners 34. The bands are made in various head sizes, and by substituting a band of appropriate size, a single size of hat body may be fitted to any head size. The flexible tabs 23 permit the band to shape itself to the wearer's head; and the pivoted relation of the suspension mounting members 21 and supports 16 further aid in permitting the band and head straps to accommodate themselves to heads of various size and shape.

I claim:

1. The method of making protective headgear which comprises introducing a sheet of loosely felted fibrous strand material treated with a formable plastic material between cooperating die sections, initially shaping the sheet to hat form under a pressure of about 500 to 2,000 pounds per square inch at a temperature of about 150° F. to 250° F. and thereafter pressing the shaped body under a pressure exceeding about 4,000 pounds per square inch at a temperature approximating the critical temperature of the plastic material.

2. The method of making protective headgear which comprises making a loosely felted mat of long fibre fibrous material, coating the mat with thermo-setting plastic material, preheating the

coated sheet at a temperature of about 150° F. to 250° F. and pressing the preheated material into the form of a hat under a pressure exceeding about 4,000 pounds per square inch at a temperature approximating the critical temperature of the plastic material.

3. The method of forming protective headgear which comprises placing a mat of loosely felted fibrous material treated with thermo-setting plastic in a die, fluting the peripheral portion of the mat while pressing the central portion of the mat into the die, the fluted portion being drawn into the die with the flutes regularly spaced around the periphery of the die without material overlapping, and pressing the mat under conditions of pressure and temperature suitable for converting the plastic material to an infusible form.

4. A protective hat comprising a mat of unwoven strands of fibrous material treated with formable plastic material and consolidated therewith under heat and pressure to produce a rigid crown and brim, the strands of the strand material being substantially uniformly distributed and embedded in the plastic material in unoriented relation relative to each other and being individually bonded together by plastic filling the interstices between the fibers throughout the thickness and area of the crown and brim with portions of many of the unoriented strands extending across the thickness of the body for providing a bond between the inner and outer surfaces thereof.

5. A protective hat comprising a body composed of long unwoven strands of fibrous material treated with thermo-setting plastic material and consolidated under heat and pressure to produce a rigid crown and brim, the strands being substantially uniformly distributed and embedded in the plastic material in unoriented relation throughout the thickness and area of the body, and suspension supports upon the interior of the body and united therewith through the medium of the plastic material for providing attachments for head strap and sweat band mounting means, said suspension supports being confined to locations inside the outer surface of the crown and being insulated by a thickness of said crown covering the outer portions of said supports.

6. A protective hat comprising a body of loosely matted unwoven strand material and formable plastic material, the strand material being embedded in the plastic material and consolidated therewith under high heat and pressure to form a rigid crown and brim, said crown and brim having inner and outer surface portions of high density and a portion intermediate the surface portions having relatively low density, and the strands of said strand material being disposed in unoriented relation relative to each other substantially uniformly throughout said surface and intermediate portions of the crown and brim, with the plastic material filling the spaces between the strands and bonding the strands together throughout the thickness of the body.

7. A protective hat comprising a body composed of long unwoven lengths of strand material treated with thermo-setting plastic material and consolidated under heat and pressure to produce a rigid crown and brim, the strands being distributed and embedded in unoriented relation throughout the thickness and area of the crown and brim and being bonded together

by the plastic material, and inwardly extending lugs upon the interior of the body and held thereon by the plastic material for providing attachments for head strap and sweat band mounting means, said lugs having their outer portions covered by portions of the crown extending thereover.

8. A protective hat comprising a body composed of unwoven lengths of strand material treated with thermo-setting plastic material and consolidated under heat and pressure to produce a rigid crown and brim, the strands being distributed and embedded in unoriented relation throughout the thickness and area of the crown and brim and being bonded together by the plastic material, and lugs having base portions embedded within the wall of the crown without extending therethrough and having inwardly extending stem portions arranged to engage head strap mounting means.

9. A protective hat comprising a rigid crown, a plurality of spaced lugs die-fixed to and projecting inwardly from the lower portion of the crown, the lugs being disposed entirely inside the outer surface of the crown without extending therethrough, head strap mounting means engaging the lugs, head straps connected to the mounting means, and a sweat band carried by the head strap mounting means.

10. A protective hat comprising a rigid crown, a plurality of lugs extending inwardly of the crown, a plurality of suspension members attached to the lugs and having substantially rigid body portions provided with integrally formed relatively flexible upper extensions forming head straps and integrally formed relatively flexible lower extensions arranged to engage a sweat band.

11. A protective hat comprising a rigid crown, a plurality of lugs fixed upon the interior of the crown, a like plurality of suspension members each comprising a relatively rigid central portion engaging the lugs, and flexible extensions integrally formed upon the upper and lower ends of the central portions, said upper extensions forming head straps connected to each other within the upper portion of the crown and said lower extensions being provided with means for engaging a sweat band.

12. A protective hat comprising a rigid pressed and vulcanized crown, a plurality of suspension mounting lugs fixed upon the inner side of the crown without extending therethrough, a suspension member attached to each lug and comprising a relatively rigid central portion, a flexible upper head strap portion and a flexible lower portion, a sweat band connected to the flexible lower portions of the suspension members, and means connecting the upper ends of the head strap portions.

13. A suspension for protective headgear comprising a plurality of suspension members each comprising a relatively rigid central body portion and relatively flexible extensions upon opposite ends thereof, a bearing carried by the central portion for engaging a supporting lug, means connecting the extensions at the upper ends of the body portions as head straps arranged to extend over the head of a wearer, a sweat band, and means for securing the sweat band to the extensions at the lower end of the body portions.

14. A protective hat comprising a thickness of matted unwoven and unoriented strand material treated upon opposite surfaces with thermo-set-

ting plastic material and compacted therewith under heat and pressure to form a rigid body, the strands of the strand material extending indiscriminately in all directions throughout the thickness of the body and being embedded and bonded together in zones of high density at opposite surfaces and an intermediate zone of relatively low density with portions of the strands contained in the intermediate zone extending substantially to the surfaces of the zones on opposite sides thereof.

15. In a protective hat, a suspension member comprising a plurality of thicknesses of strip material forming a central body portion, a portion of said strip material extending from one end of the body being arranged to provide a mounting for a sweat band, another portion of the strip material being extended from the opposite end of the body to provide a head strap, and means for imparting rigidity to the central body portion without affecting the flexibility of the end extensions.

16. In a protective hat, a suspension member comprising a plurality of thicknesses of strip material forming a central body portion, a portion of said strip material extending from one end of the body being arranged to provide a mounting for a sweat band, another portion of the strip material being extended from the oppo-

site end of the body to provide a head strap, means for imparting rigidity to the central body portion without affecting the flexibility of the end extensions, said means being provided with a bearing portion for effecting interlocking engagement with a supporting lug carried within the crown of the hat.

17. The method of making protective headgear which comprises applying heat and pressure to a myriad of loosely matted unwoven fibrous strands pretreated with a formable plastic material, for consolidating the materials and converting the same into a rigid hat-shaped body in which the fibrous strands are individually bonded together by the plastic material and substantially uniformly distributed and embedded in the plastic material in unoriented relation throughout the area and thickness of the body.

18. In a protective headgear of the character described, a suspension strap comprising a flexible head engaging portion, a relatively heavy rigid mounting section of increased thickness integral with the strap portion and provided with means for attaching the straps to the headgear, and a portion integral with the mounting section and projecting downwardly therefrom to provide a mounting for a sweat band.

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