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[54] **PROTECTIVE HEADGEAR**

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[52] **U.S. Cl.** .... **2/3 R**
[51] **Int. Cl.** **A42b 3/00**
[58] **Field of Search** .... 2/3 R, 3 A, 3 B, 3 C, 5, 2/6; 161/159, 160, 190

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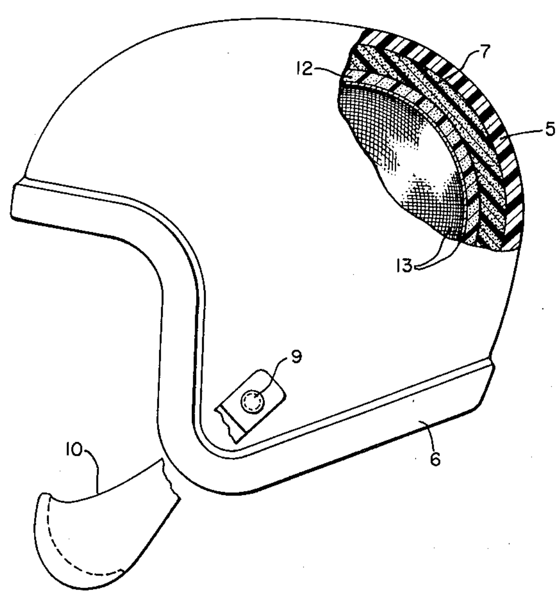
[57] **ABSTRACT**

A protective headgear characterized by microporous semi-flexible polyurethane outer shell and a soft, flexible cellular liner, the outer shell having a density of about 30 to 42 pounds per cubic foot and a deflection test (Z-90 impact) of one inch at about one to 5 pound load and a temperature of 75°F.

3 Claims, 2 Drawing Figures



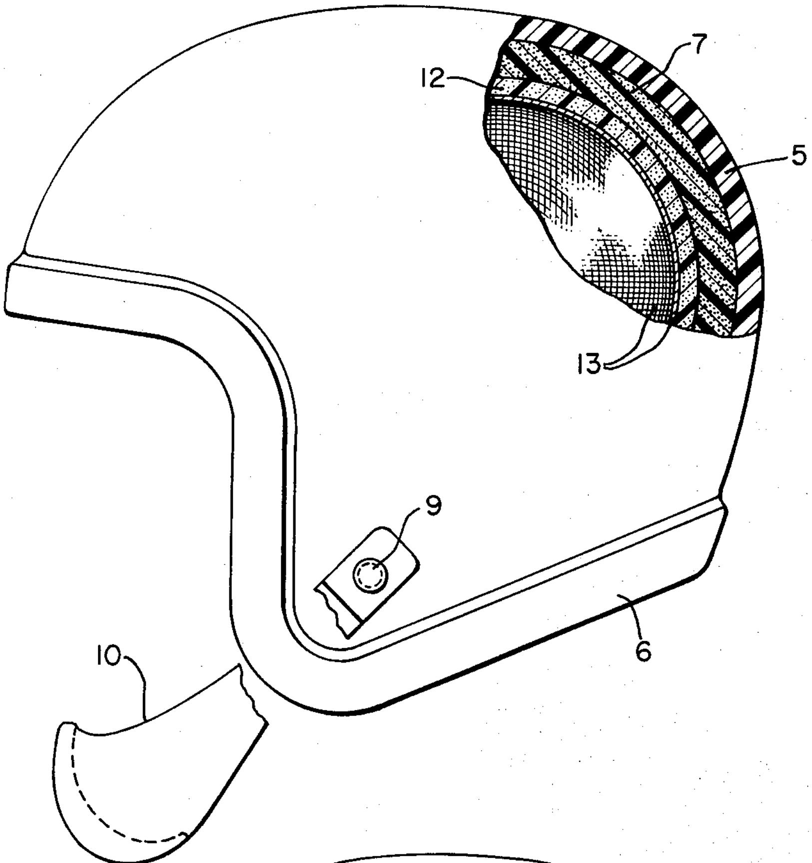


FIG. 1

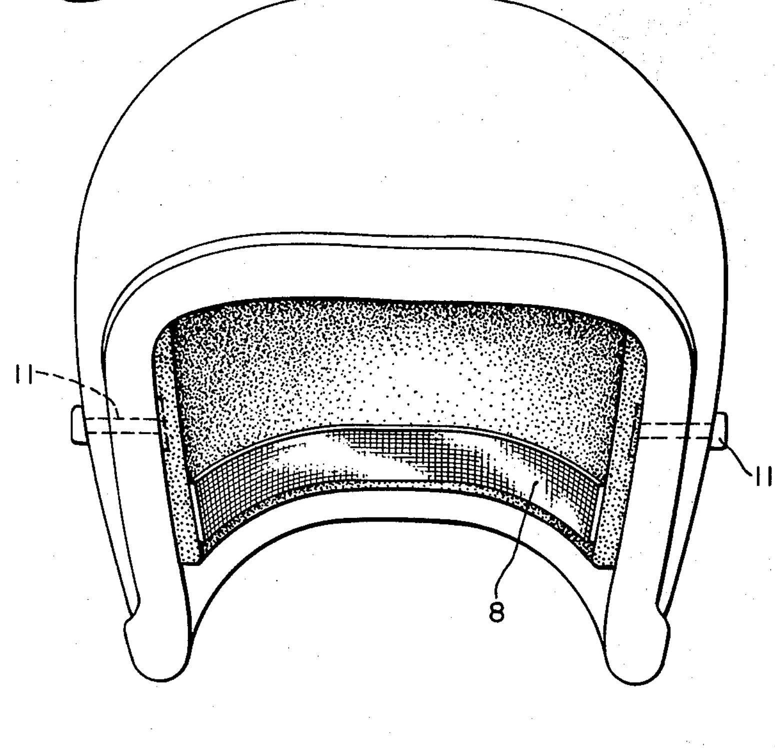


FIG. 2

PROTECTIVE HEADGEAR

This invention relates to a nonrigid protective headgear. More particularly, it relates to helmets and the method of construction. The term "protective headgear" has traditionally been used to cover helmets and related protective devices for use in protecting vehicular riders such as motorcycle, automobile and motor bike riders. Also, it has been used to cover the devices used in sports, such as baseball, football and hockey, and in the military service for protecting people in the Air Force, Navy and Army. The protective headgear traditionally has comprised these elements, the first being a rigid outer shell; second, a soft head-contacting liner therein, with a means such as a strap sling to adjust the liner to fit the contour of the wearer's head; and third, an anchor means for anchoring the outer shell with the inner strap sling liner on the wearer's head, this being traditionally a chin strap device.

Heretofore, the protective headgear has almost universally been comprised of a rigid outer shell member and this rigid outer shell member in some embodiments could extend outward over the face in a bill-like projection or in other embodiments could extend down in the back like a tail to protect the wearer's neck. In some instances it has been desirable that some embodiments of the outer shell be shaped to permit ear phones or like special apparatus to be fitted in or on the shell.

Although the protective headgear has been used extensively for ages it has had a number of drawbacks, one of the principal ones being that the outer shell was rigid and had to depend on the inner sling liner or undershell and the means for adjusting the sling liner to distribute the impact to the wearer's head.

Also, the rigid outer shell was able to function as a sound deadener or as an insulator from heat. Thus, where the helmet is to be worn on a motorcycle or around aircraft it is very desirable that the outer shell be able to act as a sound or noise deadener.

An object of this invention is to provide a protective headgear wherein the outer shell is nonrigid and is capable of acting as an energy absorber through compression of itself as well as a noise absorber and a heat insulating means. A further object is to provide a protective headgear that is lighter in weight than that normally obtained with the rigid outer shell member.

In the accompanying drawings wherein

FIG. 1 is a perspective view in side elevation with a portion cut away to show one embodiment of the shell liner relationship and

FIG. 2 is a front view in elevation without the chin strap.

In the drawing, the outer shell **5** is shown as having an enlarged area or flange **6** near the outer edge of the outer shell. This enlarged rounded flange member functions in the capacity of imparting greater strength to the outer shell and also, since it is semi-flexible, permits the distribution of any unusual loads in contact with the neck to be more readily distributed. Resting within the outer shell is a head contacting liner which can be both a flexible soft foam, cork, etc., liner and a strap means, viz., an adjustable head band **8** for adjusting the fit of the liner to the wearer's head and this means for adjusting the fit of the liner to the wearer's head may be any of the well-known devices for achieving this, such as straps or headbands. Also, it should be noted that the means for anchoring the protective

headgear on the wearer is riveted or otherwise attached to or through the outer shell and extends down and to a means such as a slip buckle **10** that may be fastened or unfastened or adjusted whereby the protective headgear can be fastened under the chin of the wearer.

The outer shell has been described as being nonrigid and semi-flexible in nature. Also, the outer shell is usually smooth but this smoothness may be varied to give a decorative or more aesthetic design to the helmet as described above in regard to the flange around the outer extremity. The outer shell may be formed by pouring a liquid foamable polyurethane reaction mixture into a mold having the contour of the outer shell to form a porous semi-rigid outer shell member. This outer shell member may be removed from the mold and the head contacting liner placed therein. The liner may be secured to the outer shell in any of the well-known manners, for instance, by riveting, bolting or adhesively adhering thereto.

The nature of this invention can more readily be appreciated and understood by reference to the following exemplary and representative examples where all parts and percentages are by weight unless otherwise indicated.

EXAMPLE I

A polyester fiberglass helmet shell mold of the helmet type shown in FIG. **1** was assembled and given a coating of a polyethylene mold release agent. Then the cavity of the shell mold was charged with sufficient amount of a liquid foamable polyurethane reaction mixture to fill the mold and preferably develop a slight positive pressure, usually approximately 0.5 to 45 pounds per square inch during the foaming of the mixture. The charge in the mold is let stand until cured, usually about 15 to 60 minutes if at elevated temperature, but if at room temperature a longer time may pass before opening the mold and stripping out the semi-flexible microporous shell.

The shell is desirably given a decorative coat of an elastomeric paint to give the shell the desired color and appearance. Alternately, the liquid foamable polyurethane mixture is dyed or pigmented to eliminate the need to paint the shell. Also, the shell can be bored or punched to provide the bolt or rivet holes **11.**

The soft liner can be prepared by pouring a soft flexible polyurethane reaction mixture in the liner mold and allowing it to foam and cure. This liner is placed in the shell and preferably adhered therein by use of a thin layer of the flexible polyurethane reaction mixture as an adhesive. The soft liner can be made by the use of any of the well-known soft flexible polyurethane reaction mixtures that give a foam of about 2.5 to 20 pounds per cubic foot in density and a compression set of 80 to 100 percent by ASTM Method 2204.

The semi-flexible foam for the outer shell was made by mixing in an Admiral Foam Machine the following recipe:

Preblended resin*	100 parts
Triethylene diamine	0.07 part
Dibutyl tin dilaurate	0.10 part
Quadrol	8.0 parts
Water	0.35 part
Quasi Prepolymer, 30% Free NCO**	1.03 index

* A blend of 88 parts of acrylonitrile grafted polypropylene ether triol of 6400 molecular weight, 10 parts diethylene glycol and 2 parts triisopropanol amine.

**An adduct of toluene diisocyanate (80/20 24,26 isomeric mixture) and diethylene glycol. Foams of this type have a density of about 30 to 55 pounds per cubic foot.

The soft, flexible helmet liner foams were made by mixing the ingredients on an Admiral Foam Machine using the following recipe:

	Parts
Resin *	100
Water	1.5
Calcium stearate	3.0
Triethylene diamine	1.0
Stannous octoate	0.25
Mondur MRS **	78.1

*85/15 percent blend of a 4500 molecular weight ethylene oxide capped polypropylene ether triol and 400 molecular weight polypropylene oxide based sucrose polymer.

**Mondur MRS is a crude polymeric isocyanate of methane di(phenyl isocyanate) i.e. MDI of approximately 40 percent 4,4-MDI, 10 percent 2,4-MDI and 50 percent trifunctional higher analogues of 2,4- and 4,4-MDI.

Polyurethane reaction mixtures that yield microporous polyurethanes of about 30 to 42 pounds per cubic foot, Shore A hardness of 80 to 100, puncture resistance of 60 to 100 pounds, hammer cold crease resistance to −40°F. and exhibit a 1-inch deflection under loads of about 1 to 5 pounds at 75° F. and 5 to 10 pounds at −14°F. are satisfactory for the shell of this invention. The puncture test measures the resistance in pounds to the penetration of a push of one-eighth inch diameter flat head pin type through a one-fourth inch thick sample. The hammer crease test is run at decreasing cold temperature at 10°F. intervals until the sample fails under hammer impact. The deflection test (Z–90 impact) is run usually at 75°F. and −14°F. and the amount of deflection of a ¼ inch × 1 inch × 6 inch strip when suspended on a 4 inch span on a load is applied at the center to effect a deflection which is recorded as the inches of deflection at the specified load.

Referring to FIG. **1**, it will be seen that in this embodiment a polystyrene foam head member **12** is positioned inside the liners **7** to adjust the liner to the contour of the wearer's head. It is preferred that this polystyrene foam head member have a compression set of at least 90 to 100 percent. Also, the polystyrene foam head member **12** is covered with a soil preventing member **13**, usually of fabric such as nylon, polyester or cellulose types. The soil preventing member **13** can be used to give the helmet varying sizes in the manner customarily achieved by stuffing behind a headband.

Any of the well known polyurethane reaction mixtures that yield microporous polyurethane or foams having compression set of 80 to 100 percent at 2.5 to 20 pounds per cubic foot can be used. Also, it should be appreciated that the impact resistance of the microporous polyurethane can be varied readily by use of a tri- to hexa-functional crosslinker as the curative in about 0.5 to 1.0 mole per mole of excess organic polyisocyanate. The organic polyisocyanate is used in excess relative to the polyester or polyether and usually about 1.5 to 3.5 moles per mole. The ingredients useful in making polyurethane reaction mixtures are well illustrated in U.S. Pat. No. 3,680,329.

While certain representative embodiments and details have been shown for the purpose of illustrating the invention, it will be apparent to those skilled in this art that various changes and modifications may be made therein without departing from the spirit or scope of the invention.

What is claimed is:

1. A protective headgear adapted to protect the head, comprising a microporous semi-flexible polyurethane outer shell, a head-contacting liner within the shell of a soft, flexible cellular material, said liner having means to adjust the liner to fit the contour of the wearer's head, said outer shell having a density of about 30 to 42 pounds per cubic foot and a deflection test (Z–90 impact) of 1 inch at about 1 to 5 pound load and a temperature of 75°F.

2. The headgear of claim **1** in which the means to adjust the liner comprises a band secured to the liner.

3. The headgear of claim **1** wherein a polystyrene foam head member of 90 percent or more compression set is placed in the liner as the means to adjust the liner to fit the contour of the wearer's head.

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