Jan. 31, 1961 C. A. BROWN 2,969,569

COMPOUND ANGULAR EJECTION SYSTEM

Filed Sept. 5, 1957 4 Sheets-Sheet 1

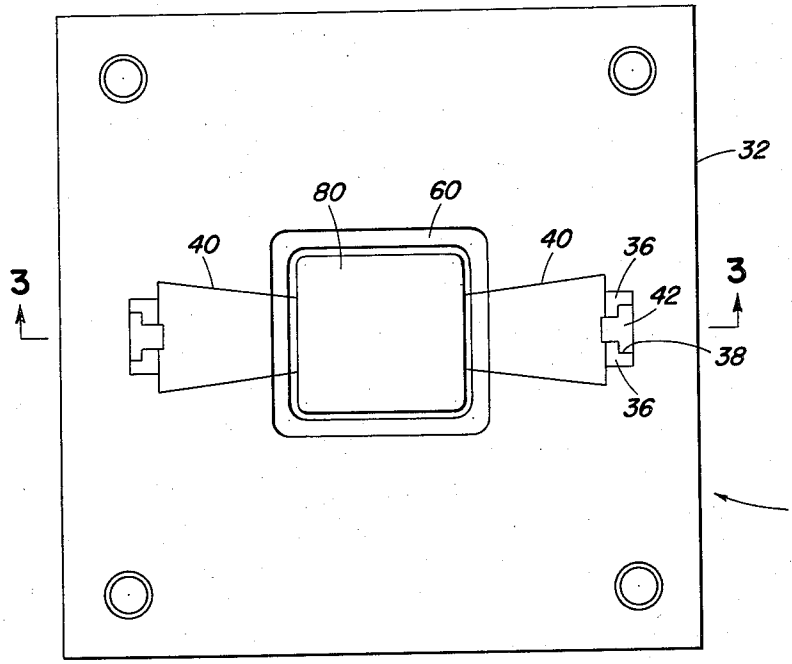


Fig. 1.

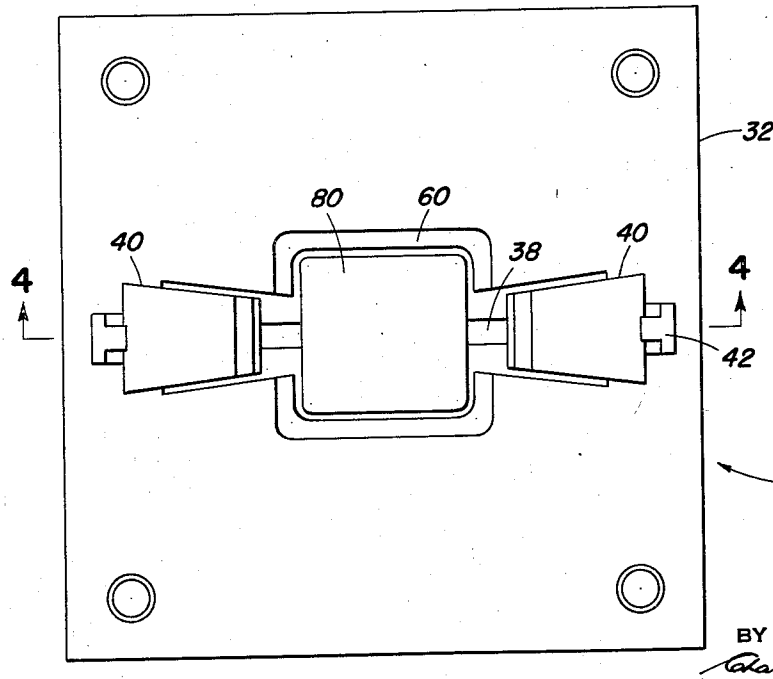


Fig. 2.

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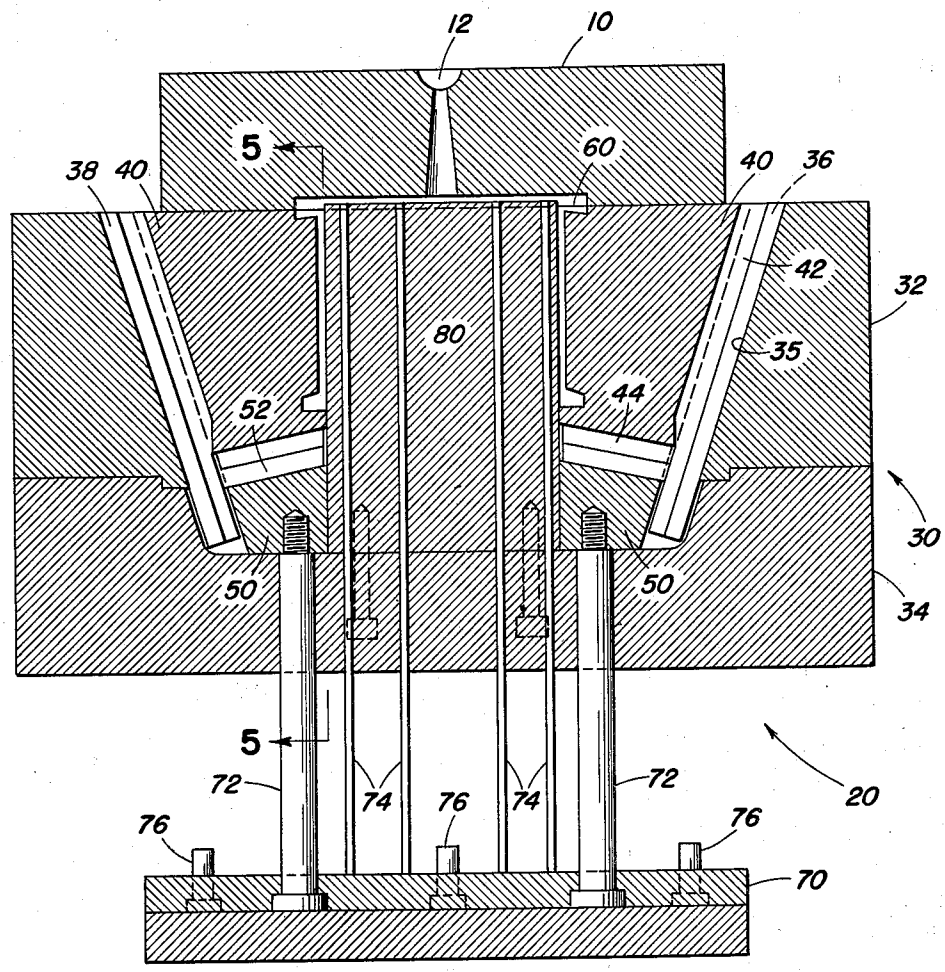


Fig. 3.

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COMPOUND ANGULAR EJECTION SYSTEM

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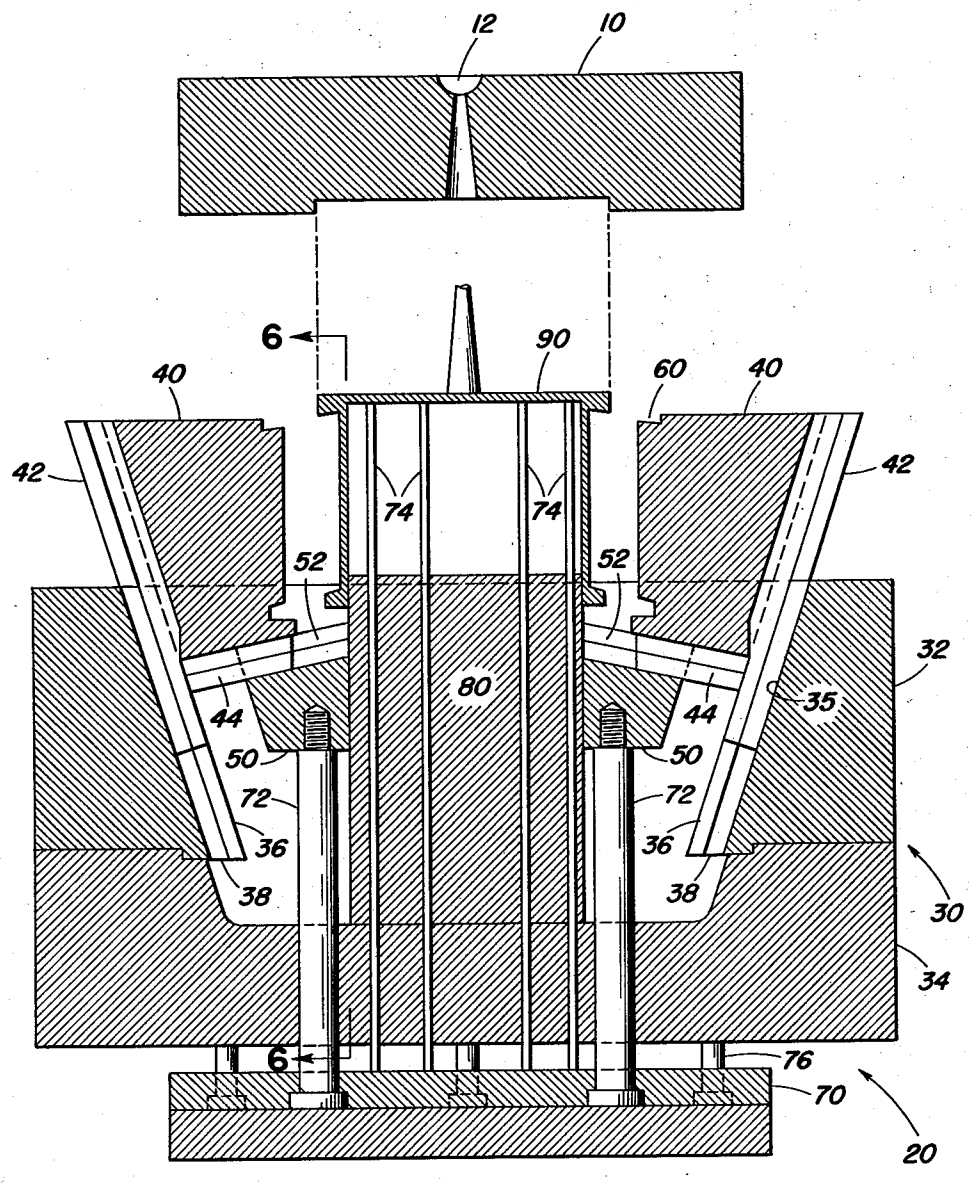


Fig. 4.

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COMPOUND ANGULAR EJECTION SYSTEM

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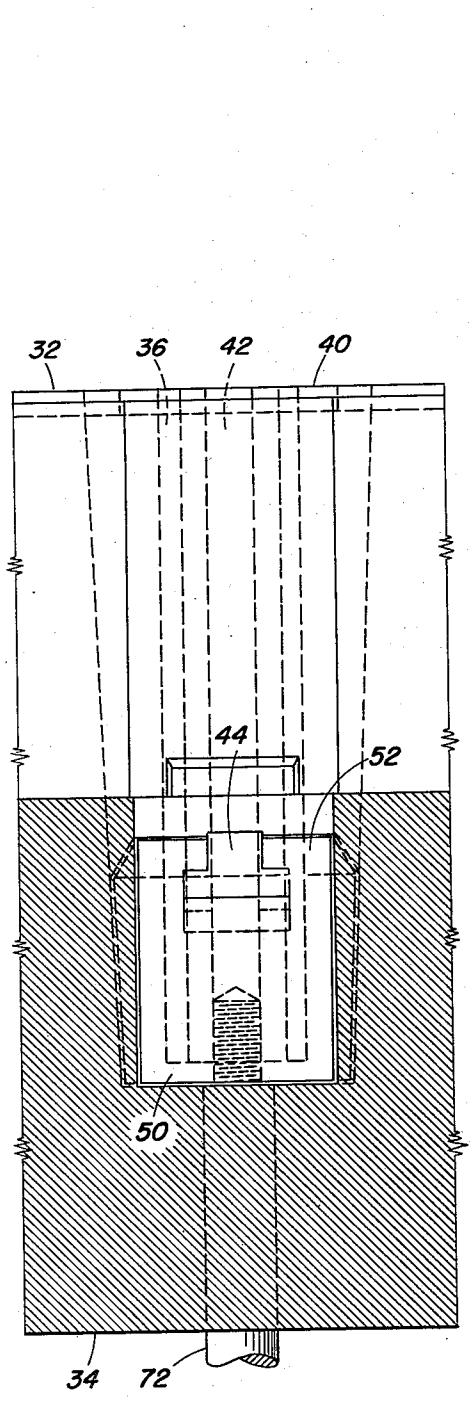


Fig. 5.

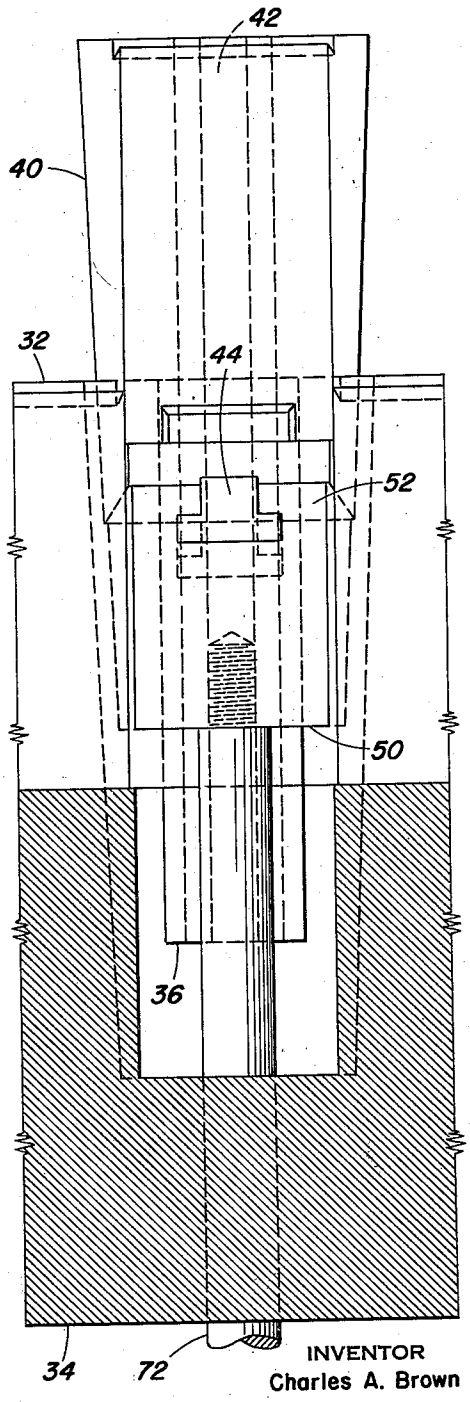


Fig. 6.

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COMPOUND ANGULAR EJECTION SYSTEM

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7 Claims. (Cl. 22—92)

This invention relates to die casting, and more particularly to an improved form of die assembly.

Die casting lends itself readily to the production of parts having many different and often very complex shapes. Some shapes require a very complex system of coring for successful reproduction and frequently the withdrawal of cores or die segments from such castings presents a very difficult problem.

The angular ejector is a well known device used in die casting dies to withdraw cores and die segments from the casting coincidentally with the ejection of the casting from the die and is actuated by the ejector movement. This device is usable only when the cores or die segments can be withdrawn at an angle of 90° with the direction of the ejector movement.

The compound angular ejector is a device that will withdraw cores or die segments from the casting at angles other than 90° with the direction of ejection and is operated coincidental with and by the ejection movement. This, as far as is known, has never been accomplished before.

The hereinafter described die assembly and system of compound angular ejection was devised to facilitate the release of castings with complicated undercuts. By use of this system, either or both withdrawing angles may be varied to change the resultant movement of die segments or cores relative to the movement of the casting during ejection.

It is therefore an object of this invention to provide an improved form of die assembly incorporating one or more relatively movable segments or cores in which the movement is so controlled as to withdraw the segments in the proper angular relationship with respect to the casting so that the segments will clear the casting and no interference will be encountered during withdrawal.

Another object of this invention is to provide an improved form of die assembly including one or more relatively movable die segments, each forming a portion of the die cavity, and in which the die segments are constrained from movement from the die cavity along paths which are separately inclined for each such segment.

A further object of this invention is to provide an improved form of die assembly to be used for casting complex forms without the use of individually operated slides for undercut portions in which the die includes one or more compound angularly withdrawing segments adapted for movement both angularly and laterally from the casting.

Another object of this invention is to provide an improved die assembly incorporating a die housing, and one or more separate die segments, within which a guide block is movable and upon which the die segments are also movably mounted such that motion of the block imparts a compound angular movement to the die segments with respect to the casting, in accordance with the manner of mounting these segments both on the housing and on the guide block.

Other and more specific objects will become apparent in the following detailed description of a typical form of die illustrating the present invention, and the accompanying drawings, wherein:

Fig. 1 is a plan view of the ejector die half with the compound angularly movable segments in closed position;

Fig. 2 is a similar view of the same die half with the movable segments in opened position;

Figs. 3 and 4 are elevational sectional views taken on the lines 3—3 and 4—4 in Figs. 1 and 2 respectively;

Figs. 5 and 6 are internal views of one of the movable die segments taken on lines 5—5 and 6—6 in Figs. 3 and 4 respectively.

The relative relationship of parts in the specific form of the die assembly shown in the drawings for the purpose of illustration can be most clearly seen from a study of Figs. 3 and 4, wherein the reference numeral **10** designates the cover die and the numeral **20** designates the ejector die which is comprised of ejector plate **70**, holding block or housing **30**, guide block **50**, movable die segments **40**, and core **80**.

The ejector die **20** is mounted onto the sliding plate (not shown) of the die casting machine. This die assembly includes in the specific form shown a holding block **30** composed of a pair of plates **32** and **34** rigidly secured together and provided with tapered depressions **35** within which the movable die segments **40** are nested when the assembly is in the closed position. Also included in this die assembly is core **80** which imparts to the castings its interior configuration. Attached to the sloping wall of the depression are one or more pairs of guide bars **36** arranged in spaced relationship, as will be seen most clearly in Fig. 1, so that the keyway **38** will be provided between such pair of bars. This keyway **38** is of T-slot configuration and is adapted to receive a corresponding key member **42** which is provided on the movable die segment **40**.

The inner face of movable die segment **40** is of such configuration as to provide a portion of the die cavity **60** and when the die assembly is closed, as is shown in Fig. 3, the said movable die segments are intimately engaged along their opposite side faces with the mating side faces of the holding block depression so as to form a complete die cavity.

In addition to being slidably mounted and guided by the keyed interengagement between the die segments **40** and the holding block plate **32**, each movable die segment is additionally provided with a key member **44** which is slidably interengaged with the guide plate **52** fixed to the inclined upper surface of guide block **50**. The guide block **50** is guided in the holding block depression **35** by means of core **80** rigidly mounted in the holding block.

When the parts are in the closed position, as is shown in Fig. 3, the cover die **10** is engaged against the front face of ejector die **20**, thus forming, as the name implies, a cover for the die cavity. Thus, the die cavity **60** is defined or bounded by the inner faces of movable die segments **40**, the inner face of plate **32** or holding block **30**, cover die **10** and core **80**. The cover die is provided with an injection hole **12** through which the molten metal is injected into the die cavity **60**.

The ejector plate **70** is disposed to the rear of holding block **30** and has provided thereon connecting rods **72** projecting through the back plate **34** of the holding block **30** and engaged as by the threaded connection shown to guide block **50**. The ejector plate also has provided thereon ejector pins **74**, projecting through the back plate **34** of the holding block **30**, which eject the casting from the die cavity as the die is moved to the open position.

After the molten metal has been injected and allowed to solidify, with the die parts in the position of Figs. 3

and 5, the ejector die 20 is moved away from the cover die 10 and at this time, the solidified sprue will remain with the casting. The casting cannot, of course, move relative to the ejector die components since it is interlockingly engaged by the compoundly movable segments. After the ejector die has been moved to its open position, as is shown in Fig. 4, the ejector plate 70 is actuated by a hydraulic cylinder or other suitable means (not shown) until the stop pin 76 thereon engages the back surface of the holding block 30. Due to this movement of the ejector plate 70, the connecting rods 72 will move the guide block 50 toward the cover die to the position shown in Figs. 4 and 6 and the ejector pins 74 will at the same time move in the same direction. Simultaneously, the casting 90 will be moved since it is supported during the initial movement by a portion of the movable die segments 40 and during the remainder of the movement by ejector pins 74. At the same time, the movable die segments 40 will have a compound motion with respect to the casting by virtue of the inclinations of the keyways on the inner surface of the holding block depression 35 and on the inner surface of guide block 50. In other words, the movable die segments 40, being moved forward with the guide blocks 50, retreat from the center of the core 80 in the direction determined by their lateral keyways 52 and at the same time they are being moved outwardly from the axis by virtue of the diverging relation of the keyways 38. The resultant motion of the die segments 40 relative to the casting is a composite motion as afforded by the angularity of the two keyway systems. This composite motion not only wtihdraws the segments laterally away from the casting, but moves the segments at an angle to the perpendicular so that the die segments will withdraw from undercuts in the casting, such as are shown at the axial faces of the flanged cylinder used as an example in the drawings. The composite motion effects a simultaneous lateral expansion of the die segments and an axial movement of the die segments with respect to the casting. The axial movement of the casting is greater than the axial component of movement of the die segments because of the downward slope of the keyways 52.

In the particular example shown, the compound motion of the die segments with respect to the casting will be a lateral outward movement and an angularly backward movement, as will be readily apparent. Of course, the particular inclination of the two aforementioned keyway systems will determine the overall relative motion between the die segments 40 and the casting. That is to say, the inclination of the keyway system on the inner surface of holding block depression 35 controls the rate of laterally outward movement of the movable die segment, whereas the inclination of the keyway system on the inner surface of guide block 50 determines the angular rate of withdrawal with respect to the longitudinal axis of the casting, the two motions being interdependent. The inclination of the keyway system 52 on the guide block 50 directs the movement of the die segment 40 with a component perpendicular to the direction of movement of the casting and with a component parallel to the direction of movement of the casting, not merely perpendicular to the direction of such movement, which would not permit a withdrawal of the die segment from an undercut in the casting.

After the casting has been removed from the ejector die, the latter is closed by backward movement of the ejector plate 70. The movements performed in the opening of the die as described above, are now reversed with the guide block 50 and die segments 40 being returned to their original interfitting positions. With the ejector die closed against the cover die 10, the machine is ready to make the next casting.

The compound guided movements of the movable die segments may be arranged to separate the die segments in any desired relative angular direction and with any desired axial movement thereof with respect to the casting, depending upon the particular shape of the casting. Many complex mechanical castings, previously necessitating a complex system of special cores, may be easily produced in accordance with the teachings of this invention.

As previously mentioned, the angular disposition and directions of the keyways is dependent upon the shape and peculiarities of the particular object to be cast and the particular angularity, direction and relative relationship of the keyways shown in the drawings and need not necessarily prevail. Also the number of such movable die segments may vary from one segment, necessary to impart the desired configuration to a portion of the casting, to a multiplicity of such segments which may form, when closed, the entire peripheral configuration of the casting. Broadly speaking, the essence of this invention resides in the compound angular movement of separable die members so as to accommodate for cast shapes having projecting or undercut portions.

Although in the specific illustration shown, the die segments which are restrained to a compound angular movement are a part of the die cavity forming the exterior surface of the casting, it is contemplated that the same principal may be employed to form undercut portions on the interior of the casting. In order to accomplish this, the compoundly movable segments would be keyed to and form a part of the core of the die which imparts the internal configuration to the casting and would move angularly toward the center of the die cavity rather than angularly away from it as the ejector plate is moved toward the ejector die.

In order to avoid a multiplicity of claims and the use of alternatives, the claims are worded and directed as to specifically mention the use of the compoundly movable die segments in the housing portion of the die assembly. By the substitution of the word "core" for "housing" and the idea of movement toward the center of the cavity rather than outwardly therefrom, the claims apply equally as well to the employment of movable die segments in the core portion of the die assembly. It is, therefore, the intent that both conceptions are understood to be included in the following claims.

I claim:

1. A compounded ejection die comprising a die housing portion, at least one movable die portion closely interfitted with the die housing portion and together with said housing portion forming a die cavity, means for ejecting a casting from the die cavity, a guide block resting on the back plate of said housing portion and a cover die fitted over the open end of said die cavity and having a sprue for injection of the molten metal for the casting, an outwardly extending key and keyway between the movable die portion and said guide block for determining the relative direction of retraction of said movable portion from the casting, said key and keyway extending outwardly at an angle other than 90 degrees with respect to the direction in which a casting is ejected, another outwardly and angularly extending key and keyway between the movable portion and said housing portion for determining the extent of such withdrawal upon effecting relative movement of said guide block, and means for effecting such relative movement of said guide block coincidental with ejection of the casting, the direction of retraction of the movable portion being at an angle of less than 90° with respect to the direction of ejection of the casting.

2. A die as defined in claim 1, said means for effecting relative movement of the guide block including an ejector plate having at least one push rod slidably extending through bores in the rear of said housing portion and being fixed at their terminal ends to said guide block, and a plurality of short pins of equal length spaced about said ejector plate between said push rods to provide a

stop for said ejector plate against the rear of said housing portion when said die segments are opened.

3. In a die casting machine, a die assembly including an ejector plate and a cover die and ejector die forming a die cavity, said ejector die comprising a die housing having a recess therein, at least one movable die segment nested within said recess and forming a part of the die cavity, and a guide block fixedly attached to said ejector plate and movable therewith, a first means connected to said die segment for moving it axially outwardly of said recess, a second means slidably mounting the outer edge of said die segment upon an angular surface of said housing whereby said die segment is moved laterally outwardly from said recess as it is moved axially outwardly of the recess, and a third means for ejecting a casting formed within the die cavity axially outwardly from the die cavity, said first means comprising a key member on the die segment slidably engaged with a keyway in said guide block, said key member and keyway extending at an angle other than 90 degrees with respect to the direction of ejection of a casting, said second means comprising a key member on the outer edge of the die segment slidably engaged with a keyway in an angular surface of said housing, said third means comprising ejector pins movable by said ejector plate such that a constant relationship is maintained between the ejector pins and the guide block, said first, second and third means cooperating to cause the movable die segment to be withdrawn from the casting at an angle of less than 90° to the direction of ejection of the casting from the die.

4. In a die casting machine, a core, a plurality of movable die segments cooperating with said core to define a die cavity, ejector plate means both for lineally moving a casting off said core and for imparting motion to said die segments, and guide means for directing the movement of said die segments away from said core in a direction having a component parallel to the direction of movement of the casting and a component perpendicular to the direction of movement of the casting, the magnitude of the former component being less than the magnitude of the movement of the casting and more than any magnitude of movement of said core.

5. In a die casting machine, a core, a plurality of movable die segments cooperating with said core to define a die cavity, a holding block surrounding said movable segments, a guide block for each of said movable segments, means for lineally moving a casting off said core, means for moving said guide blocks parallel to the direction of movement of the casting, first guide means associated with said die segments and said holding block for guiding said die segments in a diverging direction with respect to the direction of movement of the casting, and second guide means associated with said die segments and said guide blocks, said second guide means being formed to guide said die segments in a direction having a component perpendicular to the direction of movement of the casting and a component parallel to the direction of movement of the casting.

6. In a die casting machine, a core, a plurality of movable die segments cooperating with said core to define a die cavity, a holding block surrounding said movable segments, a guide block for each of said movable segments, means for lineally moving a casting off said core, means for moving said guide blocks parallel to the direction of movement of the casting, first guide means associated with said die segments and said holding block for guiding said die segments in a diverging direction with respect to the direction of movement of the casting, and second guide means associated with said die segments and said guide blocks, said second guide means being formed to guide said die segments in a direction having a component perpendicular to the direction of movement of the casting and a component opposite to the direction of movement of the casting.

7. In a die casting machine, a plurality of movable die segments at least partially defining a die cavity, a holding block surrounding said movable segments, a guide block for each of said movable segments, means for lineally moving a casting away from the die cavity, means for moving said guide blocks parallel to the direction of movement of the casting, first guide means associated with said die segments and said holding block for guiding said die segments in a diverging direction with respect to the direction of movement of the casting, and second guide means associated with said die segments and said guide blocks, said second guide means being formed to guide said die segments in a direction having a component perpendicular to the direction of movement of the casting and a component opposite to the direction of movement of the casting.

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