the carpet, gives the collection a touch of contrast. The basis for the development of the collection is the use of different depth and intensity of shades in the background and the figure. Dark colors are at the edges, lighter in the figure, the contrast in the figure, quiet in the background.

Texture is represented by a pile of 9 mm, is closely associated with the pattern itself and emphasizes its expressiveness. The properties of the yarns attach for added depth of color. Raw material composition – polypropylene yarns that have a low cost, high antistatic properties, susceptibility to heat treatment, resistance to many contaminants, do not cause allergic reactions and is able to maintain color throughout the service life.

One of the elements of the collection in the size 2x3 m was completed at the "Brest Carpets". We used four colors of yarns.

The collection of jacquard carpets is made in a minimalist design that will complement of originality to the interior. It is expected, that the carpets will be used in a residential living room that combines ultra-modern elements and ethnic components of the style.

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AUTOMATED DEVICE FOR DETERMINING OF HEAT-PROTECTIVE PROPERTIES OF PACKAGES OF CLOTHING MATERIALS

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Key words: coefficient of thermal conductivity, thermal resistance, coefficient of air permeability, packages of clothing materials, heat-shielding properties, automated device.

Ключевые слова: коэффициент теплопроводности, тепловое сопротивление, коэффициент воздухопроницаемости, пакеты материалов одежды, теплозащитные свойства, автоматизированная установка.

Abstract. The automated device is developed to measure values of heat-protective properties of clothing materials and their packages which construction gives the chance to reproduce temperature of the space under the clothes and parameters of the environment over a wide range that will allow to carry out tests of materials in the conditions which are brought closer to real conditions of their maintenance.

Аннотация. Разработана автоматизированная установка для определения показателей теплозащитных свойств материалов одежды и их пакетов, конструкция которой дает возможность воспроизводить температуру пододежного пространства и параметры окружающей среды в широких пределах, что позволит проводить испытания материалов в условиях, приближенных к реальным условиям их эксплуатации.

Great demands placed on consumer properties and quality of the modern clothes define its competitiveness in the market. From all diversity of properties of clothing materials one of the most important is heat-protective properties which characterize ability of clothing materials to protect a body of the person from thermal losses and overheating in case of different temperature conditions. Assessment of indices of heat-protective properties has the greatest value in case of design of demi-season and winter clothes and also clothes of a special purpose.

Now in literary and patent sources it is possible to meet the description of a large number of methods and instruments for measuring values of heat-protective properties of materials. The existing methods and means of assessment of heat-protective properties of clothing materials despite variety possess a number of shortcomings: they allow to define indices of heat-protective properties only in the limited test environments which often are not corresponding to real operating conditions of materials. Besides, the existing technical means of assessment of heat-protective properties are quite often characterized by big overall dimensions, high energy consumption and an outdated technical basis.

In this regard the relevant task is development of a method of measure values of heat-protective properties of clothing materials and their packages and its implementation in the form of the automated device on the basis of the modern technical means allowing to carry out tests as in the conditions of natural convection, and stimulated.

Proceeding the analysis of climatic conditions of the Republic of Belarus requirements imposed to automated system are formulated:

1. The reproduced indices: ambient temperature -20 … +40 ºС, temperature of space under the clothes 0 … 40 ºС, wind speed 0 … 7 m/s.

2. Defined indices: coefficient of thermal conduction, thermal resistance, coefficient of air permeability.

The method of the stationary thermal mode is put in a basis of a technique of determination of thermal resistance and coefficient of thermal conduction.

The diagram of the test camera of the developed device for measuring values of heat-protective properties of clothing materials and their packages is provided in a figure 1.

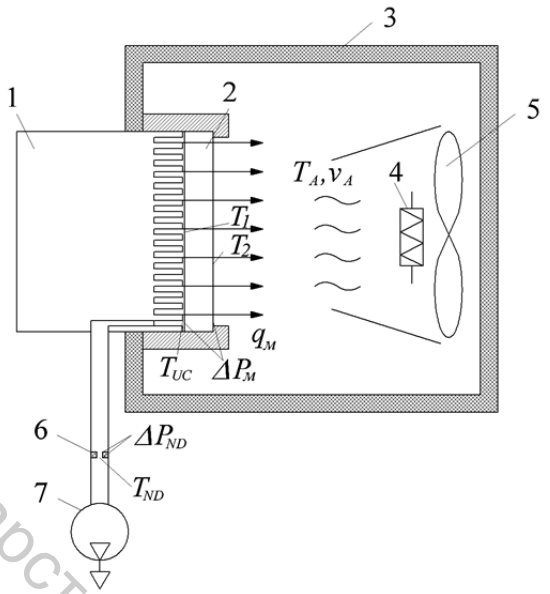

Figure 1 – Scheme of the test chamber of the apparatus for determining the heat-protective properties of clothing materials and their packages:
1 – the unit of reproduction of parameters of the space under the clothes, 2 – the researched sample, 3 – the camera for reproducing the environmental parameters, 4 – the electric heater, 5 – the fan, 6 – the narrowing device, 7 – the vacuum pump, T_1, T_2 – temperatures on the surfaces of material, T_{UC} – temperature of the space under the clothes, T_A – ambient temperature, v_A – wind speed, q_M – the heat flux passing through material, ΔP_M – differential pressure on material, ΔP_{ND} – differential pressure on the narrowing device, T_{ND} – air temperature, passing through the narrowing device

Structurally the developed device can be divided into two parts: the first allows to imitate a microclimate of the space under the clothes, the second – to reproduce climatic parameters of the environment.

Reproduction of temperature condition under clothes is realized by means of thermoelectric modules of Peltier together with the system of water cooling. The camera reproducing environment parameters allows to support as the positive, and the negative air temperatures near the researched sample. The electric heater which is set in a stabilizing branch pipe of the centrifugal fan creating an air flow is used for heating. Cooling of air in the camera is carried out by means of the compressor refrigerating aggregate.

Maintenance of set speed of an air flow, temperatures of the space under the clothes and the environment is carried out in an automatic mode. Data collection from sensors is carried out with use of specially developed software for the personal computer.

Such construction gives the chance to carry out tests of various clothing materials in the climatic conditions as close as possible to real operating conditions.

Determination of thermal resistance and coefficient of thermal conduction is carried out as follows. The researched material sample having the form of a round disk of 0.01 m^2 is placed in device. Thermoelectric modules of Peltier, the electric heater and the fan connect to a network and, regulating the power given on them, set the given temperature condition and speed of an air flow. In case of carrying out tests in the conditions of natural convection the fan is closed a wipe. After establishment of the stationary thermal mode take readings of temperature sensors on the surfaces of material, and on the hot and cold sides of thermoelectric modules of Peltier.

For determination of thermal resistance, K·m^2/W and coefficient of heat conduction, W/m·K clothing materials the following dependences are received:

$$R_M = \frac{Fc\left(T_1 - T_2\right)}{nKNc\left(2\alpha IT_C - RI^2 - 2k\left(T_H - T_C\right)\right) - \lambda_G F_G \left(T_H - T_C\right)},$$

$$\lambda_M = \frac{\delta_M nKNc\left(2\alpha IT_C - RI^2 - 2k\left(T_H - T_C\right)\right) - \lambda_G F_G \left(T_H - T_C\right)}{Fc\left(T_1 - T_2\right)}.$$

where T_1, T_2 – temperatures on the surfaces of material, K; F – the surface area of dispersion of the heat sink of device to which the researched sample of material, sq.m; δ_M – thickness of the researched sample of material, m; K – the coefficient considering losses of thermal power in nodes of the unit of reproduction of parameters of the space under the clothes defined experimentally; n – the number of thermoelectric modules of Peltier in device; λ_G – coefficient of thermal conduction of the thermopaste filling a gap between thermoelectric modules of Peltier, W/m·K; F_G – a gap cross-section area between thermoelectric modules of Peltier, sq.m; T_H, T_C – temperatures on the hot and cold ends of a thermoelectric branch respectively, K; c – thickness of thermoelectric modules of Peltier, m; N – number of couples of thermoelectric branches in the thermoelectric module of Peltier; α – thermoeMF swore a thermoelectric branch, W/K; R – electrical resistance of a thermoelectric branch, Ohm; I – the measured value of current intensity, passing through a thermoelectric branch, A; k – complete thermal conduction of a thermoelectric branch, W/K.

In addition to thermal resistance and coefficient of thermal conduction the developed device allows to define coefficient of air permeability of clothing materials which can indirectly be carried to indices of heat-protective properties. In this case by means of the vacuum pump on the researched sample of material differential pressure ΔP_M = 49 Pa is created. For air bleeds in the unit of reproduction of parameters of the space under the clothes, the special channel in which the narrowing device is set is provided.

The coefficient of air permeability B, dm^3/m^2 from the researched material is determined by a formula:

$$B_M = \frac{a \cdot \left(1 - b\Delta P_{ND}\right)\sqrt{\Delta P_{ND} T_{ND}}}{F_M},$$

where F_M, – the area of the researched sample of material, m^2; a and b – constructive coefficients; ΔP_{ND} – pressure differential on the narrowing device, Pa; T_{ND} – air temperature, passing through the narrowing device, K.

For the purpose of practical approbation of the offered technique of a measure definition of heat-protective properties on the developed automated device the pilot studies of clothing materials are conducted. Objects of researches were the materials used for manufacture of fighting clothes of firefighters and their packages.

The measure values of heat-protective properties received with use of the developed technique were compared to the values determined by a technique, standard for materials of fighting clothes of the firefighter (according to STB 1971-2009 and GOST 12088-77).

The analysis of the received results allows to mark that the error of determination of values of coefficient of thermal conduction and thermal resistance by the offered method does not exceed 6 %, and coefficient of air permeability – 10 %.

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INVESTIGATION OF THE ACCURACY OF LOCATION BASED ON LOCATORS

ИССЛЕДОВАНИЕ ТОЧНОСТИ БАЗИРОВАНИЯ ПО ОРИЕНТИРАМ

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Key words: location, precision, stitching, zigzag, shoe upper, appliqué, control program.

Abstract. The article examines the experiment on the study of the accuracy of location of details of shoes according to the locators. The results are used in the development of an automated technology for applying applique to the details of upper shoe in a zigzag pattern.

With the automated execution of the operation of applying the applications to details of upper shoe, the movement of the semi-finished product is carried out in two coordinates according to the specified control program in a special technological equipment-cassette.

One of the auxiliary operations of the technological process is the completion of the rigging, that is placement of the details of the top of the shoe and details of the application in the cassette.