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[54] **METHOD OF MAKING INTRICATE DIE CASTINGS**
4 Claims, 3 Drawing Figs.

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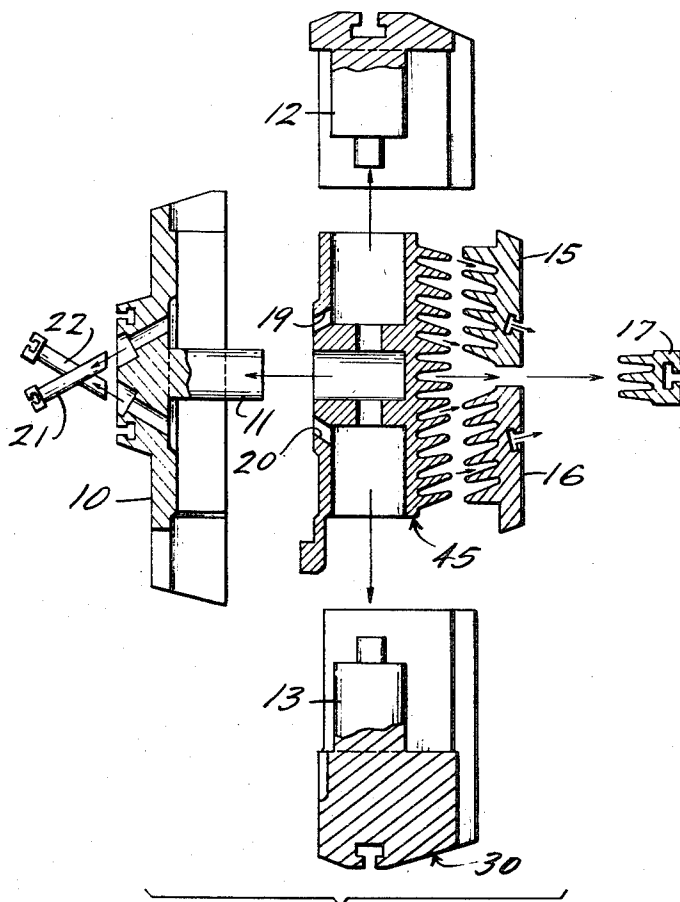
[51] Int. Cl..... **B22d 27/10,**
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[50] Field of Search..... **164/113,**
119, 137, 303, 339—343; 18/42 D, DIG. 58

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ABSTRACT: A method of making intricate diecastings that have undercuts and intersecting surfaces such that removal of a casting from a conventional diecasting machine would be extremely difficult. In accordance with the invention, a plurality of separable die elements are brought together outside the diecasting machine to form a complete die cavity. The assembled die is inserted into a conventional diecasting machine, the shot made, and the die, with the casting therein removed as a unit. The die parts are disassembled from the casting outside the machine. Each or all of the die parts may be lubricated and brought to a predetermined temperature prior to reassembly.



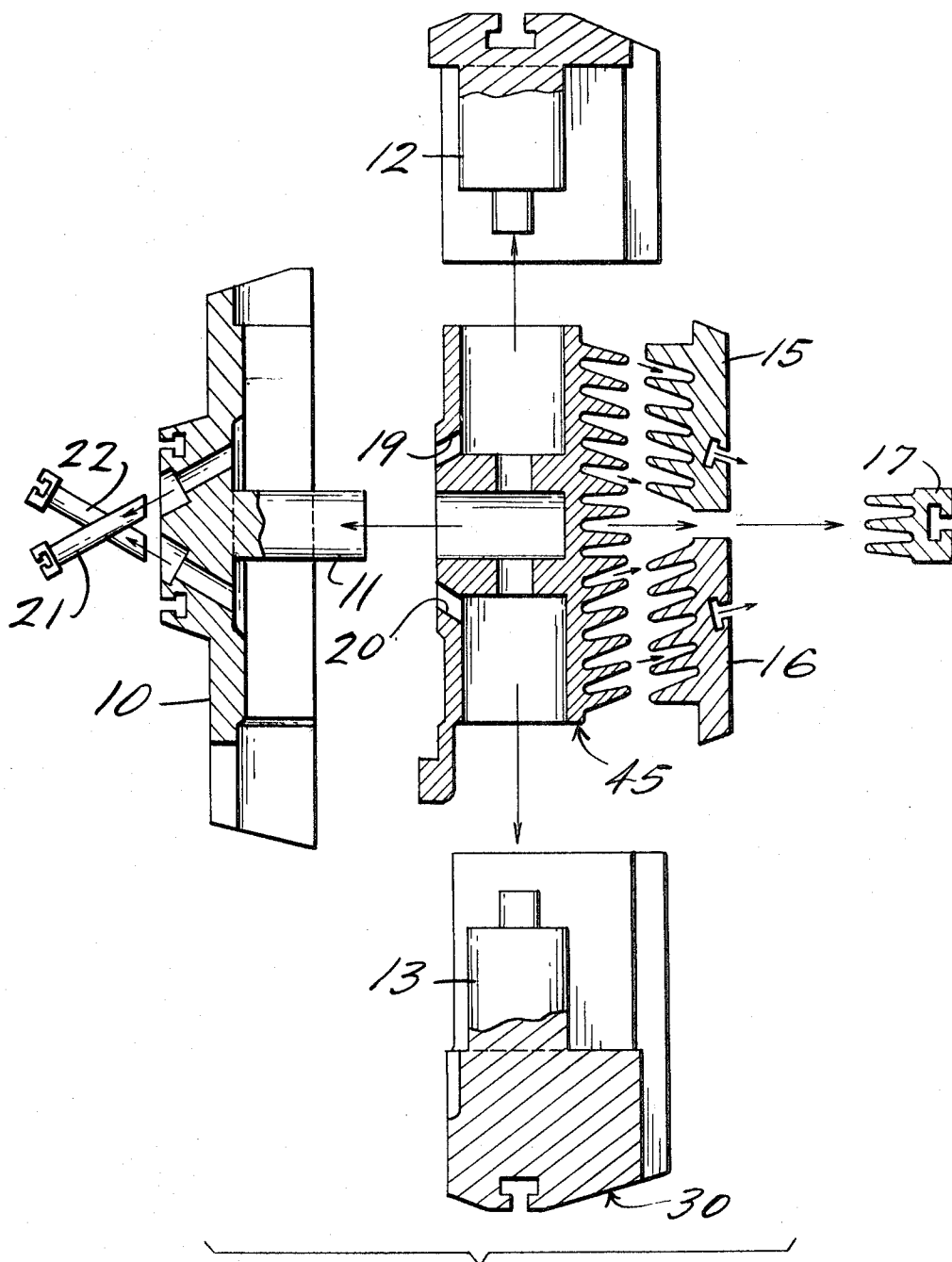


FIG-1-

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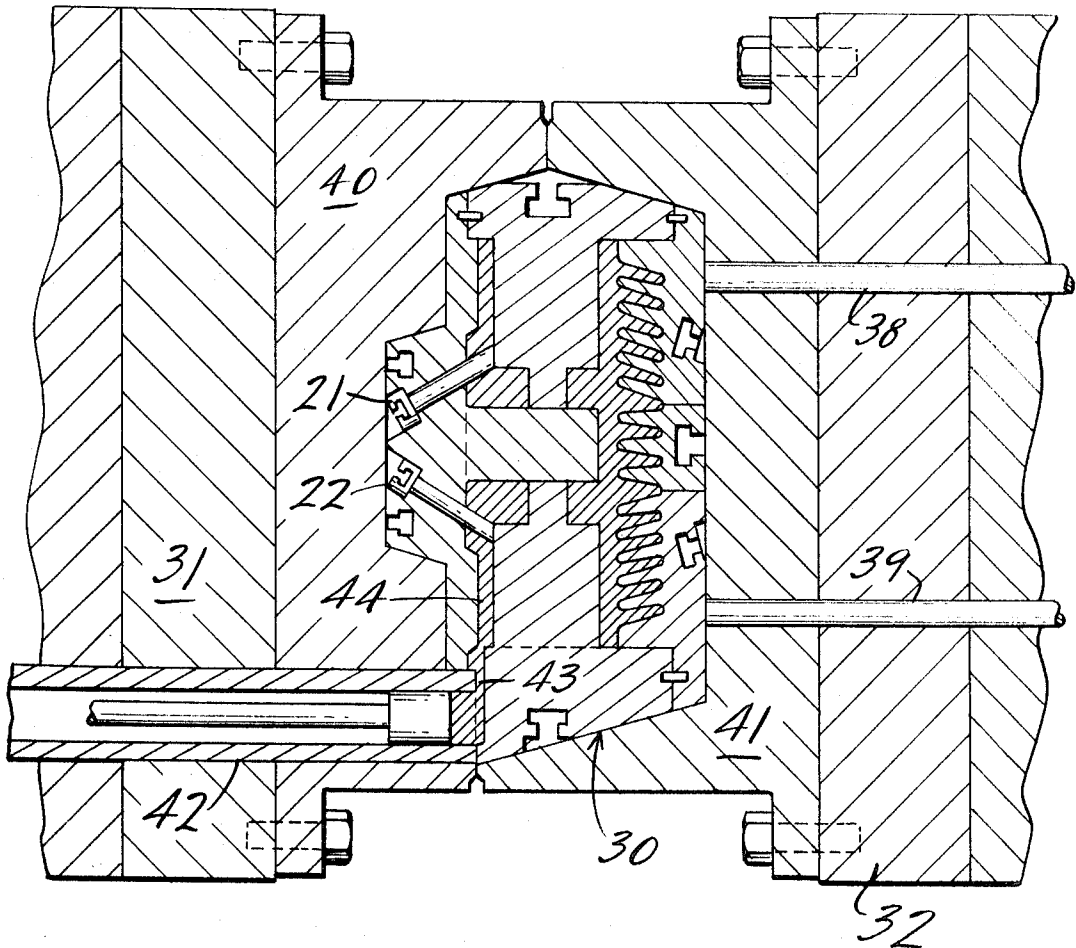


FIG-2-

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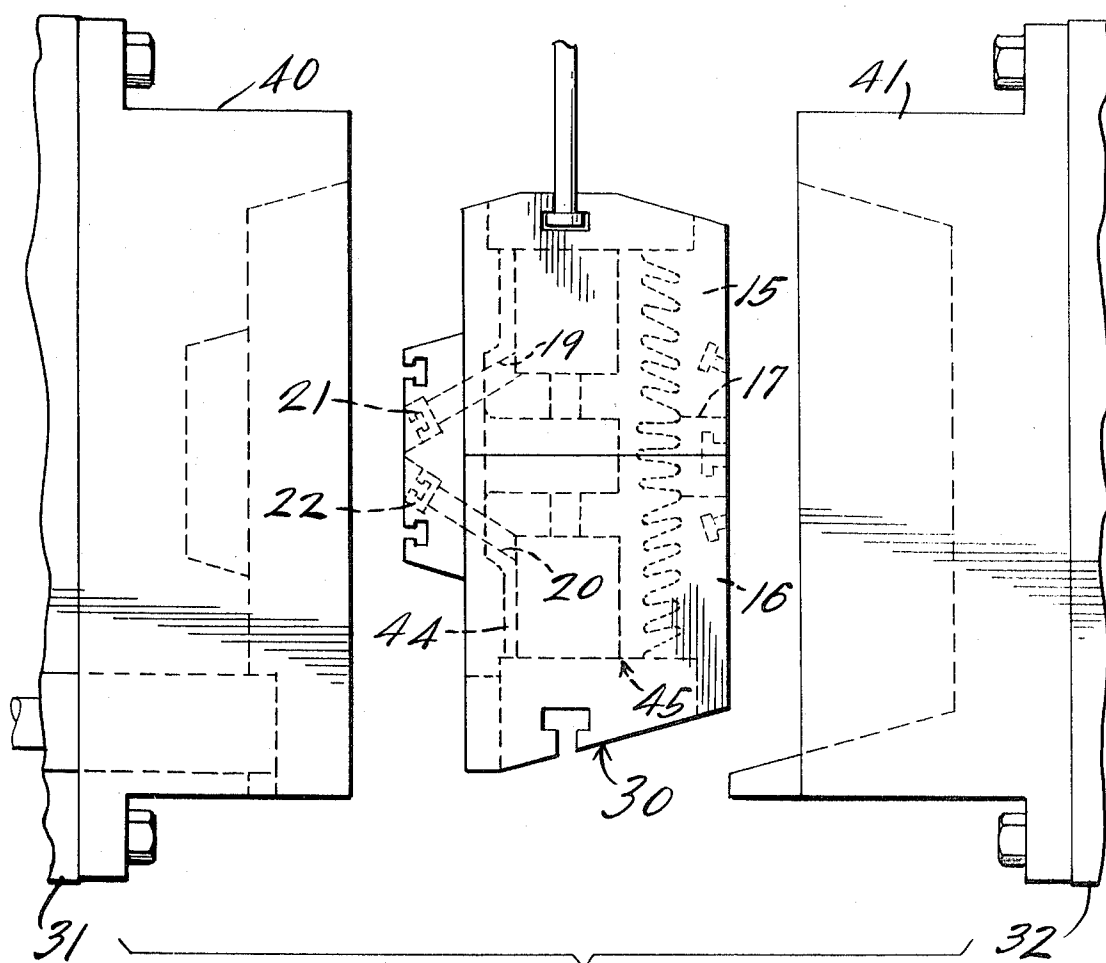


FIG-3 -

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METHOD OF MAKING INTRICATE DIE CASTINGS

This invention relates to a method of repeatedly making intricate diecastings and is particularly directed to a method in which a greatly simplified die apparatus is used.

In diecasting complex parts containing undercuts and recesses, it has heretofore been the practice to provide the die with a plurality of movable cores that can be withdrawn from the die cavity to permit the casting to be ejected. The movable cores require that the machine be equipped, frequently on all six sides of the die with a complicated operating mechanism that functions at the proper time in the cycle of operation of the machine itself to insert and withdraw the cores. The present invention permits the elimination of all such cores and their operating mechanisms.

Further, complex diecastings will usually include various parts having widely different wall thicknesses. In the manufacture of finned parts for air cooling a heated body, such as a cylinder for an internal combustion engine or other parts having closely set grooves, the fins and grooves result in sections that are long and thin while the base from which the fins extend or into which the grooves are formed are, by comparison, relatively thick and massive. In diecasting parts of this nature it is necessary to cool the various die areas at different rates because the heat buildup in the die varies from one area to another as a function of the surface area of the die as well as the mass of metal to which each area increment is exposed. Thus, a finned area is required to extract only a small quantity of heat from the casting and requires only a small volume of cooling water, while the base or body of the casting contains much more heat than must be passed into the die, and the die area opposite the base or body must be cooled at a rapid rate because of the large volume of molten metal to which it is exposed. This area of the die, then, requires a larger volume of cooling water. The present invention eliminates all cooling problems by providing a die which is completely removed from the machine at each casting operation or each shot, disassembled, precooled or preheated and reassembled and reinserted into the machine for the next shot.

The use of loose pieces to form undercuts in a diecasting is well known and is sometimes used as a substitute for or in conjunction with movable cores as previously mentioned. These loose pieces are set into the die while the fixed die portions are attached to the machine plates and are ejected with the casting to be later removed. In general, the use of loose pieces is discouraged in the art because of the difficulty and inconvenience of loading them properly in a hot machine and for various other reasons and the expedient is adopted only when the part cannot be economically made in any other way.

The present invention broadly comprises a method in which a plurality of die core and impression elements are provided; such die elements are lubricated and brought to a proper preselected temperature, and assembled into a unitary die structure; the unitary die structure is then inserted into or between the platens of a substantially standard diecasting machine, the machine closed and the shot is thereafter made. Following the injection of the diecasting metal the entire die with the cast object therein is removed from the die at this point and the die parts are recycled through the heating, lubricating assembly and casting cycles.

Because all of the parts of the die that go into the assembled unitary die structure or member are available for pretreatment outside of the machine and can be closely controlled as to temperature prior to assembly, the machine need not be provided with the usual cooling water connections and there is no problem with one die part running hotter than another due to heat buildup as the result of making successive castings. Further, it will be seen that there is no problem of improper die lubrication because each element of the assembly can be dipped in a lubricant bath held at the proper temperature while it remains separate from all of the other elements that go to make up the complete die cavity prior to assembly and insertion in the machine.

The operator of the machine in which the method of the present invention is employed is not required to insert loose pieces in a die fixed to the machine plates and is thus relieved from the unpleasant task of working in a hot space between the die plates when the machine is open.

Various other objects and advantages of the invention will become apparent from the following specification describing a preferred form of the invention, reference being had to the accompanying drawings, in which:

FIG. 1 is a somewhat diagrammatic view, in exploded form, of a plurality of die core and impression elements necessary to make a casting, prior to assembly, shown in association with a completed casting;

FIG. 2 is a fragmentary sectional view of a diecasting machine, with parts broken away, into which the assembled die elements shown in FIG. 1 have been loaded; and

FIG. 3 is a fragmentary view of the opened die casting machine and assembled die elements during loading prior to a diecasting operation.

The drawings illustrate sequentially the principal steps of the method of the present invention. The disclosure is related to the diecasting of a finned part cored on mutually perpendicular axes, this hypothetical part having been chosen for illustration because of the varying wall thicknesses involved and because the part is such that it would normally require side cores, and further because the part would normally require carefully related cores that are difficult to cool evenly and are somewhat liable to being broken in service. The part is such that it would be virtually impossible to produce it with known diecasting methods and apparatus.

FIG. 1 of the drawings illustrates, in general, the parts that would be necessary to form the finned and cored part. As there indicated, an impression plate 10 may be taken as the element to which the remaining core parts are related. The plate 10 is provided with a center core element 11 and is associated with side core elements 12 and 13 which cooperate to complete a circular core which will form a stepped bore from end to end of the casting. The center core element 11 forms a bore entering one side of the casting and intersecting the bore formed by the side core elements 12 and 13 on mutually perpendicular axes.

Opposite the impression plate 10, the casting is such that finned areas are required with the angle of the fins converging towards a center area having fins normal to the parting line of the casting. By any known diecasting apparatus it would be virtually impossible to make such a casting without resorting to an extremely complex and costly machine. The finned parts are formed by three die sections, 15, 16 and 17.

To further complicate the casting, it has been assumed that upper and lower passages 19 and 20 are required to be formed in a wall thereof opposite the finned area. These passages are formed by core pins 21 and 22 which are held in the impression plate 10 and extend into the cavity on diverging axes. The pins must be removed before the casting can be released from the die. In a conventional machine where the casting is removed in a path along the axis of the machine, there is no way in which core pins can be used to form diverging or converging passages of the form shown. With the present invention, however, the formation of such passages becomes a simple matter because the core pins are assembled and removed from the impression plate 10 outside the diecasting machine.

When the die parts have been assembled with relation to each other, the unitary assembly, now designated 30 in FIG. 2, is placed, by any suitable loading device, into a diecasting machine. A conventional diecasting machine is shown in FIGS. 2 and 3 and includes a stationary platen 31 and a movable platen 32 operated, in the usual manner, by a conventional operating cylinder (not shown). A conventional ejection pin operating plate is carried intermediate the ends of the machine and is operated by an ejection cylinder (not shown). The ejection cylinder and ejection pin plate operate to move ejection pins 38, 39 forwardly to move the entire assembly 30 out of the machine, into the position shown in FIG. 3, at the completion of the casting portion of the cycle.

A dieholder 40 which would normally be a portion of the cover die of a machine is fixed to the stationary plate 31 and a second dieholder 41 is fixed to the movable machine platen 32. Under normal circumstances the dieholder 41 would comprise the ejector die half and would be provided with a die cavity and all of the usual cooling lines necessary to maintain the parts at the desired temperature.

A shot sleeve 42 is fixed to the stationary machine plate 31 and extends through the machine plate and the dieholder 40. The shot sleeve terminates in the usual sprue opening 43 which, in turn, communicates with a sprue passage 44 in the base plate 10, the passage extending upwardly into the die space around the core 11 and between the core 11 and the remainder of the die elements when the latter are in assembled position as indicated in FIGS. 2 and 3.

When the assembled die elements have been placed in the machine, metal can be ladled into the shot sleeve 42, forced into the die in the normal manner by an appropriate shot plunger and the casting completed under the usual very high diecasting pressures. These pressures may be from 2,000 to 8,000 p.s.i.

When the casting is completed, the entire assembly is ejected from the machine as indicated in FIG. 3. In this case the assembled die elements 30 are shown with the casting therein.

When the assembled die elements and casting have been removed from the machine, the die elements are disassembled as shown in FIG. 1 to remove from the die elements the now completed casting which is indicated at 45. The manner of disassembly is also indicated in FIG. 1. The die elements come apart in four directions. The central fin forming die part 17 may be first removed, after which the companion fin die parts 15 and 16 will come out without interference. The core pins 21 and 22 may be withdrawn sequentially from their openings in the plate 10. The impression plate 10 may be pulled back, and the upper and lower die elements 12 and 13 withdrawn finally to free the casting.

The die elements 10, 12, 13, 15, 16, 17, 21 and 22 may then be placed in a lubricant bath maintained at an appropriate temperature. The lubricant bath may be held at a temperature of, for example, 300° F. and a lubricant in the form of a graphite suspension may be contained in the bath. The die elements will tend to assume the temperature of the bath and will have deposited thereon a thin coating of lubricant. After a predetermined time the parts are removed from the heating bath and are dried and subsequently assembled as described above in connection with FIG. 1. Removal of the parts from the bath while in a heated condition will vaporize the liquid vehicle from the surface of the part leaving the steel die element covered with a uniform, extremely thin coating of graphite to protect the die steel against soldering during a subsequent casting step. In present practice where die lubrication is done by the operator swabbing the die between shots in the machine, lubrication becomes a haphazard and somewhat unreliable step. The operator lubricates the die when he feels that lubrication is needed and frequently does not lubricate all the parts that require lubrication.

It will be seen that the present invention provides for the diecasting of intricate parts and for the elimination of core pulls normally present in such diecastings. The intricate cavity is made up by a plurality of associated die pieces which are ejected from the die with the casting. The die pieces, cores and cavity impressions may be removed in the steps indicated in FIG. 3 of the drawings by appropriate mechanical, pneumatic or hydraulic forces and may be loosened from the die parts by sonic or ultrasonic vibration so that the casting is susceptible of separation from the die parts by a relatively small force.

It will also be seen that the present invention eliminates the extremely complicated water cooling system which adds materially to present day die costs and is extremely costly to maintain. The water cooling holes that are presently drilled into a die are limited by the shape of the die parts, by the loca-

tion of ejector pins, core openings and set-in pieces so that the present water cooling system is never perfect and results in uneven temperatures and residual stresses which cause heat checking of the die steels. The conventional water cooling system is replaced by the present invention by a simple immersion of the parts on a predetermined time cycle as discussed above.

If, desired, mechanical loaders can be used if the assembled die parts are heavy.

It is characteristic of die elements that are used to form heavy casting sections that they will overheat, build up solder and will slow down the casting process by requiring more cooling time between successive shots. With the present removable die parts, the thick sections are heated only by a single shot and may then be properly cooled and brought down to the desired temperature. With the present methods now in use, thin cores surrounded by molten metal absorb an incremental quantity of heat with every shot. If the cross section of the core part and the water cooling do not extract this same amount of heat before the next shot is made, then the heat accumulates, increasing the temperature of the core more and more which means that the casting cycle must be slowed down to give the thin core element an opportunity to cool and to prevent localized overheating. Even at slow cycle times, however, thin core sections frequently overheat, build up solder, and are subject to premature failure.

Another important advantage of the present invention is that in many large dies there are small cores located in the cover die or the ejector die or on one of the side cores which can be replaced only by taking the entire die apart which may consume hours or even days of time. In the new method of the present invention, if a particular core part fails it can be replaced instantly during the next assembly operation since the present invention contemplates that spare die parts are always available inasmuch as continuous operation of the method of the present invention will require that one complete die be in the process of assembly, another be in place in a machine and a third be in the process of extraction of the casting.

The advantage of proper preheating of the cavity parts before the first casting is made eliminates another disadvantage that invariably accompanies present diecasting methods. At the present time dies are preheated by torches but the die never attains an operating temperature under which good castings can be produced until a few cycles have been run. It is the present practice to scrap between five and 30 castings when a casting operation begins. Elimination of this starting scrap by the practice of the present invention adds to the efficiency of the system.

The present invention, of course, eliminates all angular mechanical core pulls located in the machine so that the diecasting machine itself can be much less complicated.

There are other advantages of the invention that will occur to those skilled in the art. Various modifications of the several steps may be made without departing from the invention as defined in the appended claims.

What I claim is:

1. The method of repeatedly making intricate diecastings comprising the steps of assembling a group of separable die cores and impression members into a unitary die member having therein at least one complete die cavity, inserting said unitary die member between the platens of a diecasting machine, closing the platens of said machine to maintain the parts of said unitary die member in assembled relation, injecting metal under high pressure into said die member to form a cast object, removing said die member with said cast object therein from the diecasting machine, disassembling said die member to remove the cast object therefrom and to separate said die cores and impression members, and reassembling said group of separable die cores and impression members for repetition of said steps.

2. The method of repeatedly making intricate diecastings as defined in claim 1 which includes preheating each of said die

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core and impression members to predetermined working temperatures.

3. The method defined in claim 1 and the additional step of lubricating and preheating each of said die core and impression members to predetermined working temperatures.

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4. The method defined in claim 3 in which said lubricating step is performed by immersing said die core and impression members in a lubricant containing solution, and drying said die core and impression members prior to assembly.

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