Oct. 18, 1955

A. P. HIGGINS ET AL

2,720,686

DIE CASTING APPARATUS

Filed Sept. 12, 1952

3 Sheets-Sheet 1

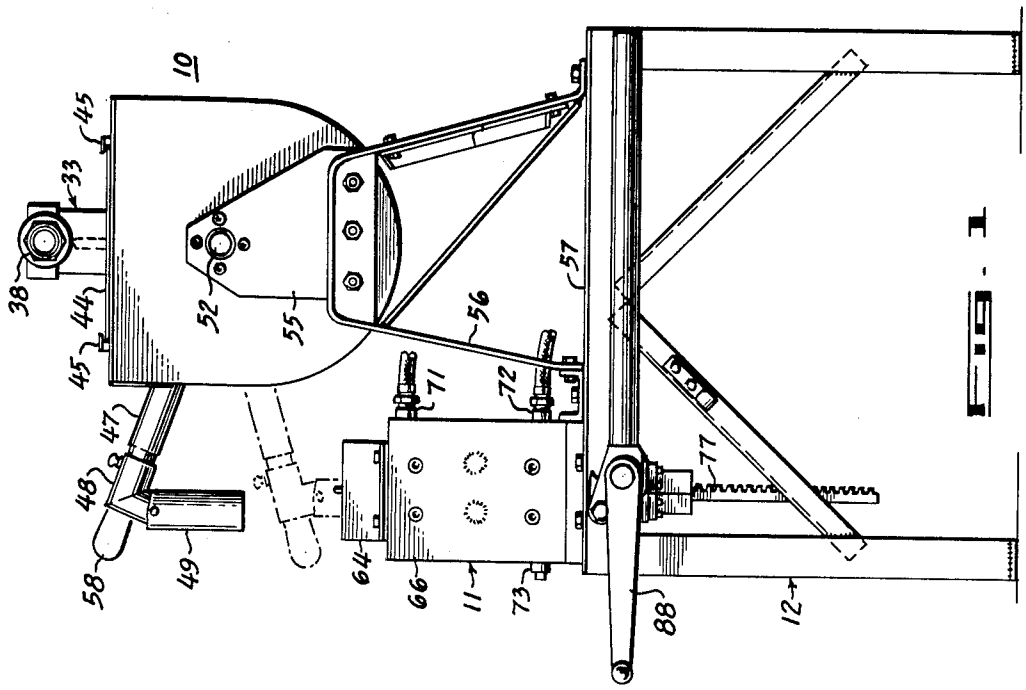


Fig. 1

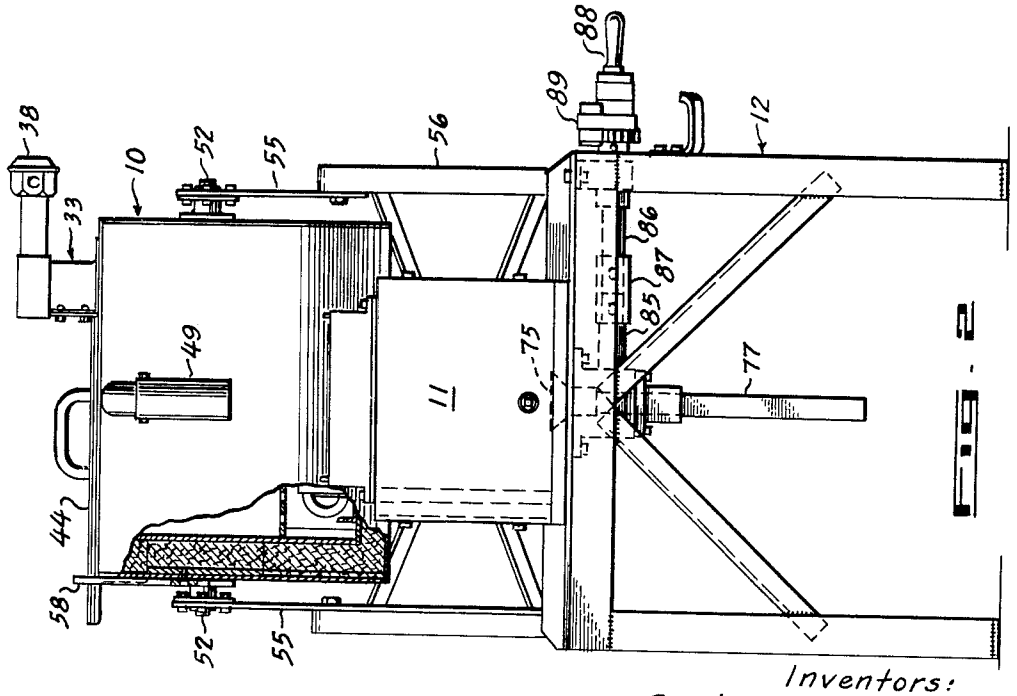


Fig. 2

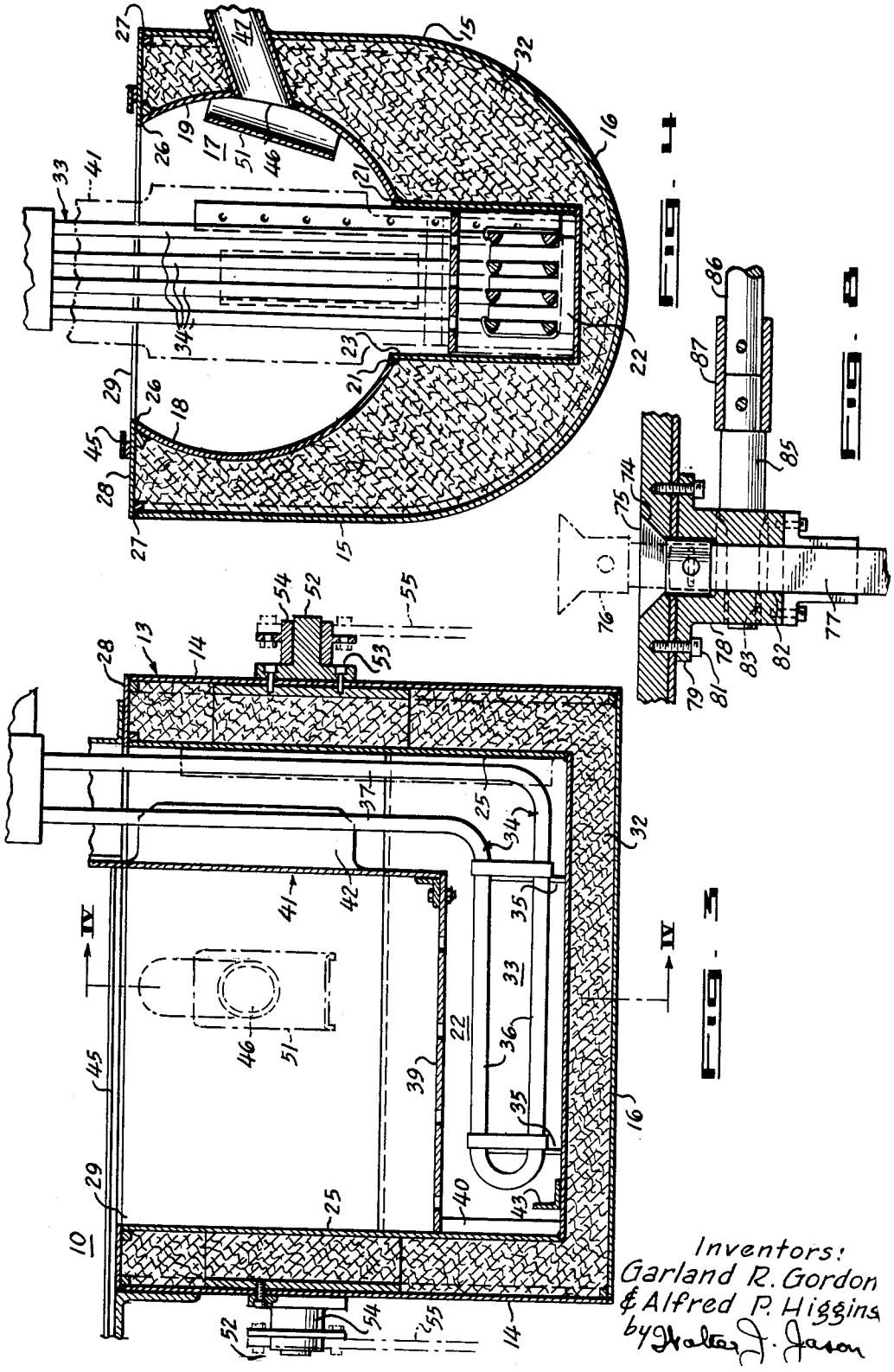
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

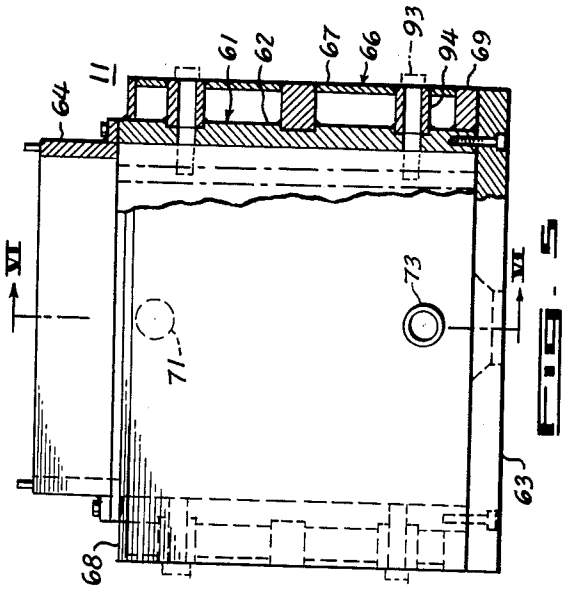


Fig. 5

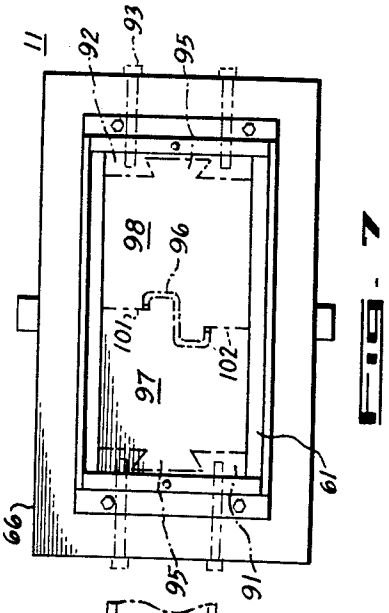


Fig. 7

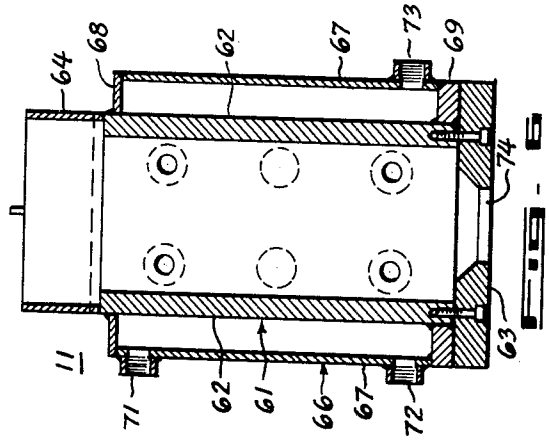


Fig. 6

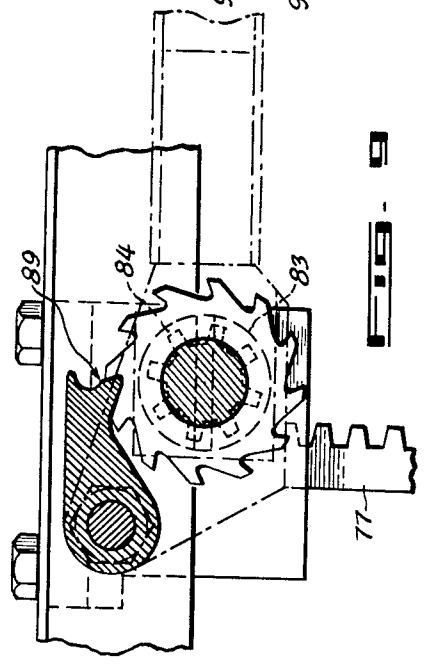


Fig. 9

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2,720,686

DIE CASTING APPARATUS

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Application September 12, 1952, Serial No. 309,214

3 Claims. (Cl. 22—57)

This invention pertains generally to the forming and more particularly to improved die-molding apparatus for the rapid and inexpensive production of die castings.

Sheet metal coverings of automotive, aircraft and similar frames by their very nature require support members of A, V, U, L, and the like cross-sectional configurations, and further each of these may be of various dimensions. Conventional machines which do work on such varied members must of necessity be equipped with an elaborate and therefore expensive set of dies in order to accommodate the various sizes and configurations of such support members. Sets of dies are utilized to avoid delays while the die shop machines a required die.

One object of the present invention is to provide means which a set of dies can be made inexpensively and within a relatively short time as the special need arises, thereby providing practically stock tooling in terms of continuous production line techniques.

Another object of this invention is to provide a means for making a set of inexpensive dies formed from castable material, and which produces dies without the use of costly machining.

Still another object of this invention is the provision of a method and apparatus for the rapid and efficient casting of metal jaws whose mating faces are designed to support and grasp members of varied cross-sectional configurations such as those employed as support members for sheet metal fabrications similar to those used in the so-called skin of aircraft, or the body housing of automotive vehicles and the like.

Other objects and features will be readily apparent to those skilled in the art from the following specification and appended drawings wherein is illustrated a preferred embodiment of the invention, and in which:

Figure 1 is a side elevational view of die-forming apparatus in accordance with the present invention.

Figure 2 is a front elevational view of the die-forming apparatus of Figure 1 with a portion broken away.

Figure 3 is a vertical sectional view of the melting chamber portion of the die-forming apparatus of Figure 1.

Figure 4 is a sectional view taken along the line IV—IV of Figure 3.

Figure 5 is a side elevational view of the die mold portion of the die-forming apparatus of Figure 1.

Figure 6 is a sectional view taken on the line VI—VI of Figure 5.

Figure 7 is a top view of the die mold of Figure 5.

Figure 8 is a view in cross-section of a detail; and

Figure 9 is a view of a detail.

Having particular reference now to Figure 1, the invention is shown to comprise as essential elements, a melting pot assembly **10**, and a die mold **11**, both rigidly affixed to a work table **12**.

Melting pot assembly **10** embodies a generally rectangular housing **13** having end walls **14** and side walls **15** which merge into a rounded base shown at **16**. Disposed within housing **13** is a crucible **17** having opposed, arcuate side walls **18** and **19** whose lower edges **21** terminate at the opening to a well **22** formed as a generally box-like structure. Arcuate side walls **18** and **19** are connected to well **22** by welding their lower edges **21** to side walls **23** of well **22**. A pair of plates **25** form the end walls of the crucible **17**, being suitably affixed to the lateral edges of the arcuate side walls **18** and **19** and the well side walls **23**. Upper edges **26** of crucible side walls **18** and **19**, as shown, lie in the same plane as upper edges **27** of housing **13**. A plate **28** of rectangular shape having a central rectangular opening **29** is suitably affixed, as by welding, at its outer perimeter to upper edges **27** of the housing **13**. The upper edges **26** of crucible side walls **18** and **19** and the upper edges **31** of end plates **25** are secured by welding to plate **28** about the perimeter of opening **29**. Crucible **17** thus is supported from plate **28** and through this manner of support is maintained in proper space relationship to housing **13**. The space separating housing **13** and crucible **17** is filled with a suitable insulating material **32** to retard heat flow from the crucible.

A conventional immersion heater assembly **33** extends within well **22** and, as shown, comprises a plurality of heating coils **34** supported by sludge legs **35** which rest on the bottom of well **9**, legs **35** in addition to supporting coils **34** space these coils above sludge level. The heating coils **34**, as shown, comprise horizontal portions **36** which are carried by sludge legs **35** and vertical portions **37** which project upwardly and outwardly through opening **29** in housing plate **28**. A usual immersion type thermostat with a perforated protection tube (not shown) is employed to determine the temperature of the molten metal. In use, heater assembly **33** is connected to a suitable source of electrical power (not shown) through a usual electrical plug element **38**. Heating element assemblies such as the type employed in the present invention are available commercially, one source being the Wiegand Mfg. Co., Pittsburgh, Pennsylvania, which offers a tank immersion heater designated as the Chromalox type TBL.

A perforated baffle plate **39**, having one end rigidly affixed to an upright support member **40** which itself is suitably rigidly mounted within well **22**, is horizontally positioned within well **22** immediately above the horizontal portions **36** of the heater coils **34**. To the opposite end of baffle **39** is conventionally fastened a vertical baffle plate **41** having two side flanges **42** which extend to either side of the vertical portions **37** of the heater coils **34**. Baffle plates **39** and **41**, in cooperation, substantially enclose the heater coils **34** and effect a protective assembly designed to shield the horizontal and vertical portions of heater coils **34** from damage from the solid chunks of castable metal which may be thrown into crucible **17**.

An angle stop **43** is affixed to the bottom of well **22** adjacent the inner ends of heater coils **34** and serves to limit the movement of the heater assembly **33** to maintain a space between upright baffle **41** and the vertical portions of heater coils **34**. If desired the upright baffle **41** may be secured by suitable fastening means to the housing plate **28**.

A cover **44** is positioned upon housing **13** for slidable movement between spaced guide brackets **45** and acts to substantially close opening **29** in plate **28**.

Communication from the interior of crucible **17** to the exterior of housing **13** is afforded through a vent **46** in side wall **18**, a spout pipe **47**, a right-angle guide tube **48**, and a hinged splash control tube **49**, as best shown in Figures 1 and 4. The vent **45** is covered by a shield **51** of the form shown in Figure 4 which allows the flow of molten metal through vent **45** but retards chunks of unmelted metal.

The end walls **14** of housing **13** are each fitted with a

trunnion 52 held thereto by bolts 53 and disposed on a horizontal line which is centered laterally of the end walls 14 and slightly above a line which would pass through the center of gravity of the melting pot assembly 10. Trunnions 52 are rotatably received by a pair of sleeve bearings 54 which bearings 54 are bolted to two support plates 55 arranged at opposite sides of housing 13 and carried by an ordinary four-legged support member 56 of sufficient structural strength to withstand the weight of the melting pot with a full charge. Work table 12 is provided with a work surface 57 to which support member 56 is bolted in such position relative to die mold 11, that splash control tube 49 may be directed into the die mold 11 when melting pot assembly 10 is rotated to a position where molten metal may flow by gravity from crucible 17 through vent 46.

A usual handle 58 is secured to an end wall 14 of housing 13 to provide a ready means for rotating melting pot assembly 10 upon its trunnions 52.

Die mold 11 is of generally a box within a box type construction. It includes an inner box 61 which is fluid tight and comprised of four vertical side walls 62 secured by bolts to a bottom plate 63 which in turn is bolted to the work surface 57 of work table 12 to secure die mold 11 to table 12. A frame 64 having generally the same perimetrical dimensions as inner box 61 is bolted to the top thereof, and provides a support for means (not shown) for suspending a workpiece in the center of the mold, for a purpose to be described. The suspension means, it is understood, could comprise various conventional arrangements of thumbscrews, clamps, and slide bars which will grasp and hold a work piece centrally disposed within box 61.

Box 61 is surrounded by an outer box 66 which effects a fluid tight jacket about box 61. Box 66 includes four vertical walls 67 and top and bottom plates 68 and 69 suitably rigidly held together and affixed to the vertical walls 62 of inner box 61 as by welding.

Vertical walls 67 of outer box 66 are spaced a sufficient distance from vertical walls 62 of inner box 61 that an adequate amount of cooling fluid may be introduced for flow therebetween. Outer box 66 is fitted with conventional threaded inlet and outlet fluid ports 71 and 72 and a drain port 73 whereby cooling fluid may be conveyed to and withdrawn from outer box 66.

Bottom plate 63, through which die mold 11 is secured to work surface 57 of work table 12 is, as best shown in Figure 8, afforded an opening 74 which is countersunk to receive a die breaker 75 complemental in configuration to opening 74. The mating surfaces of the counter-sunk opening 74 and the die breaker 75 are machined to fluid tight smoothness to prevent fluid leakage when the latter rests within the former. Die breaker 75 is pivotally connected at its end 76 to the upper end of a usual rack 77, this connection permitting self-alignment and proper seating of die breaker 75 within counter-sunk opening 74.

A generally cylindrical member 78 having a mounting flange 79 at its upper end and is secured to the under side of work table surface 57, by bolts 81 which extend into bottom plate 63 of die mold 11. As shown, cylindrical member 78 is positioned in coaxial alignment with die breaker 75 and has a longitudinal bore 82 therethrough which serves as a guide race for rack 77. Cylindrical member 78 is provided with a transverse opening 83 within which is positioned a sprocket wheel 84 in mesh with rack 77. Sprocket wheel 84 is keyed to a shaft 85 conventionally supported on bearing surfaces in transverse opening 83. Shaft 85 is connected to an extension shaft 86 by a sleeve 87, and extension shaft 86 is in turn fastened to a hand crank 88 through conventional escapement mechanism 89 detailed in Figure 9. Rotation of hand crank 88 effects the desired movement of rack 40 to move die breaker 75.

In the formation of dies by use of the apparatus above

described, suitable forms are first provided within inner box 61 of die mold 11. These forms, as shown in Figures 5 and 7, may include elements 91 and 92 secured against opposed side walls 62 of box 61 by suitable bolts 93 which pass through the walls 67 of outer box 66, spacer sleeves 94, side walls 62 and are threaded into form elements 91 and 92. The faces of form elements 91 and 92 are provided with grooves having a configuration which will result in the desired dovetails 95 being formed on the dies to be produced. Since all dies used by any particular press will be usually secured in position in like manner the dovetail forming elements 91 and 92 will usually not be required to be changed and will remain in place from one die forming operation to the next. A work piece 96 is suspended, by conventional supporting apparatus (not shown), centrally within inner box 61 and serves as a form to produce faces on the dies which will have configurations conforming to the shape of work piece 96. Figure 7 illustrates, in dash-dot outline, a pair of dies 97 and 98 which may be formed by the present invention. The shape of the opposing faces of these dies will follow the contour of work piece 96, and the dovetails 95 will assume the shape determined by the form elements 91 and 92. Dash-dot lines 101 and 102 indicate lines where the casting is cut after removal from the die mold 11 to provide the two dies 97 and 98.

The operation whereby dies 97 and 98 are formed will now be described. In this operation, melting pot assembly 10 is charged with a quantity of castable metal and the heater assembly 33 is electrically connected to a suitable power source. While the charge is being heated, die mold 11 is prepared to receive the molten metal. Die breaker 75 is, therefore, properly seated to close opening 74 in base plate 63 and work piece 96 is suspended in the center of the mold cavity by any suitable arrangement of suspension means. After the castable metal has been reduced to a molten state lever 58 is pressed down to rotate melting pot 10 on its trunnions 52 to carry splash control tube 49 into die mold 11 and effect a flow of the molten metal from crucible 17 through vent 46, spout pipe 47, right-angle guide tube 48 and splash control tube 49 into the cavity of inner box 61 to surround work piece 96 to a height desired for the height of the dies 97 and 98. Cooling fluid is then caused to flow through the space between inner and outer boxes 61 and 66 by way of inlet and outlet fluid ports 71 and 72 until the dies are cast and cooled.

To break the casting away from the die mold 11 to permit its removal hand crank 88 is turned in a clockwise direction, as viewed in Figure 1, to rotate shafts 85 and 86 and sprocket 84. Rotation of sprocket 84 will cause rack 77 to move upwardly to force die breaker 75 against the bottom of the cooled casting to break the latter away from the mold. The casting is raised upwardly within the mold by continued turning of hand crank 88 until the casting may be grasped and carried away. Escapement mechanism 89 prevents backturning of the hand crank 88 during the removal operation.

After the casting is removed it is then sawed longitudinally through lines 101 and 102 to form the two dies 97 and 98 and permit removal of the work piece 96 from the mating surfaces of the dies. The casting may further be cut into two or more pairs of dies, if required, by sawing the casting in a transverse plane.

While a certain preferred embodiment of the invention has been specifically disclosed, it is understood that the invention is not limited thereto as many variations will be readily apparent to those skilled in the art and the invention is to be given its broadest possible interpretation within the terms of the following claims.

What we claim is:

1. Apparatus for forming dies comprising metal melting means and a mold for receiving molten metal from said melting means, said melting means and said mold

being located in side-by-side relationship, said metal melting means comprising a housing, a crucible within said housing for receiving castable metal, heating means disposed within said crucible for reducing said metal to a molten state, said heating means comprising a plurality of generally L-shaped electrical heating elements each having a horizontal portion positioned adjacent the base of said crucible and a vertical portion extending to the exterior of the crucible, baffle means within said crucible substantially enclosing said heating elements, and outlet means leading from said crucible to the exterior of said housing, said outlet means comprising a vent in a wall of said crucible, a tubular member extending from said vent to the exterior of said housing, a right-angle guide tube and a hinged splash control tube, means mounting said housing for rotative movement whereby said housing may be moved to a position permitting free flow of molten metal through said outlet means and into said mold, said mold comprising a container for housing die shape defining elements and for receiving molten metal from said crucible, said container having side walls and a base plate, a fluid-tight structure spaced from and surrounding said side walls receiving cooling fluid for circulation about said side walls, said base plate having an opening therethrough, a movable member normally disposed in said opening for sealing it, and means for moving said movable member into said container for forcing cooled die castings therefrom.

2. Apparatus for forming dies comprising metal melting means and a mold for receiving molten metal from said melting means, said melting means and said mold being located in side-by-side relationship upon a common support, said metal melting means comprising a housing, a crucible within said housing for receiving castable metal, said crucible including a well portion, heating means disposed within said crucible for reducing said metal to a molten state, said heating means comprising a plurality of generally L-shaped electrical heating elements, each having a horizontal portion positioned in said well and a vertical portion extending therefrom to the exterior of the housing, a horizontal baffle plate disposed in said well over the horizontal portions of said heating elements, a second baffle plate extending upwardly from said horizontal baffle plate in shielding relation to the vertical portions of said heating elements, and outlet means leading from said crucible to the exterior of said housing, said outlet means comprising a vent in a wall of said crucible, a tubular member extending from said vent to the exterior of said housing, a right-angle guide tube and a hinged splash control tube, means mounting said housing for rotative movement whereby said housing may be moved to a position permitting free flow of molten metal through said outlet means and into said mold, said mold comprising a container for housing die shape defining elements and for receiving molten metal from said crucible, said container having

side walls and a base plate, a fluid-tight structure spaced from and surrounding said side walls receiving cooling fluid for circulation about said side walls, said base plate having an opening therethrough a movable member normally disposed in said opening for sealing it, and means for moving said movable member into said container for forcing cooled die castings therefrom.

3. Apparatus for forming dies comprising a metal melting assembly and a mold for receiving molten metal from said melting assembly, said melting assembly and said mold being located in side-by-side relationship on a common support, said metal melting assembly comprising a housing, a crucible within said housing for receiving castable metal, said crucible including a well portion, heating means disposed within said crucible for reducing said metal to a molten state, said heating means comprising a plurality of generally L-shaped electrical heating elements, each having a horizontal portion positioned in said well and a vertical portion extending therefrom to the exterior of the housing, a horizontal baffle plate disposed in said well over the horizontal portions of said heating elements, a second baffle plate extending upwardly from said horizontal baffle plate in shielding relation to the vertical portions of said heating elements, and outlet means leading from said crucible to the exterior of said housing, means mounting said housing for rotative movement whereby said housing may be moved to a position permitting free flow of molten metal through said outlet means and into said mold, said mold comprising a box-like structure having vertical walls and a base plate, said box-like structure housing readily removable die shape defining elements and adapted to receive molten metal therewithin, a second box-like structure surrounding the vertical walls of said first box-like structure having vertical walls spaced from the vertical walls of said first box-like structure to provide a chamber for circulation of cooling fluid thereabout, said base plate having an opening therethrough, a movable member having a configuration complemental to that of said opening disposed therewithin for sealing it, and means for moving said movable member into said first box-like structure to apply a force against a cooled die casting for breaking it loose from said first box-like structure.

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