

1,404,334.

Fig.1.

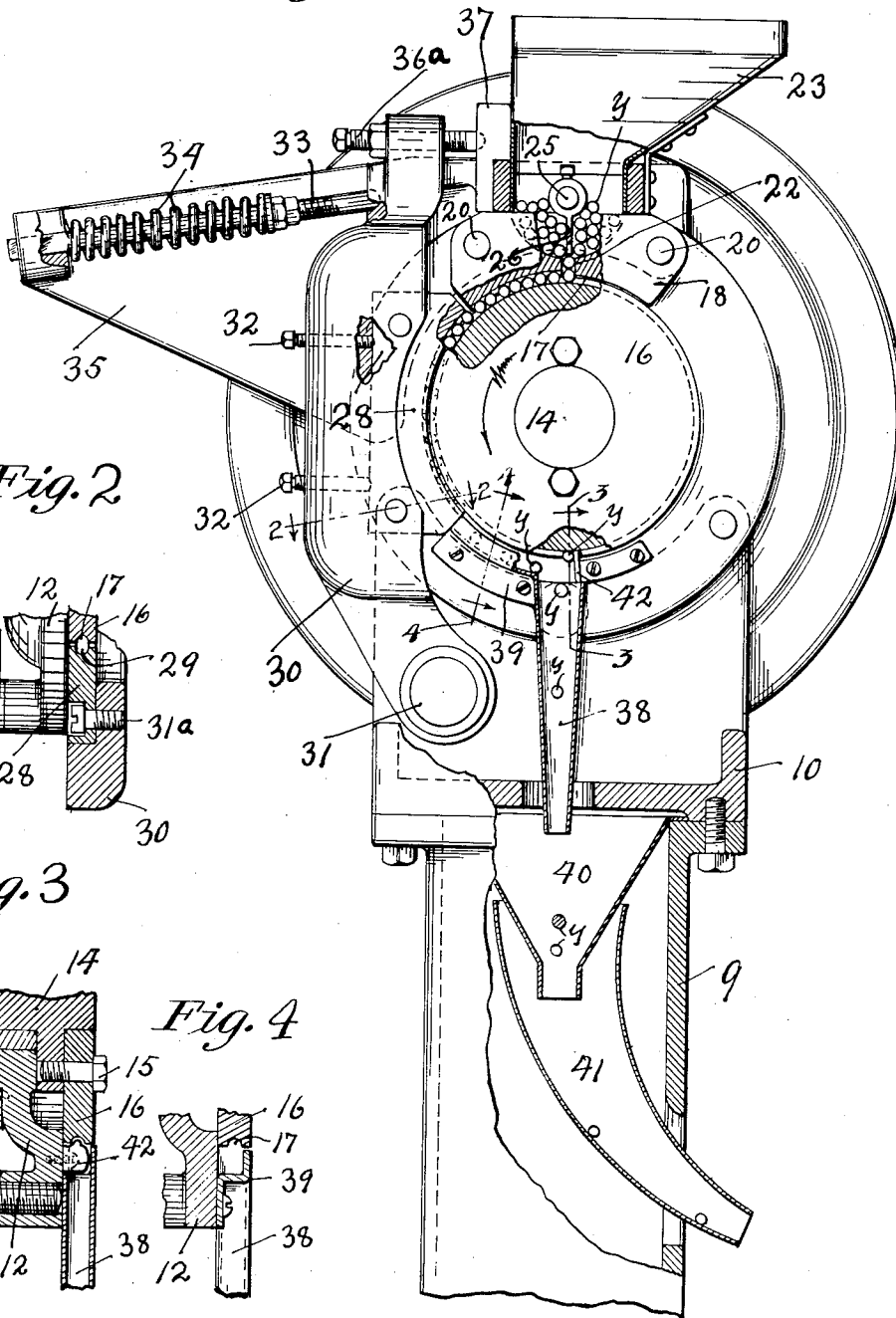


Fig. 2

Fig. 3

Fig. 4

Inventor
J. P. Appleby.
By his Attorneys
Williamson & Muckland

J. P. APPLEBY.
BALL FORMING MACHINE.
APPLICATION FILED MAR. 8, 1917.

1,404,334.

Patented Jan. 24, 1922.
3 SHEETS—SHEET 2.

Fig. 5.

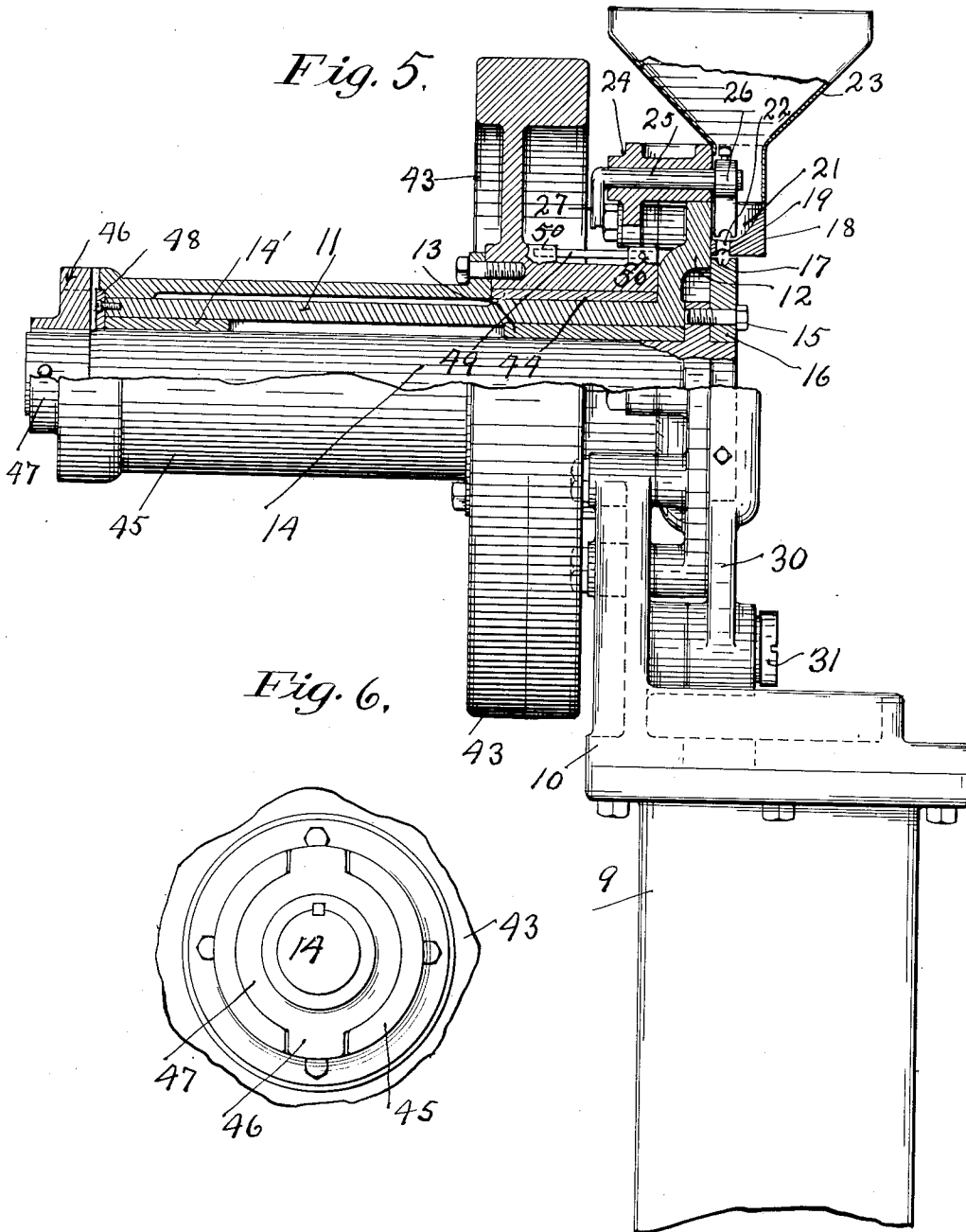


Fig. 6.

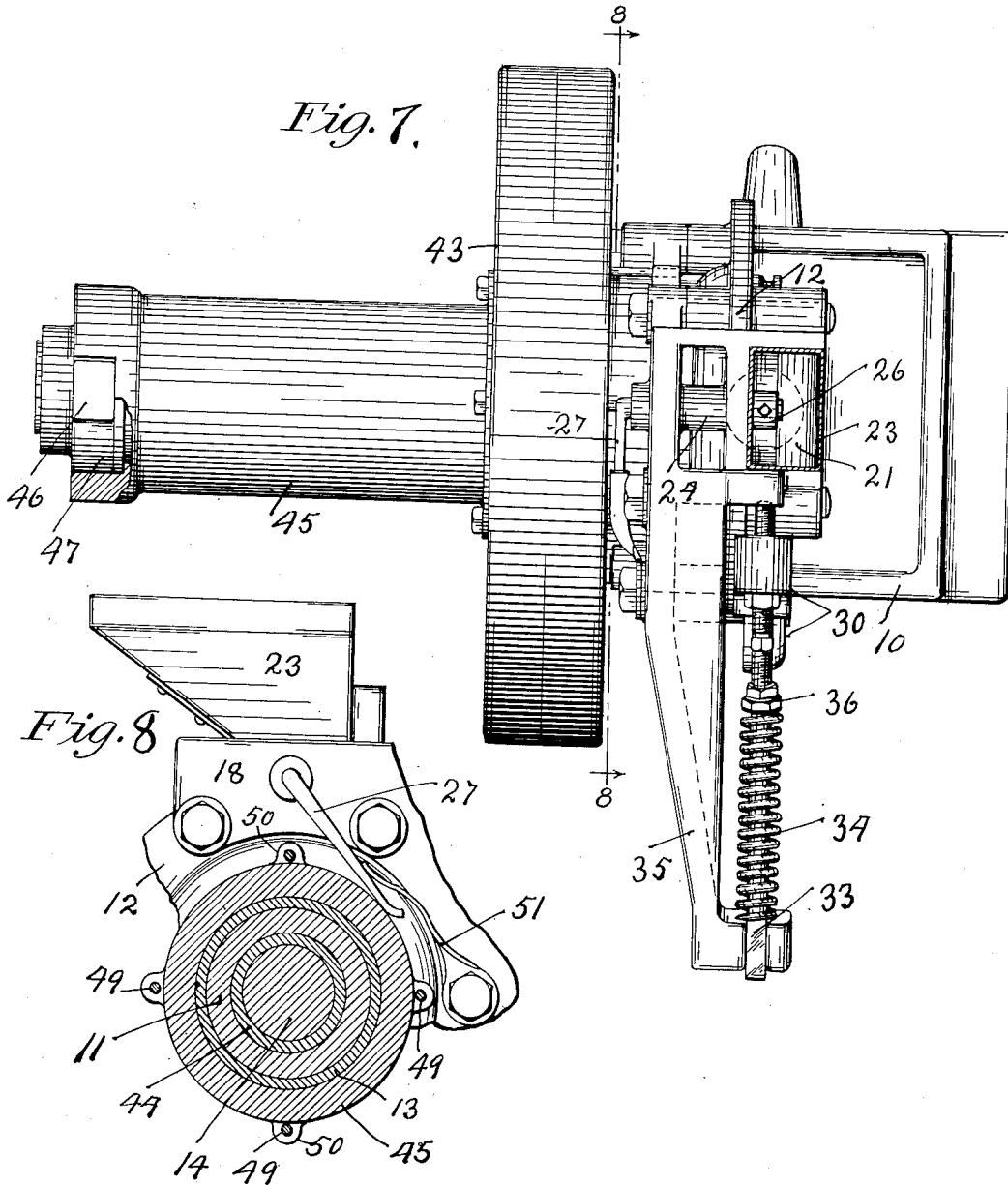
Witnesses
H. L. Opsahl.
E. C. Wells

Inventor
J. P. Appleby.
By his Attorneys
William W. Mucka

J. P. APPLEBY.
BALL FORMING MACHINE.
APPLICATION FILED MAR. 8, 1917.

1,404,334.

Patented Jan. 24, 1922.
3 SHEETS—SHEET 3.



Witnesses:
H. L. Opsahl.
E. G. Wells

Inventor
J. P. Appleby.
By his Attorneys
William M. Muehler

UNITED STATES PATENT OFFICE.

JAMES P. APPLEBY, OF MINNEAPOLIS, MINNESOTA, ASSIGNOR TO APPLEBY ENGINEERING COMPANY, OF MINNEAPOLIS, MINNESOTA, A CORPORATION OF MINNESOTA.

BALL-FORMING MACHINE.

1,404,334.

Specification of Letters Patent. Patented Jan. 24, 1922.

Application filed March 8, 1917. Serial No. 153,355.

To all whom it may concern:

Be it known that I, JAMES P. APPLEBY, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Ball-Forming Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention has for its object to provide an extremely simple and highly efficient machine for automatically truing up and completing the formation of solid metal balls, such, for example, as produced in rough form by swaging from steel wire; and to such ends, generally stated, the invention consists of the novel devices and combinations of devices hereinafter described and defined in the claims.

Solid steel balls, such as produced by cutting and swaging sections of steel wire, for example, cannot be made in true spherical form, but will have rough projections and usually will be primarily formed with small diametrically opposite axle trunnion-like projections or spindles. Such steel balls, whether or not they are to be tempered, should have very true spherical surfaces, and such surfaces should be even more solid and compact than the interior body portions thereof. This result my improved machine accomplishes rapidly and at small cost.

In the accompanying drawings which illustrate the invention, like characters indicate like parts throughout the several views.

Referring to the drawings;

Fig. 1 is a front elevation of the machine, some parts being shown in vertical section;

Fig. 2 is a fragmentary detail in section on the line 2—2 of Fig. 1;

Fig. 3 is a fragmentary detail in section on the line 3—3 of Fig. 1;

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

Fig. 5 shows the machine in side elevation, with some parts broken away and some parts sectioned;

Fig. 6 is a fragmentary view in rear elevation, showing the hub and spindle structure of the machine, other parts of the machine being broken away;

Fig. 7 is a plan view of the machine with some parts sectioned; and

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

The frame of the machine, as shown, involves a hollow pedestal 9 suitably secured to the floor, and a head bracket 10 rigidly secured on the said pedestal. This head bracket 10 has a long horizontal bearing sleeve 11, which, at its front end, has an integral face plate or aligning flange 12. This bearing sleeve 11 has front and rear longitudinally spaced bushings 13 and 14 in which are journaled a heavy shaft 14, the front end of which is rigidly but detachably secured, as shown, by machine screws 15, to an annular so-called die wheel 16. This die wheel 16 has a peripheral forming groove 17 that is approximately semi-circular in cross section. The shaft 14 and forming die wheel 16 are designed to rotate in the direction of the arrow marked on Fig. 1.

Overlying the upper portion of the die wheel 16 is a segmental hopper bottom 18, which, in its under surface, is provided with a delivery channel 19 that is approximately semi-circular in cross section and is aligned with the upper portion of the so-called forming channel 17 of the die wheel. This hopper bottom 18, as shown, is rigidly, but detachably secured to the upper portion of the annular face plate 12, by means of bolts or machine screws 20 and, at its upper side, it is formed with a depressed pocket 21 that opens at one side directly against the face plate 12, and at its bottom, is in communication with the delivery channel 19 through a ball delivery port 22 that is of such size that only one ball at a time can pass there-through from the hopper pocket 21 to the said delivery channel 19.

The swaged or incompletely formed balls y are placed in a supply hopper 23 that is rigidly secured to the hopper bottom 21 and to the upper portion of the face plate 12 and delivers the balls directly to the hopper pocket 21. The hopper pocket 21, as shown, has a flanged bearing sleeve 24 located above the face plate 12 and at the back of the hopper; and in this sleeve 24 is mounted a short rock shaft 25 provided at its front end with a rigidly secured agitating blade 26 that works in the lower portion of the hopper 23 and in the hopper pocket 21. The lower end of this agitating blade 26 is arranged

to swing to and fro just above the ball delivery port 22, and to prevent the same from cutting or jamming a ball entered into and projecting upward from the said port, said blade is formed, at its extreme lower end, with an approximately semi-circular notch, as best shown in Fig. 5. At its rear end, the rock shaft 25 is formed with a projecting cam actuated arm 27 that is intermittently acted upon by a device hereinafter described.

Closely following the downwardly moving side of the die wheel 16 is a segmental concave die 28 (see particularly Figs. 1 and 2), that has a segmental forming channel 29 aligned with the forming channel 17 of the die wheel 16. This concave die 28 is supported by a heavy presser lever 30, which, at its lower end, is pivoted to the head bracket 10, on a heavy headed stud 31. The said concave forming die 28, as shown, is clamped to a flange of the lever 30 by means of machine screws 31^a, which permit slight adjustments thereof under the action of thrust screws 32. At its upper end, the presser lever 30 is spring-pressed toward the downwardly moving side of the die wheel 16, by a very strong spring device shown as made up of a thrust bolt 33 and coiled spring 34. This spring 34, under all normal conditions, of course, will hold lever 30 in a fixed position, so that adjustments of screws 32 will force die 28 inward. This thrust bolt 33, at its front end, is seated against the upper end of the presser lever 30, and at its outer end, works through a bearing on a heavy arm 35 that is integral with or rigidly secured to the head bracket 10. The spring 34 is compressed between the bearing end of the bracket 35, and an adjustable nut 36 on the said thrust bolt. Obviously, by adjustments of the nut 36, the spring pressure on the arm 30, and hence, on the segmental die 28, may be varied. The movement of the upper end of the lever 30, and hence, of the grooved concave edge of the die 28, toward the grooved face of the die wheel 16, is adjustably located by a stop screw 36^a that works through the upper end of the arm 30 and bears against a fixed bearing 37, which, as shown, is an integral part of the hopper base.

To receive the balls that have passed from the lower end of the concave die 28, a discharge spout 38 is secured to the lower portion of the face plate 12 and is provided at one side with an extended segmental flange 39 (see particularly Figs. 1 and 4), that terminates immediately against the lower end of the said die 28 and delivers the balls from the latter to the said spout. The spout 38 is located at the lower portion of the die wheel 16 and, as shown, delivers the balls to a receiving hopper 40, which, in turn, delivers them to a final delivery spout 41

from which they are directed to any suitable receptacle. The said parts 40 and 41 are shown as secured to the pedestal 9.

Oil will be supplied freely to the balls while they are passing through the forming grooves and this oil will tend to cause the formed balls to adhere to the forming channel 17 of the die wheel 16; and to overcome this and to insure the discharge of the balls from the said forming groove 17 into the sprout 18, a small scraper blade 42 is secured to the face plate 12, at one side of the spout and is provided with a lip that extends into the forming groove 17 of the said die wheel (see particularly Figs. 1 and 3), the said lip being sufficiently narrow to not interfere with the movement of the die wheel.

As a means for rotating the shaft 14 and die wheel 16, I provide a pulley 43 shown as in the form of a fly wheel. The hub of this pulley is shown as provided with a bushing 44 that directly runs on the front end portion of the bearing sleeve 11. Also, the hub of said pulley is provided with a long rigidly secured sleeve-like hub extension 45, the outer end of which runs directly on the outer portion of the bearing sleeve 11. At its outer end, the hub extension 45 has diametrically opposite notches that are engaged by diametrically opposite driving lugs 46 of a hub 47 that is rigidly secured on the outer end of the shaft 14. The said hub therefore affords sort of a half clutch that interlocks the hub extension 45, and hence, the driving pulley 43, for rotation with the shaft 14.

A metallic thrust washer or ring 48 (see Fig. 5) is rigidly secured to the end of the bearing sleeve 11 and overlaps a shoulder on the outer end of the extension hub 45 and holds the said extension hub and driving pulley 43 against axial movements but free for rotary movements. There is sufficient play between this washer 48 and the adjacent face of the clutch hub 47, and between the latter and the end of the extension hub 45, to permit a slight axial movement of the shaft 14, and hence, of the die wheel 12. Also, it is important to note (see Fig. 5) that there is slight play between the head of the pivot stud 31 and the adjacent end of the hub of the presser lever 30, so that the said lever, and consequently, the concave die 28, may partake of slight lateral movements. Experience has shown that these lateral movements of the die wheel and co-operating concave die are important. Such lateral movements may be very slight, usually not more than a thirty-second of an inch, and in the operation they will seldom be given such relative movement, but they are free, nevertheless, to automatically assume positions in which the balls, in passing between the forming channels 17 and 29 of the

die wheel and concave die, respectively, will set or hold the said channels automatically aligned. This arrangement obviates the setting of the die wheel and concave die with extreme accuracy as to relative lateral positions. It has been found in practice that by permitting a slight lateral motion of the die wheel and concave die that the best results of the rolling action have been secured on the balls. If the dies are rigidly adjusted, the balls must of necessity follow the grooves therein. When the dies are permitted to have the relative lateral movement set forth, the train of balls passing therethrough acts to aline the grooves and a superior product is obtained. The slight lateral movement of the dies apparently gives the balls a freer motion than the rigidly set dies. In fact, it would be practically impossible to set the said die wheel and concave die in lateral alignment for as good work as will be done by the said elements when they are free to adjust themselves to such alignment.

For operation the agitation blade 26, the hub of the driving pulley 43 is provided with a multiplicity of circumferentially spaced tappets, or cam-acting elements that are operative in succession on the free end of the arm 27 of the rock shaft 25 (see Figs. 5 and 8). As shown, these tappets are afforded by small rods 49 detachably set into bosses 50 on the hub of the said pulley 43. These rods 49 are replaceable when worn. Under rotation of the driving pulley, the rods 49 successively engage the arms 27 and oscillate the agitating blade 26 over the ball port 22. A leaf spring 51 anchored to the face plate 12 yieldingly presses the arm 27 normally into engagement with the hub of the driving pulley, as best shown in Fig. 8.

Under action of gravity, assisted by the agitation from the blade 26, the balls from the hopper pocket 21 will be delivered in succession through the port 22 into the forming channel 17 of the die wheel 16 and will be carried through the delivery channel 19 of the die block 18 into the forming channel 29 of the segmental die 28. In passing through the said channel 29, the balls will be rolled under high pressure against the same and against the forming channel 17 of the die wheel 16, and will be given a smooth, true spherical surface. Furthermore, these balls, by this rolling process, will be reduced to uniform diameter and their final diameter will be slightly less than the diameter of the original balls. Under the said rolling action under pressure, not only is there a rolling action, but there is a sliding or frictional engagement which produces a sort of a stratification and condensation of the surface of the balls and causes a sluffing off in the form of very thin flakes from the surfaces of the balls. This flak-

ing and sluffing off will be slight, but sufficient to produce the desired finish and slight reduction in size of the balls, and furthermore, this action has a hardening effect on the surface of the balls. The balls thus produced, will not be highly polished but may be subsequently polished by the customary buffing acting, when desired. The balls thus produced, will be hard enough for many purposes, but where extremely hard or high grade balls are desired, they may, of course, be tempered or otherwise hardened.

The purpose of making the elements 11, 14 and 45 of considerable length is to provide a wide bearing for the fly wheel and parts carried thereby and to afford means for connecting the extended portions of the members 14 and 45 beyond the member 11.

What I claim is:

1. In a machine for reducing and truing metal balls, the combination with a rotary die wheel having a peripheral forming channel, of a co-operating concave die having a forming channel, at least one of the said members being free for slight lateral movements with respect to the other, so that the balls, in passing through the said co-operating forming channels, will determine the relative lateral position of the said two members.

2. In a machine for reducing and truing metal balls, the combination with a rotary die wheel mounted for slight lateral movements and having a peripheral ball-forming channel, of a pivoted spring-pressed presser lever capable of slight lateral movements and provided with a concave die having a ball forming channel arranged for co-operation with the ball forming channel of said die wheel.

3. In a machine for reducing and truing metal balls, the combination with a rotary die wheel having a peripheral forming channel, of a co-operating concave die having a forming channel, at least one of the said members being free for slight lateral movements with respect to the other, so that the balls, in passing through the said co-operating forming channels, will determine the relative lateral position of the said two members, a ball supplying hopper having a discharge port arranged to deliver the balls, one at a time, directly to the peripheral groove of said die wheel.

4. In a machine for reducing and truing metal balls, the combination with a rotary die wheel having a peripheral forming channel, of a co-operating concave die having a forming channel, a ball supplying hopper having a discharge port arranged to deliver the balls, one at a time, directly to the peripheral groove of said die wheel, and an automatically operated agitating blade working in said hopper immediately above the discharge port thereof.

5. In a machine for reducing and truing metal balls, the combination with a rotary die wheel having a peripheral forming channel, of a co-operating concave die having a forming channel, a ball supplying hopper having a discharge port arranged to deliver the balls, one at a time, directly to the peripheral groove of said die wheel, and an automatically operated agitating blade working in said hopper immediately above the discharge port thereof, the said agitating blade having a clearance notch in its lower end immediately above said port.
6. In a machine for reducing and truing metal balls, the combination with a rotary die wheel having a peripheral forming channel, of a co-operating concave die having a forming channel, at least one of the said members being free for slight lateral movements with respect to the other, so that the balls, in passing through the said co-operating forming channels, will determine the relative lateral position of the said two members, and a scraper blade fitting the lower portion of the forming channel of said die wheel to insure discharge of the formed balls therefrom.
7. In a machine for reducing and truing metal balls, the combination with a frame bracket having a rigid tubular spindle, a shaft rotatable in said spindle and provided at its front end with a die wheel having a peripheral ball forming channel, a concave die having a ball forming channel co-operating with the forming channel of said die wheel, and a driving wheel journaled on said tubular spindle and provided with a long sleeve-like hub, the rear end of which is connected to the rear end of said die wheel shaft for rotation therewith.
- In testimony whereof I affix my signature in presence of two witnesses.
- JAMES P. APPLEBY.
- Witnesses:
CLARA DEMAREST,
F. D. MERCHANT.