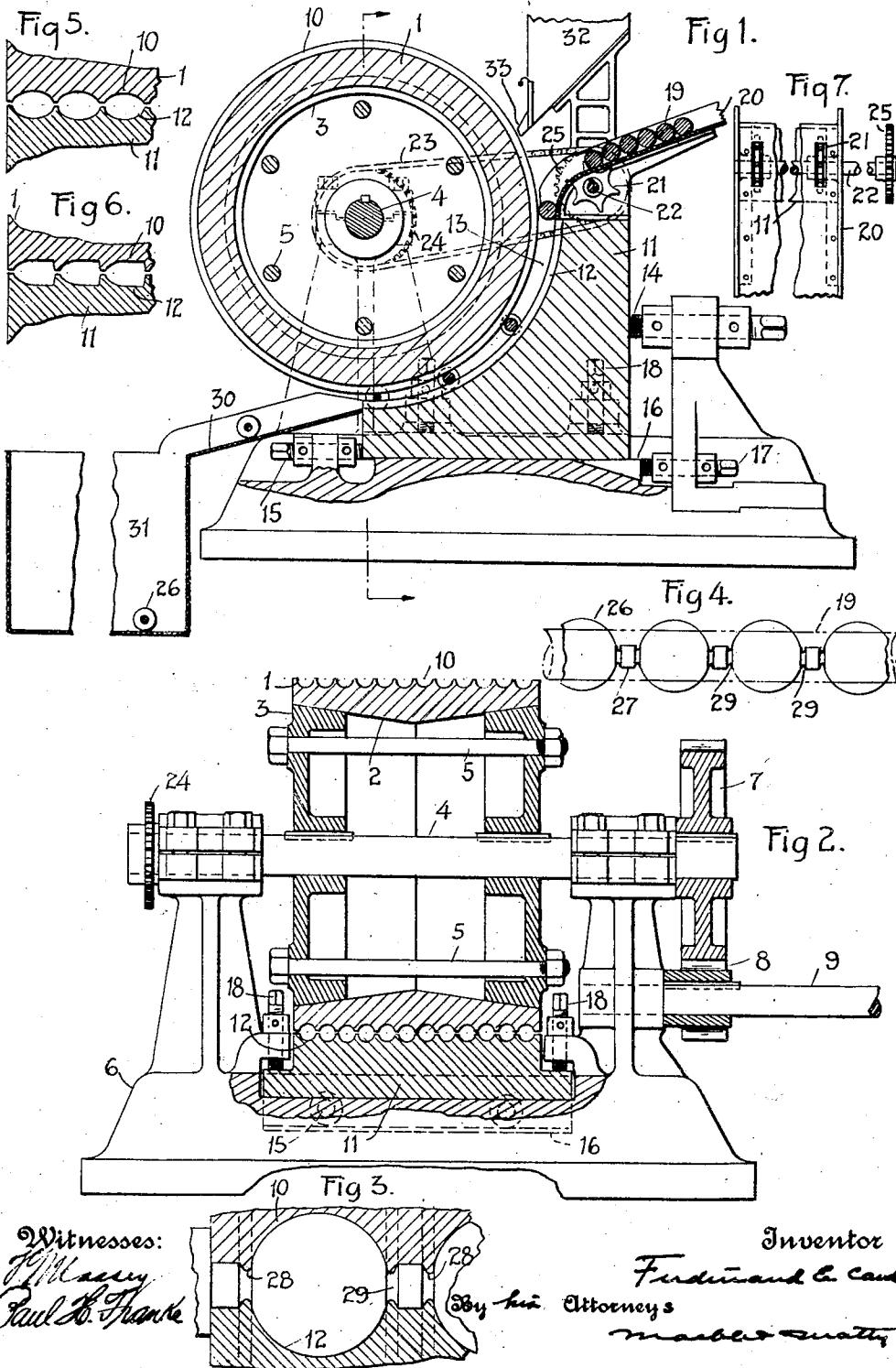


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METHOD OF ROLLING BALLS AND OTHER OBJECTS OF ROTATION.
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UNITED STATES PATENT OFFICE.

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METHOD OF ROLLING BALLS AND OTHER OBJECTS OF ROTATION.

1,337,640.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, FERDINAND E. CANDA, citizen of the United States of America, and a resident of New York city, county and State of New York, have invented certain new and useful Improvements in Methods of Rolling Balls and other Objects of Rotation, of which the following is a specification.

My invention relates to methods of forming balls and other bodies of rotation, and is particularly intended for the formation of balls of lead, steel and other metals, but is also applicable to the formation of briquets and various other bodies of rotation. My invention embodies the progressive grooving of a blank at spaced points, and the progressive spreading of the blank at intermediate points, preferably by the action of a grooved rotating roll and a cooperating and correspondingly grooved breast eccentrically located with respect to said roll; the hot rolling of blanks into balls or other bodies of rotation, at one heat, and the immediate tempering thereof without reheating; and other features as hereinafter described and particularly pointed out in the appended claim.

The object of my invention is to provide an improved method of and improved means for forming balls and other objects of rotation with great rapidity and at low cost, and with apparatus of a simple character.

I will now proceed to describe my invention with reference to the accompanying drawings, and will then point out the novel features in claim.

Figure 1 shows a vertical transverse section of one form of apparatus adapted for carrying out the process of my invention.

Fig. 2 shows a vertical axial section of the apparatus.

Fig. 3 is a fragmentary section on a larger scale than the previous views illustrating the nicking of the necks adjacent the surfaces of the balls.

Fig. 4 shows a fragmentary elevation of one of the ball groups.

Figs. 5 and 6 are fragmentary axial sections of adjacent portions of the roll and breast, indicating such parts provided with grooves for forming objects of other than spherical shape.

Fig. 7 is a fragmentary top view of the rod feeding device.

In the drawings 1 designates a roll shell,

shown in this instance as hollow, with reversely tapering interior surfaces 2, and mounted upon tapered disks 3 keyed to a shaft 4, and held together by means of through bolts 5. The shaft 4 is mounted in suitable bearings in pedestals provided on the base plate 6, and is driven by a gear 7 and a pinion 8, the latter mounted upon a driving shaft 9.

The roll 1 is shown, in Figs. 1, 2 and 3, as provided with a number of grooves 10 of approximately semi-circular profile. Adjacent the roll 1 is a breast provided with corresponding and registering grooves 12. The face of the breast 11, adjacent the roll, is of approximately cylindrical curvature subtending about 90° (though the angle so subtended may vary within wide limits without departing from my invention), and is somewhat eccentric with reference to the roll, so that the space 13 between the breast and roll is relatively wide at the top and grows progressively narrower toward the bottom. Preferably, means are provided for adjusting the position of the breast with respect to the roll; to which end the breast is mounted to slide upon the base plate 6 as indicated, and set screws 14 are provided for forcing the breast toward the roll, and other set screws 15 are provided for forcing the breast away from the roll; and furthermore wedges 16, between the breast and the base plate, and set screws 17 for actuating such wedges, are provided for tilting the breast slightly, other set screws 18 being provided for holding the breast down. It will be seen that by tightening up the various set screws the breast may be held very rigidly in any position to which it may be adjusted.

The blanks supplied to this machine are customarily in the form of rods, which conveniently may be of circular section, such as the rods 19, shown in Fig. 1, though I do not limit myself to the use of blanks of circular cross section. When the material of these blanks is steel or other material which is very hard when cold, these blanks are preferably heated to a suitable forging or rolling temperature before they pass through the machine; and preferably suitable feed means is provided for advancing the blanks at regular intervals. For so feeding the blanks I have indicated the provision of a feed shelf 20, preferably slightly inclined toward the roll, and a sprocket feeding device 21 mounted upon a shaft 22,

arranged to be driven from shaft 4 by a suitable drive chain 23 and sprocket wheels 24 and 25. It will be apparent that as the roll 1 rotates, the teeth of the sprocket feeding device 21, engaging the blanks 19 upon the feed shelf 20, will permit same to pass, one by one, into the space 13 between the roll 1 and breast.

Preferably, the space 13 is, at the top, of just about sufficient width to receive the blanks 19; though it will do no harm if the width of the space 13 be slightly greater than the diameter of the blanks 19, at the top, in which latter case each blank, as soon as it drops into the space 19, will drop down until engaged on one side by the roll, and on the other side by the breast. The roll being in rotation, each blank 19 so engaged, will be caused to rotate, and as in its rotation it passes into the more contracted portion of the space 13, the blank will be grooved in correspondence with the ridges of the roll 1 and breast 11, and also the material of the blank, being forced aside by the ridges of the roll and breast, will be drawn into the grooves of the roll and breast so as to eventually fill such grooves, while on the other hand, the necks formed by the ridges of the roll and breast will be reduced, eventually, to very small dimensions. To facilitate the subsequent separation of the balls 26 (see Fig. 4), formed by this rolling operation, from the necks 27, also formed by this rolling operation, the ridges of the roll and breast, intervening between the grooves 10 and 12 of that roll and breast, are preferably provided with projecting lips 28 which will form grooves 29 in said necks adjacent the surfaces of the balls 26. It will be understood that the cross section of the blanks 19 is more or less carefully proportioned with respect to the grooves of the roll and breast to supply sufficient material to substantially fill those grooves; but exact accuracy in this respect is not required, since the spaces between two adjacent lips 28 constitutes a space into which excess metal may flow; it not being essential that the portions of the necks 27 intermediate the lips 28 shall contact with the surfaces of the roll and breast respectively.

It will be apparent that the effect of the operation of the roll and breast upon the blanks is to convert such blanks into a succession of balls 26 connected by integral necks 27, forming what might be termed a ball-group, such as shown in Fig. 4.

I particularly intend to form, by the machine and method above described, steel or other iron balls adapted for use in crusher mills and the like. It is desirable that such balls shall be formed of very hard steel, and that the balls shall be properly and uniformly tempered; consequently I provide at the lower end of the passage 13, between the

roll and breast, a shelf 30, down which each complete ball-group will roll, as it emerges from such passage, into a tempering tank 31, which tank may contain oil or any other suitable tempering liquid. It will be noted that the blanks 19, placed at a proper rolling temperature upon the feed shelf 20, will pass through the machine at a uniform rate, and so quickly that they will still be at a temperature high enough for tempering when they escape from the passage 13 and reach the tempering tank 31. The temperature at which they reach the tempering tank may be regulated by the initial heat of the blank, and, if necessary, by making the shelf 30 of greater or less strength as conditions may dictate; also, of course, by regulating the speed of rotation of the roll 1; though in general it will be desirable to rotate that roll 1 at as high a speed as is consistent with proper rolling of the blanks, so that the capacity of the machine may be as great as possible. The diameter of the roll 1, and therefore the curvature of the breast 11, will be regulated in design so as to secure the necessary gradual change of section of the blanks; for, as is well known, time must be provided for the flow of the metal. It is intended that the roll 1 shall be rotated at a speed of about ten revolutions per minute, though this speed may be varied, and naturally will be varied somewhat, in accordance with the diameter of the roll. For the treatment of chrome steel and other hard steels, the diameter of the roll 1 should preferably be such with reference to the diameter of the balls to be formed, that the blanks shall rotate at least ten times during their passage through the space 13.

To secure ample traction between the roll 1 and the blanks, I may spread quartz sand or other suitable material over the surface of the roll 1, so as to cause such roll to "bite" the material of the blanks. For this purpose I have shown a sand reservoir 32 provided with a delivery spout 33 whereby sand or other gritty material may be fed to the exterior of the roll.

Because of the uniformity in time occupied during the passage of the blanks through the machine, it is evident that blanks which are delivered to the machine at a uniform temperature, will reach the tempering tank 31 at uniform or nearly uniform temperature; a very uniform tempering of the product being thereby insured. After the ball-groups are cold, the balls 26 can be broken away from the necks 27 very readily; and this is facilitated greatly by the forming of the grooves 29 in these necks.

My invention is not limited to the formation of crusher balls by the method and apparatus above described. It is equally applicable to the formation of balls of other

materials, for example, of copper, or lead, or even plastic materials, such for example as the plastic compositions of which coal briquets or briquets of various ores are formed. When the machine is acting upon readily ductile material such as copper or lead, or briquet compositions, such material may often be rolled cold or nearly so. Bearing balls may also be formed by the method and machine above described, since such balls require grinding in any case, and in the process of grinding the balls will be brought to true spherical form.

While it appears at present that the principal utility of the method and machine described will be for the formation of spherical or approximately spherical bodies, still my invention is by no means confined to the formation of spherical or approximately spherical bodies, but is applicable to the formation of various bodies of rotation. In Fig. 5 I have indicated the provision of the roll and breast with grooves adapted for the formation of ellipsoid bodies; and in Fig. 6 I have indicated the provision of the roll and breast with grooves adapted for the formation of bodies of still another profile.

In an application for Letters Patent filed

June 10, 1915, Serial No. 33,223, now Patent No. 1,189, 662, dated July 4, 1916, I have claimed the apparatus herein illustrated and described for carrying out the method embodying the present invention, and therefore such apparatus is not claimed herein.

What I claim is:

The herein described method of forming metal balls which comprises rolling a heated metal bar about its central axis and in so doing grooving such bar at three or more equi-distant points, and thereby producing in the bar a series of balls, and in so doing forcing excess metal into such balls and thereby extending them to a diameter greater than the original diameter of the bar, and while the said balls are still connected by necks, and are still hot, immersing them in a tempering bath, and then separating the balls from their connecting necks.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

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Witnesses:

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