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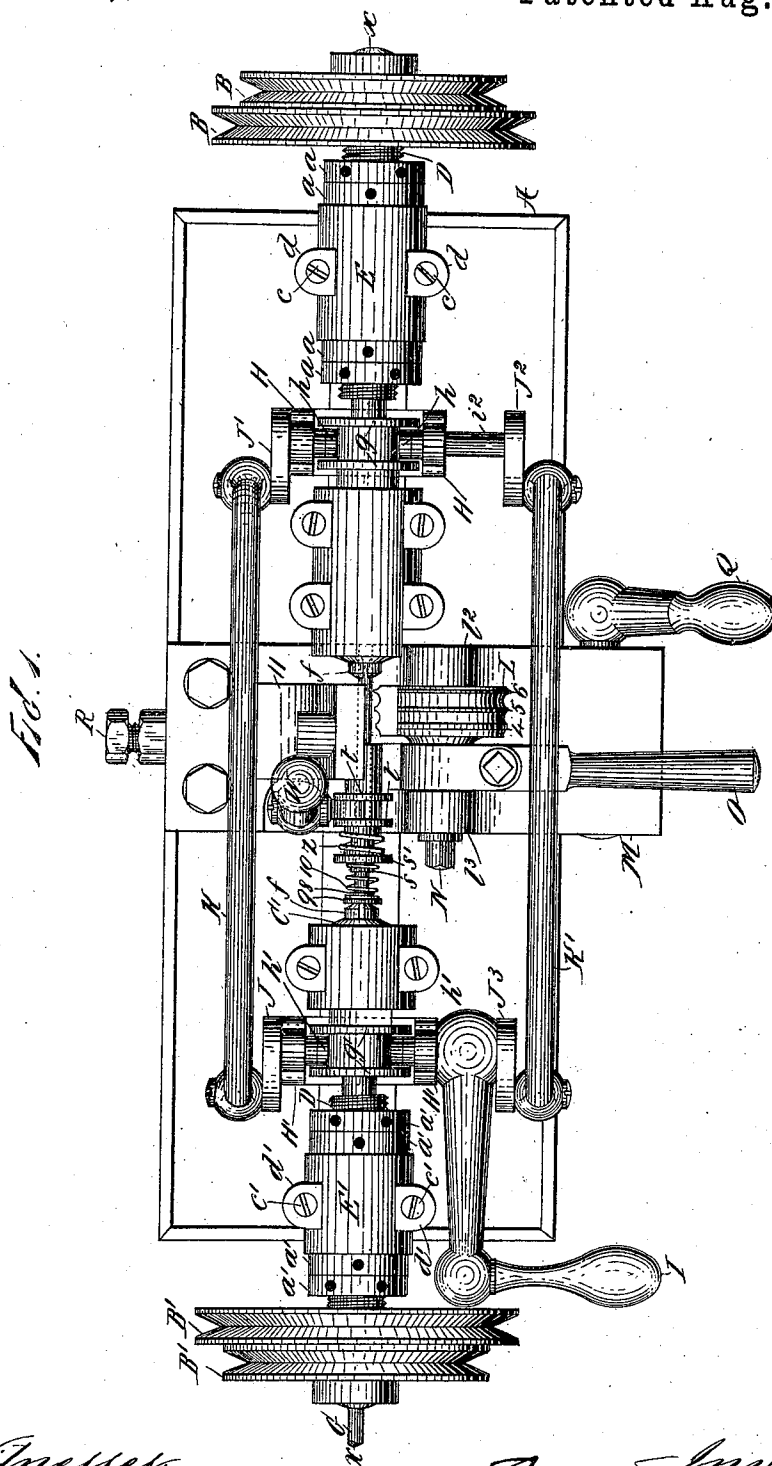
4 Sheets—Sheet 1.

E. G. HOFFMANN.

MACHINE FOR MANUFACTURING METAL BALLS, &c.

No. 504,083.

Patented Aug. 29, 1893.



Witnesses:
John Buckler,
E. M. Taylor.

Inventor:
Ernest Gustav Hoffmann,
By *Sperry & Smith*
Attorneys.

(No Model.)

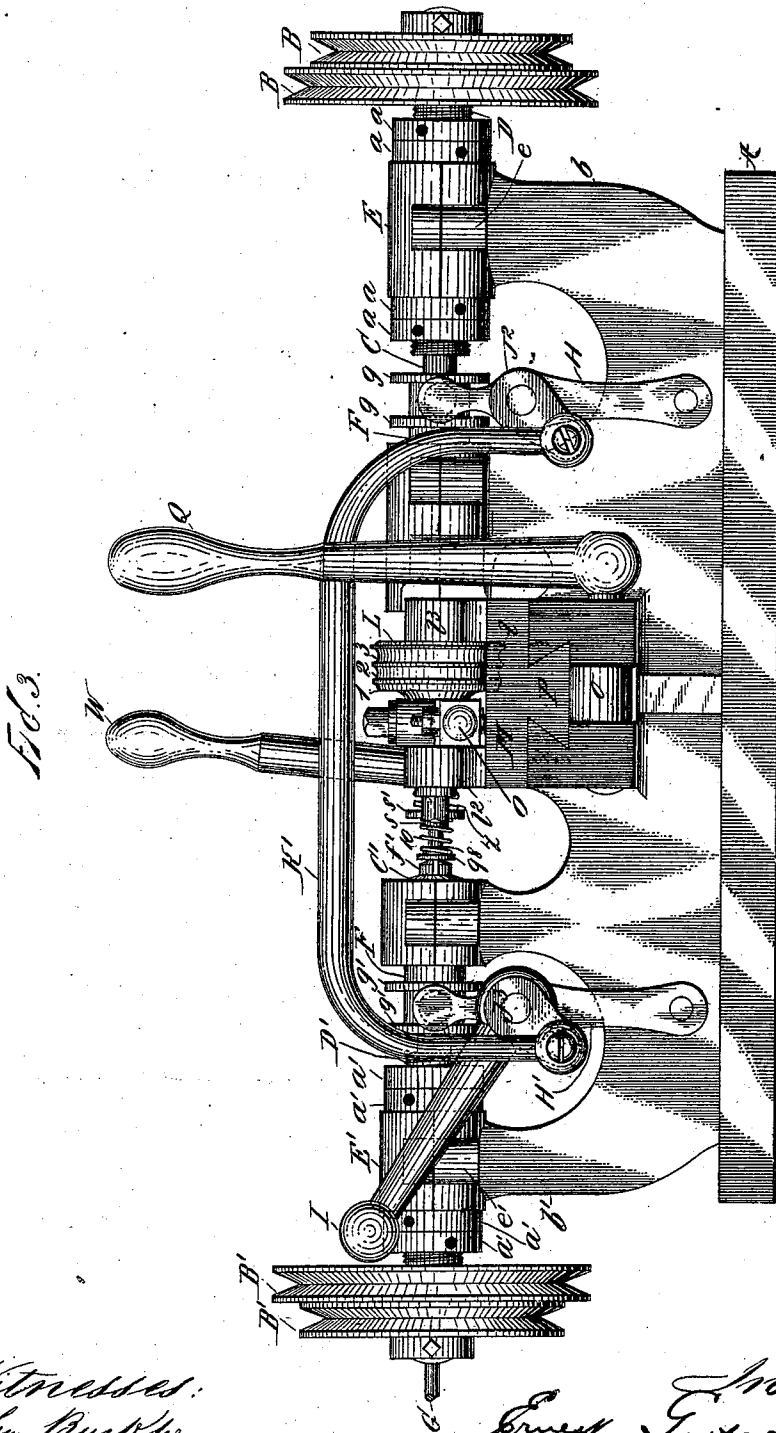
4 Sheets—Sheet 3.

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MACHINE FOR MANUFACTURING METAL BALLS, &c.

No. 504,083.

Patented Aug. 29, 1893.



Witnesses:
Wm. Buckler,
E. M. Taylor.

Inventor:
Ernest Gustav Hoffmann
By Peaslee & Stiddle
Attorneys.

(No Model.)

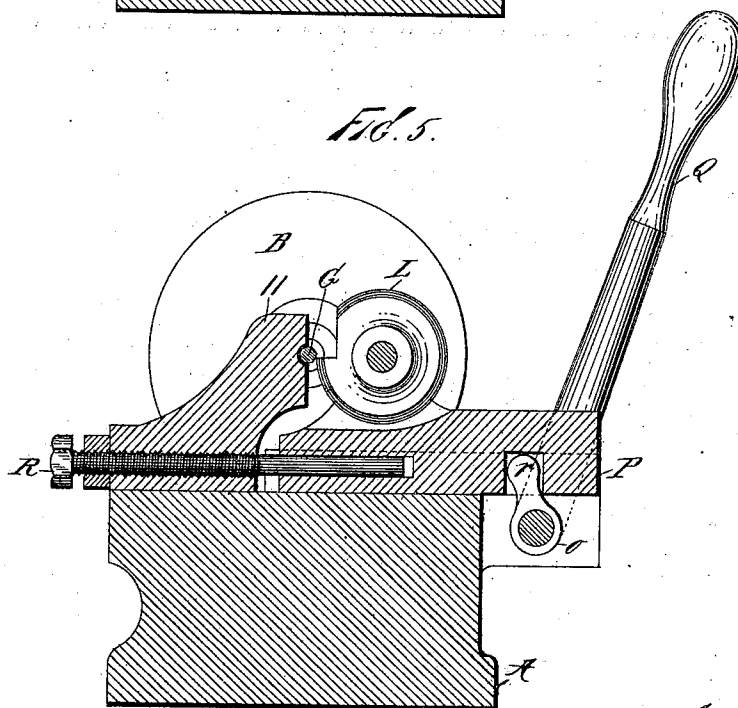
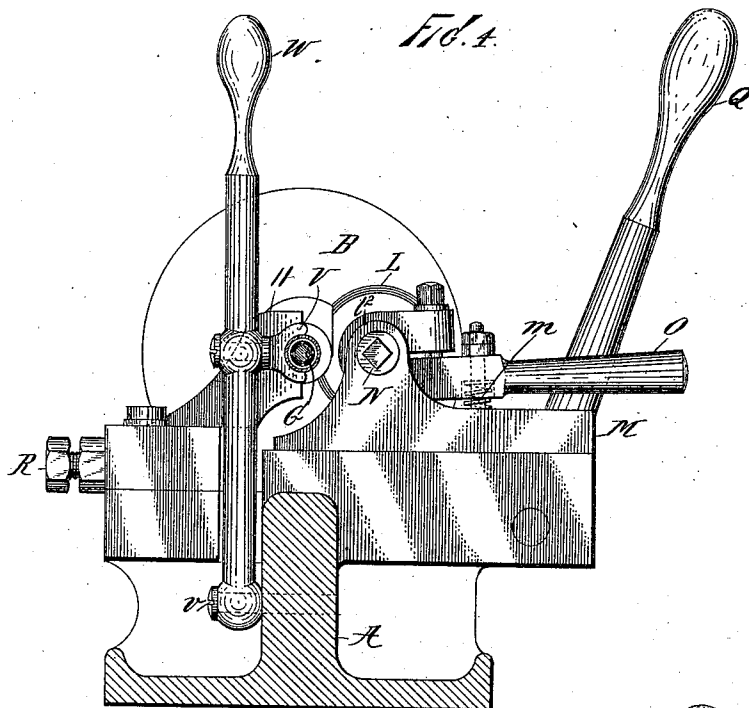
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John Buckler,
E. M. Taylor,

Inventor:
Ernest Gustav Hoffmann
By *Sperry, Kieckhefer & Co.*
Attorneys.

UNITED STATES PATENT OFFICE.

ERNEST GUSTAV HOFFMANN, OF NEW YORK, N. Y.

MACHINE FOR MANUFACTURING METAL BALLS, &c.

SPECIFICATION forming part of Letters Patent No. 504,083, dated August 29, 1893.

Application filed February 13, 1893. Serial No. 462,199. (No model.)

To all whom it may concern:

Be it known that I, ERNEST GUSTAV HOFFMANN, a subject of the Emperor of Germany, residing at New York city, in the county and State of New York, have invented certain new and useful Improvements in Machines for Manufacturing Metal Balls and Like Articles, of which the following is a specification.

My invention relates to machines for making metal balls and other like articles for use as ball bearings and rollers of small diameter by which such metal articles may be produced or turned from a metal rod, the machine embodying my invention being capable of producing such articles with great speed and economy and a large number in a very short period of time, the machine being so constructed and operated that the rod from which the balls are to be produced is inserted at one end or side thereof, and the finished ball or balls cut therefrom in a continuous operation.

I will describe my invention in connection with the manufacture of small balls or spheres for the purposes above-mentioned and in the accompanying drawings, forming a part hereof, I have illustrated one form or construction of machine embodying my invention which is more particularly set out in the claims hereinafter following, comprising part of this specification.

Like letters and figures denote corresponding parts in all the figures.

Figure 1 is a top view of a machine embodying my invention. Fig. 2 is a central vertical lengthwise section taken through line $x-x$ of Fig. 1. Fig. 3 is a side view in elevation looking in the direction of the arrow or from the side to which the arrow is pointing in Fig. 1. Fig. 4 is a vertical section taken through line $y-y$ of Fig. 1. Fig. 5 is a view partly in elevation and partly in section taken through line $w-w$ of Fig. 1; and Fig. 6 is a detail view partly in section showing the rod that has been inserted from one end or side of the machine with one ball completely turned or severed from the rod and held in the chuck at the other or opposite end of the machine while the others are being turned or cut from the same rod by the cutting mechanism, shown in elevation in that figure.

By my invention a rod or bar is securely

held at one end by a chuck or clutching device and the rod or bar is rapidly revolved in front of a suitable cutting and forming tool, which in the device shown in the drawings consists of a circular metal piece having a number of grooves and corresponding cutting edges on its periphery which are so arranged that while one ball is being roughed out or fashioned others from the same rod are being further worked on, and one is being severed from the rod or bar and finished, the cutting edge for this purpose being made in step form or increasing in length or depth to one end or side so as to correspondingly increase the degree of penetration into the rod, as shown in Figs. 1, 3 and 6.

For the purpose of holding the last ball or the one being finished a chuck or clutching device is arranged to grip it at the proper time, the chuck being revolved at the same rate of speed as the rod by means of separate driving mechanisms. The chuck is adapted to hold the ball for a short time after it is severed, at the same point or in the same position as it was when it was completely cut from the rod, and before it has been advanced to make way for another ball, so that the severing edge of the tool will have an opportunity to remove the fin or projection which is usually left on the ball, and then the chuck is opened to release the ball which is afterward forced into it by the rod as it is advanced to present a fresh portion of the rod to the tool as shown in Fig. 6, the finished balls being forced in succession, or one after the other, after they have been wholly severed from the rod and finished into the tube or hollow shaft D, to be described hereinafter, and they will be crowded out therefrom in the operation of the machine, rolling or falling into any desired receptacle or place provided for the purpose, as will be more clearly understood from the detailed description following.

In producing large quantities of the desired articles the cutting edge will of course become blunt after a period of time, and to prevent the blunt edge from causing a fin to be left on the ball after it has been severed, I arrange the tool so that it is presented to the rod centrally or slightly below the center of the rod, and at the moment of finishing or

severing the ball, or when the ball has been formed and the tool has reached its stop, the tool is raised slightly by suitable means as by levers shown in the drawings, and is thus caused to pass the center of the rod and severed ball and thereby effectually cuts off or removes from the ball any fins or projections that may be left thereon, as also shown in Fig. 6. These hand levers are preferably so arranged that the one which is employed for moving the tool forward into position with relation to the rod, so that it may operate on the rod, is so placed or combined with regard to the one that is employed for giving the lifting motion to the tool, above-referred to, as will enable the operator to work them without shifting his hand; or if desired a single lever arranged to produce the double motion and operation may be employed.

In the drawings A represents a base or bed-plate from which rise the several standards or uprights which provide bearings and supports for the revolving and other parts of the machine.

B B are grooved pulleys or wheels adapted to be connected by suitable belting to a driving mechanism for the purpose of rotating the chuck or clutch C above referred to which chuck is intended to clutch the rod and hold the severed ball as before stated; and B' B' are two similar grooved pulleys or wheels also adapted to be connected by suitable belting to a driving mechanism, said pulleys B' B' being adapted to rotate at the same rate of speed as the pulleys B B, but by separate belting in order to rotate the clutch C' which grasps the rod and thereby rotates it. Through each of the pulleys B B and B' B' passes a tube or hollow shaft D D' screw-threaded at their inner ends and also near their outer ends and over which screw-threaded portions are secured jam-nuts *a a*, *a a* and *a' a'*, *a' a'*, and between these nuts is placed over the shafts D D' a cap E E' fastened over a recessed portion in the upper surface of the standards *b b'* which standards provide bearings for such shafts or tubes, and the caps E E' are fastened to the uprights *b b'* by means of screws *c c* and *c' c'* which pass through lugs *d d* and *d' d'* on the caps and into corresponding lugs *e e* and *e' e'* as clearly shown in the drawings, thereby providing a firm substantial bearing for the shafts as they rotate. To the inner end of each of the shafts D D' is screwed or otherwise fastened a tube C C' which has its inner end thickened as shown at *f f'* at which end the tube is split so that when the tube F F' which is sleeved thereover is forced to one end or the other of said tubes C C' it will draw together the split portions of the tubes C C' making the diameter of the tube at that point smaller, whereby the tube will comprise a chuck and clutch the rod G which is passed therethrough; and in order to move the tube F F' so as to enable it to operate the chuck C C' and in order that each chuck may operate simultaneously or grasp the rod at

the same time, the tubes F F' are provided with collars *g g*, *g' g'*, which are engaged by the inwardly projecting arms *h h* and *h' h'* which are supported at the upper ends of the upright arms H H, H' H' located on both sides of the tubes F F' and connected together by a cross bar *i i'* which passes underneath the tubes F F', and which uprights are securely fastened near the bottom of the base A by bolts *j j'* upon which bolts the uprights are adapted to turn slightly by means of the hand lever I one arm of which passes through one of the cross-bars *i i'* and connected at one end with a link J to which link is also connected one of the curved arms K the other end of which curved arm being connected with a corresponding link J' at the other end of the machine, to which link is also connected another rod *i²* which passes through the other cross-bar *i'* to the other end of which cross-bar *i'* is connected one end of a similar curved cross-bar K', the one end of which curved arm K' is connected with the link J', the other end of which curved arm being connected with a link J³ connected with the lever I and which is adapted to be operated thereby. Thus it will be seen that the two clutches C and C' will be operated at the same time, one of which grasps the body of the rod and the other one end of the rod, as shown in Fig. 2, or the severed ball as shown in Fig. 6, and both chucks are rotated at the same rate of speed but by separate driving belts or mechanisms, and the chuck C holds the severed ball in the same relation to the cutting device which it occupied before it was severed for the purpose of removing the fin or projection as hereinbefore referred to. After the rod has been inserted as shown in Fig. 3, in order to rotate the rod the hand-lever I is operated so that it will cause the tubes F F' to slide over the split enlarged ends of the chucks C C' which will be thereby bound or fastened to the rod sleeved there-through and by rotating the pulleys B B and B' B' by suitable gearing separate from each other the shafts D D' will be revolved thereby revolving the chucks C C' which will rotate the rod; and to release the rod to stop its rotation the lever is reversed whereby the chuck is opened as will be readily understood.

L is a cutting and forming device circular in form having grooves 1, 2, 3 on its periphery and with an extending or projecting portion *l* which is produced by cutting away a portion of the periphery, as shown in Figs. 1 and 5, and the periphery also has the corresponding projecting edges or tongues 4, 5, 6 which grooves and tongues or edges are adapted to operate upon the rotating rod so as to simultaneously form or fashion balls therefrom, the grooves 1 and 2 and tongues 4 and 5 forming or partially forming balls while the groove 3 and edge or tongue 6 are completely finishing a ball and severing it from the rod by the edge 6, which is longer or higher than the others, the tongues and grooves being made

of different heights or depths as shown in Figs. 1, 3 and 6. This cutting and forming device is secured to a base-plate M from which rise uprights $\mathcal{P}$ which provide bearings for a shaft N on which the cutting and forming device is fastened at one end and between which and the upright $\mathcal{P}$ is placed a lever or arm O also fastened to the shaft N at one end of said lever O, by which lever the cutting and forming device is raised after one of the balls has been severed and is held by the chuck C so as to remove the fins or projections that may be left on the balls, the cut-away portion of the cutting device being arranged slightly below the center of the rod so that when the cut-away portion is raised by pressing upon the lever O the edge 6 will remove the fins; that is to say the cutting edge 6 when it is raised by the lever O will remove the fin from the left side of the severed ball in the chuck at the same time removing the fin from the right side of the adjacent ball, and it will of course be understood that when the rod is inserted and after the balls have been formed thereon the one to the extreme right, looking at the drawings, which will be completely formed and severed by the edge 6 of the cutting device will have the fin removed from that side of the ball by the cutting device and when the rod is advanced in the manner to be presently explained, the other side of the severed ball or the side to the left, looking at the drawings, (the ball being held in the chuck C) will be in such position as will enable the edge 6 of the cutting device to sever or remove the fin on that side of the ball; and this operation of removing the fins first from one side of the ball and then from the other is the same as each ball is formed and severed. The lever O is restored to its original position by means of a spring m (see Fig. 4) suitably housed between the under side of said lever and the plate M, the tension of which spring being upward, but of course any other suitable device may be used to restore the lever to its normal position. The base-plate M is adapted to move on a projecting portion or bed P of the base A traveling in a dove-tail slide n , the plate M being moved backward and forward therein by means of a lever Q connected with one end of a link o the upper end of which extends into a socket r on the under side of the plate M (see Fig. 5) whereby as the lever Q is moved backward and forward the plate M and with it the cutting and forming device L will also be moved backward and forward away from or to the rod G, intended to be formed and cut; and in order to limit the forward motion of the plate M and the cutting device L, an adjustable device or screw or bolt R is passed through from one side of the base A, the inner end of which protrudes into an opening made therefor in the plate M as shown in Fig. 5.

In order to advance the rod, I provide the following mechanism: Between the two clutches C and C', is located another clutch S which

also consists of a section of a piece of tubing split on one end and thicker at the other over which is sleeved the piece of metal tubing T having two collars t thereon between which said sleeve is grasped by the arms of the curved piece V to which curved piece is attached a lever W which lever is pivoted to the base A on the pivot or bolt v on which the latter turns whereby the sleeve T is moved in one direction or the other over the clutch S. To the left of the clutch S or the collar t' on the tube T is arranged another short section of a piece of metal tubing s with a collar s' thereon and between which and the clutch S is placed a comparatively stiff coiled spring Z. To the other side of the piece of tubing s is placed another piece of tubing 8 with a collar 9 thereon, between which and the tube s is located a spring 10 of less tension than the coiled spring Z. The operation of this mechanism is as follows: After the rod has been inserted the lever I is operated so as to close both clutches C and C' on to the rod whereby the rod is rotated as before explained, and the cutting and forming mechanism is then moved in to its stop near the clutch C so as to form and cut the balls on the rod and after one of the balls has been completely severed on the right side thereof by the edge 6 by raising the cutting device by the lever O in the manner before explained, the rod must be advanced in order to present another portion thereof to the action of the forming and cutting device, and in order to enable the chuck C to receive the formed ball and expose the left hand surface thereof to have the fin removed therefrom by the cutting mechanism through the action of the lever O (the chucks C C' still being tight to the rod and the rod rotating), the lever W is taken and forced to the left moving the tube T by means of the curved piece V engaging with the collar t' whereby the clutch S is made to bind the rod at that point, and whereby that clutch will then rotate with the rod, and the lever W is forced to the left compressing the springs Z and 10 between their seats or bearings, and the parts are held in their tight or closed position at that point by means of the engagement of the tube T with the clutch S, the tension of the spring 10 not being sufficient to overcome the binding power of the clutch S; and to advance the rod the lever I is again taken and moved over to the right to the end of its motion whereby both the clutches C and C' are opened and the rod freed at those points, and the spring 10 will then force the piece of tubing s away to the right forcing with it the clutch S which carries to the right the rod the distance that the clutch moves, which is a predetermined one, the sleeve T being still on the clutch S holding it closed onto the rod, and the spring Z being still compressed between its bearings; and in order to release the clutch S the lever W is moved to the right sliding the sleeve T from off the top of the clutch, when the spring Z

will retain the parts in their normal position again, and the amount of advance of the rod is determined by the distance between the outer or narrow end of the clutch S or end to the right, looking at the drawings, (at which point the clutch grasps the rod,) and the left hand end or edge of the metal piece 11 against which the right hand end of the clutch S rests, as does also the right hand collar *t* of the tube T when the clutch S is open and the lever W can only be moved so far away from its normal position as will enable the clutch to bind the rod at the predetermined distance as above stated.

The operation of the machine shown in the drawings and hereinbefore described will be clearly understood from the foregoing description, but it is to be understood that I do not limit my invention to the precise construction of parts shown in the drawings and herein described, nor to their relative arrangement making up the machine shown in the drawings; and it is also to be understood that the movements of the parts of the machine hereinbefore described may be accomplished automatically as by means of cams or otherwise instead of by the use of the separately operated hand levers shown in the drawings and described herein.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a machine for making balls and other like articles from a metal rod which is adapted to rotate the combination of a cutting and forming device adapted to form or fashion two or more balls on said rod at the same time and to completely sever one of said balls so formed while the others are forming, and means for holding the said ball so severed in position in the same relation to the cutting device which it occupied before it was severed so that it may be further operated upon by said cutting device to remove any fins or projections that may be left thereon, and thereby finish said ball before it has been released or removed from the machine.

2. In a machine for making balls and other like articles from a metal rod which is adapted to rotate, the combination of a cutting and forming device adapted to form or fashion two or more balls on said rod at the same time and to completely sever one of said balls so formed while the others are forming, and means for holding the said ball so severed in position so that it may be further operated upon by said cutting device to remove any fins or projections that may be left thereon, said holding means being adapted to rotate so as to rotate the severed ball while the said cutting device is removing the fins or projections therefrom, and thereby finish said ball before it has been released or removed from the machine.

3. In a machine for making balls and other like articles from a metal rod which is adapted to rotate, the combination of a cutting and forming device adapted to form or fashion two or more balls on said rod at the same time and

to completely sever one of said balls so formed while the others are forming, and means for holding the said ball so severed in position so that it may be further operated upon by said cutting device to remove any fins or projections that may be left thereon, and thereby finish said ball before it has been released or removed from the machine, and means for advancing the rod so that another ball may in like manner be severed therefrom and finished by the said cutting and forming device while still others are being formed on the rod.

4. A machine for making balls and other articles from a metal rod or bar which has in combination means adapted to rotate so as to rotate the rod or bar, means for forming thereon two or more balls at the same time, means for severing one of said balls while the others are being formed, means to hold the severed ball while any fins or projections which may remain thereon are being removed or cut therefrom, means adapted to rotate said holding means to rotate the severed ball while said fins or projections are being removed and the ball completely finished by said forming and severing means before said ball has been released or removed from the machine and means for advancing the rod or bar so that other balls may be in like manner formed, severed and finished, all arranged so that they will operate substantially as and for the purposes herein set forth.

5. In a machine for making balls and other articles from a metal rod or bar which is adapted to rotate, the combination of a cutting and forming device adapted to be moved to and away from said rod, said cutting and forming device being also adapted to form two or more balls thereon at the same time and to completely sever one of said balls so formed while the others are forming and means forming part of said cutting and forming device for removing the fins on each side of the ball, and thereby finish said ball before it has been released or removed from the machine.

6. In a machine for making balls from a metal rod, the combination with means for holding or clutching the rod at two points, said means being adapted to rotate in order to rotate said rod, of a cutting and forming device adapted to form or fashion two or more balls on said rod at the same time and to completely sever one of said balls so formed while the others are forming, and means for holding the severed ball so that it may be operated upon to remove any fins or projections that may be left thereon.

7. In a machine for making balls and other articles from a metal rod or bar, the combination with means for rotating said rod, of a cutting and forming mechanism located a little below the center of said rod, said cutting and forming device being adapted to form two or more balls on said rod at the same time and to completely sever one of said balls so formed while the others are forming and a device for

raising the cutting mechanism to remove any fins or projections that may be left on the severed ball.

8. In a machine for making balls and other articles from a metal rod the combination with two chucks or clutches adapted to rotate, said clutches being adapted to operate to clutch said rod which is passed therethrough in order to rotate said rod, of a cutting and forming device located between said clutches slightly below the center of said rod adapted to form two or more balls thereon at the same time, and to completely sever one of said balls so formed while the others are forming, one of said clutches being arranged to hold the severed ball and to rotate it so that it may be further operated upon by the cutting device in order to remove any fins or projections that may be left thereon.

9. In a machine for making balls and other articles from a metal rod which is adapted to rotate, the combination of a cutting and forming device adapted to form two or more balls thereon at the same time and to completely sever one of said balls while others are forming, consisting of a circular metal piece having grooves and edges on its periphery of varying depths and lengths, said cutting and forming device being adapted to be operated so as to remove any fins or projections that may be left on the severed ball and thereby finish said ball before it has been released or removed from the machine substantially as set forth.

10. In a machine for making balls and other articles from a metal rod which is adapted to rotate, the combination of a cutting and forming device adapted to form two or more balls thereon at the same time and to completely sever one of said balls while others are forming, consisting of a circular metal piece having grooves and edges on its periphery of varying depths and lengths, said circular piece having a portion of its periphery cut away, adapted to be raised so that one edge of the cut-away portion will operate to sever the fins on the balls as the device is raised, and thereby finish the severed balls before they have been released or removed from the machine, substantially as set forth.

11. In a machine for making balls and other articles from a metal rod which is adapted to rotate, the combination of a cutting and forming device adapted to form two or more balls thereon at the same time and to completely sever one of said balls while others are forming and thereby finish said severed ball before it has been released or removed from the machine, and means for advancing the rod a predetermined distance so that another ball may in like manner be severed therefrom by the cutting and forming device.

12. In a machine for making balls and other articles from a metal rod which is adapted to rotate, the combination with a cutting and forming device adapted to form or fashion two or more balls on said rod at the same time,

and to completely sever one of said balls so formed while others are forming, and means for advancing the rod a predetermined distance so that another ball may in like manner be severed therefrom, while others are forming, consisting of a chuck or clutching device adapted to operate by the movement of a lever in one direction to clutch the rod and by the movement of a lever in the opposite direction to advance the rod a predetermined distance before the clutch opens, substantially as set forth.

13. In a machine for making balls from a metal rod or bar, the combination with the chucks C and C' adapted to be operated to clutch the rod by the movement of the lever I in one direction, of the cutting and forming device L adapted to be moved backward and forward by the lever Q and raised by the lever O, the chucks C and C' being adapted to be simultaneously opened to release the rod by the movement of the lever I in the opposite direction, substantially as and for the purpose set forth.

14. In a machine for making balls from a metal rod or bar which is adapted to rotate, the combination with the chucks C and C' adapted to be operated to clutch the rod by the movement of the lever L in one direction and to be opened to release the rod by the movement of said lever in the opposite direction, the cutting and forming device L being adapted to be moved backward and forward by the lever Q and to be raised by the lever O, the clutch S adapted to be operated by the lever W to clutch the rod, the spring Z and spring 10, said spring 10 operating to move or advance the rod a predetermined distance when the lever I is moved to open the chucks C and C', substantially as set forth.

15. In a machine for making metal balls and other articles from a metal rod which is adapted to rotate, the combination with a cutting and forming device adapted to form or fashion two or more balls on the same rod at the same time and to completely sever one of said balls so formed while the others are forming and means for advancing the rod a predetermined distance so that other portions of the rod may be presented to the cutting and forming device for operation consisting of a chuck or clutching device adapted to clutch the rod and a spring to force or move said clutch and with it the rod a predetermined distance before said clutch is opened, substantially as set forth.

16. In a machine for making balls from a metal rod, the combination of a rotating clutch to grasp the rod at one point and a separate rotating clutch to receive and hold the ball after it has been fashioned from the rod and before it has been finally severed therefrom, said clutch being also adapted to hold the said ball after it has been severed in the same relation to the cutting device as it was before it was severed, said cutting device being adapted to remove the fin therefrom and

thereby finish said severed ball before it has been released or removed from the machine, substantially as set forth.

17. In a machine for making balls and other articles from a metal rod which is adapted to rotate, the combination of a cutting and forming tool consisting of a circular metal piece having grooves and edges on its periphery of various depths and lengths, a portion of the periphery of said tool being cut away, said tool being adapted to form or fashion two or more balls on the rod and to completely sever one of said balls at the same time, said tool being also adapted to be operated to remove the fins from the severed ball, and thereby finish the severed ball before it has been released or removed from the machine, substantially as set forth.

18. In a machine for making balls and other articles from a metal rod the combination with two rotating spindles adapted to rotate at the same rate of speed by separate driving

mechanisms, said spindles being adapted to clutch the rod at different points between which is located a cutting device or tool adapted to be moved to and away from the rod and to form or fashion several balls therefrom at the same time, a portion of the cutting device partially forming the ball from one part of the rod while another part of the said device completely severs a ball from an adjoining part of the rod, and which cutting and forming device is also adapted to be operated to remove the fins from the severed balls and thereby finish said severed balls before they are released or removed from the machine, substantially as set forth.

This specification signed and witnessed this 17th day of January, A. D. 1893.

ERNEST GUSTAV HOFFMANN.

In presence of—

E. M. TAYLOR,

M. GIBSON.