Jan. 13, 1942. F. H. G. BRANDT 2,269,899

APPARATUS FOR FORGING AND FORMING BALLS

Filed Oct. 16, 1939 5 Sheets-Sheet 1

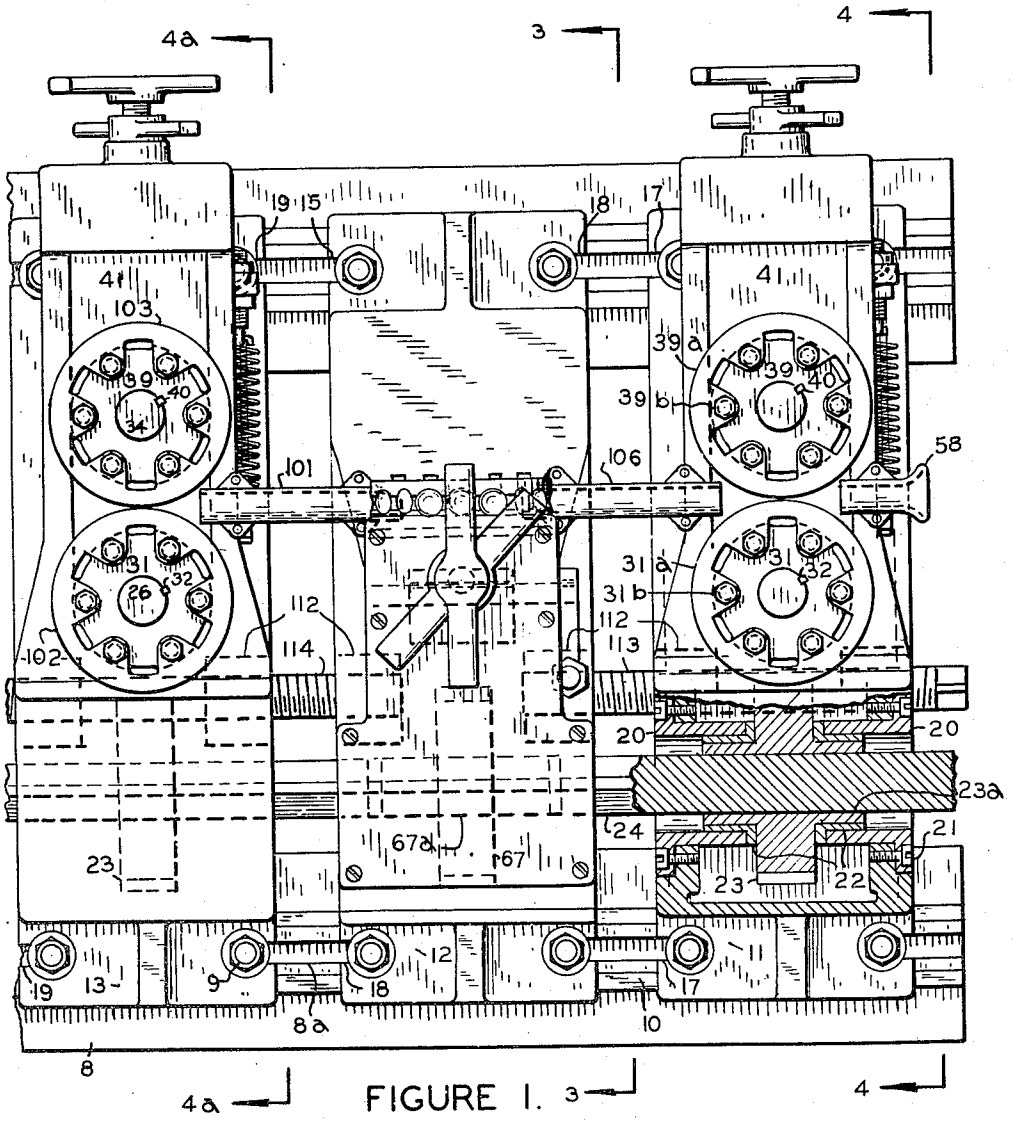


FIGURE 1.

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APPARATUS FOR FORGING AND FORMING BALLS

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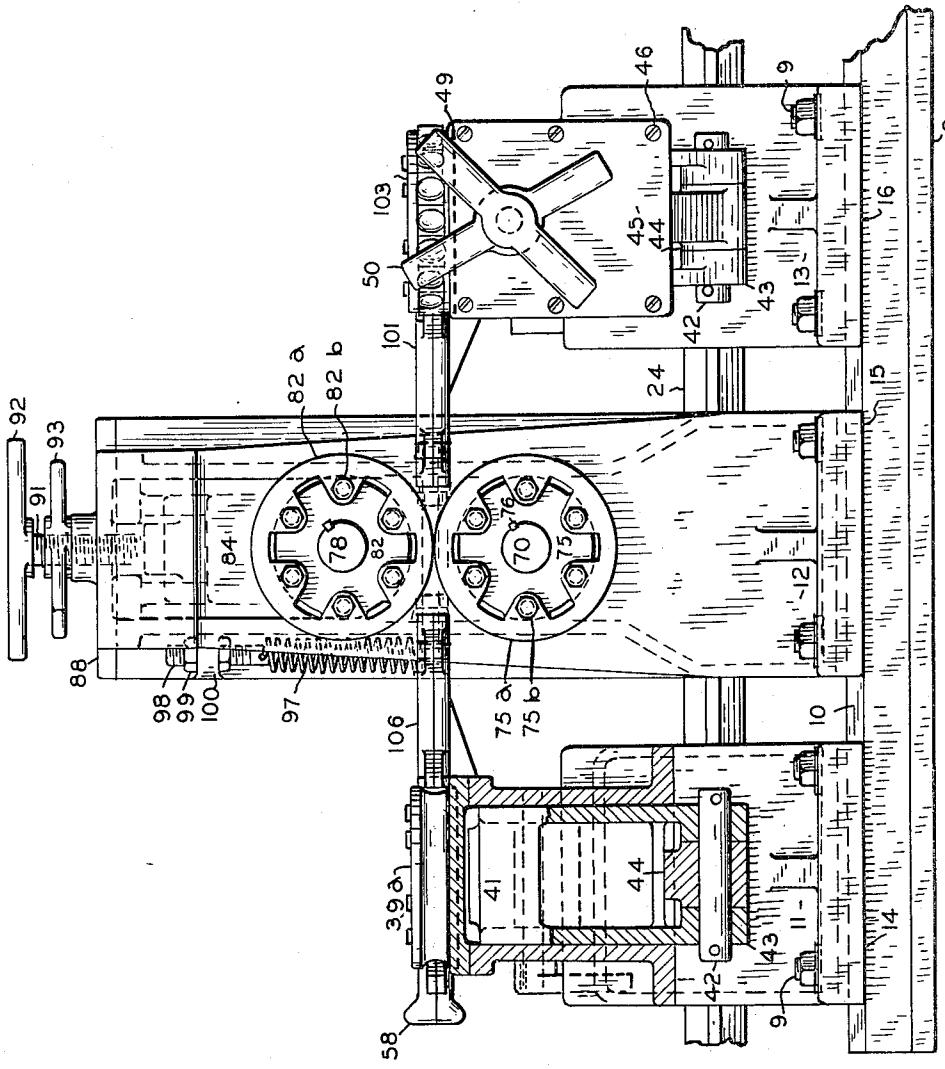


FIGURE 2.

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APPARATUS FOR FORGING AND FORMING BALLS

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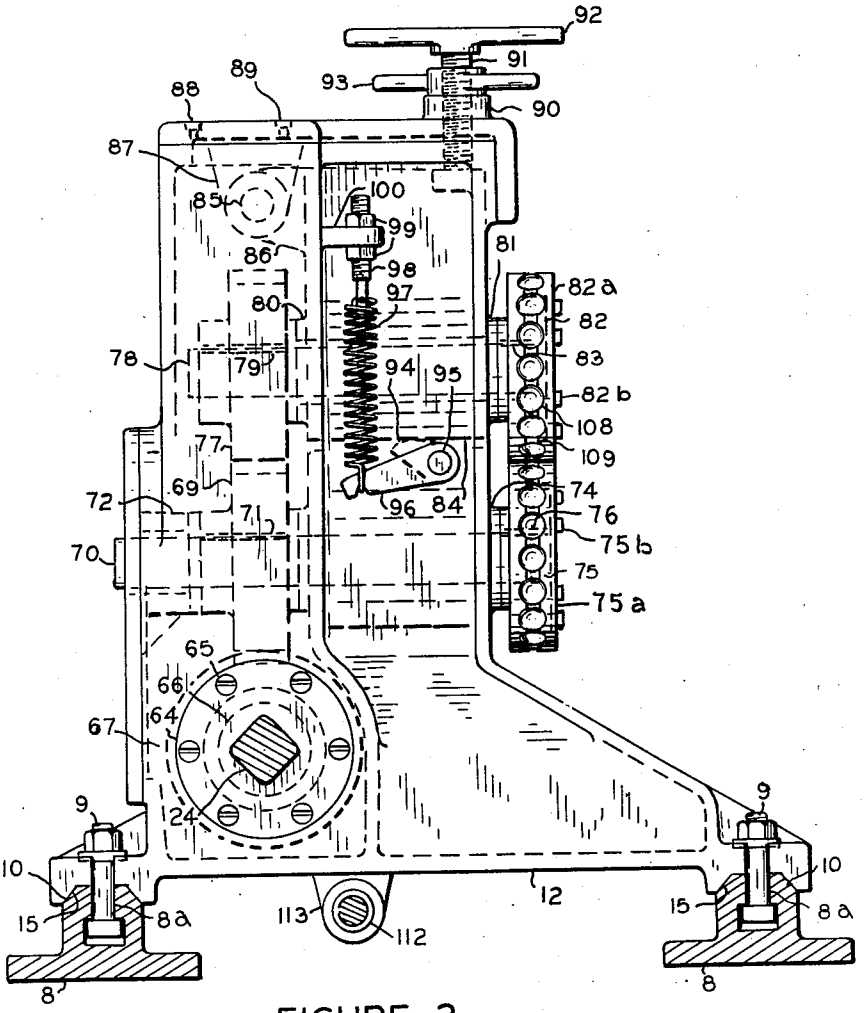


FIGURE 3.

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APPARATUS FOR FORGING AND FORMING BALLS

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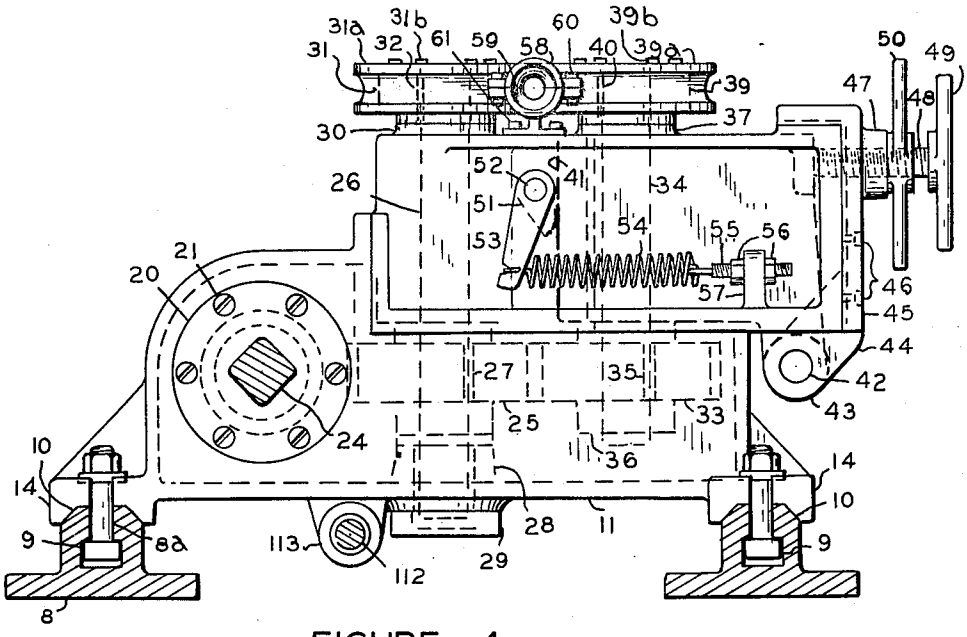


FIGURE 4.

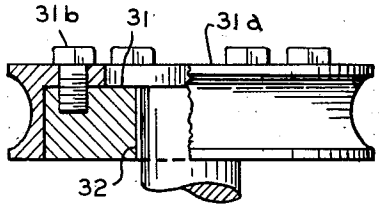


FIGURE 5.

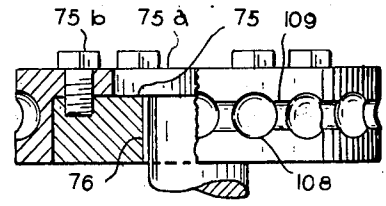


FIGURE 6.

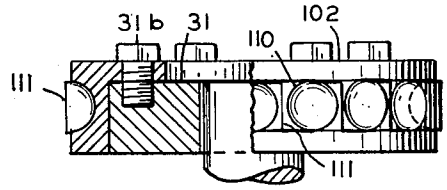


FIGURE 7.

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APPARATUS FOR FORGING AND FORMING BALLS

Filed Oct. 16, 1939 5 Sheets-Sheet 5

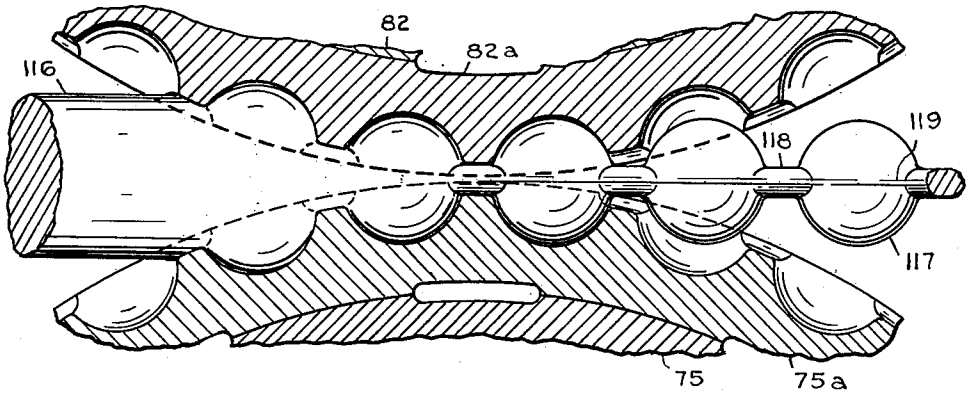


FIGURE 8.

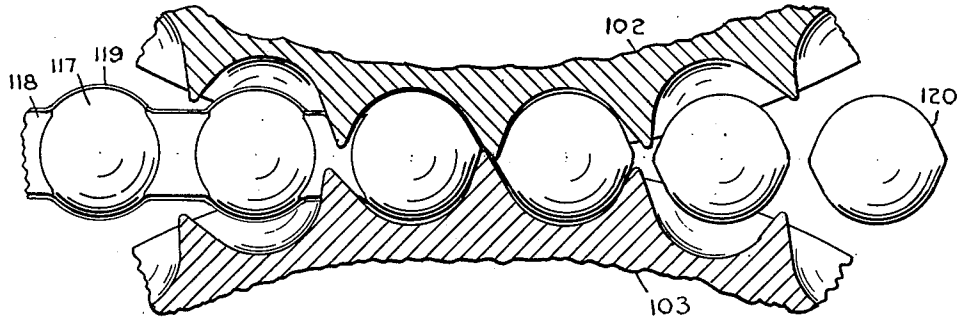


FIGURE 9.

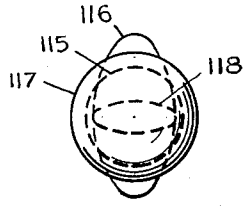


FIGURE 10.

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Patented Jan. 13, 1942 2,269,899

UNITED STATES PATENT OFFICE

2,269,899

APPARATUS FOR FORGING AND FORMING BALLS

Fred Henry Gerhard Brandt, Kansas City, Mo.

Application October 16, 1939, Serial No. 299,689
In Canada October 18, 1938

3 Claims. (Cl. 80—27)

This invention relates to the Apparatus for forging and forming balls and more particularly to that type that forms the balls from a steel rod. These balls are usually used for ball mill grinding but are not restricted to this use.

An object of the present invention is to form an oval shaped rod from a round rod with rotating dies, another pair of co-operating rotating dies with their axes turned substantially 90 degrees from the axes of the previous dies to receive and form the oval shaped rod into ball portions with poles integrally connecting therebetween, and a third pair of co-operating rotating dies with their axes substantially paralleling the first mentioned pair of dies to receive the balls in a position to eliminate the equator marks of the previous dies and shear the poles, thereby forging and separating the balls preparatory for a finishing machine, if further refinement is desired.

Another object of the present invention is to provide apparatus to forge or knead the metal beyond the shape of the balls in one direction and then forging the shape partially back into sphere or ball shapes with the exception of poles integrally connecting the balls, the balls then being forged in a different direction and severed by rotating shear dies.

Another object of the present invention is to provide three pair of co-operating rotating dies for forging a rod into balls, each pair of dies forming a portion of the ball and being adjustable therebetween so that the different dies can be properly synchronized or registered, the adjustment between each pair of dies being separated from the other adjustments to take care of the creep of the metal in the forging process.

Another object of the present invention is to provide each pair of roller dies in a housing with shafts and gears and a splined driving shaft passing through each housing and driving said gears.

Another object of the present invention is to provide pairs of roller dies in housings being driven by a splined shaft, said housings being mounted on a pair of rails with sliding adjustments, and means to secure said housings in their proper adjustments.

Another object of the present invention is to provide one die of each pair of dies with a hinge adjustment, a screw takeup and a spring cam and lever release whereby the dies can be properly adjusted.

With these and other objects in view the invention further consists in the combination of elements illustrated in the accompanying drawings, described in the specifications, and more particularly pointed out in the appended claims.

In the drawings:

Figure 1 is a plan view illustrating the improved forging machine with certain portions broken away to show certain details.

Figure 2 is a front view in elevation of the improved ball forging machine with certain fragments broken away to illustrate the interior, the shaft and rails being broken away to save illustrating space.

Figure 3 is a sectional view in elevation taken on line 3—3 of Figure 1.

Figure 4 is a sectional view in elevation taken on line 4—4 of Figure 1, this sectional view being similar to a view taken on line 4a of Figure 1.

Figure 5 is an enlarged detailed view of one of the first pair of dies illustrating the elliptical shaped recess for distorting the rod beyond the desired spherical diameters in one direction, a portion of die being broken away to sufficiently illustrate.

Figure 6 is an enlarged detailed view of one of the second pair of dies illustrating the spherical-like recesses for forming the elliptical shaped portions of the rod into balls with poles connecting therebetween, a portion of the die being broken away to illustrate.

Figure 7 is an enlarged detailed view of one of the third pair of dies for shearing the poles between the balls with certain portions being broken away to sufficiently illustrate; thus completing the forging operation and if further refinement is desired they may be heated and finished in a ball finishing machine, the ball finishing machine and furnace for heating the balls not being shown in this application.

Figure 8 is a still further enlarged fragmentary view of the rolls for forging the balls with thin poles from the oval shaped rod.

Figure 9 is a view of the same rod turned substantially 90 degrees on its axis and of the same scale but passing through the last pair of rolls to remove the equator marks and polar connections by forging and shearing.

Figure 10 is an end view of the rod showing the ball formation on the end thereof, a dotted cross section of the integral poles, and the oval formed from the round rod while passing through the first dies. This rod is illustrated with the same scale as Figures 8 and 9.

The rails 8 are formed in an inverted T shape with a slot 8a in the stem portion for the bolts 9 and bevel edges 10 for retaining and supporting the housings 11, 12 and 13, the housings hav-

ing their respective shoes 14, 15 and 16 arranged to slide on the T stem shaped portions of the rails. The housings are slotted at 17, 18 and 19 to receive the bolts 8 so that they may be clamped into any adjusted position on the rails.

The housing 11 is integral with the shoes 14 and is formed to receive the bearing flanged sleeves 20 held in place by the screws 21, the screws passing through the flanges into the housing 11. A pair of flanged bushings 22 receive a right angle spiral gear 23 with a square hole 23a therethrough to provide a driving means with the horizontal square or splined shaft 24. The gear meshes with the right angle spiral gear 25 having a vertical shaft 26 secured therein by the key 27, the shaft 26 passing through the bearing 28 in the lower portion of the housing 11 and having a collar 29 secured on the end thereof. The top portion of the vertical shaft 26 passes through the bearing 30 in the housing 11 and has the die arbor 31 secured thereto by the key 32 to receive the die 31a secured to the arbor by capscrews 31b.

The helical spur gear 33 meshes with the right angle spiral gear 25 and being driven thereby has a vertical shaft 34 passing therethrough and secured thereto by the key 35, the lower end of shaft 34 passing through the bearing 36 and the upper portion of the shaft passing through the bearing 37 to receive the die arbor 39 secured thereto by the key 40 to receive the die 39a secured thereto by capscrews 39b. The bearings 36 and 37 integrally secured to a box shaped portion 41, guided in the housing 11, and being pivoted on the pin 42 by the boss 43 and hinge lugs 44. The lugs 44 are integral with the screw plate cover 45 which is secured to the top of the housing by the screws 46. The plate 45 has a boss 47 integral therewith and threaded to receive a screw 48 with a handle 49 and lock nut with handles 50, the screw 48 passing through the threaded boss 47 and bearing down on the box shaped portion 41. A cam 51 secured to a shaft 52 bears against the box portion 41 and is provided with a lever 53, tension spring 54, takeup screw 55, lock nuts 56, the takeup screw 55 passing through the boss 57 integral with the housing 11. The tension spring, lever, shaft and cam are provided to move the bearing box shaped housing 41 away from the shaft 26 thereby causing the dies 31a and 39a to separate as the screw 48 is withdrawn from the boss 47. The minor adjustment of the dies will govern the exact size of the elliptical shaped rod to allow the operator to control the amount of kneading or forging of the material to give the best results. The rod is led into the dies through split sleeve guide portions 58 and 59 held together by bolts 60 and secured to the housing 11 by cap screws 61.

The housing 13 with its various parts being similar to the housing 11 and its various parts has been given like numbers for like parts to avoid duplicate description, the only exception being in the sleeve 62 being straight and not having a bell like portion as shown on sleeve 58.

The housing 12 is integral with the shoes 15 and is formed to receive the bearing flanged sleeves 64 held in place by the screws 65, the screws passing through the flanges into the housing 12. A pair of flanged bushings 66 receive a right angle spiral spur gear 67 with a square hole 67a therethrough to receive the horizontal square of splined driving shaft 24. The gear 67 meshes with the right angle spiral spur gear 69 having a horizontal shaft 70 secured therein by the key 71, the shaft passing through the bearing 72 in the rear portion of the housing 12. The front portion of the horizontal shaft 70 passes through the bearing 74 in the housing 12 and has the die arbor 75 secured thereto by the key 76, the die 75a being secured to the arbor 75 by the cap screws 75b. The helical spur gear 77 meshes with the gear 69 and being driven thereby has a substantially horizontal shaft 78 passing therethrough and secured thereto by the key 79, the shaft 78 passing through the bearing 80 and the front portion of the shaft passing through the bearing 81 to receive the die arbor 82 secured thereto by the key 83. The die 82a is secured to the arbor 82 by cap screws 82b.

The bearings 80 and 81 are integrally secured to a box shaped portion 84 guided in the housing 12, and being pivoted on the pin 85 by the boss 86 and hinge lugs 87 integral with the screw plate cover 88. The cover 88 is secured to the top of the housing by the screws 89. The plate 88 has a boss 90 integral therewith and threaded to receive a screw 91 with the handle 92, a lock nut with handles 93, the screw 91 passing through the threaded boss 90 and bearing downwardly on the box shaped portion 84. A cam 94 secured to a shaft 95 bears against the box portion 84 and is provided with a lever 96, tension spring 97, takeup screw 98, and lock nuts 99. The takeup screw 98 passes through the boss 100 integral with the housing 12. The tension spring, lever, shaft and cam are provided to move the bearing box shaped housing 84 away from the shaft 70 thereby causing the die arbors 75 and 82 to separate as the screw 91 is withdrawn from the boss 90.

The housings 11, 12 and 13 are spaced apart and adjusted by the screws 113, 114 and threaded bosses 112.

The minor adjustment of the spacing of the dies will govern the exact size of the spherical shaped portion of the rod to allow the operator to control the kneading or the forging of the material to give the desired substantially spherical shape. The rod is fed through the sleeve 58 and 59 to the dies 31a and 39a held to their respective arbors 31 and 39 by their respective cap screws 31b and 39b.

The roller dies 75a and 82a have a series of hemispherical shaped recesses 108 arranged in the faces of the dies with polar recesses 109 connecting the hemispherical shaped recesses.

The roller shearing dies 102 and 103 have recesses 110 to receive the balls and shearing blades 111 to shear the poles as they pass through the roller shearing dies. The blades 111 are preferably shown integral with the die.

The round stock rod 115 Figure 10 is heated to a forging heat and is rolled into an elliptical shape 116 by the first pair of roller dies 31a and 39a. The elliptical shaped rod passes on to the second pair of roller dies 75a and 82a where it is forged into balls 117 having integral poles 118 connecting therebetween, the balls being formed by forging the elliptical rod on its edges thus kneading and working the metal to the best advantage. This method also reduces the stresses in the forging process. In this second operation the overrun metal which is squeezed out between the dies forms equator lines 119 on the balls and the improved method consists of the third pair of dies 102 and 103 being turned at substantially 90 degrees from the second pair of roller dies to forge the equator and polar metal into the ball

and shear the balls apart leaving only a small polar projection 120 on each end of each ball. These may be used as shown for some ball mills without further processing but if it is desired to have a perfect ball they can then be reheated and run through a ball rolling and finishing machine.

From a thorough study of the method and apparatus it will be apparent that it is a high speed arrangement and can produce more balls than any other process on the market for the initial cost of the equipment required.

It is obvious from the foregoing description that a rod when heated with forging heat can be passed without rotation through the bell shaped sleeve 58 and 59 into the roller dies 31*a* 39*a* to form the elliptical shape with its dimensions greater in one direction than the diameter of the finished ball. The elliptical shaped rod then passes without rotation rapidly through the sleeve 106 into the roller dies 75*a* and 82*a* which have their axes positioned at substantially 90 degrees from the axes of the dies 31*a* and 39*a*, this second pair of roller dies forging the elliptical shaped portions into spherical like shapes with the exception of poles integrally connecting therebetween, the rotating action of the rolls thereby feeding the spherical like portions of the rol through the sleeve 101 without rotation to the roller shearing dies 102 and 103 for severing the substantially spherical like shapes from the material that has passed through the two previous pair of dies. These nearly spherical shapes may then be further processed by passing on to a reheating furnace and finishing machine for fine texture and surface of balls.

What I claim as new and desire to secure by Letters Patent, is:

1. In a rolling mill apparatus having plural progressive pairs of rolls for rolling a rod into approximate ball shapes, having in combination an entrance pair of rotatable dies, said entrance pair of rotatable dies having a substantially parabolic rolling surface between them, an intermediate pair of rotatable dies, said intermediate pair of rotatable dies having plural substantially ball shaped rolling surfaces between them, said intermediate rotatable dies having link rolling surfaces connecting said ball rolling surfaces, a pair of separating rotatable dies, said separating rotatable dies having plural substantially ball shaped rolling surfaces between them, said separating rotatable dies having shearing edges between each of said ball rolling surfaces, said shearing edges of one die passing the shearing edges of the opposite die for complete parting of balls, and said shearing edges with said ball surfaces converging to forge parted links of balls into the balls.

2. In a rolling mill apparatus having plural progressive pairs of rolls for rolling a rod into approximate ball shapes, having in combination a pair of rotatable dies, said rotatable dies having plural substantially ball shaped rolling surfaces between them, said rotatable dies having link rolling surfaces connecting said ball rolling surfaces, a pair of separating rotatable dies, said separating rotatable dies having plural substantially ball shaped rolling surfaces between them, said separating rotatable dies having shearing edges between each of said ball rolling surfaces, said shearing edges of one die passing the shearing edges of the opposite die for complete parting of balls, and said shearing edges with said ball surfaces converging to forge parted links of balls into the balls.

3. In a rolling mill apparatus having plural progressive pairs of rolls for rolling a rod into approximate ball shapes, having in combination an entrance pair of rotatable dies, said entrance pair of rotatable dies having a substantially parabolic rolling surface between them, an intermediate pair of rotatable dies, said intermediate pair of rotatable dies having plural substantially ball shaped rolling surfaces between them, said intermediate rotatable dies having link rolling surfaces connecting said ball rolling surfaces, a pair of separating rotatable dies, said separating rotatable dies having plural substantially ball shaped rolling surfaces between them, said separating rotatable dies having shearing edges between each of said ball rolling surfaces, said shearing edges of one die passing the shearing edges of the opposite die for complete parting of balls, said shearing edges with said ball surfaces converging to forge parted links of balls into the balls, and each pair of rolls being adjustable to register ball material for each pair of dies with respect to the next operating pair of dies.

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