SECTIONAL HEAT INSULATING JACKET

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ABSTRACT
A sectional heat insulating jacket is a removable, repeatedly used for various process equipment heat(sound-) insulation product been made of a set of the insulation sections (2), which are separated at the stage of installation by the assembling joints (22) and are connected among themselves in an organic whole using the connecting means (24). The insulating sections (2)—polyhedral, closed protective housings (4), are formed by thread-stitched seams (6) and comprise the bottom (8), upper (10), and lateral (12) flexible layers. There is a middle heat (sound)insulation-forming layer, placed inside the housing (4). The layers (8), (10), and (12) are fastened among themselves by the fastening means (16), consisting of the fastening rod (18) and the fixing means (20) and providing invariable thickness of the insulation section (2) and its all layers mutual work during thermal deformation. The connecting means (24) comprise the studs (26) fixed on the fastening rods (18), and the plates-clamps (28), which are able to be turned around on one of the studs (26) and to fix a mutual positions of the fastening rods (18) and, consequently, a mutual positions of the adjacent insulation sections (2) at a stage of installation, under an equipment heating process and after the assembling joint (22) "self-sealing", i.e. at a stage of operation. The assembling joints (22) "self-sealing" effect is provided due to the insulation sections shape (2) and due to the offered method for calculation of the assembling joints (22) widths at levels of the upper (10) and bottom (8) flexible layers of the insulation sections (2) in longitudinal and transverse directions.
FIG. 3B

Not to overload the drawing details 28 (#2, #4 in FIG. 3A) in the cross-sectional view are not shown.
SECTIONAL HEAT INSULATING JACKET

[0001] This application is entitled to the benefit of U.S. Provisional Patent Application Ser. No. 60/569,398, filed May 5, 2004.

BACKGROUND OF THE INVENTION

[0002] 1. Field of Invention

[0003] The invention relates to the external heat and sound insulation of technological equipment and devices for different application.

[0004] There are known multi-functional insulation sections fabricated in the form of two half-sections—"semi-cylinder shells," which during installation are combined in the unitary assembly with buckles and straps (U.S. Pat. No. 4,696,324 September 1987 Retronco 137/37). To compensate for differential temperature expansion between the pipe and insulating sections, temperature seams are provided between the insulating blocks, filled with inserts of semi rigid fiberglass or heat insulating straps. During installation the temperature insert is contracted from 75 mm to 40 mm. The temperature insert is covered with an outer strap, which allows free displacement of the adjoining block about strap. (Voronkov S. T. "The heat insulation of power plants" M., 1974). The drawbacks of the described construction include excessive labor of semi cylinder manufacturing and substantial time and labor expenditures to mount and dismount. In an emergency situation, it is difficult to find the exact location of the damaged site (area) of equipment in order to provide quick access.

[0005] There are many kinds of protective assemblies for different types of units and joints of equipment, pipes and pipe accouterments. For example, a pipeline fitting to enclose an insulated Y-shaped joint, comprising of two half sections, formed from pressed aluminum foil, coated with a plastic (selected from a group, consisting of polyurethane, polyester, epoxy resin, vinyl resin, silicon resin, polyethylene) and connected with adhesive tape during installation (U.S. Pat. No. 5,158,114 October 1992 Botsolas 138/149). Different operational conditions will determine the types of joints required to connect the half sections of the covers, for example; special metal pins (U.S. Pat. No. 4,553,308 November 1985 Botsolas 29/450) or other means of fastening; such as different tapes including adhesive tapes, screws, rivets (U.S. Pat. No. 5,025,836 June 1991 Botsolas 138/110; U.S. Pat. No. 4,669,509 June 1987 Botsolas 138/110), also miscellaneous types of belts (U.S. Pat. No. 4,207,918 June 1980 Burns 137/375; U.S. Pat. No. 4,696,324 September 1987 Retronko 137/375; U.S. Pat. No. 4,696,324 September 1987 Retronko 137/375) and metal hooks (U.S. Pat. No. 4,142,565 March 1979 Plunket 150/52R). Many of the products from the above discussion of patents are able to provide enough effective and convenient processes to join the separate insulation sections. However there is still an unsolved problem that needs to be addressed. This issue entails the quantity of fasteners applied to each individual jacket, thus resulting in a more complicated construction, labor intensive installation and heat loss from the jacket.

[0006] There is a known removable insulation jacket comprising of at least two sections to cover the pipe junction completely. Every section has protective metal layers (inner and outer) formed in a closed jacket with insulation material inside, and a protective inner shell diameter corresponding to the outer pipe diameter and adjacent jacket sections that have a face overlapping ledge connected with screws (U.S. Pat. No. 3,724,491 April 1973 Knudsen 137/375). There are drawbacks associated with this insulation construction such as a complicated production process, non-hermetic seams between adjoining elements, unnecessary heat loss due to many heat conductive inserts as well as difficult installation and removal.

[0007] There are also known pipe-insulation products with differently shaped configurations to cover combinations of different constructions, pipe fittings, accoutrements, etc. For instance, the preliminary formed unitary heat insulating construction comprises of joined rigid heat insulating foam plastic elements fastened onto the covering layer with a porous foam plastic surface that has truncated V-shaped grooves to secure a good connection of the joined elements in operation (U.S. Pat. No. 3,557,840 May 1968 Maybee 138/149). In so doing, the necessity to make chamfers restricts an application of this construction because of the strictly determined insulated surface curvature radius that demands many machine-tool attachments to elaborate different types of products.

[0008] The heat insulation means for power equipment inner surfaces in the form of panelelements fastened to an insulated shell with metal fasteners is described in SU invention # 1010141, G21 c 13/00, F 16 L 59/00, 1981. The said arrangement has better heat technology performance, but a more complicated construction.

[0009] It is worth mentioning that the shield heat insulation, of the high temperature equipment and means for compensation of heat extensions made as V-shaped flexible element with a flange surface of which, is covered with a protective strap (SU invention # 1540413, F 16 L 59/00, 1988). In this construction there are measures to avoid namely convection steam metal shield pack rigidly linked from two adjacent sides to the elastic V-shaped element, which under operational temperature growth allows the shield and protective sheeting to expand freely without construction temperature tension.

[0010] Among removable and reusable insulation products of the “Advance Thermal Corp.”, USA (see: www.advancethermal.com) there are some of unique shape and design for heat and sound insulation of different equipment: steam and gas turbines, valves, pumps, hot pipe fittings and connections, special hatches and tunnel pipes, and different instruments.

[0011] Removable and reusable insulation produced by “Thermohelp Canada, Inc.”, Ontario, Canada (see: www.thermohelp.com) and “Thermohelp Chicago, Inc.”, Buffalo Grove, Ill., USA for heat exchangers and hot pipes most closely relates to the disclosed heat saving construction as to operational temperature range and design features. The analogous products used to insulate gas turbines, steam pipes etc. are manufactured by “Techorizons of America, Inc.”, Great Neck, N.Y., USA (see: www.techorizons.com), “Insultec, Inc.”, Fairfield, Iowa, USA (see: www.insultec.com), “Remco Technology, Inc.”, Chicago, Ill., USA (see: www.remco-tech.com). In general these insulation products represent multi-layered flexible and semi-rigid insulating covers (jackets) that are composed of inner so-called middle (insulating) layer and outer (protective) layers-sheetings. As
a rule, the inner layer is made of light soft or elastic fibers (from super thin mineral or glass fibers) highly effective heat (sound) insulating materials with a standard thickness in the form of rolls or mats. The outer upper and bottom layersheets are made of certified film, fabric or sheet materials with guaranteed longevity, resistant to water and air, oil and acid, other aggressive chemicals, as well as temperature and standard fire-resistant. To fasten and connect different insulation sections with each other, the known technical means are used (see described Patents of USA). The common drawback of the majority of the existing removable insulation products is non-hermetic joints between the adjacent sections of the insulating cover, presence of multiple heat conducting inserts that results in unnecessary heat loss of expensive technological energy thus increasing financial expenditures.

[0012] 2. Objects and Advantages

[0013] Basic objects and advantages of the present invention comprise the following:

[0014] (a) to provide the possibility to use the sectional heat (sound) insulating jackets repeatedly for technological equipment including turbines, engines, boilers, valves and various pipelines connections. The shape of an insulated entity’s external surface can be diverse, without limitations of size, configuration, and accuracy;

[0015] (b) to increase the efficiency of the repeatedly used heat (sound) protection assembly for entities operating under extreme temperature and/or with a high noise level by the creation of the “self-sealing” assembling joints between the contiguous insulation sections and the controllable reduction these joints at the stage of operation;

[0016] (c) to simplify the heat (sound) protection assembly installation (or dismantling), increasing the insulating assembly reliability due to application of the universal integrated fastening and connection means which provide connection of the insulation sections’ layers during installation and heating. These means simultaneously fix the constant assembly thickness and mutual position of the contiguous insulation sections after “self-sealing” of the assembling joints between them;

[0017] (d) to provide a hermetic sealing of the heat (sound) protection assembly joints as a result of the use of special slot inserts, fabricated out of elastic braid fixed on the adjacent insulation sections’ lateral flexible layers. The braid completely fills the assembling joints during the temperature expansion of the insulation sections.

[0018] (e) to reduce the heat loss significantly through the assembling joints and through the fastening and connection means of the heat (sound) protection assembly which are attributed to the “self-sealing” effect of the assembling joints and essential heat loss decrease through the fastening means owing to their original design.

[0019] Further objects and advantages may enable the use of the invention for a variety technological equipment from turbines, engines etc. any valves or connections of pipes with a form exclusively individual without limitation in dimension and accuracy of a manufacture.

SUMMARY

[0020] In accordance with the present invention the sectional heat insulation jacket comprising a set of multi-layer insulation sections in which layers are fastened among themselves by special fastening means and fixing means. Adjacent insulation sections are separated from each other by assembling joints and are connected in an organic whole using the original connecting means. Assembling joints are self-sealed under operating conditions, due to the insulation sections forms and sizes, and a mutual position of the adjacent sections is reliably fixed by the connecting means at each stage of heating.

DRAWINGS—FIGURES

[0021] The present invention will be more particularly described in the following discussion of the preferred embodiments there of with reference to the accompanying drawings.

[0022] FIG. 1 illustrates a perspective view of the sectional heat insulating jacket (the first variant embodiment of the invention) for the entity with a curvilinear external surface (boiler) at the stage of operation;

[0023] FIG. 2 illustrates the insulations sections (the first variant embodiment of the invention): fragments of the plan at the stages of installation (FIG. 2A), at the stage of operation (FIG. 2B), the cross-section 2C-2C across the assembling joint between adjacent sections (FIG. 2C) at the stages of installation (it is shown by continuous lines) and at the stage of operation (it is shown by dashed lines);

[0024] FIG. 3 illustrates the top view on the connection of four adjacent insulation sections with ledge (the second variant embodiment of the invention) at the stage of operation (FIG. 3A) and cross-section 3B-3B across the assembling joint between adjacent sections at the stages of installation and operation (FIG. 3B);

[0025] FIG. 4 illustrates the top view on the connection of adjacent insulation sections with elastic heat resistant polymer braid (the third variant embodiment of the invention) at the stage of operation (FIG. 4A) and cross-sections 4B-4B and 4C-4C across the assembling joint between adjacent sections at the stages of installation (FIG. 4B) and operation (FIG. 4C);

[0026] FIG. 5 illustrates the plan’s fragment of the insulation section with an elastic heat-resistant polymer braid (third variant embodiment of the invention).

DETAIL DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

[0027] A perspective view of a sectional heat insulating jacket, which gets together out of assembling multi-layer insulation sections 2 (the first variant embodiment of the invention), is shown on FIG. 1. As an example an entity with a curvilinear external surface (boiler) at the stage of operation is presented.

[0028] Multi-layer insulation sections 2 (the first variant embodiment of the invention) as fragments of the plan and a section across an assembling joint at the stages of instal-
lation and operation are shown on FIGS. 2A, 2B and 2C. Each of the insulation sections 2 is fabricated as closed protective housing 4, formed by thread stitched seams 6 from a bottom flexible layer 8 inverted to the insulated hot surface of the process equipment (boiler) and skintight to this surface, an upper flexible layer 10 which is equally spaced from the bottom flexible layer along the all surface of the insulation section 2 and inverted to an environment, lateral flexible layers 12 inclined under a sharp angle beta (111) to the top flexible layer 10 at the stage of installation and perpendicular to surfaces of both layers 8 and 10 at the stage of operation and also inverted to the lateral flexible layers 12 of adjacent insulation sections 2. A middle semi-rigid heat (sound) insulation-forming layer 14 is placed inside each of the housing 4. All insulation sections 2 are supplied with special fastening means 16, placed equisitantly and consisting of fastening rods 18 and fixing means 20 to fasten off the rods 18 on the surface of the insulation sections 2. Adjacent insulation sections 2 are separated from each other by assembling joints 22 and are connected in an organic whole using the connection means 24 which are distributed along the joining insulation sections 2 perimeter in the regular order and comprise the special studs 26 fixed on the fastening rods 18 and coupled with the special plate-clamp 28. The plate 28 has, for example, T-form shape and at least two round holes 30 at the narrow plate’s end and an arched slot 32 at the opposed (broad) end of the plate 28. A flange 34 on the broad end of the plate 28 allows to turn this plate around one of the fastening rods 26, following the approach of the adjacent insulation sections 2 lateral layers during heating, and to fasten a mutual positions of the fastening means 16 gradually, at each intermediate step of heating, fixing final position of fastening means 16 after the assembling joint 22:"self-sealing".

[0029] The presence of the same fastening means 16 placed in the certain order on all surface of the insulation sections 2 also affects the assembling joints 22:"self-sealing". The fastening rods 18 are screwed into the insulation section 2 body and fixed on bottom 8 and upper 10 flexible layers by special fixing means. The different means for each variant fixing allow holding up an insulation section 2 thicknesses and simultaneously providing joining of the layers 8, 10 and 14. Fastening and fixing means design provide the upper 10 and the bottom 8 layers moving towards the assembling joints 22 during heating from the layer 8 side without protrusion of the upper flexible layer 10.

[0030] The fastening means 16 are disclosed in two variants of embodiment. In the first variant (FIG. 2C) the fastening rod 18 is made from heat-resistant stainless steel as, for example, a conical helical spring 36 with a height equal to the insulation section 2 thickness, having a flat coil 38 (radius R) at the spring base and a straight axial part 40 with a thread 42 at the other end Fixing means 20 comprise an abutment washer 44 with a threaded hole 46 for the stud 26 in the centre rigidly fixed (for example by spot welding) inside the flat coil 38 of the spring, a special self-locking washer 48, and locking nut 50, screwed on the spring’s straight part with a thread 42. A fastening unit of the rod 18 is shown in a large scale in the circle drawing FIG. 2C where the stud 26 is screwed into the abutment washer 44 of the plate-clamp 28.

[0031] The second variant embodiment of the invention is shown on FIGS. 3A and 3B. In this case the insulation sections 2 are made with bottom 52 and upper 54 ledges conformed from the lateral flexible layers 12 and overlapping each other at a level of a insulation section 2 median surface. The lateral flexible layers 12, which formed ledges 52 and 54, represent two parallel inclined surfaces 12a, connected by an intermediate horizontal flexible layer 56. The inclined flexible layers 12a and the intermediate horizontal flexible layer 56 of each section are inverted to corresponding layers of the adjacent insulation sections 2. The bottom ledges and, accordingly, the upper ledges are placed in pairs on adjacent surfaces of lateral flexible layers of the insulation section 2. Besides, a layer of polished steel 58 foil is fixed (needled, for example) on the flexible layer 56 upper surface of the bottom ledges 52 of each insulation section 2. The adjustment insulation section 2 ledges 52 and 54 overlap guarantees high reliability of self-sealing assembling joints 22 at the stage of operation. An application of nonmetallic polymer rods 18 is preferable. The use of ledges is reasonable when the insulation sections 2 thickness is 100 mm and more.

[0032] At the second variant embodiment of the fastening means 16 (FIG. 3B) the fastening rod 18 (is shown in the large scale inside an oval) is fabricated out of a heat resistant polymer with low thermal conductivity in the shape of a tube-like bushing 60 with trapezoidal lugs 62 located along a helical path of the outlet bushing surface. The bushing 60 having height, equal to distance between the bottom 8 and the upper 10 flexible layers, after the process of being screwed into the insulation sections 2 body from the side of the upper flexible layer 10 are fixed at the flexible layers’ surfaces with the fixing means 20. The fixing means 20 comprise: two support steel washers 64, placed on each of the bushing 60 faces, steel stud 66, installed from the flexible layer 10 side (for fastening rods 18 placed along the insulation sections 2 perimeter), and a screw 68 from the flexible layer 8 side or two screws 68 from the sides of flexible layers 8 and 10 (for other fastening rods 18) correspondently. The screws 68, which are screwed in the bushing 60, form a self-tapping fastening thread on the inner bushing surface during the screwing process. The bushing 60 can be fabricated out of Teflon or Textolite. The studs 66 are a part of the fixing means and are simultaneously used as a component of the connection means 24 together with the plate-clamp 28.

[0033] The third variant embodiment of the invention is shown on FIGS. 4A, 4B, 4C and includes a sectional heat insulating jacket each insulation sections 2 of which is in addition supplied between its two adjacent inclined lateral flexible layers 12 with an elastic braid 72 from heat-resistant polymer. The braid 72 is fixed (for example, with adhesive or clamped) to the inclined lateral flexible layers. The braid 72 has a trapezoidal profile, which corresponds to inclinations of lateral flexible layers 12 with V-shaped cut-outs on the upper 74 and bottom 76 surfaces. The elastic insert-braid 72 height is 10-20 mm less than the width insulation sections 2 thickness (delta). Geometrical parameters of the insert-braid 72 are chosen so that to provide conditions at which the insert-braids (made from, for example, silicone resin), being deformed at heating, completely fill the assembling joints 18 at a stage of operation.

[0034] The fragment of the plan of the insulation section 2 with the insert-braids 72 fixed on adjacent inclined lateral flexible layers 12 (the third variant embodiment of the invention) is shown on FIG. 5.
Designated on FIGS. 2, 3, 4 and 5 dimensions of the assembling insulation sections 2, representing a removable multi-layered repeatedly used sectional heat insulating jacket to be installed on an insulated entity with formation of longitudinal and transverse assembling joints and skin-tight to its external surface, are defined from the following formulas:

\[ L(I; 1b) = L(I; 1a) + K(I; s) / [1 + \alpha(1) \cdot (T(o; 1e) - T(o; 1b))]; \]  
(1.1)

\[ L(II; 1b) = L(II; 1a) + K(II; s) / [1 + \alpha(1) \cdot (T(o; 1e) - T(o; 1b))]; \]  
(1.2)

\[ L(I; 2b) = L(I; 2a) + K(I; s) / [1 + \alpha(2) \cdot (T(o; 2e) - T(o; 2b))]; \]  
(2.1)

\[ L(II; 2b) = L(II; 2a) + K(II; s) / [1 + \alpha(2) \cdot (T(o; 2e) - T(o; 2b))]. \]  
(2.2)

\[ \beta(I) = \text{arc} \, \tan \{L(I; 1b) + \alpha(I) \cdot (T(o; 1e) - T(o; 1b)) - L(I; 2b) + \alpha(2) \cdot (T(o; 2e) - T(o; 2b)) / 2 \}; \]  
(3.1)

\[ \beta(II) = \text{arc} \, \tan \{L(II; 1b) + \alpha(I) \cdot (T(o; 1e) - T(o; 1b)) - L(II; 2b) + \alpha(2) \cdot (T(o; 2e) - T(o; 2b)) / 2 \}. \]  
(3.2)

where:

- \( L(I; 1b) \) — initial length of bottom (“1”) sheeting in a given direction (I — “longitudinal”) under ambient temperature of fabrication \( T(o; 1b) \);
- \( L(II; 1b) \) — initial length of bottom (“1”) sheeting in a given direction (II — “transverse”) under ambient temperature of fabrication \( T(o; 1b) \);
- \( L(I; 2b) \) — initial length of upper (“2”) sheeting in a given direction (I — “longitudinal”) under ambient temperature of fabrication \( T(o; 2b) \);
- \( L(II; 2b) \) — initial length of upper (“2”) sheeting in a given direction (II — “transverse”) under ambient temperature of fabrication \( T(o; 2b) \);
- \( \alpha(I) \) — temperature liner expansion coefficient of bottom (“1”) sheeting (reference book data);
- \( \alpha(2) \) — temperature liner expansion coefficient of upper (“2”) sheeting (reference book data);
- \( T(o; 1b) \) — initial temperature of bottom (“1”) sheeting;
- \( T(o; 2b) \) — initial temperature of upper (“2”) sheeting (the designed ambient air temperature);
- \( \beta(I) \) — slope angle of end faces of joint insulation section in given (I — “longitudinal”) direction towards joint axis between them;
- \( \beta(II) \) — slope angle of end faces of joint insulation section in given (II — “transverse”) direction towards joint axis between them;
- \( T(o; 1e) \) — final temperature of bottom (“1”) sheeting under operation;
- \( T(o; 2e) \) — final temperature of upper (“2”) sheeting under operation;
- \( K(I; s) \) — “joint reduction” coefficient in given direction (I — “longitudinal”) defined in experiment; it depends on middle layer material and alters from 1.000 to 1.006. It is chosen under design;
- \( K(II; s) \) — “joint reduction” coefficient in given direction (II — “transverse”) defined in experiment; it depends on the middle layer material and alters from 1.000 to 1.006. It is chosen under design.
- \( \delta \) — general insulation section thickness, including bottom and upper sheeting.

The insulation sections 2 parameters, calculated using formulas (1-3), provide an effect of assembling joints 22 “self-sealing”. To rise the reliability it allows the so called “extra self-sealing” of the assembling joints provided that the performance of the bottom 8 and upper 10 flexible layers forms with some positive tolerance, which is determined with empirical coefficients \( K(I; s) \) and \( K(II; s) \). In this case length and width of the flexible layers 8 and 10 are made to meet guaranteed sealing of the assembling joints 22 between the joining lateral flexible layers 12 of the adjacent insulation sections 2 in view of different temperature liner expansion coefficients of the flexible layers 8 and 10 materials and the middle insulating layer volume shrinkage under heating. It is obvious that using this new insulation section 2 design and having reduced assembling joints 22 width on 15-20% compared with the calculation, it is possible to produce assembling joints reduction. By having experimental data it is possible to get computation formulas for design sectional heat insulating jackets with practically hermetic assembling joints. In the first mode the fastening rod 18 is made of heat-resistant stainless steel as a conical helical spring 36 with a length 2 . . . 6 times larger than the overall insulation sections thickness and is determined from the formula (4):

\[ L(hc) = 0.82 \times \lambda(0) \times (T(o; 1e) - T(o; hc)) + \frac{d(D^2)}{2} / (\alpha(0) \times (T(o; hc) - T(o; 2b))). \]  
(4)

where:

- \( L(hc) \) — a required length (uncoiled length) of the conical helical spring under the condition of minimal heat losses;
where:

\[ L_{(m)}^{1} = 0.5 \left[ L_{(m)}^{10} + L_{(m)}^{20} \right] + \Delta L_{(m)}^{1} \quad (5.1) \]
\[ L_{(m)}^{2} = 0.5 \left[ L_{(m)}^{10} + L_{(m)}^{20} \right] + \Delta L_{(m)}^{2} \quad (5.2) \]
\[ \Delta L_{(m)}^{1} = 0.5 \left[ L_{(m)}^{10} + L_{(m)}^{20} \right] \times \delta \times K_{(m)}^{1} \quad (6.1) \]
\[ \Delta L_{(m)}^{2} = 0.5 \left[ L_{(m)}^{10} + L_{(m)}^{20} \right] \times \delta \times K_{(m)}^{2} \quad (6.2) \]

Advantages

From the description above, a number of advantages of this sectional heat insulating jacket become evident:

a) A sectional heat insulating jacket assembles from numerous factory made flexible assembly sections, which allows insulating easily any kind of the process equipment with various fashions and sizes, providing required quality of insulation in virtue of using of assembly sections with simple shapes and acceptable dimensions in view of weight restrictions.

b) Assembling joints between the adjacent insulation sections are self-sealed at a stage of operation. Such effect takes place due to the original insulation sections shape, carried out with the lateral flexible layers, which inclined under a sharp angle to the surface of the upper flexible layer. The sizes of the assembling joints between adjacent sections at levels of the upper and bottom flexible layers are equal to the temperature extensions of these layers in longitudinal and transverse directions correspondingly under the insulated entity heating until the operating temperature is reached.

c) The disclosed fastening rod configuration, for example, in the shape of a conical helical spring, sufficiently increases the length of metallic inclusions with high thermal conductivity from a insulated entity to an environment in comparison with simple straight metal pins used nowadays, which pierce insulation by the shortest way. It allows decreasing considerably both the heat flow through the metal fastening and the temperature on the insulation sections upper surface where the fastening rods are located. It is obvious that the length of the spring wire is determined with consideration of the cost-effective advantages and equal from 2 to 6 of the insulation sections thickness. It also solves a problem of structural integration among all insulation sections layers providing their cooperative deformation during heating.

d) The offered plate-clamp with several round holes and arched slot is universal since allows to fasten adjacent insulation sections at their temperature deformation under heating from +150 up to +1200 degrees of Celsius.

e) In the second variant embodiment of the invention the layer of polished steel foil is fixed on the upper surface of the lower ledges of each insulation sections. The foil decreases a friction force between the contact surfaces of the joined insulation sections inside the assembling joints and simultaneously decreases heat losses through the bottom ledge due to reflection of infrared radiation.

Conclusion, Ramification and Scope

Accordingly, the reader will see that a sectional heat insulating jacket is the invention which opportunity of use practically has no restrictions. So, further, except for the described area, the sectional heat insulating jackets due to
the advantages can successfully be used as demountable repeatedly used heat (sound-) insulation for:

[0083] a) various equipment with high level of heat emissions and industrial noise in the power industry;
[0084] b) heat savings and working places climate providing in hot shops of a metallurgy;
[0085] c) environment protection from casual emissions of aggressive liquids and gases in the chemical industry;
[0086] d) insulation, for example, exhaust pipes in motor industry;
[0087] e) protection of open valves and other devices, various tanks in the oil and gas industry etc.

[0088] Although the description above contains many specificities these should not be construed as limiting the scope of the invention but as merely providing illustrations of some of the presently preferred embodiments of this invention. For example, fastening rods in the first variant of an embodiment of the invention can be made not only as a conic spring, but a cylindrical one with providing of the declared effect. Or, for example, the T-shaped plate-clamp can be triangular or trapezium-shaped, etc.

[0089] Thus the scope of the invention should be determined by the appended claims and their legal equivalents, rather than by examples given.

[0090] Further, it should be understood that various changes and modifications to the presently preferred embodiments described herein will be apparent to those skilled in the art. Such changes and modifications may be made without departing from the spirit and scope of the present invention and without diminishing its attendant advantages. It is, therefore, intended that such changes and modifications be covered by the appended claims.

What is claimed is:

1. A sectional heat-insulating jacket, that is removable, repeatedly used for various process equipment insulation, said jacket comprising:

(a) set of multi-layer insulation sections with assembling joints between them, self-sealing under operating conditions; each of said insulation section is made as a polyhedral, closed protective housing, formed by thread-stitched seams from the bottom flexible layer inverted to the insulated hot surface of the process equipment and skintight to this surface, the upper flexible layer which is equally spaced from the bottom flexible layer along the entire surface of said insulation section and inverted to an environment, the lateral flexible layers inclined under a sharp angle to said upper flexible layer at the stage of installation and perpendicular to surfaces of both said layers at the stage of operation and also inverted to said lateral flexible layers of adjacent insulation sections;

a middle semi-rigid heat (sound) insulation-forming layer, placed inside said housing;

fastening means placed equidistantly from the side of said upper flexible layer of each insulation section along its surface and intended for connection of said bottom and upper flexible layers and the middle insulation-forming layer, located between the flexible layers;

(b) connecting means for adjacent insulation sections connection with each other and for their mutual positioning fixing at a stage of installation, in intermediate positions—during heating and in final position—at the stage of operation; said connecting means are made as steel studs, fixed during installation from the side of the upper flexible layer on said fastening means placed equidistantly along a perimeter of each of said insulation section, and special cover fixing plates.

2. A sectional heat-insulating jacket as defined by claim 1, comprising fastening means made as fastening rod and the fixing means of this rod located on the surface of said insulation section.

3. A sectional heat insulating jacket as defined by claim 2, wherein said fastening rod, fabricated out of heat-resistant stainless steel as a conical helical spring whose height is equal to the distance between said bottom and upper flexible layers; at the basis of said spring a flat coil is formed, and on its other end a straight part of the spring, directed along a spring axis, is formed and is supplied with a thread; said fixing means include: a round steel abutment washer rigidly fixed inside said flat coil of the spring, having a threaded hole in the center for the said stud, a special self-locking washer, put on said straight part of the spring and fixed on the surface of said bottom flexible layer by a locking nut, screwed on said straight part of the spring.

4. A sectional heat insulating jacket combination as defined by claim 1, wherein said insulation sections of which are made with upper and bottom ledges conforming from said lateral flexible layers and overlapping each other at a level of a median surface; said lateral flexible layers, which formed ledges, represent two parallel inclined surfaces, connected by an intermediate horizontal flexible layer; said inclined flexible layers and said intermediate horizontal flexible layer of each said insulation section are inverted to corresponding layers of the adjacent insulation sections; between adjoining surfaces of said bottom and upper ledges a layer of polished steel foil fixed to the upper surface of the bottom ledges is placed, and said upper and bottom ledges are placed in pairs on adjacent surfaces of said lateral flexible layers of the insulation sections.

5. A sectional heat insulating jacket as defined by claim 2, wherein said fastening rod is fabricated out of heat resistant polymer in the shape of a tube-like bushing with trapezoidal lugs located along a helical path of the outer bushing surface, and the height of said bushing and distance between said bottom and upper flexible layers are equal; said fixing means, fixing each of said bushing on the surfaces of said bottom and upper flexible layers are accepted as two support steel washers, steel stud and screw (or two screws) which form a self-tapping fastening thread on the inner bushing surface during the screwing process.

6. A sectional heat insulating jacket as defined by claim 5 wherein said fastening rod is fabricated out of Teflon or Textolite.

7. A sectional heat insulating jacket as defined by claim 2 wherein each insulation section is supplied in addition between its two adjacent inclined lateral flexible layers with an elastic braid from heat-resistant polymer.
8. A sectional heat insulating jacket as defined by claim 7 wherein the elastic braid is fabricated out of silicone resin.

9. A sectional heat insulating jacket as defined by claim 1, comprising said connecting means fabricated as steel studs, fixed at the stage of installation from the side of said upper flexible layer on said fastening means, and special T-shaped plates—clamps; wherein said plates-clamps are supplied with round holes and arched slot for fastening said plates on said studs.