March 17, 1970 J. L. MARCHELLO 3,500,473

SAFETY HEADGEAR ASSEMBLY

Filed Dec. 14, 1967 2 Sheets-Sheet 1

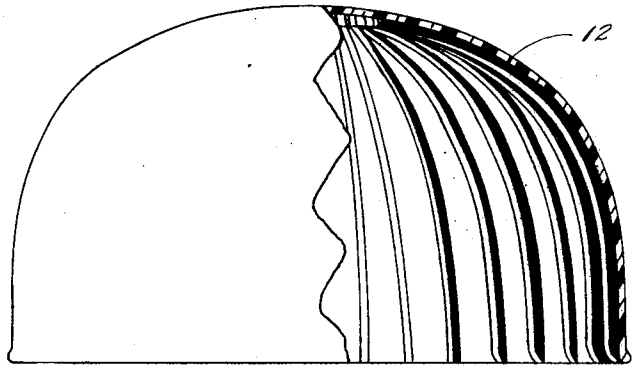


FIG. 1.

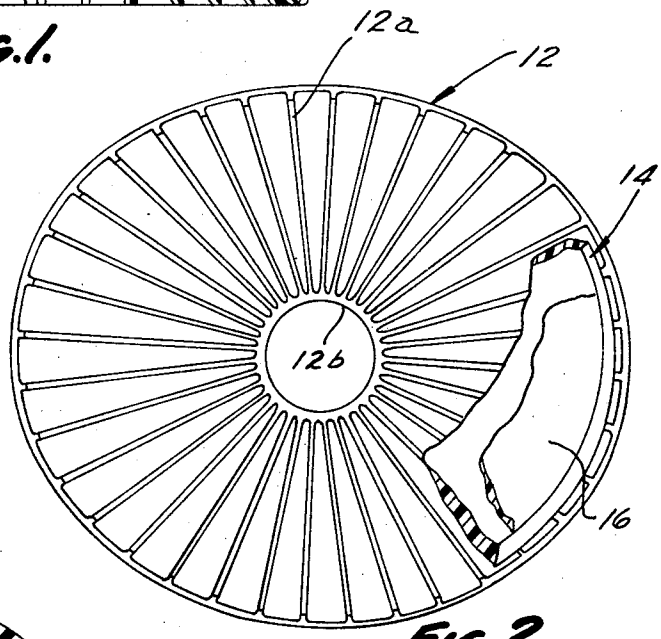


FIG. 2.

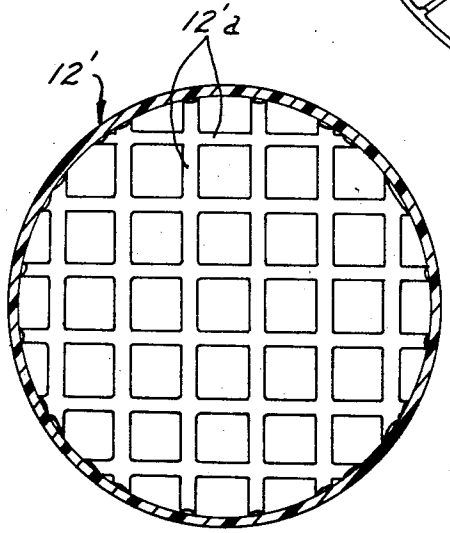


FIG. 4.

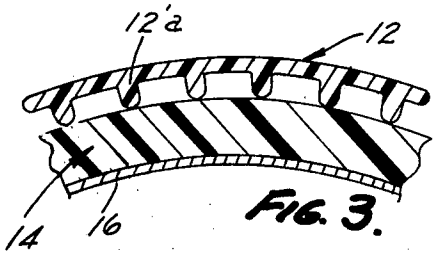


FIG. 3.

INVENTOR.
JOHN L. MARCHELLO
BY Price, Heneveld, Huizenga & Cooper
ATTORNEYS

March 17, 1970 J. L. MARCHELLO 3,500,473

SAFETY HEADGEAR ASSEMBLY

Filed Dec. 14, 1967 2 Sheets-Sheet 2

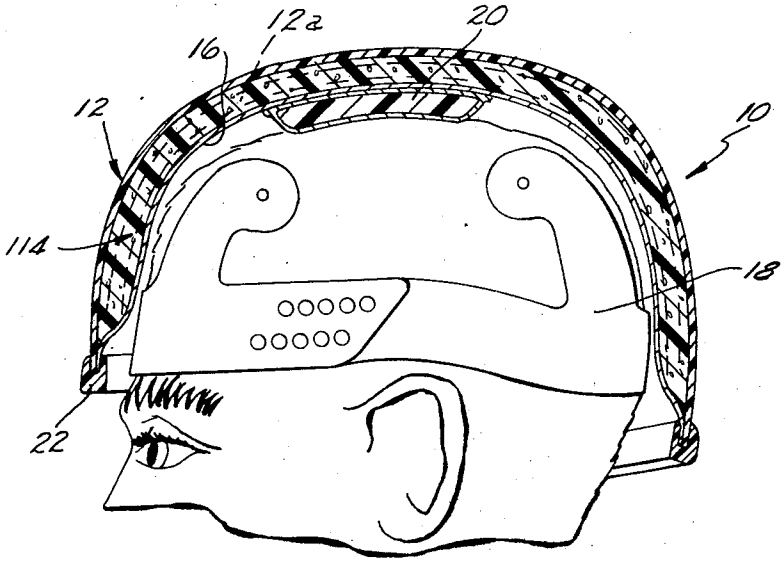


FIG. 5.

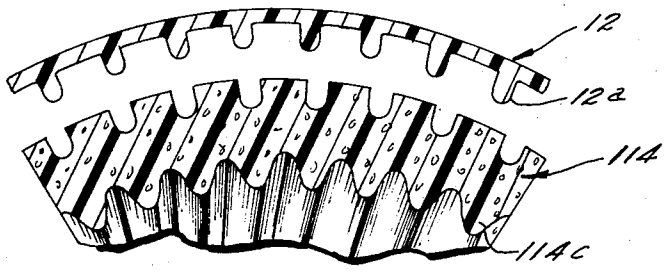


FIG. 7.

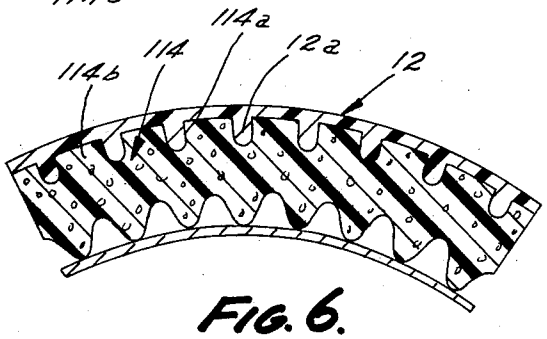


FIG. 6.

INVENTOR.
JOHN L. MARCHELLO
BY Price, Heneveld, Huizenga & Cooper
ATTORNEYS

United States Patent Office 3,500,473 Patented Mar. 17, 1970

3,500,473

SAFETY HEADGEAR ASSEMBLY

John L. Marchello, New Hudson, Mich., assignor to Wolverine World Wide, Inc., Rockford, Mich., a corporation of Michigan

Filed Dec. 14, 1967, Ser. No. 690,609
Int. Cl. B42b 1/08
U.S. Cl. 2—3 5 Claims

ABSTRACT OF THE DISCLOSURE

Safety headgear having an outer shell with special ribbing formed of a plurality of ribs, preferably extending radially of the headgear or alternately in crisscross honeycomb pattern and normally on the inner surface of the shell. This shell is combined with an impact absorbing liner that preferably is configurated with grooves to interfit with the ribbed shell.

BACKGROUND OF THE INVENTION

This invention relates to the safety headgear, and more particularly relates to helmet type safety headgear capable of meeting established safety regulations while also being of substantially lighter weight construction than existing headgear.

Safety headgear presently available basically falls into two general categories: (1) those models capable of meeting established safety standards but which are heavy, cumbersome, and quite uncomfortable to wear, such models weighing two pounds or more, and (2) those models of relatively lightweight construction which fall short of meeting established safety standards. Those models of the first category are of course the only effective type of safety headgear since those in the latter category only create false confidence. Yet, the safe reliable type units are not worn as frequently or as constantly as they should be due to the discomfort resulting from their cumbersome heavy construction.

Consequently, there is needed a safety helmet that is lightweight and comfortable but also satisfies established safety standards.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a unique safety headgear or helmet assembly that is relatively lightweight, but which satisfies established safety standards. This blend of these desirable characteristics which are usually generally mutually exclusive is achieved by the novel construction of the headgear components, particularly the outer shell subassembly. Its construction enables the basic shell to be relatively thin and light while effecting superior external impact resistance. Preferably this is specially interfitted with the inner impact absorbing liner for optimum coaction.

Specifically, the outer shell has a novel ribbing construction which preferably interfits with a specially configurated inner foam helmet liner.

The details of the invention, as well as additional objects and advantages will become apparent upon studying the following specification and drawings, with the invention being defined by the attached claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a bottom fragmentary view of the first embodiment of the novel safety headgear, showing the liner and its inner cover mostly cutaway for viewing of the shell interior;

FIG. 2 is a side elevational, partially cutaway view of the first form of the novel safety headgear outer shell in this first embodiment;

FIG. 3 is an enlarged fragmentary sectional view of a segment of a second embodiment of the novel headgear assembly;

FIG. 4 is a fragmentary enlarged view of the under side of a second embodiment outer shell;

FIG. 5 is a side elevational, sectional view of a third embodiment of the novel helmet assembly in its preferred form having a special liner interfitting with the special shell;

FIG. 6 is an enlarged fragmentary, sectional view of a portion of a fourth embodiment of the novel headgear assembly, wtih the liner being configurated to interfit with the shell ribbing, and with the liner also having a special inner surface structure; and

FIG. 7 is an enlarged sectional fragmentary exploded view of the liner and shell in the assembly of FIGS. 5 and 6.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The basic components of all embodimnets of the safety headgear assembly include an outer shell and an inner liner, e.g., **12** and **14** in FIGS. 1 and 2. Normally, an additional thin liner cover **16** is also employed. The complete safety helmet assembly also usually includes an adjustable sizing suspension band means, e.g., **18** in FIG. 5, (if the helmet is not custom-made to exactly fit a person's head), plus a crown pad, e.g., **20** in FIG. 5 for comfort and ventilation, and a chin strap (not shown). The outer shell, inner liner, and thin cover may be additionally secured together at their peripheral edges by an edge enveloping peripheral strip or band, e.g., U-shaped band **22** in FIG. 5. Because such suspension means, crown pad, chin strap, and band are conventional, no effort has been made to illustrate them on each embodiment.

In the unique headgear assembly, a special outer shell is used which has ribbing, this ribbing preferably extending out radially from the crown zone to the periphery as in FIGS. 1 and 2, or being oriented in crisscross honeycomb pattern as in FIGS. 3 and 4. The liner preferably is configurated on its outer surface to interfit with the ribbing of the shell as illustrated in FIGS. 5 through 7. In addition, a novel type of inner surface configuration of the liner is preferably used as illustrated in FIGS. 5 through 7 for improved cranial impact absorption due to displacement principles as explained in detail hereinafter. It will be understood that these variations in shell construction, liner outer surface construction and liner inner surface construction may be combined in various ways, with the illustrated figures being exemplary.

The first embodiment in FIGS. 1 and 2 includes outer shell **12** having a plurality of elongated ribs **12*a*** that are spaced from each other and that straddle elongated cavities or recesses therebetween. These ribs are integral with the remainder of the shell structure, with the integral unit being formed by injection molding or the like. They normally extend inwardly from the shell. These ribs are radially oriented, extending from an annular crown zone rib **12*b*** in divergent manner to the periphery. This particular rib orientation resists racking of the helmet under the impact of locally applied externally force. Tests have indicated that a helmet made with such construction exhibits an increase in load support capacity of at least about 75% over conventional units. In fact, the actual overall shell thickness can be made significantly less than normally required to meet safety regulations, resulting in substantially reduced overall weight of the headgear assembly.

In the second embodiment shown in FIGS. 3 and 4, a modified shell **12'** is employed in combination with inner liner **14**, and its cover film or sheet **16**. In modified shell **12'**, the ribbing is honeycombed, with ribs **12'*a*** and **12'*b*** criss-crossing generally transversely to each other over the

helmet inner surface. In this illustrated embodiment, both sets of ribs are generally parallel to others in their respective sets. It is also conceivable that radial ribbing of the type in FIGS. 1 and 2 could be crisscrossed in honeycomb pattern by annular ribs of varying diameter from the shell periphery to its crown zone. It is also conceivable that the described ribbing patterns could be used on the shell outer surface in addition to or instead of the shell inner surface. It is preferred that such be on the inner surface location since such adds substantial strength without detracting from product appearance.

Both the honeycombed and radial forms of rubbing resist racking of the helmet under the impact of locally applied external stresses. The honeycomb has distinct advantages due to its increased strength, while the radial form has distinct advantages due to its capacity to be more readily formed by injection molding techniques. Within very broad aspects of the concept, the ribbing may be other than radial or honeycomb, e.g., front to back ribbing, side to side ribbing, annular ribbing, or random ribbing. Although such shells constitute a substantial improvement over prior art shells, these are normally inferior to the noted preferred forms.

The shell structure can be formed of several different materials presently available for conventional shells, including polycarbonate materials, with or without a chopped or fibrous glass fill, ABS polymers, polyvinyl materials, or others known in the art. The shell is generally rigid, but slightly resilient, and of sufficient thickness to resist external impact forces. It typically will have a shell thickness of about 0.075 inch, a rib depth of about 0.312 inch (i.e. 5/16 inch), and a rib thickness of about 0.125 inch (i.e. 1/8 inch). These dimensions may be varied somewhat depending on materials used, type of liner, nature of the wearer's activity, and the like.

The liner, which is the primary force absorbing member, basically constitutes a cellular type, expanded foam polymer of the "stiff"" category, capable of being permanently compressed (distorted) under impact but preferably having some resilience to enable the headgear to meet the "double impact" requirement of federal safety standards. Typically, the liner may be formed of an expanded ABS foam, polyurethane foam, or others. The liner and shell are adhered or bonded together at their contact areas.

The preferred form of the helmet assembly **10** illustrated in FIG. 5 includes the novel outer shell **12** of the form illustrated in FIGS. 1 and 2, or that in FIGS. 3 and 4, is specially interfitted with the foam liner **114**. Specifically, liner **14** includes outer surface grooves **114***a* specifically oriented, located, and dimensioned to intermesh neatly with and to receive the ribs, e.g., **12***a* of the shell. This integrates the shell and liner, with liner protrusions **114***b* between grooves **114***a* engaging the shell in the cavties or spaces between ribs **12** of the shell. The interocked members are adhered or bonded together.

As a result of these features, and particularly those of the outer shell construction, established safety standards can be readily satisfield while the helmet assembly has a substantially less weight than usually required More specifically, the helmet assembly having a weight of 20 ounces or less is capable of meeting the standards, while previously, helmets meeting these standards necessarily weighed 3 lbs. or more. This differential represents a substantial comfort feature, and encourages wearing of the helmet.

Such head gear units or assemblies can be employed for various sports activities, occupational duties, during vehicular travel, or other.

In the preferred form of the headgear assembly combination illustrated in FIGS. 5 through 7, cellular liner **14** also has another unique safety feature. This results from the inner surface of the liner having a generally corrugated nature formed by a plurality of protrusions **14***c* or **214***c* in liners **114** or **214**, respectively. This unique feature is preferably used in combination with this ribbed shell. In this special liner, the inner protrusions are preferably elongated, straddling spaces therebetween. This arrangement provides a greatly improved impact absorption function as a result of a two-fold action of the liner.

During an impact situation, for example in a vehicular collision or comparable situation, the important energy absorption time is the first few micro seconds, with ten microseconds being the established critical period according to conventional testing techniques. As the skull slams into the local zone of the helmet where the external impact is applied, the crushing of the foam liner cells absorbs cranial impact energy. The absorption of the impact energy of the cranium against the helmet normally depends almost completely upon compression and crushing of the liner cell structure. Extensive testing has shown that the conventional liner increases in density so markedly during the first few microseconds of cranial impact that only part of the impact force is effectively absorbed, even if the liner is of substantial thickness. The remainder of the impact force must be absorbed by the victim's head. Moreover, this rapid increase in liner density seriously limits the distribution of the impact force to a larger contact area of the head to the liner, i.e., limits the area of forced conformity of the liner to the head, so that the impact force remains largely concentrated in a relatively small zone, to the detriment of the person.

The structure of the novel liner has greatly improved results due to a dual energy asborption function, and concomitant improved forced conformity of liner to skull with increased distribution of impact force over a larger cranial area. More specifically, the novel liner interior construction enables impact absorption to be improved by the complementary energy asborption functions of (a) compression and (b) displacement. That is, energy is absorbed by compression of the expanded cellular material as previously, but is also significantly absorbed by forced lateral displacement of protrusions **214***c* or **114***c* by the head into the adjacent spaces between these protrusions. This displacement occurs with significant controlled resistance that is overcome by cranial impact force in a controlled manner. The ribs have a gradually increased thickness toward their root or base portions to prevent uncontrolled breaking off of the ribs with initial impact, i.e., in the first couple of microseconds. The overall result is an energy absorption capacity that is substantially increased over the ordinary liner.

It is conceivable that the particular displaceable protrusions **114***c* or **214***c* might be configurated somewhat differently and/or oriented or arranged somewhat differently, from those particular ones illustrated.

As examples, instead of the inner ribs being parallel and extending from side to side or front to back or the like, they may be radially oriented with respect to the headgear, oriented in controlled patterns of concentrations and sizes.

Typical dimensions for the liner in the form shown comprise an inner rib (e.g., **114***c*) depth of about 0.250 inch, and total liner thickness of about 0.750 inch (including inner ribs). If outer surface grooves **114***a* are incorporated, such grooves will project into the 0.750 inch thickness about 0.312 inch or so to match the depth of shell ribs **12***a*. Typically, the peaks of the inner ribs or projections, if arranged in parallel fashion, (e.g., **114***c*) are at intervals of about 0.500 inch, with the peaks preferably having an arcuate configuration, with, i.e., a radius of about 0.156 inch (i.e., 5/32 inch). Again, these dimensions can be varied depending upon the constructional details, the usage environment of the headgear, and so forth.

Those having ordinary skill in this art will readily appreciate additional objects and advantages of the various forms of the invention upon studying this description. They will also realize that the novel features disclosed can be combined in various fashions with each other to form several different combinations.

I claim:

1. A safety headgear assembly comprising: a generally rigid, external-impact-resisting, configurated, outer, head covering shell, said shell having a plurality of inwardly-protruding, generally rigid ribs over its inner surface; and an impact distributing and absorbing, head covering, cellular inner liner attached in said shell, said liner having a plurality of grooves in its outer surface located, oriented, and dimensioned to receive said ribs of said shell to cause said liner to neatly interfit with said shell.

2. The headgear assembly in claim 1 wherein said ribs and matching grooves extend radially from the crown zone of said shell and liner toward their peripheries.

3. The headgear assembly in claim 1 wherein said ribs and matching grooves have a crisscross arrangement generally resembling a honeycomb pattern.

4. The headgear in assembly in claim 1 wherein said inner liner comprises a cellular foam having a plurality of protrusions projecting from its inner surface with intermediate spaces, said layer and its protrusions having the characteristic of being subject to permanent compressive distortion under cranial impact, and said protrusions having the further characteristic of being permanently, controllably, laterally, distortionally displaceable at least partially into said intermediate spaces under cranial impact, whereby said liner exhibits a dual impact absorption with excellent capacity for forced conformity with the head over a substantial cranial area.

5. The headgear assembly in claim 4 wherein said liner inner surface protrusions comprise corrugations.

References Cited

UNITED STATES PATENTS

882,686	3/1908	Ireland et al.	2—3
2,123,275	7/1938	Dym	2—3
2,664,567	1/1954	Nichols	2—3
3,186,004	6/1965	Carlini	2—3
3,274,612	9/1966	Merriam	2—3
3,280,402	10/1966	Scheibchen	2—3
3,425,061	2/1969	Webb	2—3

FOREIGN PATENTS

918,178	2/1963	Great Britain.
254,900	9/1927	Italy.

JAMES R. BOLER, Primary Examiner