Jan. 7, 1941. G. D. ROGERS 2,227,845

CONTINUOUS EXPLOSIVE MELT UNIT

Filed Feb. 9, 1940 2 Sheets-Sheet 1

Fig. 1.

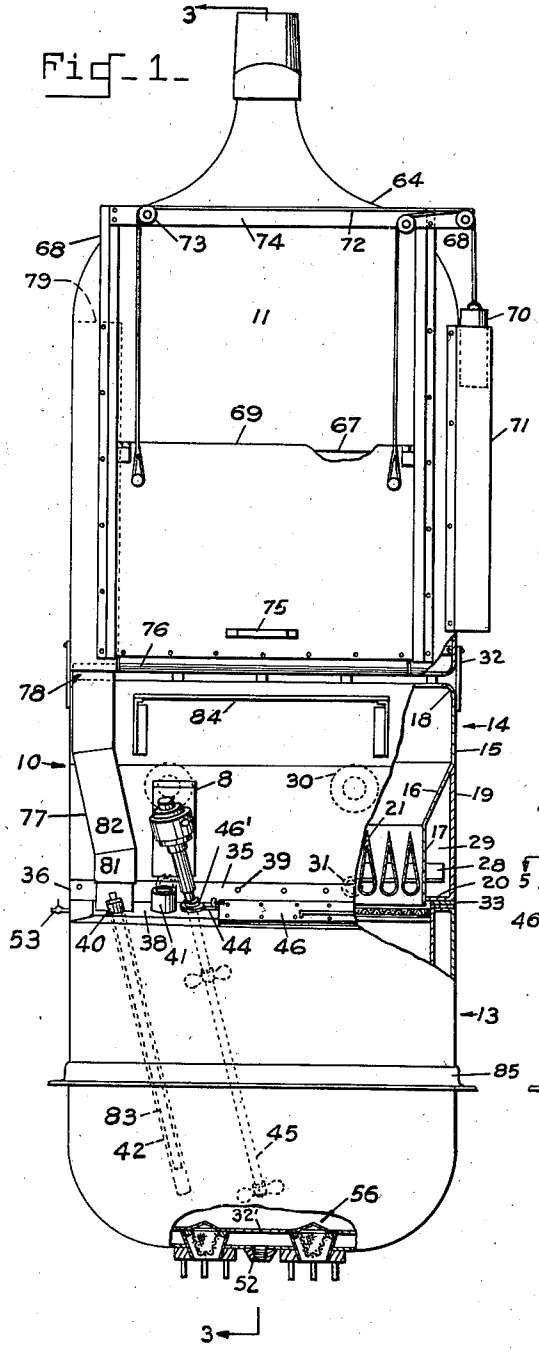
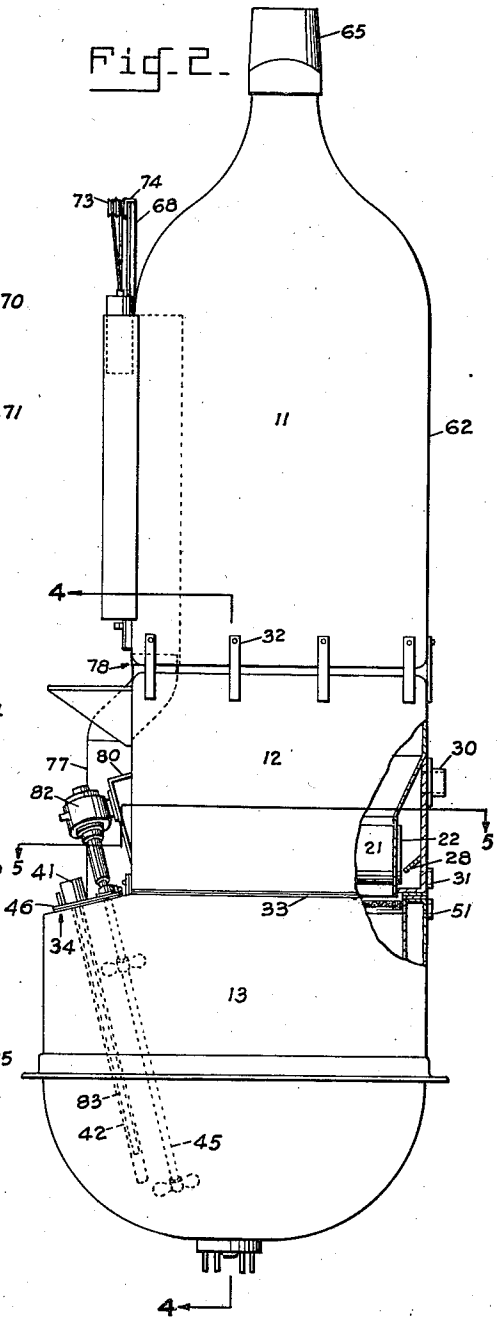


Fig. 2.



Inventor
George D. Rogers
By: G. J. Kessenich and J. Schmuck
Attorneys

Jan. 7, 1941. G. D. ROGERS 2,227,845

CONTINUOUS EXPLOSIVE MELT UNIT

Filed Feb. 9, 1940 2 Sheets-Sheet 2

Fig. 3.

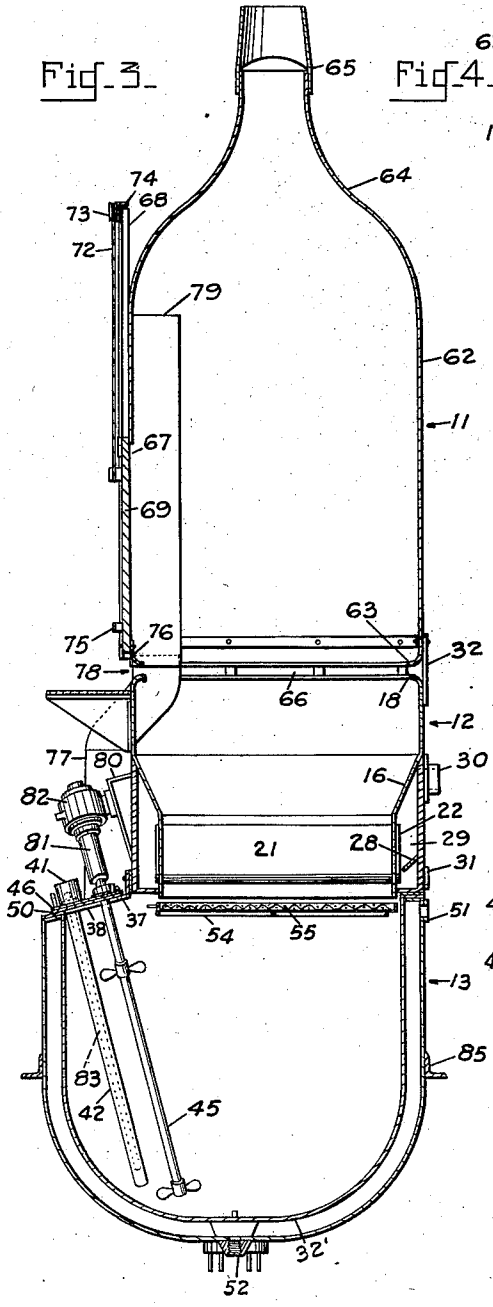


Fig. 4.

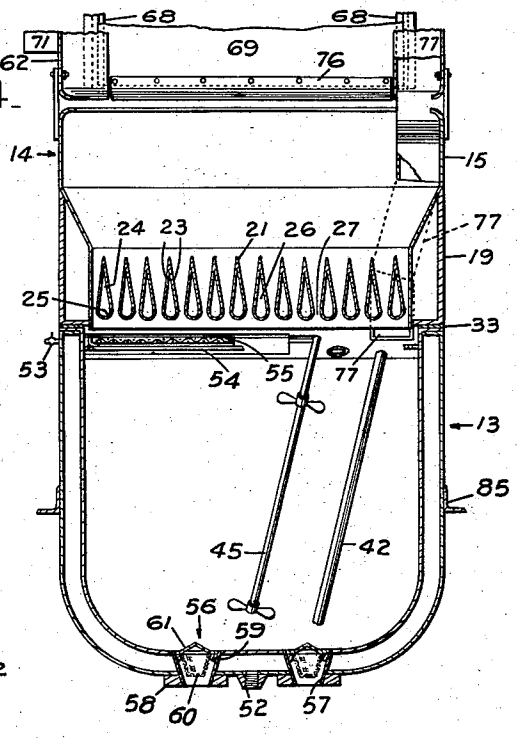
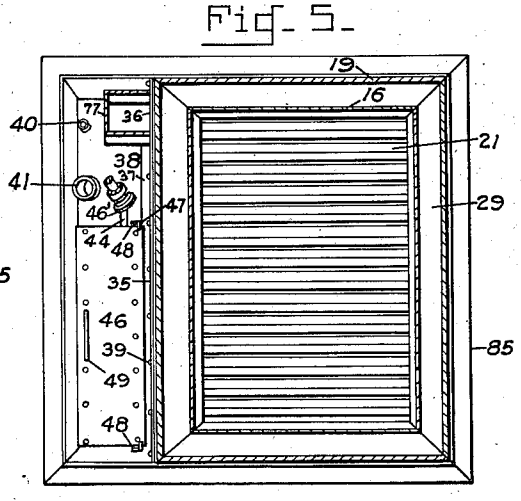


Fig. 5.



Inventor
George D. Rogers
By: G. J. Kesselring and J. McHugh
Attorneys

Patented Jan. 7, 1941

2,227,845

UNITED STATES PATENT OFFICE

2,227,845

CONTINUOUS EXPLOSIVE MELT UNIT

George D. Rogers, Dover, N. J.

Application February 9, 1940, Serial No. 318,119

12 Claims. (Cl. 126—343.5)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to apparatus for melting explosives and more particularly to apparatus for continuously melting explosives in contradistinction to apparatus for batch melting of the same.

It is a prime object of the invention to provide a grid for melting explosives so constructed and arranged that the passage of molten explosive through the grid will at no point contact a "cold spot" or zone therein where the temperature is above the solidification point of the explosive; whereby all freezing of the molten explosive in the grid is obviated, thereby providing maximum flow of molten explosive through the grid with minimum superheating thereof.

It is a further object of the invention to so arrange the grid for melting the explosives that the heat exchanging area of the individual elements of the grid may be greatly increased and their relative spacing so organized that explosive lying between the grid elements will be subjected to substantially uniform differential temperature change from the temperature of the solidified form of the explosive to the temperature of its molten form to thereby avoid excessive superheating of the explosive.

Another object of the invention is to arrange the grid for melting the explosive within a housing or casing provided with a charging door wherein the housing or casing and door are so relatively organized and disposed as to prevent escape of fumes and/or vapors arising from the molten explosive on the grid when the charging door is opened for introducing solidified explosive within the housing to be melted.

Still another object of the invention is to arrange the lower part of the housing or casing for the unit as a receiving pan or basin for molten explosive which passes the melting grid and to so provide such pan or basin with suitable heat control and agitating means that the explosive may be maintained in molten condition without superheating in readiness for pouring or casting into any desirable containers, such as high explosive shells.

Fig. 1 is a front elevation in section showing the continuous melt unit of this invention;

Fig. 2 is a side elevation, also partially in section, of the structure shown in Fig. 1;

Fig. 3 is a section taken on the line 3—3 of Fig. 1;

Fig. 4 is a section taken on the line 4—4 of Fig. 2;

Fig. 5 is a section taken on the line 5—5 of Fig. 2.

Referring now to the drawings by characters of reference, and more particularly to Figs. 1 and 2, there is shown in accordance with this invention a melt unit 10 of a type for continuous operation in melting materials having relatively low solidification points; such as explosives having the characteristics of TNT, for example. The melt unit 10 is enclosed within a housing or casing of generally rectangular cross section and is comprised of the fume or vapor stack portion 11, melting grid portion 12, and molten explosives receiving basin or pan 13 arranged in superimposed relation as shown.

The melting grid portion 12 includes a hopper member generally designated by the numeral 14 of any desirable configuration; but herein shown as preferably being of rectangular cross section and as comprising the upstanding side wall portions 15, inwardly and downwardly converging wall portions 16 extending from the side walls 15, respectively, and downwardly extending or depending wall portions 17 extending from the wall portions 16, respectively, in parallel relation with the upstanding wall portions 15. The various component wall portions of the hopper member may be made from an integral piece of material or of separate sections suitably secured in functionally integral relation by any conventional securing means such as welding. The upstanding wall portions 15 are arranged to serve as a portion of the housing or casing for the melt unit and their upper edges are inturned on a suitable radius to provide an endless inturned flange 18 about the upper terminus of the melting grid portion 12 for a purpose made clear hereinafter. A rectangular jacket member 19 coextensive in outside dimensions with the rectangularly arranged wall portions 15 is secured, as by welding, at its upper edge to the hopper member 14 at the junction of the wall portions 15 and 16 thereof in fluid sealed relation and has at its lower end an endless inturned flange 20 arranged in normal relation to its upstanding wall portions and extending inwardly into engagement with the depending wall portions 17 of the hopper member where it is welded or otherwise secured to the wall portions 17 in fluid sealed relation. Conveniently, the inturned flange 20 engages the wall portions 17 of the hopper slightly above the lower edges of the latter to facilitate welding the two members together and maintaining the inside faces of the wall portions 17 free of objectionable protrusions; also the member 19 is preferably of a heavier gage material than the hopper member, as it is designed to carry the load of the melting grid through the flange 20, however, as will be readily understood in the art these particular expedients are by way of preferable embodiments and not of limitation, as the hopper may be secured to the member 20 in any desirable man-

ner and the member 19 and wall portions 15 made integral while the wall portions 16 and 17 are formed as a separate unit secured to the wall portions 15 and member 19 as made integral. It will be obvious from an inspection of Figs. 1 and 2 that the member 19 serves as the housing or casing member portion for the melt unit contiguous to the wall portions 15. The grid proper consists of a plurality of substantially identical tubular grid elements 21 extended in equi-spaced parallel relation between the front and rear wall portions 17 of the hopper member 14 with their ends 22 slightly protruding within the space or chamber 29 formed by the wall portions 16 and 17 of the hopper member and member 19 where they are secured to the wall portions 17 confronting the member 19 in fluid sealed relation, as by welding. As a convenience in fabrication the grid elements 21 will be secured to the wall portions 17 prior to assembly of the member 19 with the hopper member 14. Each grid element 21 is formed from a single blank of material of suitable width and length bent sharply on its longitudinal median line to form the diverging side walls 23 which are inwardly turned at their lower end portions on a suitable radius into meeting engagement where they are secured to each other by any suitable expedient, such as welding, in fluid sealed relation. The angle 24 between the diverging side walls 23 of the grid elements will be governed by the heat conducting characteristics of the metal comprising the elements and the volume permissible between adjacent walls of adjacent grid elements for substantially uniform heat treatment, and the radii 25 of the inturned lower end portions of the grid elements will be so related to the lines of tangency thereof with the side wall portions 23 that the volume 26 of the grid elements included between the lines of tangency of the lower inturned end portions and the portions themselves will be greater than any volume of condensate capable of collecting in the lower end portions of the grid elements during normal operation of the melt unit, to thereby prevent the metal of the grids, at the lines of tangency above referred to, from becoming cooled above the solidification point of the explosives being melted and hence obviate all freezing of the explosives at the egression zone 27 between adjacent grid elements. In forming the grid elements as herein described all lines of welds have been placed in a position where the non-homogenity of the metal effected by the welds will in no wise come in contact with the explosives being treated whereby uniform heat exchange between the explosives and grid elements is obtained. By way of example, the use of one-sixteenth inch steel plate bent to form an angle 24 that will permit inturning of the lower end portions on a three-quarter inch radius into contact to give a grid element of an overall height of six inches has been found very satisfactory in use. The grid elements may be spaced to give an egression zone 27 between grid elements of any width depending upon the particular material being treated, which in the case of TNT has been found to be satisfactory between the limits of three-quarters to one-quarter inch. An inclined baffle 28 is secured to the rear wall of member 19 and extends inwardly and downwardly therefrom into engagement with the adjacent ends of the grid elements 21 at the points of tangency of the inclined side walls 23 and lower inturned end portions thereof and serves to direct steam or a similar heating agent admitted to the space 29 through one or more inlet ports 30 into the tubular grid elements 21. The steam is withdrawn from space 29 through one or more outlet ports 31 located in member 19 below the baffle 28. The side and rear wall portions 15 of member 14 are provided with a plurality of clips 32 suitably secured thereto and projecting above the flange 18 for a purpose made clear hereinafter.

The molten explosives receiving basin or pan 13 is of spaced wall construction and is of generally rectangular shape in cross section having a bottom 32' joined to the side walls on a gentle radius to facilitate cleansing of the pan after use. The pan is preferably of the same outside transverse dimension as the corresponding dimension of the melting grid portion, but is of greater dimension from front to rear than the grid portion. As shown in Figs. 1 and 2 the upper edge of basin portion 13 is formed to provide a horizontal ledge across the rear wall and side walls for a distance corresponding to the comparable dimensions of the melting grid portion to furnish a seat upon which the flange 20 of the member 19 of the grid portion may be supported. To provide a sealed joint between the pan and melting grid an asbestos or similar gasket 33 is interposed between the horizontal ledge formed by the upper edge portion of the basin 13 and flange 20. Forwardly of the melting grid unit the upper edges of the basin are forwardly and downwardly inclined from the horizontal edge portions as indicated at 34. An angle clip 35 which has a vertical leg 36 of the same length as the width of the melting grid portion, and an inclined leg 37 of the same length as the inside transverse dimension of the basin portion 13 is secured by the end portions of its vertical leg to the upper edge of the basin in proximity to the junction between the horizontal and forwardly inclined edge portions of the basin with the inclined leg 37 engaging the inner side walls of the basin and corresponding in slope with the forwardly inclined upper edges of the basin. A cover plate 38 of less than half the width of the basin is secured to the inclined leg 37 of the angle clip and the forwardly inclined upper edge portions of the inner wall of the basin as by welding. The vertical leg 36 of the angle clip 35 is perforated or slotted at spaced intervals to receive stud bolts or similar fastening devices 39 secured in the lower portion of the forward wall of member 19 as a means for conveniently fixing the melting grid unit relative to the basin portion 13. Tubular couplings 40 and 41 protruding through the cover plate 38 with their axes disposed at a predetermined inclination are secured thereto and serve for serving a recording thermometer well 42 and deluge pipe respectively, to the basin 13. The cover plate 38 is also slotted from its inner transverse edge adjacent the weld to the inclined leg of the angle clip as indicated at 44 to receive an agitator shaft 45 which is mounted in a sleeve or bushing 46' secured to the cover plate. A rectangular door 46 provided with pintles 47 and retained in position by stops 48 is employed to normally close the opening between the closure plate 38 and front and side wall portions of the basin 13 leading into the interior of the latter. The door is actuable by the handle 49 and carries an asbestos gasket 50 engageable with the closure plate 38, inclined leg 37 of the angle clip 35 and the upper edges of the forward and side walls upon which

it normally rests. Hot water or a similar heating agent is admitted into the space between the walls of the basin portion 13 through one or more suitable inlet ports 51 located adjacent the upper end portion of the basin and may be withdrawn from the bottom thereof through one or more outlet ports 52. A petcock 53 located adjacent the upper edge portion of the basin in one of its side walls may be employed to permit escape of air and to determine the condition of the water in the space between the walls of the basin. Contiguous to the upper end of the basin and rearwardly of the forwardly inclined upper edges thereof an open frame 54 is secured to the inner walls for supporting a plurality of comparatively fine mesh and preferably brass screens 55 which may be introduced within the basin through the door 46. The bottom of the basin is formed with one or more egress openings 56 and each consists of an inverted truncated conical sleeve 57 secured to the inner bottom wall of the basin and projecting through the outer bottom wall in fluid sealed relation. A reinforcing flange 58 is secured to the projecting end of the sleeve 57 and outer bottom wall of the basin and is tapped to receive stud bolts or other fastenings for securing a suitable valve or closure over the egree end of the sleeve. An annular element 59 is removably fitted in the upper end of the sleeve and carries an inverted truncated conical screen 60 of relatively fine mesh which depends within the sleeve 57 in spaced relation thereto. The annular element 59 and attached screen 60 are readily removable by means of the strap 61 secured to the element in diametral bridging relation.

The vapor or fume stack portion 11 comprises a body portion 62 of rectangular cross section, coextensive with the outside dimensions of the melting grid portion, and formed with a flange 63 at its lower edge portion inwardly directed on a radius substantially equal to the radius of the inturned flange 18 on the walls 15 of member 14. The upper end portion 64 of the stack is inwardly directed on reversed radii to gently converge to an outlet 65 adapted to be attached to the intake of a suitable ventilating system not shown. As shown in the drawings the stack 11 is attached to the clips 32 with its flange 63 disposed in spaced parallel relation to the flange 18 to provide an intake gap 66 between the lower edge of the stack and upper edge of the melting grid unit. For charging explosives into the unit a rectangular opening 67 is formed in the forward face of body portion 62 of the stack which extends from the lower edge of the body portion upwardly to a line below the horizontal median line of the stack. Guide members 68 are secured to the body portion 62 adjacent each side edge of the opening 67 in parallel relation and extend upwardly to a position wherein they serve to retain a closure 69 in slidably closing relation to the opening 67. The closure is counterweighted by a weight 70 slidable within a tubular guide 71 and operably fastened to the door by cables 72 trained over pulleys 73 carried by a cross arm 74 secured to the upper ends of the guides 68. The closure is slidable by means of an actuating handle 75 and its lower edge portion has secured thereto an inwardly extending flange 76 which forms a continuation of the flange 63 when the closure is in the closed position with respect to opening 67.

To vent the explosives basin portion 13 of fumes and/or vapors a vent pipe 77 is placed in communication with the basin 13 through the closure plate 38 in by-passing relation to the melting grid portion 12 and extended within the stack 13 as indicated at 78 where it terminates at a position 79 adjacent the inwardly converging top portion 64 of the stack.

An angle motor support 80 is secured to the forward wall of the melting grid portion of the unit at an inclination such that the axis of the driving shaft 81 of an air motor 82, secured to the support may be aligned with the axis of the agitator shaft 45 for coupling therewith.

A recording thermometer 83 is located in the thermometer well 42 and is adapted through a suitable thermostatic control, not shown, to continuously record the temperature of the explosives in basin 13 and control the temperature of the water admitted between the walls of the basin.

For the convenience of the operator a shelf 84 is located on the forward wall of the melting grid unit just below the opening 67 in the stack so that charges of explosive to be introduced in the unit may be supported on the shelf while the door 69 is opened.

The entire unit may be supported on any suitable foundation, not shown, through an endless angle clip 85 or series of separate clips secured to the basin portion 13 by means of one of their legs so that the other leg projects from the basin for engagement with the support.

In operation steam or other suitable heating agent is admitted into the space 29 surrounding the grid elements and into the grid elements 21 above the baffle 28 and withdrawn from the ports 31 below the baffle to bring the grid to a temperature below the solidification point of the explosives being poured. Explosives are introduced into the unit through the charging opening 67 and supported on the grid until molten whereupon the explosives in the molten state will drip from the grid upon the screens 55 which serve to bring the explosives to a temperature level slightly above the solidification point of the explosives and to catch and retain any foreign matter in the explosives not removed by prior refining operations. Because of the shape of the grid elements 21 condensate cannot collect in the arcuate portions of the grid elements to a level coinciding with the level of the lines of tangency between the arcuate portions and side wall portions and therefore the lines of tangency which are in the zone of egression of the grid do not become cooled as in the prior art constructions and freezing of the molten explosive in this critical zone is obviated without resort to superheating with consequent greater rapidity in the melting and subsequent pouring and cooling operations. The molten explosive collects in the basin 13 where it is maintained in the molten condition through automatic control of the temperature of the water between the spaced walls of the basin as effected by the thermometer 83 which also continuously records the temperature of the molten explosives. To keep the temperature of the molten explosives at a constant level the agitator shaft 45 with the attached paddles is run through the air motor 82. Fumes or vapors collecting in the basin are removed by the vent pipe 77 to the stack 11. When it is desired to recharge the unit the closure 69 is raised and due to the shape of the flanges 18, 63 and 76 and their spacing a continuous draft of air is drawn in through the gap 66 and under the flange 76, in any position of the door, by the ventilating system to prevent all escape of gases or fumes from

the unit. The explosive is charged into the unit and the closure 69 is closed until further charging is essential.

Due to the absence of any corners of sharp radius and protrusions within the unit engageable by explosives, the device lends itself to ready thorough cleansing which is so necessary to safe operation. When it is desired to fill shells or other containers molten explosive is withdrawn from the basin 13 through the opening 56 controlled by any desirable valve and conducted by suitable conduits to the containers for casting therein.

Having now particularly described what is at present a preferred embodiment of the invention what is claimed is:

1. In a melt unit in combination, a molten explosives receiving basin, a melting grid portion superimposed upon the receiving basin in sealed relation, a fume stack portion secured to the upper end of the melting grid portion in spaced relation to form an intake gap intermediate said grid and stack portions, and a vent pipe establishing communication between the basin and stack-portion bypassing said grid portion.

2. In a melt unit in combination, an explosives melting portion, a stack portion coextensive in cross section with the explosives melting portion, means securing said portions to each other in superposed relation with the adjacent ends of the portions in spaced relation to form an air intake circumjacent said portions, a molten explosives receiving basin disposed subjacent said melting grid portion in sealed relation, means providing access to the interior of said unit through the stack portion and a vent pipe establishing communication between the basin and stack by-passing the melting grid portion.

3. In a melt unit in combination, a melting grid portion having its upper edge flanged inwardly on a relatively gentle radius, a fume stack coextensive in cross section with the melting grid portion formed with an opening extending upwardly from its lower edge, said stack having its lower edge between the sides of the opening inturned on a relatively gentle radius, means securing the stack in superposed relation to the melting grid portion with said flanges in spaced parallel relation, a vertical slidable closure for said opening, and an inturned flange on the lower edge of the closure adapted in the closed position of the opening to form a continuation of the flanged lower edge of the stack.

4. In a melt unit in combination, an explosives receiving basin having an upper edge portion formed as a horizontal ledge terminating in a forwardly and downwardly inclined edge portion, a melting grid portion having an inturned lower flange seated upon said horizontal ledge in sealed relation, a cover plate having an opening therein disposed between said forwardly and downwardly inclined edge portion and the forward wall of the melting grid unit in sealed relation, a movable closure for the opening secured to said cover plate, and a support secured within the basin adjacent its upper edge underlying the melting grid portion, whereby screens may be introduced through said opening to be positioned upon the support.

5. The structure of claim 4 wherein means are provided in the cover plate for securing a thermometer well and agitator shaft thereto.

6. The structure of claim 4 wherein an angle clip is secured peripherally of the basin with one leg thereof projecting outwardly and adapted to engage a support for the melt unit.

7. In a melt unit in combination, an inner hopper member comprising a lower upstanding wall portion and an upper inclined wall portion outwardly diverging therefrom, an outer member having an upstanding wall portion coextensive with and engaging the upper edge of said inclined wall portion and a lower inturned flange engaging the upstanding wall portion of the hopper member adjacent the lower edge thereof, means securing the engaging portions of said inner and outer members in fluid sealed relation to form a fluid tight chamber, grid elements disposed in spaced parallel relation between opposed portions of the upstanding wall portion of said inner hopper member in fluid sealed communicating relation with said chamber, an inclined baffle extending inwardly and downwardly from the inner surface of said outer member into engagement with an intermediate portion of the adjacent ends of the grid elements, means above said baffle for admitting a heating agent into said chamber, and means below said baffle for exhausting the heating agent from said chamber.

8. The structure of claim 7 wherein an additional upstanding wall is secured to the upper edges of said inner hopper and outer member and is formed with an inturned flange at its upper end portion disposed on a gentle radius.

9. In an explosive melt unit, in combination, a molten explosives basin provided with an egress opening and spaced jacket means for admitting and withdrawing a heating agent to and from the space enclosed by said jacket, a melting grid portion superimposed upon said basin comprised of a hopper member, a spaced jacket secured to the hopper member in fluid sealed relation defining a chamber extending around said hopper member, spaced tubular grid elements extending between and in communication with opposed portions of said chamber, a stack portion secured to the melting grid portion in superimposed relation, a closure in said stack providing for access to the interior of the stack and melting grid portion, and means intercommunicating with said stack portion and basin in by-passing relation to the melting grid portion for withdrawing fumes from said basin.

10. In a melt unit in combination, a molten explosives receiving basin, a melting grid portion superimposed upon the receiving basin in sealed relation, a fume stack portion secured to the upper end of the melting grid portion, and means constituting a vent passage establishing communication between the basin and stack portion, by-passing said grid portion.

11. In a melt unit of the type described, in combination, a pair of inner and outer spaced walls secured together to form a chamber, a plurality of hollow grid elements extending between opposed portions of said inner wall and communicating at opposed ends with said chamber in fluid sealed relation, said grid elements being of airfoil form in section and having the ridge portion extending upwardly with respect to the melt unit.

12. In a melt unit, grids as in claim 11, said grids having a seam and said seam being located beneath the bulge at the wider end of the airfoil section.

GEORGE D. ROGERS.