June 7, 1960 E. W. EDSTRAND ET AL 2,939,899

METAL MELTING FURNACE

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Fig. 1

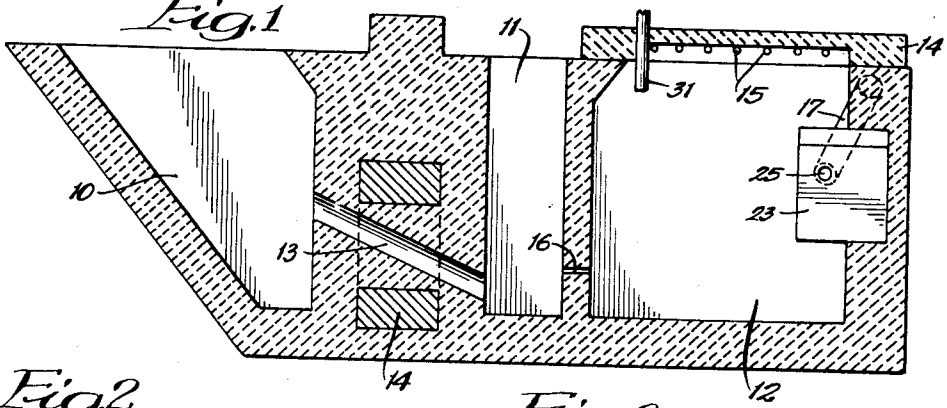


Fig. 2

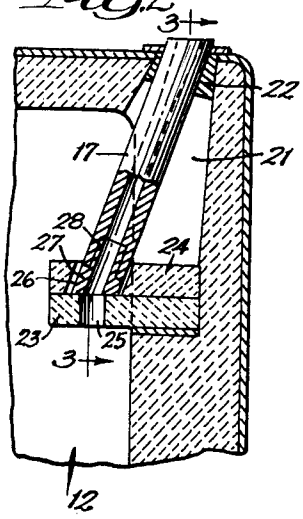


Fig. 3

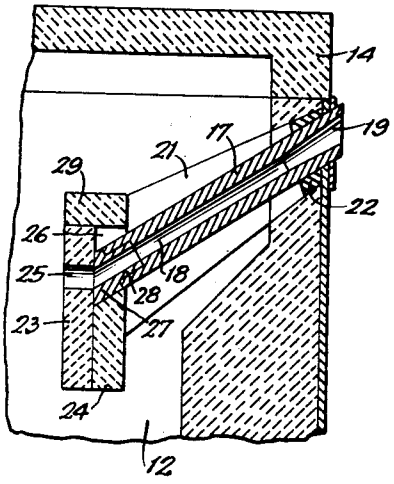
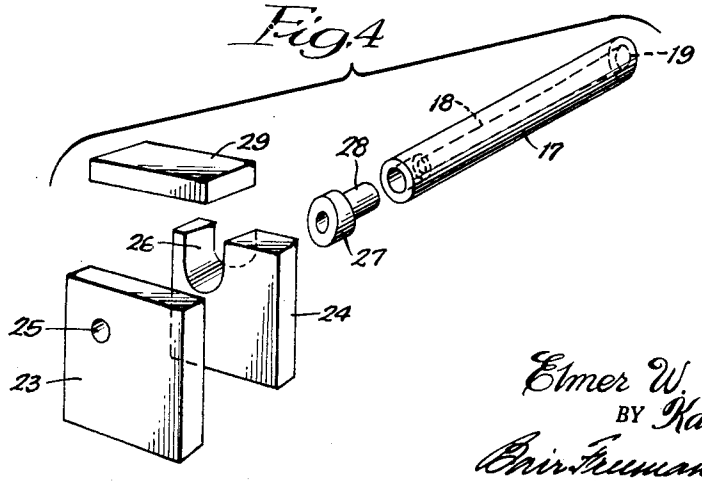


Fig. 4



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METAL MELTING FURNACE

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3 Claims. (Cl. 13—33)

This invention relates to metal melting furnaces and more particularly to a furnace from which molten metal is discharged by the action of fluid under pressure.

It has heretofore been proposed to discharge molten metal from a furnace by supplying a gas under pressure to the furnace chamber to force the metal out through a discharge tube projecting into the chamber. For this purpose, the discharge chamber must be closed to retain the gas pressure and if the furnace is charged in the same chamber, the closure would be removed each time metal is added. This operation slows down and complicates use of the furnace.

If a two-chamber furnace is employed having an open charging chamber and a closed discharge chamber the pressure will cause the metal to back up in the charging chamber and may cause overflow. Valving to prevent backing up of the metal is expensive and impractical and any restriction in the connecting melting channels cannot be tolerated because of interference with the melting operation.

It is therefore one of the objects of the present invention to provide a metal melting furnace in which metal may be discharged from the furnace by fluid pressure without interference with normal operation and charging of the furnace.

Another object is to provide a metal melting furnace in which a separate closed discharge chamber has restricted communication with a melting or holding chamber to limit backflow of the metal when the discharge chamber is under pressure.

According to one feature of the invention, the metal in the melting or holding chamber is heated by electric induction through a secondary loop connected thereto and the melting or holding chamber communicates with the discharge chamber through a restricted passage below the normal level of molten metal. In a preferred construction, the furnace comprises a charging chamber connected to a holding chamber through relative unrestricted melting channels and the holding chamber is connected through a restricted passage to a separate discharge chamber.

A further object is to provide a metal melting furnace in which an elongated straight discharge tube projects through and terminates closely adjacent to the outer wall of the discharge chamber with its lower end supported in the discharge chamber below the normal level of molten metal therein.

According to a feature of the invention, the discharge tube is formed with a passage of uniform section extending from its lower end through the major portion of its length.

The above and other objects and features of the invention will be more readily apparent from the following description when read in connection with the accompanying drawing, in which:

Figure 1 is a vertical sectional view through a metal melting furnace embodying the invention;

Figure 2 is a horizontal section through the furnace of Figure 1 with parts of the discharge tube in section;

Figure 3 is a partial vertical section on the line 3—3 of Figure 2; and

Figure 4 is a disassembled perspective view of the discharge tube and support.

The complete furnace, as shown in Figure 1, is an induction type furnace provided with a separate discharge chamber having restricted communication with the melting or holding chamber of the furnace from which molten metal is discharged by gas under pressure. The furnace, as shown, is a three-chamber furnace including a charging chamber **10** into which metal may be charged and a holding chamber **11** and a discharge chamber **12**. The three chambers may be formed in a single unitary body of refractory material or could be separately formed and connected as desired. To heat the metal for melting it, the charging and holding chambers are connected by a plurality of channels **13** which are spaced horizontally apart and which are threaded by a primary unit **14** to create a time varying flux cutting the melting channels. The primary unit may include a magnetic closed core, at least one leg of which carries a winding to be energized by alternating current.

The charging and holding chambers and the channels and primary unit comprise a conventional two-chamber induction furnace in which the metal is heated by induced flow of current through the metal in the channels and in the chambers. While the chamber **10** is referred to as the charging chamber, metal to be melted can be charged in the chamber **11** equally well. Preferably, however, the chamber **11** is made relatively small compared to the chamber **10** and the latter is utilized as the charging chamber.

The discharge chamber **12** is closed at its top by a cover **14** which may, if desired, carry heating elements, as shown at **15**, to add heat to the metal therein. The discharge chamber **12** communicates with the holding chamber **11** through a restricted passage **16** in the lower parts of the chamber. Metal in the discharge chamber is adapted to be forced therefrom through a discharge tube **17** projecting into the discharge chamber from a point above the normal level of molten metal therein.

As best seen in Figures 2, 3 and 4, the discharge tube is an elongated straight tube formed with a uniform bore **18** therein extending from its lower end through the major portion of its length. The upper end of the tube projects through the side wall of the discharge chamber near the top thereof and terminates in a flat outer face closely adjacent to the outer wall of the discharge chamber.

To provide for easy mounting of the tube and to insure heating of the tube to maintain the metal therein molten, the walls of the discharge chamber are recessed, as shown at **21**, adjacent to the corner through which the discharge tube projects. An opening is provided extending completely through one wall of the chamber and the discharge tube may extend through this opening and be secured therein by refractory cement, or the like, as shown at **22**. Due to recessing of the chamber wall, the tube is free between its ends so that it may be substantially surrounded by molten metal in the chamber and in any event will be heated throughout its length so that metal will not freeze therein.

The lower end of the tube is supported in the chamber beneath the level of molten metal therein by a pair of supporting blocks **23** and **24** which are mounted in the side wall of the chamber and project outward therefrom. The block **23** is formed with an opening **25** therein of substantially the same size as the bore **18** in the tube through which metal can flow into the tube. The block **24** is formed with an open groove **26** extending

downward from its top into which the lower end of the tube is received. The lower end of the tube is formed with an acute angle to cooperate with the supporting plates 23 and 25. Preferably a short plug element 27 of refractory material is provided having one end shaped to fit into the groove 26 and flat against the face of the plate 23 around the opening 25 and with a narrow tubular projection 28 thereon. The projection 28 fits into an enlarged recess in the lower end of the tube 18 to form a continuation of the tube 18 and to support the lower end thereof. After the lower end of the tube 18 and the plug member 27 are mounted in the groove 26, as shown in Figures 2 and 3, a cover block 29 may be mounted over the plates 23 and 24 to prevent accidental removal of the lower end of the tube. With this construction, the tube can easily be installed and can be replaced when necessary without requiring tearing down of the furnace or taking it out of service for any prolonged period of time. In operation, with molten metal in the furnace the discharge chamber 12 will be filled through the restricted passage 16 to the same level as the metal in the charging and holding chambers. When it is desired to discharge metal as, for example, to fill molds or the like, the receiving nipple on a mold or other receptacle may be placed in sealing engagement with the outer end of the tube 17 and gas under pressure may be forced into the discharge chamber through a pipe 31. The gas pressure will force molten metal out through the tube 17 which provides for relatively unrestricted flow so that the metal can be discharged relatively rapidly. The gas pressure tends to force metal from the discharge chamber back through the passage 16 into the holding and charging chambers. However, because the passage 16 is restricted relative to the discharge tube only a relatively small quantity of metal will flow back so that operation of the furnace is not materially interfered with.

While the actual dimensions of the discharge tube and the passage 16 will vary with the size of the furnace and the type of operation contemplated, we have found that in one very satisfactory construction the discharge tube may have a diameter of the bore 18 of approximately one inch while the bore 16 may have a diameter of one-half inch. The diameter of the passage 16 will be determined in each case to be sufficient to let enough metal into the discharge chamber when it is not under pressure to satisfy the discharge requirements when the chamber is under pressure. In other words, the passage 16 must allow flow of sufficient metal into the discharge chamber when no pressure is applied to satisfy the demand for discharge of molten metal on each discharge cycle plus the amount which will flow back through the passage 16. This can easily be determined for each particular installation and enables metal to be discharged without interfering with normal operation of the furnace and without requiring any restriction of the melting channels 13.

While one embodiment of the invention has been shown and described herein, it will be understood that it is illustrative only and not to be taken as a definition of the scope of the invention, reference being had for this purpose to the appended claims.

What is claimed is:

1. A metal melting furnace comprising three horizontally spaced chambers including a charging chamber, a holding chamber and a discharge chamber, melting channels connecting the charging and holding chambers, a primary winding threading the melting channels to induce a flow of heating current therein and in the charging and holding chambers, means providing restricted communication between the charging and holding chambers below the level of molten metal therein, a relatively unrestricted discharge conduit extending into the discharge chamber from the upper part thereof to a point below the normal level of molten metal therein, and means to place the discharge chamber periodically under pressure to force molten metal therefrom through the discharge conduit.

2. A metal melting furnace comprising three horizontally spaced chambers including a charging chamber, a holding chamber and discharge chamber, melting channels connecting the charging and holding chambers, a primary winding threading the melting channels to induce a flow of heating current therein and in the charging and holding chambers, means providing restricted communication between the charging and holding chambers below the level of molten metal therein, a relatively unrestricted discharge conduit extending into the discharge chamber from the upper part thereof to a point below the normal level of molten meal therein, a cover for the discharge chamber, and means for periodically introducing gas under pressure into the upper part of the discharge chamber to force metal therefrom through the discharge conduit.

3. In a metal melting furnace having a discharge chamber formed with vertical side walls meeting at an angle, an elongated straight discharge tube of substantially uniform section extending through one of the walls adjacent to the top of the chamber and terminating closely adjacent to the outer surface of the wall, the tube extending downward into the chamber at an acute angle to horizontal, and a supporting block carried by and projecting from the other of the walls and supporting the lower end of the tube at a point below the normal liquid level in the chamber.

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