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APPARATUS FOR DEGASSING MOLTEN STEEL

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FIG. 1

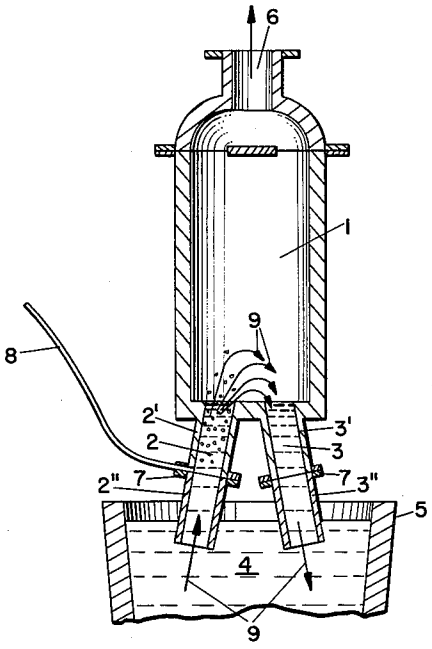


FIG. 2

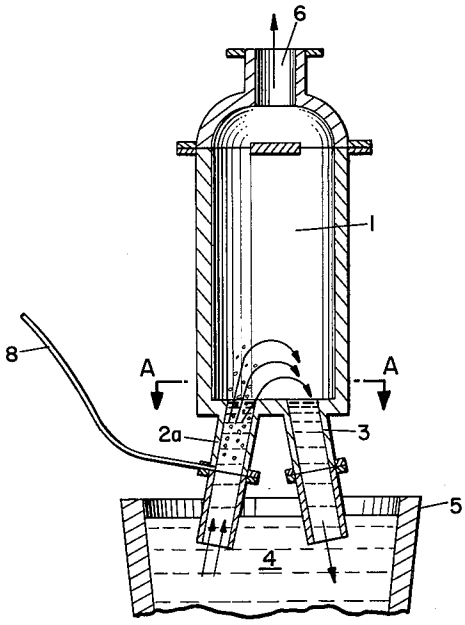
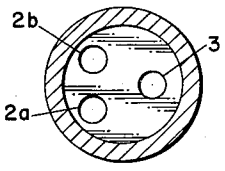


FIG. 3



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APPARATUS FOR DEGASSING MOLTEN STEEL

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The present invention relates to an apparatus for degassing molten steel by the circulatory degassing method.

The circulatory degassing method which is being applied in recent times consists in immersing a pair of substantially vertically pipes on an evacuated degassing vessel from above into the molten steel and in then circulating the molten metal by means of an inert or other conveying gas from its container through the degassing vessel.

The liquid metal then passes from its container upwardly through the suction pipe in which it is mixed with the conveying gas, and into the degassing vessel in which the conveying gas and considerable parts of the gases contained in the molten metal are expelled by the evacuation of this vessel. The metal after thus being at least partly degassed then flows back into the container through the second or discharge pipe. During this evacuation treatment, the molten metal or at least a considerable part thereof therefore carries out a circulatory movement from the container, usually a casting ladle, through the evacuated degassing vessel and back into the container. At the beginning of this treatment, the first parts of the circulating current still consist of untreated molten metal, while during the subsequent operation some or all parts which have already once been treated will again be circulated once or several times through the degassing vessel.

The present invention is based upon the finding that, since a mixture of molten metal and inert conveying gas passes through the suction pipe, only a part of the cross-sectional area of the suction pipe will be available for the flow of the molten metal, and that therefore the amount of molten metal which is being drawn up through the suction pipe into the degassing vessel will always be smaller than that which would flow therethrough if no conveying gas were added. Since the supply of molten metal to the degassing vessel is thus reduced, the return flow of metal from the degassing vessel will be likewise reduced. Due to such slow return flow, the degassed portions of the metal will not properly penetrate into the main body of metal in the container or casting ladle and will therefore not be sufficiently mixed with the remainder of metal in the container.

It is an object of the present invention to provide a very simple apparatus for considerably improving the efficiency of the above-mentioned circulatory degassing method and for quickly and thoroughly mixing those parts of the molten metal which have already been degassed.

For attaining this object, the present invention provides the degassing vessel with a discharge pipe of a cross-sectional area smaller than that of the suction pipe, so that the ratio of the cross-sectional area of the two pipes preferably amounts to 1:2. For attaining the same purpose still more effectively, two or more suction pipes may be used, in which the total cross-sectional area of all of these pipes is approximately twice as large as the cross-sectional area of the discharge pipe. A preferred embodiment of the invention consists, for example, in providing a degassing vessel with three pipes extending downwardly therefrom which have an equal cross-sectional area and two of which serve as suction pipes and are provided with

means for supplying a conveying gas into the same, while the third pipe serves as the discharge pipe.

These objects, features, and advantages of the present invention will become further apparent from the following detailed description of two preferred embodiments thereof, as illustrated in the accompanying diagrammatical drawings, in which—

FIGURE 1 shows a vertical section of a circulatory degassing apparatus according to the invention which is provided with two immersion pipes of different cross-sectional sizes;

FIGURE 2 shows a vertical section of a similar apparatus which is provided with three immersion pipes of the same cross-sectional size; while

FIGURE 3 shows a cross section taken along line A—A of FIGURE 2.

Referring first particularly to FIGURE 1, the degassing vessel **1** is provided at its lower end with pipes **2** and **3** which are adapted to be immersed into a bath of molten steel **4** in a container **5** which may be a casting ladle. At its upper end, the degassing vessel **1** has an outlet **6** through which it is evacuated by suitable evacuating means, not shown. Immersion pipes **2** and **3** consist of upper pipes **2'** and **3'** which are rigidly secured to the degassing vessel **1** and exchangeable pipes **2''** and **3''** which are removably secured to the lower ends of pipes **2'** and **3'** by flanges **7** and form those parts of pipes **2** and **3** which are actually immersed into the molten metal. Pipe **2** which serves as a suction pipe is provided with an inlet to which a pipe **8** may be connected through which an inert conveying gas may be passed into the liquid metal which is rising in pipe **2** so as to convey the metal into and through the degassing vessel **1** in the direction of arrows **9**. During its passage through the degassing vessel **1**, the molten metal is freed by the vacuum in this vessel of a considerable part of the gases contained therein, including the conveying gas which was added through pipe **8** into suction pipe **2**.

After being passed into suction pipe **2**, this conveying gas forms bubbles within the molten metal therein which increase in diameter as the gas rises. Consequently, a part of the cross-sectional area of suction pipe **2** will always be taken up by gas bubbles and is therefore not available for the flow of molten metal. If the discharge pipe **3** is made of the same cross-sectional size as the suction pipe **2**, the molten metal from which the gas bubbles of the conveying gas as well as a considerable part of the gases normally contained therein have been removed will flow back into container **5** at a relatively low velocity which is often not sufficient to effect a thorough mixture of the degassed part of the molten metal with the main body **4** thereof in container **5**.

According to the present invention, the cross-sectional size of suction pipe **2** is made considerably larger than, and preferably twice as large as the cross-sectional size of the discharge pipe **3**. The molten metal which is mixed with the conveying gas and is being lifted upwardly can therefore pass through a suction pipe **2** of an adequate size with the result that, after the gases have been substantially removed from the molten metal in the degassing vessel **1**, the volume of molten metal and thus also the velocity of the flow thereof through discharge pipe **3** and from the latter into the main body **4** of metal in container **5** will be considerably increased and will therefore also be more powerful so that a thorough mixture of the degassed returning part of the molten metal with the main body **4** thereof in container **5** will be attained.

FIGURE 2 illustrates a modification of the invention in which the increase in the cross-sectional size of the suction pipe is attained by providing two suction pipes **2*a*** and **2*b***, each of which preferably has the same cross-

sectional size as that of the discharge pipe 3 so that a ratio of 2 to 1 between the sizes of the suction and discharge pipes will be attained.

Although the invention has been illustrated and described with reference to the preferred embodiments thereof, it should be understood that it is in no way limited to the details of such embodiments, but is capable of numerous modifications within the scope of the appended claims.

The invention having now been fully disclosed, what is claimed is:

1. In a continuous recycling device for the vacuum degassification of molten metal and having as elements vacuum degassing chamber means, a lower positioned container for holding molten metal, riser conduit means for conveying molten metal from said container to said chamber means, discharge conduit means for discharging molten metal from said chamber means into said container, and means for forcing gas bubbles into and through said riser conduit means, said riser and said discharge conduit means being with their immersion ends arranged in non-concentric separate and spaced relation, the improvement which comprises, in combination with said elements, such discharge and riser conduit means in

which the cross-sectional area of said discharge means is appreciably smaller than that of said riser means.

2. In an apparatus as defined in claim 1, in which the ratio of the cross-sectional size of said suction pipe to that of said discharge pipe amounts approximately to 2 to 1.

3. In an apparatus as defined in claim 1, in which a plurality of suction pipes are provided, the total cross-sectional size of said suction pipes being greater than the cross-sectional size of said discharge pipe.

4. In an apparatus as defined in claim 3, in which the total cross-sectional size of said suction pipes is substantially twice as great as the cross-sectional size of said discharge pipes.

5. In an apparatus as defined in claim 1, in which two suction pipes and one discharge pipe are provided, all of said pipes having substantially the same cross-sectional size.

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