Jan. 28, 1958 M. TAMA 2,821,378

TAPPING DEVICE FOR MOLTEN METALS

Filed Feb. 28, 1955 2 Sheets-Sheet 1

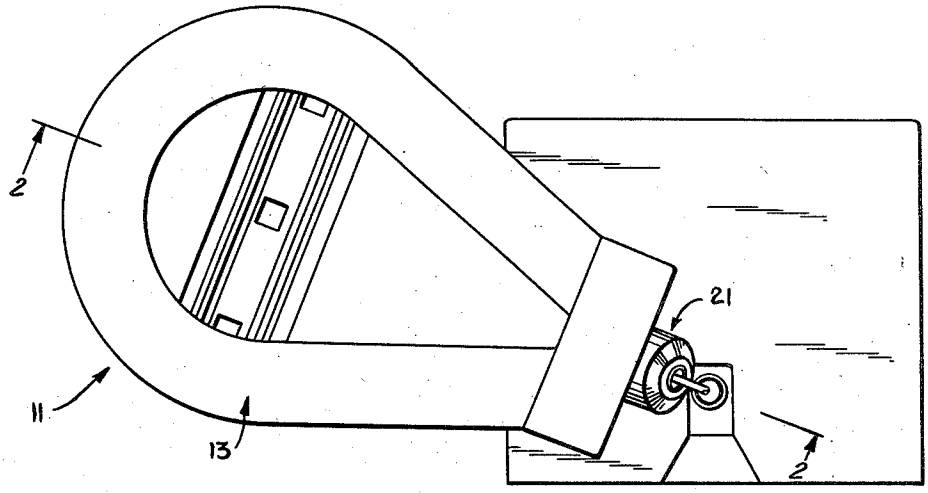
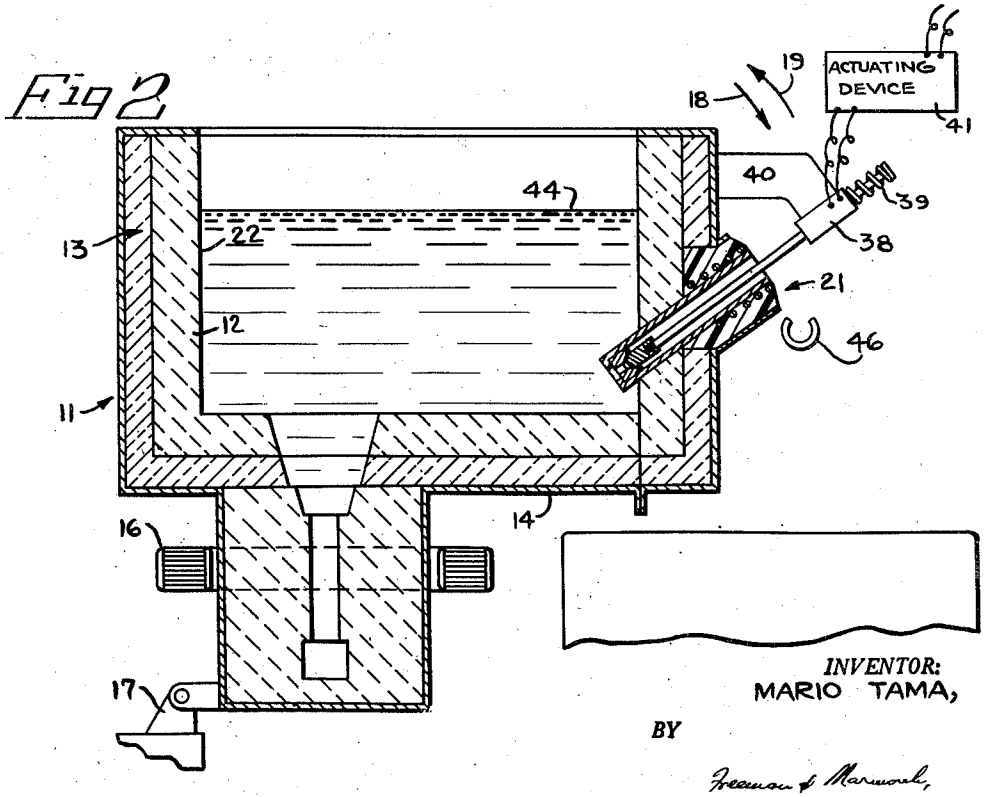


Fig 1

Fig 2



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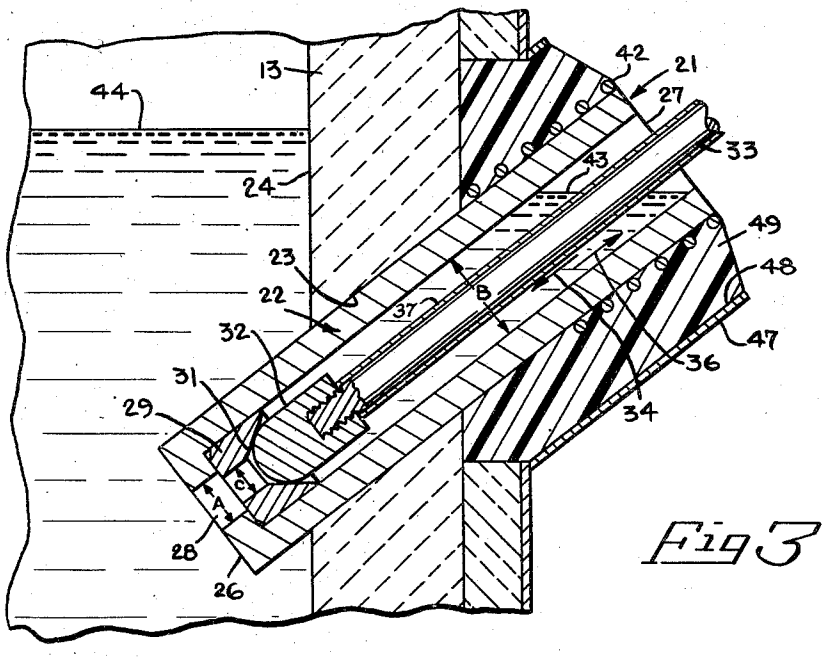


Fig 3

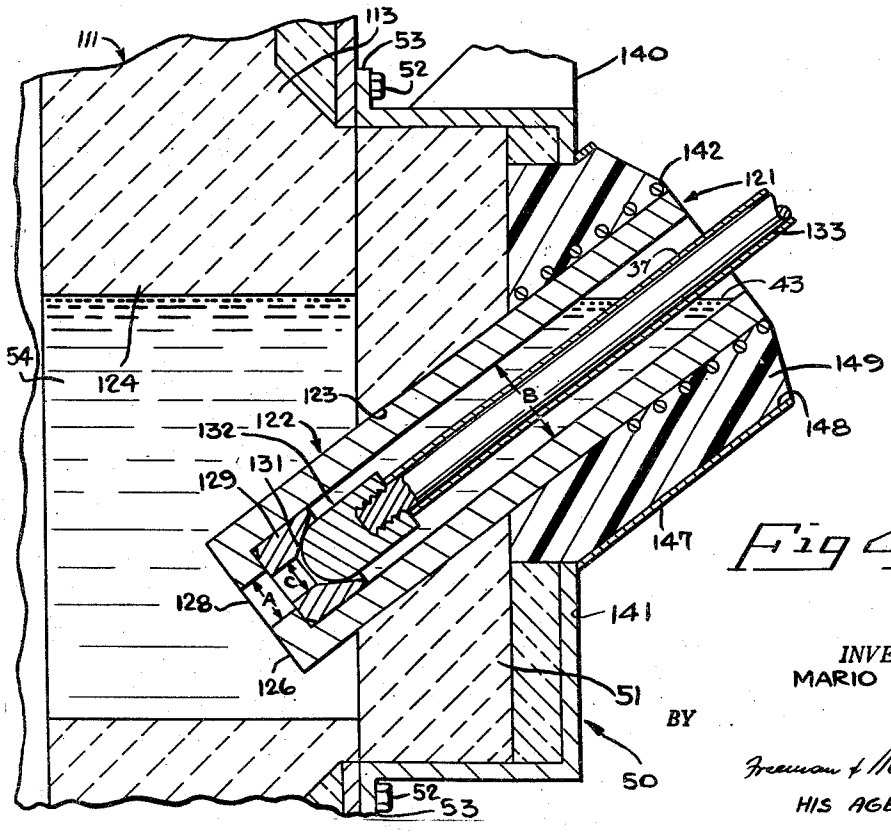


Fig 4

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United States Patent Office 2,821,378
Patented Jan. 28, 1958

2,821,378

TAPPING DEVICE FOR MOLTEN METALS

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Application February 28, 1955, Serial No. 490,940

5 Claims. (Cl. 266—42)

The invention relates to furnaces for molten metal and relates more particularly to tapping devices for the control of the outlet of molten metal from such furnaces.

Heretofore, the conventional method of tapping metals from such furnaces was to provide the furnace with a tapping hole at or near the bottom of the furnace and closing the hole temporarily with clay or similar material. This temporary closure was opened with the aid of a rod and then the metal permitted to flow out in a stream, in most instances into a ladle, until either the furnace was emptied or a new closure made by introducing a ball of fire clay into the tapping hole by means of a rod.

It has been proposed to provide other means for tapping melting pots or furnaces, but these attempts have not been successful for use with metals of high melting point such as aluminum, steel, brass and the like, as the mechanisms of these proposals are subject to dissolution by the prevailing contact with the high temperature molten metal.

The instant invention has among its objects the provision of a tapping device that may be used with high temperature molten metals and be opened and closed at will without destruction to the closure, and which will promote a continuous and free flow easily controllable so that the metal may directly be discharged into a mold.

This application is a continuation-in-part of my copending application Serial No. 29,263 that was filed on May 26, 1948, now Patent No. 2,707,718, dated May 3, 1955.

Further objects and advantages of the invention will be set forth in part in the following specification and in part will be obvious therefrom without being specifically referred to, the same being realized and attained as pointed out in the claims hereof.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description, taken in connection with the accompanying drawings, in which:

Fig. 1 is a plan view of a furnace for molten metal having a tapping device in accordance with the invention;

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1;

Fig. 3 is a large-scale fragmentary sectional view showing a detail of the tapping device; and

Fig. 4 is a fragmentary sectional view, similar to Fig. 3, but embodying a modification.

In carrying the invention into effect in the embodiments which have been selected for illustration in the accompanying drawings and for description in this specification, and referring now particularly to Figs. 1 and 2, there is provided a furnace for molten metal generally indicated at **11**, which may either be a metal furnace or a holding furnace.

The furnace **11** is lined with refractory material **12** along the side wall **13** and the bottom **14**, and has heating means generally indicated at **16** which may be of the induction type such as described in my Patent No. 2,539,800, issued January 30, 1951.

The furnace **11** may, in accordance with a preferred embodiment, be tiltable about a pivot **17** that acts as a

fulcrum. This tilting has the advantage for completely emptying the furnace **11** when desired by tilting in the direction **18** and also for tilting it back in a direction **19** to free the tapping device from contact with molten metal, should that be desired while metal is still in the furnace.

A tapping device generally indicated at **21** is provided in the side wall **13**. It comprises a tube **22** that is sealed into an inclined bore **23** that is formed in the side wall **13**. The tube **22** forms with the horizontal an acute angle and extends through the wall **13** upwardly and outwardly in respect to the metal chamber **24** of the furnace **11**. The tube **22** is open at its lower end **26** and at its upper end **27**, and is constricted near the lower end **26**. The lower end **26** has an inlet **28** that has a smaller cross-sectional area A than the interior cross-sectional area B of the remainder of the tube **22**.

A constriction is provided by an annular apertured valve seat element **29** that is formed near the inlet **28**; the element **29** has an area "C" of aperture that is smaller than the area "B," and it has an annular conical surface **31**, which surrounds the aperture of the element **29** and faces the upper end **27**, and that surface **31** defines a valve seat. A valve closure element such as a stopper **32** fits against said valve seat **31**, and is carried at the end of a rod **33**. The rod **33** is movable axially of the tube **22** in opposite directions **34** and **36** towards and from a valve closure position wherein the stopper **32** engages the seat **31**. The valve seat **31** is immersed in the molten metal not only during pouring but also during the time intervals between the pours.

The tube **22** is made of heat resistant material, such as refractory material, for instance silicon-carbide, or of similar suitable material. The stopper **32** and the valve seat element **29** are made of heat resisting material, for instance graphite or carbon. The rod **33** may be made of steel or cast iron but is covered at least throughout that portion which reaches into the tube **22** by a layer **37** of heat resistant material, such as refractory material or a coating of suitable material such as for instance material known under the trade-name or trade-mark "Spattershield."

A solenoid, generally indicated at **38**, may be carried by a bracket **40** attached to the side wall **13**, in such a manner that the armature of the solenoid **38** is connected to the rod **33**. Furthermore, a spring **39** may be arranged to bias the rod **33** towards return to its normal position wherein the stopper **32** engages the valve seat **31**. The leads of the solenoid **38** may be connected to an actuating device **41**, such as a push button or a timer (not shown in detail) in order to control the solenoid **38** and thereby the rod **33** and stopper **32**. Upon energization of the solenoid **38**, it will remove the stopper **32** off the valve seat **31**, against the bias of the spring **39**; upon deenergization, the solenoid **38** will release the rod **33** to be returned to its normal position under the impulse of the spring **39** to cause valve closure.

The upper portion of the tube **22** is surrounded by an electric heater coil **42** that may be energized to prevent freezing of the metal in the tube **22**. When the valve is closed, the metal stands in the tube **22** at the level **43**, close to the lower tip of the upper end **27**. The metal level **44** in the chamber **24** is normally higher than the metal level **43** causing, upon opening of the stopper **32**, a free flow of the molten metal outwardly through the upper end **27** of the tube **22**. A mold **46** may be positioned below the outpouring stream of molten metal for direct discharge of the molten metal into the mold **46**, as best shown in Fig. 2.

A steel jacket **47** is provided around the upper portion of the tube **22** and is spaced therefrom, forming an annular space **48** that may be filled with insulating material, for instance plastic insulation **49**.

In the modification shown in Fig. 4, there is provided a removable unit **50** that comprises a cover plate **141** which is surrounded by a steel jacket **147**; the steel jacket **147** is applied against the side wall **113** of the furnace **111** and may removably be secured thereto, for instance by screws **52** applied to a flange **53** of the steel jacket **147**. The cover **51** has an inclined bore **123** into which is sealed the tube **122**. The chamber **124** of the furnace **111** has a channel **54** into which the tube **122** reaches, dipping into the molten metal that fills the channel **54**, and the cover plate **51** is applied to close the channel **54**.

A space **148** is provided between the steel jacket **147** and the tube **122**, and insulating material **149** and a heater coil **142** are located in that space **148**. The bracket **140** may be attached to the cover **51**; the other parts, the rod **133**, the stopper **132**, and the valve seat **131**, operate in the same way as in the previously described embodiment.

The operation of the above described invention is as follows.

Energization of the solenoid by the actuator **41** will remove the stopper **32** off the valve seat **31**, and molten metal will flow from the chamber **24** through the tube **22**, and will be discharged in a free flow off the lower tip of the open end **27** of the tube **22**. The molten metal flowing into the tube **22** through the aperture of the valve element **29**, which forms a constriction relative to the interior cross sectional area "B" of the tube **22**, will flow easily and continuously from the chamber **24** into the tube **22**. The constriction which is immersed in the metal bath promotes continuous flowing by preventing build-up, and this is apparently caused by the rapid flow through the constriction. The metal emerging from the tube **22** in a free flow may be directed to be discharged directly into a mold **46**. Upon deenergization of the solenoid **38**, the spring **29** will return the stopper **32** to close the valve; similarly, upon power failure, the solenoid will be de-activated and the spring **39** will act to close the valve in the same manner.

As best shown in Figs. 3 and 4, the tube **22** (**122**) is during the intervals between pours filled with molten metal to the level **43** near the pouring lip, so that upon lifting of the stopper **33** (**133**) the tube will substantially without delay start pouring the metal in a free gentle parabolic flow, for instance into the mold **46**.

The furnace **11** may be tilted about the fulcrum **17**, either in direction **18** when the metal level **44** has become too low for normal gravitational discharge through the tube **22** in the normal position of the furnace **11**, or be tilted in direction **19** to free the lower end **28** of the tube **22** from contact with molten metal.

It will be apparent to those skilled in the art that the novel principles of the invention disclosed herein in connection with specific exemplifications thereof will suggest various other modifications and applications of the same. It is accordingly desired that in construing the breadth of the appended claims they shall not be limited to the specific exemplifications of the invention described herein.

Having thus described the invention, what I claim as new and desire to be secured by Letters Patent, is as follows:

1. In a tapping device, for use in connection with a furnace for molten metal having a bottom and a side wall defining a chamber for the molten metal bath, in combination, a tube having a solid uninterrupted encircling wall and being open at both ends protruding through said side wall and being inclined at an angle to the horizontal plane and adapted to extend with its lower end into the metal bath in said chamber and with its upper end to the exterior of said furnace, said tube being composed of heat resistant material and having near its lower end a constriction, a valve seat formed near said constriction on the tube interior and adapted to be immersed in the molten metal during pouring and during the time intervals between pours, and a stopper on the interior of said tube movable within said tube in opposite directions to and from said valve seat for releasably sealing the same and including a stem extending from said stopper through said open upper end to the exterior of said tube, the molten metal filling said tube between pours to a level slightly below the pouring level and below the level in the furnace, whereby upon removal of said stopper off said seat molten metal may flow upwardly through said tube and thereafter in a free constant flow emerge from the upper end of said tube.

2. In a tapping device, as claimed in claim 1, together with, heating means surrounding at least the upper portion of said tube for restraining metal freezing therein.

3. In a tapping device, as claimed in claim 1, together with, a metal casing surrounding at least the upper portion of said tube and spaced therefrom defining with the exterior of said tube portion an annular space, and insulating material disposed in said space.

4. In a tapping device, as claimed in claim 1, together with, means operatively connected to said stem and operable for guding said stopper to and from its sealing position on the valve seat, resilient means actuatable to urge said stopper towards said seat for normally closing the valve, and a mechanism energizable to move said stopper away from said valve seat against the bias of said resilient means and arranged to release said stopper upon deenergization for return thereof under the impulse of said resilient means.

5. In a tapping device unit, for use in connection with a furnace for molten metal including a bottom and a side wall defining a chamber for the molten metal bath including a lateral channel formed in said side wall below the normal metal level, in combination, a side cover secured to said side wall adjacent said channel and having a larger dimension than the cross-section of said channel to close the same throughout, said cover comprising a wall having a bore inclined upwardly when said wall is positioned on said furnace intercommunicating with the interior of said channel, a refractory tube disposed in said channel and open at both ends and extending with its upper end to the exterior of said wall and extending with its lower end into said channel, said lower end being in said channel immersed in the molten metal bath, and having a constriction and adapted to be immersed in the molten metal bath, a valve seat formed near said constriction, and a stopper movable on the interior of said tube in opposite directions to and from said seat for releasably sealing the same and including a stem extending from said stopper through said open upper end of said tube to the exterior, the molten metal filling said tube between pours to a level slightly below the pouring level, whereby upon removal of said stopper off said seat molten metal may flow upwardly through said tube and thereafter in a free constant flow emerge from the upper end of said tube.

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