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(54) **Method of producing nodular iron and a machine for the implementation thereof.**

(57) The invention relates to a method of producing nodular iron and to a machine for carrying out this method in foundry practice. The problem on which the invention is based is the improvement of the nodular iron processing method carried out in a tundish-cover-system and a machine for implementing this method. The problem is solved by adjustably controlling the pouring of molten iron into the processing tundish (6) or ladle by means of a pressure tap stationary furnace (1).

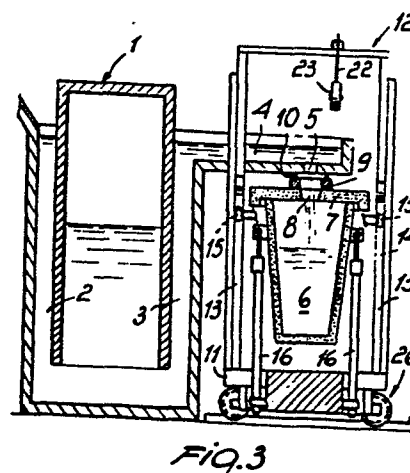


FIG. 3

"METHOD OF PRODUCING NODULAR IRON AND A MACHINE FOR
THE IMPLEMENTATION THEREOF"

This invention relates to a method of producing
nodular iron and to a machine for the implementation
thereof.

5 It is known that in foundry practice graphite
spheroidization to produce nodular iron is carried
out by adding to the molten iron, as contained in
suitable processing ladles, magnesium-based
spheroidizing alloys.

10 On contacting atmospheric oxygen, the magnesium
oxidizes and releases a considerable volume of fumes,
and accordingly, the technological improvements
introduced heretofore have been essentially directed
toward a reduction in the amount of atmospheric
oxygen made available to the reaction.

15 One approach provides for iron processing in a
so-called tundish cover system, wherein the molten
iron collecting pot associated with the cover has
the function of preventing air from undesirably
getting into the tundish interior during the treatment
20 step.

Keeping the tundish closed during the process
and pouring the metal into the pot overlying the
cover should give assurance of the reaction taking
place in a nearly oxygen-free medium, thus preventing
25 magnesium oxidation and promoting a smooth reaction,
with attendant savings in spheroidizing alloy and
minimization of environmental pollution owing to the
absence of fumes.

However, such an approach has been unsuccessful

in actual practice because the metal cast, which is effected by means of an overturning furnace, cannot keep the pot evenly filled and, accordingly, fails to prevent air from leaking inside through the filler
5 hole.

The net result is an uneven process and consequent inconsistent yields combined with an intense agitation of the bath and iron splashes which readily foul both the tundish and contact surface of
10 the cover with the tundish, thus putting the device out of operation within a short time.

The problem may be overcome by using a suitable intermediate transfer tundish arranged to tap the iron from the furnace and pour it into the
15 processing tundish.

A significant temperature drop has, however, to be accommodated as due to the additional step of transferring the iron into the transfer tundish, as well as the introduction of complications in the
20 processing operations which make the remedy wholly unsuitable for application to high rate production lines.

In the light of the foregoing technical problems, it is a primary object of this invention to remove
25 such prior deficiencies by providing a method of producing nodular iron and a machine for the implementation thereof, which can afford adequately smooth spheroidization reaction conditions and consistent results.

Another object of the invention is to provide a method and a machine as indicated, which can afford a reduction in the amount of spheroidizing alloy required to accomplish the reaction, and accordingly,
5 in the cost of the nodular iron thus produced.

It is a further object of this invention to provide such a machine which can increase the average life of the processing tundishes.

Still another object of the invention is to
10 provide a nodular iron making machine which can eliminate the problem of air pollution by minimizing the release of fumes during the graphite spheroidization reaction.

A not unimportant object of the invention is to
15 provide such a machine which can afford significant power savings.

The invention objects are achieved by a method of producing nodular iron, comprising the steps of:

collecting a body of molten iron in a stationary
20 furnace with pressure tap;

arranging a preset amount of spheroidizing alloy in a processing tundish;

fluid-wise connecting said tundish to said furnace such that the topmost portion of the tundish cover
25 is mated with the bottom portion of the iron runner of said furnace to prevent air from leaking into said tundish past the mating surface area;

blowing a gaseous medium into the crucible of said furnace such that molten iron may be tapped off said
30 iron runner;

adjusting the flow of gaseous medium into said crucible to keep the runner constantly filled during the process; and

5 stopping the flow of molten iron through the runner and the admission of gaseous medium into the crucible.

A preferred machine for implementing the above method comprises a pressure tap stationary furnace defining an iron runner, and is characterized in that
10 detachably associated with the bottom portion of said runner is a processing tundish closed at the top by a cover, said tundish and said runner being fluid-wise interconnected and held in mutual contact relationship by a means of handling said processing tundish.

15 Further features and advantages of the invention will be more clearly apparent from the following detailed description of a method of producing nodular iron and of a preferred, though not exclusive, embodiment of a machine for implementing this method,
20 as illustrated by way of example and not of limitation in the accompanying drawings, where:

Figures 1 and 2 show, respectively, a longitudinal section view of an inventive machine and a sectional view taken in a plane lying perpendicularly to the
25 former and containing the axis of the tundish sprue, during the step of depositing spheroidizing alloy into the tundish;

Figures 3 and 4 show similar sectional views of the machine according to the invention, but during the

step of tapping molten iron off the stationary furnace and step of casting the molten iron into the processing tundish;

5 Figure 5 shows again a longitudinal section view of the inventive machine during the steps of shutting off the molten iron flow and removing the processing tundish for the slagging step;

10 Figures 6 and 7 show sectional views taken in a plane containing the axis of the tundish sprue, respectively during the slagging step and step of transferring the nodular iron from the processing tundish into the casting ladle;

15 Figure 8 shows a longitudinal section view of a modified embodiment of the runner-tundish assembly and of the means for continuously introducing spheroidizing alloy as molten iron is being poured into the processing tundish;

20 Figure 9 shows an automated embodiment of said means for introducing spheroidizing alloy during the cast; and

Figures 10 to 12 are elevational views of the tundish and means of moving said tundish to a processing position, to a position of slagging/admission of spheroidizing alloy into the tundish, and to a position of transfer into the casting ladle, respectively.

To explain the method of producing nodular iron according to this invention, the operation will be described hereinafter of a preferred embodiment of the machine which implements it; the machine generally

comprises a pressure tap stationary furnace including essentially a closed crucible 1 fluid-wise connected, in a manner known per se, to a pressurized gaseous medium supply device, not shown, which communicates with
5 the outside environment through an inlet line 2 and outlet line 3.

The outlet line 3 defines, at the top portion thereof, a runner 4 having a sprue 5 wherethrough the molten iron is allowed to flow during the cast.

10 Detachably associated with the runner 4 is a processing tundish 6 closed at the top by a cover 7, which is preferably hinged to the tundish and provided at the middle region thereof with a channel 8 allowing the molten iron to flow from the runner into the
15 tundish.

Coaxially with the channel 8, outwardly with respect to the tundish, the cover 7 has an abutment ring 9 for a gasket 10 which is formed from a heat resisting material and intended to prevent air from
20 getting into the tundish during the spheroidization process.

In order to facilitate the processing operations, also provided is a means of moving the tundish 6, associated with the tundish itself, which comprises
25 essentially a bed 11 having rigidly mounted thereon a front frame 12 provided with a pair of vertical uprights 13, each defining, along a portion of its length, a guide 14 engaging a front guiding device 15 connected to the tundish.

30 Also connected to the processing tundish are the

top ends of a pair of fluid-operated cylinders 16
the opposed ends whereof are pivoted to the bed 11
such as to permit the tundish to be moved along a path
guided by the front guiding device 15 and a rear wheel
5 17 which is movable along a rear guide 18, also rigid
with the bed 11.

The guide 18 has of preference a first sloping
zone 19, intended for tilting the tundish during the
slagging step, which is followed by a substantially
10 vertical portion 20 along which the wheel 17 can roll
as the tundish is being brought to mate with the iron
runner, and extends then into a substantially
curvilinear portion 21 operative to guide the tundish
along its path during the overturning steps explained
15 hereinafter.

Hinged to the frame top is a shaped rod 22 having
a counterweight 23 which holds the cover 7 in the
proper position during the cited tundish overturning
steps.

20 Also connected to the rear guide is a detent 24
which, during the steps of lowering the tundish down
to the lowermost zone, will partly raise the cover 7
to facilitate the slagging operations, by protecting
the operator against radiating heat, or to allow
25 manual introduction of the spheroidizing alloy.

Further, provision is made for the insertion of
a filling probe 25 into the processing tundish which
is responsive to the level of iron in the tundish and
drives the admission of a gaseous medium into the
30 closed crucible 1 such as to establish, upon filling

of the processing tundish, a sufficient pressure within the crucible to maintain the metal standby level shown in Figure 5, that is, immediately below the iron runner, or completely releases the pressure
5 from the crucible inside so as to equalize the levels in the crucible and inlet and outlet channels.

The bed 11 is carried on a carriage 26 so as to enable quick transportation of the processing tundish from the zone underlying the furnace 1 to the transfer
10 zone into a casting ladle 27, shown in Figure 7.

Shown in Figure 8 is a detail of the runner-processing tundish assembly, wherewith there is associated a means for introducing spheroidizing alloy on a continuous basis during the casting of molten
15 iron into the processing tundish; said means comprises essentially an intake chamber 30 containing a feeder of spheroidizing alloy 31.

Formed in the top portion of the chamber 30, at a location adjacent the feeder 31, is a hole 32 for
20 charging spheroidizing alloy into the feeder, which is protected by a movable cover 33 effective to prevent fumes from escaping out of the chamber 30.

The intake chamber is further provided, at the bottom portion thereof, with a charging hopper 34
25 which extends through the iron runner with a tubular element 35 extending coaxially with the sprue 5 and runner 8 to open to the interior of the processing tundish.

Also provided is the application of a probe 36
30 for detecting the level of the molten iron, which is

located in the iron runner and acts on the feeder 31,
so as to initiate the introduction of spheroidizing
alloy through the tubular extension 35, short after the
casting of the iron into the tundish has been started so
5 that the iron runner and the tundish pouring siphon
are covered with molten iron prior to the starting of
the reaction, thus preventing fumes from escaping
through the runner and siphon, during the initial phase.

A preferred embodiment of the means for introducing
10 spheroidizing alloy continuously during the cast is
shown in Figure 9, wherein the cover 33 is replaced
with a feeder hopper 37, e.g. of the vibrating
extractor type, which, under the control by a logic
circuit not shown, dispenses spheroidizing alloy to
15 the feeder, e.g. also of the vibratory type and being
mounted on a weighing cell 38 which, upon reaching the
weight, sends a command to interrupt the flow of
spheroidizing alloy to the feeder hopper.

With reference to the machine just described,
20 the method of producing nodular iron according to the
invention comprises the following steps:

first, a body of molten iron is collected into
the pressure tap stationary furnace. With each processing
operation, a preset amount of spheroidizing alloy is
25 charged into the processing tundish.

That operation is facilitated with the inventive
machine by virtue of the tundish handling means
allowing, with the tundish fully lowered, the cover 7
to be opened. Where the inventive machine is equipped
30 with a means for introducing spheroidizing alloy

continuously during the iron casting into the processing tundish, the admission of spheroidizing alloy to the tundish may be delayed until after the cast has begun with a further improvement of the uniform admixing of the spheroidizing alloy to the iron body, which enables a further reduction in the undesired oxidation of the magnesium with attendant saving of spheroidizing alloy and smoother reaction. Both where the spheroidizing alloy has been introduced initially into the processing tundish and where this operation is carried on continuously during the cast, the following step provides for the mating of the tundish to the stationary furnace, which is performed by placing the tundish into fluid communication with the furnace such that the top portion of the tundish cover, and specifically the ring 9, can mate with the bottom portion of the iron runner to communicate the runner to the inside of the tundish through the sprue 5 and channel 8.

20 In order to prevent air from getting into the tundish during the processing steps, the fluid-operated cylinders 16 hold the ring 9 in constant contact with the gasket 10, thus providing an air-tight seal.

25 At this point, gaseous medium must be blown into the furnace crucible to raise the level of the molten iron in the inlet and outlet channels, conveying it toward the runner.

30 In the event that the runner is provided with the probe 36, the level in the runner may be maintained directly by the cited probe, which in

addition to controlling the admission of spheroidizing alloy, preferably in granulate form, also drives the metering of gaseous medium into the crucible so as to keep always full the iron runner during the process.

5 As the probe 25 located in the tundish warns of the tundish having been filled, the flow of molten iron through the iron runner is interrupted by discontinuing the admission of gaseous medium into the crucible. The tundish is then lowered by means of the
10 fluid-operated cylinders 16 and placed in the slagging position as shown in Figure 6.

During this phase, the detent 24 and wheel 17 acting on the rear guide cause a simultaneous opening of the cover and tilting of the tundish so as to allow
15 the succession of the slagging operations with the operator fully protected from the heat.

Thanks to the carriage-mounted bed, the tundish can be easily transported to the transfer zone where the nodular iron is poured into a casting ladle.

20 The invention as conceived is susceptible to many modifications and variations, without departing from the scope of the inventive concept. Furthermore, all of the details may be replaced with other technically equivalent elements.

25 In practicing the invention, the materials used, as well as the dimensions, may be any ones contingent on requirements and the state of the art.

CLAIMS

- 1 1. A method of producing nodular iron, comprising
2 the steps of:
3 collecting a body of molten iron in a stationary
4 furnace with pressure tap;
5 arranging a preset amount of spheroidizing alloy
6 in a processing tundish (6);
7 fluid-wise connecting said tundish to said furnace
8 such that the topmost portion of the tundish cover (7)
9 is mated with the bottom portion of the iron runner
10 (4) of said furnace to prevent air from leaking into
11 said tundish (6) past the mating surface area;
12 blowing a gaseous medium into the crucible (1)
13 of said furnace such that the molten iron may be tapped
14 off said iron runner (4);
15 adjusting the flow of gaseous medium into said
16 crucible (1) to keep the runner (4) constantly filled
17 during the process; and
18 stopping the flow of molten iron through the
19 runner (4) and the admission of gaseous medium into
20 the crucible (1).
- 1 2. A method of producing nodular iron, according
2 to Claim 1 and characterized in that said spheroidizing
3 alloy is introduced in an even and continuous fashion
4 into the processing tundish (6) simultaneously with
5 the molten iron flow.
- 1 3. A method according to Claims 1 and 2,
2 characterized in that spheroidizing alloy in granulated
3 form is used.
- 1 4. A machine implementing the method according to

2 one or more of the preceding claims, comprising a
3 pressure tap stationary furnace defining an iron
4 runner (4) and being characterized in that detachably
5 associated with the bottom portion of said runner (4)
6 is a processing tundish (6) closed at the top by a
7 cover (7), said tundish (6) and said runner (4) being
8 fluid-wise interconnected and held in mutual contact
9 relationship by a means for handling said processing
10 tundish.

1 5. A machine according to Claim 4, characterized
2 in that associated with said furnace is a means for
3 introducing spheroidizing alloy continuously during
4 the casting of molten iron into said processing
5 tundish (6).

1 6. A machine according to Claim 5, characterized
2 in that said means for introducing spheroidizing alloy
3 comprises an intake chamber (30) enclosing a feeder
4 (31) therein and defining, on the side facing the
5 runner, a charging hopper (34) extended through said
6 runner (4) and opening into said processing tundish (6).

1 7. A machine according to Claim 6, characterized
2 in that said intake chamber (30) has a movable cover
3 (33) for the admission of spheroidizing alloy into
4 the feeder.

1 8. A machine according to one or more of Claims
2 5 to 7, characterized in that said means for introducing
3 spheroidizing alloy comprises a feeder hopper (37)
4 communicating with said feeder (31) which comprises an
5 automatic weighing cell (38) for the amount of
6 spheroidizing alloy contained therein and driving the

7 flow of said spheroidizing alloy from said feeder
8 hopper (37) to said feeder (31).

1 9. A machine according to one or more of Claims
2 5 to 8, characterized in that said means for conti-
3 nuously introducing spheroidizing alloy comprises
4 a probe (36) for detecting the level of the molten
5 iron placed in the iron runner (4) and driving said
6 feeder (31).

1 10. A machine according to one or more of Claims
2 4 to 9, characterized in that it comprises a filling
3 probe (25) located inside the processing tundish (6)
4 and driving the flow of gaseous medium into said
5 pressure tap stationary furnace.

1 11. A machine according to one or more of
2 Claims 4 to 10, characterized in that said means for
3 handling said processing tundish (6) comprises a
4 carriage-mounted bed (11) having rigid therewith a
5 front frame (12) and rear guide (18), said front
6 frame having a pair of vertical uprights (13) each
7 defining a guide (14), said guides (14, 18) cooperating
8 with said processing tundish (6) during the displacement
9 movements imparted to said processing tundish by
10 fluid-operated cylinders (16) pivoted to said bed (11)
11 and hinged to said processing tundish (6).

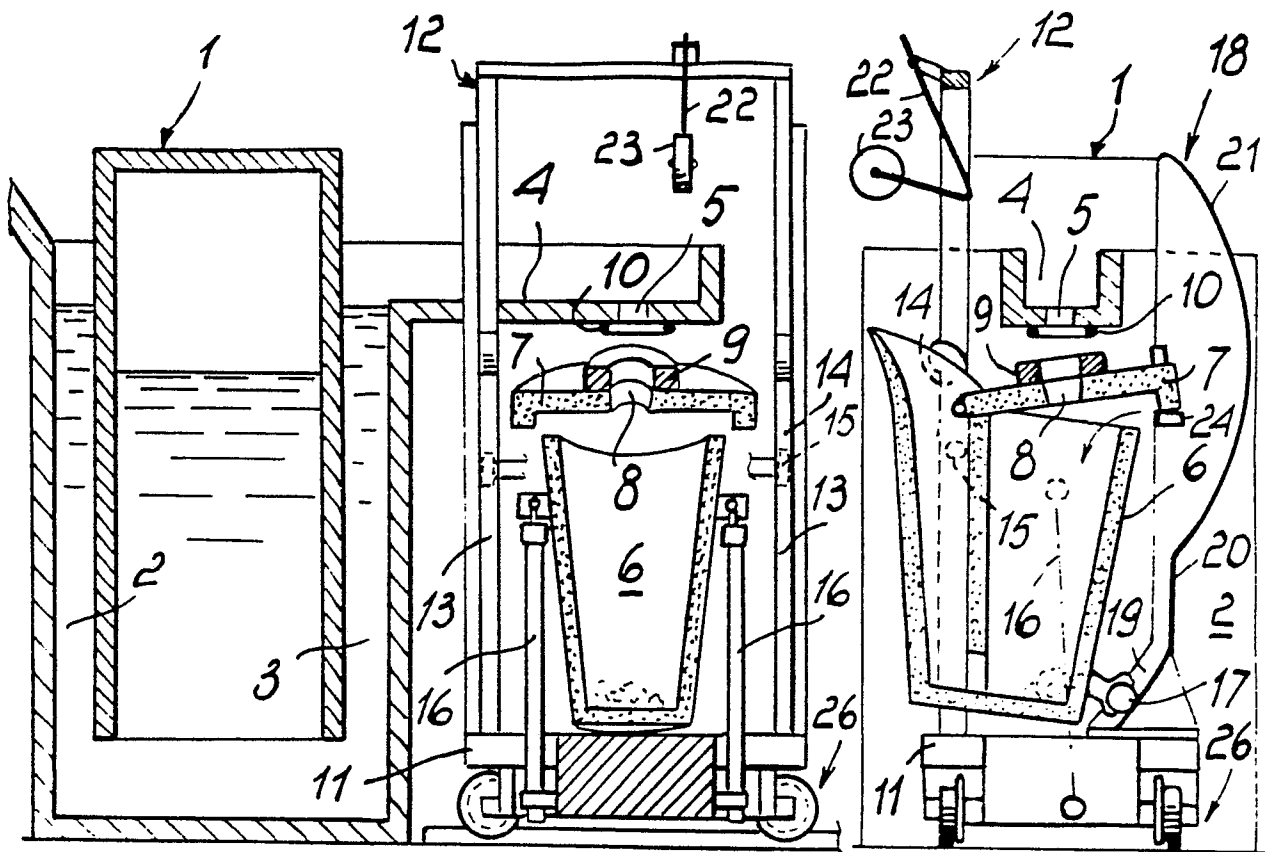


Fig. 1

Fig. 2

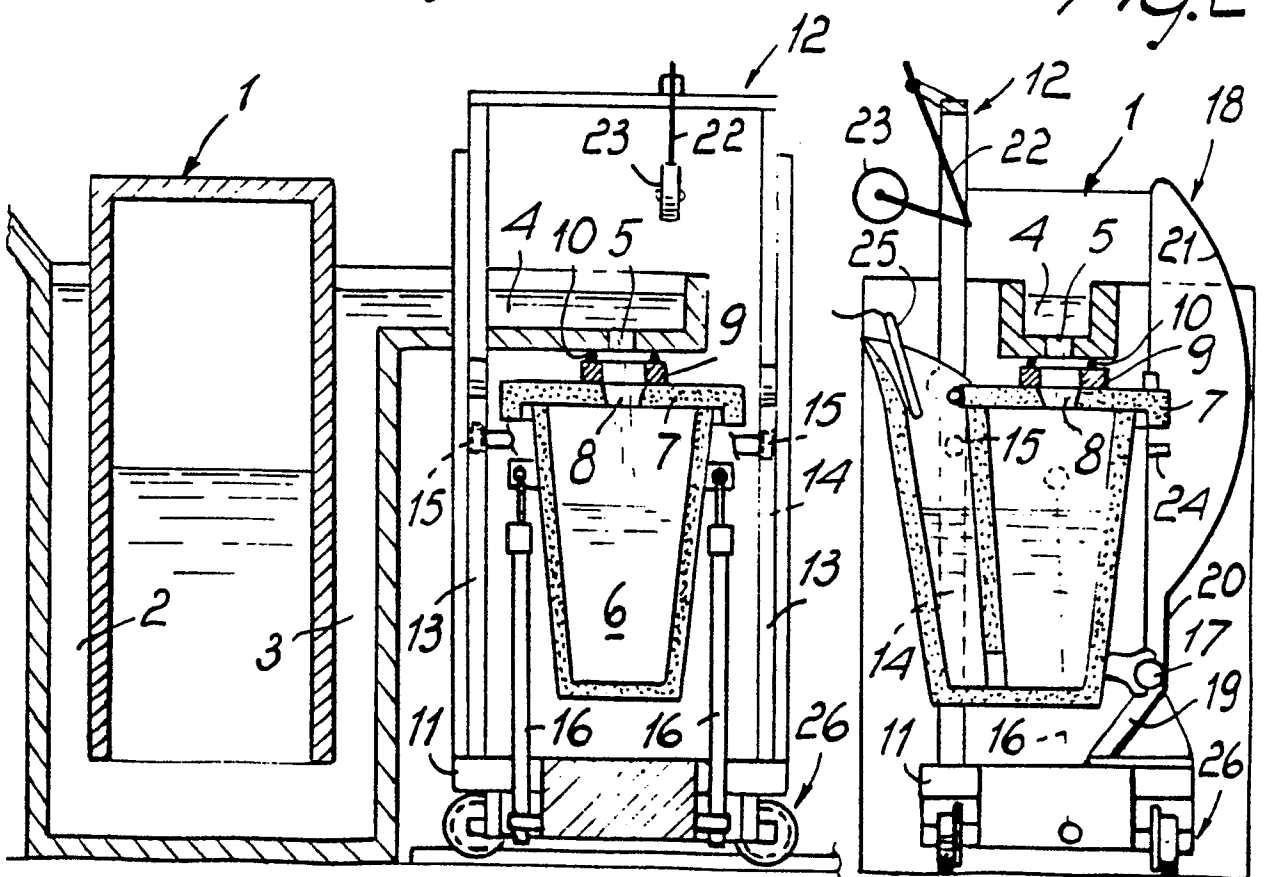


Fig. 3

Fig. 4

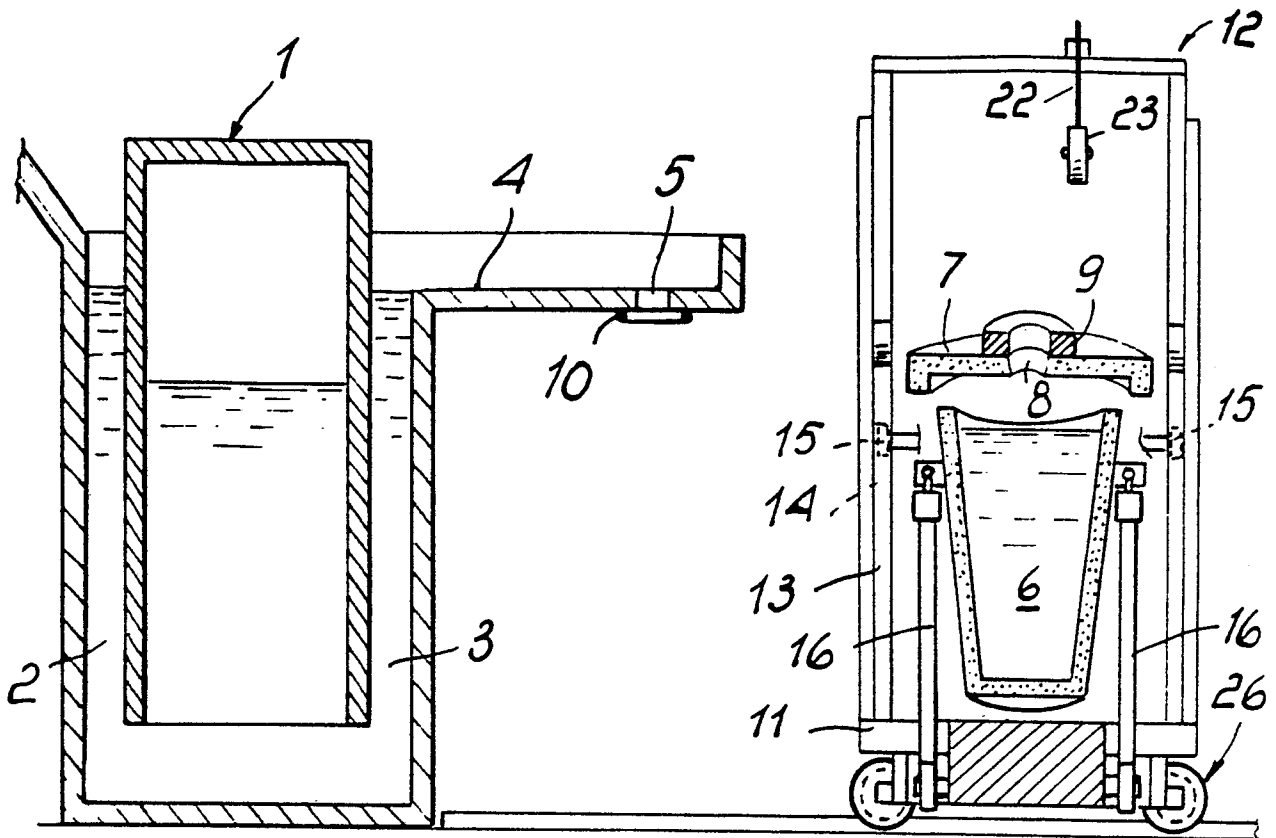


Fig. 5

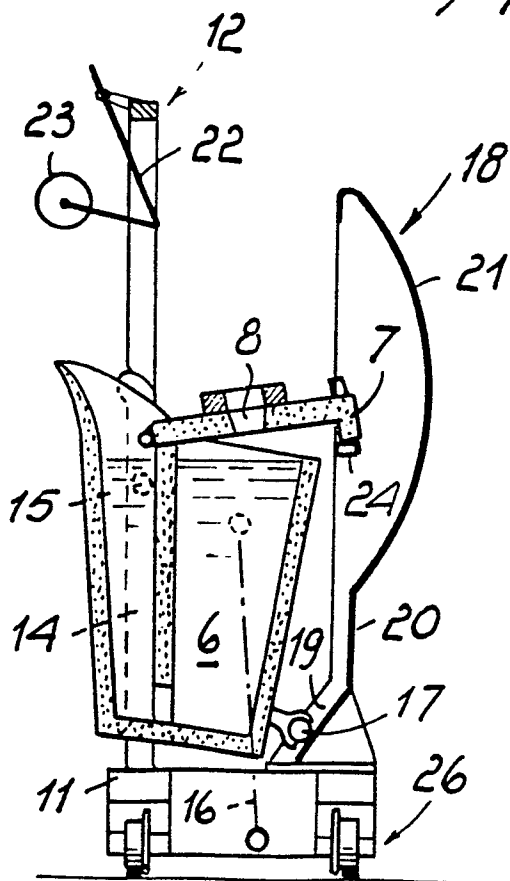


Fig. 6

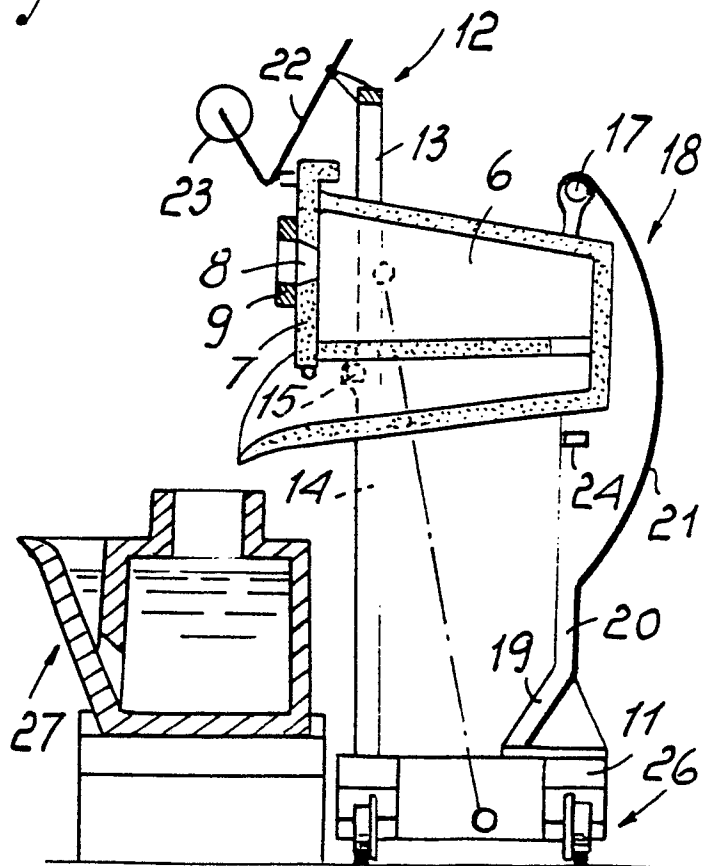
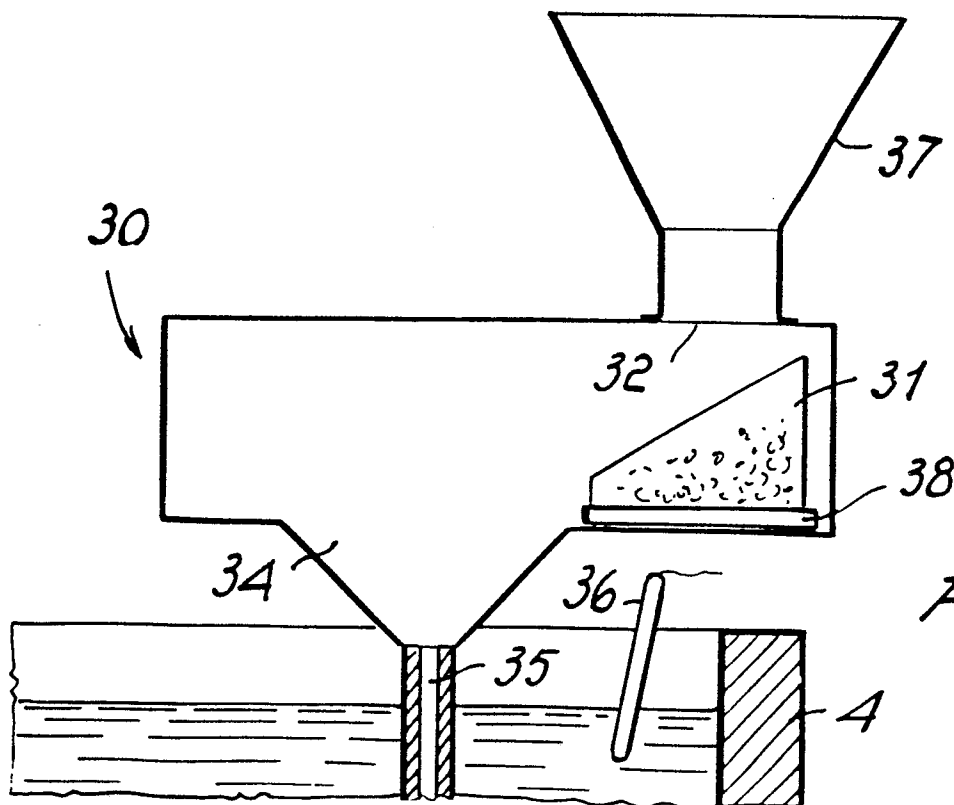
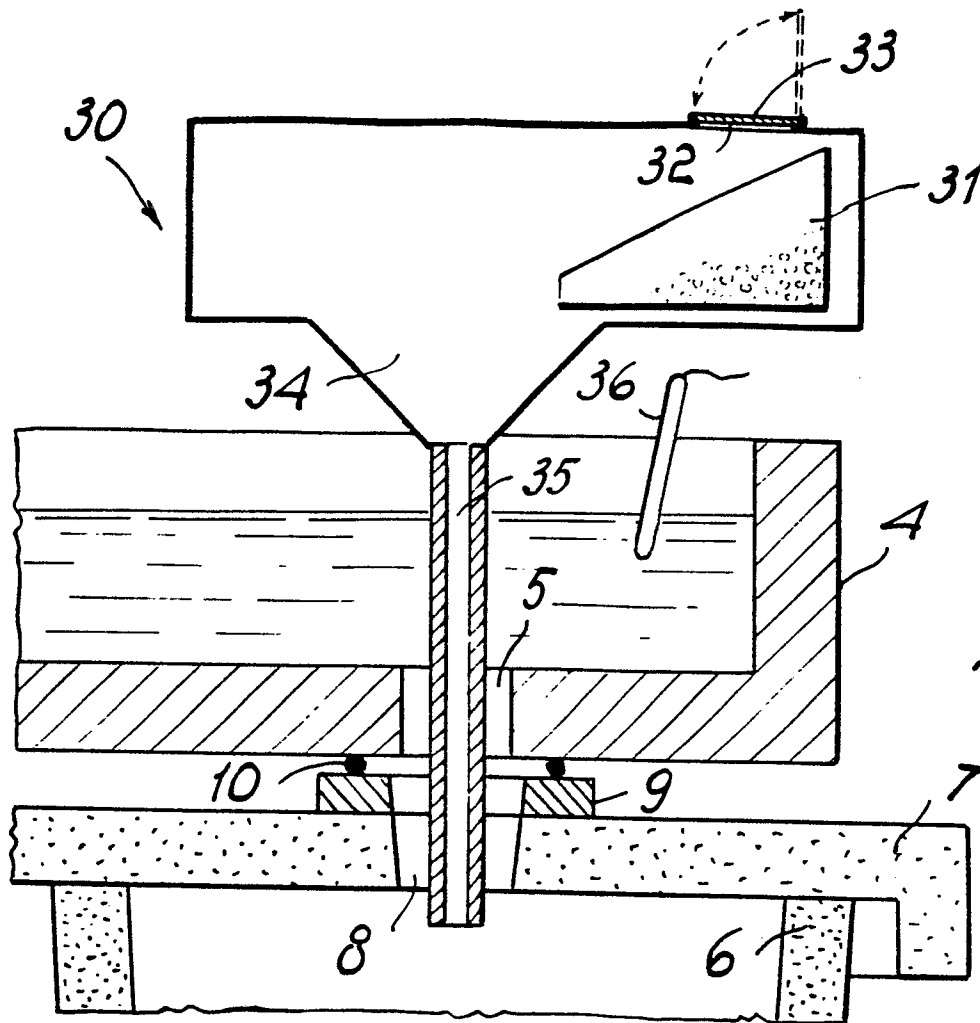
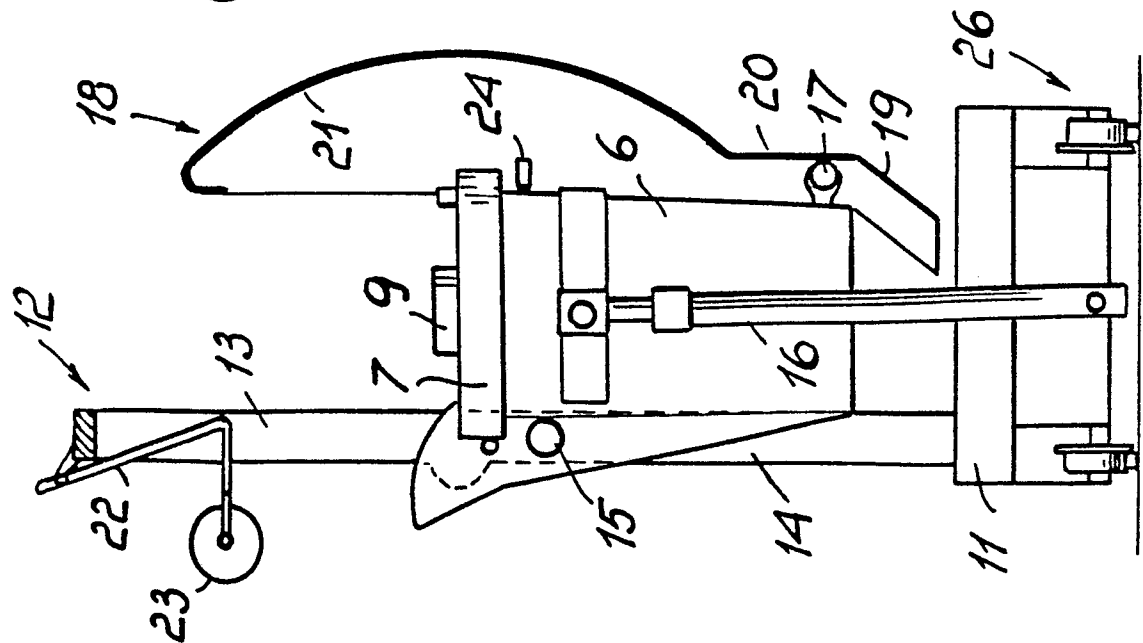
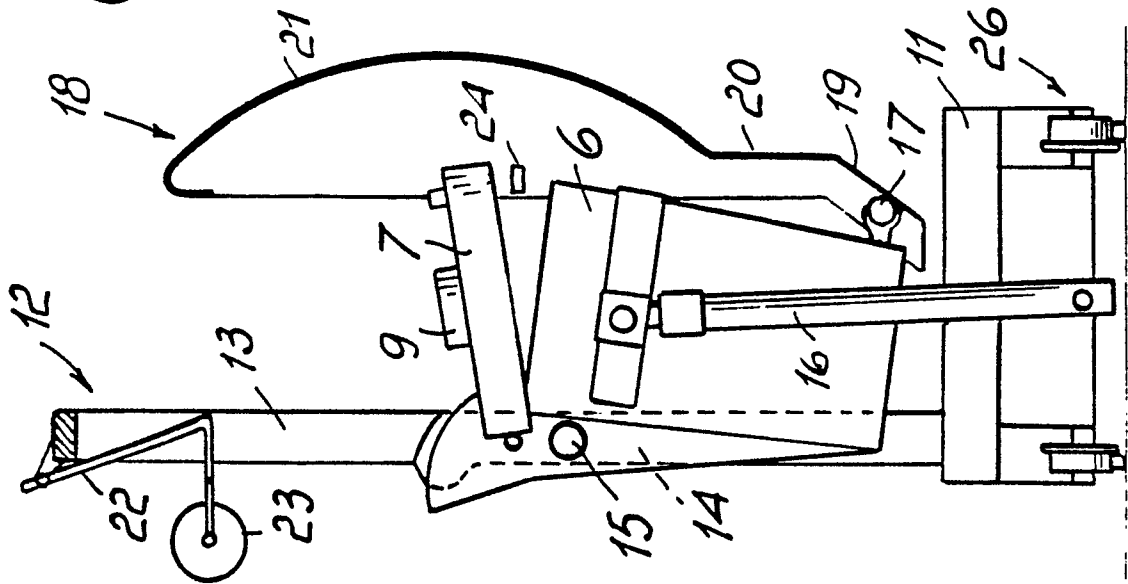
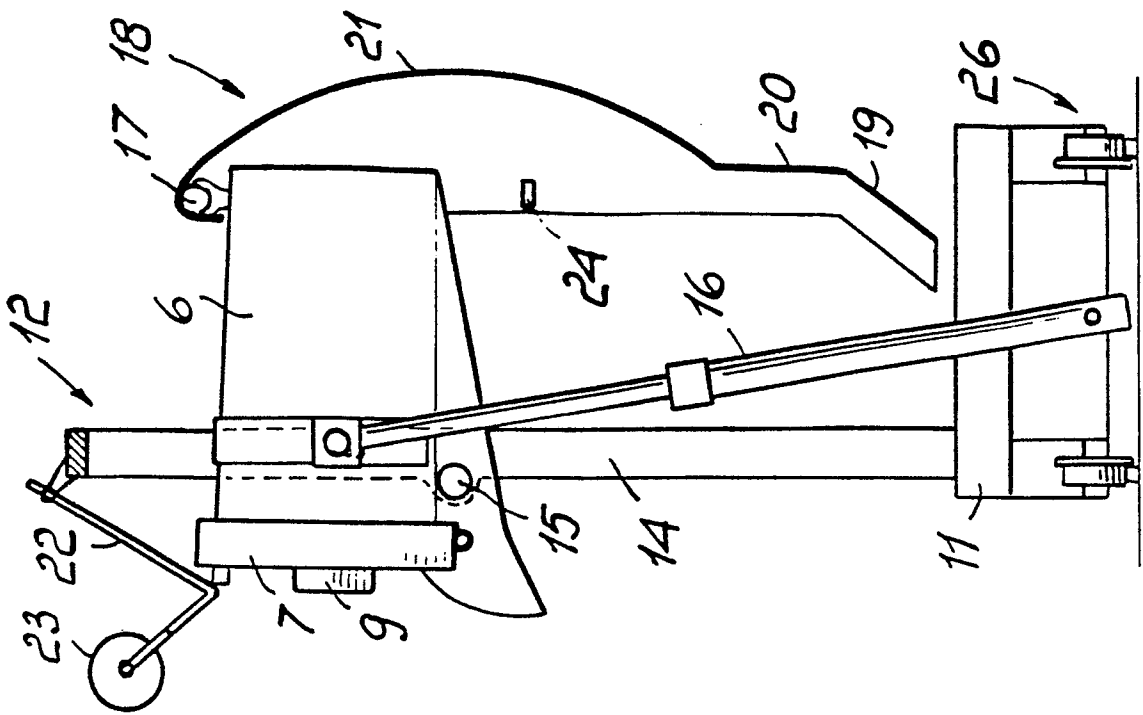


Fig. 7







European Patent
Office

EUROPEAN SEARCH REPORT

0104392

Application number

EP 83 10 7982

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Y	US-A-3 414 250 (SNOW) * Figures; claims *	1	C 21 C 1/10 C 22 C 33/10 B 22 D 1/00
Y	US-A-3 137 566 (J. THIEME) * Figures; claims *	1	
Y,P	GIESSEREI-PRAXIS, vol. 17, September 1982, page 260 and 261, Berlin DD T.L. FORSHEY et al.: "Gusseisen mit Kugelgraphit" J.V. ANDERSON et al.: "Abgedeckte Behandlungspfanne für die Herstellung von Gusseisen mit Kugelgraphit" * Whole document *	1	
A	BE-A- 657 119 (STANDARD MESSO)		TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
A	DE-B-1 275 556 (INTERNATIONAL NICKEL)		B 22 D B 21 C C 22 C
A	GB-A-1 203 339 (TSENTRALNOE KONSTRUKTORSKO-TEKHNOLOGICHESKOE BJURO)		
A	GB-A-2 092 037 (ABEX)		
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 07-12-1983	Examiner OBERWALLENEY R.P.L.I
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			