Aug. 2, 1960 W. M. GOLDHAMER 2,947,045

DIE CASTING BAR INJECTION MACHINE

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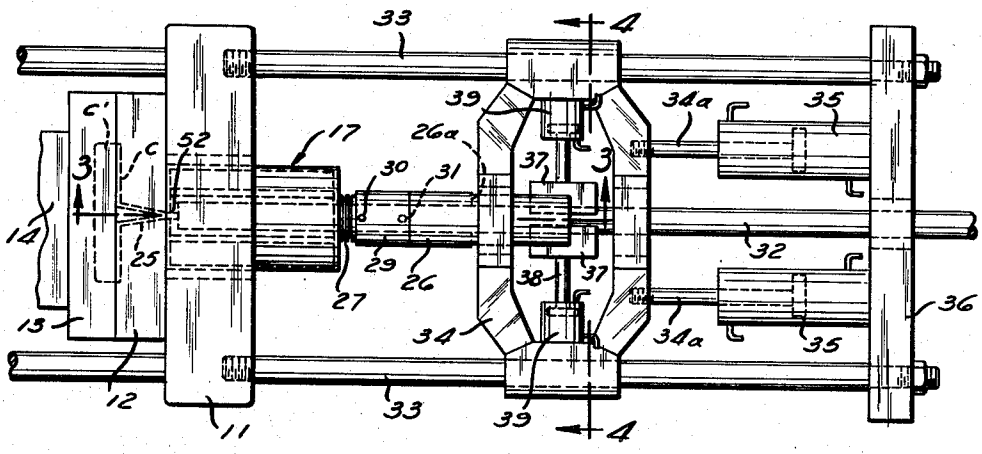


Fig. 1

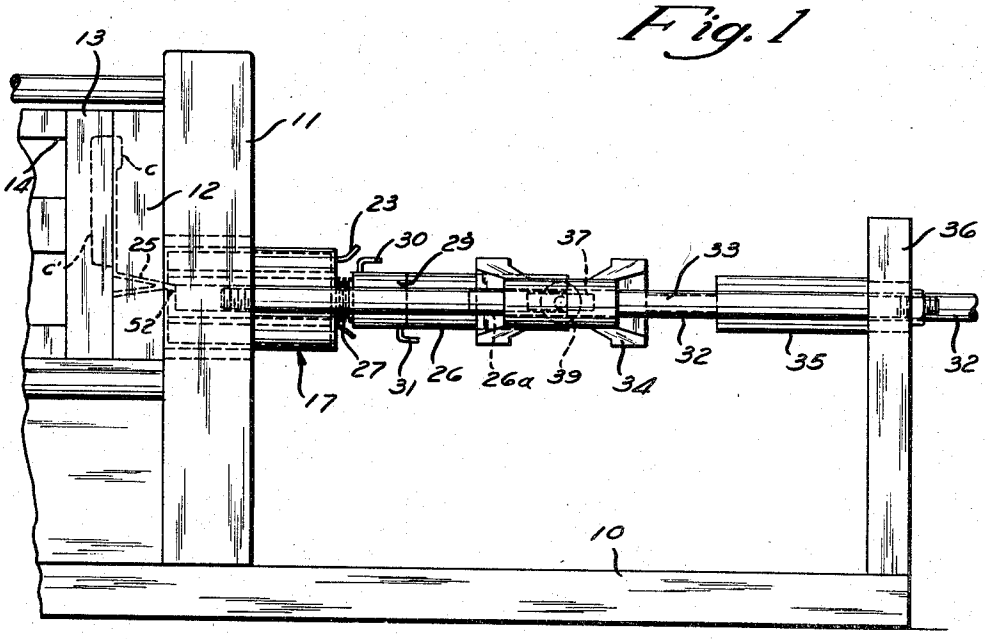


Fig. 2

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Fig. 3

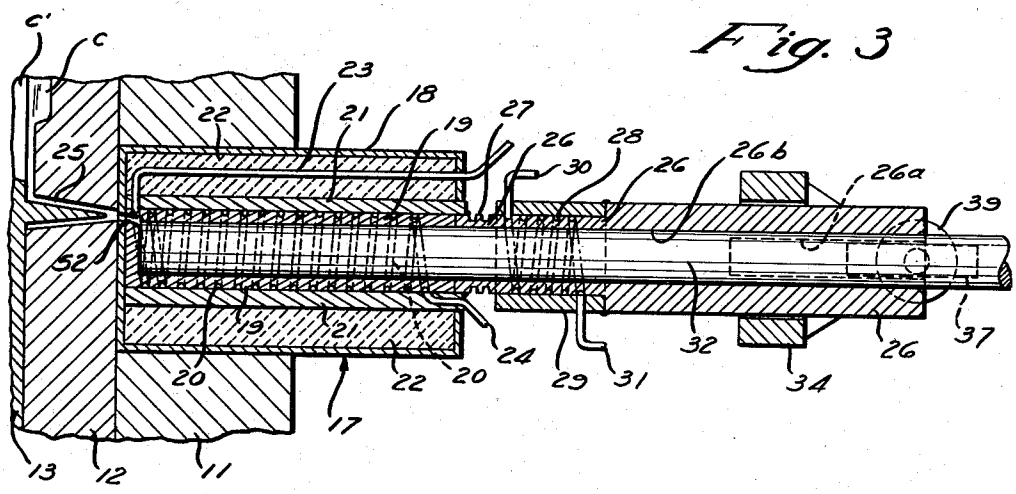
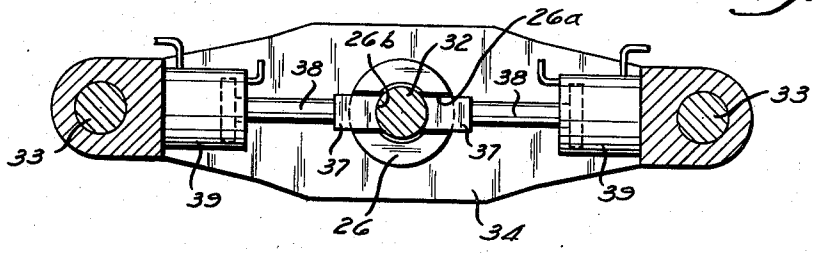


Fig. 4



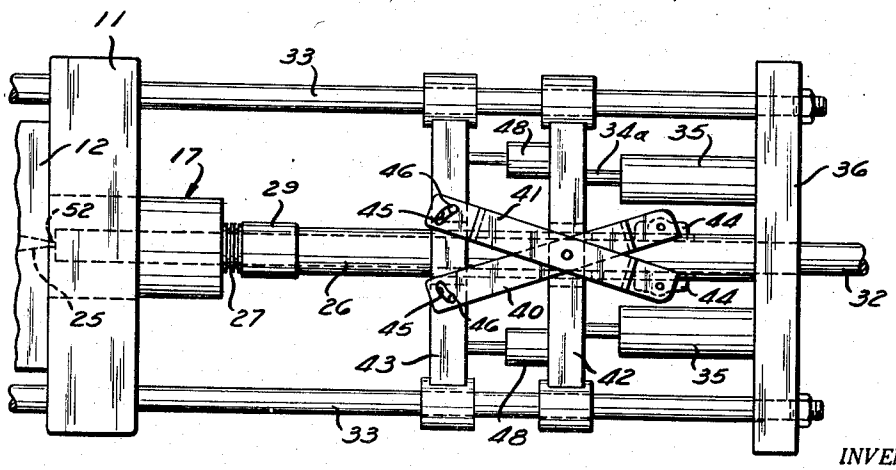


Fig. 5

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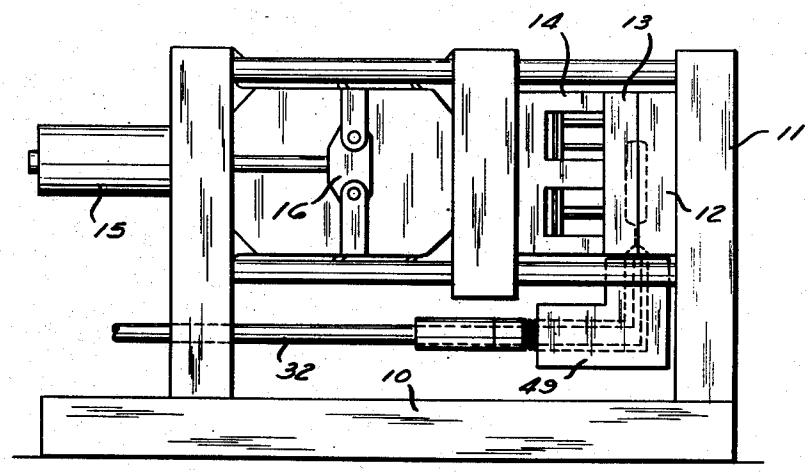


Fig. 6

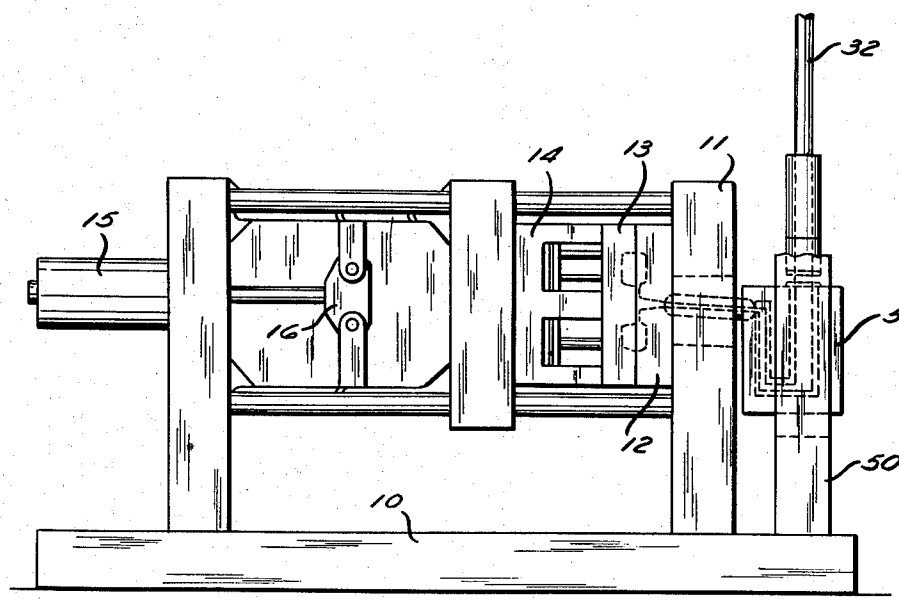


Fig. 7

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DIE CASTING BAR INJECTION MACHINE

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5 Claims. (Cl. 22—68)

This invention relates broadly to die casting machines and more specifically to an improved method for and treatment of the metal injected into the cavity of a die.

Heretofore, it has been the practice to reduce quantities of the casting metal into a molten state in a melting furnace attached to or adjacent the casting machine, and charge a small portion thereof into the die either by means of an injection piston cylinder assembly immersed directly in the metal bath, or by ladling or otherwise transferring it into a non-immersed piston cylinder assembly for injection into the die.

The former method was used for zinc base alloys and other metals of low melting temperature, while alloys of aluminum and others of higher melting temperature were die cast by the latter method.

Both of these methods were unsatisfactory. The exposed surface of the metal bath oxidized in the air and drosses formed, and these oxides and drosses were often carried into the injection system and incorporated into the castings deleteriously affecting their quality. Also, proper compression fit of the piston and cylinder were difficult to maintain. The immersed injection assembly system was faster, but could not be used for aluminum alloys because absorption of iron from the piston cylinder assembly contaminated the aluminum and destroyed the piston to cylinder compression fit, nor for magnesium alloys which could not be melted without shielding the surface of the molten metal from air to prevent dangerous rapid oxidation, nor for copper base alloys which melted at a temperature so high as to destroy the strength of the piston cylinder assembly if immersed continuously in the molten metal. This has necessitated use of different machines for different casting metals. Where the non-immersed injection assembly was used, air entrapped in the compression cylinder resulted in oxidation and segregated chilling of the metal, thus causing porosity, contamination and other defects in the casting. To increase the castability of the chilled metal and to finely divide the entrapped air and gases, excessively high injection pressures were used, increasing the cost of the equipment and the product.

In the present invention, hereinafter called the bar injection method, the desired casting metal and/or alloy, in the form of rods or bars of given cross section and length, are successively fed into a heating chamber of the same inside cross section as the rod or bar, where the inner end thereof is melted and directly injected into the die, by the forced advance of the still solidified outer portion of the rod or bar itself. The outer end of the melting chamber is provided with a heat exchanger or chill of the same hollow interior cross section as the bar or rod itself to preserve the shape, form and rigidity of the rod and accommodate the use thereof as a piston for successive injection operations.

It will be recognized that the difficulties enumerated above will be eliminated with this improved method and apparatus since,

(1) The piston is itself formed of the desired alloy and

is continuously providing an air and gas free supply of molten metal.

(2) Melting is carried on immediately prior to injection and free from exposure to ambient air, eliminating oxidation and dross contamination.

(3) Compression fit necessary for pressured injection is automatically and continuously provided outside the zone of contact with the molten metal so that all casting metals or alloys may be handled with the same injection system.

In addition to the foregoing, a further object of the invention is to provide a bar injection mechanism which may be readily adjusted to effect sufficient translation of the bar to produce a requisite volume of molten metal for the die cavity.

A further object of the invention resides in the provision of a bar injection mechanism which is designed for sequential operation with the die closing device.

Another object of the invention is to provide a melting chamber for the end of a bar which is constructed to preclude the admission of air therein.

Another object of the invention is to provide a system of metal injection which will permit evacuation of air from the die cavity without separately blocking off incoming metal flow prior to injection.

Further objects of the invention reside in a structure which is economic of manufacture, efficient of operation and adapted for use in die casting machines of various types and metals or alloys of various chemical characteristics and properties.

Other objects and advantages more or less ancillary to the foregoing, and the manner in which all the various objects are realized, will appear in the following description, which considered in connection with the accompanying drawings, sets forth the preferred embodiment of the invention.

Referring to the drawings:

Fig. 1 is a plan view of a fragmentary portion of a die casting machine embodying the improved melting chamber, chill and bar injection mechanism;

Fig. 2 is a side elevational view thereof;

Fig. 3 is a vertical sectional view of the bar heater, chill and guideway for the bar, the section being indicated by the line 3—3 in Fig. 1;

Fig. 4 is a transverse sectional view through the bar injection mechanism, the section being taken on a plane indicated by the line 4—4 in Fig. 1;

Fig. 5 is a plan view of an alternate form of the bar injection mechanism; and

Figs. 6 and 7 are side elevational views of fragmentary portions of the machine shown in Figs. 1 and 2 illustrating alternate forms of mounting the heating unit and the associated chill.

Referring first to Figs. 1 and 2, the die casting machine embodies a base **10**, a stationary end plate **11** mounted thereon, a die block **12** rigidly secured thereto, and a second die block **13** mounted for reciprocative movement towards and away from the fixed die **12**. The die **13** is slidably supported on a member **14** of the customary form employed in die casting mechanism. The translation thereof is effected by a piston cylinder assembly **15** and linkage **16** (see Figs. 6 and 7) in the usual manner. The die blocks **12** and **13** are each formed with a cavity *c—c'* therein of the shape and form of the casting.

The end plate **11**, as shown, is provided with a heating unit **17** embodying a tubular body **18** disposed in the horizontal axis of the machine and formed with a tubular core **19** in the axis thereof (Fig. 3) having a helical heating element **20** embedded therein, a circumambient sleeve **21** and a jacket **22** of insulating material surrounding the sleeve **21**. Lines **23** and **24**, from the helical heating element, are coupled with a source of electric current. It is

to be understood that the term "heating element" as used herein, includes all forms of electric resistance wire, electric induction elements, infra-red heaters and means for the circulation of high temperature heat exchange liquid around the core **19**. The inside cross section and length of the core **19** may vary commensurate the size and volume of the cavities *c*—*c'* and the canals **25** that lead thereto.

The outer end of the core **19** and sleeve **21** are affixed to a tubular chill **26** embodying radiation fins **27** and a helical groove **28** on the outer portion thereof, a sleeve **29** thereover and inlet and outlet conduits **30** and **31** coupled with the groove to accommodate the circulation of a coolant therethrough. The bore in the tube **26** is disposed in coaxial relation with the bore in the core **19** and the shape and cross section of each bore is equal. The dimensions of the heating element **20** and the size and the number of convolutions of the groove may vary to meet the volumetric requirements of the die cavities *c*—*c'* and the character of the metal being cast.

The die casting metal is in the form of a rod or bar **32** which is cast, drawn, extruded or otherwise formed to a size and cross section which snugly, though slidably, engages the similarly shaped bore in the core **19** and tube **26**. The length of the casting metal bars **32** may vary to meet the available space in the environs of the machine and the lineal limitation imposed in the manufacture of the bars. The metal, per se, or alloy thereof is controlled by the demands of the work being die cast.

Each bar **32** is inserted into the bore **26***b* of the chill **26** and is progressively advanced therein by a feed mechanism, such as the clutch and ram device illustrated in Fig. 1, the toggle clamp and linkage shown in Fig. 5, or any ratchet pushers of a well known form. As shown in Fig. 1, the end plate **11** of the machine is provided with a pair of parallel columns **33** constituting ways for a slide **34** mounted thereon. The slide is reciprocated towards and away from the plate **11** by hydraulic rams **35** secured to a stanchion **36** mounted on the base **10** of the machine parallel to the plate **11**. The slide is provided with a pair of opposed shoes **37** mounted on piston rods **38** in cylinders **39** carried by the slide frame.

The circumferential wall of the chill **26** is machined with opposed slots **26***a* therein for the reception of the shoes **37**. The shoes engage the bars as they are successively fed through the chill, and the slots **26***a* are of sufficient length to assure stability and coaxial alignment of the end of the bar being used with a new bar injected into the chill. The rearward end of the chill **26** is bell mouthed to accommodate the ready entry of the bars injected therein.

The rams **35**, cylinders **39**, and cylinder assembly **15** are all connected to a control valve (not shown) designed to effect the sequential actuation of the pistons therein. Thus, after the die block **13** is brought into abutting engagement with the die **12**, the cylinders **39** will effect the engagement of the shoes with the bar **32**, then the ram pistons **34***a* will advance the slide **34** inwardly. In the alternate form of the pusher, illustrated in Fig. 5, the mechanism comprises a pair of arms **40** and **41** pivoted intermediate their ends on a cross head **42**. Each arm is provided at its outer end with opposed shoes **44** mounted in toggle joints on the arms. The opposed ends of the arms **40** and **41** are machined with arcuate slots **45** therein engaged with pintles **46** in a sliding cross bar **43**. The cross bar **43** is advanced forwardly by pistons in cylinders **48** mounted on the cross head **42**, thereby effecting clamping engagement of the shoes **44** with the bar **32**. Actuation of the pistons in the cylinders **35** will effect the inner translation or feeding cycle of the bar **32**.

Alternate forms of positioning the bar injection mechanism are illustrated in Figs. 6 and 7. In Fig. 6 where the passageway that feeds the die cavity is in the base of the die blocks, the heating unit **49** and chill are subtended from the bottom of the stationary die **12** and the bar injection mechanism therefor (not shown) extended therefrom below the machine parallel to the base **10**. This arrangement affords the advantage of having the molten metal supply in close proximity to the die cavity, and thus eliminates the possibility of solidification of the molten metal before it reaches the die. In Fig. 7 where the area around the machine is limited, a vertical post **50** may be mounted on the base **10** parallel to the end plate **11**, and a heating unit **51** of an alternate form and chill may be secured to the post so the bar **32** protrudes upwardly. The machine may be provided with a storage rack or hopper and automatic bar loading device therefor to facilitate continuous operation of the machine and to shorten the operating time thereof. Such device and its appurtenances is contemplated as falling within the scope of the present invention, though not illustrated herein. The invention further comprehends a bar injection mechanism having limit switches thereon for holding the shoes or jaws of the clutch engaged with the bar during all or part of the retractive movement of the slide. The actuation or position of these switches may be made to accommodate adjustments so the molten metal remaining in the passageway between the die cavity and the heating unit will be forced back by atmospheric pressure, as the die halves are parted, thus preventing dripping of molten metal from the die end of the passageway while the die halves are apart.

In operation, a bar **32** is inserted in the bore of the chill tube **26** and advanced therethrough into heating unit **17** where the end portion thereof is melted by the heating element **20** and ejected through an orifice **52** in the top of the core **19**. The portion of the bar in the adjacent circumambient chill **26** will remain solidified and will perform the function of a piston and thus effect the injection of the molten metal through the orifice **52** and passageway **25** leading to the die cavities *c*—*c'* (Fig. 3). The die halves **12** and **13** are closed and then held in impinged relation with each other until completion of the metal injection cycle of the machine. This also permits evacuation of air from the die cavity prior to injection without danger of flow of molten metal into the die cavity and without the necessity of mechanically blocking the metal flow during evacuation, as in this system the atmospheric pressure is excluded from contact with the molten metal.

The travel of the casting metal bar is regulated to displace a sufficient volume of molten metal to completely fill the die cavities. When the slide reaches its innermost position, the portion of the bar formerly supported in the chill, is melted in preparation for the successive injection cycle of the machine. As the slide is retracted, the shoes will slide over the bar, but upon reversal of the movement thereof, the shoes re-engage the bar and effect the inward translation thereof.

It will be seen from the foregoing that the metal within the heating unit **17** is never exposed to atmosphere, thus there is no possibility of oxidation. The molten metal is injected into the die cavities immediately after it reaches its molten state and before absorption thereof of iron or other metals having a deleterious effect on the die casting material, and the bar or bars are formed of the metal or alloy that is desired for the casting being made.

The rate of movement of the slide **34** and the length of the travel or stroke thereof is regulated by adjustment of the valves (not shown) connected to the rams **35** illustrated in Fig. 1, though other mechanism for the reciprocative movement and speed of the slide, such as a cam and rack, pinion or crank, and connecting rod assembly may be substituted therefor with equal facility.

Although the foregoing description is necessarily of a detailed character, in order that the invention may be completely set forth, it is to be understood that the specific terminology is not intended to be restrictive or confining, and that various rearrangements of parts and modifications of detail may be resorted to without depart-

ing from the scope or spirit of the invention as herein claimed.

What is claimed is:

1. In a die casting machine embodying a fixed and a movable die block, each having a die cavity therein, the combination of a heating unit for melting the end of a bar of die casting metal and a contiguous chill to preserve the solidified form of the bar, said heating unit comprising a core having a bore therein for the support of the bar, a helical electric resistance element circumambient the perimeter thereof to melt the portion of the bar therein, said chill comprising a tube affixed to said core in coaxial alignment therewith, said tube having a helical groove in the perimeter thereof, a sleeve circumambient said groove constituting a waterjacket to maintain the solidification of the portion of the bar therein, and mechanism rearward and coaxial said chill to progressively feed the bar into said chill and the molten metal in the heating unit into the die cavities.

2. In a die casting machine embodying a fixed and a movable die block having die cavities therein, the combination of the die casting machine with a heating unit for melting the end of a bar of die casting metal and a contiguous chill to preserve the solidified form of the bar, said heating unit comprising a tubular core for the support of the bar, an electric heating element circumambient the perimeter thereof to melt the portion of the bar therein, said chill comprising a tube affixed to said tubular core in coaxial alignment therewith, said tube having a helical groove in the perimeter thereof, a sleeve circumambient said groove constituting in combination with the groove a passageway for the circulation of a coolant to solidify the portion of the bar therein, and mechanism rearward and coaxial said chill to progressively advance the bar into the chill and inject the molten metal in the heating unit into the cavities in the die when the die blocks are closed.

3. A die casting machine embodying a fixed and a movable die block, each having die cavities therein, a heating unit for melting the end of a bar of die casting metal and a contiguous chill to preserve the solidified form of the bar, said heating unit comprising a tubular support for the bar, a heating element engaged with the perimeter thereof to melt the portion of the bar therein, said chill comprising a tube affixed to said core in coaxial alignment therewith, said tube having grooves in the perimeter thereof, a sleeve circumambient said grooves defining a coolant passageway to maintain the solidification of the portion of the bar therein, said heating chamber having a discharge opening in the inner end thereof communicating with the die cavities, and a clutch mechanism rearward and coaxial said chill to progressively feed

the bar into said chill, the solidified portion of the bar constituting a pusher to effect injection of the molten metal in the heating unit into the die cavities and to form a metal slug to be melted in the heating chamber for sequential cyclic operation of the machine.

4. A die casting machine embodying a fixed and a movable die block, each having die cavities therein, a heating unit on the fixed die communicating with the die cavity therein for melting the end of a bar of die casting metal, a chill contiguous and coaxially aligned with the heating unit to preserve the solidified form of the bar, said heating unit comprising a core having a melting chamber therein for the end of the bar, an electric heating element surrounding said core to melt the end portion of the bar therein, said chill comprising a tube affixed to said core in coaxial alignment therewith, said tube having a bore therein for sliding engagement with the bar, a helical groove in the perimeter of the tube, a sleeve circumambient said groove constituting in combination with the groove, a coolant passageway to maintain the solidification of the portion of the bar therein, and a clutch mechanism rearward and coaxial said chill to progressively advance the bar into said chill and to progressively inject the molten metal in the heating unit into the die cavities when the die blocks are moved into abutting relation.

5. A die casting machine embodying fixed and movable die blocks having die cavities therein, a heating unit on said fixed die block for melting the end of the portion of the bar of die casting metal, a chill contiguous said heating unit to preserve the solidified form of the bar, said heating unit comprising a core having a chamber therein communicating with the die cavities, a heating element contiguous said core to melt the portion of the bar in said chamber, said chill comprising a tube affixed to said core in coaxial alignment therewith, said tube having a groove in the perimeter thereof and a sleeve circumambient said groove constituting a passageway for circulation of a coolant to maintain the solidified form of the portion of the bar therein, and a unidirectional gripper rearward and coaxial said chill to progressively feed the bar into said chill and to inject molten metal in the heating unit into the die cavities.

References Cited in the file of this patent

UNITED STATES PATENTS

1,219,358	Stewart	Mar. 13, 1917
2,307,001	Johnson	Dec. 29, 1942
2,533,468	Jurgeleit	Dec. 12, 1950
2,656,588	Ovshinsky	Oct. 27, 1953
2,799,066	Federman	July 16, 1957
2,831,214	Eyles et al.	Apr. 22, 1958