

Jan. 19, 1960

D. J. VOSS ET AL

2,921,318

DEVICE FOR ABSORBING SHOCK OF TENSILE FORCE

Filed May 29, 1957

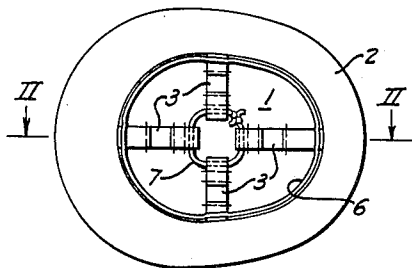


Fig. 1

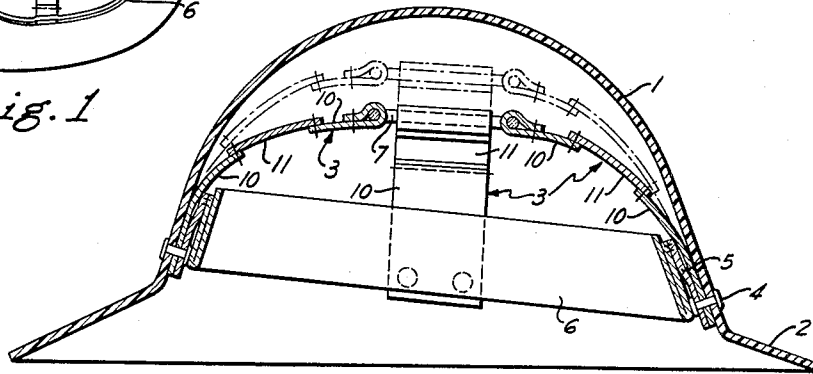


Fig. 2

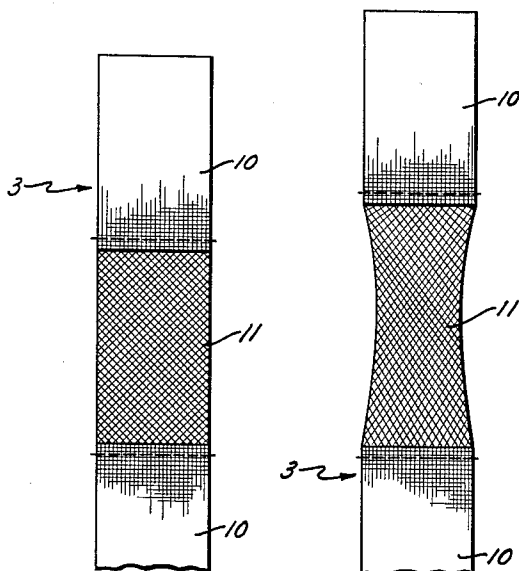


Fig. 3

Fig. 4

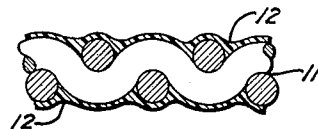


Fig. 5

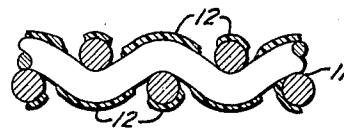


Fig. 6

INVENTORS
DONALD J. VOSS AND
BY MICHAEL THEODORE

Brown, Citchlow, Flick & Ackham
HIS ATTORNEYS

1

2

2,921,318

DEVICE FOR ABSORBING SHOCK OF TENSILE FORCE

Donald J. Voss and Michael Theodore, Pittsburgh, Pa., assignors to Mine Safety Appliances Company, Pittsburgh, Pa., a corporation of Pennsylvania

Application May 29, 1957, Serial No. 662,500

3 Claims. (Cl. 2—3)

This invention relates to shock absorbing apparatus, and more particularly to a device for absorbing the shock of an excessive tensile force that has been applied suddenly, such as a blow against a protective helmet.

The well-known protective helmet or hat worn by industrial workers or miners has a rigid shell provided with a lining, which includes a cradle of straps that rest on the head with their lower ends connected to the lower part of the shell. The purpose of the lining is to fit the helmet to the head and space the head from the shell so that impacts against the shell will not be transmitted directly to the head. Cradle straps are ordinarily made from a woven webbing that has some degree of elasticity. These straps transmit force to the wearer's head during impact in the following manner. The initial transfer of force begins at the instant of impact against the shell and rapidly increases to the point where the webbing ceases to stretch. At this instant the magnitude of the force becomes great if the impact is one of high energy. If the impacting mass is substantially balanced on the shell or has partly penetrated it and is being loosely held by the shell, the energy transfer does not stop when this mass is halted in its downward travel. On the contrary, the energy stored in the elastic webbing through its elongation is now released and the impacting mass is accelerated upward. As it is propelled away from the shell, there is a corresponding downward reacting force on the head. Consequently, below its elastic limit the webbing acts as a storer of energy, like a spring, and not as an energy absorber.

It is among the objects of this invention to provide a device that will actually absorb shock, which is extremely simple and inexpensive in construction, and which is easy to apply in many different situations.

According to this invention, the shock absorbing device includes a length of woven material that is composed essentially of crossed threads, which are disposed diagonally of the longitudinal axis of the material. Where the threads of the material cross one another, they are connected firmly together by a binding composition, but the connections are designed to be ruptured in order to permit the material to stretch when tensile force of more than a predetermined amount is applied to the material lengthwise thereof. The energy consumed in rupturing the connections is therefore absorbed.

The preferred embodiment of the invention is illustrated in the accompanying drawings, in which

Fig. 1 is a bottom view of a protective helmet, looking up into it;

Fig. 2 is an enlarged longitudinal section taken on the line II—II of Fig. 1;

Fig. 3 is a further enlarged fragmentary view of one of the helmet lining straps;

Fig. 4 is a view similar to Fig. 3, but showing the shock absorbing portion of the strap stretched out;

Fig. 5 is a fragmentary detail through the shock absorbing portion of the strap shown in Fig. 3; and

Fig. 6 is a similar detail through the shock absorbing portion of the strap shown in Fig. 4.

Referring to Figs. 1 and 2 of the drawings, the helmet may be made in conventional form of any suitable material, such as metal or laminated plastic, which will provide it with a shell consisting of a dome-shaped rigid crown 1 surrounded by a rigid brim 2. The lining inside the shell includes several flexible cradle straps 3 extending up into the crown from circumferentially spaced points around its lower part. The lower end of each strap is rigidly connected to the crown in any suitable manner, such as by a pair of rivets 4 that also may extend through the lower part of a fairly stiff fiber band 5 extending around the inside of the shell. The upper edge of this fiber band is sewed to the upper edge of the outer layer of a headband 6. The upper ends of the cradle straps may be tied together with a lace 7 or, if desired, the straps may completely cross the top of the head. The cradle is therefore supported by the head and the shell is supported by the cradle.

It is a feature of this invention that the cradle straps 3 are shock absorbing elements, although it is preferred that only a section of each strap have shock absorbing characteristics. Accordingly, each strap is formed from one or more lengths of standard webbing 10 and a length or strip 11 of special woven material. The standard webbing may have some elasticity if desired, but it is not necessary. The threads that are woven together to form it extend lengthwise of the webbing and crosswise of it. On the other hand, the strip 11 of special material is formed or cut on the bias so that its threads extend diagonally of the length or longitudinal axis of the strap, as shown in Fig. 3. All of these diagonal threads are disposed at substantially the same angle to the axis of the strap, and preferably at a 45° angle. For best results, they are substantially inelastic. Furthermore, the diagonal threads are connected firmly together where they cross by coating them or impregnating them with a suitable binding composition that joins them together at their intersections and prevents them from slipping against one another. The connections thus formed between the threads thus maintain the original unstressed pattern of the threads under conditions of normal use. The composition may be starch, rubber, polyethylene, vinyl or other resins or materials. Such a composition, used as a coating 12, is shown in Fig. 5. The strength of the connections where the threads cross depends not only on the connecting composition, but also upon the threads themselves, which can be, for example, nylon, rayon, cotton, glass or other suitable material.

Under conditions of normal usage, the composite cradle straps will perform in the usual way and will not stretch appreciably. However, if the helmet receives a sudden blow, which causes it to pull down on the straps with more than a predetermined amount of force, the connections between the threads of the shock absorbing material 11 will break loose as indicated in Fig. 6 and permit that material to stretch as the threads are pulled across one another. Strip 11 will neck down as it stretches, as shown in Fig. 4, but the amount of stretching will be limited. The force that was required to break the connections between the threads is energy that is consumed by the shock absorbing material, so the absorbed energy is not available for application of force to the head of the wearer. The amount of energy that will be absorbed can be controlled by selecting a shock absorbing strip of the proper length and width, or by using two or more plies of such material.

Although the invention has been described as applied to protective helmets, it will be apparent that it can be used in other connections where shock absorbing is desirable, such as in automobile safety belts.

According to the provisions of the patent statutes, we have explained the principle of our invention and have

3

illustrated and described what we now consider to represent its best embodiment. However, we desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

We claim:

1. A shock absorbing lining for a protective helmet shell, comprising a plurality of cradle straps adapted to cross the head of the wearer and rest thereon, and means adapted to connect the lower ends of the straps with the helmet shell to support it, each of said straps including a length of woven material composed essentially of crossed threads disposed diagonally of its length, and a binding composition joining the threads wherever they cross one another to connect them firmly together, said connections being weaker than the threads and adapted to rupture and permit the straps to stretch when the shell

4

receives an impact force of more than a predetermined amount, whereby the energy required for rupturing said connections will be absorbed.

2. A shock absorbing lining according to claim 1, in which said threads are substantially inelastic.

3. A shock absorbing lining according to claim 1, in which all of said threads in a strap are disposed at substantially the same oblique angle to the longitudinal axis of the strap.

References Cited in the file of this patent

UNITED STATES PATENTS

2,156,294	Kessenich	May 2, 1939
2,355,038	Barnard	Aug. 1, 1944
2,526,264	Nieff	Oct. 17, 1950
2,705,692	Patterson	Apr. 5, 1955
2,796,609	Fisher et al.	June 25, 1957