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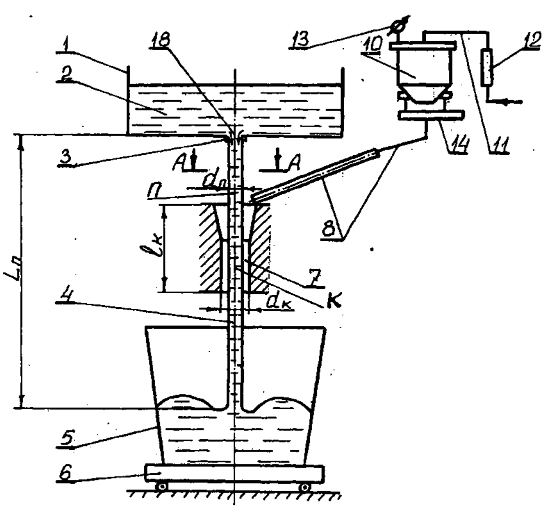
(54) METHOD FOR INFLUENCING A LIQUID METAL CHEMICAL COMPOSITION IN A LADLE AND AN EQUIPMENT SYSTEM FOR CARRYING OUT SAID METHOD

(57) The invention relates to ferrous metallurgy, more exactly to steelmaking. The method suggests the passing of steel flow poured from the smelting chamber into the bucket inside the canal and in the process of such a pass to deliver into the metal flow deoxidizing and desulfurizing agents as well as other modifying elements changing chemical composition of metal in the bucket. The delivery is carried out by the way of free sedimentation with the help of screw and gas injection. Inactive or inert gas is used in all examples. The delivery of elements is carried out at the input to the canal including in several sections along its perimeter. The delivery of elements is carried out in several sections throughout the height and along the perimeter of the canal. It was suggested to succeed the sections of element delivery and in the process of this succeeding to replace the bucket. The elements are given in flour and / or granules. Outfit of equipment for method realization except for smelting chamber, bucket and rated delivery system of elements also includes a mechanism that contains a canal the operating space of which is made of fireproof material, in particular graphite, at that during the process of steel pouring the mechanism is positioned between the outlet of smelting chamber and the bucket, upon that under mentioned positioning of mechanism the long axis of the canal and that of the outlet are coaxial. The mechanism possesses a drive of displacement or self-adjusting or can be immovably mounted. The mechanism contains a bearing construction and replaceable part with canal. The last is made of graphite. The canal has a tapered form at the entrance and the rest part is cylindrical, at that canting angle of the tapered surface from vertical line comprises maximum 30°. I11. 14.



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Description

[0001] The invention relates to ferrous metallurgy, more exactly to steelmaking. It can also be implemented in nonferrous metallurgy.

[0002] There is a known process of influence upon chemical composition of molten steel including steel preparation in smelting chamber and its pouring through the outlet from the basic chamber in intermediate chamber, addition of elements changing chemical composition of steel being in smelting chamber and during the process of pouring (for example, see VS 4632368A, B22D 11/118, 11/14, OT 30.12.1986).

[0003] The known process possesses essential disadvantages:

- Firstly the delivery of elements to the molten steel changing its chemical composition is carried out with the help of glass that prevents from method implementation for the influence on chemical composition of steel in the bucket.
- Secondly significant losses of deoxidizing agents and alloy elements are observed.

[0004] There is a known process of influence on chemical composition of molten steel inside the bucket that includes pouring of molten steel from the outlet of smelting chamber into the bucket and addition of alloy elements and/or deoxidizing agents to the steel. At that the delivery of elements to the steel bucket is executed from above by: 1) injection of powder materials; 2) dipping of special capsules filled with powder materials into the depth of metal; 3) mechanical feeding of elements pressed inside the pipe of low-alloy steel band, etc. (for example, see V.I. Yavojskij and others "Steel metallurgy", textbook for higher institutions, M.: Metallurgia, 1983, p. 322).

[0005] According to dominant features this widely-known process of influence upon chemical composition of steel in the bucket is very close to advanced method, so it is accepted as a prototype.

[0006] The known process possesses essential disadvantages.

[0007] Firstly, only the part of elements added to steel (especially aluminum, calcium, earth metals, alkaline-earth metals, etc.) takes part in the process of steelmaking since their considerable part evaporates (burns).

[0008] Secondly, in order to provide evenness of steel working by volume the process realization requires intensive working of molten steel in the bucket by gas blow.

[0009] Thirdly, it's impossible to produce small lot of steel feeds in large metallurgy if steel mass in the bucket can reach 300 t.

[0010] Fourthly, dust formation and combustion of added elements worsens environmental situation in the area of steelmaking in bucket.

[0011] The advanced method of influence upon chemical composition of molten steel in the bucket is free from indicated disadvantages. It solves the problem of constant and economic delivery of alloy elements and/or deoxidizing agents together with inert gas in molten steel. It provides technical result concerning small lot production of steel feeds in large metallurgy, so it extends processing capabilities in getting of steel feeds with different chemical composition. Environmental situation under delivery of elements into the steel is improved.

[0012] Getting of mentioned technical results is provided thanks to the fact that in advanced method of influence upon chemical composition of molten metal in the bucket that includes pouring of molten metal from smelting chamber outlet into the bucket and system delivering into metal the elements influencing on chemical composition of metal in the bucket according to invention it is proposed to pass the metal flow (stream) that forms during indicated pouring through a canal the dimension of which is less than this flow and cross section somewhat exceeds the cross section of the flow, at that motion pass of the metal flow and long axis of the canal are identical and at least at the canal head the elements changing chemical composition of metal in the bucket are supplied toward the metal flow. In addition the delivery of elements is accompanied by feeding of inactive or inert gas. Besides, the delivery of elements is carried out by their free sedimentation. The elements are delivered slantwise and this feeding is forced. Delivery of elements is executed by gas injection. Elements are added through a screw. Furthermore feeding of elements is executed in several parts of the canal. Elements are added to the canal entrance in several sections along its perimeter. Delivery of elements is carried out in several sections throughout the height and along the perimeter of the canal. Besides sections of delivery of elements succeed each other and during this succeeding the process of metal pouring stops and the bucket is replaced. Motion path of metal at the canal entrance and inside the canal represents a vertical straight line. Motion path of metal at the canal entrance and inside the canal represents a slanting line. At that the elements are supplied in milled and / or granular state.

[0013] The condition of even distribution of elements added to steel in volume terms of molten metal inside the bucket is of prime importance for effective realization of advanced method and it can be performed with the help of advanced system "steel-smelting chamber - bucket".

[0014] There is a known system "steel-smelting chamber - bucket" that contains a smelting chamber (for example, Siemens-Martin furnace) with an outlet and a bucket (for example, see fig. VII. 9 on p. 356, textbook from V.I. Yavojskij and others mentioned above).

[0015] By dominant features this system of steelmaking is very close to advanced structure, so it is accepted as a prototype.

[0016] The known system has essential disadvantages analyzed in description of known process. Marked disadvantages result in necessity of execution of additional operation: blow of molten steel in bucket by inactive or inert gas (for example, see fig. 2.1 on p. 102 in the book "Processes of continuous steel casting" / Monography. A.N. Smirnov and others - Donetsk: DonNTU, 2002).

[0017] The advanced system "smelting chamber - bucket" is free from disadvantages of the known system. It solves the problem concerning delivery of elements influencing on chemical composition of metal in bucket into the molten metal (deoxidizing and desulfurizing agents, modifying elements) with their even distribution within the volume of metal inside the bucket and economical use of these elements (deoxidizing agents, alloy elements, etc.).

[0018] Getting of technical results in advanced system is provided thanks to the fact that the system containing smelting chamber, bucket and mechanisms that are necessary and sufficient for delivery of elements with different fraction into metal according to the invention has an ending part of mechanisms on the way of element delivery into metal; this part includes a canal the operating space of which is made of fireproof material and it provides a possibility of its positioning between the chamber outlet and the bucket during the process of metal pouring, at that under indicated positioning of mechanism the long axis of the outlet and that of the canal are identical and coaxial. Upon that the mechanism possesses a drive of its positioning with displacement of the canal axis in coaxial relationship with the long axis of outlet. Besides the mechanism has a possibility of self-adjusting against the chamber outlet with certain axiality between long axes of the outlet and the canal. Among other things the mechanism is mounted completely immovable relating to the smelting chamber. Furthermore the mechanism is fixed on the frame of smelting chamber. The mechanism and the drive of its displacement are settled outside the operating space of smelting chamber. The mechanism includes bearing construction and replaceable part with the canal. The replaceable part with the canal is made of graphite. The canal possesses tapered and cylindrical parts, at that the tapered part serves as an entrance to the canal and canting angle of the tapered surface from vertical line comprises maximum 30°. The method of influence on chemical composition of molten metal inside the bucket with system outfit for its realization is explained by figures 1-14.

[0019] The fig. 1 schematically represents the system "smelting chamber - bucket" for method execution; fig. 2 - section A-A of the fig. 1; fig. 3 - system "smelting chamber - bucket" for method execution at Siemens-Martin furnace; fig. 4 - section A-A-A of the fig. 3; fig. 5 shows the delivery of elements into metal by screw; fig. 6 - section A-A of the fig. 1 in the event that elements are added to the metal at the beginning of canal entrance in several sections along its perimeter; fig. 7 - section A-A of the fig. 5 in the event that elements are added to the metal in several sections throughout the height and along the perimeter of canal; fig. 8 - self-adjusting of mechanism against the outlet of chamber turned for discharging with provision of axiality of outlet and canal long axes; fig. 9 - section A-A of the fig. 8; fig. 10 and 11 shows positioning of mechanism and its drive of displacement outside the operating space of smelting chamber (vessel); fig. 12 - connection of supporting part and replaceable part with the canal; fig. 13 - embodiment of replaceable part of the system with canal; fig. 14 - test diagrams of the method analyzed for a cold model under laboratory conditions.

[0020] Smelting chamber 1 (Siemens-Martin furnace, arc steel-smelting furnace, basic oxygen furnace, induction furnace, etc.) is filled with molten metal 2 (fig. 1, 3, 8). The chamber 1 contains outlet 3 where through the molten metal in the shape of flow (stream) 4 comes into the bucket 5 mounted on barrow 6 with possible displacement to / from the chamber 1. During pouring of molten metal 2 from the chamber 1 into the bucket 5 the flow (stream) 4 is formed that is characterized (for the stream) by diameter d_f and dimension L_f that is a variable value. Relating to pouring of the molten metal 2 from the chamber 1 of Siemens-Martin furnace (fig. 3) the flow 4 with dimensions B_f И H_f is formed during the process of metal pouring (fig. 4). Between the chamber 1 and the bucket 5 there is a canal 7 with the length l_c and internal diameter d_c (fig. 1, 2, 5-7, 13, 14 and 15); in the case of Siemens-Martin furnace the canal 7 with dimensions $B_c = B_f$, the height $H_c > H_f$ and the length l_c is used (fig. 3 and 4).

[0021] During the process of pouring the molten metal in the shape of flow 4 moves in a path F; the long axis of the canal 7 is marked in figures as C. The flow path F and the long axis of the canal C are identical and in most cases coaxial. The exclusion represents the system "Martin furnace - bucket" when the flow path F and the long axis of the canal C are identical but not coaxial (fig. 4).

[0022] Canal 7 section ($\frac{\pi d_c^2}{4}$ for the majority of figures and $B_c \cdot H_c$ in the fig. 4) somewhat exceed the stream area $\left(\frac{\pi d_f^2}{4}\right)$ or flow area ($B_f \cdot H_f$) correspondingly. The mentioned excess gives 1,3...1,4. If the excess is less then the flow (stream) of metal is likely to have more frequent contact with canal surface that is unwanted since it disturbs even metal fall inside the flow after coming out from the canal 7 as well as increases metal scattering after output from the canal. The higher excess considerably reduces suction of fed inactive or inert gas into the clearance "metal flow - canal" and worsens mixing and embedding of elements into the metal flow during their free delivery.

[0023] The canal length l_c is less than minimum value of flow length l_f and that excludes the possibility of frequent contact of canal 7 surface with the flow 4 of molten metal 2. The preferred length l_c is approximately

$$\left(\frac{1}{4}\cdots\frac{1}{2}\right)L_f .$$

[0024] Deoxidizing, desulfurizing agents and modifying elements are supplied into the canal 7 through the pipe (channel) 8. Delivered elements can be of different fraction: from flour to granules. The indicated elements can be supplied separately or together. The delivery of elements can be free: they fall by gravity vertically in slanting line with appropriate gradient (fig. 3). The delivery of elements can be forced: by gas injection through the pipe (fig. 1), with the help of screw 9 (fig. 5) as well as by any other method of forced feed for granular materials. Dominantly delivery of elements is supplied with inactive or inert gas. At that gas can be fed separately but more often gas feeding and delivery of elements are overlapped that is a common channel for input into the flow of molten metal is used.

[0025] Delivery of elements basically provides a system (fig. 1) containing pipe arrangement 8, container 10 filled with flour or / and granules of delivered elements. By mobile structure for delivery of elements flexible pipes (hoses) 8 must be used. To the container 10 through the pipe 11 inactive or inert gas is fed the consumption of which is controlled by the device 12, pressure - by the device 13; consumption of delivered elements is checked by dosing mechanism 14 (if several containers are used then every container has a separate dosing mechaism).

[0026] The pipe 8 can be led to the input of metal flow 4 to the canal 7 (fig. 1). The pipe 8 can be let to the body 15 of the canal 7 but closer to the input of the canal 7 (fig. 5). At that the delivery of elements can be carried out only from the pipe 8 connected to the canal 7 but it is also possible to use the delivery of elements in several sections of the canal 7, for example, in three along the perimeter at the entrance of canal 7 input (fig. 6) or in three throughout the height and along the perimeter (fig. 7) but closer to the input of the canal 7.

[0027] The body 15 of the canal 7 must be made of fireproof material. It is preferred to use graphite since it excludes sticking of molten metal to the internal surface of the canal 7. The canal 7 in the body 15 is embodied of tapered and cylindrical parts (fig. 13), at that canting angle of the tapered surface from vertical line generally comprises not more than 30°, since the greater angles provide a possibility of scattered instances when the falling metal particles of the flow 4 spring back outside the body 15. As applied to metal tapping from Siemens-Martin furnace the canal 7 is formed by covering of discharge spout 16 by the body 15 made of fireproof material and bearing construction (fig. 3 and 4).

[0028] Thus the delivery of elements into the metal flow 4 provides the usage of mechanism containing the canal 7 the operating space of which is made of fireproof material, preferably of graphite. The mechanism is executed of supporting part 16 (fig. 12) and part 15 with the canal. The canal containing part 15 is replaceable. The mechanism provides a possibility of its positioning (during the process of metal pouring) between the outlet 3 of smelting chamber 1 and the bucket 5, at that under indicated positioning of mechanism the long axis 18 of outlet 3 and the long axis *C* of canal 7 are identical i.e. in coaxial. For fulfillment of this condition the mechanism has a possibility of self-adjusting or/and regulation by the drive of displacement. The mechanism can be fixed on smelting chamber 1 (fig. 3).

[0029] Any embodiment of mechanism excludes negative influence on the work with smelting chamber 1 including operation of the outlet 3.

[0030] For self-adjusting of the mechanism with part containing canal the supporting part 16 of the mechanism is fixed on the frame of the chamber 1 (for example, ASF[1]) by joints 17, so by the rotation of chamber 1 for metal tapping the supporting part 16 of the mechanism is also rotated and the long axis C of the canal 7 is situated coaxial with the long axis 18 of the outlet 3 (fig. 8 and 9).

[1] Arc steel-smelting furnace.

[0031] For adjustment of mechanism with canal containing part 15 during the process of metal tapping between the outlet 3 of the smelting chamber 1 (vessel) and the bucket 5 (fig. 10 and 11) the mechanism provides a drive. Drive versions can be different but in any case of its embodiment the drive and the mechanism are not situated inside the operating space of smelting chamber 1 before chamber positioning for molten metal tapping. Likewise in either case the drive must provide coaxial alignment of the long axis *C* of canal 7 and motion path of the metal flow 4 i.e. the axis *F*.

[0032] The drive can be executed (fig. 10) for example in the form of batten 16 (it also serves as bearing construction 16 of the mechanism) and a drive of its displacement in the form of gear 19 having the drive from the engine 20. At that the rollers 21 represent a bearing of the batten 16. In the fig. 10 the position of mechanism in workless condition is shown by full lines, the operative position is illustrated by dashed lines.

[0033] The drive of the mechanism can be executed (fig. 11) for example by way of four-link chain of Chebyshev 22 (fig. 11) and a drive appropriate for it (in the fig. 11 not shown for clarity).

[0034] It is possible to use drives of other types executed with due account of described requirements with regard to implementation and mechanism positioning.

[0035] Smelting chamber 1 of the type ASF (fig. 8 and 9) and basic oxygen furnace (fig. 10 and 11) contains the axis 23 and rotating mechanism of the chamber 1 about this axis during process realization of metal pouring from the chamber 1 into the bucket 5.

[0036] The method of influence on chemical composition of molten metal in the bucket is carried out in the following way.

[0037] Molten metal 2 is produced in the chamber 1 (fig. 1; Martin furnace in the fig. 2; ASF in fig. 3 and 4; basic oxygen furnace in fig. 10 and 11). The metal 2 is prepared for tapping from the chamber 1 into the bucket 5 through the outlet 3. As applied to ASF and basic oxygen furnace the chamber must be rotated about axis 23.

[0038] The mechanism with canal 7 is carried in the gap chamber 1 - bucket 5; relating to Martin furnace in the fig. 2 the canal 7 is formed at the expense of the top part 15 mounted over the discharge spout 16 or immovably fixed above it. The axis *C* of the canal 7 and the axis 18 of the outlet 3 must be situated in coaxial relationship. There must be used self-adjusting of bearing construction 16 of the mechanism (fig. 8 and 9) or the displacement drive of bearing construction 16 corresponding to the given in fig. 10 and 11 and in descriptions of these figures.

[0039] The outlet 3 is open and metal 2 in the form of flow (stream) 4 rushes down into the bucket 5 along the path *F*. The path *F* and the axis *C* are identical and in most cases coaxial. During method realization by Martin furnaces it is difficult to provide coaxial relationship of the path *F* and the axis *C* (see fig. 4) but in this situation a strict axiality is not necessary, identity is already enough.

[0040] When the bucket 5 contains about 10...15 t of metal (the last depends on parameters of the chamber 1 and appropriate dimension of the bucket 5) deoxidizing and/or desulfrurizing agents and/or modifying elements are given from the container 10 with the help of dosing mechanism 14 through the pipe 8 toward the metal flow 4. The delivery is carried out by free sedimentation including in slanting line (fig. 3), by gas injection (fig. 1), through the screw (fig. 5) or by other means. The most convenient technique of delivery toward the metal flow 4 must be chosen for every instance of production process. The delivery of elements toward the metal flow 4 is accompanied by inactive or inert gas feeding. In some cases especially at delivery of elements in granules the delivered elements must receive higher speed that provides embedding of elements (granules) into the metal; the speed is achieved by injection of inactive or inert gas feeding through the pipe 11 and controlled by devices 12 and 13 (fig. 1).

[0041] In the strict sense at method realization it is preferred to feed inactive or inert gas together with delivery of elements. But it is possible to realize the method without gas feeding or with air supply.

[0042] Preference of inactive or inert gas usage is conditioned by increased metal protection by these gases from oxidation. The latest happens due to: firstly, suction of these gases into the gap between the flow 4 and the surface of canal 7 as well as enveloping of the flow by these gases and secondly, penetration of partial gas into the metal flow and then into the bucket 5. Both these phenomena take place at method realization and improve the quality of metal in the bucket. Even the mentioned excess of canal 7 size over dimensions of the flow 4 provides the described phenomena during method realization.

[0043] In order to simplify technical realization of the method the delivery of elements is carried out at the input of the metal flow 4 into the canal 7 (fig. 1). At that tapered part at the input to the canal 7 and described phenomenon of gas flow suction into the gab between the flow 4 and the surface of canal 7 are additionally used.

[0044] However, the delivery of elements to the metal flow can be also realized in different places throughout the height of canal 7 (its supporting part 15; see fig. 5 and 7). Expediency of such a delivery of elements to the metal flow 4 is conditioned merely by design considerations (arrangement of system "chamber 1 - bucket 5"). But this delivery of elements into the metal flow 4 is preferred by the usage of fine elements in dispersed state when supply of these elements at the input into the canal 7 causes considerable dust pollution of this area in the work of system and to additional losses of delivered elements.

[0045] The method realization doesn't exclude the simultaneous implementation of described variants of element supply into the metal flow 4: one part - at the input of the canal 7, another one - at a distance from the canal input in the direction of metal flow travel.

[0046] The method realization provides a possible delivery of elements at the entrance of canal 7 input along its perimeter (fig. 6) or throughout the height and along the perimeter of the canal (fig. 7). It realizes separation of elements delivered into the flow 4.

[0047] Furthermore the described delivery of elements along several sections of the canal 7 provides small lot production of steel differing by chemical composition in large metallurgy. In this case the delivery system is equipped with several containers 10 as well as units and modules 8, 10-14 (fig. 1) that ensure their functioning. Every container has its own measured amount and content of elements. Containers 10 operate in turns, with interruption of work. During mentioned interruption the process of metal pouring is stopped, for example by rotation of the chamber 1 about the axis 23, the bucket 5 is refreshed with the help of barrow 6, then the chamber 1 must be rotated to the position of metal 2 poring into the bucket 5 and delivery of elements in the metal flow 4 is carried out from another container 10. Thereby small lots of molten steel with different chemical composition in every bucket are produced in large metallurgy. It is natural that the realization of described technique requires the presence of buckets with smaller capacity together with buckets of greater capacity in the steel plant.

[0048] Thus the method of influence on chemical composition of molten metal in the bucket together with the system for its realization at initial stage of teeming is advanced: before entrance of metal into the bucket the molten metal flow is supplied with elements (deoxidizing and desulfurizing agents and other modifying elements) changing chemical composition of steel in the bucket. The entrance of this metal flow into the bucket intensifies intermixing of these elements with molten metal and speeds up the process of homogenization of steel chemical composition in the volume of the bucket. Significant technical aspect of advanced method consists in loss reduction of elements delivered into metal; together with increased economic factors it improves ecological conditions of work in the area of element delivery into the steel. Manufacturing capabilities in metal production are extended at the expense of conditions that provide receiving of small lots of steel with different chemical composition in large metallurgy.

[0049] Example 1. Smelting chamber in cold model (fig. 14) was imitated by vessel 1, the bucket - by vessel 5. The vessel 1 possessed the outlet 3 closed by fitting mechanism (in the fig. 14 not shown for clarity). Bearing construction 16 with mounted canal containing body 15 and canal 7 was fixed to the vessel 1. Long axis 18 of the outlet 3 and the axis C of the canal 7 were coaxial. The canal 7 was executed with tapered (at the entrance) and cylindrical parts. Inclined pipe 8 with the container 10 in its upper part was connected to the canal 7. The container 10 was filled with granular material 24 (colored salt, chips). Container 10 has a fitting plug 25 with a handhold enabling opening (closing) of granular material delivery into the vessel 5 (see the arrows).

[0050] The vessel 1 was filled with water 2, the fitting plug was opened and water flow in stream 4 being passed through the canal 7 fell downward into the vessel 5. At that the axis C of the canal 7 and descent trajectory of the stream F coincided. After filling of about a quarter of the vessel 5 the fitting plug 25 was opened and granular material 24 was delivered through the pipe 8 into the water flow 4 at the entrance of the canal 7.

[0051] In the volume of vessel 5 was produced evenly colored water. Identical filling of the vessel 5 by water from the vessel 1 (but without passing of water flow 4 through the canal 7) and delivery of the same granular material into vessel 5 show observantly more unequal coloring of water in the volume of the vessel 5 at the end of water pouring.

[0052] Example 2. The conditions prescribed for example 1 (fig. 14) for delivery of granular material 24 from the container 10 into the pipe 8 and then into the water flow 4 provide feeding of gas 26 into the container 10 after opening of fitting plug 25. In the volume of vessel 5 was observed the analogous to example 1 distribution of colorant.

[0053] Example 3. On ASF intended for production of about 100 t of steel in one smelting process and having an outlet situated in the bay window the body 15 with the canal 7 was mounted after furnace rotation; this channel received steel flow from ASF into the bucket in amount of 160 kg during 80 s. The pressure of injected air was equal to 6 bar at the input and about 2,0 bar nearby the canal 7. Feeding speed of aluminum shot into the metal flow came up to 2,0...2,5 m/s. The shot was of fraction ∅ 1,0...5,0 mm with dominant size 1,0...2,0 mm. The received results were compared with accepted technique of aluminum feeding in the form of bars in mass 10...11 kg. The consumption of basic alloy elements was the same in both cases.

[0054] At practically the same deoxidation degree of steel inside the bucket the consumption of aluminum according to existing technique was 1,48 kg/t; during realization of advanced method it consists of 1,17 kg/t, i.e. was reduced in 0,31 kg/t.

Claims

1. The method of influence upon chemical composition of molten metal in the bucket including pouring of molten metal from the smelting chamber through the outlet into the bucket and delivery system of elements influencing on chemical composition of metal in the bucket differs since the flow (stream) of metal being formed during mentioned pouring is passed through the canal the dimension of which is less than the length of this flow and the section somewhat exceeds the flow area, at that the motion path of metal flow and the long axis of the canal are identical and at least at the entrance of canal the elements changing chemical composition of metal in the bucket are delivered.

2. According to the claim 1 the method differs since the delivery of elements is carried out together with inactive or inert gas.

3. According to the claim 1 the method differs since the delivery of elements is carried out by the way of free sedimentation.

4. According to the claim 3 the method differs since the delivery of elements is carried out in slanting line.

5. According to the claim 1 the method differs since the delivery of elements is carried out forcibly.

6. According to the claim 5 the method differs since the delivery of elements is carried out by the way of gas injection.

7. According to the claim 5 the method differs since the delivery of elements is carried out with the help of screw.

8. According to the claim 1 the method differs since the delivery of elements is carried out in several sections of the canal.

9. According to the claim 8 the method differs since the delivery of elements is carried out at the input to the canal in several sections along its perimeter.

10. According to the claim 8 the method differs since the delivery of elements is carried out in several sections throughout the height and along the perimeter of the canal.

11. According to the claim 8 the method differs since the delivery of elements is carried out by succeeding of sections, at that during this succeeding the process of metal pouring stops and the bucket is replaced.

12. According to the claim 1 the method differs since the motion path of metal at the canal entrance and inside the canal represents a vertical straight line.

13. According to the claim 1 the method differs since the motion path of metal at the canal entrance and inside the canal represents a slanting line.

14. According to the claim 1 the method differs since the elements are delivered in flour and/or in granules.

15. According to the claim 1 the system "smelting chamber - bucket" containing smelting chamber with outlet, bucket and mechanisms that are necessary and sufficient for delivery of elements with different fraction into metal differs since there is an ending part of mechanisms on the way of element delivery into metal that includes a canal the operating space of which is made of fireproof material and it provides a possibility of its positioning between the chamber outlet and the bucket during the process of metal pouring, at that under indicated positioning of mechanism the long axis of the outlet and that of the canal are identical and coaxial.

16. According to the claim 15 the system differs since the mechanism possesses a drive of adjustment with the axis of canal positioned coaxially to the axis of the outlet.

17. According to the claim 15 the system differs since the mechanism has a possibility of self-adjusting against the chamber outlet with provision of axiality between long axes of the outlet and the canal.

18. According to the claim 15 the system differs since the mechanism is mounted immovable relating to the smelting chamber.

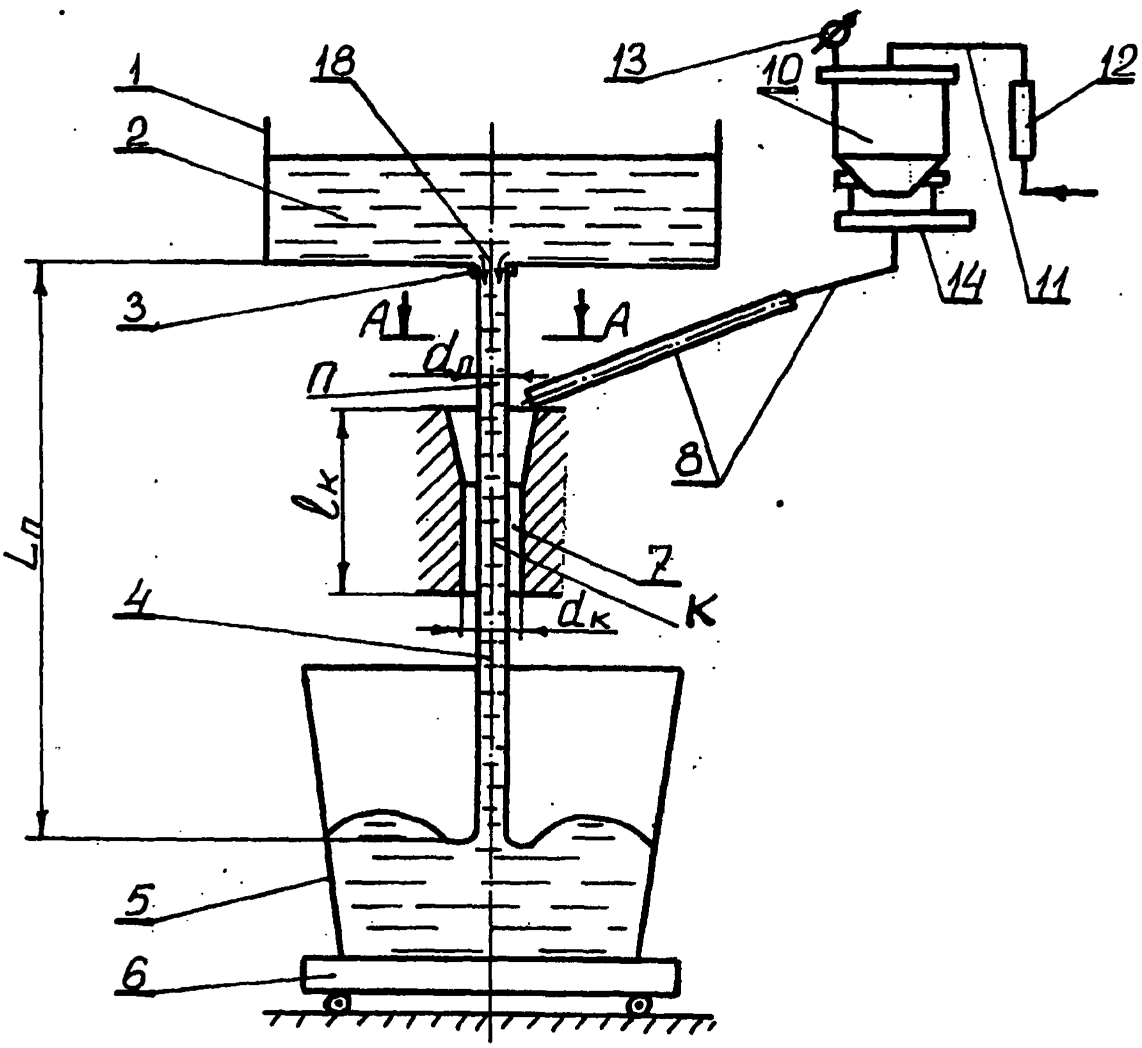
19. According to claims 16 and 17 the system differs since the mechanism is fixed on the frame of smelting chamber.

20. According to the claim 16 the system differs since the mechanism and the drive of its displacement are settled outside the operating space of smelting chamber.

21. According to the claim 15 the system differs since the mechanism consists of bearing construction and replaceable part with the canal.

22. According to the claim 15 the system differs since the replaceable part with the canal is made of graphite.

23. According to the claim 15 the system differs since the canal possesses tapered and cylindrical parts, at that the tapered part serves as an entrance to the canal and canting angle of the tapered surface from vertical line comprises maximum 30°.



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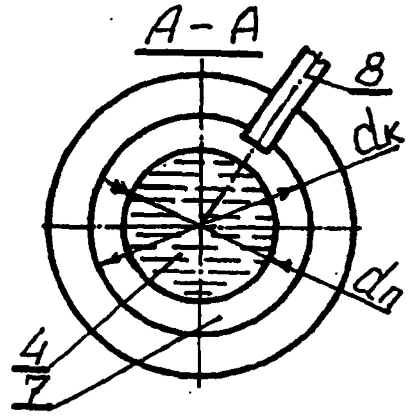

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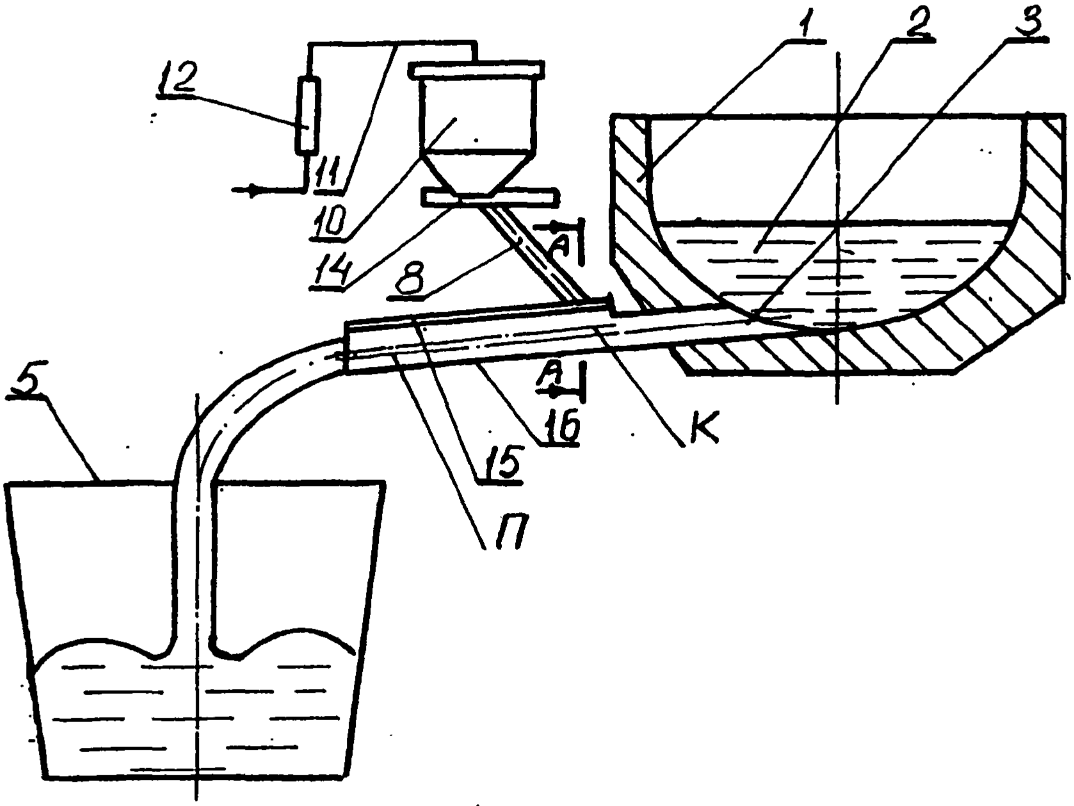

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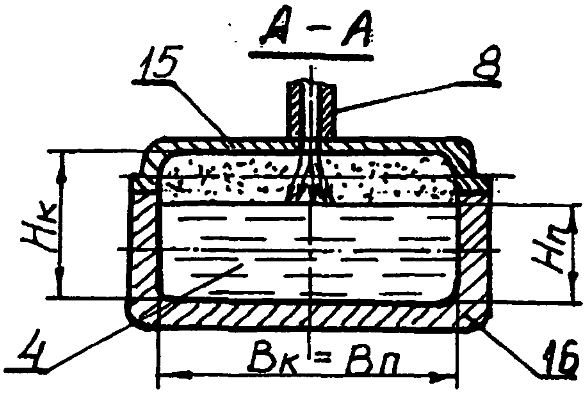

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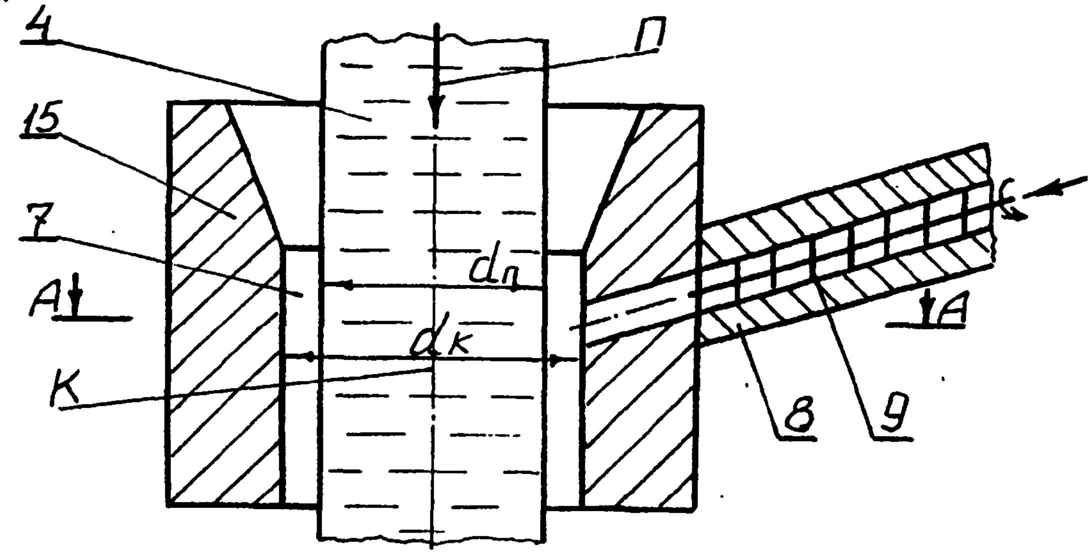

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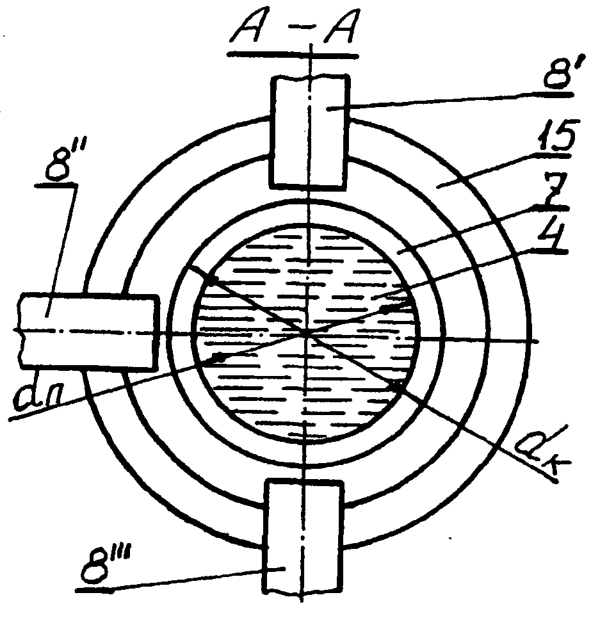

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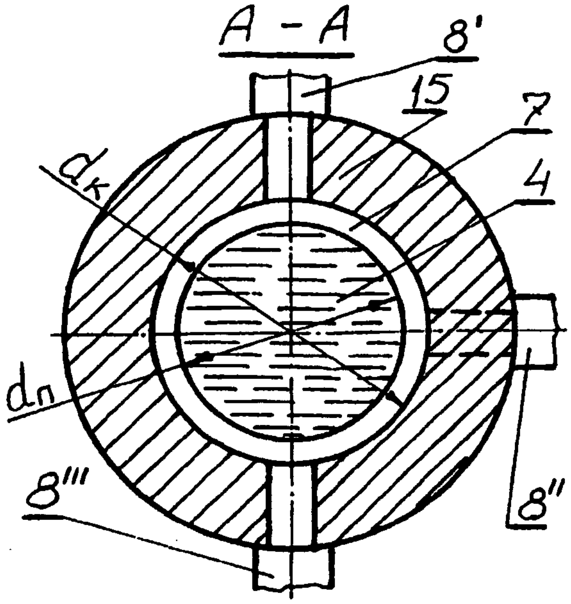

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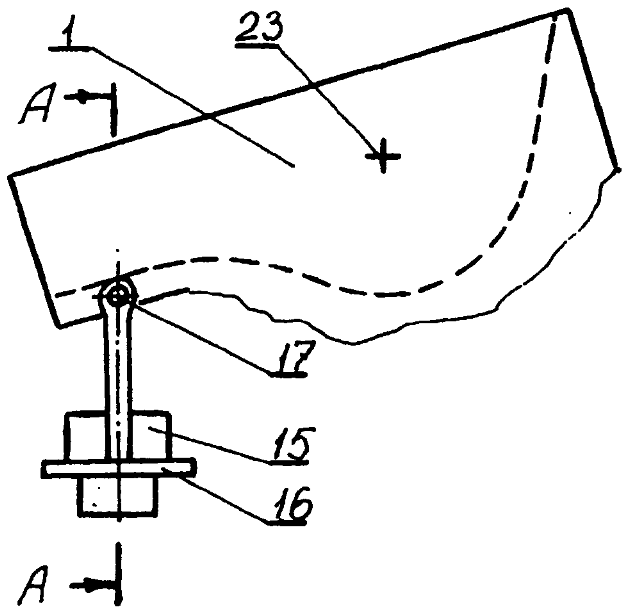

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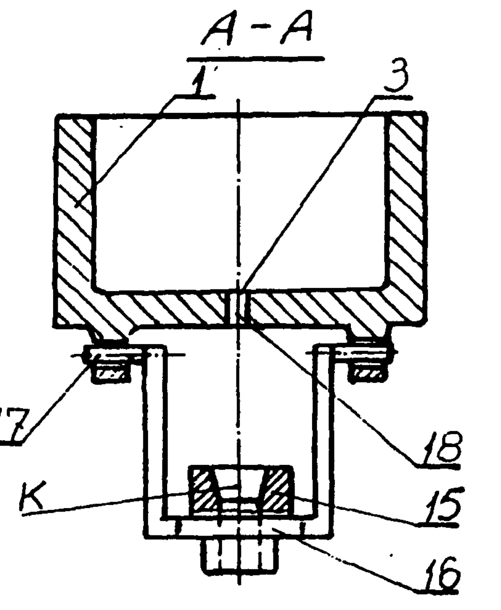

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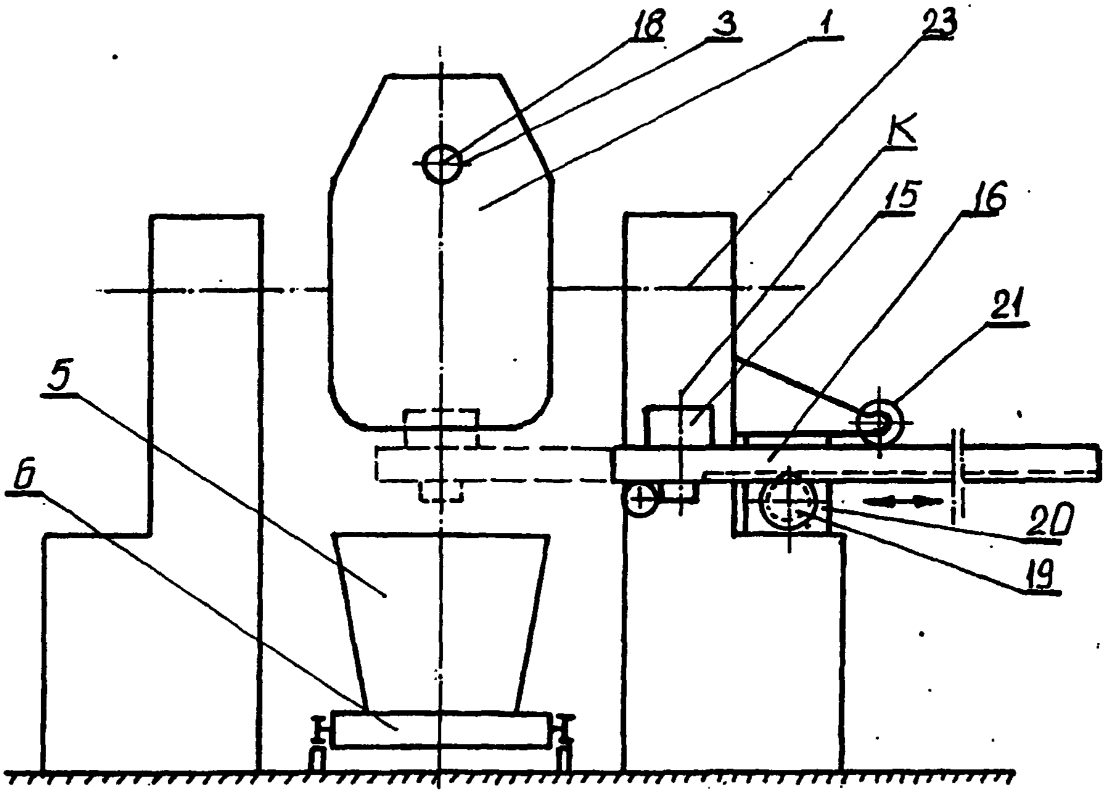

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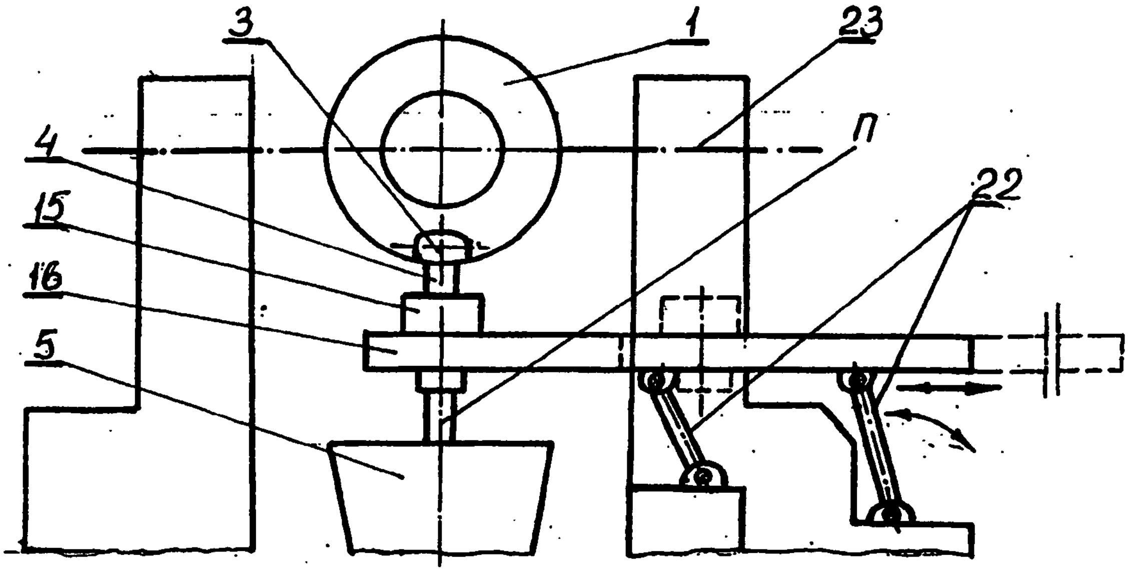

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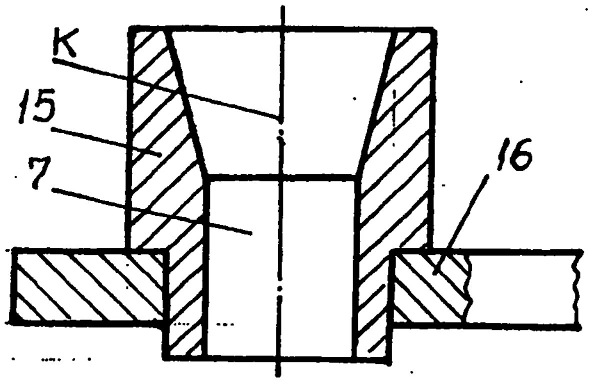

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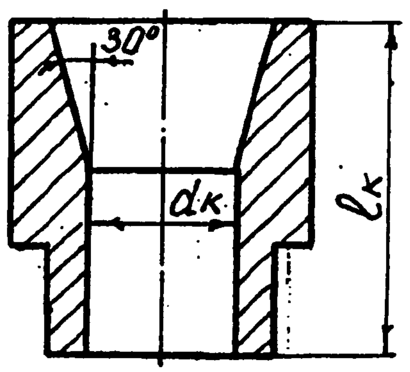

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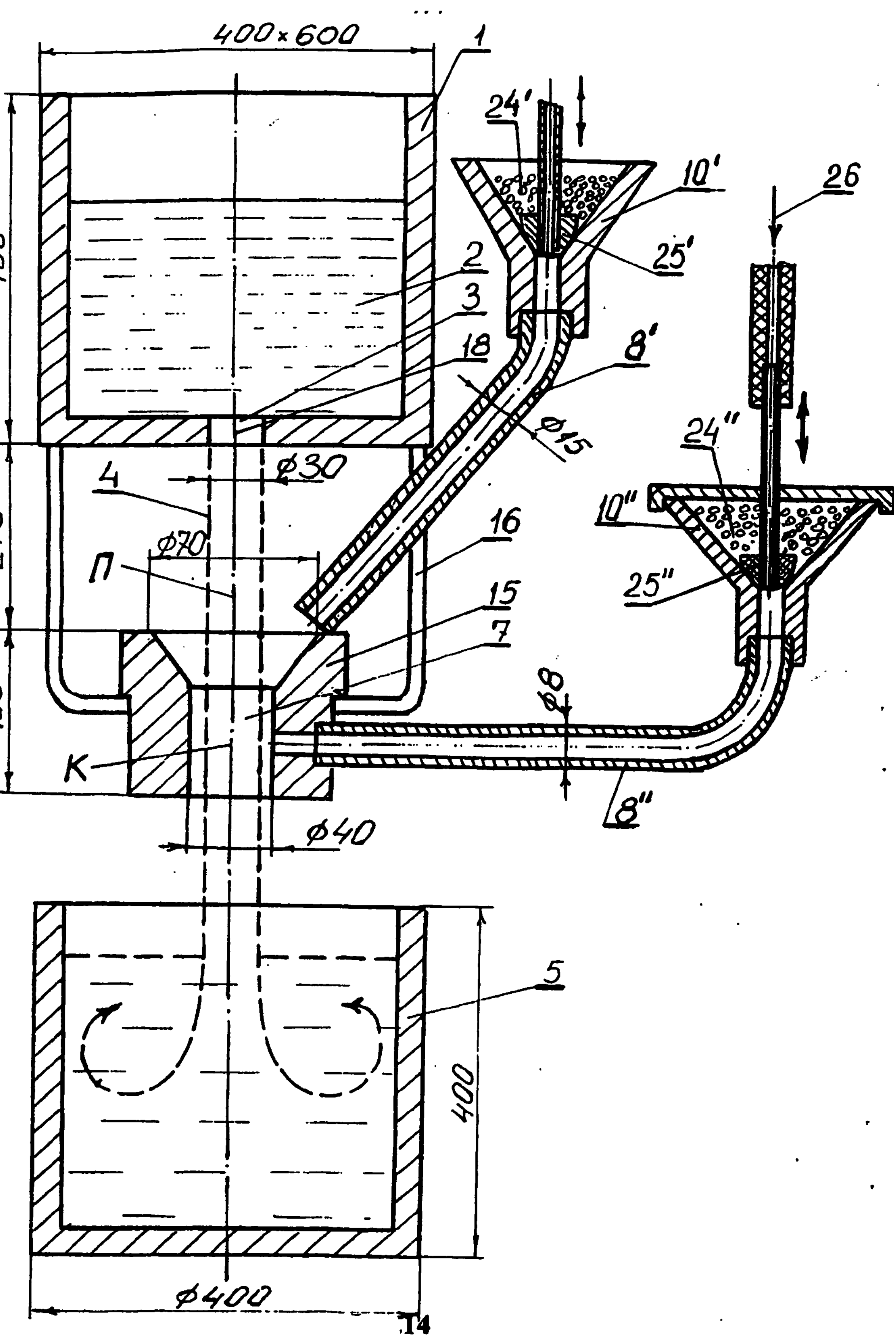
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1
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10'
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25'
2
3
18
8'
Ф15
Ф30
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24"
10"
16
Ф70
П
25"
15
7
Ф8
K
8"
Ф40
5
400
270
100
400
Ф400
14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/RU2005/000346

A. CLASSIFICATION OF SUBJECT MATTER
B22D 1/00 *(2006.01)*

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B22D 1/00, C21B 3/00, 3/04, C21C 1/00, 1/02, 7/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	US 4632368 A1 (CENTRO SPERIMENTALE METALLURGICO S. P. A.) 30.12.1986 the abstract, figure 1	1-7, 13-15, 18, 22, 8-12, 16-17, 19-21, 23
Y A	SU 394434 A (DONETSKY NAUCHNO-ISSLEDOVATELSKY INSTITUT CHERNOI METALLURGII) 22.08.1973 column 2, figure 1	1-7, 13-15, 18,22 8-12, 16-17, 19-21, 23
Y	SU 668951 A (NAUCHNO-PROIZVODSTVENNOE OBIEDINENIE "TULACHERMET") 25.06.1979, columns 2-3	2, 6-7, 14
Y	SU 374375 A (INSTITUT PROBLEM LITYA AN UKRAINSKOI SSR) 20.03.1973, figure 1	3
Y	RU 2015800 C1 (PENZENSKY POLITEKHNICHESKY INSTITUT) 15-07.1994, the example, figure 1	5

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 November 2005 (30.11.05)	22 December 2005 (22.12.05)
Name and mailing address of the ISA/ Facsimile No.	Authorized officer Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/RU 2005/000346

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	SU 304306 A (M. L. RODSHTEIN et al) 11.04.1972	1-23

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REFERENCES CITED IN THE DESCRIPTION

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Non-patent literature cited in the description

- **V.I. YAVOJSKIJ.** Steel metallurgy. *textbook for higher institutions, M.: Metallurgia,* 1983, 322 **[0004]**