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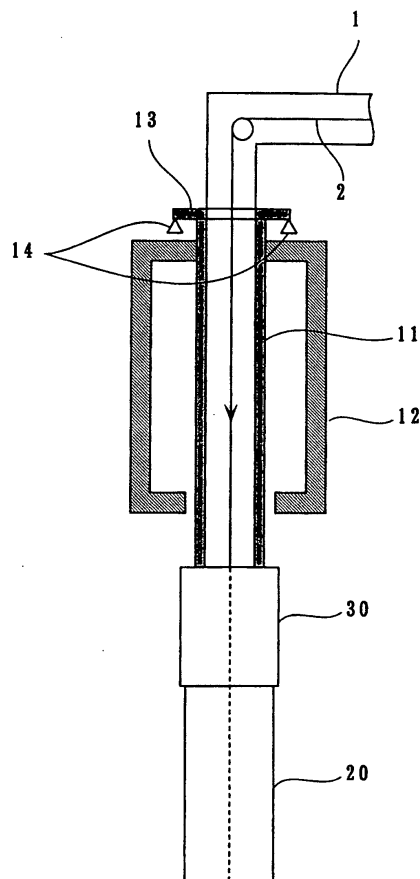
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(54) **VERTICAL MUFFLE TYPE HEAT TREATING FURNACE**

(57) In a vertical muffle-type heat treating furnace including: a vertically disposed muffle allowing metal strips to be led therein from an upper side to a lower side thereof; a heating zone for heating, from the outside of the muffle, the metal strips passed through the muffle; and a cooling zone disposed at place downstream from the muffle with respect to a moving direction of the metal strips and serving to cool the heated metal strips, the muffle has its upper end fixed to place whereas an extendable muffle elongation adjusting zone is provided which maintains a space between a lower end of the muffle and the cooling zone in a sealed state.

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Description

TECHNICAL FIELD

[0001] The present invention relates to a vertical muffle-type heat treating furnace. More particularly, the invention relates to a vertical muffle-type heat treating furnace comprising: a vertically disposed muffle allowing metal strips to be led therein from an upper side to a lower side thereof; a heating zone for heating, from the outside of the muffle, the metal strips passed through the muffle; and a cooling zone disposed at place downstream from the muffle with respect to a moving direction of the metal strips and serving to cool the heated metal strips, the furnace characterized by being designed to readily accommodate the elongation of the heated muffle.

BACKGROUND ART

[0002] The vertical muffle-type heat treating furnaces have conventionally been used for annealing the metal strips such as of stainless steel.

[0003] In such a vertical muffle-type heat treating furnace, the muffle is vertically disposed with its upper end fixed to place, whereas the heating zone is provided for heating the muffle from the outside thereof. The metal strips are led into the muffle from a lower side to an upper side thereof such that the metal strips passed through the muffle may be heated in the aforesaid heating zone. The metal strips thus heated are cooled in the cooling zone disposed on an upper side with respect to the muffle, whereby the metal strips are annealed. In some cases, the aforesaid cooling zone may include a slow cooling zone for slowly cooling the metal strips.

[0004] In such a vertical muffle-type heat treating furnace, the muffle has its upper end fixed to place, as described above. When the muffle is heated to about 900 to 1200° C in the aforesaid heating zone, the muffle is thermally expanded and is also elongated downwardly by gravity. The muffle is particularly raised in temperature at an upper part thereof because the metal strips are heated as led through the muffle from the lower side to the upper side thereof. Hence, the muffle is elongated so much as to encounter plastic deformation. This leads to a progressive increase of the length of the muffle.

[0005] More recently, Published Japanese Translation of PCT International Publication for Patent Application No.2000-508712 has proposed a vertical muffle-type heat treating furnace which includes the vertically disposed muffle having its lower end fixed to place, and the heating zone for heating the muffle from the outside of the muffle. The metal strips are led through the muffle from the upper side to the lower side thereof. The metal strips are heated in the heating zone as passed through the muffle. The metal strips thus heated are cooled in the cooling zone disposed on a lower side with respect to the muffle, whereby the metal strips are annealed.

[0006] Unfortunately, in the case where the muffle has its lower end fixed place, as described above, the muffle fails to be elongated properly upwardly when heated to 900 to 1200°C in the heating zone. This results in the buckling of the muffle.

[0007] In this connection, the furnace disclosed in the aforementioned publication is provided with support means for pulling upward the upper end of the muffle. The support means pulls the muffle upwardly thereby preventing the muffle from buckling.

[0008] However, the provision of the support means for pulling upward the upper end of the muffle results in a complicated construction of the furnace and thence, in increased costs. In addition, it is difficult to provide a proper control of the force of the above support means pulling upward the upper end of the muffle. If the tensile force of the support means is too great, the muffle is excessively elongated upwardly so that the plastic deformation results. If, on the other hand, the tensile force of the support means is too small, the muffle buckles.

DISCLOSURE OF THE INVENTION

[0009] It is an object of the invention to solve the aforementioned problems encountered by the vertical muffle-type heat treating furnace used for annealing the metal strips such as of stainless steel.

[0010] The invention is directed to a vertical muffle-type heat treating furnace adapted to readily accommodate the elongation of a heated muffle, the furnace comprising the vertically disposed muffle allowing metal strips to be led therein from an upper side to a lower side thereof; a heating zone for heating, from the outside of the muffle, the metal strips passed through the muffle; and a cooling zone disposed at place downstream from the muffle with respect to a moving direction of the metal strips and serving to cool the heated metal strips.

[0011] According to the invention, the vertical muffle-type heat treating furnace comprises: a vertically disposed muffle allowing metal strips to be led therein from an upper side to a lower side thereof; a heating zone for heating, from the outside of the muffle, the metal strips passed through the muffle; and a cooling zone disposed at place downstream from the muffle with respect to a moving direction of the metal strips and serving to cool the heated metal strips, and is characterized in that the muffle has its upper end fixed to place and that an extendable muffle elongation adjusting zone is provided which maintains a space between a lower end of the muffle and the cooling zone in a sealed state. In some cases, the aforesaid cooling zone may include a slow cooling zone for slowly cooling the metal strips. In the case where the muffle has its upper end fixed to place as suggested by the vertical muffle-type heat treating furnace according to the invention, the muffle is elongated downward when the metal strips are heated in the heating zone as led through the muffle from the upper side to the lower side thereof. Thus, the muffle is pre-

vented from buckling, which occurs in the case where the muffle has its lower end fixed to place.

[0012] The vertical muffle-type heat treating furnace according to the invention is provided with the extendable muffle elongation adjusting zone which, as described above, maintains the space between the lower end of the muffle and the cooling zone in the sealed state. Therefore, the elongation of the muffle, which is elongated downward as described above, is accommodated by the muffle elongation adjusting zone. Furthermore, the muffle elongation adjusting zone also prevents a flammable gas containing a hydrogen gas from leaking out of the muffle. In addition, the muffle elongation adjusting zone also prevents the heated metal strips from being oxidized as exposed to the outside air or the like.

[0013] The vertical muffle heat treating furnace according to the invention negates the need for providing the support means for pulling upward the upper end of the muffle and for performing the difficult task to control the tensile force of the support means for properly elongating the muffle upwardly, the need stated in the aforementioned publication. Thus, the furnace of the invention is adapted to readily accommodate the elongation of the heated muffle.

[0014] In the vertical muffle-type heat treating furnace according to the invention, the extendable muffle elongation adjusting zone which maintains the space between the lower end of the muffle and the cooling zone in the sealed state may be arranged as follows, for example. A ring-like container having a predetermined depth for containing therein a water-free fluid may be provided on the cooling zone. On the other hand, the muffle is provided with a cylindrical closing member extended downwardly from the lower end thereof. The closing member is inserted in the fluid held in the container thereby maintaining the space between the lower end of the muffle and the cooling zone in the sealed state. Alternatively, a heat-resistant connecting member formed of an extendable bellows may be disposed between the lower end of the muffle and the cooling zone, such that the connecting member may maintain the space between the lower end of the muffle and the cooling zone in the sealed state.

[0015] According to the vertical muffle-type heat treating furnace of the invention, the muffle elongation adjusting zone may preferably be provided with a cooling device for cooling the muffle elongation adjusting zone or with a heat insulating member for preventing the muffle elongation adjusting zone from being heated, such as to prevent the water-free fluid in the muffle elongation adjusting zone from being evaporated due to heat or to prevent the heat-resistant connecting member from being deteriorated by heat.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

Fig.1 is a schematic sectional view illustrating a vertical muffle-type heat treating furnace according to an embodiment of the invention;

Fig.2 is a sectional view illustrating a construction of a muffle elongation adjusting zone in a vertical muffle-type heat treating furnace according to Embodiment 1 of the invention; and

Fig.3 is a sectional view illustrating a construction of a muffle elongation adjusting zone in a vertical muffle-type heat treating furnace according to Embodiment 2 of the invention.

BEST MODES FOR CARRYING OUT THE INVENTION

[0017] A vertical muffle-type heat treating furnace according to an embodiment of the invention will hereinbelow be described in details with reference to the accompanying drawings. It is noted that the vertical muffle-type heat treating furnace according to the invention is not limited to the following embodiments and may be practiced in modifications or variations as required, so long as such modifications or variations do not deviate from the scope of the invention.

(Embodiment 1)

[0018] In a vertical muffle-type heat treating furnace according to Embodiment 1 of the invention, as shown in Fig.1, metal strips 2 guided through a guide path 1 are led into a muffle 11 via an upper end thereof, the muffle filled with a reducing gas such as a hydrogen gas. In the muffle 11, the above metal strips 2 are moved from an upper side to a lower side of the muffle.

[0019] The muffle 11 is provided with a heating zone 12 around an outer periphery thereof, the heating zone equipped with heating means (not shown) such as a burner. The heating zone 12 heats, from the outside of the muffle 11, the aforesaid metal strips moved through the muffle 11 from the upper side to the lower side thereof. The aforesaid metal strips 2 are heated to about 850 to 1150°C.

[0020] The metal strips 2 thus heated are led into a cooling zone 20 via an extendable muffle elongation adjusting zone 30 provided in a manner to maintain a space between the aforesaid muffle 11 and the cooling zone 20 in a sealed state. In the cooling zone 20, the metal strips 2 are cooled so as to be annealed. Incidentally, the cooling zone 20 may include a slow cooling zone (not shown) for slow cooling of the metal strips 2.

[0021] According to the vertical muffle-type heat treating furnace of Embodiment 1, as shown in Fig.1, a flange 13 is assembled to the upper end of the muffle 11. Via the flange 13, the upper end of the muffle 11 is fixed to place by way of fixing means 14, so that the muffle 11

is suspended. That is, an arrangement is made such that the muffle 11 may be elongated downwardly when the metal strips 2 passing through the muffle 11 are heated in the heating zone 12, as described above.

[0022] In the vertical muffle-type heat treating furnace of Embodiment 1, as shown in Fig. 2, there are provided, as the aforesaid extendable muffle elongation adjusting zone 30 for sealing the space between the muffle 11 and the cooling zone 20, a ring-like container 32 having a predetermined depth for containing therein a water-free fluid 31 and disposed on the cooling zone 20; and a cylindrical closing member 34 attached to a lower end of the muffle 11 via a flange 33 and extended downwardly from the flange. The closing member 34 is inserted in the aforesaid fluid 31 contained in the container 32 thereby sealing the space between the lower end of the muffle 11 and the cooling zone 20. The aforesaid water-free fluid 31 may be any fluid that does not affect a dew point of an interior of the muffle 11. The fluid 31 may employ, for example, commonly used turbine oil or the like, which is circulated with cooling.

[0023] In the vertical muffle-type heat treating furnace of Embodiment 1, a ring-like cooling wall 35 of water cooling system is provided on an inside circumferential side with respect to the cylindrical closing member 34, the wall extending downwardly from the flange 33 attached to the lower end of the muffle 11. The cooling wall serves the purpose of preventing the water-free fluid 31 from evaporating due to a raised temperature of the aforesaid muffle elongation adjusting zone 30. Furthermore, an inside circumferential portion constituting the aforesaid container 32 is also formed of a similar cooling wall 32a of water cooling system.

[0024] According to the vertical muffle-type heat treating furnace of Embodiment 1, when the metal strips 2 are heated via the muffle 11 by the heating zone 12 while being moved through the muffle 11 from the upper side to the lower side thereof as described above, the muffle 11 is elongated downwardly thus moving the closing member 34 attached to the lower end of the muffle 11 downwardly in the fluid 31 contained in the container 32. Thus, the elongation of the muffle 11 is accommodated by the muffle elongation adjusting zone 30, so that the muffle 11 is prevented from buckling. When the muffle 11 is elongated downwardly, as described above, the closing member 34 attached to the lower end of the muffle 11 is merely moved downward in the fluid 31 contained in the container 32. Hence, the space between the lower end of the muffle 11 and the cooling zone 20 is maintained in the sealed state, so that the heated metal strips 2 are prevented from being oxidized as exposed to the outside air or the like.

[0025] In addition, the vertical muffle-type heat treating furnace of Embodiment 1 is adapted to suppress the temperature rise of the muffle elongation adjusting zone 30 in the aforementioned manner and hence, the evaporation of the water-free fluid 31 is prevented. It is thus ensured that the furnace is operated in a stable manner

over an extended period of time.

(Embodiment 2)

[0026] A vertical muffle-type heat treating furnace of Embodiment 2 is arranged the same way as the vertical muffle-type heat treating furnace of Embodiment 1, except that the extendable muffle elongation adjusting zone 30 for sealing the space between the muffle 11 and the cooling zone 20 differs from that of the vertical muffle-type heat treating furnace of Embodiment 1.

[0027] In the vertical muffle-type heat treating furnace of Embodiment 2, a heat-resistant connecting member 36 formed of an extendable bellows, as the aforesaid muffle elongation adjusting zone 30, is provided between the lower end of the muffle 11 and the cooling zone 20, as shown in Fig. 3. The space between the lower end of the muffle 11 and the cooling zone 20 is maintained in the sealed state by means of the connecting member 36.

[0028] In the vertical muffle-type heat treating furnace of Embodiment 2, as well, a ring-like cooling wall 37 of water cooling system is provided on an inside circumferential side with respect to the connecting member 36 as extended upwardly from the cooling zone 20, whereas the ring-like cooling wall 35 of water cooling system is disposed on an inside circumferential side with respect to the cooling wall 37 as extended downwardly from the flange 33 attached to the lower end of the muffle 11. The cooling walls serve the purpose of preventing the deterioration of the heat-resistant connecting member 36 due to the raised temperature of the muffle elongation adjusting zone 30.

[0029] According to the vertical muffle-type heat treating furnace of Embodiment 2, when the metal strips 2 are heated via the muffle 11 by the heating zone 12 while being moved through the muffle 11 from the upper side to the lower side thereof as described above, the muffle 11 is elongated downwardly thereby contracting the heat-resistant connecting member 36. Thus, the elongation of the muffle 11 is accommodated by the muffle elongation adjusting zone 30, so that the muffle 11 is prevented from buckling. Furthermore, the space between the lower end of the muffle 11 and the cooling zone 20 is maintained in the sealed state by the heat-resistant connecting member 35, so that the heated metal strips 2 are prevented from being oxidized as exposed to the outside air or the like.

INDUSRIAL APPLICABILITY

[0030] According to the invention as described above, the vertical muffle-type heat treating furnace including: the vertically disposed muffle allowing the metal strips to be led therein from the upper side to the lower side thereof; the heating zone for heating, from the outside of the muffle, the metal strips passed through the muffle; and the cooling zone disposed at place downstream

from the muffle with respect to the moving direction of the metal strips and serving to cool the heated metal strips, has the arrangement wherein the upper end of the muffle is fixed to place. Therefore, the muffle is elongated downwardly when the metal strips within the muffle are heated by the heating zone while being passed through the muffle from the upper side to the lower side thereof. In contrast to the case where the lower end of the muffle is fixed to place, the furnace of the invention does not encounter the buckling of the muffle.

[0031] In addition, the vertical muffle-type heat treating furnace according to the invention is provided with the muffle elongation adjusting zone which is free to extend or contract and maintains the space between the lower end of the muffle and the cooling zone in the sealed state. When the muffle is elongated downwardly, therefore, the elongation of the muffle is readily accommodated by the above muffle elongation adjusting zone, which also prevents the flammable gas containing hydrogen gas in the muffle from leaking outside. In addition, it is ensured that the heated metal strips are prevented from being oxidized as exposed to the outside air or the like.

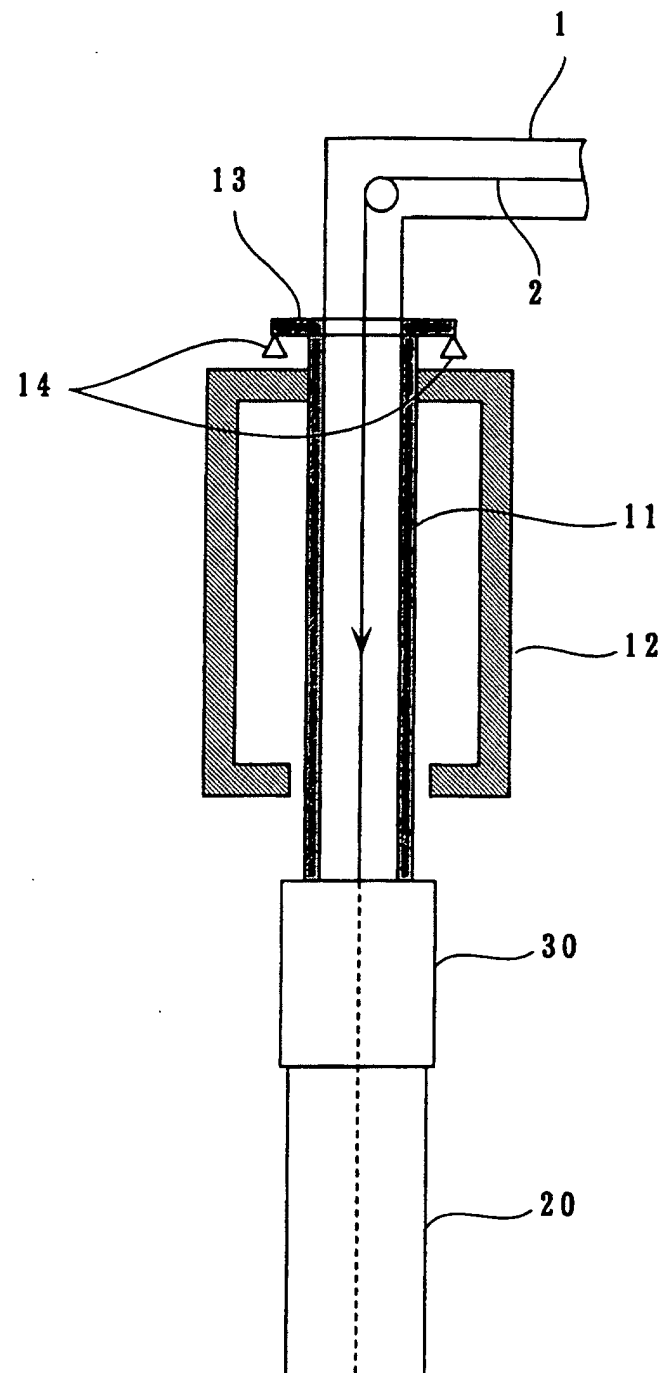
zone.

4. A vertical muffle-type heat treating furnace as claimed in any one of Claims 1 to 3, further comprising a cooling device for cooling said muffle elongation adjusting zone.
5. A vertical muffle-type heat treating furnace as claimed in any one of Claims 1 to 4, further comprising a heat insulating member for preventing said muffle elongation adjusting zone from being heated.

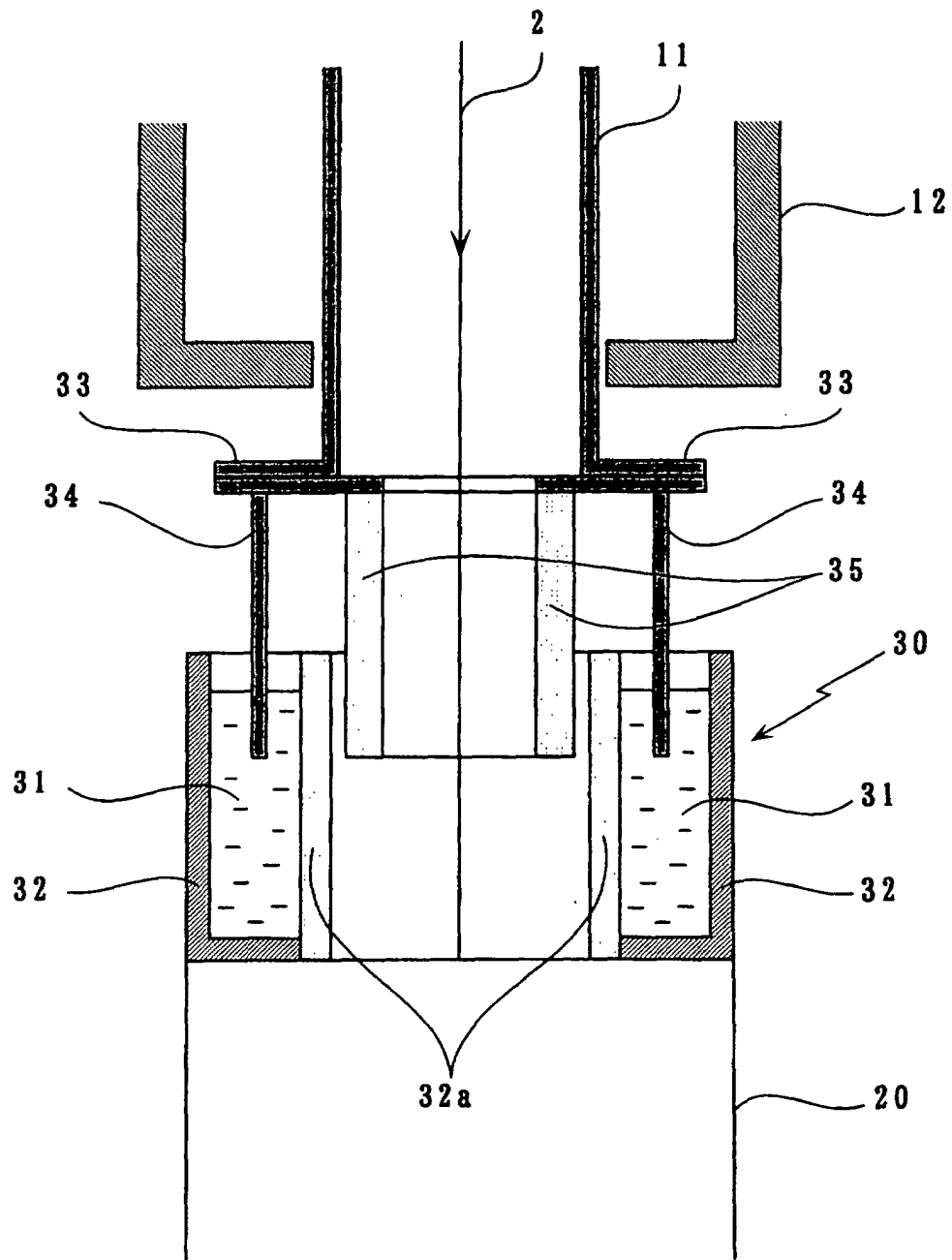
Claims

1. A vertical muffle-type heat treating furnace comprising: a vertically disposed muffle allowing metal strips to be led therein from an upper side to a lower side thereof; a heating zone for heating, from the outside of the muffle, the metal strips passed through the muffle; and a cooling zone disposed at place downstream from said muffle with respect to a moving direction of the metal strips and serving to cool said heated metal strips, wherein said muffle has its upper end fixed to place and wherein an extendable muffle elongation adjusting zone is provided which maintains a space between a lower end of the muffle and the cooling zone in a sealed state.
2. A vertical muffle-type heat treating furnace as claimed in Claim 1, wherein said muffle elongation adjusting zone includes: a ring-like container having a predetermined depth for containing therein a water-free fluid and disposed on said cooling zone; and a cylindrical closing member disposed at the lower end of said muffle as extended downwardly therefrom, the closing member inserted in the fluid contained in said container thereby maintaining the space between the lower end of said muffle and said cooling zone in the sealed state.
3. A vertical muffle-type heat treating furnace as claimed in Claim 1, wherein said muffle elongation adjusting zone is a heat-resistant connecting member comprising an extendable bellows disposed between the lower end of said muffle and said cooling

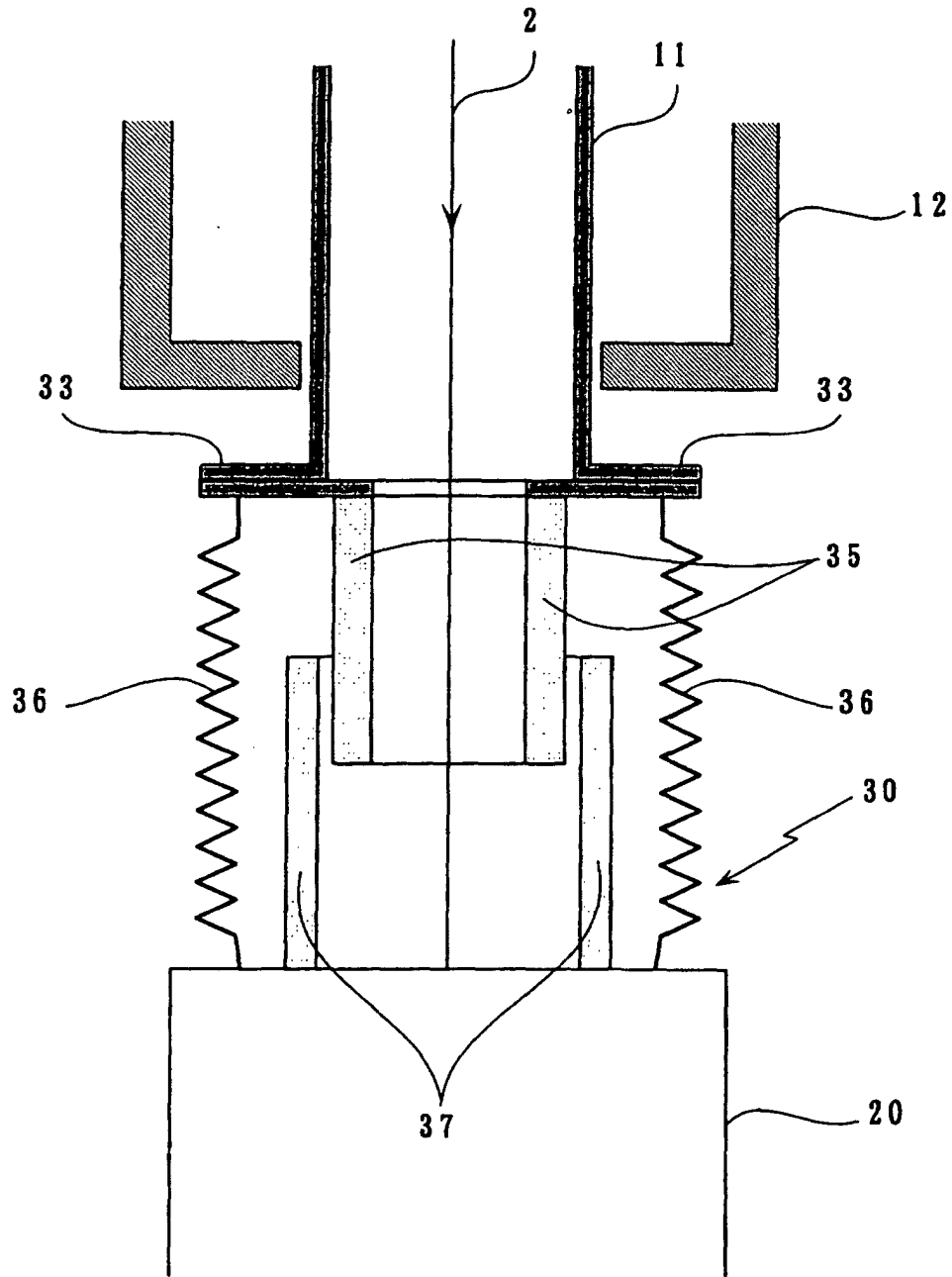
F i g . 1



F i g . 2



F i g . 3



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP03/01996

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl ⁷ C21D9/56, 1/00, F27B5/04, 5/10		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) Int.Cl ⁷ C21D9/56, 1/00, F27B5/04, 5/10		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-2003 Kokai Jitsuyo Shinan Koho 1971-2003 Jitsuyo Shinan Toroku Koho 1996-2003		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) WPI		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2000-28269 A (Chugai Ro Co., Ltd.),	1, 3
Y	28 January, 2000 (28.01.00), Full text; Fig. 1 (Family: none)	2, 4, 5
Y	JP 58-56861 U (Kawasaki Steel Corp.), 18 April, 1983 (18.04.83), Claims; Fig. 3 (Family: none)	2
Y	JP 02-21757 Y2 (Chugai Ro Co., Ltd.), 12 June, 1990 (12.06.90), Claims (Family: none)	4
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 10 April, 2003 (10.04.03)		Date of mailing of the international search report 30 April, 2003 (30.04.03)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP03/01996

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 01/92800 A1 (Matsushita Electric Industrial Co., Ltd.), 06 December, 2001 (06.12.01), Claims & JP 2002-90067 A	5
A	EP 0675208 A1 (CHUGAI RO CO.), 18 August, 1994 (18.08.94), Full text & DE 69416823 C & JP 07-268493 A & CN 1112607 A & US 5588828 A1 & AT 177157 T & ES 2130316 T	1-5
A	JP 2753854 B2 (Nisshin Steel Co., Ltd.), 20 May, 1998 (20.05.98), Full text (Family: none)	1-5
A	JP 63-119657 U (Kobe Steel, Ltd.), 02 August, 1988 (02.08.88), Claims (Family: none)	2,5

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