

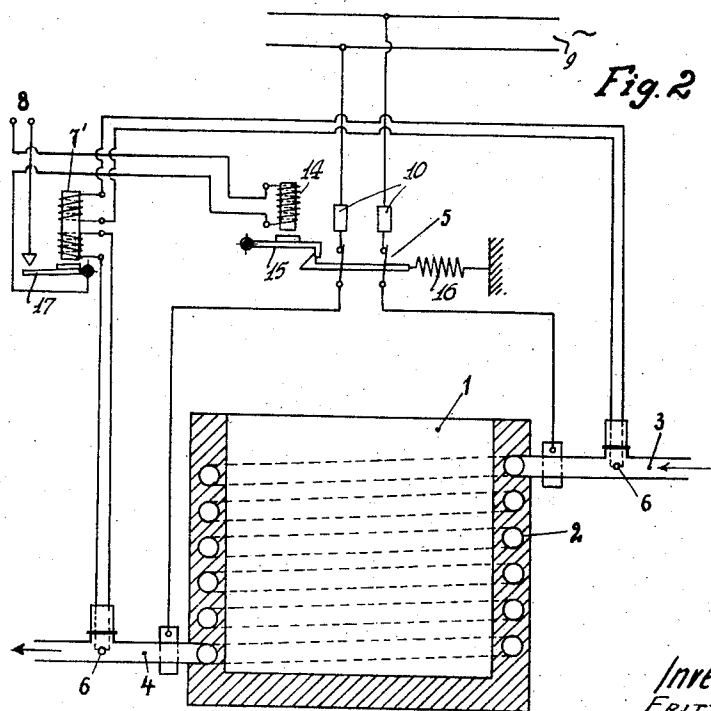
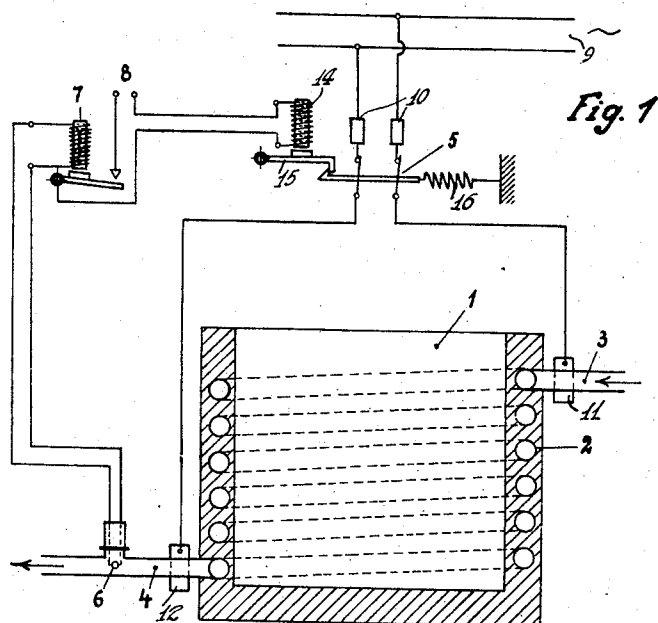
Dec. 26, 1939.

F. HARTMANN

2,184,741

HIGH FREQUENCY SMELTING FURNACE

Filed Nov. 17, 1938



Inventor:
FRITZ HARTMANN
BY *Redd Schuetz*
Attorney

UNITED STATES PATENT OFFICE

2,184,741

HIGH FREQUENCY SMELTING FURNACE

Fritz Hartmann, Dortmund, Germany, assignor to
Kohle-und Eisenforschung G. m. b. H., Dussel-
dorf, Germany, a limited-liability company

Application November 17, 1938, Serial No. 240,930
In Germany November 19, 1937

4 Claims. (Cl. 13-27)

When smelting metals in high-frequency fur-
naces of large capacity there exists, owing to the
relatively thin walls of the crucible, the danger
of the liquid metal breaking out through the
crucible wall. In the case of such breaking out,
apart from the destruction of the coils, explo-
sions might occur, and the liquid metal may
come into contact with the cooling water.

Experience has shown, that a breaking out is
prepared by the formation of small cracks or
crevices in the crucible wall which cracks and
crevices fill with metal and spread in outward
direction. It is evident that such cracks cannot
be detected during the smelting.

In most cases the breaking out takes place so
suddenly that, even if the threatening breaking
out can make itself apparent in some way by
external signs, there is nevertheless not enough
time to cut out the furnace.

To counteract the danger of breaking out, it
is proposed according to the invention to utilize
the change of temperature of the cooling water,
caused by the penetration of the hot metal into
the wall of the crucible, by arranging in the
cooling water current temperature-influenced
devices, such as thermo-electric couples, re-
sistance coils or bimetal strips, which in the
event of inadmissible rise in temperature cut
out the furnace switch by means of known me-
chanical or electrical transmission elements. It
is advisable to arrange a thermo-electric couple
or the like not only at the cooling water outlet
but also at the cooling water inlet. Thus, it is
possible to control the actual rise in tempera-
ture of the cooling water in the furnace inde-
pendently of the inlet temperature of the cool-
ing water which mostly fluctuates. If the two
thermo-electric couples in differential connec-
tion are jointly actuated, even a considerable in-
crease in the sensitivity of the cut out can be
thereby attained so that it is possible to indicate
breaking out in its inception.

Two embodiments of the invention are illus-
trated by way of example in the accompanying
drawing, in which:—

Fig. 1 is a diagrammatical view showing the
arrangement of a thermo-electric couple in the
cooling water inlet,

Fig. 2 is a similar view showing the arrange-
ment of a thermo-electric couple in the inlet
and another in the outlet of the cooling water.

In the drawing 1 designates a crucible in
whose wall a current conducting coil 2 is em-
bedded and is connected to a source 3 of high
frequency alternating current through the con-

tacts 11 and 12. In the example illustrated the
coil consists of a tube, through which the cool-
ing water flows. The cooling water enters at 3
and passes out at 4. The electric connection of
the induction furnace is effected in the usual
manner over fuses 10 and a main switch 5. Ac-
cording to Fig. 1 the protecting device consists
of a thermo-electric couple 6 which acts on a
relay 7. The relay 7 in responding, closes a
secondary circuit 8 to energize an electromagnet
14 to attract a detent armature 15 by which the
main switch 5 is switched off through the action
of a spring 16.

An indicating instrument may be used instead
of the relay 7, if this instrument has in known
manner cut off contacts by which the secondary
circuit 8 is controlled. The use of an indicating
instrument instead of a relay presents the ad-
vantage that the heating process can be observed
and the outflow temperature of the water can be
read at any time. The interposing of a secondary
circuit 8 is recommended as the thermo-currents
are too weak to attain the direct actuation of the
main switch.

Instead of the thermo-electric couple 6, other
devices may be fitted according to the invention
provided they can be influenced by changes in
temperature. For example a resistance coil may
be provided which presents the advantage that
an intermediate relay between resistance coil
and cut out of the main switch can be dispensed
with. Thermometers with cut off contacts may
also be employed. By using bimetal strips as
temperature influenced devices a mechanical
transmission of the movement of the bimetal
strip under changes of temperature to the main
switch may also be attained.

According to Fig. 2 thermo-electric couples are
arranged one 6' in the outlet 4 and another 6
in the inlet 3 for the cooling water. The two
thermo-currents, in the case of differential con-
nection, indicate the difference in the tempera-
tures of the cooling water at the inlet and outlet
points. By the differential connection on the
electromagnet 7' the protecting arrangement is
rendered independent of temperature fluctuations
of the inflowing cooling water. Furthermore, by
the differential connection the sensitivity of the
indication or of the adjustment of the cut out
point of the main switch can be considerably in-
creased. This is perhaps advantageous for show-
ing on an indicating instrument the relatively
slight increase in temperature already at the
beginning of a break out. The protecting ar-
rangement cuts out the furnace only when the

difference in temperature of the water at the inlet and outlet points increases. In most cases this will take place only when the metal breaking out is already near the coil whereby electromagnet 7' will be energized sufficiently to attract its armature 17 for closing the secondary circuit 8, as in the previously described embodiment, to actuate switch 5 through the release of detent 15 by electromagnet 14 and the action of spring 16.

I claim:

1. In a high frequency smelting furnace, means for avoiding breaking through, comprising in combination with a crucible and an electric circuit for heating said crucible, a main switch in said circuit, a cooling water conduit surrounding said crucible, at least one heat influenced device inserted in the cooling water, arranged in said circuit and influenced by an excessive rise in temperature in the cooling water circulating through said conduit, and transmission elements between said device and switch and adapted to cut out said circuit through the actuation of said switch at the influencing of said device, by an excessive rise in temperature in the cooling water.

2. In a high frequency smelting furnace of the nature set forth in claim 1, two heat influenced

devices in the circuit, a differential relay connected to both of said devices and cooperatively connected to the main switch.

3. In a high frequency smelting furnace, means for avoiding breaking through, comprising in combination with a crucible and an electric circuit for heating said crucible, a main switch in said circuit, a cooling water conduit surrounding said crucible and connected with said circuit to constitute the induction heating coil of the furnace, at least one heat influenced device inserted in the cooling water, arranged in said circuit and influenced by an excessive rise in temperature in the cooling water circulating through said conduit, and transmission elements between said device and switch and adapted to cut out said circuit through the actuation of said switch at the influencing of said device, by an excessive rise in temperature in the cooling water.

4. In a high frequency smelting furnace of the nature set forth in claim 3, two heat influenced devices in the circuit, one inserted in the inlet and one in the outlet for the cooling water, and a differential relay connected to both of said devices and cooperatively connected to the main switch.

FRITZ HARTMANN.