

Dec. 27, 1960

H. H. GRAY
MACHINE FOR SHEARING RAILS INTO SMALL PIECES
FOR USE IN A FORGING MACHINE

2,966,087

Filed May 3, 1954

3 Sheets-Sheet 1

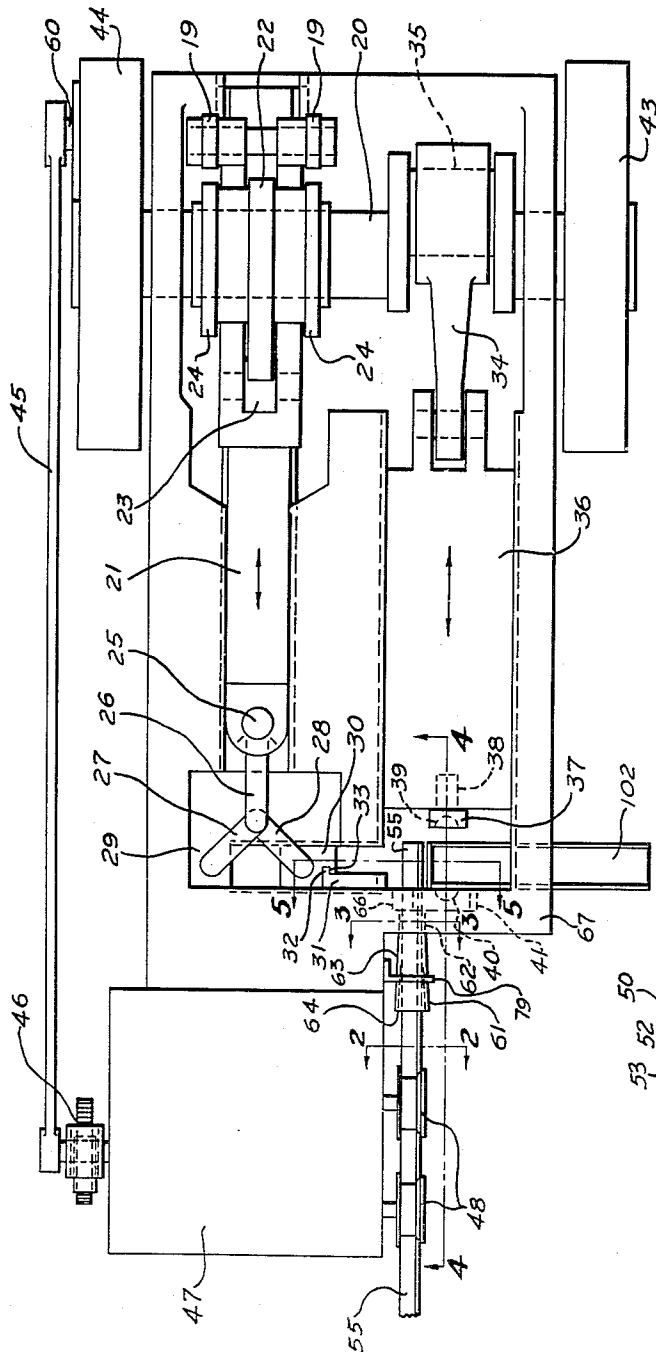


Fig. 1

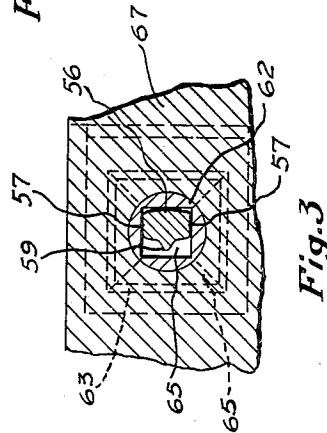


Fig. 3

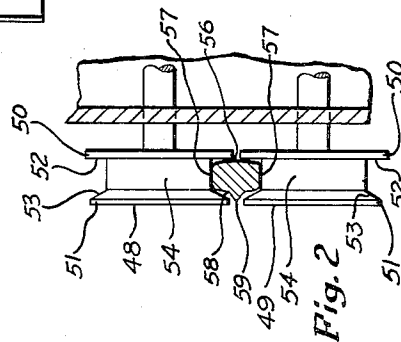


Fig. 2

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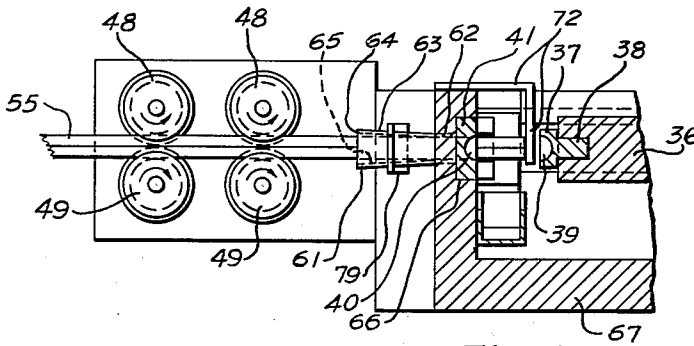


Fig. 4

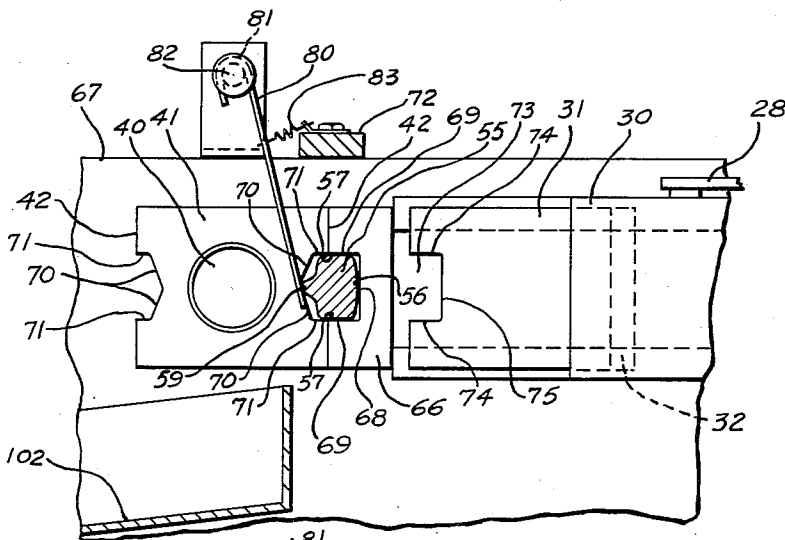


Fig. 5

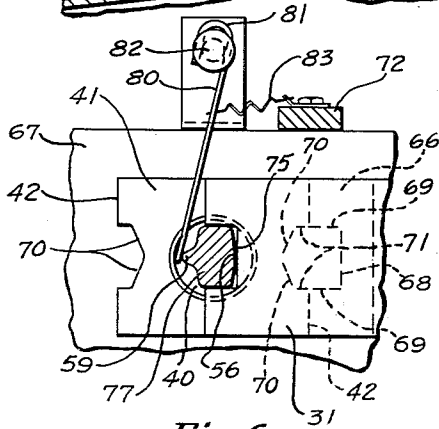


Fig. 6

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MACHINE FOR SHEARING RAILS INTO SMALL PIECES FOR USE IN A FORGING MACHINE

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2 Claims. (Cl. 83—247)

My invention relates to grinding ball making machines and methods, and more particularly to a method of making grinding balls from the heads of split railroad rails.

In splitting a railroad rail it is ordinarily divided into a head section, a web section and a base or flange section.

It is the principal purpose of my invention to provide a new and improved method and apparatus for making grinding balls from the head portions of such split railroad rails. Said head portions comprise the head of the rail and a small portion of the web projecting from one side thereof, which cannot be removed by the splitting process. As a result, the head of the rail that has been split and is available for the carrying out of my improved method, has a top wearing surface which was the top surface of the railroad rail, that approaches flatness, a pair of side surfaces that are substantially parallel and flat, and a surface opposite the top wearing surface of the rail, which has a longitudinal projection in the form of a rib thereon, that is a short stub of the web portion that is incapable of removability by ordinary splitting methods. It will be obvious that the use of such material for making such objects as grinding balls, which are symmetrical about the axis or center thereof, involves special problems due to the peculiar cross sectional character of the raw material from which the balls are to be made, as it is unsymmetrical.

In making grinding balls by my improved method, the balls are formed by a forging operation between a pair of dies, one of which moves toward the other thereof, said dies each having a concavely curved cavity therein whereby spheroidal portions are formed on the blank. In a machine of this character it is common practice to feed the material from which the blank is to be cut to the machine longitudinally of the material, the material being ordinarily a rod that is round in cross section, cutting off a blank of a predetermined length and then moving it transversely of the direction in which it was previously moved into cooperative relation with the forming dies. A machine of this same general type is utilized in carrying out my improved method. In order to accomplish the proper formation of a ball by such a machine, it is necessary that the blank be properly located relative to the forming dies. In order that this can be accomplished it is necessary that the blank have a predetermined definite relation to the means that moves the blank into this position. In a machine of this character this means is one of the shearing dies.

It is an important purpose of my invention to provide means for feeding a blank that is unsymmetrical about its longitudinal axis, such as the head of a split railroad rail, to its proper position with respect to a shearing die that forwards it and locates it relative to forming dies in such a manner that the rail head, or member of similar cross section, will not turn about its longitudinal axis during either the feeding, shearing or forwarding movements of the material and the blank that is cut off therefrom. In order to accomplish this purpose I provide new

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and improved feed rollers that are so constructed and arranged that the rail head or similar member will not turn about its longitudinal axis during the feeding movements of said feed rollers, and to further provide means for guiding the rail head toward the shearing dies, that also prevents any such rotation of said rail head about said axis.

It is a further important purpose of my invention to provide a movable shearing die that is of such a character that a flat face thereon will engage with the top or wearing surface of the rail, and that is further of such a character that the blank cut off will remain in the same position relative to said flat face throughout the forwarding movement of the shearing die in moving the blank cut off from the position at which the shearing takes place to the position in which it must be placed for proper engagement with the forming dies. While the material of the blank is of unsymmetrical cross section, the center of mass of the cross section must be located properly relative to the axial center line of the forming dies in order that the spheroidal members resulting from the forming operation are properly formed so that these spheroidal members can be made into a ball of a satisfactory character for use as a grinding ball.

My method more specifically comprises the shearing of an elongated blank from a rail head, said blank having a longitudinal rib on one longitudinal face thereof, forging a spheroidal member therefrom by forming a pair of partially spherical portions on opposite ends of said blank that are axially spaced from each other by a fin that is at the equatorial portion of the spheroidal member, and rolling the resulting spheroidal member between a moving and stationary transversely concave surface to roll the fin portions into the ball. The equatorial fin, due to the character of the blank, will have interruptions therein, as does also the spheroidal surface in that there are slight shallows or grooves therein at the interruptions. The invention has for its purpose the forming of such a spheroidal product of this character that it can be rolled in the above referred to manner so that the excess material forming the fin will be rolled into the depressions in the spheroidal surface to form a substantially spherical member from the spheroidal one. In order to do this it has been found desirable to have the forming dies at their final position spaced sufficiently from each other that there will not be too thin and wide a fin projecting at the equatorial portion, even should this result in some small flats that would remain in the spheroidal member at the polar portions thereof, the rolling into a ball being more readily accomplished under the above referred to conditions than if a more complete hemisphere is formed at each end of the blank and a relatively thin, wide fin provided between the two hemispherical portions.

Other objects and advantages of my invention will appear as the description of the drawings proceeds. I desire to have it understood, however, that I do not intend to limit myself to the particular details shown or described, except as defined by the claims.

Fig. 1 is a plan view of a ball making machine to which my invention has been applied, certain parts being omitted to more clearly show the structure below the same.

Fig. 2 is a section taken on the line 2—2 of Fig. 1 on an enlarged scale.

Fig. 3 is a similar section taken on the line 3—3 of Fig. 1.

Fig. 4 is a fragmentary section taken on the line 4—4 of Fig. 1.

Fig. 5 is a fragmentary view partly in section and partly in elevation, taken on the line 5—5 of Fig. 1.

Fig. 6 is a fragmentary view similar to Fig. 5, showing a different position of the parts.

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Fig. 7 is a view partly in section and partly in elevation diagrammatically showing the forming dies in their final position, with a spheroidal member in position between the same.

Fig. 8 is a side elevational view of a ball rolling apparatus used in the carrying out of my method.

Fig. 9 is an enlarged diagrammatic sectional view through the ball rolling members shown in Fig. 8.

Fig. 10 is a perspective view of the blank after it has been cut from the rail head.

Fig. 11 is a perspective view of a spheroidal member resulting from the die shaping operation, and

Fig. 12 is an elevational view of the ball formed from the spheroidal member shown in Fig. 11.

Referring in detail to the drawings, in Fig. 1 is shown the general type of ball forging machine to which my invention is applied, said machine having a shaft 20 that is provided with suitable means for reciprocating a slide that comprises the bar-like member 21, said slide being provided with suitable means for guiding the same for straight line reciprocating movement in the frame of the machine. The means for reciprocating the member 21 comprises a cam 22 that cooperates with a roller 23 to move the slide comprising the member 21 to the left as shown in Fig. 1, and cams 24 engaging rollers 19 for moving the slide in the opposite direction. Any suitable means for reciprocating the slide comprising the member 21 in properly timed relation may be provided, the structure illustrated being merely one conventional type utilized for this purpose. Pivotally connected with the slide to swing about the pivot member 25 is a link 26, which is connected with a pair of toggle links 27 and 28, the link 27 being pivoted at a fixed point to a portion 29 of the frame of the machine, and the link 28 being pivoted to a slide 30 that is mounted in suitable guideways for straight line movement transversely of the direction of movement of the slide having the bar 21 as a portion thereof. Mounted on the slide 30 so as to move therewith is the movable shear blade 31, said shear blade having a fixed position relative to the slide because of the projection 32 thereon mounted in a notch or recess 33 in said slide.

The reciprocation of the slide 30 is between a position such that the shear blade 31 has the position shown in Figs. 1 and 5 and a position in which the shear blade has the position shown in Fig. 6, the position of the shear blade shown in Fig. 6 being that which it has when the blank has been moved into proper position for the forming operation by the forming dies to be performed thereon.

The shaft 20 has a crank 34 mounted on an offset portion 35 thereof for reciprocating a slide 36 mounted for straight line reciprocating movement in the frame of the machine in any suitable manner. Suitable means is provided for mounting the forming die 37 in said slide 36, said die 37 being shown as having a reduced body portion 38 mounted in a recess in the slide 36 and being fixed on said slide 36 in any suitable manner. Said die 37 is provided with a partly spherical recess 38 therein, which cooperates with a similar recess 40 in the stationary forming die 41 to perform the forging operation when the die 37 is moved into cooperative relation with the die 41 by the movement of the slide 36 in a well known manner. The die member 41 is in the form of a block that is mounted in a suitable recess in the frame of the machine.

The block 41 is provided with shear blade portions at the ends 42 thereof, the recess 40 in the block 41 aligning axially with the recess 39 in the movable die member 37, so that said die members will properly cooperate to form the spherical portions on the blank when the die 37 is moved toward the block 41 and into its position in proximity thereto, the spacing of said dies being determined by the adjustment of the machine so

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as to obtain the desired shape for the spheroidal member that it can be made into a ball by a rolling operation.

Mounted on the shaft 20 are the flywheels 43 and 44, the flywheel 44 having a rod 45 pivotally connected therewith at 60, thus serving as a means for oscillating the rod 45. Said rod 45 serves as means for operating a one-way driving connection 46 provided on the ball forging machine for driving the feed rollers, to be described below, so as to rotate the same intermittently in the direction indicated by the arrows thereon in Fig. 4, through a predetermined amount of rotary movement with each oscillation of said rod 45. Two pairs of said feed rollers are shown as being mounted on the machine, suitable means being provided within the housing 47 for rotating the rollers in synchronism in the direction indicated by the arrows thereon.

Each pair of rollers comprises an upper roller 48 and a lower roller 49 and each of the rollers 48 and 49 is constructed in the same manner. Accordingly the same reference numerals are applied to corresponding parts of both the rollers 48 and the rollers 49. Referring to Fig. 2, it will be noted that each of the rollers 48 and 49 is provided with a pair of flanges, the flange 50 being taller than the flange 51, and said flanges 50 having the peripheral portions thereof closely adjacent when said rollers are in proper cooperative relation. The flanges 50 have their inner faces 52 extending perpendicularly to the axis of the rollers, while the inner faces 53 of the flanges 51 are inclined so that these diverge from the flanges 50 in an outward direction from the main body portion 54 of the roller. Said main body portion is cylindrical in character.

It will be noted that the rail head 55 will be moved from left to right as viewed in Fig. 1 by means of the rollers 48 and 49 into a guide tube 61, which will be described below.

Referring to Figs. 2, 3 and 10, it will be noted that the head portion split off the rail, or rail head, has a substantially flat, wide surface 56 that was the top wearing surface of the rail, and substantially parallel flat side faces 57 and an irregular face 58, which results from the web portion of the rail being split or cut off from the head portion, leaving a longitudinal projection or rib 59 on that side of the rail head. The rollers 48 and 49, due to the shape thereof, serve to feed the rail head properly into the machine so that there will be no turning thereof about its longitudinal axis during said feeding movement, the top side of the rail 56 remaining next to the flanges 50, and the rib portion 59 being positioned between the peripheries of the flanges 51.

The guide tube 61 has a circular end portion 62 that is mounted in a suitable opening in the frame of the machine, and has a gradually flaring portion 63 that is square in cross section, the largest end thereof being at the inlet end 64 of said guide tube. Said guide tube is mounted also on a bracket 79 on the machine, which engages the square cross sectional portion 63 of said guide tube. Said guide tube has a bore 65 therethrough that is square in cross section, as will be evident from Fig. 3, and which flares or widens toward the end 64 thereof, as will be evident from Fig. 4. Said guide tube 61 extends to a block 66 mounted in a suitable recess in the frame portion 67.

The block 66 is provided with an opening therein that has a flat vertical face 68 and a pair of parallel top and bottom faces 69, which are adapted to guide the rail head 55 into proper position for engagement with the shear blades that cooperate to cut off the blank or slug that is to be made into the spheroidal member in the machine. This guiding is accomplished due to engagement of the faces 56 and 57 with the walls 68 and 69 of the block 66. The block 41 is mounted in the machine adjacent the block 66, as will be evident from Figs. 1 and 5, and is provided with stationary shear blade portions 70, which are provided at both ends of the block

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41, said block being reversible end for end to use either of said shear blade portions. Said shear blade portions 70 are provided in recesses in the block 41 and lie inwardly toward the recess 40 from the ends of the block, short wall portions 71 being provided on said recesses that align with the wall portions 69 of the block 66.

The feeding movements of the feed rollers 48 and 49 will advance the rail head 55 a predetermined distance for each feeding movement of said rollers. In order to assure that the proper length of rail head 55 is presented to the forming dies in the form of a blank or slug for forging into a spheroidal member, a stop 72 is provided for limiting movement toward the right of the rail head 55 due to the feeding action of the rollers 48 and 49, said stop being adjustable as is customary in machines of this character. The movable shear blade 31 has a recess 73 in the forward face thereof that has top and bottom walls 74 that are parallel to each other and align with the walls 69, and a transverse shearing blade portion 75 that is straight edged and extends perpendicularly to the direction of movement of the movable shear blade 31. As the shear blade 31 moves from the position shown in Fig. 5 past the wall 68, the shear blade portions 70 and 75 cooperate to cut or shear off the blank to the desired length, this continuing until the blade portion 75 has passed the blade portions 70 in its movement toward the left in Fig. 5. The blank that results is shown in Fig. 10, having substantially the cross section of the rail head 55, except for a somewhat flattened portion at 76 resulting from the cooperative action of the shear blades. Said slug or blank is indicated by the numeral 77 in Fig. 10. After the blank is cut off the movable shear blade 31 has said blank resting in the recess 73 in engagement with the straight walls 74 and 75 of said shear blade. The shear blade continues movement to the left until it reaches the proper position relative to the die portion 40 for formation of the spheroidal member from which the ball is produced. Due to the peculiar shape of the blank or slug 77 this has to be definitely determined so as to place the center of mass of the blank or slug 77 substantially at the axial center of the recess 40. It is for this reason that the shearing blade 31 is provided with the recess 73 having the straight or flat bottom wall 75. This assures the proper positioning of the slug or blank 77 relative to the die portions 39 and 40 after proper adjustment of the stroke of the shear blade 31.

Means is provided for holding the blank 77 in position in the recess 73, comprising a finger 80, which has a hook portion 81 that engages around a headed pin 82 provided on the frame of the machine and which is urged toward the blank or slug 77 by means of a coil spring 83 secured at its opposite ends to the frame of the machine and said finger. The finger is in engagement with the portion 59 of the rail head 55 prior to the proper length thereof being sheared off to form the blank, as shown in Fig. 5, and remains in engagement with the portion 59 of said blank 77 after it has been cut off so as to retain the blank in the recess 73 until the shear blade 31 has reached its limiting position shown in Fig. 6 in its movement from right to left. However, when the die 37 is moved toward the block 41 the beveled portion 84 thereon engages the finger 80 to swing it out of the way so that it will not be in a position to interfere with the movement of the dies toward each other. The shear blade 31 commences its return movement as soon as the blank is firmly held between the two cooperating dies and the finger 80 drops back to the position shown in Fig. 5 after the dies have again separated.

A fragmentary enlarged sectional view through the block 41 and the slide 36 is shown in Fig. 7, showing a fragmentary portion of the frame 67. The die 37 has reached its position closest to the block 41 and the recessed portions 39 and 40 have completed their forming operations when the dies are in the position shown in said

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figure. It will be noted that there is considerable space at 85 between the dies, leaving a fin or rib 86 at the equatorial portion of the spheroidal member that has been formed. The dies have formed two spheroidal portions 87 from the blank with a rib or flange 86 between them. Due to the difference in the wear of rails there may be a slight difference in the amount of material in the blank 77 and a flat portion 88 may remain at each of the poles of the spheroidal member, as shown in Fig. 11, where the end faces of the blank previously existed. Also due to the rib 59 a tapering projection 89 exists on the spheroidal member, which is in the equatorial portion thereof and in alignment with the ribs or flanges 86 so that the portions 86 and 89 form a rib or flange that is relatively thick, but not very tall, that has interruptions therein between the portions 86 and 89. Also due to the shape of the blank 77 there is a pair of interruptions or shallow recesses 90, that run transversely to the rib or flange 86, in the spheroidal portions 87.

The spheroidal member shown in Fig. 11 is made into a ball 91, such as shown in Fig. 12, by means of a rolling operation that is accomplished between stationary and rotatable transversely concavely curved members. The machine that is utilized for this purpose is a modified form of the machine shown in the patent to F. H. G. Brandt, 2,178,031, patented October 31, 1939, on Apparatus for Shaping and Sizing Balls. The principal difference between the machine shown in said patent and the machine shown in Figs. 8 and 9 of the drawings is in simplification thereof by providing only a single rotatable grooved member or rotatable die, as described in said above referred to patent, and grooved shoes cooperating therewith. The rotatable grooved roller or die member 92, shown diagrammatically in Fig. 9, is mounted in the same manner as the rotatable die members described in the above referred to patent on a rotatable mounting member 93, which is mounted on the shaft 94 to rotate therewith. The shoes 95 shown in Fig. 8, and diagrammatically shown in Fig. 9, cooperate with the rotatable member 92 in the same manner in the machine shown in Fig. 8 as in the device shown in said patent to Brandt, 2,178,031, being mounted on arms 96 and arms 97 extending at right angles to the arms 96, the arms 96 having rearward extensions 98 between which and brackets 99 on the arms 97 are mounted springs 100 for yieldingly urging the shoes 95 toward the rotatable member 92, the arms 96 and 97 being both pivoted on the shafts 101 to permit yielding movement of the opposite ends of the shoes 95 against the compression of the springs 100. Adjusting screws are provided, as shown in Fig. 8, for the same purpose as described in said patent to Brandt, 2,178,031.

When the die 37 moves away from the block 41 the spheroidal member formed by the die shaping operation is released and drops down into a chute 102 and rolls down the inclined bottom thereof to a chute 103 that provides the means for feeding the spheroidal members into position between the lowermost shoe 95 and the rotatable member 92, which is rotating in the direction indicated by the arrow on the member 93 in Fig. 8. The spheroidal slug is rolled between the members 92 and 95, turning about various axes and being still at a forging heat. The projections 86 and 89 are thereby rolled into the surface of the spheroidal member and serve to eliminate any flat portions 88 that may have existed and substantially eliminate the shallow recesses 90 therein so as to form a spherical member 91 that is suitable for use as a grinding ball. This is accomplished during movement of the spheroidal member from the left hand end of the lower shoe 95 due to rotation of the rotatable grooved member 92 to its position at the left hand end of the upper shoe 95, whereupon it discharges into a suitable discharge chute 104 in the form of a sphere that is subsequently quenched to form a grinding ball of the desired character.

It will accordingly be obvious that in carrying out my

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improved method the rail heads 55 are fed into the machine so as to advance intermittently into position to be acted on by the shearing dies that cut off a predetermined length of said rail head to form the blank or slug 77, which is moved transversely of the direction of feed of the rail head 55 by means of the movable shearing die into position between a pair of dies having substantially hemispherical recesses 39 and 40 to form a spheroidal slug of the character shown in Fig. 11, the feeding means and the movable shearing die being of such a character that the rotation of the rail head and the blank cut therefrom about its axis is avoided and the blank is properly fed into position for the forming dies to act thereon. It will further be noted that the spheroidal member that is formed is of such a character that it can be perfected by a rolling operation between a stationary and rotatable grooved die to form a ball, and that this is accomplished by rolling the excess material at the equatorial portion of the spheroidal member into the surface of the sphere to remove said excess projecting portion and fill any flat portions or recesses in the surface of the spheroidal surfaces of said spheroidal member to form a substantially true sphere of the spheroidal member that is suitable for use as a grinding ball.

What I claim is:

1. In a machine for forging spheroidal members from a rail head, a movable shear blade having means for holding said rail head from rotation about its longitudinal axis comprising a rectangular recess in the forward edge thereof having flat parallel side walls and a straight shearing edge at the bottom of said recess extending perpendicularly to said side walls, means for reciprocating said shear blade in a direction parallel to said side walls, means for feeding a rail head transversely of said shear blade into said recess with the top wearing surface thereof adjacent the bottom of said recess, and a cooperating shear blade having a recess therein having oppositely inclined shearing edges at the bottom thereof and parallel side walls aligning with the side walls of said movable shear blade.

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2. In a machine for forging spheroidal members from a rail head, paired feed rollers having cylindrical body portions and each having marginal flanges, one of said flanges on each roller being taller than the other flange on said roller, said taller flange having an inner face extending perpendicularly to said cylindrical body portion and said other flange having an inner face diverging outwardly from said taller flange, said taller flanges of each pair of rollers being in alignment with each other and said other flanges of each pair of rollers being in alignment with each other, a movable shear blade having means for holding said rail head from rotation about its longitudinal axis comprising a rectangular recess in the forward edge thereof having flat parallel side walls and a straight shearing edge at the bottom of said recess extending perpendicularly to said side walls, a cooperating shear blade having a recess therein having oppositely inclined shearing edges at the bottom thereof and parallel side walls aligning with the side walls of said movable shear blade, and a feed tube having a rectangular passage there-through into which said rollers feed said rail head, said feed tube being interposed between said feed rollers and cooperating shear blade and having one of said walls aligning with the inner faces of said taller flanges.

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