Oct. 18, 1932. E. F. BEGTRUP 1,883,755

CRUCIBLE FOR ALUMINO-THERMIC REACTIONS

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Fig. 1

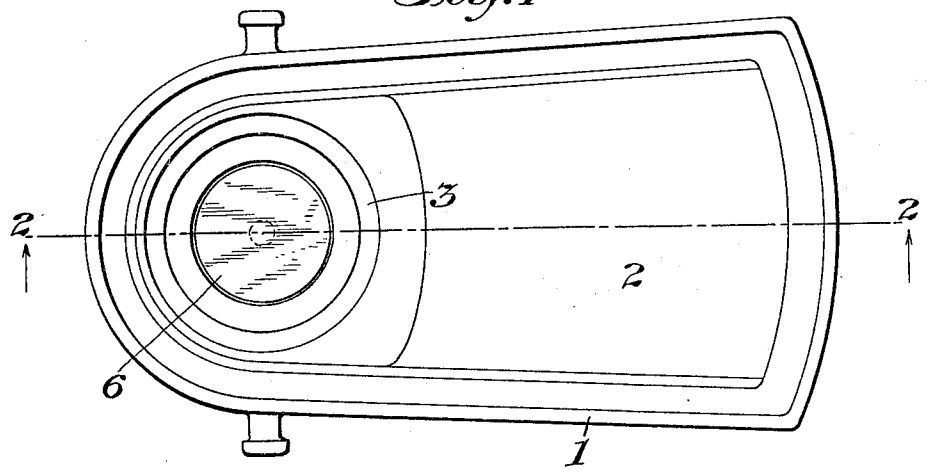
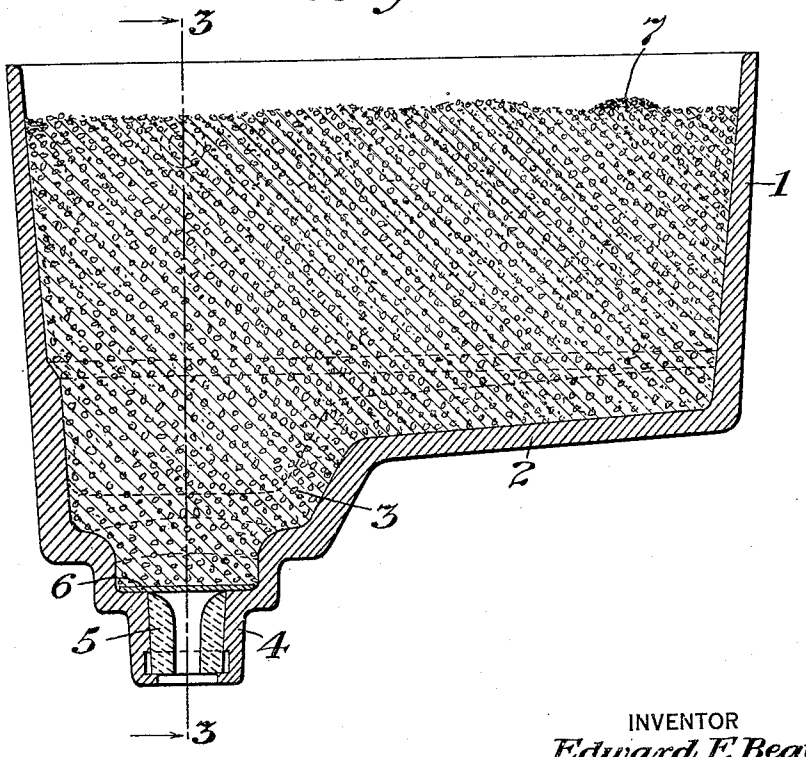


Fig. 2



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Fig. 3

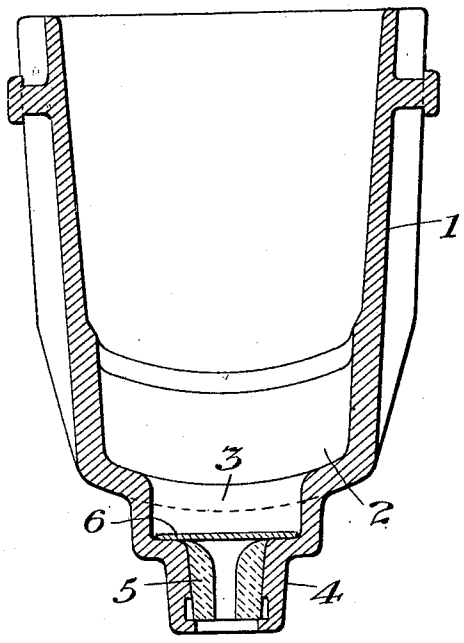
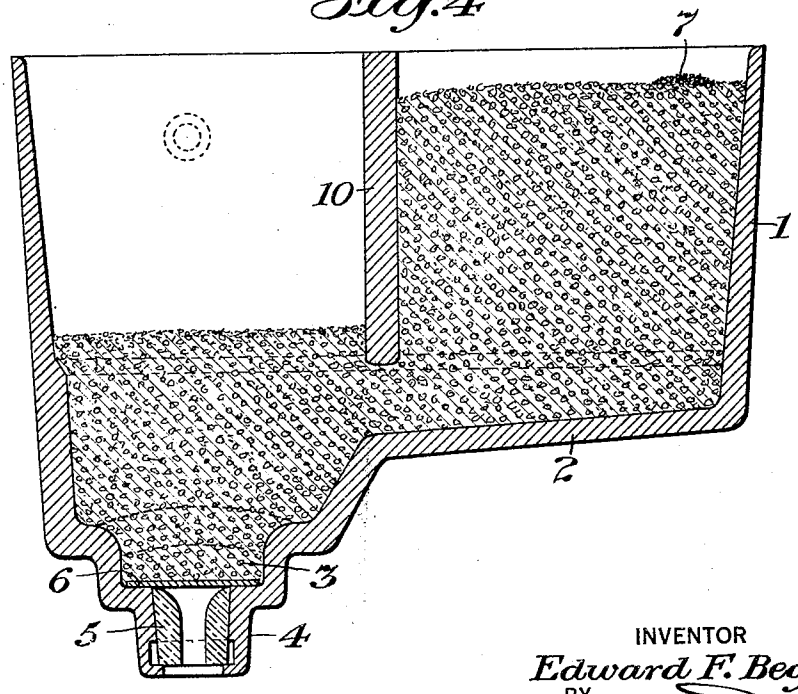


Fig. 4



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Fig. 5

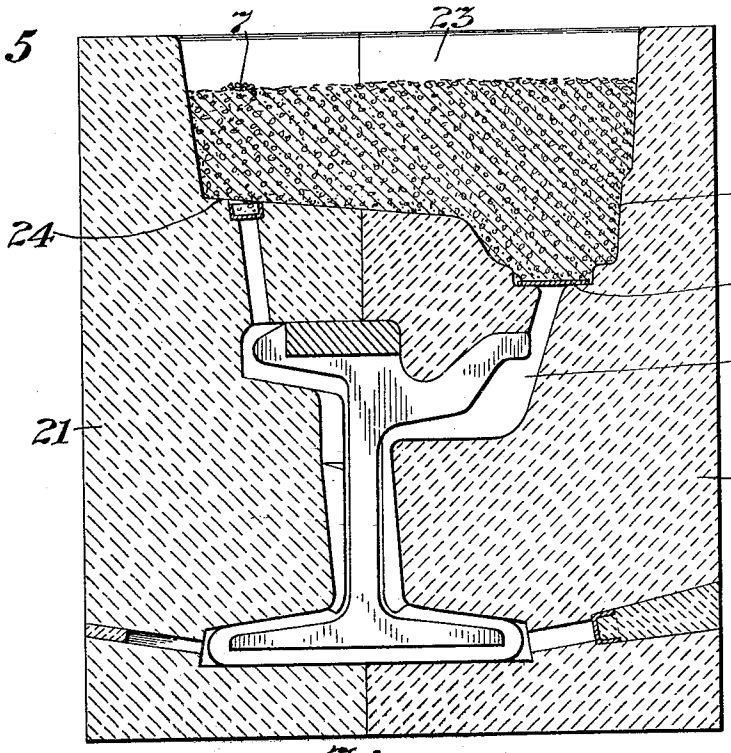
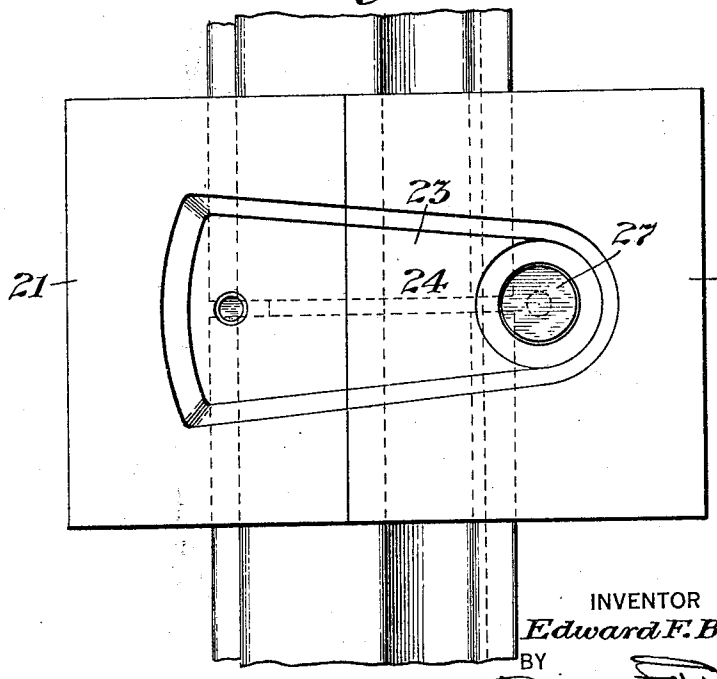


Fig. 6



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UNITED STATES PATENT OFFICE

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CRUCIBLE FOR ALUMINO-THERMIC REACTIONS

Application filed March 23, 1932. Serial No. 600,815.

The invention relates to certain new and useful improvements in crucibles for use in effecting the production of metals by means of metallic reducing agents, such, for example, as the production of superheated molten steel by the alumino-thermic process for welding, and has for its object to provide a novel form of crucible either as a separate unit or as a component part of the mold in which the welding operation is effected, which will eliminate the need of the usual plugging means for retaining the products of the reaction, will insure a quieter reaction with less ebullition, that is particularly advantageous in rail welding operations, that is automatically self-tapping, thereby eliminating the personal equation predicated on the operator's judgment as to the proper time to tap, together with other advantages, as will appear from the particular description of the invention hereinafter.

The invention is illustrated in the accompanying drawings, in which:—

Fig. 1 is a plan view of a typical form of crucible adapted especially for rail welding.

Fig. 2 is a section on line 2—2 of Fig. 1, showing the crucible supplied with a charge of the reactive mixture.

Fig. 3 is a section on line 3—3 of Fig. 2, with the reactive mixture omitted.

Fig. 4 is a view similar to Fig. 2 showing a modification.

Fig. 5 is a further modification showing the crucible embodied in the mold structure and supplied with a charge of the reactive mixture.

Fig. 6 is a plan view thereof with the reactive mixture omitted.

As illustrated in Figs. 1 to 4, the crucible is constructed as an independent unit especially adapted for welding the ends of rails together and comprises, in the exemplary form shown, a more or less elongated trough-shaped body 1 having a bottom 2 of relatively large superficial area as compared with the old types of crucibles used for this particular purpose, the general shape or configuration of the structure resembling that of a bath tub with its sides tapering slightly toward what would be the outlet end of the bath tub, the main portion of the bottom 2 tapering toward said narrow end. Formed in the narrow end of the bottom is a well or sump 3 provided at its bottom with a nipple 4, which constitutes the tap hole provided with the usual liner or thimble 5, the tap hole being adapted to be closed by any suitable means, such as the disc 6, which may be of metal or paper, or by any suitable combustible wadding, such as paper, steel wool, cotton waste or the like, which will be effective in preventing the granular mixture to be reacted escaping before the reaction takes place. As thus constructed, the body of the crucible comprises a vessel of a depth considerably less than its longitudinal dimension and of a width much less than its length, with the tap hole located near one end, so that the bulk of the reactive material will occupy that portion of the crucible wholly to one side of the vertical axis of the tap hole. The crucible may be made of metal, such as steel, in the form of a casting, or of refractory material provided with a suitable casing or, as in the example illustrated, a metal casting.

In the modification shown in Fig. 4, the interior of the crucible is divided by a cross partition 10, which terminates short of the bottom 2 to form two communicating chambers to receive the reactive mixture, the chamber above the tap hole preferably being the smaller, and the dividing partition or wall constituting a barrier which will prevent the products of the reaction reaching the tap hole too quickly.

In applying the crucible to its intended use, it is positioned over the mold in which the weld is to be effected, with the tap hole in vertical alignment with the pouring gate of the mold. A requisite quantity of reactive mixture is placed in the crucible, as shown in Figs. 2 and 4, and a small charge of ignition powder, as indicated at 7, placed on the upper surface of the mixture at a point well toward the end of the crucible remote from the tap hole, so that, when said powder is ignited, it will initiate the reaction in the alumino-thermic or equivalent mixture at a point farthest removed from the tap hole.

The particular advantage of this form of

crucible will be apparent from a comparison of the operation of the same with that of the conical crucibles heretofore employed having a centrally disposed tap hole, the use of which necessitated the plugging of the tap hole, as by a tapping pin, which had to be dislodged by a tapping spade or other appropriate instrument after the reaction had been completed, in order to teem or discharge the products of the reaction from the crucible. Plugging of these old types of crucibles is imperative, because the first liquid steel and slag produced quickly sinks or settles to the bottom before the major part of the reaction gets under way, and, therefore, if such plugging means were not provided, a mixture or mass of liquid steel and slag would be teemed or discharged out of the crucible together and enter the welding mold, whereas the molten steel alone should be permitted to enter the mold. This rapid settling of the initial portion of the molten steel and slag is due to the fact that the reaction propagates or progresses relatively slowly in a horizontal direction as compared with the speedy progress of the reaction in a vertical direction in a body of thermit. This results in the unreacted portions of the mixture on all sides of the path of propagation of reaction sliding or tumbling inward and downward upon the previously reacted products. Meanwhile, a pool or body of the reacted products, including the steel and the slag, is collected at the bottom of the crucible, above which pool the reaction of the rest of the mass continues to completion. It is evident that the reaction as a whole propagates at a continuously accelerated rate, particularly in a downward direction, until nearly completed and also that horizontal or sidewise propagation of the reaction is at a relatively slow rate. Basically, the present invention is designed essentially to obviate the difficulties inherent in the older types of conical crucibles with a centrally disposed tap hole and to provide a crucible having a relatively large bottom area with a tap hole at or adjacent one end of the bottom, so that the reaction of the exothermic material may be started at a point or points horizontally remote from the tap hole. With a crucible so constructed and the reaction being initiated near the end opposite or remote from the tap hole end, it will be seen that advantage is taken of the comparatively slow lateral propagation of the reaction and also of the fact that the unreacted exothermic mixture adjacent the tap hole, as well as the body of the mixture intervening between the tap hole and the reactive mass, acts as a barrier wall, which prevents the initial reaction products from reaching the tap hole too quickly. It has been found that alumino-thermic iron reactions, such as used in effecting rail welds, are completed in from fifteen to twenty-five seconds. In practical application, the crucible, as designed, results in a discharge of the first portions of the molten steel alone from the tap hole in from eight to fourteen seconds after the reaction has been initiated and thus, due to the rapidly accelerated rate of reaction, practically three-fourths or more of the mixture has been reacted before the molten steel emerges from the tap hole and the latter is of such area that the reaction of the entire mass is completed before all of the previously produced molten steel has been teemed or discharged from the crucible.

Although it has been indicated that a fusible disk of metal or a wadding of fusible or combustible material is preferred as the means for closing the tap hole, so that the crucible will be of the automatic self-tapping type, it will be understood that the invention is not limited to the employment of such means for closing the tap hole, as the crucible is quite as well adapted for use with the usual form of plug which must be displaced manually.

It will also be apparent that the crucible may be given any other shapes or forms than that exemplified in the drawings, provided these forms embody the fundamental principle of the invention, which requires that the crucible have a bottom of relatively large superficial area and that the tap hole be so located in the bottom that the point at which the exothermic mixture is ignited is laterally removed for a considerable distance from the tap hole.

One modification is that indicated in Fig. 4, in which the transverse partition 10 divides the interior of the crucible into two chambers, one preferably being considerably larger than the other, with the tap hole in the bottom of the smaller chamber. The separating wall between the two chambers acts as a barrier wall in much the same manner as the mass of the unreacted mixture between the point of ignition and the tap hole, in the form of the invention first described. In this case, the reaction would be started at the surface of the material in the larger chamber and, if desired, the opening below the partition 10 connecting the chambers may be sealed by a fusible or combustible strip, so that the seal would not be broken and the passage between the chambers opened until the reaction is well under way.

As stated, the crucible may be formed as a component part of the mold in which the weld is to be effected and such an application of the invention is exemplified in Figs. 5 and 6, in which 20 and 21 represents the halves of the two part mold adapted to enclose the ends of the rails or other elements to be welded, the mold being made of suitable refractory material as commonly used in the art, with the upper portions of the two mold sections being shaped to form a receptacle or basin 23,

formed in the body of the mold and having the same characteristic shape or form and dimensions as the independent crucible as hereinbefore described, namely, an elongated trough-shaped body with a bottom 24 of relatively large superficial area inclining toward the sump 25, which opens into the pouring gate 26 of the mold at one end of the trough-shaped receptacle, so that, when the connection between the sump and the pouring gate is closed by a fusible or combustible plate, as 27, and a charge of the reactive material placed in the crucible and ignited at a point near the opposite end of the crucible from that communicating with the pouring gate, all of the operative advantages of the separate or unitary crucible may be realized.

What I claim is:

1. A crucible for alumino-thermic and similar reactions having a basin of general trough shape with a tap hole near one end of the bottom thereof.

2. A crucible for alumino-thermic and similar reactions having a basin of general trough shape and a bottom of relatively large superficial area with a tap hole near one end of the bottom.

3. A crucible as described in claim 1 provided with a cross partition dividing the basin into chambers and terminating above the bottom.

4. A crucible as described in claim 1 having a well or depression in its bottom surrounding the tap hole.

5. A crucible for alumino-thermic and similar reactions having side and end walls defining an elongated basin with a bottom of large superficial area, and a tap hole located in the bottom near one end wall.

In testimony whereof I affix my signature.

EDWARD F. BEGTRUP.