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2,585,818

DEVICE FOR GENERATION OF HIGH-PRESSURE

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FIG. 1.

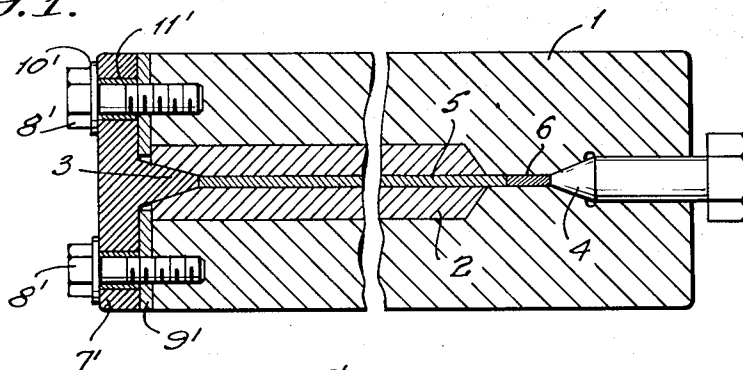


FIG. 3.

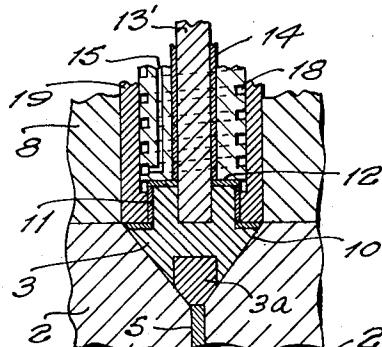
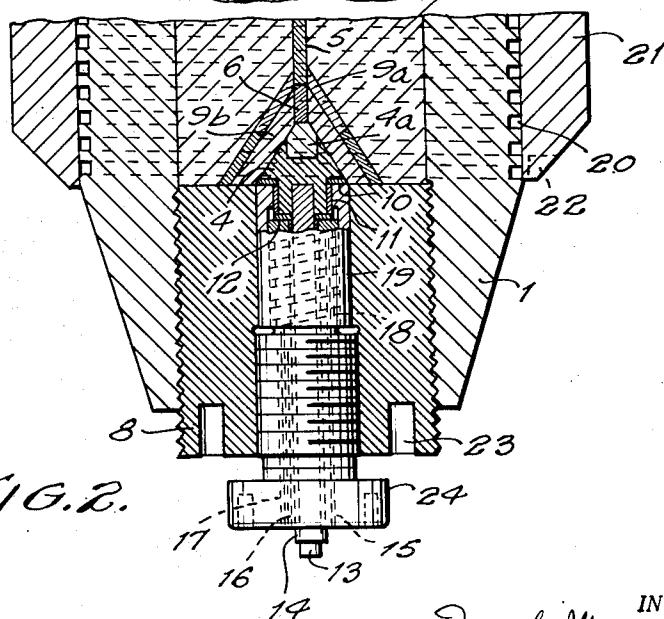


FIG. 2.



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DEVICE FOR GENERATION OF HIGH PRESSURE

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14 Claims. (Cl. 219—1)

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The present invention relates to a method and a device for generation of high pressures by making use of the dilatability of different materials by action of heat.

The dilatation of solid materials due to the effect of heat generates pressures, the magnitude of which is dependent upon the specific heat and weight of the substance and upon its coefficient of volume dilatability. The equation in which the respective values have been put up shows that different substances, subjected to the action of heat, produce different pressures.

According to the present invention the dilatability of the substances is utilized in the following way. In a closed space, filled up by any substance whatever this substance is heated in a suitable manner (e. g. by electricity) up to a certain temperature at which the substance should attain the maximum of dilatation. The substance, being in a closed space, cannot dilate, on the contrary, it must compress itself, whereby it is deforming internally, or changing its structure and modification. It is of course necessary to arrange the closed space for a compressed substance in a device of suitable dimensions to enable the device to support high pressures, generated by dilatation of the heated substance. After cooling the compressed substance remains deformed, if the internal pressures, generated by the dilatation, were higher than the elasticity limit of the compressed substance. In another case the closed end of the space is not entirely filled up by the heated substance, the remaining space being filled up by another substance which shall be subjected to the pressure. If the first substance is heated, it dilates and compresses the tested substance which owing to the action of the pressure of the first substance is deformed and reduces its volume. The compression makes it warm and after cooling it keeps its reduced volume together with its changed structure, or its changed modification.

Examples of a device for generating high pressures are illustrated in the accompanying drawings, where

Fig. 1 shows the device in a longitudinal section,

Fig. 2 showing another device of this kind, equally in longitudinal section of the right hand extremity, the left hand extremity, a section of which is shown on the Fig. 3, being arranged symmetrically, with exception of some minimal differences which will be described later.

In comparison to devices for generating high pressures used hitherto, e. g. presses, the inven-

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tion offers the advantage of obtaining much higher pressures by means of smaller and less expensive devices.

The arrangement shown in the Fig. 1 consists in principle of a body 1, in which is lodged a hollow cylinder 2 of thick walls and a small inner width, preferably with a low coefficient of warm dilatability, e. g. made of glass, porcelain, corundum and the like. The central bore of the cylinder 2 passes on the left side into a conical recess, a corresponding conical projection 3 of a metallic cover 7' engaging the recess, the cover 7' being insulated against the body 1 by a washer 3' and tightened to the same by circumferential screws 8', insulated against the cover 7' by washers 10' and by intermediate layer 11'. The opening in the cylinder 2 continues on the right hand even in the body 1, being closed therein by a closing cone 4, screwed into the body 1. Into the bore of the cylinder 2 there is lodged a metallic bar 5, heated by electrical current, supplied from the line of the closing cone 3 and that of the body 1 (the supply lines are not shown). The section and the length of the bar 5 have to be of convenient dimensions in order to obtain a sufficient elongation of the bar heated. The remaining space of the cavity of the body 1 is filled up by the tested material 6 and the cavity is closed by the cone 4. The cone 3 and the body 1 are brought into contact with an electric supply line, the heated metallic bar dilates, whereby the generated pressure is acting on the tested metallic bar or another substance 6 the volume of which begins to decrease. The generated heat is absorbed by the body 1. After the cooling of the tested bar 6 the closing 4 is opened, then the current is switched on once more so that by another dilatation of the bar 5 the tested bar 6 is pressed out of the cavity of the body 1, whereafter the compressed material may be used for various purposes.

The pressure acting on the bar 6 may eventually increase its hardness and change its crystalline structure. The material obtained in this way may be used e. g. as welded cutting-edge of working machines whereby the expensive agglomerate tools could be replaced.

It has been found that the same principle may be used to generate high pressures in a similar device if the whole device is heated. For this purpose a small dilatation bar is used, made of a material having a dilatation coefficient substantially different from that of the other material of which the device is made, e. g. steel. If the dilatation bar, used for the experiment, is

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made of a material having a higher dilatation coefficient than that of the other material of which the device is made, e. g. a zinc dilatation bar, closed in a steel cylinder, a high pressure is generated already when the whole device is heated to a certain temperature, e. g. 300° C. If on the contrary, a dilatation bar, made of a material, the dilatation coefficient of which is lower, e. g. of Invar, is used and the device, the body of which is made e. g. of steel, a high pressure is produced during the cooling only, supposing of course, that the Invar bar has been put into a preheated steel body and still in warm state tightened therein.

The method according to the invention offers the advantage that there is not necessary to use an insulating internal jacket and that the heating can be carried out in any way, e. g. by means of a direct flame from outside or by means of an induced current.

Example I

A substance which shall be subjected to the action of pressure and a zinc bar, tightly fitting inside of the body after the tightening of the screw closing, are lodged into a steel cylinder with a deep bore of a small inner width and provided by a screw closing. The other arrangement of the device is identical with the Fig. 1, with the exception that there is no warm insulating inside cylindric jacket whereas at the left hand neither a special cover nor a projection and a current line are necessary. On this end the body 1 is simply closed. The closed device is then slowly heated to a temperature of 300° C. A zinc bar having a thermic dilation coefficient 2-2½ times larger than that of steel, a high pressure is generated inside of the zinc bar and simultaneously inside of the tested substance.

Example II

The same device is preheated to a temperature of 300-400° C. then a closely fitting Invar bar is lodged therein, the closing being screwed in and duly tightened. Thereafter the whole device is let to cool slowly. During the cooling the steel block is contracting 7 times more than the Invar bar so that a high pressure of several tens of thousands of atmospheres is generated.

The Fig. 2 shows a section of the right hand end of the device for the production of very high pressures. In such cases the hollow cylinder 2 is subjected to very high pressures and therefore is to be made of an insulation material of a high resistance to pressure and of a small coefficient of thermic dilatability. Silicate glass or melted corundum are suitable for this purpose. The cylinder 2 is placed in the jacket body 1 in warm state and is secured therein on one extremity by a closing stopper 8 provided with a thread cooperating with a threaded portion of the body 1. The stopper 8 can be rotated by inserting a suitable tool into the bore 23 on the front side of the stopper. The points 3a, 4a of the closing cones 3, 4, which are in a close contact with the bar 5 or with the material 6 respectively are made of a hard metal. The closing cone 3 on the left hand side of the device has a diameter by about 25% larger than that of the right hand closing cone 4 in order to secure a sufficient supply of electric current by means of the electrode 13'. Both cones are made of high speed tool steel containing about 4% chromium, 1% vanadium and 18% tungsten. In order to enable the cones 3, 4 to be duly pressed against the

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material, subjected to pressure, the bolts of the tightening screws 24 are in the part passing by bushings or jackets 19 provided by spiral channels 18, the ends of which are through bores 15, 16 conducted up to the surface of the screw heads 24. The jackets 19 are lodged in warm state into the closing 8.

Before bringing the device into action a heating medium is conducted into channels 16, 18, 15, this mediums heating thoroughly the closing cones 3, 4, which are expanding and thereby pressing against the other adjacent material. If it is necessary to take out the closing cones, a cold medium is driven through the channels, whereby the cones are cooled, reduced in volume and loosened.

In order to prevent a deformation of the conic inside-wall of the hollow cylinder 2 owing to an overpressure after a screwing out of one of the cones out of the device, it is necessary to reduce the radial overpressure before such a screwing out. For this purpose the annulus 21, embracing the bush 1, forms simultaneously a covering wall of the channels 20, cut in the form of a thread in the surface of the body 1 onto which the annulus 21 is fitted in warm state. The mouths of the channel 20 are arranged on the surface of the annulus 21 both on the right and on the left in the bores 22. If the overpressure acting at all sides onto the hollow cylinder 2, is to be reduced, a hot medium is driven through the channels 22, 20 this medium imparting the heat to the body 1, by expansion of which the overpressure acting onto the cylinder 2 is reduced. On the contrary, before putting the device into action, a cold medium is led through these channels, producing a volume reduction of the body 1 which thus becomes tightly fitting to the cylinder 2.

The annulus 21, jackets or bush insert pieces 19, stopper 8, conic insert pieces 9 and the body 1 are made of special steel. The tubes 17 of the channels 16 are made of asbestos, the tubes 14 of the electric lines 13, 13' of fibre, the insulating washers and underlayers 10, 11, 12 of silicate glass, the cones 3a, 4a and 9a of a hard metal. The hollow conic insert piece 9b is made of melted corundum.

The functioning of the arrangement corresponds to that of the apparatus according to the Fig. 1.

A tightly filling up of the inside bore of the cylinder by the bar 5 may be carried out mechanically or electrolytically.

According to the necessity and purpose the electric current may be conducted only into the dilatating bar 5 from the left hand electrode 13' and the tightening cone 3, 3a, and furthermore through the cones 9a, 9 into the close 8, or it is possible to heat by means of the current event the compressed substance 6 in such a way that the current is not conducted from the right hand extremity of the bar 5 into the parts 9a, 9 and 8, but through the mass 6 into the cone 4a, 4 and through the right hand electrode 13 away or, of course, in the opposed direction.

The copper electric lines 13' and 13 must have a sufficiently large contact surface with their closing cones 3 and 4 and a sufficiently large diameter in order not to get warm too much, the amount of current passing through them being considerably large as it is necessary to compensate the current losses due to the leading away of heat by the hollow cylinder 2 from the dilatating bar 5 and by the insulating conic

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insertion 9b from the tested mass 6, when they are heated to high temperatures.

The left hand part of the device is quite analogic with the exception of the mass 6, subjected to pressure, which of course, is dispensed with, so that the cone 3 touches by its top piece 3a the left hand extremity of the dilatating bar 5. The parts 9a, 9 and 9b are equally dispensed with.

I claim:

1. A device for exerting a pressure on a body, comprising in combination, a body provided with a hollow; means for tightly closing the hollow of said body; a metal bar and a body to be compressed arranged in the hollow of said body abutting against each other and opposite walls of said hollow; and means for imparting temperature changes to said bar.

2. A device for exerting a pressure on a body, comprising in combination, a body provided with a hollow; means for tightly closing the hollow of said body; a metal bar and a body to be compressed arranged in the hollow of said body abutting against each other and opposite walls of said hollow; and means for causing temperature changes between said bar and said hollow body.

3. A device for exerting a pressure on a body, comprising in combination, a body provided with an elongated hollow; means for tightly closing the hollow of said body; a metal bar and a body to be compressed arranged in the hollow of said body abutting against each other and opposite walls of said hollow and filling the hollow of said body tightly; and means for imparting temperature changes to said bar.

4. A device for exerting a pressure on a body comprising in combination, a body provided with an elongated hollow; means for tightly closing the hollow of said body; a metal bar and a body to be compressed arranged in the hollow of said body abutting against each other and opposite walls of said hollow and filling the hollow of said body tightly; and means for causing temperature changes between said bar and said hollow body.

5. A device for exerting a pressure on a body, comprising in combination, a body provided with an elongated hollow; means for tightly closing the hollow of said body; a metal bar and a body to be compressed arranged in the hollow of said body abutting against each other and opposite walls of said hollow and filling the hollow of said body tightly; and means for electrically heating said bar.

6. A device for exerting a pressure on a body, comprising in combination, a body provided with an elongated hollow; means for tightly closing the hollow of said body; a metal bar and a body to be compressed arranged in the hollow of said body abutting against each other and opposite walls of said hollow and filling the hollow of said body tightly; means for insulating electrically said bar from said hollow body; and means for leading an electric current through said bar.

7. A device for exerting a pressure on a body, comprising in combination, a body provided with a hollow; means for tightly closing the hollow of said body; a tube made of thermically and electrically insulating material and arranged in the hollow of said body; a metal bar and a body to be compressed tightly arranged in said tube abutting against each other and opposite walls of said tube; and means for leading an electric current through said bar and said body to be compressed.

8. A device for exerting a pressure on a body, comprising in combination a body provided with

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a hollow; means for tightly closing the hollow of said body; a tube made of thermically and electrically insulating material having a low coefficient of thermal expansion and arranged in the hollow of said body; a metal bar and a body to be compressed tightly arranged in said tube abutting against each other and opposite walls of said tube, and means for leading an electric current through said bar and said body to be compressed.

9. A device for exerting a pressure on a body comprising in combination, a body provided with a hollow; means for tightly closing the hollow of said body; a metal bar and a body to be compressed arranged in the hollow of said body abutting against each other and opposite walls of said tube; said bar having a lower coefficient of thermal expansion than said hollow body.

10. A device for exerting a high pressure on a body comprising in combination, a body provided with an elongated hollow; means for tightly closing the hollow of said body; said means including conical closure pieces arranged at opposite ends of the hollow of said body; a metal bar and a body to be compressed arranged in the hollow of said body abutting against each other, and against said conical closure pieces; and means for leading an electric current through said bar and said body to be compressed.

11. A device for exerting a high pressure on a body comprising in combination, a body provided with an elongated hollow; means for tightly closing the hollow of said body, said means including a conical insert piece provided with an axial bore; a metal bar arranged in the hollow of said body; a body to be compressed arranged in the bore of said conical insert piece, said metal bar and said body to be compressed abutting against each other and opposite walls of said hollow; and means for leading an electric current through said bar and said body to be compressed.

12. A device for exerting a high pressure on a body comprising in combination, a body provided with an elongated hollow; means for tightly closing the hollow of said body, said means including a conical insert piece provided with an axial bore; a metal bar arranged in the hollow of said body and having a lower coefficient of thermal expansion than said hollow body; a body to be compressed arranged in the bore of said conical insert piece, said metal bar and said body to be compressed abutting against each other and opposite walls of said hollow; and means for leading an electric current through said bar and said body to be compressed.

13. A device for exerting a high pressure on a body comprising in combination, a steel body provided with an elongated hollow; means for tightly closing the hollow of said body, said means including a conical insert piece made from molten corundum provided with an axial bore; a metal bar arranged in the hollow of said body; a body to be compressed arranged in the bore of said conical insert piece, said metal bar and said body to be compressed abutting against each other and opposite walls of said hollow; and means for leading an electric current through said bar and said body to be compressed.

14. A device for exerting a high pressure on a body comprising in combination a body provided with an elongated hollow; means for tightly closing the hollow of said body, said means including a conical insert piece provided with an axial bore; a metal bar arranged in the hollow of said

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body; a body to be compressed arranged in the bore of said conical insert piece, said metal bar and said body to be compressed abutting against each other and opposite walls of said hollow; a cone concentrically arranged in said insert piece and being in close contact with said body to be compressed; and means for leading an electric current through said bar and said body to be compressed; said leading means including a conductor arranged in said cone.

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