

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

DECLARATION IN SUPPORT OF CONVENTION OR NON-CONVENTION APPLICATION FOR A PATENT

In support of the Application made for a patent for an invention entitled: "HEATING ELEMENT"

Insert title of invention.

Insert full name(s) and address(es) of Declarant(s) being the applicant(s) or person(s) authorized to sign on behalf of an applicant company.

I, Hiroshi SAITO, c/o NIPPON STEEL CORPORATION, of 6-3, Ohtemachi-2-chome, Chiyoda-ku, Tokyo, Japan,

Cross out whichever of paragraphs 1(a) or 1(b) does not apply.

1(a) relates to application made by individual(s).

1(b) relates to application made by company; insert name of applicant company.

do solemnly and sincerely declare as follows :-

1. I am the applicant for the patent

or (b) I am authorized by NIPPON STEEL CORPORATION, one of

Cross out whichever of paragraphs 2(a) or 2(b) does not apply.

2(a) relates to application made by inventor(s)

2(b) relates to application made by company(s) or person(s) who are not inventor(s); insert full name(s) and address(es) of inventor.

the applicant, S..... for the patent to make this declaration on its behalf.

2. (a) I am the actual inventor of the invention

or (b)

Ryoichi SUZUKI, c/o Daiichi Gijutsu Kenkyusho of NIPPON STEEL CORPORATION, of 1618, Ida Nakahara-Ku, Kawasaki-Shi, KANAGAWA 211 JAPAN.

Hiroyuki KONDO, - DITTO -
Susumu MIZUNUMA, - DITTO -

I am the actual inventor...S..... of the invention and the facts upon which the applicant, S..... are entitled to make the application are as follows :-

State manner in which applicant(s) derive title from inventor(s)

The applicants are the assignees of the invention from the inventors.

Cross out paragraphs 3 and 4 for non-convention applications. For convention applications insert basic country(s) followed by date(s) and basic applicant(s).

3. The basic application, S..... as defined by Section 141 of the Act were made in Japan on the March 18, 1988 by NIPPON STEEL CORPORATION in Japan on the May 17, 1988 by NIPPON STEEL CORPORATION in on the by

4. The basic application, S..... referred to in paragraph 3 of this Declaration were the first application, S..... made in a Convention country in respect of the invention the subject of the application.

Insert place and date of signature.

Declared at Tokyo, Japan this 11th day of October, 1989.

Signature of Declarant(s) (no attestation required).

NIPPON STEEL CORPORATION

Hiroshi SAITO, Representative Director

DAVIES & COLLISON, MELBOURNE and CANBERRA.

Note: Initial all alterations.

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HEATING ELEMENT

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(57) Claim

1. A heating device comprising a heat generating portion, a firing portion and an igniting portion;
the heat generating portion composed of a mixture of at least one of ferric oxide, cupric oxide and trilead tetraoxide powder, and a powder of silicon and/or silicon-iron alloy,
the firing portion disposed contiguous to said heat generating portion and composed of a mixture of boron and/or aluminium powder and at least one of ferric oxide, cupric oxide, barium peroxide and strontium peroxide powder,
and the igniting portion situated adjacent to said firing portion and being adapted to generate frictional heat to set off said firing portion.

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COMMONWEALTH OF AUSTRALIA
PATENTS ACT 1952
COMPLETE SPECIFICATION

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This document contains the
amendments made under
Section 49 and is correct for
printing.

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COMPLETE SPECIFICATION FOR THE INVENTION ENTITLED:

Heating element

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

1 TECHNICAL FIELD

This invention relates to a heating device for quickly heating liquids such as water, oil, etc., and solid matters. More particularly the invention pertains
5 to a heating element which is capable of effecting quick heating with no need of using generally used heating means such as electrical means, combustible gases and solid fuels.

BACKGROUND ART

10 Electricity, combustible gases, and liquid and solid fuels comprising hydrocarbons are generally used as heating means for heating liquids and solid materials. As a specific heating technique, hydration reactions of calcium oxide, calcium chloride, aluminum
15 or the like are utilized for generating heat (see Japanese Utility Model Application Kokai (Laid-Open) Nos. 60-70235, 61-89332, 62-93654, etc.).

Lately, as a more specific heating medium, there has been proposed a heating device comprising a
20 mixture of red lead oxide powder and silicon powder packed into an elongated tube, such as adopted in a portable boiler-warmer disclosed in Japanese Patent Application Kokai (Laid-Open) No. 52-19358.

1 Commonly used electricity and combustible
gases are very convenient for indoor use, but their
outdoor utilization involves many inconveniences. On
the other hand, liquid and solid fuels using
5 hydrocarbons are poor in portability since the equipment
needs to be enlarged for accelerating the heating speed.
Also, difficulties are involved in their outdoor use in
a rainy or windy days.

 The heating element utilizing heat generation
10 by a hydration reaction of calcium oxide, calcium
chloride or aluminum is suited for outdoor use, but it
has the drawbacks that the heating speed is relatively
slow and that the amount of heat obtainable per unit
volume of the calorific agent is very low.

15 The portable boiler-warmer making use of a
calorific agent comprising a mixture of red lead oxide
powder and silica powder packed into an elongated tube
(Japanese Pat. Application Kokai No. 52-19358) is fit
for either indoor or outdoor use for boiling of water or
20 oil and heat retention. In the case of this device,
however, it is unavoidable that the whole casing is
relatively enlarged in size. Also, its use is limited
to some specific heating purposes, and further the
structure of the container is complicated. In addition,
25 the calorific agent itself has the problems of involving
troublesomeness in packing it into an elongated tube and
the concomitant high production cost. Also, due to the
nature of the calorific agent, it needs to apply heating

for a while by an electric heater or a lighter for effecting ignition. Thus, a large amount of heat is needed for igniting the calorific agent, which means poor ignitability of the agent.

5

DISCLOSURE OF THE INVENTION

As a result of many experiments and studies on the heaters in which a large amount of heat can be generated by a calorific agent and which is easy to handle and low in cost, the present inventors have succeeded in developing in accordance with the invention a heating device comprising a heat generating portion, a firing portion and an igniting portion;

10 the heat generating portion composed of a mixture of at least one of ferric oxide, cupric oxide and trilead tetraoxide powder, and a powder of silicon and/or silicon-iron alloy,

15 the firing portion disposed contiguous to said heat generating portion and composed of a mixture of boron and/or aluminium powder and at least one of ferric oxide, cupric oxide, barium peroxide and strontium peroxide powder,

20 and the igniting portion situated adjacent to said firing portion and being adapted to generate frictional heat to set off said firing portion.

25 Further according to the present invention there is provided a container having a heating function in which a heating device as described in the immediately preceding paragraph is disposed at the bottom, side or periphery of a casing having a section for receiving the object to be heated. Furthermore, an instantaneous heater having said heating device disposed in a metallic casing, which may or may not be the casing described immediately above, may have a small hole formed at a part of its wall so that
30 ignition can be effected by an operation from the outside of the casing through said small hole.
35



The heating device according to this invention comprises a heat generating portion composed of materials which, although relatively hard to ignite, may be low in cost, high in safety and capable of generating a
5 sufficient amount of heat, a firing portion situated contiguous to said heat generating portion which may be capable of easily taking fire and of instantaneously causing said heat generating portion to generate heat and to perform heating, and an igniting portion disposed
10 adjacent to said firing portion and capable of igniting said firing portion by generating frictional heat, for example sparks from a flint. This heating device may be capable of generating a large amount of heat in a short time. The generated heat is conveniently quickly and
15 efficiently transmitted through the wall surface of a heat-conductive metallic casing, a plate, wire gauze or the like to the object to be heated, so that said object can be heated in a very short time with a minimum of heat loss.

20 This heating device, in practical use thereof, is properly varied in the amounts of its constituents and in its general configuration in conformity to the purpose of use, the place of use, kind of the object to be heated, etc. Typical examples of the object to be heated are the
25 liquids such as water, oil, etc., and foods (such as Chinese vermicelli, soup, etc.).

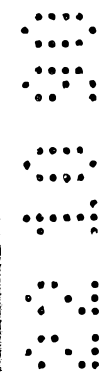
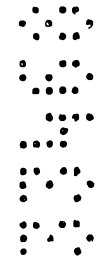
As for the form of the casing in which said heating device may be disposed, it may be basically of an
30 encapsulating type, bottom-setting type, peripheral heating type, indirect heating type, plate heating type, or other like types. The heat generating portion of the heating device may be rectangular parallelepipedal, prismatic, disc-shaped, thin plate-shaped or hollow
35 cylindrical, with the firing portion integrally molded contiguous to said heat generating portion.

In the instantaneous heater according to the present



invention, the small hole formed in the wall of the metallic casing serves for guiding to the outside a fine wire or stick used for operating the igniting portion and also functions as a gas outlet for arresting the rise of
5 pressure in said casing after enkindling. In case the object to be heated is a liquid and the metallic casing is directly immersed in the liquid, said small hole may be defined by a fine tube designed to prevent the liquid from flowing into said casing. Practically, one or two
10 of such small hole or fine tube is provided.

In case a solid object is heated by the present heater or in case the object to be heated is a liquid but it won't flow into the casing, the present heater having said small hole or holes is used in close



1 attachment to the object to be heated. In this case,
both heater and object to be heated are preferably
covered with a heat insulator except for the area of
close attachment where heat transfer is effected, since
5 such covering minimizes heat loss and improves heating
efficiency.

On the other hand, in case the present heater
is used for heating a liquid such as water or oil with
the heater immersed in the liquid, a fine tube or tubes
10 are provided to the heater for preventing the liquid
(object to be heated) from flowing into the metallic
casing of the heater. In this case, paper, glass,
metal, porcelain or synthetic resin is used for the
casing in which the object to be heated is placed, and
15 the igniting portion is caused to ignite by giving
friction effected by an operation from the outside of
the container, such as pulling, pushing or turning of a
fine wire or the like emerging from an end of the fine
tube. This ignition causes the firing portion to take
20 fire, followed by instantaneous heat generation by the
heat generating portion, thus allowing generation of a
large volume of heat in an extremely short time. Said
igniting portion is caused to ignite by means of
friction. More specifically, such ignition is effected
25 by letting the priming agent to ignite by frictional
heat or by rubbing the flint to generate sparks.

Since the generated heat is quickly and
efficiently transferred to the object to be heated

through the wall face of the well heat-conductive metallic casing the object can be heated in a very short time with a minimum of heat loss.

5 The small hole or fine tube is only required to be one through which a fine wire or the like can be taken out as described above and which is capable of releasing gases from the inside of the heater. As for the form of such a hole or tube, it may be circular or columnar with a diameter of about 1 to 10 mm or may take other suitable
10 forms such as triangular, square, prismatic, etc.

BRIEF DESCRIPTION OF THE DRAWINGS

Various embodiments of heating device and/or instantaneous heater according to the invention will now
15 be described by way of example only with reference to the accompanying drawings, in which:

Figures 1, 2 and 3 show the basic structures of respective embodiments of the heating device;

20 Figures 4 to 8 show respective embodiments of casing with heating function adapted for use with the heating devices of Figures 1 to 3;

Figures 9 to 12 are schematic illustrations of embodiments of the instantaneous heater; and

25 Figure 13 is a front view of a part 4B of the heater of Figure 12.

BEST MODE OF CARRYING OUT THE INVENTION

The invention will be described more particularly below with reference to the accompanying



1 drawings.

FIG. 1 shows a disc type heating device, FIG. 2 shows a bottomed hollow cylindrical type heating device, and FIG. 3 shows a thin plate type heating device.

5 Needless to say, the heating device according to this invention is not limited to the types shown in the drawings but may take various other forms such as prismatic, rectangular parallelepipedal, etc., as desired.

The heating device shown in FIG. 1 comprises a
10 disc-shaped heat generating portion 1, a firing portion 2 press molded integrally so that it is in contact with a part of the top face of said heat generating portion 1, and an igniting portion 3 disposed in adjacency to said firing portion 2. The combination of said heat
15 generating portion 1 and firing portion 2 may not necessarily be of a structure in which the firing portion 2 is embedded in a part of the heat generating portion 1; the firing portion may be molded separately and disposed in contact with the top face, bottom face or side face
20 of the heat generating portion 1. The mode of contact may be properly selected to suit the situation. The igniting portion 3 needs to be positioned adjacent to said firing portion 2 within a range of distance where the firing portion 2 can be infallibly fired by the
25 ignition of the igniting portion 3.

The heating device shown in FIG. 2 consists of a bottomed generating hollow cylindrical heat generating portion 1A, a firing portion 2A generating attached to a

1 part of the bottom face of said heat generating portion
1A by bonding or coating, and an igniting portion 3A
situated in close adjacency to said firing portion 2A.
This heating device, when formed with powder of a
5 desired calorific agent, can hardly retain shape because
of its small thickness so that ~~in accordance with this~~
~~invention~~, a casing 4 molded from a thin plate of a
metal such as iron is used as reinforcement, and a
pulverized calorific agent suspended in a solvent (such
10 as water, alcohol, resin, etc.) is coated to a predeter-
mined thickness on the external surface of said casing,
followed by drying. Press molding is another method
available for producing the heating device. ~~of this~~
~~invention.~~

15 The heating device shown in FIG. 3 is of a
thin plate type, consisting of a thin plate-formed heat
generating portion 1B, a firing portion 2B provided
continuous to said heat generating portion, and an
igniting portion 3B situated in close adjacency to said
20 firing portion. Said thin plate-like heat generating
portion 1B can be made by coating powder of a calori-
genic agent kneaded with a solvent such as alcohol,
water, etc., on one or both sides of an iron plate 5
(which may be, for instance, a 0.1 mm thick flat tin-
25 plate sheet, or a plate with a high degree of surface
roughness, a plate with unevenness on the surface, or a
plate having a large number of pores, for increasing the
bonding strength) and then drying the coat, or by



1 placing powder of a calorigenic agent (afforded with a
certain degree of fluidity) on said plate and pressing
them into a thin plate. This provides the heating
device with sufficient solidity even though it is a thin
5 plate.

The heat generating portion (1, 1A, 1B) con-
stituting a part of the heating device is composed of a
mixture of powder of at least one of ferric oxide,
cupric oxide and trilead tetroxide and powder of silicon
10 and/or silicon-iron alloy, which is greater in heat of
formation of oxide than the metals forming said oxides.
The powder of silicon and/or silicon-iron alloy gener-
ates a large volume of heat of formation when it is
oxidized by depriving the oxide of oxygen.

15 The firing portion (2, 2A, 2B) is provided for
facilitating firing of the heat generating portion which
requires a large amount of heat and relatively hard to
fire. This portion is made from a mixture of boron
and/or aluminum powder and at least one of ferric oxide,
20 cupric oxide, barium peroxide and strontium peroxide.
At this firing portion which, though requiring a high
temperature, is easily fired with a small quantity of
heat, a large volume of heat of formation is generated
when boron and/or aluminum is oxidized with said compound
25 (ferric oxide, cupric oxide, barium peroxide, etc.), so
that this firing portion provided contiguous to the heat
generating portion assures infallible firing of the heat
generating portion. In case the heating element is used

1 in a powdery form, the firing agent is made from
aluminum, preferable with a small amount of boron as
needed, and barium peroxide and strontium peroxide. In
case the heating device is used in a solid form, the
5 firing agent is made from boron, preferably with a small
amount of aluminum as needed, and ferric oxide and/or
cupric oxide.

The igniting portion (3, 3A, 3B) is easily
ignited by friction. This portion is so designed that
10 it may be ignited by the heat of friction or by the
sparks generated by rubbing a flint. Ignition of the
igniting portion proceeds through the firing portion to
the heat generating portion to let it fire very easily
to generate heat. In other words, the igniting portion
15 and firing portion combines to enable quick and easy
firing and calorification of the heat generating
portion. For constituting such an igniting portion, an
igniting agent made of a mixture of at least one kind of
combustible substance such as red phosphorus, sulfur,
20 arsenic sulfide, phosphorus sulfide, etc., and an
oxidizing agent such as potassium chlorate, potassium
perchlorate, potassium nitrate, etc., is spread on a
sheet of thin paper (such as Japanese paper) having a
width of about 5 to 20 mm and coiled around a fine
25 metallic wire or string several turns so that the
igniting agent will be entwisted into the contacting
sections of said fine wire and thin paper. The igniting
portion is properly fixed to the casing by a suitable

1 fixing tube or other means. The fine wire or string is
pulled, pushed or turned so as to generate frictional
heat at its parts contacted with the paper, thereby
causing ignition of the igniting agent made of said
5 mixture. The igniting portion may comprise a spark
generating mechanism constituted with a flint (REM, Fe
or Mg alloy, etc.) and a hard substance such as iron,
which is further described later.

Since the materials used for said heat
10 generating portion (1, 1A, 1B) and firing portion (2,
2A, 2B) are originally powdery, they are blended at the
compositions mentioned before, then added and kneaded
with a proper binder and/or other additives, and press
molded into a desired form such as block, plate,
15 cylinder, etc., or the mixture is packed into a
container made of iron or stainless steel.

The modes of practical use of said heating
device set in the casing having a heating function are
shown in FIGS. 4 to 8.

20 FIG. 4 illustrates a mode of use in which a
heater constituted by packing a heating device of this
invention in a casing 11 is placed in a container having
a housing portion of the object to be heated (liquids
such as water, oil, etc., or solid materials) and
25 operated to generate heat. A heating device of the form
shown in FIG. 1 is packed into a casing 11 provided with
a fine tube 12, and a fine wire 13 extending from the
igniting portion 3 is passed outside through said fine

1 tube 12. A heater incorporated with such heating device
is set in a container 14. Then a liquid to be heated 15
is put into said container 14, and the fine wire 13 is
pulled to let the igniting portion 3 ignite, causing the
5 firing portion 2 and heat generating portion 1 to fire
successively to generate heat, thus heating the liquid
15 through the packed casing 11. The casing may be
composed to be disposable so that it is thrown away
after one time use, or said casing may be designed to be
10 an opening and closing type so that the used heating
device therein may be replaced with new one.

FIG. 5 illustrates a casing of the type in
which the heating device is set at the bottom of the
casing. In this type, the casing 14 having a section
15 for receiving the object to be heated is separately
provided with a heating device housing portion at the
bottom. The heating device used here is of the type
shown in FIG. 1. At a side close to the bottom of the
casing 14 is provided a small hole 17 intended to allow
20 operation for the igniting portion from the outside. A
fine wire 13 passed outside through said small hole 17
is pulled, pushed or turned to cause successive firing
of the igniting portion 3, firing portion 2 and heat
generating portion 1 to generate heat by which to heat
25 the object 15. In this mode of use, too, the casing may
be composed to be either disposable or usable
repeatedly. Numeral 19 in the drawing denotes an
insulator.

1 FIG. 6 illustrates a peripheral heating type
which is suited for effecting uniform heating of the
object to be heated. In this mode of use, a heating
device shown in FIG. 2 is used. A can 4 in the inside
5 and the heat generating portion 1A are encompassed by an
insulated casing 20, and a firing portion 2A is provided
at the bottom of the heat generating portion. Situated
in close adjacency to said firing portion is an igniting
portion 3A constituted by providing an igniting agent
10 and a sheet of thin paper at the end of a metallic wire
held by a metallic or plastic fixing ring 21. The rear
end of the metallic wire is extended outside of the
casing and attached with a pull 22. The operator grips
and pulls it to cause ignition by friction, letting the
15 firing portion 2A and heat generating portion 1A fire to
generate heat. Numeral 23 designates a cover.

 FIG. 7 shows an indirect heating type. This
mode of use of the invention is suited when the object
to be heated is a solid materials (for example, a lunch
20 box) and it is desired to avoid any scorching. As shown
in the drawing, a heat insulating layer 25 is provided
at the bottom of a covered casing 24 in which the sub-
stance to be heated is contained, and a heating device
of this invention is disposed beneath said insulating
25 layer 25. The heating device used here is of the same
type as shown in FIG. 1. The heating portion 1 is held
by a holder 26 made from a metallic plate, metallic
wire, ceramic or the like and so arranged that said

1 portion will make point or line contact with the bottom
of the casing so as to minimize heat transfer. The
mechanisms of the firing portion 2 and igniting portion
3 and their interrelation are the same as those of the
5 heating device shown in FIG. 6. The insulating layer 25
is so designed that the object to be heated is directly
placed thereon. It is constituted by a heat insulating
material such as steel wool, honeycomb structure insu-
lator, mica, ceramic powder, etc., and a pneumatic
10 structure layer. The surface temperature of the
insulating layer is adjusted by the type of the
insulating material used and the thickness of the layer.

FIG. 8 illustrates a flat plate heating type
which is suited for heating an object having a relative-
15 ly wide area such as lunch box. In this type, a thin
plate-like heat generating portion 1B shown in FIG. 3 is
disposed beneath the bottom plate of a covered shallow
casing 27 having a section for receiving the object to
be heated, and a firing portion 2B is provided con-
20 tiguous to said heat generating portion and an igniting
portion 3B in close proximity to said firing portion.
The igniting portion 3B is the same in structure as
those shown in FIGS. 6 and 7. As this igniting portion
is ignited, the heat generating portion 1B is energized
25 to generate heat to heat an iron plate 28 of the casing,
which then heats the object to be heated which is placed
on said iron plate.

FIGS. 9 to 12 show ~~the~~ various embodiments of



1 instantaneous heater according to this invention.

In a circular or square-shaped metallic casing 11 are packed a heat generating portion 1 and thereon a firing portion 2 which is easier to fire than the calorific agent, and an igniting portion 3 is provided adjacent to said firing portion. A fine metallic wire or filament 13 is passed outside through a small hole 17 or a fine tube 12, said wire or filament 13 being operated from the outside of the casing 1 to generate a frictional heat by which the igniting portion 3 is ignited.

An end of said fine wire or filament 13 runs into the inside of the igniting portion 3 so that when said wire or filament is pulled, frictional heat is generated in the igniting portion to let it ignite, causing successive firing of the firing portion 2 and heat generating portion 1. In case the fine wire or filament may be short as in the example shown in FIG. 9, said wire or filament may be replaced by a stick-like piece of a hard material, such as pin, which is run into the igniting portion and pulled, pushed or turned to cause firing by friction.

In order to remove the smoke which is produced in a small amount in the heater, a filter 9 made of glass wool, active carbon or the like may be provided in the fine tube as shown in FIG. 11.

FIG. 12 illustrates an embodiment using a flint as igniting means. In this embodiment, there are

1 provided a round bar of flint 4A composed of approxi-
mately 85% of a mixture of rare earth metals (REM) with
the balance consisting essentially of iron and a trace
amount of other material or materials such as Mg, and a
5 hard iron plate 4B in which a jugged hole 4C is formed
with a number of notches 4D being made radially around
said hole. FIG. 13 is a frontal view of the iron plate
4B. A handgrip 4E may be provided on the flint as
desired. The flint is pulled or pushed to generate
10 sparks which ignite the firing portion.

examples in accordance with
Some ~~embedments~~ of the present invention will
be given below.

Example 1

(1) Casing and object to be heated

15 Casing: a casing (80 mm in diameter and 130 mm high)
having the structure shown in FIG. 4.

Object to be heated: water, 500 ml

(2) Heating device

Heat generating portion: composed of a mixture of 70 g
20 of ferric oxide (Fe_2O_3) powder and 30 g of
ferro-silicon (75% silicon and 25% iron)

Firing portion: made of 0.5 g of a firing agent
composed of 15% of aluminum powder, 3% of
boron and the balance accounted for by an
25 oxidizing agent consisting mainly of cupric
oxide and small amounts of barium peroxide and
strontium peroxide.



1 Igniting portion: an igniter made by wrapping 0.01 g of
a mixture of red phosphorus and potassium
chlorate around Japanese paper.

(3) Result

5 By pulling the fine wire extending from the
igniting portion, the firing and heat generating
portions were set off to generate heat, whereby the
temperature of water which was 10°C could be raised to
100°C in four minutes.

10 Example 2

(1) Casing and object to be heated

Casing: a casing (65 mm in diameter and 80 mm high)
having the structure shown in FIG. 5
(thickness of heat insulating layer: 10 mm;
15 thickness of heating device housing section:
20 mm)

Object to be heated: 200 cc of tea

(2) Heating device

Heat generating portion: composed of 40 g of a mixture
20 of 28 g of ferric oxide (Fe_2O_3) powder and 12
g of ferro-silicon (75% silicon and 25% iron)

Firing portion: made of 0.2 g of a calorific agent
comprising 15% of aluminum powder, 3% of boron
and remaining percentage of an oxidizing agent
25 consisting mainly of barium peroxide and
containing small amounts of cupric oxide and
strontium peroxide.

1 Igniting portion: a spark generator consisting of a
flint (REM, Fe or Mg alloy) and hard Fe

(3) Result

By pulling the fine wire lead out from the
5 igniting portion, the firing and heat generating
portions were set off to generate heat, whereby the
temperature of tea could be raised to 100°C in two
minutes.

Example 3

10 (1) Casing and object to be heated

Casing: a casing (170 mm in diameter and 30 mm high)
having the structure shown in FIG. 8
(thickness of heating device housing section:
20 mm; heating device comprising a 0.2 mm
15 tinfoil sheet with a 2 mm thick layer of a
calorific agent laminated on both sides of the
tinfoil sheet)

Object to be heated: 500 g of eel and rice in a lunch
box

20 (2) Heating device

Heat generating portion: composed of 50 g of a mixture
of 35 g of ferric oxide (Fe_2O_3) powder and 15
g of ferrosilicon (75% silicon and 25% iron)
powder

25 Firing portion: made of 0.3 g of a firing agent
comprising 15% of aluminum powder, 3% of boron
and a complement (to 100) of an oxidizing

1 agent composed mainly of cupric oxide and
small amounts of barium peroxide and strontium
peroxide

Igniting portion: an igniter made by wrapping 0.01 g of
5 a mixture of red phosphorus and potassium
chlorate around Japanese paper.

(3) Result

By pulling the fine wire of the igniting
portion, the firing and heat generating portions were
10 set off to generate heat, whereby the lunch could be
warmed to 50°C in five minutes.

Example 4

A heating portion was made from a mixture of
70 g of ferric oxide (Fe_2O_3) and 30 g of ferrosilicon
15 (75% silicon and 25% iron) powder. Overlaid on said
heat generating portion was a firing portion (0.5 g)
composed of 15% of aluminum powder, 3% of boron and a
complement of an oxidizing agent composed mainly of
barium peroxide and containing small amounts of cupric
20 oxide and strontium peroxide. Further, an igniting
portion was made by wrapping 0.01 g of a mixture of red
phosphorus and potassium chlorate around a sheet of
Japanese paper, and said portions were set in an iron-
made casing as shown in FIG. 10 to fabricate a heater.

25 This heater was placed in a glass container
containing 500 ml of water, and the calorific agent was
ignited by pulling the fine wire 13. By this, the

1 temperature of water which was 10°C could be raised to
100°C in one minute.

Example 5

A heat generating portion was constituted from
5 a mixture of 79.2 g of ferric oxide (Fe_2O_3) powder and
20.8 g of silicon powder, and above said heating portion
was overlaid 0.5 g of a firing agent comprising 15% of
aluminum powder, 3% of boron and a complementing
percentage of an oxidizing agent composed mainly of
10 barium peroxide and containing small amounts of cupric
oxide and strontium peroxide. These were press molded
into pellets measuring 50 mm in diameter and about 15 mm
in thickness. Further, an igniting portion was formed
by wrapping 0.02 g of red phosphorus and potassium
15 chlorate around a sheet of Japanese paper. An assembly
of said heating, firing and igniting portions was set in
an iron-made casing as shown in FIG. 11 to fabricate a
heater.

This heater was placed in a glass container
20 containing 600 ml of water, and the calorific agent was
ignited by pulling the wire 13. A filter made of a 0.2
g glass wool - 0.5 g active carbon - 0.2 g glass wool
lamine was provided in the fine tube. There was
observed no smoke from the fine tube, and 10°C water
25 could be heated to 100°C in about one minute.

1 Example 6

The pellets of the same kinds and same amounts of calorific agent and firing agent as used in Example 5 and an igniting portion also similar to the one used in
5 Example 5 were set in an iron-made casing to make a heater. The heater was placed on a 100 mm x 100 mm x 10 mm thick iron plate, and the heating device was fired to heat the iron plate. As a result, the lower part of the iron plate was heated to 300 - 350°C in approximately
10 one minute.

Example 7

Used as calorific agent was a mixture of 70 g of ferric oxide (Fe_2O_3) powder and ferrosilicon (75% silicon and 25% iron) powder. Placed beneath said
15 calorific agent was 1.5 g of of a firing agent consisting of 13% of boron powder and 87% of an oxidizing agent composed mainly of cupric oxide. These compounds were press molded into pellets. These pellets and an igniter using a flint shown in FIGS. 12 and 13 were set in an
20 iron-made casing as shown in FIG. 12 to fabricate a heater.

This heater was placed in a glass container holding 500 ml of water, and the flint was pressed in to cause ignition and heat generation. As it turned out,
25 10°C water could be heated to 90°C in three minutes.

1 Example 8

(1) Casing and object to be heated

Casing: a casing (84 mm in diameter and 150 mm high)
having the structure shown in FIG. 5, with an
5 igniter shown in FIG. 12 being secured to the
back side of the top can cover with an
adhesive tape

Object to be heated: 65 g of instant noodle (Chinese
vermicelli) with 10 g of soup and ingredients
10 and 310 ml of water

(2) Heating device

Heat generating portion: made from a mixture of 56 g of
ferric oxide (Fe_2O_3) powder and 24 g of ferro-
silicon (80 wt% silicon and 20 wt% iron)
15 powder

Firing portion: made from 1.2 g of powder comprising
12% by weight of boron and 85% by weight of
ferric oxide

Igniting portion: hard steel plate shown in FIG. 13

20 (3) Heat insulating material: silica-alumina fiber in
the area closely adjacent (about 5 mm in
thickness) to the heating element and glass
wool (about 20 mm in thickness) in the area
therebelow

25 (4) Result

The top cover of the can was opened to take
out the igniter 4A, 4E, and after pouring water, the
igniter was inserted from a side of the can bottom to

1 cause ignition and consequent firing of the firing
portion and heat generating portion. As a result, the
temperature of the object to be heated could be raised
to 100°C in approximately 3 minutes. The instant noodle
5 thus restored to its edible state was better in shape
and taste than the one prepared by pouring hot water as
ordinarily done.

As described above, the heating device ~~accord-~~
^{comprises}
~~ing to this invention consists of~~ a heat generating
10 portion which is relatively hard to fire, low in combus-
tion temperature, high in safety and low in cost, a
small amount of a firing agent (constituting a firing
portion) which is although relatively high in cost, and
a simple igniting portion for firing said firing por-
15 tion, so that it is possible with this heating device to
heat an object to be heated in a very short time and at
low cost. Therefore, by making use of this heating
element, there can be provided a small-sized portable
heating equipment.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A heating device comprising a heat generating portion, a firing portion and an igniting portion;
the heat generating portion composed of a mixture of at least one of ferric oxide, cupric oxide and trilead tetraoxide powder, and a powder of silicon and/or silicon-iron alloy,

the firing portion disposed contiguous to said heat generating portion and composed of a mixture of boron and/or aluminium powder and at least one of ferric oxide, cupric oxide, barium peroxide and strontium peroxide powder,

and the igniting portion situated adjacent to said firing portion and being adapted to generate frictional heat to set off said firing portion.

2. The heating device according to claim 1, wherein the heat generating portion is rectangular parallelepipedal, prismatic, disc-shaped, thin plate-shaped or hollow cylindrical, with the firing portion integrally molded contiguous to said heat generating portion.

3. The heating device according to claim 1 or claim 2 wherein the igniting portion is adapted to generate frictional sparks from a flint.

4. A heating device substantially as herein described with reference to the examples and/or drawings.

5. A container having a heating function in which a heating device as set forth in any one of claims 1 to 4 is disposed at the bottom, side or periphery of a casing having a section for receiving the object to be heated.

6. An instantaneous heater of a structure in which a



heating device as set forth in any one of claims 1 to 4 is disposed in a metallic casing and a small hole is formed at a part of the wall of said metallic casing, said small hole being designed to allow performing an igniting operation therethrough from the outside of the casing.

7. An instantaneous heater according to claim 6, wherein the small hole formed at a part of the metallic casing wall is fine tubular.

8. An instantaneous heater according to claim 6 or 7, wherein the heating device is situated at the bottom, a side or periphery of the casing having a section for receiving the object to be heated.

9. An instantaneous heater comprising a heating device and a casing and being substantially as herein described with reference to the accompanying drawings.

DATED this 22nd day of October, 1990.

NIPPON STEEL CORPORATION,
NIPPON FOOD PRODUCTS CO., LTD. and
NITTO SEIKI CO., LTD.

By their Patent Attorneys
DAVIES & COLLISON



FIG. 1

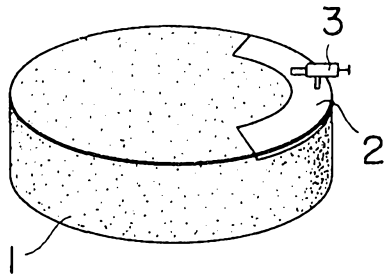


FIG. 2

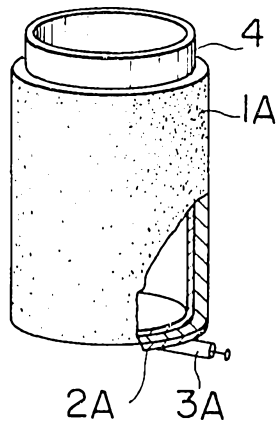


FIG. 3

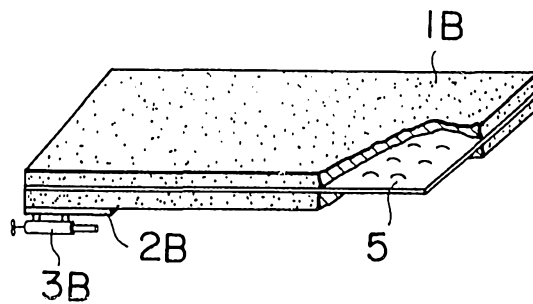


FIG. 4

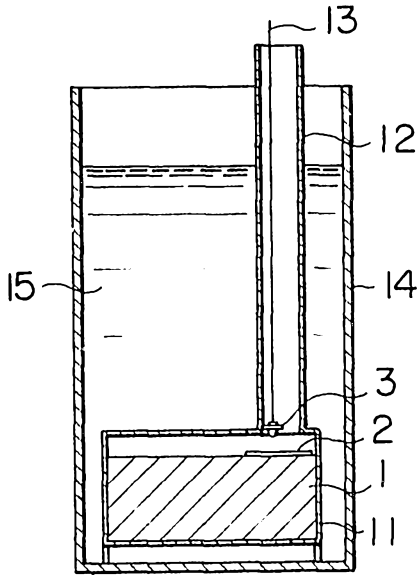


FIG. 5

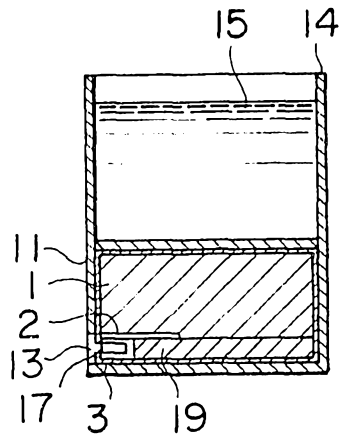


FIG. 6

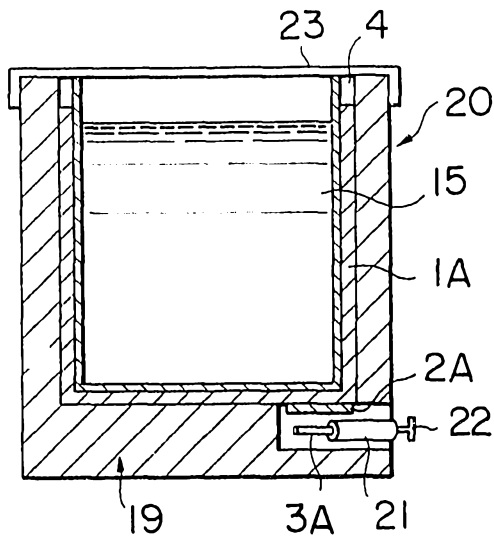


FIG. 7

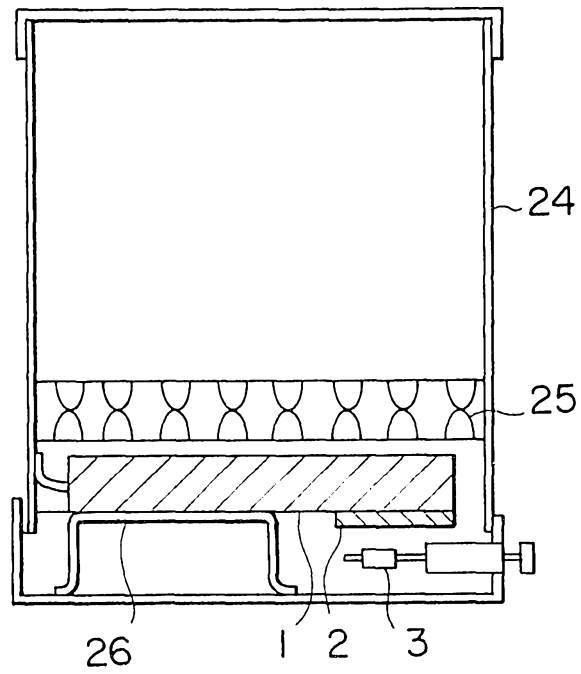


FIG. 8

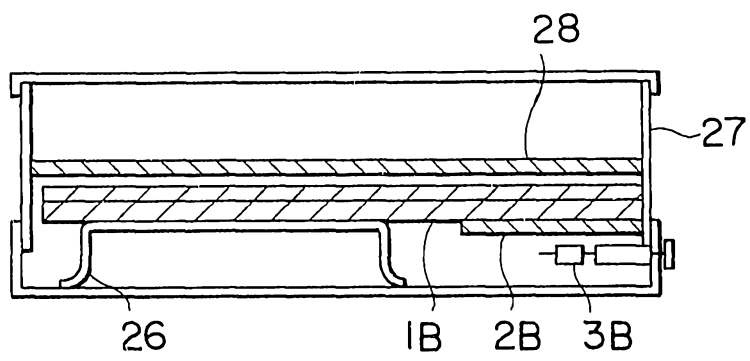


FIG. 9

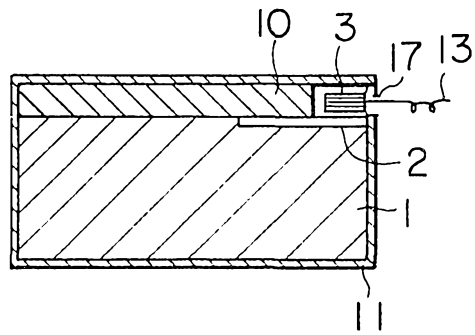


FIG. 10

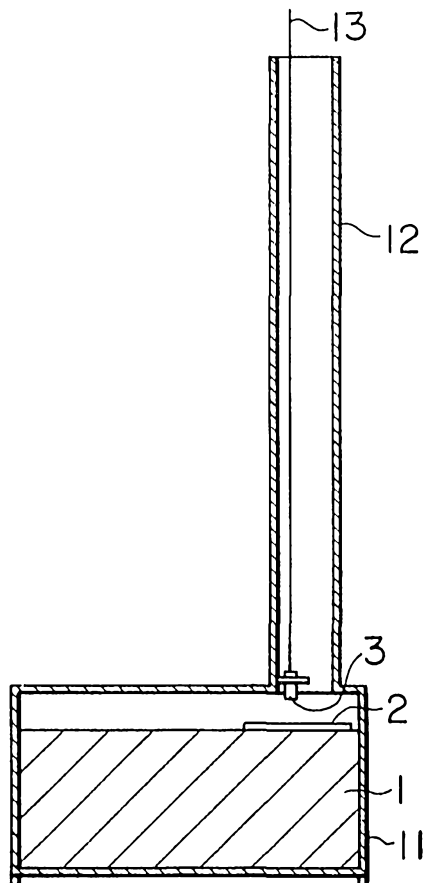


FIG. 11

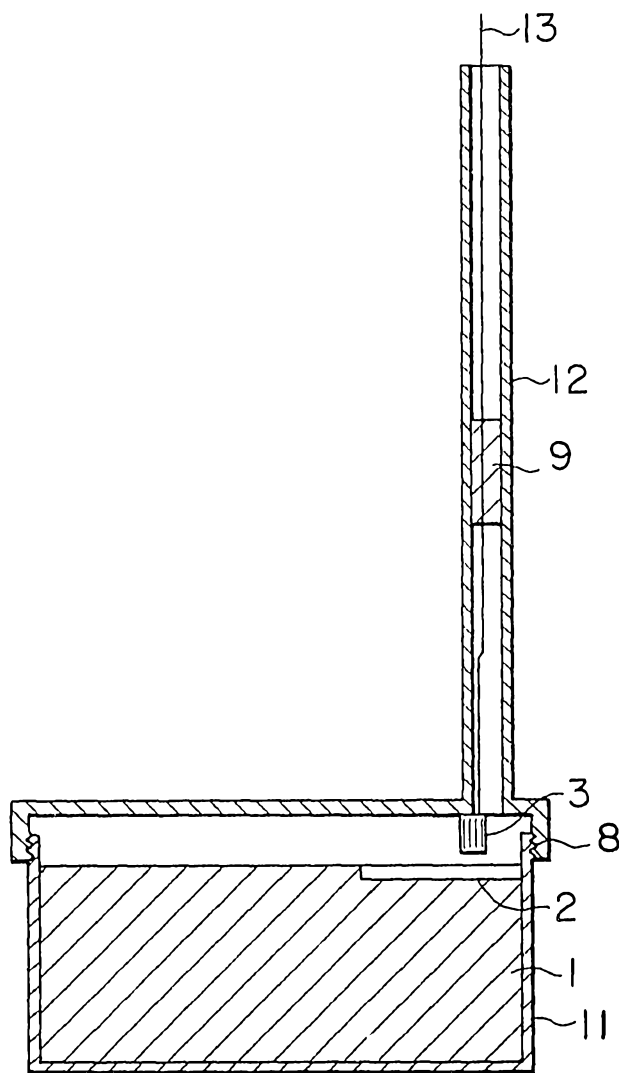


FIG. 12

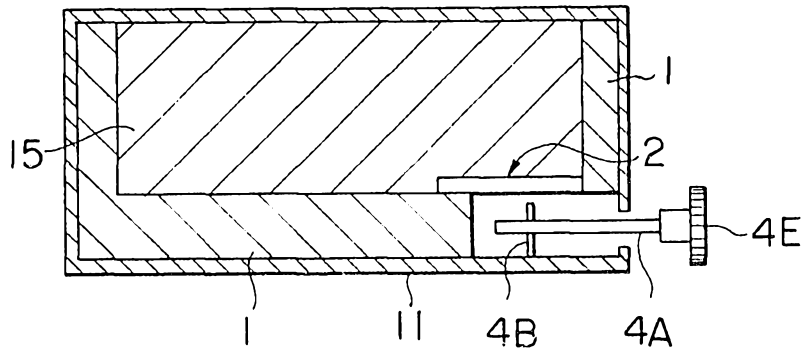


FIG. 13

