United States Patent [19]

Johansson et al.

[11] **3,867,978**

[45] **Feb. 25, 1975**

[54] **METHOD AND APPARATUS FOR INTRODUCTION OF STEEL INTO A CONTINUOUS CASTING MOLD**

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[22] Filed: **Apr. 12, 1973**

[21] Appl. No.: **350,597**

[52] **U.S. Cl.** **164/82,** 164/281
[51] **Int. Cl.** **B22d 11/10**
[58] **Field of Search** 164/82, 133, 135, 281; 222/DIG. 1

[56] **References Cited**

UNITED STATES PATENTS

3,648,761 3/1972 Speith et al. 164/281

FOREIGN PATENTS OR APPLICATIONS

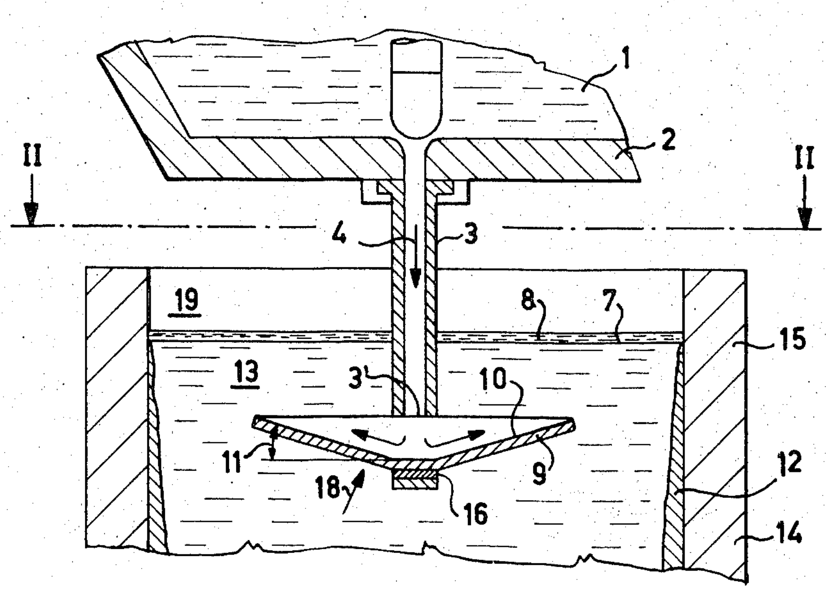
252,828 1/1948 Switzerland
1,570,056 6/1969 France

Primary Examiner—Francis S. Husar
Assistant Examiner—John E. Roethel
Attorney, Agent, or Firm—Werner W. Kleeman

[57] **ABSTRACT**

A method of, and apparatus for, the introduction of steel into the liquid metal pool of a continuous casting mold of a continuous casting installation, wherein a casting jet which is enclosed at its periphery at all sides is guided beneath the level of the molten bath of the liquid metal pool in the continuous casting mold and thereafter deflected out of its original position. The casting jet is guided substantially immediately after its aforesaid deflection substantially only at its underside to impart thereto an upwardly directed flow component, and the upper surface of the casting jet is permitted to freely admix with the steel of the liquid metal pool. The apparatus for the practise of the method comprises a pouring tube for the throughflow of a casting jet and a distributor device cooperating with the pouring tube. The distributor device comprises a distributor plate secured, preferably detachably, at the pouring tube, and the distributor plate has one or more guide surfaces for the casting jet emanating from the pouring tube, which guide surface or surfaces substantially only contact the outflowing casting jet at its underside to impart thereto an upwardly directed flow component in the mold.

27 Claims, 13 Drawing Figures



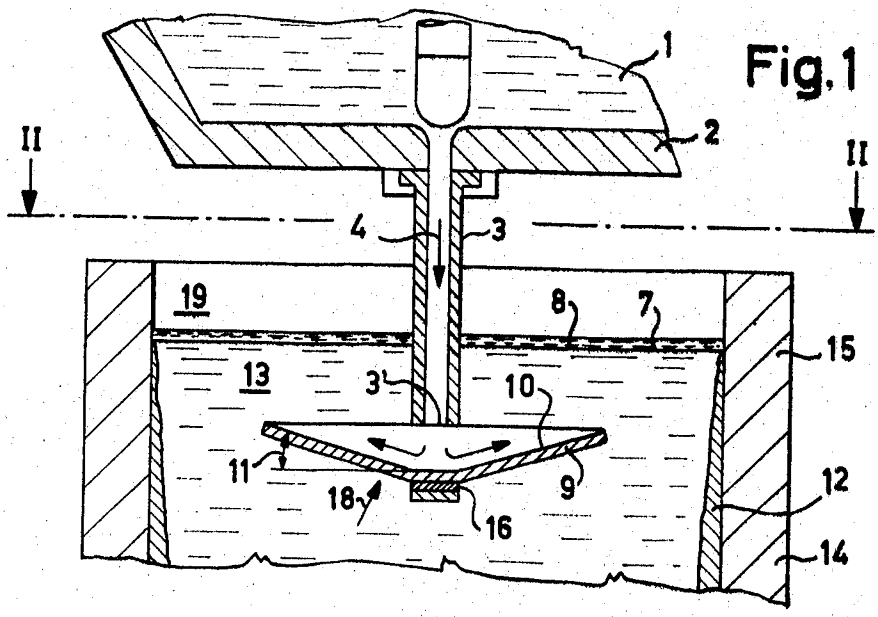


Fig.1

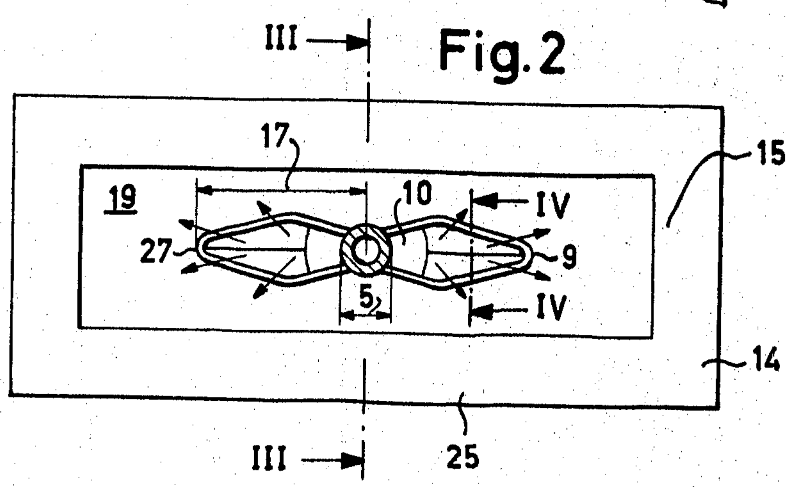


Fig.2

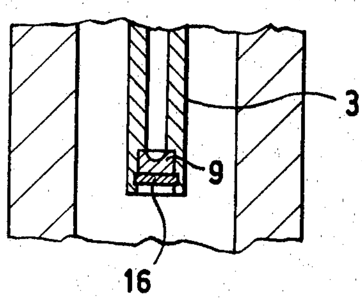


Fig.3

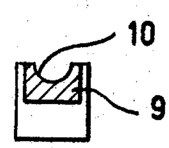


Fig. 4

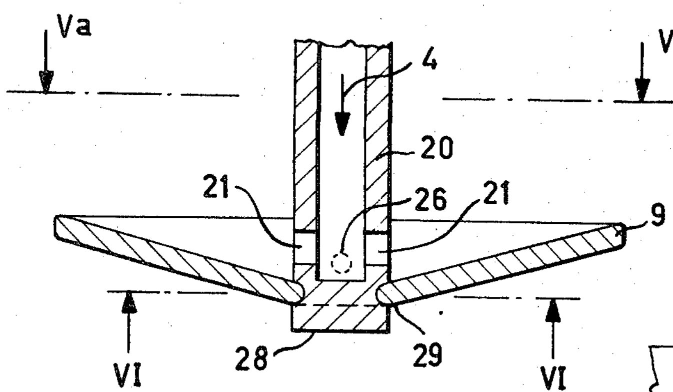
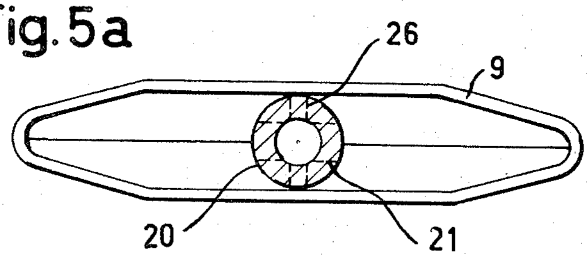


Fig.5

Fig.5a



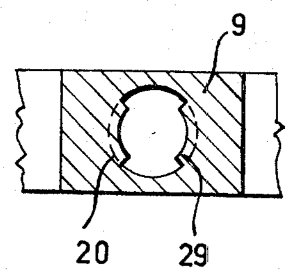


Fig.6

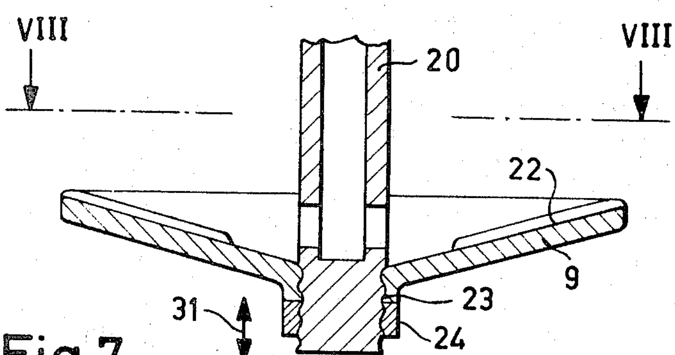
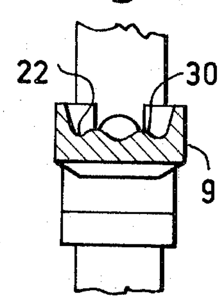


Fig.7

Fig.9



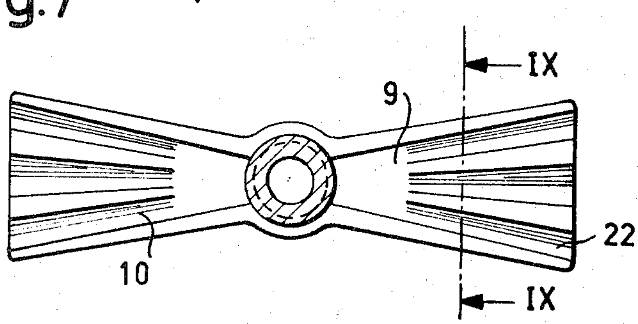


Fig.8

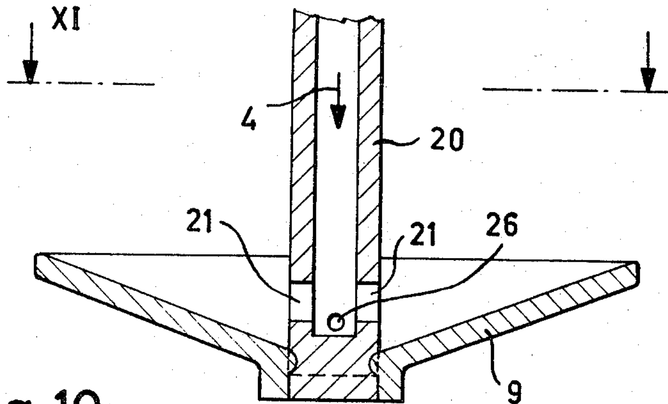


Fig.10

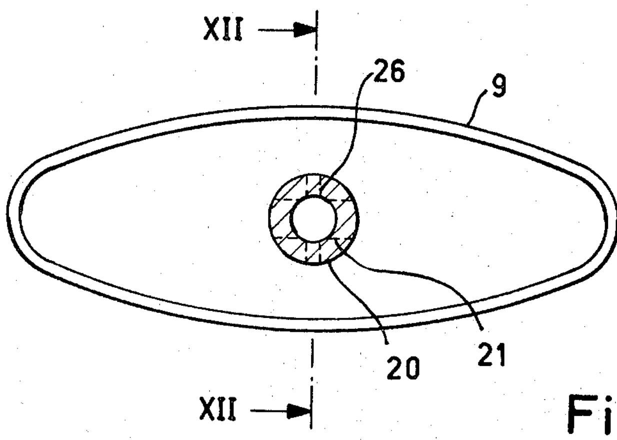
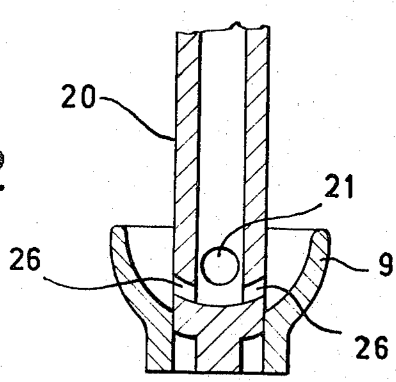


Fig.11

Fig.12



METHOD AND APPARATUS FOR INTRODUCTION OF STEEL INTO A CONTINUOUS CASTING MOLD

BACKGROUND OF THE INVENTION

The present invention broadly relates to the continuous casting of metals and, more specifically, pertains to a new and improved method of introducing steel into the liquid metal pool of a continuous casting mold and apparatus for the performance of the aforesaid method.

It is well known that the content and distribution of non-metallic inclusions can be influenced by appropriately introducing steel into the liquid metal pool of the casting mold. This becomes of particular significance when using flux powder by means of which the level of the liquid metal or melt in the mold is generally covered, since the behavior of the powder, among other things, is dependent upon the flow conditions prevailing at the liquid metal pool and the nature of the pouring or pour-in system.

Immersible pouring tubes with one or a number of outlet ports or openings which are located beneath the level of the metal bath in the continuous casting mold constitute a first type of expedient employed in this particular art for improving the degree of purity of the steel. In this regard attention is invited to U.S. Pat. No. 3,648,761, Canadian Pat. No. 510,528, British Pat. No. 1,249,854, German Pat. No. 160,659 and French Pat. No. 1,570,056. Since the wall thickness of conventional pouring tubes is relatively thin it is not possible to subject the cast material or casting jet to any really appreciable permanent controlled guiding action as it departs from the pouring tube, because pouring tubes tend to wear relatively rapidly and the outflow cross-section changes and thereby also the guiding action, so that the desired inflow into the liquid metal pool is not possible.

A proposal which has become known in the art and as exemplified in the aforementioned U.S. Pat. No. 3,648,761, is to provide the pouring tube with a collecting chamber into which the steel flows. The steel then is deflected at the collecting chamber and guided at all sides, thereafter flowing into the liquid metal pool in the continuous casting mold through outlet openings of the chamber having a larger cross-section than the pouring tube. While this prior art construction of steel distribution apparatus tends to reduce the kinetic energy of the inflowing steel, it has been found that by virtue of the resultant guiding and enclosure of the steel at all sides by the walls of the chamber it is not possible to attain a really intensive and good admixing of the inflowing steel with the steel in the liquid metal pool which is located above the chamber. In effect, the metal is directly introduced in the form of a compact flow at the regions of the narrow sides of the mold, and at each such location is sub-divided into two streams which are directed downwardly and upwardly respectively. Due to this flow phenomena it is possible for the skin which forms at the strand to be washed away. Moreover, it is not possible to realize a really satisfactory temperature compensation at the liquid metal pool when utilizing this prior art equipment.

In the aforementioned French Pat. No. 1,570,056 there is taught a floating-type inflow regulating device at the location of which there is deflected the incoming casting jet or stream of molten metal. Due to the action of the inflowing casting jet which impinges against the floating inflow regulating device and the movement of the metal in the liquid metal pool the regulating device becomes unstable in its position with respect to the pouring tube. Consequently, it is not possible to obtain any constant flow conditions in the liquid metal pool, with the result that it is impossible to realize a uniform growth of a frozen shell or layer at the strand. Since the metal flow also cannot be controlled the desirable uniform separation conditions for the impurities also cannot be attained. Additionally, the floating body which is required with this system actually hinders the flow of metal which, among other things, is associated with further drawbacks when casting with flux powders.

SUMMARY OF THE INVENTION

Hence, it is a primary object of the present invention to provide a new and improved method of, and apparatus for, introducing a molten metal, typically steel, into a continuous casting mold in a manner enabling infeed of the steel into the liquid metal pool within the mold so as to possess a controlled flow direction, and upon encountering different casting conditions, for instance upon changing the shape or format of the cast strand, allows for simple accommodation of the pouring system to these new casting conditions.

Another object of the present invention is to provide a new and improved method of, and apparatus for, introducing steel into a continuous casting mold wherein the incoming casting jet of metal is substantially immediately deflected upwardly after leaving the pouring tube and is not confined against partaking in such upward flow immediately after leaving the pouring tube, and wherein with the upward deflection of the incoming casting jet the same can substantially immediately admix with the metal pool at the region of the pouring tube.

Yet a further significant object of the present invention relates to an improved apparatus for the introduction of steel into a continuous casting mold employing a pouring tube having an accessory attachment which can be preferably readily exchanged to accommodate the casting system to different casting parameters.

Still another object of the present invention relates to a pouring tube equipped with a dish member designed to provide an accessory dish attachment for a standard pouring tube, the dish member being preferably readily exchangeable for different designed dish arrangements to readily accommodate the casting system to various mold configurations and quality requirements.

Now in order to implement these and still further objects of the invention which will become more readily apparent as the description proceeds, the method aspects of this development for the introduction of steel into the liquid metal pool of a continuous casting mold for casting slabs or blooms, contemplates guiding a jet or stream of molten metal enclosed at all sides about its periphery to a location beneath a metal bath and thereafter deflecting the casting jet out of its original flow direction. According to important aspects of the invention the casting jet, immediately after its deflection, is primarily guided only at its underside so as to possess a flow component which is upwardly directed and the upper surface of the casting jet is allowed to freely admix with the steel already present in the liquid metal pool within the mold.

Since the casting jet is only effectively guided at its under-surface or underside immediately after its deflection, and specifically in such a way that there exists an upwardly directed flow component there prevails at the upper surface of the deflected jet or stream of casting metal a free and unencumbered possibility of mixing with the steel in the liquid metal pool. This produces a flow of the melt which favorably influences the separation and distribution of non-metallic inclusions. Furthermore, there is promoted an extensively undisturbed growth of a frozen shell or layer at the cast strand, and at the liquid metal pool there is attained a temperature compensation which beneficially influences the behavior of the flux powder when the same is used.

For casting rectangular strands, for instance in a slab mold, the encased casting jet is advantageously divided into two jets or flow streams which are deflected in the direction of the narrow sides of the mold, so that the skin of the strand at the wide sides of the mold is not directly impinged by the steel.

As already indicated above, this invention is also concerned with an improved apparatus for the introduction of steel into a continuous casting mold and which is suitable for the performance of the aforesaid inventive method, and such apparatus basically comprises a pouring tube with which there is operatively associated a distributor device. The distributor device is designed in the form of a distributor plate and is secured, preferably detachably, at the pouring tube. This distributor plate provides one or more guide surfaces for the casting jet or jets departing from the pouring tube. The guide surface or surfaces only enclose the outflowing casting jet(s) at its underside or bottom surface and impart an upwardly directed flow component to such casting jet(s). The guide surface or surfaces are advantageously inclined with regard to the horizontal in an upward direction at a predetermined angle.

Due to the preferably detachable connection of the distributor plate with the pouring tube there is afforded the possibility of exchanging such distributor plate and therefore accommodating the apparatus to different casting parameters. The outflowing steel is upwardly guided or deflected by the guide surfaces so that the non-metallic inclusions are floated upwardly within the casting mold and taken-up by the slag. This considerably reduces the quantity of inclusions present at the cast product. The non-separated inclusions are distributed due to the flow prevailing at the liquid metal pool in such a manner that there does not occur any high concentration of contaminants at given locations. The inclination angle with respect to the horizontal which the guide surfaces may partake, and which impart to the steel a flow having a flow direction or component which is directed opposite to the direction of travel of the cast strand, can be accommodated to the momentary casting conditions which are encountered by appropriate selection of the distributor plate; as a general rule when casting larger size strands the inclination angle is chosen to be relatively small. Advantageously such inclination angle does not exceed 45° and preferably is in a range between 10° to 35° with respect to the horizontal.

It is also advantageous if the distributor plate possesses a dish-like configuration, with each guide surface being inclined and forming at least one trough, because in this way there can be realized a more directed flow of the metal. It is beneficial if the guide surfaces and the distributor plate, considered wtih respect to the flow direction of the deflected casting jet, are initially wider then again become smaller, running together into a tip, or if the plate itself tapers into a tip.

A very good guiding action can be realized when using distributor plates having guide surfaces possessing one or a number of grooves or furrow-like depressions. When casting strands with a rectangular cross-section the distributor device normally extends towards the narrow sides of the continuous casting mold, and the distributor plate advantageously can possess grooves which extend in diverging fashion in the direction of such narrow mold sides. A dowel or key may be inserted between the distributor plate and the pouring tube to prevent relative rotation between these two parts during the pouring of metal.

Attachment of the distributor plate to the pouring tube so as to conveniently provide an accessory device for standard pouring tubes, can advantageously occur through the use of any suitable attachment or connection means, typically rotary-type connections, such as a bayonet-type connection or a threaded connection, for instance.

In order to obtain a controlled flow of the steel directly following its deflection out of its original flow direction the length of each guide surface advantageously should correspond at least to the value of the largest diameter of the associated pouring tube. In the event that very large size strands are to be cast at high casting speeds, then it can be advantageous if the pouring tube possesses one or more additional outlet openings for the steel at the region or height of the distributor plate, so as to direct a certain amount of metal, for instance when casting slabs, also against the wide sides of the mold and to prevent the formation of dead angles or regions within the mold proper.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and objects other than those set forth above, will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings wherein:

FIG. **1** is a sectional view through a casting vessel, typically a tundish, and a continuous casting mold and also depicts a sectional view through the pouring system and the strand which is formed in the continuous casting mold;

FIG. **2** is a cross-sectional view of the arrangement of FIG. **1**, taken substantially along the line II—II thereof;

FIG. **3** is a cross-sectional view of the arrangement of FIG. **2**, taken substantially along the line III—III thereof;

FIG. **4** is a cross-sectional view of the arrangement of FIG. **2**, taken substantially along the line IV—IV thereof;

FIG. **5** illustrates a variant construction of pouring system for introducing the molten metal into a continuous casting mold;

FIG. **5*a*** is a cross-sectional view of the arrangement of FIG. **5**, taken substantially along the line Va—Va thereof;

FIG. **6** is a cross-sectional view of the variant embodiment depicted in FIG. **5**, taken substantially along the line VI—VI thereof;

FIG. **7** illustrates a still further embodiment of pouring system designed according to the teachings of the invention;

FIG. 8 is a cross-sectional view of the arrangement of FIG. 7, taken substantially along the line VIII—VIII thereof;

FIG. 9 is a cross-sectional view of the showing of FIG. 8, taken substantially along the line IX—IX thereof;

FIG. 10 is a further embodiment of pouring system;

FIG. 11 is a cross-sectional view of the arrangement of FIG. 10, taken substantially along the line XI—XI thereof; and

FIG. 12 is a cross-sectional view of the arrangement of FIG. 11, taken substantially along the line XII—XII thereof;

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Describing now the drawings, it is to be understood that only enough of the continuous casting installation has been depicted to enable those skilled in the art to clearly understand the underlying concepts of this development. Turning attention therefore more specifically to the arrangement depicted in FIGS. **1** to **4** it will be understood that molten metal **1**, typically steel is cast from a casting vessel **2** typically a tundish, by means of a pouring tube **3** and conducted by such pouring tube to a point beneath the bath level **7** of the liquid metal pool in the continuous casting mold **14.** The pouring tube **3** encloses the casting jet flowing therethrough in the flow direction **4** at its periphery at all sides. The bath level **7** of the molten metal is covered with a slag layer **8.** Now the casting jet which flows through the pouring tube **3** and departs at the outlet opening **3'**, is deflected out of its original flow direction, indicated by the arrow **4,** by means of a distributor device **18** which is secured, preferably detachably, to the pouring tube **3,** the distributor device **18** being in the form of a distributor plate **9.** After the casting jet has been deflected out of its original flow direction and substantially immediately after its deflection this casting jet is only still guided at its underside or bottom surface by guide surfaces **10** of the distributor plate **18,** and which guide surfaces encompass or enclose the under-surface or underside of the casting jet and thereby impart to such casting jet an upwardly directed flow component. In the embodiment under discussion these guide surfaces **10** are shown to be inclined at a predetermined angle **11** with respect to the horizontal. Depending upon the casting conditions this angle does not normally exceed about 45° and can preferably vary between approximately 10° and 35°. The length **17** of each guide surface **10** and/or the plate **9** preferably should amount to at least the length of the outer diameter **5** of the pouring tube **3.**

In this embodiment the steel is introduced into the liquid metal pool **13** of the continuous casting mold **14** having a rectangular cross-sectional configuration of its hollow mold cavity **19** for the casting of slabs. After the deflection of the casting jet the introduced steel can directly mix at the location of its top or upper surface of its flow with the steel already located in the mold **14** and which forms the liquid metal pool **13,** with the result that there occur favorable separation possibilities for the non-metallic inclusions as well as good temperature compensation. Furthermore, the formation of the strand skin or shell **12** is not disturbed.

In the embodiment under consideration the distributor plate **9** is constructed in the form of a bowl-like or dish-like member, with the width of the dish-like plate **9** and the guide surfaces **10** thereof, initially increasing in the direction of the narrow sides **15** of the mold **14** and then again running together or converging into a tip or point **27,** as best seen by referring to FIG. **2.** As clearly shown from the sectional view depicted in FIG. **4,** each such guide surface **10** can be curved in a groove-like or trough-like manner. The distributor plate **9** may be detachably secured to the lower region of the pouring tube **3** in any suitable fashion, in this case by means of an insertable connection wedge **16,** as best seen by referring to FIG. **3,** and when required can be easily exchanged.

FIGS. **5** and **5***a* depict a further exemplary embodiment of pouring system designed according to the teachings of the invention. In this case the modified construction of pouring tube **20** possesses two lateral discharge or outflow openings **21** for the casting jet. The deflection of the casting jet-flow direction **4** out of its original direction already occurs, however, here within the confines of the pouring tube **20** which is closed at its lower end by a floor or base portion **28.** The distributor plate **9,** as best seen by referring to FIG. **6,** is detachably secured in this instance at the lower end of the pouring tube **20** by means of a rotary connection, here in the form of a bayonet-type closure connection, generally indicated by reference character **29.** As indicated in phantom lines the modified construction of distributor plate **9** and of the pouring tube **20** also possess two further matching discharge or outflow openings **26** which, for instance, when casting slabs, are directed towards the wide sides **25** of the mold **14** (FIG. **2**) in order to permit a small amount of the volume of the steel to escape towards these wide mold sides.

FIGS. **7, 8** and **9** depict an exemplary embodiment of the invention wherein the distributor plate **9** possesses an irregular bottom or floor portion **30** defining a number of grooves or depressions **22** which diverge in the direction of the outflowing steel moving along the guide surfaces **10** of said distributor plate **9.** In this way there is attained a good guiding action for the steel and considerable reduction in the flow velocity. The dish-shaped distributor plate **9** is here threadably connected to the pouring tube by means of a thread connection **23** and secured against rotation by a counternut member **24.** By means of this thread connection **23,** and as indicated by the double-headed arrow **31** it is possible to carry out elevational adjustment of the distributor plate **9.** Thus, for instance, there can be realized an optional adjustment of the pouring system to varying casting parameters. When changing the shape and/or size, in other words the format, of the cast strand it is possible for instance to exchange the distributor plate for a different one having a different angle of inclination of the guide surfaces; when changing the casting speed the spacing of the distributor plate from the level of the molten metal bath in the mold, in other words the penetration depth, can be altered. Therefore there exists really large variation possibilities with regard to the flow conditions at the liquid molten pool.

FIGS. **10, 11** and **12** show a further embodiment of a pouring system according to the present invention. In this modification, the distributor plate **9** is a substantially elliptically shaped bowl which centers around the pouring tube **20** and is attached to it by a bayonet-type connection. The large outflow openings **21** are co-axial to the longitudinal axis of the bowl and are directed towards the narrow sides of a slab casting mold, while the small outflow openings **26** are co-axial to the lateral axis of the bowl and are directed toward the wide side of a slab casting mold.

Finally, it is to be clearly understood that the different herein disclosed pouring devices are not limited to the exemplary illustrated examples. Thus, for instance, the distributor plate can also possess flat or planar guide surfaces, by way of example. When casting blooms having a square cross-sectional configuration the deflected steel can be guided in the direction of the corners of the mold and at the pouring tube there can be detachably secured a distributor plate having four guide surfaces.

While there is shown and described present preferred embodiments of the invention, it is to be distinctly understood that the invention is not limited thereto, but may be otherwise variously embodied and practiced within the scope of the following claims. Accordingly,

What is claimed is:

1. A method for the introduction of steel into the liquid metal pool of a continuous casting mold of a continuous casting installation, wherein a casting jet which is enclosed at its periphery at all sides for casting of slabs or blooms is guided beneath the level of the molten bath of the liquid metal pool in the continuous casting mold and thereafter deflected out of its original position, the improvement comprising the steps of guiding the casting jet substantially immediately after its deflection substantially only at its underside to impart thereto an upwardly directed flow component and freely exposing the upper surface of the casting jet, and permitting the freely exposed upper surface of the casting jet to freely admix with the steel of the liquid metal pool.

2. The method as defined in claim **1**, particularly for introduction of steel from a casting vessel into the liquid metal pool of a mold having a rectangular cross-sectional configuration, further including the steps of dividing the casting jet flowing out of the casting vessel into two streams, and deflecting and guiding said two casting jet streams in the direction of the narrow sides of the mold.

3. A method for the introduction of steel into the liquid metal pool of a continuous casting mold, comprising the steps of introducing a casting jet of liquid steel confined by a pouring tube beneath the level of the liquid metal pool in the continuous casting mold, deflecting the inflowing casting jet out of its original flow direction, and substantially immediately after such deflection of the casting jet subjecting the casting jet at its underside to a force producing an upwardly directed flow component, to thereby deflect the casting jet in an upward direction and counter the flow direction of the liquid metal pool through the continuous casting mold, permitting unobstructed upward flow of the upwardly deflected casting jet substantially immediately after leaving the pouring tube, to thus substantially immediately admix the upwardly deflected casting jet with the liquid metal pool at the region of the pouring tube.

4. An apparatus for the introduction of steel into the liquid metal pool of a continuous casting mold, comprising a pouring tube for the throughflow of a casting jet, a distributor device cooperating with the pouring tube, said distributor device comprising a distributor plate, means for securing the distributor plate at the pouring tube, said distributor plate having guide surface means for the casting jet emanating from the pouring tube, said guide surface means substantially only contacting the outflowing casting jet at its underside.

5. The apparatus as defined in claim **4**, wherein said securing means includes means for detachably securing the distributor plate with the pouring tube.

6. The apparatus as defined in claim **4**, wherein said guide surface means is upwardly directed at an inclination with respect to the horizontal.

7. The apparatus as defined in claim **6**, wherein the angle of inclination of the guide surface means does not exceed 45°.

8. The apparatus as defined in claim **7**, wherein the angle of inclination is in a range of 10° to 35°.

9. An apparatus for the introduction of steel into the liquid metal pool of a continuous casting mold, comprising a pouring tube for the throughflow of a casting jet, a distributor device cooperating with the pouring tube, said distributor device comprising a distributor plate, means for securing the distributor plate at the pouring tube, said distributor plate having guide surface means for the casting jet emanating from the pouring tube, said guide surface means substantially only contacting the outflowing casting jet at its underside, said distributor plate possessing a substantially dish-like configuration and inclined guide surface means.

10. The apparatus as defined in claim **9**, wherein the width of the distributor plate and the guide surface means in the direction of flow of the deflected casting jet initially increases then decreases.

11. The apparatus as defined in claim **10**, wherein the distributor plate has at least one free end portion terminating in a tip.

12. The apparatus as defined in claim **10**, wherein the dish-shaped distributor plate tapers in the flow direction of the outflowing steel casting jet.

13. The apparatus as defined in claim **4**, wherein the distributor plate possesses at least one groove.

14. The apparatus as defined in claim **13**, wherein the distributor plate possesses a number of grooves.

15. The apparatus as defined in claim **12**, wherein the casting jet is introduced into a mold having a substantially rectangular cross-sectional configuration and the distributor device extends in the direction of the narrow sides of the mold, the distributor plate having at least one groove extending in the direction of a neighboring narrow side of the mold.

16. The apparatus as defined in claim **15**, wherein the groove diverges in the direction of the neighboring narrow side of the mold.

17. The apparatus as defined in claim **4**, wherein said securing means comprises a rotatable connection means for detachably securing the distributor plate with the pouring tube.

18. The apparatus as defined in claim **4**, wherein said securing means comprises a thread connection for detachably securing the distributor plate with the pouring tube.

19. The apparatus as defined in claim **4**, wherein the guide surface means of the distributor plate is inclined with respect to the horizontal at an angle which is in the range of 10° to 35°.

20. The apparatus as defined in claim **4**, wherein the length of the guide surface means is at least equal to the length of the outer diameter of the pouring tube.

21. The apparatus as defined in claim **11**, wherein the pouring tube is provided with at least one outlet opening directed towards a wide side of the continuous casting mold and located approximately at the height of the distributor plate.

22. The apparatus as defined in claim **4,** wherein the distributor plate extends completely about the pouring tube.

23. The apparatus as defined in claim **22,** wherein the distributor plate possess a substantially elliptical bowl-shaped configuration.

24. The apparatus as defined in claim **22,** wherein the pouring tube is provided with different size openings.

25. An apparatus for the introduction of steel into the liquid metal pool of a continuous casting mold, comprising a pouring tube for the throughflow of a casting jet, said pouring tube being provided with different size openings, a distributor device cooperating with the pouring tube and extending completely about said pouring tube, said distributor device comprising a distributor plate, means for securing the distributor plate at the pouring tube, said distributor plate having guide surface means for the casting jet emanating from the pouring tube, said guide surface means substantially only contacting the outflowing casting jet at its underside, a mold into which is introduced the outflowing casting jet, said mold having narrow mold sides and wide mold sides, said pouring tube being provided with four of said openings, two of said openings being of larger size than the remaining openings and being directed towards the narrow sides of the mold and the other two openings being of smaller size and directed towards the wide sides of the mold.

26. An apparatus for the introduction of steel into the liquid metal pool of a continuous casting mold, comprising a pouring tube for the throughflow of a casting jet, a distributor device cooperating with the pouring tube, said distributor device comprising a distributor plate, means for securing the distributor plate at the pouring tube, said distributor plate having at least one guide surface for the casting jet emanating from the pouring tube, said guide surface substantially only contacting the outflowing casting jet at its underside to impart thereto an upwardly directed flow component and permitting substantially unimpeded admixing of the upwardly flowing casting jet with the liquid metal pool in the continuous casting mold substantially immediately after the casting jet departs from the pouring tube, said guide surface enclosing an angle with the horizontal which does not exceed 45°.

27. The apparatus as defined in claim **26,** wherein said enclosing angle is in a range of 10° to 35°.

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