March 26, 1940. J. R. DAESEN 2,195,360

DIE CASTING APPARATUS AND METHOD

Filed Dec. 2, 1938 3 Sheets-Sheet 1

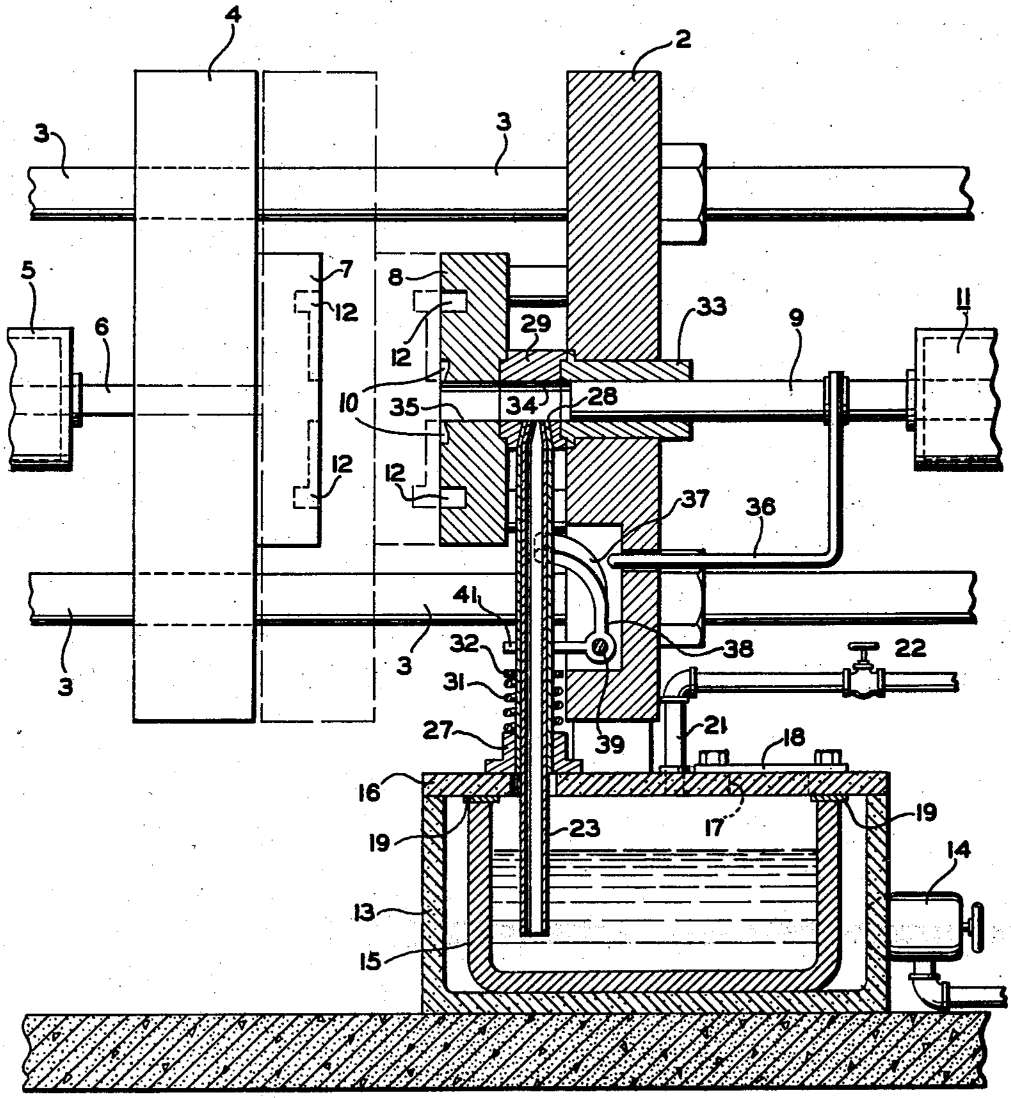

FIG. 1

Inventor

JOHN R. DAESEN

By Bailey & Larson

Attorneys

March 26, 1940. J. R. DAESEN 2,195,360

DIE CASTING APPARATUS AND METHOD

Filed Dec. 2, 1938 3 Sheets-Sheet 2

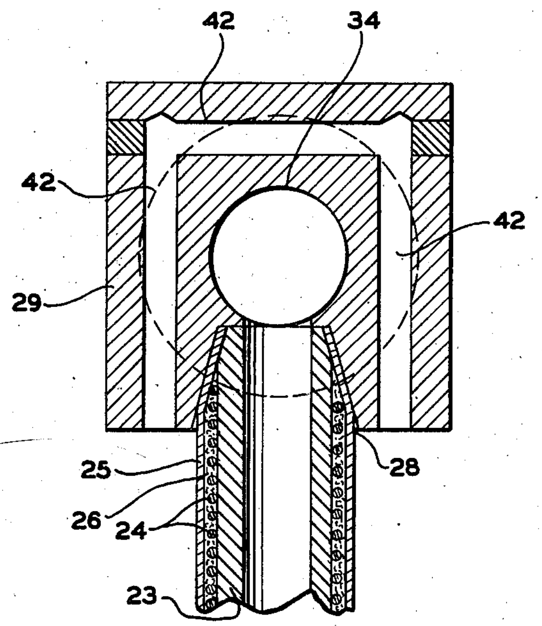

FIG. 2.

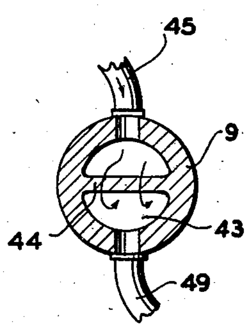

FIG. 3.

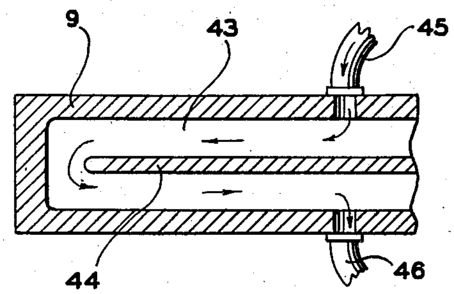

FIG. 4.

Inventor

JOHN R. DAESEN

By Bailey & Larson

Attorneys

March 26, 1940. J. R. DAESEN 2,195,360

DIE CASTING APPARATUS AND METHOD

Filed Dec. 2, 1938 3 Sheets-Sheet 3

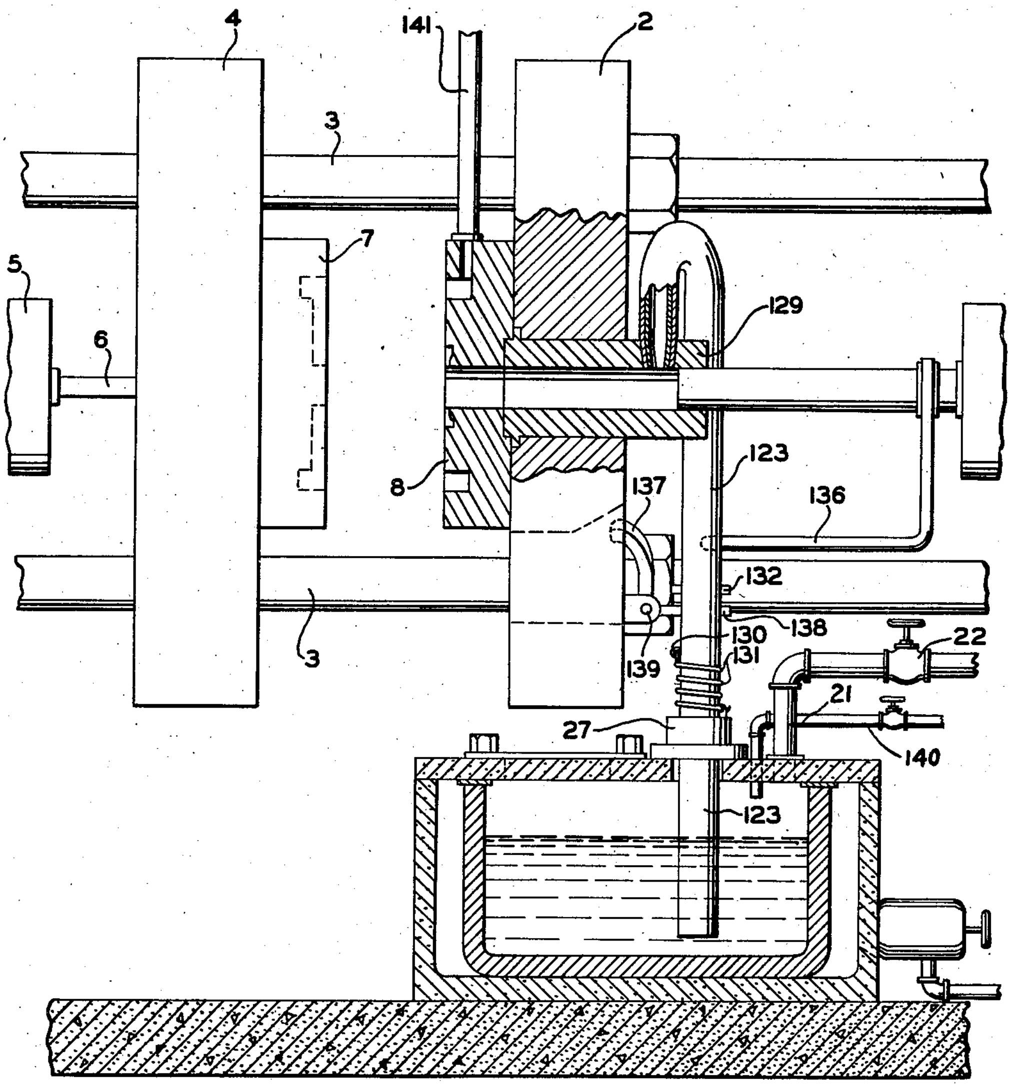

FIG. 5.

Inventor
JOHN R. DAESEN

By Bailey & Larson
Attorneys

Patented Mar. 26, 1940

2,195,360

UNITED STATES PATENT OFFICE

2,195,360

DIE CASTING APPARATUS AND METHOD

John R. Daesen, Oak Park, Ill.

Application December 2, 1938, Serial No. 243,675

10 Claims. (Cl. 22—68)

This invention relates to the die casting of metals or other substances and more particularly to the die casting of metals, such as molten brass, which have a highly corrosive action on steel.

It is well known that certain metals such as brass, aluminum, zinc alloys free from aluminum, and others, when in a molten condition, have a highly corrosive action on the steel parts of die casting apparatus with which they come in contact. To avoid contact with the steel as far as possible, such metals, in the past, have been cast in die casting apparatus into which the metal in molten form is poured by hand with a ladle. Automatic machines for the die casting of such metals have not proved satisfactory because of the corrosion of the moving parts as the result of prolonged contact with the molten metal. It is a principal object of this invention to avoid this disadvantage.

It has been suggested that one remedy would consist in making such parts of ceramic material. Such suggestion has not resulted in solving the problem because of the difficulty of making tight joints between materials which have such different rates of thermal expansion as ceramic materials and the metal which must be used to stand the high molding pressures used.

The present invention satisfactorily solves the problem by using a heated ceramic tube leading from the molten bath and by making only momentary contact between this tube and the cold metal parts of the die casting apparatus. An object of the invention is to employ a proper choice of materials, an arrangement of parts and a sequence of operations as will prevent the corrosive action from occurring.

Further objects of the invention reside in the provision of very great pressure to force the molten material into the die; the speedy, continuous and automatic operaton of the machine; a uniformity of the density and other physical properties of the molded material, and an improvement in the life of the mold or die.

Still a further object of the invention is the provision of a machine which can easily be attached to a hand fed die casting apparatus to render such apparatus automatic and capable of use with molten materials which have a pronounced corrosive effect on the moving parts of the apparatus with which they come in contact.

These and other objects of the invention will be more apparent from the following specification and claims when read in conjunction with the accompanying drawings, in which:

Fig. 1 is a side elevation, partly in section, showing one modification of the invention.

Fig. 2 is an enlarged detail view in cross section of the feed tube and feed collar.

Fig. 3 is an enlarged detail view, partly in section, of the water cooled plunger.

Fig. 4 is a longitudinal cross sectional detail of the water cooled plunger.

Fig. 5 is a side elevation partly in section, showing a modified form of the invention.

With particular reference now to that form of the invention illustrated in Figs. 1–4, a stationary die plate 2 is rigidly mounted on the rods 3 which in turn are mounted on a suitable support (not shown). There are four of the rods 3. A movable die plate 4 is slidably mounted on the rods 3 and may be moved towards or away from the stationary die plate 2 by suitable means, such as by a hydraulically operated cylinder 5, the piston of which is connected to the movable die plate 4 by the rod 6.

A removable split die is adapted to have its sections 7, 8 attached to the die plates 4 and 2 respectively.

Die casting apparatus is known in which the stationary die plate is provided with a central opening connected with an opening in the die section 8 and in which molten metal is introduced into the opening in the die plate by hand with a ladle. The molten metal is then forced into the die by a plunger such as 9 in Fig. 1 operated by an hydraulically operated cylinder 11.

Machines so constructed have even been used with such molten metals as have a corrosive effect on the metal parts of the device. Where so used, however, the operation has only been successful when the molten metal is poured into the opening in the stationary die plate 2 by hand with a ladle.

The mechanism which will now be described will render automatic the operation of a die casting machine of the type described above and will make it possible to employ such a machine in the production of die cast articles made from molten metal or other substances which have a deleterious corrosive effect on the working parts of a die casting apparatus.

Disposed beneath the die casting apparatus is a furnace 13 preferably fired by a gas or oil burner 14. The furnace may obviously be fired by other means.

Within the furnace 13 is a crucible 15 of ceramic material, which crucible is adapted to hold a considerable supply of molten metal or other material to be cast. The furnace 13 is topped by a cover 16 having a loading opening 17 through which the crucible can be filled when the supply therein becomes depleted. The loading opening is closed by the plate 18 when the apparatus is in operation.

The furnace cover 16 also acts as a cover for the crucible 15, a suitable packing or sealing gasket 19 being provided between the upper edge of the crucible and the cover 16 to render the crucible pressure tight. This is necessary, since preferably, the molten material is conveyed to the die by means of air pressure or the like supplied to the crucible through the pipe 21 leading to a source of compressed air and controlled by the valve 22. The air pressure when supplied to the crucible above the bath forces the molten material in the bath up through the feed pipe or tube 23 which leads to a passage connecting with the split die 7, 8, as will now be described.

The feed tube 23 is of ceramic material and extends down into the molten material in the crucible 15 through an opening in the cover 16. That portion of the feed tube 23 which extends above the cover 16 is electrically heated (see Fig. 2) by means of a coil of electrical resistance wire 24 connected to a suitable source of electricity (not shown). The upper portion of the feed tube 23 above the furnace is encased in a steel tube 25, insulation material 26 being disposed between resistance wire 24 and the steel encasing tube 25.

The feed tube or pipe 23 is mounted for slight vertical movement in both directions and is held in vertical position by the sleeve 27 secured to the cover 16 (Fig. 1).

The upper end of the steel encased feed tube 23 is tapered to engage a frusto-conically shaped opening 28 in a feed collar 29 when the feed tube 23 is in its uppermost position to which it is urged by means of the coil spring 31. The lower end of this coil spring abuts against the sleeve 27 while the upper end presses against an abutment ring 32 secured to the steel tube casing 25.

It will be seen from Fig. 1 that the feed collar 29 is disposed between the die section 8 and the stationary die plate 2, or more particularly between the die section 8 and a sleeve 33 disposed in a central opening in the stationary die plate 2, in which sleeve the plunger 9 is adapted to move. The opening in the sleeve is in alignment with a through opening 34 in the feed collar 29 and a corresponding opening 35 in the die section 8, so that upon operation, the plunger 9 may pass through the sleeve 33 and the openings 34 and 35.

The opening 34 in the feed collar 29 connects with the opening 28 therein so that when the feed tube 23 is in its uppermost position molten material may be forced through it to the feed collar 29 and thence to the die section 8.

The molten material is forced and packed in the die 7, 8 by operation of the plunger 9. Operation of the plunger toward the die also actuates a mechanism for lowering the tube 23 from the feed collar for a purpose to be described.

This lowering mechanism consists of a striker bar 36 secured to and travelling with the plunger 9. The free end of this striker bar is adapted to engage one arm 37 of a double armed lever 38 pivoted at 39 on the stationary die plate 2. The stationary die plate 2 is provided with a cutout to provide space for the lever. The other arm 41 of the lever is bifurcated or yoked and passes around the feed tube 23 directly above the abutment ring 32.

When the double armed lever 38 is actuated by the striker bar 36 the bifurcated arm 41 engages the abutment ring 32 and lowers the feed tube 23 against the action of the spring 31 about one-half an inch.

With reference now to Figs. 2, 3 and 4, the feed collar 29 and the plunger 9 are water cooled. Fig. 2 shows a passage 42 adapted to be traversed with water from a source (not shown). Figs. 3 and 4 show that the plunger 9 may be provided with a bore 43 which is divided longitudinally by a partition 44 except at the end. The plunger is provided with inlet and outlet openings 45 and 46 respectively. Water from a suitable source may be circulated through the inlet opening through the bore first above and then below the partition 44 and thence escape through the outlet opening 46.

It is an important feature of the invention that the plunger 9 and the feed collar 29 be maintained in a cool state while the feed tube 23 be kept at a temperature greater than the melting point of the metal or material being cast. This will be manifest from the following description of the operation of the apparatus.

The crucible 15 is filled with metal or other material to be cast and the opening 17 is closed tightly by the plate 18. The furnace is fired by the burner 14 until the metal in the crucible becomes molten. The temperature of the metal is maintained somewhat above its melting point. The die halves 7 and 8 are closed by the hydraulically operated cylinder 5 acting on the rod 6. The plunger 9 is in retracted position which is the position illustrated in Fig. 1. The plunger 9 and the feed collar 29 are maintained at a cool temperature by water cooling as described.

The ceramic feed tube 23 is maintained at a temperature above the melting point of the metal to be cast. Its upper end is seated in the conical opening 28 in the feed collar 29.

Valve 22 is opened to permit air under pressure to enter the crucible 15 through the pipe 21. The compressed air forces the molten metal through the ceramic feed tube 23 and into the opening 34 in the feed collar 29, and thence through the opening 35 in the die section 8 where the metal commences to freeze at once.

Hydraulic cylinder 11 is immediately operated to move the plunger 9 forward and force the molten metal through the constricted openings 10 into the die cavities 12. Simultaneously valve 22 is turned to shut off the compressed air and to vent the space in the crucible above the molten metal so that the molten metal in the tube 23 falls back into the crucible 15.

The striker bar 36 is so adjusted that as soon as the plunger 9 has closed the conical opening 28 in the feed collar 29, the striker bar 36 moves lever 38 so that its arm 41 engages the ring 32 and lowers the ceramic tube 23 about a half inch against the action of the spring 31. The ceramic feed tube 23 must, however, remain seated in the feed collar 29 until the opening 28 therein is closed by the plunger 9, so that the excess of molten metal in the opening 34 in the feed collar 29 may escape back down the ceramic feed tube.

After a brief interval to assure solidification of the metal in the die, the moving die plate 4 is retracted by the cylinder 5, and the plunger 9 is moved further forward to eject the finished casting and the small slug of surplus metal left in the opening 35. The hydraulic cylinder 11 is then operated to retract the plunger 13 to the position shown in the drawings, and as the end of the plunger 9 starts to uncover the opening 28 in the feed collar 29, the striker arm 36 releases the lever 38 to allow the ceramic tube 23 to seat itself again in the frusto-conical opening 28 in the feed collar, under the action of the spring 31.

The cycle is then repeated indefinitely, stopping only occasionally to replenish the supply of metal in the crucible 15.

It will be observed that the quantity of metal subjected to the great pressure of the plunger and solidified is measured by the volume of the openings 34, 35 up to the edge of the frusto-conical opening 28 nearest the die 8. This volume may be adjusted by the use of intermediate collars between the feed collar 29 and the die 8.

Because of the momentary contact of the hot ceramic tube 23 and the cold feed collar 29, it will be manifest that any tendency to leakage at the frusto-conical seat 28 will be prevented by momentary freezing of the molten metal contacting the cold feed collar 29. The continuously supplied heat keeps the ceramic feed tube 23 open at all times and prevents accretions on the outside of the tube which might prevent tight seating in the opening 28. All metallic parts of the machine are kept at a low temperature to prevent corrosive attack by the molten metal. Since the path of the molten metal consists only of a short cylindrical hole, the metal as it freezes onto the metallic parts of the machine is stripped off clean by the action of the plunger.

It will also be apparent that, if instead of momentary contact, the feed tube 23 remained in continuous contact with collar 29, thermal conditions would so equalize themselves that tube 23 could not be kept above the melting point of the metal to be cast without allowing the temperature of collar 11 to rise enough so that the molten metal instead of freezing quickly at the contacting surface would seriously corrode the metal feed collar. Similarly, if with continuous contact of feed tube and feed collar, water cooling kept collar 29 at a proper low temperature there would be some freezing of molten metal in ceramic tube 23, which would plug the tube. These considerations explain how certain designs for automatically loaded die casting machines, (some of which have been patented) resembling the machine of this invention in general aspect, have proven unworkable because of the failure to maintain, by intermittent contact, the necessary thermal conditions. Such machines may be satisfactory for use on lead alloys, or even on zinc alloys which have had their corrosive action on steel greatly reduced by the addition of aluminum to the zinc, but they cannot be used in casting brass or other metals which have a strong corrosive action on steel.

A modification of the invention is illustrated in Fig. 5. This modification is similar to the invention as illustrated in Figs. 1–4 and described above except for the following particulars. Instead of disposing the furnace beneath the apparatus, it is here disposed to one side. The ceramic feed tube 123 in this embodiment extends upwardly and its upper end is then bent over and down so that the molten metal is introduced from above. In this embodiment the feed collar 29 and sleeve 33 of Fig. 1 are made integrally with the collar portion to the rear. This collar portion 129 is provided with a frusto-conical opening on its upper side in which the end of the tube 123 is seated.

The tube 123 in this instance is normally urged in a downward direction by the spring 131 connected at one end to the sleeve 127 and at the other to a hook 130 secured to the tube.

The striker bar 136 upon operation of the plunger 9 strikes the arm 137 of the double armed lever which is pivoted as at 139, so that the other arm 138 raises the tube 123 by engaging the ring 132 secured thereto. The feed tube is thus raised out of the frusto-conical seat. A cutout is provided in the stationary die plate 2 to provide room for the lever arm 137.

The reference numeral 140 indicates a suction tube which communicates with the air space above the metal in the crucible 15 and acts to withdraw molten metal from the feed tube immediately after the plunger has passed the frusto-conical opening in which the tube is seated.

In operation, the sequence of action of the parts is similar to that described in connection with the first embodiment.

Moreover, some advantage in the soundness of the castings may be obtained in both embodiments by using (instead of air pressure to force the molten metal through the ceramic tube and into the die) a vacuum, attached to a single vent outlet of the die. Such an outlet has been indicated by the reference numeral 141 in Fig. 4. The object is to evacuate the air partially from the die cavities 12, the hole 35 in the die, and the hole 34 in the feed collar and the tube, and to draw molten metal into the holes 34, 35 preparatory to forcing the metal into the die cavities by the plunger. The advantage of this method over the use of air pressure applied to the surface of the molten metal in the crucible lies in the fact that at the moment of applied pressure by plunger 9, the partial vacuum in the die cavities provides less resistance to the complete filling of the cavities than would result if they were full of air at atmospheric pressure as in the alternative method.

Both of these methods may be used simultaneously, however; that is, the vacuum may be used to evacuate air from the die cavities and to draw the molten metal up through the ceramic tube, and compressed air applied to the surface of the metal bath may be used to force the metal up.

It will be apparent that the invention disclosed can be used with machines varying greatly in design from the ones shown. For example, the die might be split horizontally instead of vertically, with the hole in which the plunger operates, entering the die on the parting line at the side of the die. Or, the plunger might operate in a vertical plane, the ceramic tube being curved so as to enter from the side, the die being either center or side gated, and positioned either above or below the plunger.

Also, instead of the ceramic tube moving in a bath of molten metal it might be firmly fixed with respect to the crucible, and the whole assembly moved into and out of contact with the feed collar.

By placing the crucible and furnace beside the die instead of below it, a shorter path of the molten metal from the crucible to the feed collar may be provided. This might be of advantage in some cases.

The invention can also be used for the production of continuous bars of the section of openings 34, 35, by omitting the moving die plate 4, and by reciprocating the plunger 9 without completely ejecting the solidified slug or bar.

Regardless of form, however, the invention makes use of a new principle, namely, the introduction of hot casting material into a cold pressure chamber adjacent a die by momentary contact of the chamber with a heated duct connected to a source of hot casting material. I do not intend to be limited to the detail descriptions and illustrations of the invention or to any specific molding materials, except in accordance with the claims which follow.

Having now described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. In a die casting apparatus having a die, a pressure chamber communicating with said die, a source of molten material, and a duct leading from said source of material; means for maintaining said pressure chamber at a temperature substantially cooler than the temperature of the material to be cast, means for maintaining said duct at a temperature substantially equal to the melting point of said material, means for bringing said duct and said pressure chamber into momentary contact, and means for causng said material to pass through said duct and into said pressure chamber during said momentary contact.

2. A die casting apparatus comprising a die, and a pressure chamber communicating with said die, said pressure chamber having an opening therein, a plunger adapted to enter said pressure chamber and force molten material into said die, a source of molten material, a duct one end of which is disposed in said source, the other end of said duct extending to the vicinity of said pressure chamber, means for maintaining said pressure chamber at a temperature substantially cooler than the temperature of said molten material, means for maintaining said plunger at a temperature substantially cooler than the temperature of said molten material, electrical resistance means for maintaining that portion of said duct above said source at a temperature substantially equal to the melting point of said material, means for bringing said duct and the opening in said pressure chamber into momentary contact, and means for forcing molten material from said source through said duct and into said pressure chamber during said momentary contact.

3. A die casting apparatus comprising a die, a pressure chamber communicating with said die, said pressure chamber having an opening therein, a plunger adapted to enter said pressure chamber and force molten material into said die, a source of molten material, a duct one end of which is disposed in said source, the other end of said duct extending to the vicinity of said pressure chamber, means for maintaining said pressure chamber at a temperature substantially cooler than the temperature of said molten material, means for maintaining said plunger at a temperature substantially cooler than the temperature of said molten material, electrical resistance means for maintaining that portion of said duct above said source at a temperature substantially equal to the melting point of said material, means for bringing said duct and the opening in said pressure chamber into momentary contact, means for forcing molten material from said source through said duct and into said pressure chamber during said momentary contact, and means actuated by movement of said plunger toward said pressure chamber and breaking said momentary contact.

4. A die casting apparatus as defined in claim 1, said duct being of ceramic material, the portion above said source including the part which contacts with said pressure chamber being encased in metal to protect said duct from shock.

5. A die casting apparatus as defined in claim 1, said duct being of ceramic material and the portion thereof above said source being heated by an electrical resistance which surrounds the same and which is encased in a steel tube insulated from said resistance, said steel tube extending to the upper end of said duct to protect said end at the time of contact with the pressure chamber.

6. In an apparatus for forming molten or plastic metals, comprising a die, a pressure chamber adjacent said die and communicating therewith, a source of molten material; an inflexible pipe duct one end of which is disposed in said source and the other end of which extends to the vicinity of said pressure chamber, means for momentarily contacting said duct and said pressure chamber by moving said duct longitudinally while maintaining said pressure chamber and said source in fixed spacial relation to each other, and means for causing said material to pass through said duct and through said pressure chamber and into said die during said momentary contact.

7. In a pressure casting machine of the type having a melting pot, a pressure chamber for receiving a discharged fluid metal under pressure, and a pressure passage connected to said chamber for transferring fluid metal thereinto from the melting pot, means for maintaining the pressure passage at a temperature high enough to prevent solidification of metal in the pressure passage, said means including a heating element to heat said passage and mechanism for causing only momentary contact between said pressure passage and said chamber, whereby the temperature of said passage is not lowered by prolonged contact with the cool pressure chamber.

8. In an apparatus for forming molten or plastic materials comprising a die, a pressure chamber adjacent said die and communicating therewith, a source of molten material, and a duct for conducting said material from said source to said pressure chamber; one end of said duct being disposed in said source and the other end of which extends to the vicinity of said pressure chamber, a separable joint connection between said duct and said pressure chamber, means for forcing molten material from said source past said separable joint by the use of low pressure, means for subsequently completing the passage of said molten material into said die by the use of a high pressure in said pressure chamber, said low pressure being insufficient to cause leakage at said separable joint and said high pressure being greater than could be borne by said separable joint without leakage.

9. In a die casting apparatus having a die, a source of molten material, a pressure chamber adjacent said die and communicating therewith, and means for conveying the molten material from said source to said pressure chamber; said means comprising a ceramic tube adapted to connect said source with said pressure chamber, means for maintaining said tube at a temperature substantially equal to the melting point of the material to be cast, means for water cooling said pressure chamber, and means to effect a momentary connection between said tube and said pressure during which connection molten material may be introduced into said chamber from said source.

10. The method of forming articles from molten or plastic materials which comprises bringing a passage leading from a source of molten material into momentary contact with a pressure chamber communicating with a die, maintaining said pressure chamber at a temperature substantially less than the melting point of the material used, maintaining said passage at a temperature substantially equal to the melting point of said material, forcing under pressure said material in molten form through said passage and into said pressure chamber during said momentary contact, and then forcing said material from said pressure chamber into said die under greater pressure, the removal of said passage from said pressure chamber occurring before either substantially changes its above described thermal conditions.

JOHN R. DAESEN.