

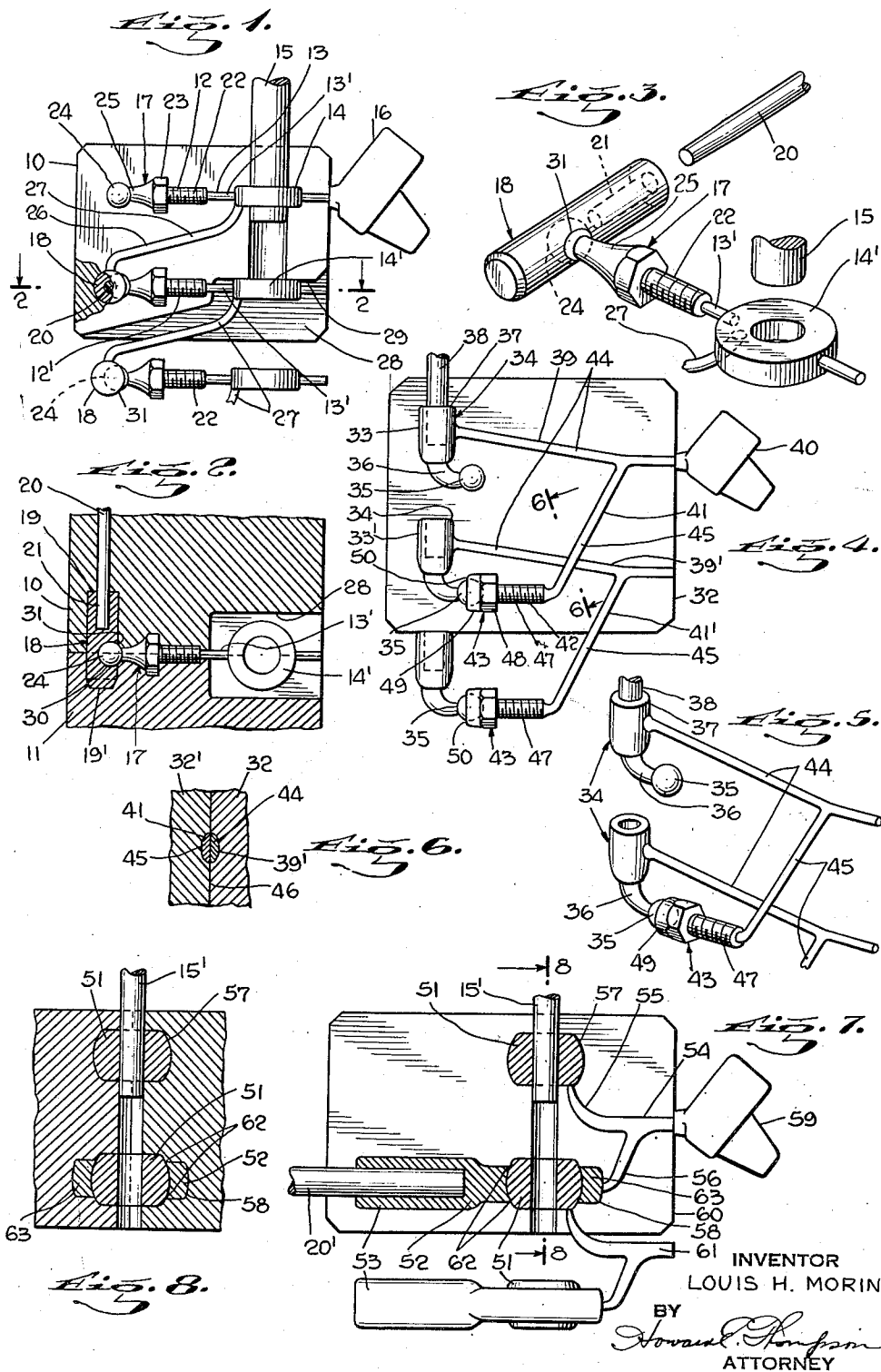
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METHOD OF CASTING JOINED BALL AND SOCKET PARTS

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METHOD OF CASTING JOINED BALL AND SOCKET PARTS

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This invention relates to the formation of parts or members which are united or joined to form what is commonly referred to as a ball and socket coupling or joint. More particularly, my invention deals with a method of producing articles of manufacture of this type and kind wherein the ball and socket parts are cast one in engagement with the other in a pair of dies as more fully hereinafter set forth.

Still more particularly, the invention deals with a method of producing products of the kind under consideration wherein one part of the product is shaped around a core pin, and further, wherein a crossed gate or sprue construction is employed in the casting of the ball and socket product parts.

The novel features of the invention will be best understood from the following description, when taken together with the accompanying drawing, in which certain embodiments of the invention are disclosed and, in which, the separate parts are designated by suitable reference characters in each of the views and, in which:

Fig. 1 is a diagrammatic face view of one die illustrating the method of casting a united pair of ball and socket parts with part of the construction broken away and illustrating three stages of the casting operation.

Fig. 2 is a section on the line 2—2 of Fig. 1.

Fig. 3 is a schematic, perspective view showing the united portions of the casting and illustrating the core pins employed, parts being shown detached with respect to the die structure.

Fig. 4 is a view similar to Fig. 1 showing the formation of a different type of interconnected assemblage.

Fig. 5 is a perspective view of the first and second stages in forming the interconnected product of Fig. 4 illustrating the gate arrangement.

Fig. 6 is a partial section on the line 6—6 of Fig. 4.

Fig. 7 is a view similar to Figs. 1 and 4 showing another modification; and

Fig. 8 is a section on the line 8—8 of Fig. 7.

In the production of united or interconnected products, it is known in the art to first form the outer part or member of the product and to then cast in a socket portion of said outer part a second or inner part, so as to rely upon the shrinkage of the metal of the second part to provide a free clearance of this part for movement in the socket of the first part. Under normal conditions, the shrinkage would tend to firmly unite the outer or socket part on the inner part if the socket part were cast directly upon the inner part. However, I have found that it is possible to cast a socket part on an inner part so that the inner part is free to move within the socket part and, in fact, will provide a very close and yet free movement of the inner part within the socket part.

In illustrating adaptations and use of this method, I have illustrated in the accompanying drawings a ball and socket assemblage wherein the socket part has a preferable minimum of holding engagement with the ball or cylindrical part so that the ball or cylindrical part is

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free to move within the socket part in producing devices generally referred to as ball and socket couplings.

In Figs. 1 to 3 inclusive, I have illustrated one adaptation of my invention, and in Fig. 2 of the drawing at 10 and 11 is illustrated a sectional view through a pair of dies adjacent the parting line thereof, the section being on the line 2—2 of Fig. 1 in which latter figure a face view of the die 10 is shown. As the die cavities are substantially identical on both dies, the cavities as appearing on the face of the die 10 only will be described. The upper portion of the die 10 has a cavity 12 into which opens a sprue passage 13, the sprue passage having an enlarged ring forming area 14 into which extends a core and feed pin 15. At 16, I have diagrammatically illustrated a discharge nozzle of a goose neck or other discharge of molten or melted material for injection of the material into the cavity 12 through the sprue 13.

The cavity 12 is so shaped as to form the ball part 17 of the resulting diecast product, the socket part being indicated at 18 and being formed by a cavity 19 in the die 10 and an associate cavity 19' in the die 11, note Fig. 2. Cavity 19' has been specifically mentioned as it is shaped to form one end of the socket form 18 and differs from the cavity 19 in that the latter is longer. Further, a core pin 20 is arranged in the die 10 and adapted to form a recess or bore 21 in the end of the socket part 18.

Returning now to the ball part 17 as noted in Fig. 1, this part comprises a threaded end 22, a central hexagon nut portion 23, a ball end 24 joining the nut 23 in a reduced and relatively long neck portion 25.

It will also be noted that the die 10 has a sprue passage 26 which extends from the ring portion 14 of sprue 13 to the cavity 19, 19', thus forming on the resulting casting a gate 27 which joins the pairs of united parts as they are produced in successive steps of operation of the casting machine as will be later described.

It will appear from a consideration of Fig. 1 of the drawing that the lower portion of the dies are recessed as shown at 28 to receive the united units and to form a stripper wall 29 for stripping the core and feed pin 15 from the cast ring portion 14' when the first casting cycle. It will also be apparent that part of the sprue 13 forms a gate 13' which joins the ring 14' with the threaded or screw end 22 of the ball part 17. In initially starting operation of the machine, a slug of any type or kind can be arranged in the cavities 19, 19' and a single operation of the machine performed which will result in producing the ball part 17 and the extended gate 27, this casting being formed on the pin 15 when in its raised position as noted in Fig. 1. Then the dies can be opened and the slug removed, the dies again closed and the machine can be put into continued operation. The next step in the cycle of operation would be to move the first cast ball part 17 into position with the ball end 24 extending partially into the cavity 19, 19', as clearly noted in Fig. 2 of the drawing, after which the dies are partially closed and the pin 15 is stripped from the ring 14' and returned to its raised position, as noted in Fig. 1, whereupon the dies will move into a fully closed position and the next casting operation will be performed which will result in forming another ball member 17 while at the same time the socket member 18 will be formed around the ball end 24 of the first cast ball member 17. This last operation results in producing a socket 30 in the part 18 around the ball 24 with an annulus 31 slightly overlying the large diameter portion of the ball 24, thus minimizing the holding engagement between the parts and facilitating free movement of the ball 24 within the socket 30 after being subjected to a

slight stress or strain in producing the universal joint movement. It will be understood that the lower portion of the dies have an impression or cavity at 12' to receive the ball part 17 and would also be recessed to receive the gate 13' as clearly shown. The next operation is a repetition of the operation last above described insofar as bringing the second cast ball member 17 into the socket 12', and in this last operation, the first united product is moved into the position shown below the dies in Fig. 1, and at this position or at a position closely adjacent the dies, the gates 13' and 27 can be severed from parts 22 and 18 to produce the resulting and completely formed united product, the gates being remelted for further use. In this connection, it will be understood that the ring 14 is used primarily as a means for conveying the first united product to the second stage by the pin 15. It will also be apparent that the core pin 20 is retracted or moved into position clearing the socket 18 prior to shifting the united assemblage from the second stage to the third or projected stage, as noted in Fig. 1 of the drawing. It will also be clear from a consideration of Figs. 1 and 2 of the drawing that the ball end 24 is offset with respect to the axis of the socket part 18 to minimize the engaging area of the socket to facilitate freeing the parts for relative movement.

In Figs. 4 and 5 of the drawing, I have shown another adaptation of my invention wherein the united product is formed in the same general arrangement and the transfer pin 15 is dispensed with, and a core pin is utilized to convey the first casting to the second casting stage. In this showing, the description will be briefed in simply defining the parts of the united product and the structure essential to the formation thereof. In Fig. 4, I have shown at 32 a face view of one of a pair of dies having cavities 33, 33' for formation and reception of a ball part 34 having a ball end 35, curved neck 36, and a socket end 37, the socket end being formed by a core and transfer pin 38. At 39 is shown a sprue into which a molding material or molten metal is pressure-injected from a nozzle 40, the sprue having a downwardly extending branch 41 which opens into a socket cavity 42 for forming a socket part 43. In the structure shown in Fig. 4 the gate 44 formed by the sprue 39 is disposed in the surface of one die only, namely, the die 32 which is illustrated in Fig. 1. Thus, the gate 44 would be generally of the cross-section shown at the right of Fig. 6 of the drawing, whereas the gate 45 formed by the sprue 41 is in the surface of the companion die 32', note Fig. 6. Thus, the flat surfaces of the gates 44, 45 are disposed on the parting line 46 of the dies and will cross each other in the manner illustrated clearly in Fig. 4 of the drawing.

The socket part 43 comprises a screw end 47, a hexagon nut portion 48 and a socket end 49 which partially encircles the ball 35. It will be sufficient to say that after the ball part 34 has been formed on the pin 38, the dies are opened and the ball part is moved downwardly into registering position with the cavity 33', the dies are partially closed, the pin 38 stripped from the part 34 and returned to the position shown in Fig. 4 after which the dies are completely closed. In the second casting operation, the socket part 43 is cast around the ball end 35 of the part 34 and then as the operation continues, the united product is moved to the position below the dies, and at such position or at a position closely adjacent thereto, the gate 45 is severed from the end of the screw 47, thus resulting in the completion of the formation of the united ball and socket parts 34, 43.

It will be understood that when the ball part is moved into the lowered position preparatory to forming the socket part 43 thereon, the gate 44 is positioned in a supplemental sprue 39', whereas the gate 45 is positioned in a passage 41'. With the construction shown in Figs. 4 and 5 of the drawing, it will be understood that the socket

portion 49 of the socket part 43 will have an annular wall portion as at 50 which is relatively thin and extends beyond the largest diameter of the ball 35 a slight degree so as to facilitate the free action of the parts one upon the other.

In Figs. 7 and 8 of the drawing, I have illustrated another adaptation of the invention wherein two pins 15', 20', generally similar to the pins 15, 20 of Fig. 1, are employed with the exception that a ball part 51 in the form of a ring-like body is formed directly on the pin 15' and conveyed by said pin to the second stage in which a socket part 52 is cast around the part 51, the part 52 including a long sleeve portion 53 formed by the core pin 20'. In Fig. 7, it will be noted that a single sprue 54 is used having branches 55 and 56 which lead to the cavity 57 for forming the ball part 51, and to the cavity 58 for forming the socket part 52. The injection nozzle for introducing the molten material is diagrammatically illustrated at 59. The steps of forming the product of Figs. 7 and 8 are generally similar in steps shown in connection with the method as disclosed in Figs. 1 to 5, inclusive. In other words, the ball part 51 is moved into the registering position with the cavity 58, the core pin 15' stripped therefrom and returned to its raised position, after which the socket 52 is cast, the core pin 20' is then stripped from 52 and finally the resulting product is positioned below the die, one portion of which is indicated at 60, and at this stage or at a point closely adjacent thereto, the gate 61 will be trimmed from the product in a trimming operation. It will also appear from a consideration of Fig. 7 of the drawing that the annular holding portions 62 of the socket part 52 are slight, and a little stress or strain of the parts will result in freeing the ball part for movement within the socket part 52. It will clearly appear from a consideration of Fig. 8 of the drawing that the portion 63 which envelopes the ball part 51 is substantially in the form of an annulus or ring. From the standpoint of description, the relatively movable united or interconnected parts may be said to comprise an inner part having rounded surfaces substantiating a ball or sphere-like member and an outer socket part which is cast around the inner part or the portion thereof having the rounded exterior surfaces.

In the foregoing, applicant has, by way of illustration, referred to the use of a slug or blocking member of some kind in one cavity of the die in forming the casting in the first cavity. In actual practice however solidification of the metal will take place so as to avoid the necessity of using such slugs, and while the first casting may be somewhat irregular, this can be remelted as are the trimmed gate portions.

As described, it is preferred that the internal socket area utilized to engage the ball shall be minimized. This socket holding area, as will be appreciated, must always be in excess of one-half of the area of the ball, in order that the socket will retain the ball; the excess area is preferably minimized, although it is capable of variation. Generally speaking, the socket holding area may vary from a value slightly in excess of one-half the ball area to a value substantially greater than one-half the ball area but short of the entire area of the ball.

As also described, upon subjecting any pair of the above described interconnected diecastings to a slight stress or strain, each casting of a pair becomes movable relatively to the other casting. The stress or strain may be applied manually by holding one casting and moving the other, using sufficient force to break the seizure that has developed between the two castings. The force required is small and its application is easily effected. The fact that the seizure or shrinkage effect can be overcome in this way is due to the spherical surfaces on the castings involved. A factor opposing the shrinkage effect is the small temperature difference between a previously cast ball part and the socket part that is cast over this ball part.

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These two parts are cast at such a high speed that their temperatures, from the standpoint of the results obtained, may be regarded to be substantially the same. As indicative of the casting speed, it may be stated that the socket part is cast in a fraction of a second after the ball part is cast. The two parts cool at the same rate, and they reach the final stage of cooling at substantially the same time having substantially the same temperature. In consequence, while there may be some shrinkage of the socket part on the ball part, it is not a serious factor and, as shown, it is quite easily taken into account and its effect permanently eliminated.

Still another but less significant factor for overcoming the effect of shrinkage is the relative thinness of the wall of the socket part at or adjacent the mouth or entrance of the socket, such as that portion of the wall indicated at 50 in Fig. 4 or at 62 in Fig. 7. The socket wall at this position, during the application of the above described stress or strain, tends to be very slightly bent away from the ball, thus aiding in making the parts relatively movable. Relatively thin socket walls at the point in question are normally obtained, and are present in the illustrated articles; with thicker socket walls the applied stress or strain force may be required to be somewhat greater than with the thinner walls.

In all cases the ball part or ball part casting is cast on or around a core or pin. In Figs. 1 to 6 a portion of the ball part casting is cast around the core or pin; the portion in Figs. 1 to 3 is a non-product portion of the casting, since ring 14 is subsequently separated from the remainder of the ball part product, whereas the portion in Figs. 4 to 6 is a product portion of the casting. In Figs. 7 and 8 the ball itself of the ball part casting is cast around the core or pin.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. Method of forming a ball and socket joint composed of a pair of relatively movable, interconnected ball and socket portions each having spherical surfaces which comprises forming a ball portion in one cavity of a pair of relatively movable dies by injecting heated casting material to said cavity, moving said ball portion, while in a heated state owing to formation of the same from said heated casting material, to another cavity in said dies spaced from the first cavity, injecting heated casting material to the second cavity to form a socket portion around said heated ball portion while maintaining the temperature of the ball portion at a level approximating that of said socket portion, said socket portion enclosing an area of the ball portion varying from slightly in excess of one-half to substantially greater than one-half of the area of the ball portion but less than the entire area of said ball portion, and allowing said interconnected ball and socket portions to cool to room temperature by natural cooling.

2. Method of forming ball and socket joints composed of a pair of relatively movable, interconnected ball and socket portions each having spherical surfaces which comprises forming a ball portion on a transfer rod in a first cavity of a pair of relatively movable dies by injecting heated casting material to said cavity, opening the dies, moving the rod having the ball portion thereon to position said ball portion in a second cavity of the dies spaced from the first cavity, said ball portion being in a heated state owing to formation of the same from said heated casting material, stripping the rod from the ball portion and returning said rod to its original position, then with the dies closed injecting heated casting material to the second cavity to form a socket portion about said heated ball portion while maintaining the temperature of the ball portion at a level approximating that of said socket portion, casting about the transfer rod in the first cavity a second ball portion connected to the socket portion by a gate coincidently with the casting of the socket portion in the second cavity, opening the dies, 75

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moving the interconnected ball portion and socket portion out of the second cavity and at the same time moving the transfer rod and second ball portion to position the latter in the second cavity, cooling said interconnected ball and socket portions at the same rate so that they reach a final stage of cooling at substantially the same time having substantially the same temperature, and continuing to cast a socket portion in the second cavity interconnected with the ball portion therein coincidently with the casting of a ball portion in the first cavity, as described.

3. The method of forming interconnected relatively movable parts which comprises forming in a cavity of a pair of relatively movable dies and at an elevated temperature an inner part having rounded exterior surfaces, forming said part on a pin, then separating the dies and shifting said formed part while in heated condition by said pin to a second cavity of the same dies, then stripping the pin from the first casting and returning the pin to its initial position preparatory to receiving another cast inner part, then closing the dies and forming a second inner part in said first named cavity and simultaneously forming an outer part around said heated first inner part while maintaining the temperature of said first inner part close to that of the outer part, thereby forming a pair of interconnected parts, said outer part enclosing an area of the rounded surfaces of the first inner part which varies from slightly in excess of one-half to substantially greater than one-half, but less than all, of the area of said rounded surfaces, joining the second inner part with the outer part by a gate portion in said last-mentioned forming step, then shifting the second inner part to the second cavity of the die and projecting said pair of interconnected parts beyond the dies, and cooling said interconnected parts at the same rate so that they reach a final stage of cooling at substantially the same time having substantially the same temperature.

4. A high speed method of continuously forming ball and socket joints each comprising a relatively movable interconnected ball portion and socket portion each having spherical surfaces, which comprises forming on a transfer rod in a first cavity of a pair of relatively movable dies an inner part having a ball portion by injecting heated casting material to said cavity, opening the dies, moving the rod and said inner part to position said ball portion while in heated condition in a second cavity of the dies spaced from the first cavity, stripping the rod from the inner part and returning said rod to its original position, then with the dies closed injecting heated casting material to the dies to form in the second cavity an outer part of the same material as the inner part and having a socket portion around said heated ball portion, the temperature of the ball portion approximating that of the newly formed socket portion prior to and during said last-mentioned injecting step, said socket portion enclosing not substantially more than one-half the area of the ball portion and having an entrance defined by relatively thin walls, forming on the transfer rod in the first cavity a second inner part connected to the outer part by a gate coincidently with the forming of the outer part in the second cavity, opening the dies, moving the interconnected ball and socket portions out of the second cavity and at the same time moving the second inner part into the second cavity by moving said rod, cooling said interconnected ball and socket portions at the same rate so that they reach a final stage of cooling at substantially the same time having substantially the same temperature, continuing to form an outer part in the second cavity interconnected with the inner part therein coincidently with the forming of an inner part in the first cavity, as described, to continuously produce interconnected ball and socket portions, and moving one of said portions of each pair relatively to the other by exerting slight force to produce said relatively movable ball and socket joint.

5. A high speed method of continuously forming ball and socket joints each comprising a relatively movable interconnected ball portion and socket portion each having rounded surfaces, which comprises forming on a transfer rod in a first cavity of a pair of relatively movable dies an inner part having a ball portion by injecting heated casting material to said cavity, opening the dies, moving the rod and said inner part to position said ball portion while in heated condition in a second cavity of the dies spaced from the first cavity, stripping the rod from the inner part and returning said rod to its original position, then with the dies closed injecting heated casting material to the dies to form in the second cavity an outer part of the same material as the inner part and having a socket portion around said heated ball portion, maintaining the temperature of the ball portion at a level approximating that of the newly formed socket portion during said last-mentioned injecting step to oppose a tendency of the socket portion to shrink about the ball portion, said socket portion enclosing just more than one-half the area of the ball portion and retaining the ball portion therein, forming on the transfer rod in the first cavity a second inner part connected to the outer part by a gate coincidently with the forming of the outer part in the second cavity, opening the dies, moving the interconnected ball and socket portions out of the second cavity and at the same time moving the second inner part into the second cavity by moving said rod, cooling said interconnected ball and socket portions at the same rate so that they reach a final stage of cooling at substantially the same time having substantially the same temperature, and recovering said interconnected ball and socket portions.

6. Method according to claim 5 in which the outer part is cast on a movable core pin.

7. Method according to claim 6 in which the core pin is movable in a direction normal to a plane passing through the parting line of the dies.

8. Method according to claim 6 in which the core pin is movable in a direction parallel to a plane passing through the parting line of the dies.

9. Method according to claim 5 in which the ball portion is formed with a bore therethrough, the socket portion is formed with a bore therethrough, the socket portion is formed with a pair of opposed openings, and the ball portion extends through each said opening.

10. Method according to claim 5 in which one of said inner and outer parts is formed with a threaded portion.

11. Method of forming a ball and socket joint comprising relatively movable interconnected ball and socket portions each having rounded surfaces which comprises forming a ball portion in one cavity of a pair of rela-

tively movable dies by injecting heated casting material to said cavity, moving said ball portion, while in a heated state owing to formation of the same from said heated casting material, to a second cavity in said dies spaced from the first cavity, injecting heated casting material to the second cavity to form a socket portion around said heated ball portion, maintaining the temperature of the ball portion at a level approximating that of the newly formed socket portion during said last-mentioned injecting step to oppose a tendency of the socket portion to shrink about the ball portion, said socket portion being of the same material as the ball portion and enclosing just more than one-half the area of the ball portion, removing the interconnected ball and socket portions from the dies, and allowing said interconnected ball and socket portions to cool to room temperature by natural cooling.

12. Method of producing a pair of relatively movable interconnected inner and outer parts which comprises forming an inner part having a heated rounded portion in a cavity of a pair of relatively movable dies by injecting molten casting material to said cavity, moving said inner part and heated rounded portion while at an elevated temperature to a second cavity in said dies, injecting molten casting material to the second cavity to form an outer part having a socket portion around the heated rounded portion of the inner part while maintaining the temperature of the rounded portion at a level approximating that of the newly formed socket portion to oppose a tendency of the socket portion to shrink about the rounded portion, said socket portion being of the same material as the rounded portion and having internal surfaces complementing the external surfaces of the rounded portion, said socket portion enclosing an area of the rounded portion varying from slightly in excess of one-half to substantially greater than one-half of the area of the rounded portion but less than the entire area of said rounded portion, removing said interconnected parts from the dies, and allowing said interconnected parts to cool to room temperature by natural cooling.

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