

[72] Inventor **John A. Grosko**
Whitaker Borough, Pa.
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[73] Assignee **United States Steel Corporation**
a corporation of Delaware

[56] **References Cited**
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3,352,465 11/1967 Shapland..... 222/512
3,408,059 10/1968 Hornak 266/34
3,443,629 5/1969 Ebeling 164/3374
3,480,186 11/1969 Grosko..... 222/512

Primary Examiner—Donald R. Schran
Attorney—Walter P. Wood

[54] **MECHANISM FOR CONTROLLING FLOW OF LIQUID TO A VACUUM-TREATING VESSEL**
10 Claims, 8 Drawing Figs.

[52] U.S. Cl..... **266/34,**
141/69; 266/38
[51] Int. Cl..... **C21c 7/10**
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34T, 34, 38; 164/337, (Inquired); 222/512,
(Inquired), 545; 141/69, 11, (Inquired); 137/611,
(Inquired)

ABSTRACT: A flow-controlling mechanism which embodies sliding gates adapted to be positioned between the inlet of a vacuum-treating vessel and the outlet of a container for feeding liquid to the vessel. One of the gates is formed of two parts which are separable. The upper of the two parts is retained on the bottom of the container to close the outlet when the container is removed from the vessel. The vacuum in the vessel holds the lower part over the inlet opening to avoid breaking the vacuum. The operating means for positioning the gates is mounted on the top of the vessel.

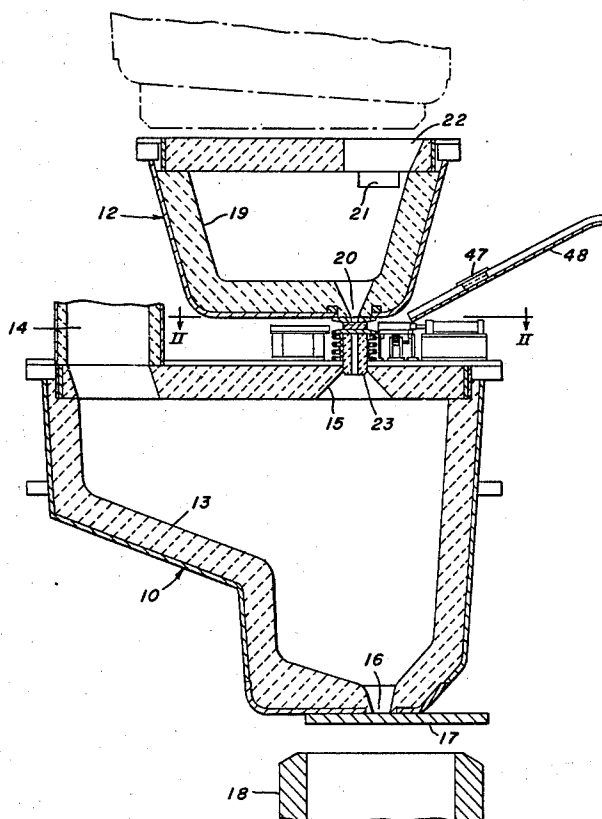
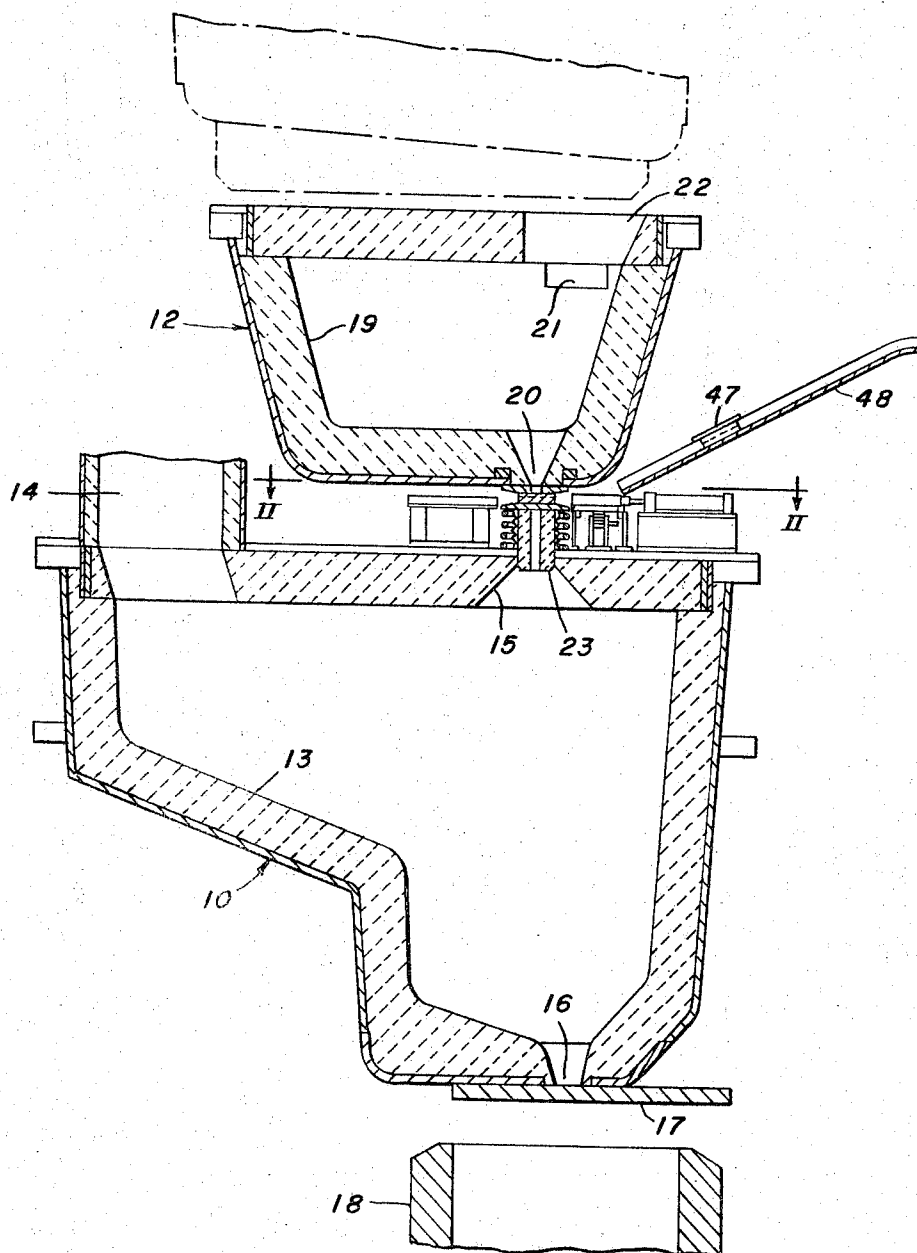
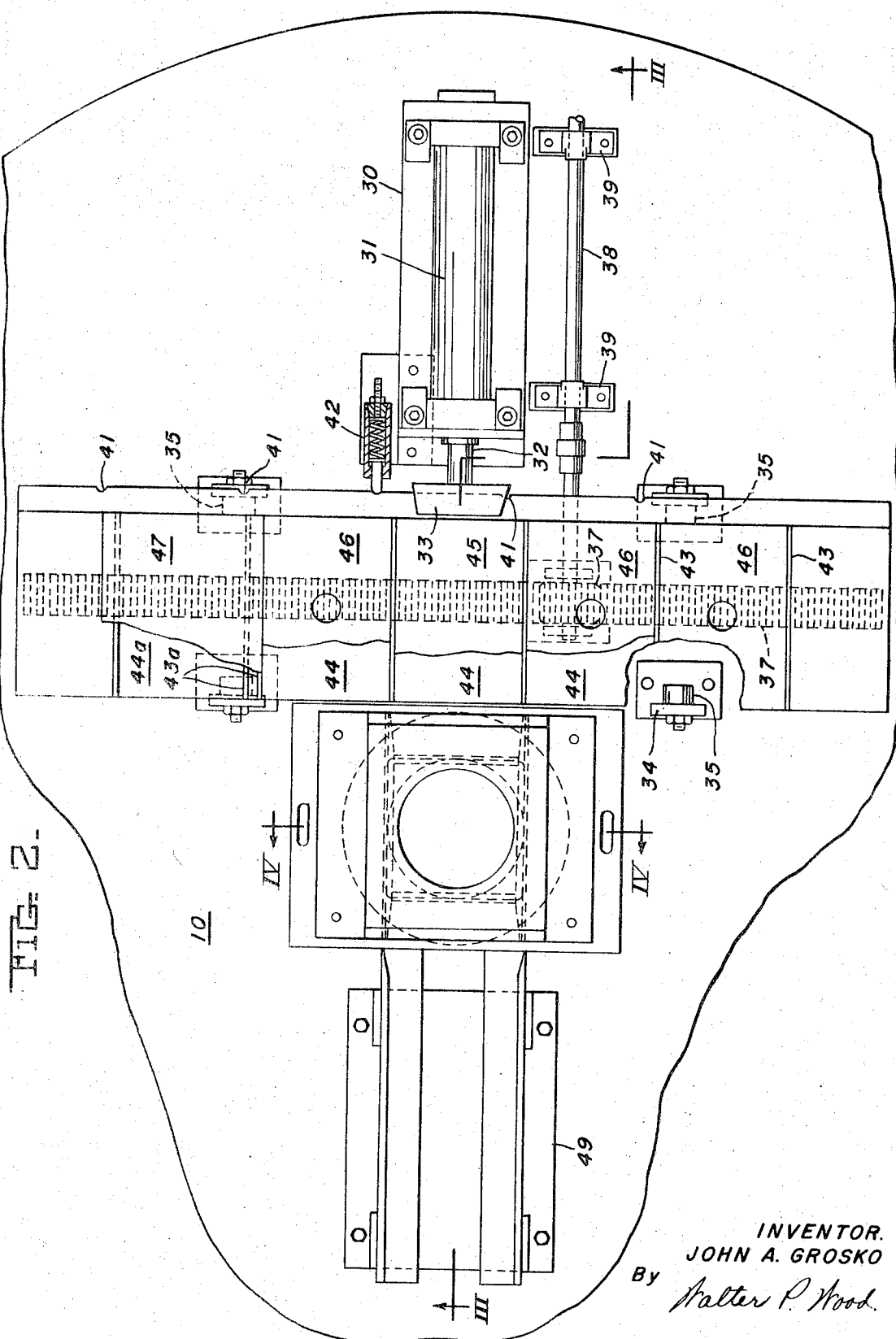


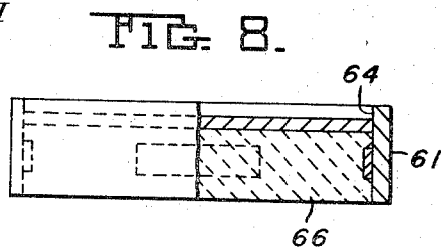
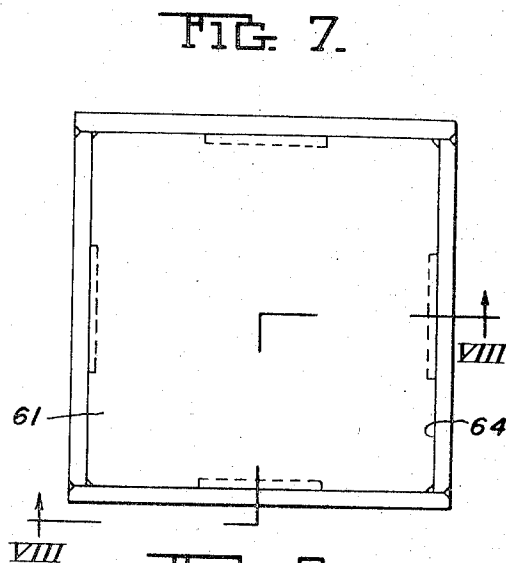
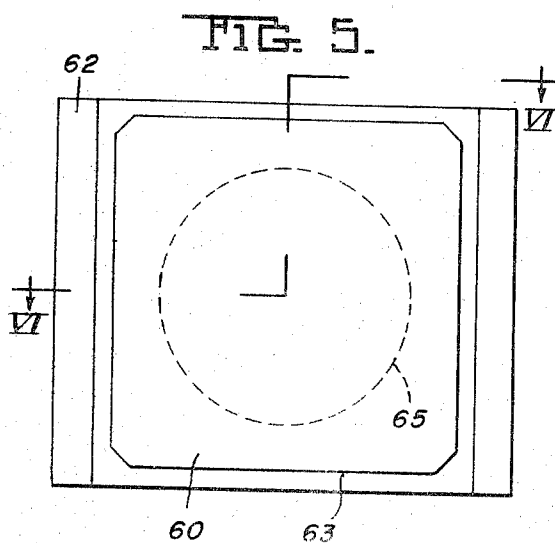
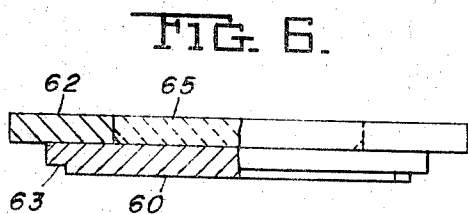
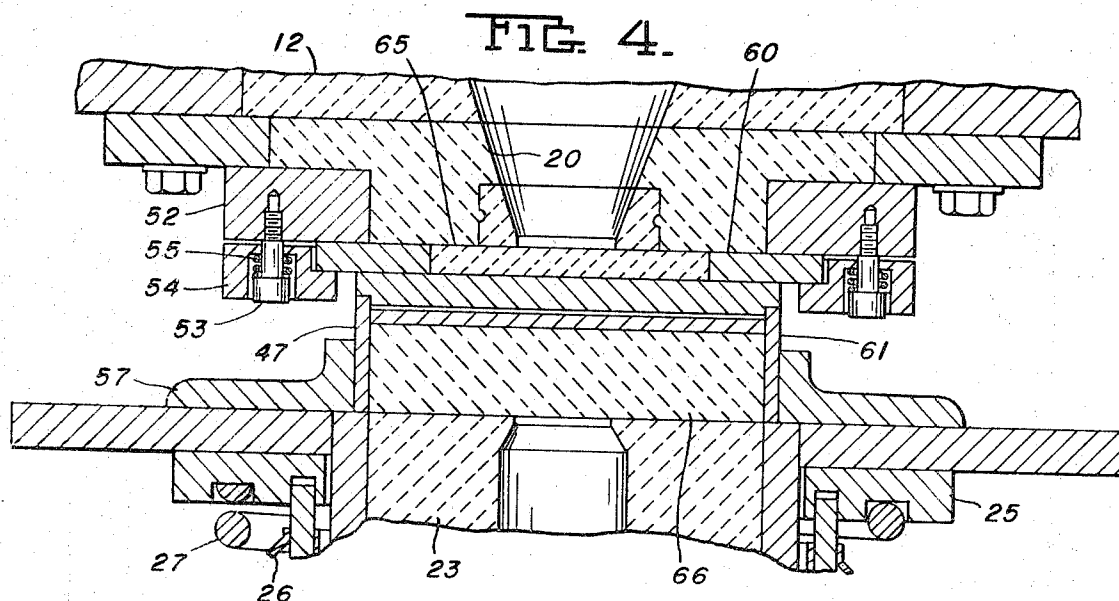
FIG. 1.



INVENTOR.
JOHN A. GROSKO
By *Walter P. Hrad*
Attorney



INVENTOR.
JOHN A. GROSKO
By *Matter P. Wood.*
Attorney



INVENTOR.
JOHN A. GROSKO
By *Walter P. Wood*
Attorney

MECHANISM FOR CONTROLLING FLOW OF LIQUID TO A VACUUM-TREATING VESSEL

This invention relates to an improved mechanism for controlling flow of liquid to a vacuum-treating vessel. Although my invention is not thus limited, the mechanism is particularly useful for controlling flow of molten steel into a vacuum-degassing vessel. The usual practice in degassing molten steel is to teem the steel from a ladle into a refractory-lined tundish and to teem the steel to the degassing vessel through an outlet in the bottom of the tundish. With the outlet closed, steel is teemed into the tundish to the level of its overflow trough. When the outlet subsequently is opened and steel feeds to the degassing vessel, the supply in the tundish is replenished continuously from the ladle. After each ladle has been emptied, steel from another ladle is teemed into the tundish, and the process repeated until the furnace supply is exhausted. From the degassing vessel the steel may discharge either to the mold of a continuous-casting machine or to an ingot mold.

The steel in the tundish carries a layer of molten slag which protects its surface against oxidation. After the last ladle of a series has been emptied and the level of steel in the tundish falls below the overflow, the tundish outlet is closed to exclude slag from the degassing vessel, where it would contaminate the steel and also damage the refractory lining. The tundish then is removed from the degassing vessel. The refractory lining of the tundish and its contents are sacrificed.

It is known to use a sliding gate closure for the tundish outlet, as shown for example in Shapland U.S. Pat. No. 3,352,465. Heretofore the gate has been formed of sections slidably mounted in guides on the outside of the bottom wall of the tundish. Certain of the gate sections form closures for the outlet, while others have nozzles to allow steel to flow. The tundish has carried a hydraulic cylinder or a mechanical device for selectively moving the different gate sections into alignment with the outlet. This arrangement has disadvantages that it does not permit the tundish to be removed from the degassing vessel without breaking the vacuum, and further that it is awkward to handle a tundish which carries a hydraulic cylinder and connections for admitting and discharging hydraulic fluid.

An object of my invention is to provide an improved flow-controlling mechanism which enables liquid to feed to a vacuum-treating vessel, yet allows the source of liquid removed from the vessel at any time without breaking the vacuum.

A further object is to provide an improved flow-controlling mechanism of the foregoing type in which the operating means is mounted on the vacuum-treating vessel, thereby avoiding the need for connections such as hoses on the portable source of liquid.

A more specific object is to provide a sliding gate closure for controlling feeding of molten steel from a tundish to a vacuum-degassing vessel, which closure enables the tundish outlet to be closed and the tundish removed from the vessel without breaking the vacuum.

A further object is to provide a two-part sliding gate for closing a source of liquid feeding to a vacuum-treating vessel, one of which parts remains with the vessel and forms a seal when the source is taken away, the other part of which serves to close the outlet of the source.

In the drawings:

FIG. 1 is a vertical sectional view of a vacuum-degassing vessel, a tundish positioned to feed molten metal thereto, and a flow-controlling mechanism constructed in accordance with my invention;

FIG. 2 is a horizontal section on a larger scale on line II-II of FIG. 1;

FIG. 3 is a vertical section on line III-III of FIG. 2;

FIG. 4 is a vertical section on line IV-IV of FIG. 2, but showing the two-part gate of my invention closing the tundish outlet;

FIG. 5 is a bottom plan view of the upper part of my two-part gate;

FIG. 6 is a vertical section on line VI-VI of FIG. 5;

FIG. 7 is a top plan view of the lower part of my two-part gate; and

FIG. 8 is a vertical section on line VIII-VIII of FIG. 7.

FIG. 1 shows a vacuum-degassing vessel 10 and a portable tundish 12 for feeding molten metal thereto. Vessel 10 has a refractory lining 13, a connection 14 leading to a source of vacuum (not shown) and inlet and discharge openings 15 and 16 in its top and bottom walls respectively. The discharge opening 16 has a closure 17 shown only diagrammatically. A mold 18, which may be either part of a continuous-casting machine or an ingot mold, is positioned below the discharge opening 16 to receive degassed metal therefrom. Tundish 12 has a refractory lining 19, an outlet opening 20 in its bottom wall, and an overflow 21 in its upper edge. Molten metal is teemed into the tundish through an opening 22 in the top. When the tundish is positioned to feed metal to vessel 10, the outlet and inlet openings 20 and 15 of the tundish and vessel respectively are aligned as shown. The structure thus far described and its operation are known and hence are not described in greater detail.

I have shown a bellows-type seal mounted in the inlet opening 15 of the degassing vessel 10. I believe this seal is novel, but it is the invention of others. The seal includes a metal-cased refractory sleeve 23, which extends through the inlet opening 15 and is vertically movable (FIG. 3). The top wall of vessel 10 carries an annular lower bearing member 24 which encircles sleeve 23. The upper end of the sleeve carries an annular upper bearing member 25. An extensible bellows 26 is connected between the two bearing members 24 and 25 and surrounds sleeve 23. A compression spring 27 surrounds the bellows and bears against the two bearing members and thus urges the sleeve upwardly.

In accordance with my invention, the top wall of the degassing vessel 10 carries an upstanding frame 30 on which I mount a double-acting fluid pressure cylinder 31 (FIGS. 2 and 3). The cylinder has the usual connections (not shown) for admitting and discharging motivating fluid, and it contains a reciprocable piston and piston rod 32 movable radially of sleeve 23. The free end of the piston rod carries a ram 33. The top wall of vessel 10 carries a series of upstanding bearings 34 in which I journal respective rollers 35. These rollers support an elongated horizontal tray 36 located between cylinder 31 and sleeve 23 and movable transversely of the piston rod 32. The underside of the tray carries a gear rack 37. I journal a shaft 38 in another series of bearings 39 upstanding from the top of vessel 10. Shaft 38 carries a pinion 40 which meshes with rack 37. One edge of tray 36 has a series of notches 41. I mount a spring-pressed detent 42 on frame 30 in a position to engage any one of the notches 41. I turn shaft 38 to propel tray 36 along rollers 35 to definite positions controlled by engagement of detent 42 with a notch 41.

The upper face of tray 36 carries a plurality of spaced parallel upstanding partitions 43 and 43a which extend transversely of the tray or parallel with the piston rod 32. Partitions 43 are spaced uniformly and define a series of compartments 44 for slidably receiving solid gates 45 and nozzle gates 46. Partition 43a is double and defines a compartment 44a for slidably receiving a two-part gate 47 of my invention, hereinafter described. In FIG. 1 I have shown a chute 48 which I may use for feeding gates to the tray 36. Whenever detent 42 engages a notch 41, the center line of a corresponding compartment 44 or 44a is horizontally aligned with ram 33 and sleeve 23. I may then operate cylinder 31 to project the piston rod 32 and push a gate from this compartment into vertical alignment with sleeve 23, after which I retract the piston rod. The top wall of vessel 10 carries another frame 49 on the opposite side of sleeve 23. When the ram pushes a new gate into vertical alignment with the sleeve, the new gate in turn pushes the old gate onto frame 49.

The underside of the bottom wall of the tundish 12 carries a pair of fixed guide bars 52 on opposite sides of its outlet opening 20 (FIGS. 3 and 4). Pairs of cap screws 53 depend from these guide bars. A pair of vertically movable guide bars 54

are mounted on the cap screws under the respective fixed guide bars. Compression springs 55 encircle the cap screws and urge the movable guide bars upwardly. The confronting faces of the guide bars 52 and 54 are beveled at each end, as indicated at 56, to provide outwardly flared guideways for receiving a gate, as hereinafter explained. As FIG. 4 shows, the upper face of the bearing member 25 carries a pair of angle iron guides 57 for a gate.

As FIGS. 4 to 8 show, I form the two-part gate 47 of my invention of separable interfitting rectangular upper and lower metal frames 60 and 61. The upper frame includes outwardly projecting horizontal flanges 62 along its upper edge. The under face of the upper frame has a peripheral groove 63. The top of the lower frame has a peripheral vertical flange 64 which fits within groove 63. The frames 60 and 61 have refractory linings 65 and 66 respectively.

In operation, I load solid, nozzle and two-part gates 45, 46 and 47 in appropriate compartments 44 and 44a of tray 36. The double partition 43a of compartment 44a affords clearance for the horizontal flange 62 of my two-part gate. The other gates are straight sided and fit freely within compartments 44. Before placing the tundish 12 on the degassing vessel 10 the first time, I turn shaft 36 to align the solid gate 45 horizontally with ram 33 and sleeve 23 and operate cylinder 31 to push this gate over the sleeve. I position the tundish, evacuate the chamber, and fill the tundish with molten metal. Next I turn shaft 36 to align a nozzle gate 46 horizontally with the ram and sleeve and operate cylinder 31 to push the nozzle gate over the sleeve and push the solid gate 45 onto frame 49. In both instances spring 27 pushes the upper end of the sleeve into tight engagement with the bottom of the gate to hold a vacuum in vessel 10. I allow molten metal to feed to vessel 10, discharge from the vessel to mold 18, and replenish the metal in the tundish in accordance with the usual practice.

Before concluding the pouring operation, I turn shaft 38 once more to align the two-part gate 47 horizontally with the ram and sleeve. When I am ready to remove the tundish, I operate cylinder 31 to push the two-part gate over the sleeve and push the nozzle gate 46 onto frame 49. The flanges 62 on the upper frame 60 of the two-part gate enter the spaces between the guide bars 52 and 54. The beveled faces 56 of the guide bars facilitate such entry, and the spring 55 hold the upper part of the gate in tight engagement with the bottom of the tundish and thus seal its outlet 20. As I lift the tundish away, the two parts of the gate separate, and the bottom part remains over the sleeve 23. The vacuum in the vessel holds the bottom part in tight engagement to provide a seal and retain the vacuum. When the next degassing operation begins, it is only necessary to change gates as already described. The delay to evacuate the chamber for each operation is avoided.

I claim:

1. The combination:

with a vacuum-treating vessel which has inlet and discharge openings in its top and bottom respectively;
a container having an outlet opening in its bottom and being removably positioned over said vessel with said outlet and inlet openings vertically aligned for feeding liquid from said container to said vessel;

of a flow-controlling mechanism comprising;

a two-part gate having separable upper and lower parts;
means on the bottom of said container for slidably receiving and retaining said upper part in a position in which it closes said outlet opening;

said lower part being slidable with upper part, but adapted to be retained by the vacuum in said vessel in a position in

which it closes said inlet opening when said container is removed from said vessel; and

operating means for sliding said gate into vertical alignment with the outlet and inlet openings.

2. A combination as defined in claim 1 in which said gate includes interfitting rectangular upper and lower frames, said upper frame having flanges along its edges engageable with said retaining means.

3. A combination as defined in claim 1 in which said operating means is mounted on the top of said vessel.

4. A combination as defined in claim 1 in which said mechanism further comprises a slidable solid gate and a slidable nozzle gate adapted to be positioned selectively in vertical alignment with said outlet and inlet openings to prevent or permit flow of liquid therebetween, and said operating means acts also to position said solid gate and said nozzle gate.

5. A combination as defined in claim 4 in which said operating means includes a tray having compartments for receiving the different gates and being supported on the top of said vessel, pusher means mounted on the top of said vessel for pushing a gate from said tray into vertical alignment with said outlet and inlet openings, and means mounted on the top of said vessel for moving said tray transversely of said pusher means to place any selected gate in alignment with said pusher means.

6. A combination as defined in claim 5 in which a gate pushed into alignment with said outlet and inlet openings in turn pushes the previous gate out of alignment, and including means mounted on the top of said vessel for receiving gates pushed out of alignment.

7. A combination as defined in claim 1 in which said vessel is a vacuum-degassing vessel for molten steel and said container is a tundish.

8. A combination as defined in claim 7 in which said gate includes refractory-lined interfitting rectangular upper and lower metal frames, said upper frame having flanges along its edges, said retaining means including vertically spaced pairs of guide bars to receive said flanges, and spring means urging said bars together.

9. The combination:

with a vacuum-treating vessel which has inlet and discharge openings in its top and bottom respectively; and
a container having an inlet opening in its bottom and being removably positioned over said vessel with said outlet and inlet openings vertically aligned for feeding liquid from said container to said vessel;

of a flow controlling mechanism comprising:

sliding gates of types which either close said outlet opening and thereby prevent flow therethrough or provide a passage permitting flow; and

operating means for selectively positioning any of said gates in alignment with said outlet and inlet openings, said operating means comprising:

a tray having compartments for receiving the different gates and being supported on the top of said vessel;

pusher means mounted on the top of said vessel for pushing a gate from said tray into vertical alignment with said outlet and inlet openings; and

means mounted on the top of said vessel for moving said tray transversely of said pusher means to place any selected gate in alignment with said pusher means.

10. A combination as defined in claim 9 further comprising a separable two-part gate for closing both said outlet and inlet openings when said container is removed from said vessel.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,550,924 Dated December 29, 1970

Inventor(s) John A. Grosko

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 9, "teem" should read -- feed --.

Signed and sealed this 15th day of June 1971.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

WILLIAM E. SCHUYLER,
Commissioner of Patent