Device for protecting athlete's legs from damage

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Abstract. The safety and quality of wearing clothing in extreme conditions are largely ensured by using clothing in combination with personal protective equipment. To protect a person and ensure his comfort, especially during work, protective equipment must block external negative factors - mechanical damage. The article is devoted to developing a device to protect legs from harm, by improving the design of the device, which can be used by a wide range of people working out in special conditions to provide the necessary protection. The results obtained during the work will provide reliable protection for the worker or athlete, reduce discomfort when performing work and physical movements, and also eliminate the risk of injury when using clothing.

1 Introduction

In world practice, research work is carried out using modern scientific and technical achievements aimed at modernizing the equipment and technologies of textile and light industry enterprises and their widespread use in production processes, developing the scientific foundations of technologies. In particular, increasing attention is being paid to developing the scientific basis for the production of clothing for various purposes, ensuring operational reliability, and introducing resource-saving innovative technologies into production.

Clothing serves to protect a person, in particular, under certain conditions, for example in production conditions, when playing sports, clothing also serves to protect against injury and damage. As long as the garment is worn at rest, its functionality is guaranteed at all times. During labor movements, sports (increasing the risk of injury), in particular, when bending at the joints, stretching and shrinkage of clothing occurs, which can negatively affect its functionality at rest [1-3]. The safety and quality of wearing clothing in extreme conditions are largely ensured by using clothing in combination with personal protective equipment. To eliminate this drawback, it is known that it is possible to provide auxiliary elements and devices on the outer sides.

Several shin and ankle protection devices are widely used in practice [4], but all of them are not effective in protecting the legs from injury.

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2 Research methods

In the field of sports, a device is known for protecting the legs of motorcyclists and athletes from damage, containing a device and fastening elements [5-7]. The disadvantage of the device is the low reliability of protecting the legs from damage since it only covers the front part of the shin and does not take into account the high shock absorption in the middle of the device.

A well-known device for protecting legs from damage, containing a device having an arched shape, a shock-absorbing elastic gasket, and fastening elements (German Patent No. 1955278, class 36 13/06, 1973). The disadvantage of this device is the unreliability of protecting the legs from damage.

Also known as a device for protecting the athlete's feet from damage, type V5.08 from PUMA AG Sport (Germany), which consists of a front protective plate and an impact-absorbing lining, and has ventilation slot-like holes. This device does not have thermal screens and an active thermal element, which does not allow for targeted local thermal effects on the tissues of a football player's shin during the educational and training process under the influence of low ambient temperatures, and also does not take into account the high shock absorption in the middle of the device.

There is also a known device for protecting the athlete's legs from damage with the effect of thermal effects on the biological tissues of the lower leg, consisting of an arc-shaped impact protection plate, an impact-absorbing pad on one side and an impact protection plate [8-10]. The device is made of two parts - front and rear, the inner surface of which is equipped with a heat-reflecting film. In this case, a thermochemical element is additionally fixed on the inner surface of the rear part of the device - a thermochemical heating pad based on sodium acetate. In addition to protecting the lower leg from mechanical damage, the device accumulates endogenous heat generated as a result of physical work and additional heat generated by the thermal element in the tissues of the lower leg (Patent 2461343(RU) Protective shield for a football player with the effect of thermal effects on biological tissues) [11] (prototype). The disadvantage of this design is that it does not take into account shock absorption when the athlete loses balance in the area of greatest load. The shock-absorbing pad is made of the same thickness along the entire circumference of the athlete's knees.

3 Results

The invention relates to devices for protecting the legs of athletes from damage, and can also be used by a wide range of people involved in special conditions (construction) that lead to damage to the legs.

The objective of the invention is to provide the necessary protection for the legs of a worker or athlete, taking into account the maximum impact interaction of the knees in the middle zone with the partition.

The design is illustrated by a drawing, where Fig. 1 is a general axonometric view of the device for protecting the athlete's legs from damage, Fig. 2 is a section A-A in Fig. 1, Fig. 3 is a side view (axonometric), Fig. 4 – parts 7 and 8, in Fig. 5 parts 8 and 9.

The device for protecting the legs of a worker or athlete from damage consists of 2 detachable parts: front and back, interconnected when installed on the athlete's shin with elastic bands attached to the front part of the device with fixation on the back part using a Velcro fastener"). The front part consists of an impact-protective plate 1, in Fig. 1 (made of polyethylene or other plastic having similar strength characteristics up to 3 mm thick), a shock-absorbing pad 2 (with a variable) with the maximum thickness in the middle of the impact-absorbing pad, a heat-reflecting screen films 3 up to 12 microns thick. In the front

part of the device in the vertical direction for 3/5 of its length in the shock-protective plate 1 and the shock-absorbing gasket 2, two slot-like holes 4 are made symmetrically located relative to the vertical axis with an indentation from the upper and lower edges of at least 1/5 of its length, opposite which in the heat-reflecting The film is provided with perforations with a diameter of no more than 1.0 mm with a frequency of at least 13 holes per 1 cm^2. The back part of the device is made in the form of a plate 5 with a thickness of 0.18 to 0.24 mm (lavsan (polyethylene terephthalate, PET, PETF)), with a heat-reflecting film 6 glued to its inner surface, with the heat-reflecting layer facing the surface of the lower leg.

The back of the device (plate 5 and film 6) has perforations over the entire surface with a diameter of no more than 1.0 mm with a frequency of at least 13 holes per 1 cm2 and is equipped with an active thermal element 7 (Fig. 2, 3, 4), which is held on the inner shielded surface of the device with latex rings 8 (Fig. 3, 4, 5) with a diameter of 50 mm (section diameter 2 mm).

The active thermal element (thermochemical heating pad) 7 is a durable sealed plastic container made of PVC (polyvinyl chloride), filled with a salt solution - sodium acetate, in which there is a button - an activator in the form of a metal membrane in a plastic case. The outer surface of the rear part of the device is equipped with Velcro fastener elements 9 (Fig. 5) for fixing the reversible elastic straps for fastening the device 10 (Fig. 1, 3).

In the process of impact interaction between the knees of a worker or athlete with a partition in critical conditions, the impact (impulse) force through the impact-protective plate 1 is absorbed by the impact-protective pad 2 due to its deformation. In this case, the maximum deformation of the shock-protective gasket occurs mainly in its middle. Due to the maximum thickness of the impact-protective pad 2 in this zone, maximum shock absorption occurs, allowing sufficient protection of the athlete's foot.

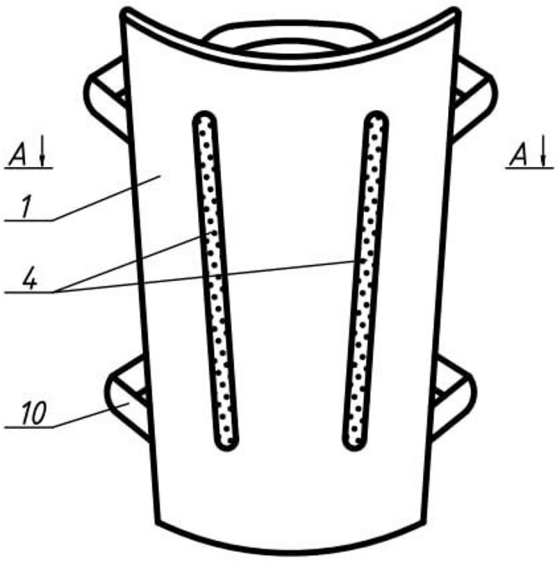

Fig.1. General view of the leg protection device.

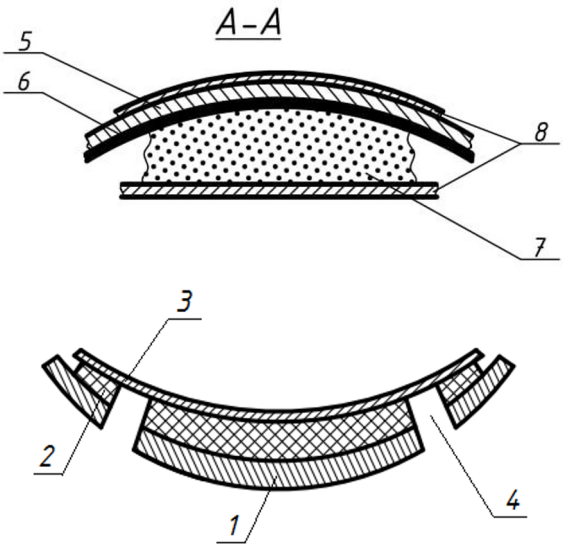

Fig. 2. Section of the device.

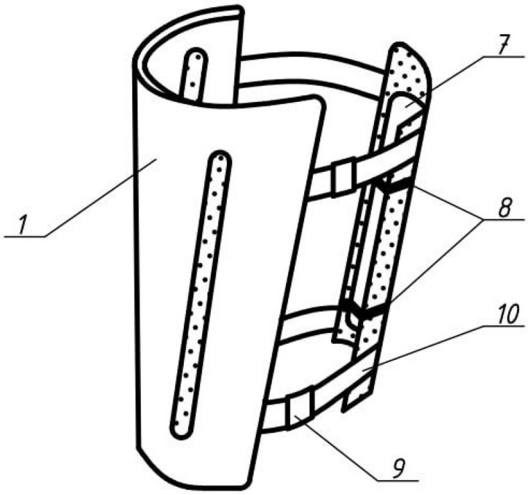

Fig. 3. General side view of the device

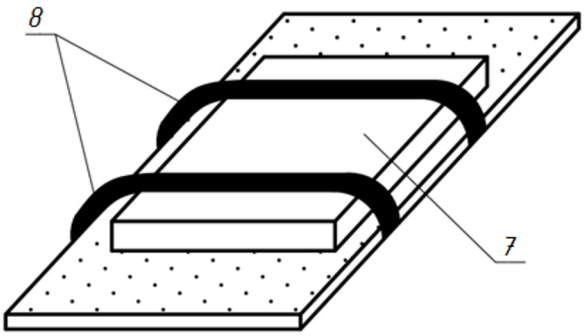

Fig. 4. View of parts 7 and 8.

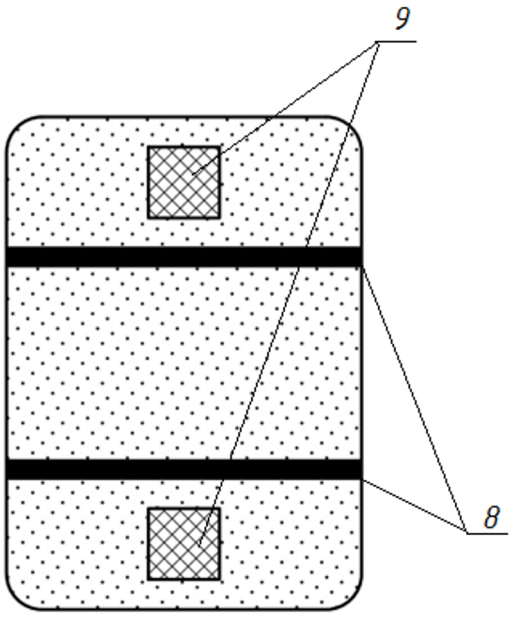

Fig. 5. View of parts 8 and 9.

4 Conclusions

Analysis of working conditions on construction sites and labor movements made it possible to form a structure of dangerous and harmful production factors and identify specific ways to reduce the degree of their influence on workers, primarily through the implementation of a set of measures to improve the consumer properties of workwear [12, 13, 14].

The essence of the invention is that a device for protecting a worker's legs from damage consists of an arc-shaped impact protection plate, and an impact-absorbing pad with variable thickness, with the greatest thickness being in the middle of the impact protection plate. The device includes two parts - front and rear, the inner surface of which is equipped with a heat-reflecting film. In this case, a thermochemical element is additionally fixed on the inner surface of the rear part of the device - a thermochemical heating pad based on

sodium acetate. At the same time, the variable thickness of the shock-absorbing pad allows the necessary shock absorption, especially in the middle, where its thickness is greatest.

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