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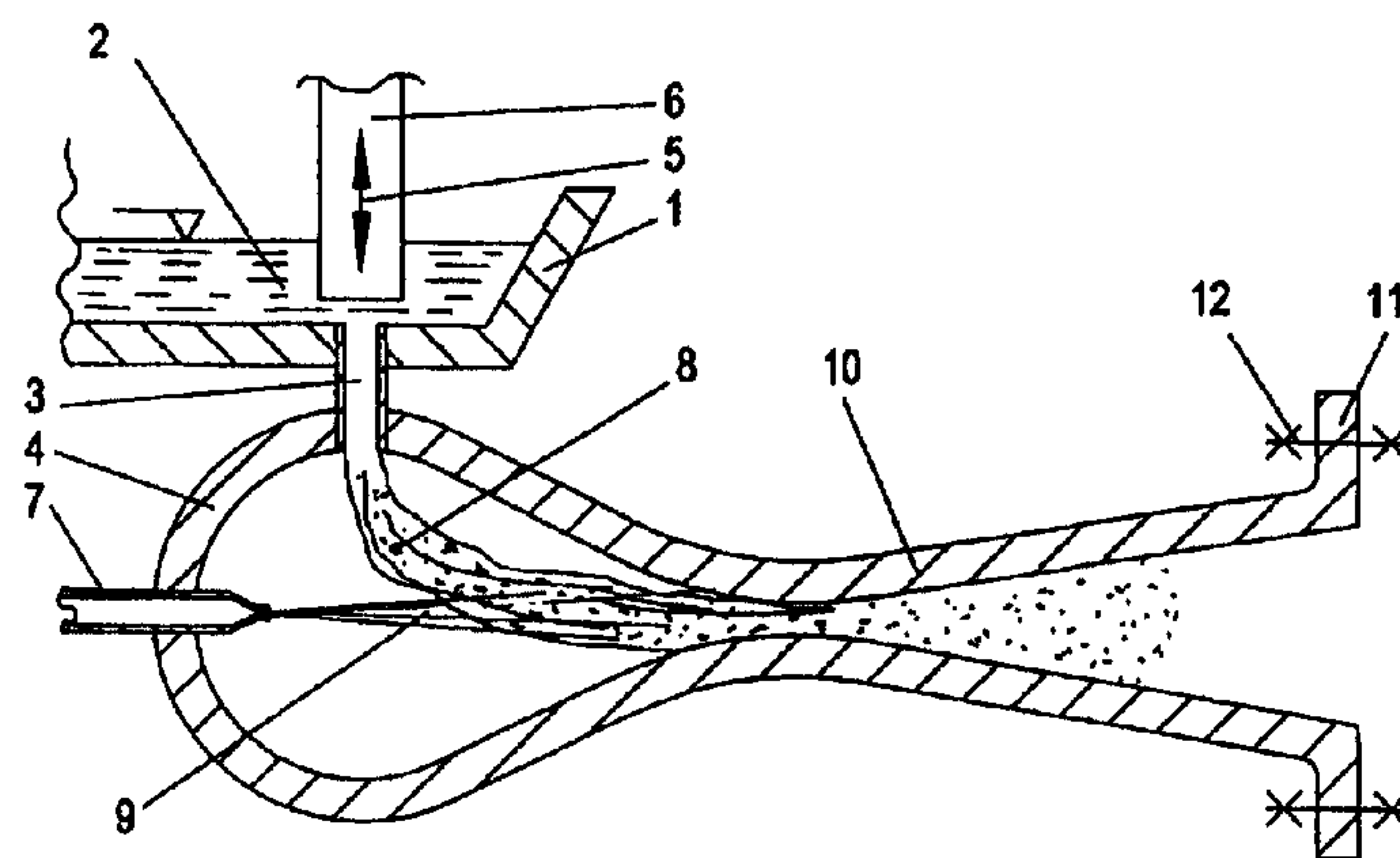
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(54) **PROCEDE PERMETTANT DE GRANULER ET DE**

FRACTIONNER DES SCORIES LIQUIDES AINSI QUE
DISPOSITIF DE MISE EN OEUVRE DUDIT PROCEDE

(54) **METHOD FOR GRANULATING AND REDUCING LIQUID**

SLAG AND DEVICE FOR CARRYING OUT THIS METHOD



(57) Procédé permettant de granuler et de fractionner des scories liquides, selon lequel des scories liquides sont introduites dans une chambre d'expansion et une zone de refroidissement. Les scories liquides sont aspirées dans une chambre d'expansion (4) se trouvant sous vide partiel et transportées dans la zone de refroidissement (10) à l'aide d'un jet de propulsion. Le vide partiel dans la chambre d'expansion (4) peut être réglé par l'intermédiaire d'une soupape d'étranglement (6) réglable située dans le passage d'introduction (3) des scories.

(57) The invention relates to a method for granulating and reducing liquid slag. According to said method, the liquid slag is introduced into an expansion chamber and a cooling area. The liquid slag is drawn into said expansion chamber (4), which is subjected to a vacuum, and transported into the cooling area (10) with a driving jet. The vacuum in the expansion chamber (4) can be adjusted using a controllable flow control valve (6) in the slag inlet (3).

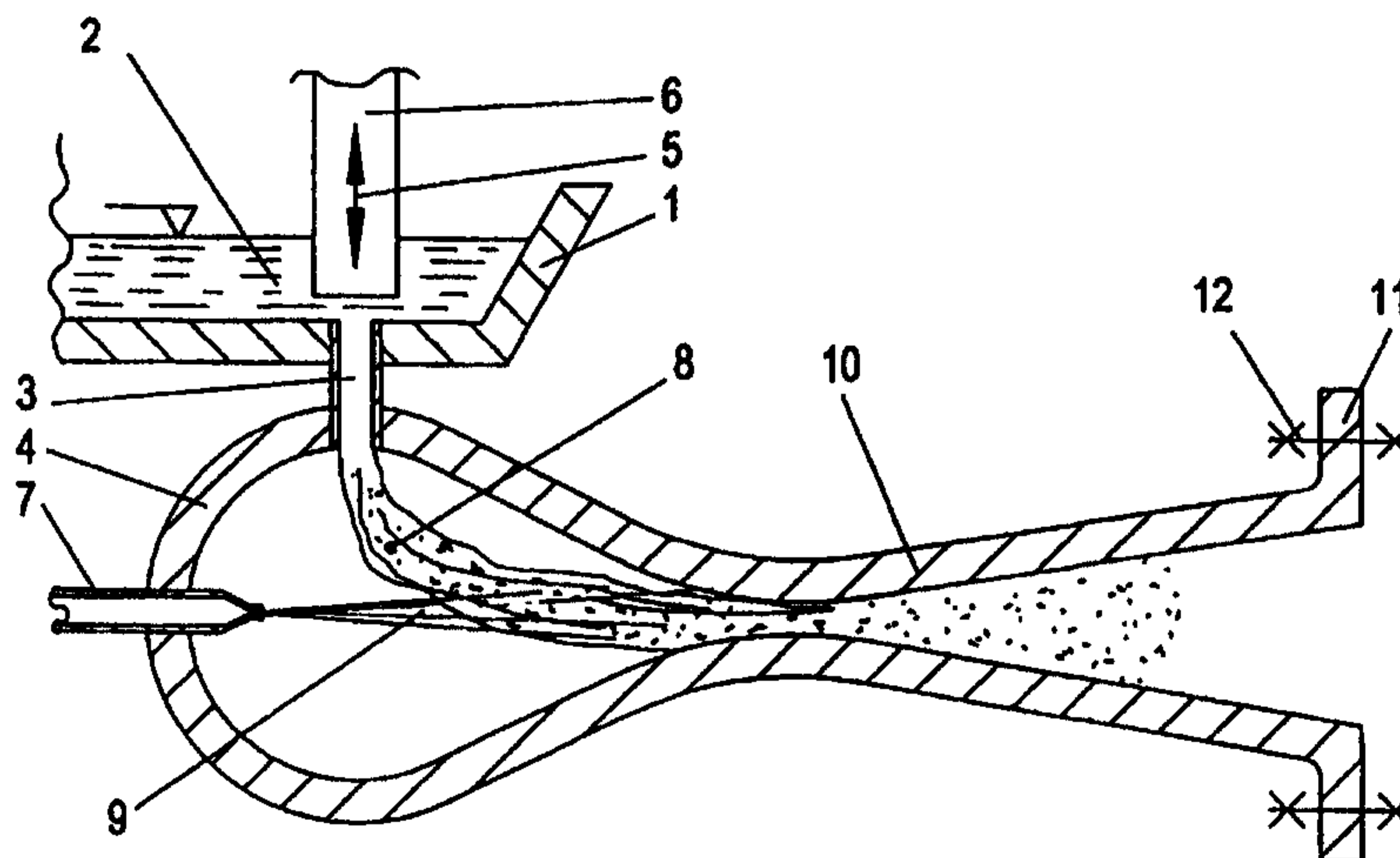


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<p>(21) Internationales Aktenzeichen: PCT/AT00/00044 (22) Internationales Anmeldedatum: 22. Februar 2000 (22.02.00) (30) Prioritätsdaten: A 316/99 24. Februar 1999 (24.02.99) AT (71) Anmelder (für alle Bestimmungsstaaten ausser US): "HOLDERBANK" FINANCIERE GLARUS AG [CH/CH]; Insel 14, CH-8750 Glarus (CH). (72) Erfinder; und (75) Erfinder/Anmelder (nur für US): EDLINGER, Alfred [AT/CH]; Chiemattweg 31, CH-5400 Baden (CH). (74) Anwalt: HAFFNER, Thomas, M.; Schottengasse 3a, A-1014 Wien (AT).</p>		<p>(81) Bestimmungsstaaten: AU, CA, MX, US, ZA, europäisches Patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Veröffentlicht Mit internationalem Recherchenbericht. Mit geänderten Ansprüchen.</p>

(54) Title: METHOD FOR GRANULATING AND REDUCING LIQUID SLAG AND DEVICE FOR CARRYING OUT THIS METHOD

(54) Bezeichnung: VERFAHREN ZUM GRANULIEREN UND ZERKLEINERN VON FLÜSSIGEN SCHLACKEN SOWIE VORRICHTUNG ZUR DURCHFÜHRUNG DIESES VERFAHRENS



(57) Abstract

The invention relates to a method for granulating and reducing liquid slag. According to said method, the liquid slag is introduced into an expansion chamber and a cooling area. The liquid slag is drawn into said expansion chamber (4), which is subjected to a vacuum, and transported into the cooling area (10) with a driving jet. The vacuum in the expansion chamber (4) can be adjusted using a controllable flow control valve (6) in the slag inlet (3).

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Method for Granulating and Disintegrating Liquid Slags and
Device for Carrying out this Method

5 The invention relates to a method for granulating and
disintegrating liquid slags, in which liquid slags are
introduced into an expansion chamber and a cooling zone, as
well as a device for carrying out this method, comprising a
slag tundish for receiving liquid slags, to which an expansion
chamber is connected.

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In order to granulate and disintegrate liquid slags, it has
already been proposed to eject such liquid slags into
granulation spaces by the aid of vapor or propellant gases.
Furthermore, disintegration also was effected in jet mills
15 using propellant jets. Based on slag temperatures ranging
between 1400° and 1600°C, the relatively large temperature
difference between the propellant gas stream and the molten
slag in such modes of procedure, as a rule, involves the risk
of the formation of more or less large agglomerates as well as
20 the danger of thread formation, which will consequently lead
to an increase in the disintegration work and a considerable
reduction of the cooling rate. In order to ensure vitreous
solidification, cooling of the liquid slags in the main has so
far been carried out as rapidly as possible.

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According to another unpublished proposal of the Applicant,
the liquid slag was ejected into the granulation space by the
aid of combustion offgases in order to reduce the danger of
the slag outlet opening from the slag tundish to get
30 obstructed by solidifying slag. With such a mode of procedure,
the slag particles injected into the granulation space get
into a consecutively arranged cooling zone at substantially
higher temperatures, which higher temperatures will cause a
reduction of the slag viscosity and a reduction of the surface
35 tension of the slag droplets so as to ensure a finer division
of the slag droplets as they enter the cooling zone. In doing
so, the fine dispersion of slag droplets resulted in

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accordingly small droplets having relatively high specific surfaces such that cooling was feasible in smaller-structured cooling chambers. The installation of burners in the region of the slag spout of the tundish, however, involves high structural and apparatusive expenses, the injection of gas into the liquid slags basically favoring the formation of foamed slag droplets, since gases in liquid slags exhibit relatively high solubilities, for instance at 1600°C. It is, thus, possible to dissolve approximately 0.4 wt.-% nitrogen in slags at, for instance, 1600°C and atmospheric pressure, said solubility of gases in liquid slags being pressure and temperature dependent, anyway. At an accordingly reduced pressure, accordingly smaller amounts of gas are, therefore, dissolvable in slags having the same temperature.

The invention aims to prevent the formation of porous foamed particles to the major extent and to ensure the rapid and efficient disintegration of the slag particles with a view to forming most finely dispersed particles, without requiring additional burners or gas lances to be installed in the region of the spout of the slag tundish.

To solve this object, the method according to the invention essentially consists in that the liquid slag is sucked into an expansion chamber being under negative pressure and transported into the cooling zone by means of a propulsion jet. By sucking the slag into an expansion chamber being under negative pressure, a sudden decrease of the pressure will occur on the throttle site at the transition from the spout of the tundish to the negative-pressure chamber in which the gas dissolved in the liquid slag is expanded in an explosion-like manner, thus tearing the slag flow into extremely fine slag particles. These extremely fine slag droplets may readily be torn further by shearing forces on those sites on which they are powered with the propulsion jet in order to be subsequently transported into a cooling zone, so that an extremely fine dispersion will be present immediately, which,

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in the following, may be caused to glassily solidify in relatively small-structured cooling zones. Because of their large relative surfaces, these extremely fine slag droplets, in principle, are able to solidify, or can partially be frozen, already in the region of contact with the propulsion jet, whereby different quenching is effected as a function of the medium used for the propulsion jet so as to enable the simple adaptation to the respectively pre-given slag composition with a view to obtaining as fine a dispersion of slag droplets as possible, by varying the propulsion jet medium. Since the nozzles used for the introduction of the propulsion jet are not directly contacted with the hot slag, those nozzles may be designed in a substantially simpler manner and made operationally safe with less structural expenditure.

As already mentioned, different media may be taken into consideration as propulsion media with, for instance, hot air, hot vapor or pressurized water being usable in practice. The medium selected determines how to construct the propulsion jet nozzles in the expansion chamber, the propulsion jet having to build up the appropriate negative pressure. To this end, the method according to the invention advantageously is carried out in a manner that the propulsion jet is injected into the negative-pressure chamber transversely to the direction of entry of the liquid slag. With such a construction, which basically is to be compared with the construction principle of a water jet pump, the propulsion jet oriented transverse to the direction of entry of the liquid slag, at the same time, also builds up the negative pressure required, whereby the propulsion jet subsequently is to impart on the extremely fine slag droplets the kinetic energy required for transporting the same through the cooling zone and optionally into a consecutively arranged mill. To this end, high-pressure water at a pressure of more than 50 bars, preferably more than 200 bars, is advantageously used as said propulsion jet, thus involving particularly small structural expenses, since

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cumbersome vapor processing measures may be reduced to a minimum. In the context of the method according to the invention, it may, however, also be proceeded such that superheated vapor having a temperature of above 800°C, preferably above 1000°C, is used as said propulsion jet at a pressure of more than 7 bars, preferably 10 bars, vapor consumption, thus, being reducible to approximately 100 to 500 kg vapor/ton slag depending on the vapor parameters selected.

10 The cooling zone may be realized as a radiation cooler, which may optionally be used to generate the required vapor if vapor is to be used as said propulsion jet. Such a vapor may subsequently be heated to the temperatures needed for the propulsion jet by means of conventional regenerative superheaters (cowpers).

In order to ensure a particularly fine dispersion of the slag droplets and an abrupt degasification of the expansion chamber, the method advantageously is carried out such that the pressure within the expansion chamber is adjusted to below 0.7 bar, preferably below 0.5 bar.

As initially mentioned, the device according to the invention for carrying out the method comprises a slag tundish for receiving liquid slags, to which an expansion chamber is connected. The device according to the invention is essentially characterized in that the expansion chamber comprises a jet nozzle which is oriented transverse to the axis of the slag inlet and that a cooling chamber, and optionally a consecutively provided jet mill, is arranged to follow said expansion chamber in the direction of the axis of the jet nozzle. Due to the jet nozzle being oriented transverse to the axis of the slag entry opening, the negative pressure required within the expansion chamber may be built up, whereby a two-phase mixture of superheated water vapor and slag microgranulates will be formed if high-pressure water is used. The arrangement of such jet nozzles transverse to the

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slag entry opening, as a rule, will imply a substantially horizontal arrangement of that axis such that the desired direction of movement into a consecutively provided jet mill, in particular counter jet mill, may be directly obtained
5 without further inversion of the direction.

In order to maintain the negative pressure sought within the expansion chamber, the slag inlet is designed as a throttling means. Advantageously, the slag inlet is designed as a
10 controllable throttle valve including an adjustable valve tappet.

Advantageously, the expansion chamber is designed as a jet pump, the construction principles of such a jet pump
15 substantially corresponding with the construction principles of a conventional water jet pump.

Due to the particularly fine slag dispersion caused by the explosion-like degasification, a consecutively arranged
20 cooling chamber may be designed to be particularly small-structured and, advantageously, as a radiation cooling chamber including water-cooled or vapor-cooled walls. With the radiation cooling chamber being comprised of annular chambers through which water or vapor flows, as in correspondence with
25 a preferred further configuration, ducts for carrying off vapor, in particular saturated vapor, are connected to those annular chambers, the drawn-off vapor being feedable to the jet pump via a heat exchanger or superheater.

30 In principle, complex vapor processing may be obviated, if high-pressure water is largely used as a propulsion jet both for the creation of a negative pressure within the expansion chamber and for the operation of a consecutively arranged mill. Advantageously, the configuration therefore is devised
35 such that nozzles for high-pressure water, which are each oriented towards a grinding point, are arranged within the jet mill in at least two planes neighboring in the direction of

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the axis of the incoming slag granulate jet. If high-pressure water is used exclusively, vapor processing can be largely omitted, which, however, involves the basic risk of threads or slag wool forming in the expansion chamber as a function of the slag composition. Yet, such short microthreads, in a consecutively arranged mill again operated by high-pressure water jets, may be safely disintegrated by the thermal shock and the high kinetics of the propulsion water jet. In principle, also combined processes may be envisaged, employing vapor jet mills in addition to water jet mills, for instance, in the form of known counterjet fluidized bed mills.

In the following, the invention will be explained in more detail by way of an exemplary embodiment schematically illustrated in the drawing. Therein, Fig. 1 depicts a first embodiment of the device according to the invention and Fig. 2 is a partially sectioned illustration of a modified embodiment including a jet mill connected thereto.

From Fig. 1 a slag tundish 1 is apparent, in which liquid slag 2 is contained. The slag tundish 1 comprises a throttle site 3, which, at the same time, constitutes the slag inlet into a consecutively arranged expansion chamber 4. This slag inlet 3 is designed as a throttle valve, wherein a valve tappet 6 capable of being displaced in the direction of the double arrow 5 is arranged to adjust the desired throttle cross section within the slag tundish 1.

To the expansion chamber 4 is connected a jet nozzle 7, via which a propulsion jet, for instance a high-pressure water jet or a vapor jet, may be injected into the expansion chamber 4. On grounds of the injector principle and the jet pump configuration, respectively, a negative pressure is built up in the expansion chamber 4, which enables the liquid slag 2 to be appropriately sucked in via the throttle site of the slag inlet 3, the slag particles sucked in and solidifying being schematically indicated by 8. The slag particles 8

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subsequently are seized by the jet 9 and transported into a cooling chamber 10, which is designed as a diffusor. In the instant case, the cooling chamber 10 is designed as a radiation cooling chamber and, on its end, comprises a flange 5 11 for the connection of consecutively arranged means such as a jet mill. The screw connection of the flange 11 with consecutively arranged means is schematically indicated by 12.

10 In the embodiment according to Fig. 1, rapid disintegration takes place within the expansion chamber 4 due to the negative pressure, or pressure decrease, prevailing there, wherein a high-pressure water jet at a pressure of more than 100 bars may be used to obtain said negative pressure.

15 At the transition from the expansion chamber into the cooling chamber, the cross section is narrowed, thus causing high shearing forces to be exerted on the accelerated slag particles, a further temperature decrease under water evaporation subsequently occurring in the substantially 20 conically widening region of the diffusor or cooling chamber 10. The particles leave the cooling chamber at mean diameters of between 5 and 250 μm while superheated water vapor at a pressure of about 10 bars and about 430°C is drawn off along with slag microparticles.

25 In the embodiment according to Fig. 2, a jet mill 13 is provided in addition to the structural parts already represented in Fig. 1, i.e., the slag tundish 1, the expansion chamber 4 and the cooling chamber 13, into which jet mill 30 high-pressure water jets are injected via annular channels 14 and 15 radially in the direction towards the respective grinding points 16 and 17.

35 The cooling chamber in the instant case comprises liquid-cooled or vapor-cooled walls, wherein in the wall of the cooling chamber 10 is provided an annular channel 18 to which water or vapor is fed. Vapor is drawn off that annular channel

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18 via a duct 19 and optionally collected at 21 together with vapor drawn off the consecutively arranged jet mill 13 via a duct 20, and supplied to a regenerative heat exchanger 22. The valves of the regenerative heat exchanger are denoted by 23 and allow for the alternative loading and unloading of the respective regenerative heat exchangers so as to have available, in duct 24, high-temperature vapor at temperatures of above 1000°C and about 10 bars. Such a highly superheated vapor via nozzle 7 may be nozzled into the expansion chamber 4 which acts as a jet pump, whereby the required negative pressure may again be maintained by appropriate adjustment of the throttling cross section within the slag inlet 3. Here again, rapid disintegration takes place within the expansion chamber 4 due to the negative pressure prevailing there, the cooled particles leaving the cooling chamber 10 at temperatures of below 1000°C and getting into the consecutively arranged jet mill 13. The grinding points 16 and 17 are located substantially on the axis of the nozzle 7, whereby the disintegrated material along with superheated vapor is drawn off through a duct 25 at temperatures of about 400°C and a pressure of 3 to 5 bars and supplied to a filter or cyclone 26. The separated solids are discharged via a duct 27 and optionally ground further, whereas the remaining superheated vapor is recycled to the regenerative heat exchanger together with the vapor drawn off the annular chambers 18 of the cooling chamber. High-pressure water having a pressure of more than 100 bars may again be used in the jet mill 13 in order to ensure effective disintegration.

AMENDED CLAIMS

[submitted at the International Bureau on August 11, 2000
(08.11.00);

5 original claims 3 and 4 deleted, original claim 1 amended;
original claims 5-11 renumbered
as claims 3-9;
all other claims unamended (2 pages)]

10 1. A method for granulating and disintegrating liquid slags,
in which liquid slags are introduced into an expansion chamber
and a cooling zone, characterized in that the liquid slag is
sucked into an expansion chamber being under negative pressure
and transported into the cooling zone by means of a propulsion
15 jet, wherein superheated vapor having a temperature of above
800°C, preferably above 1000°C, is used as said propulsion jet
at a pressure of more than 7 bars, preferably 10 bars.

20 2. A method according to claim 1, characterized in that the
propulsion jet is injected into the negative-pressure chamber
transversely to the direction of entry of the liquid slag.

25 3. A method according to claim 1 or 2, characterized in that
the pressure within the expansion chamber is adjusted to below
0.7 bar, preferably below 0.5 bar.

30 4. A device for carrying out the method according to any one
of claims 1 to 3, comprising a tundish (1) for receiving
liquid slags (2), to which an expansion chamber (4) is
connected, characterized in that the expansion chamber (4)
comprises a jet nozzle (7) which is oriented transverse to the
axis of the slag entry opening and that a cooling chamber
(10), and optionally a consecutively provided jet mill (13),
is arranged to follow the expansion chamber in the direction
of the axis of the jet nozzle (7).

35 5. A device according to claim 4, characterized in that the
slag inlet (3) is designed as a controllable throttle valve
including an adjustable valve tappet (6).

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6. A device according to claim 4 or 5, characterized in that the expansion chamber (4) is designed as a jet pump.

7. A device according to claim 4, 5 or 6, characterized in that the cooling chamber (10) is designed as a radiation cooling chamber including water-cooled or vapor-cooled walls.

8. A device according to any one of claims 4 to 7, characterized in that the walls of the radiation cooling chamber (10) are comprised of annular chambers (18) through which water or vapor flows and to which ducts (10) for carrying off vapor, in particular saturated vapor, are connected and that the drawn-off vapor is fed to the jet pump via a heat exchanger or superheater (22).

15

9. A device according to any one of claims 4 to 8, characterized in that nozzles for high-pressure water, which are each oriented towards a grinding point (16, 17), are arranged within the jet mill (13) in at least two planes neighboring in the direction of the axis of the incoming slag granulate jet.

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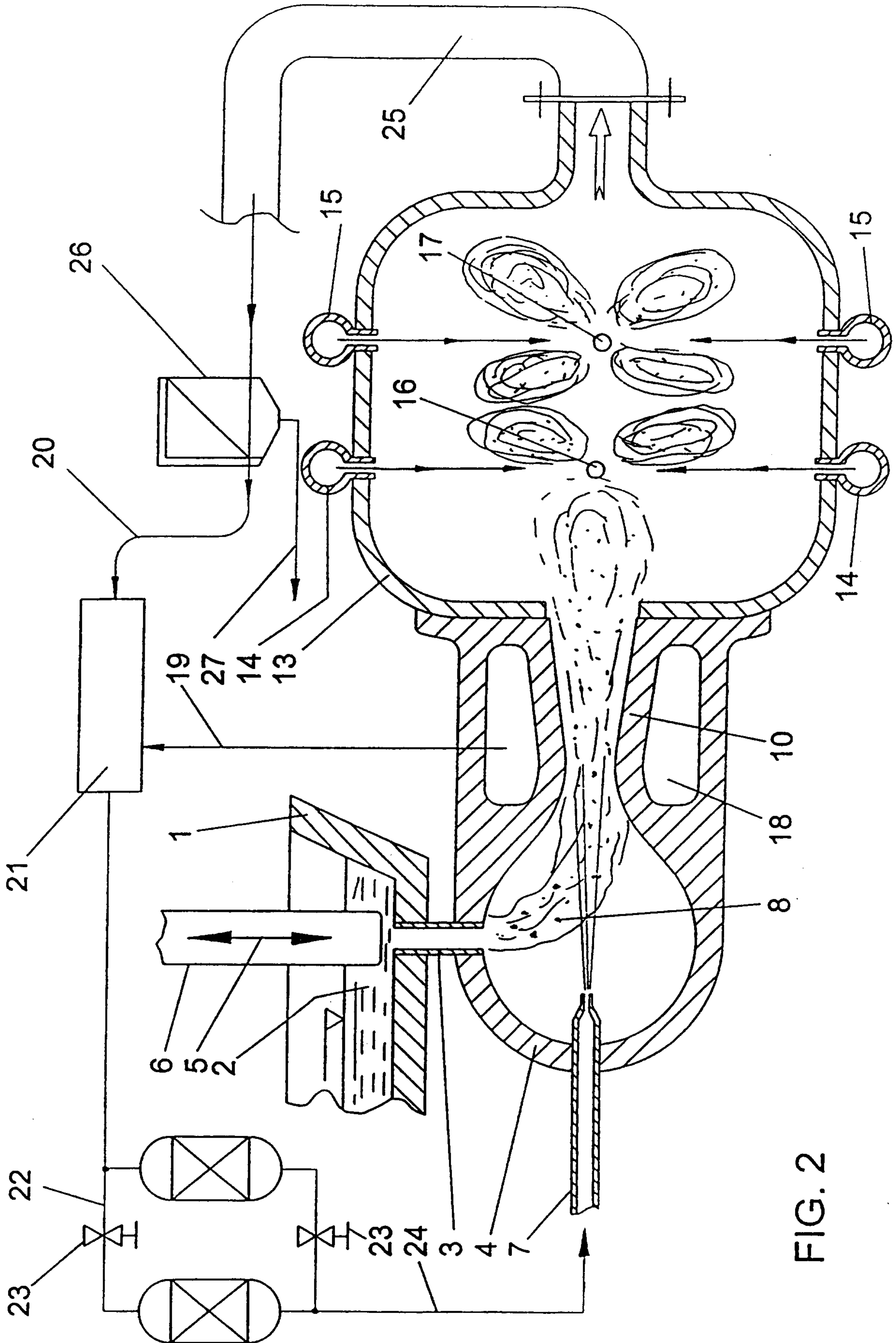


FIG. 2

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