No. 756,212. PATENTED APR. 5, 1904.

A. C. CAMPBELL.

MACHINE FOR FORMING BALLS.

APPLICATION FILED MAY 9, 1903.

NO MODEL. 7 SHEETS—SHEET 1.

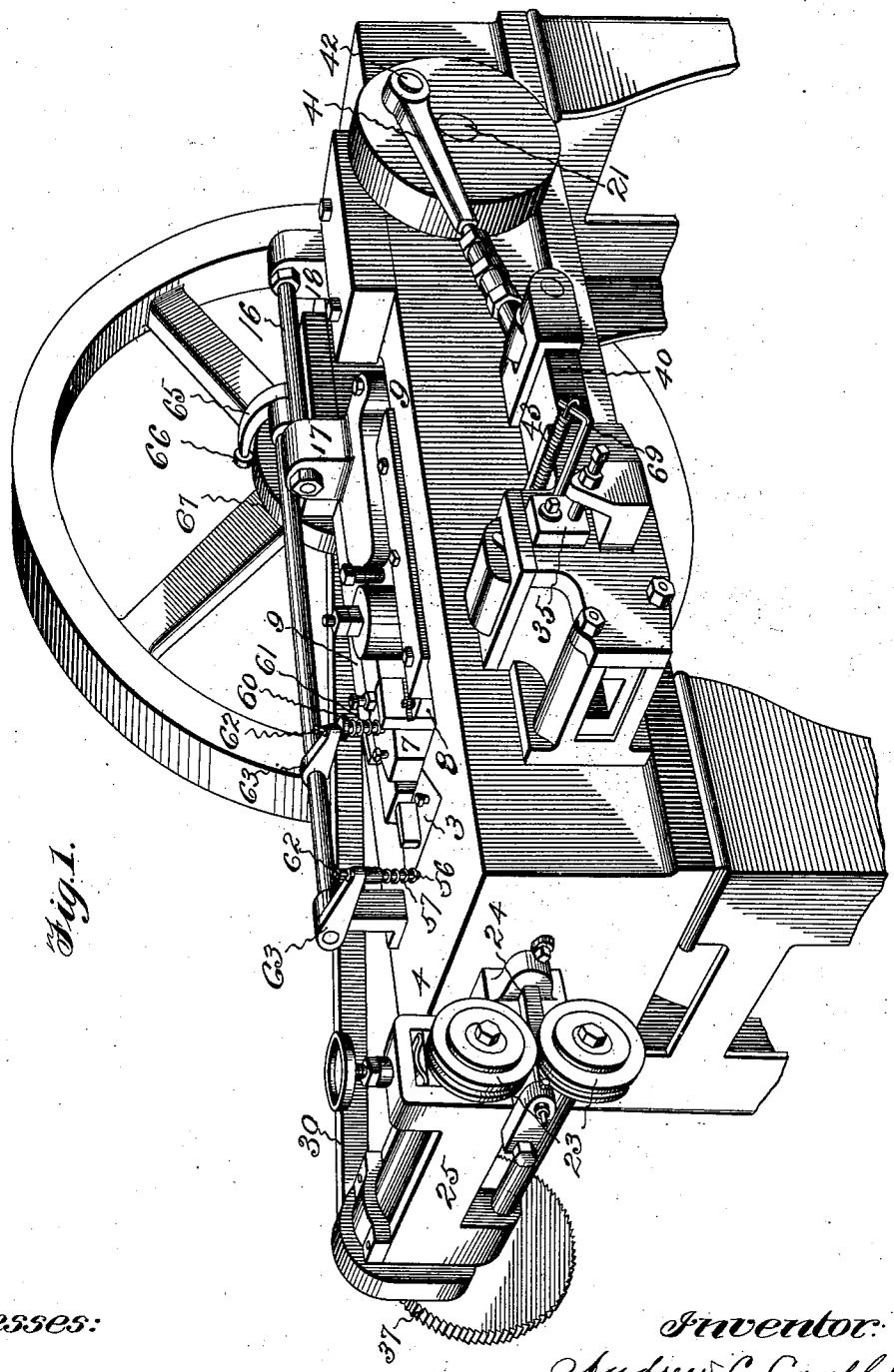


Fig. 1.

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By his Attorney.

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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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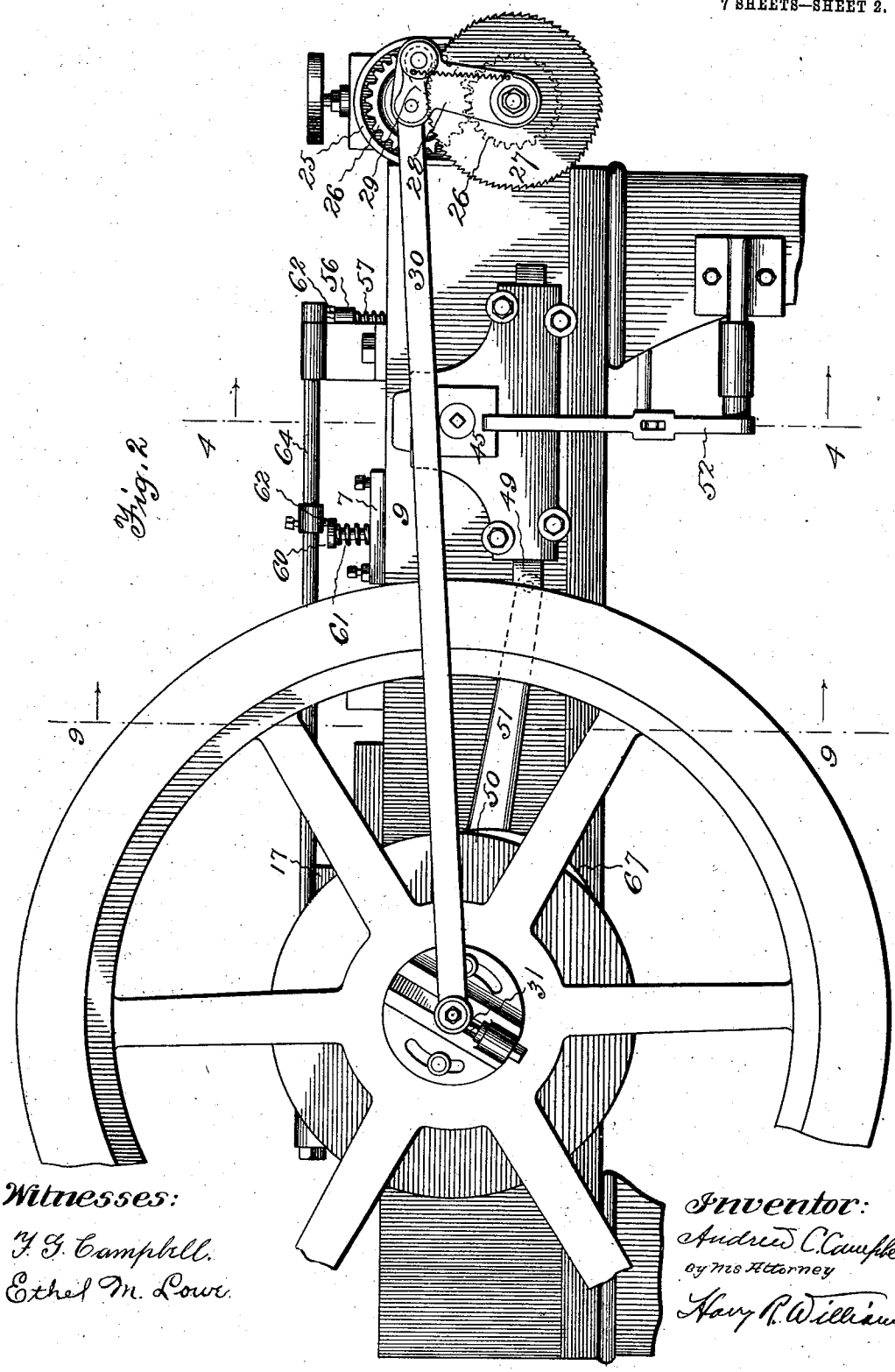
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NO MODEL. 7 SHEETS—SHEET 2.

Fig. 2



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NO MODEL. 7 SHEETS—SHEET 3.

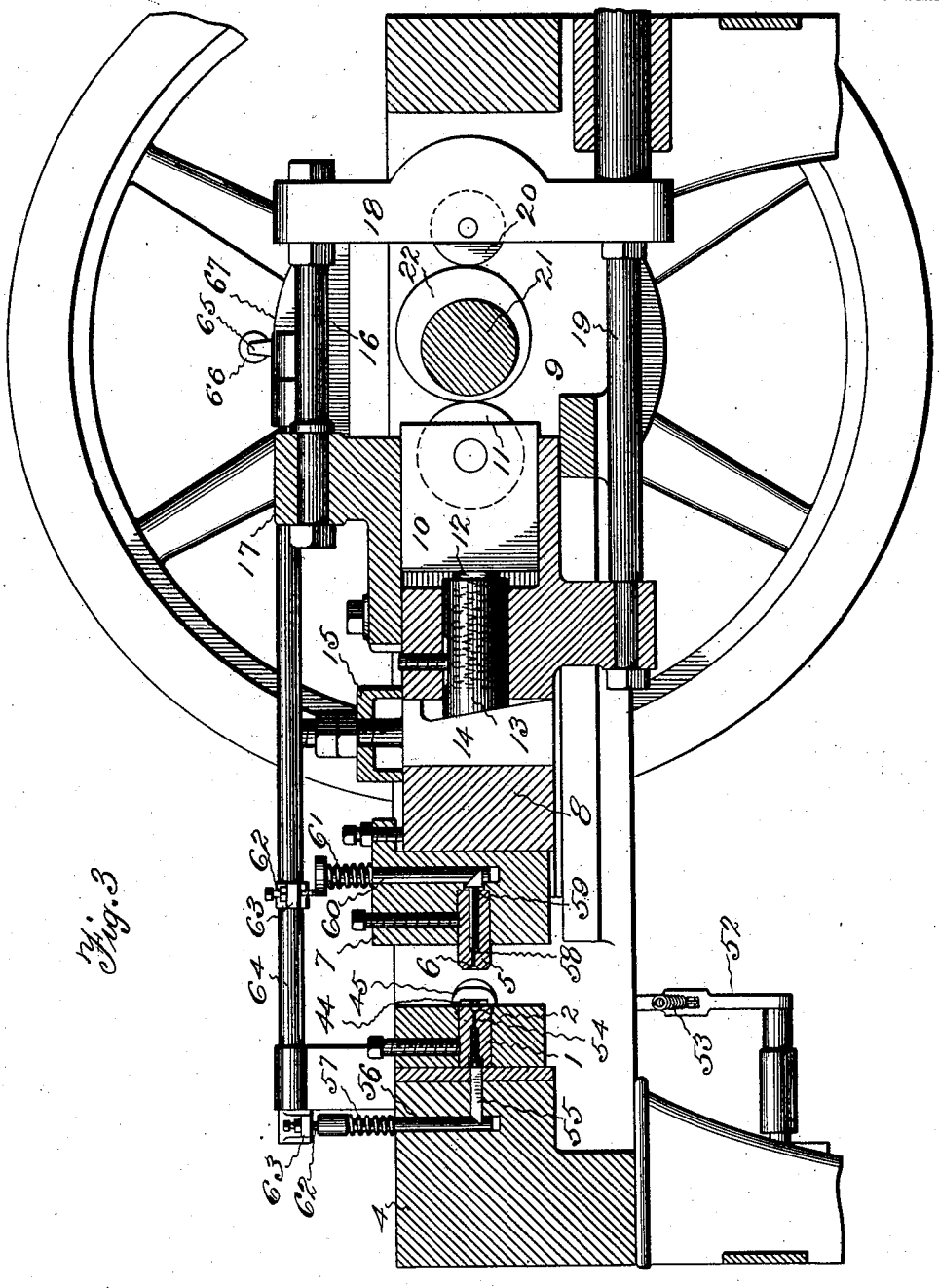


Fig. 3

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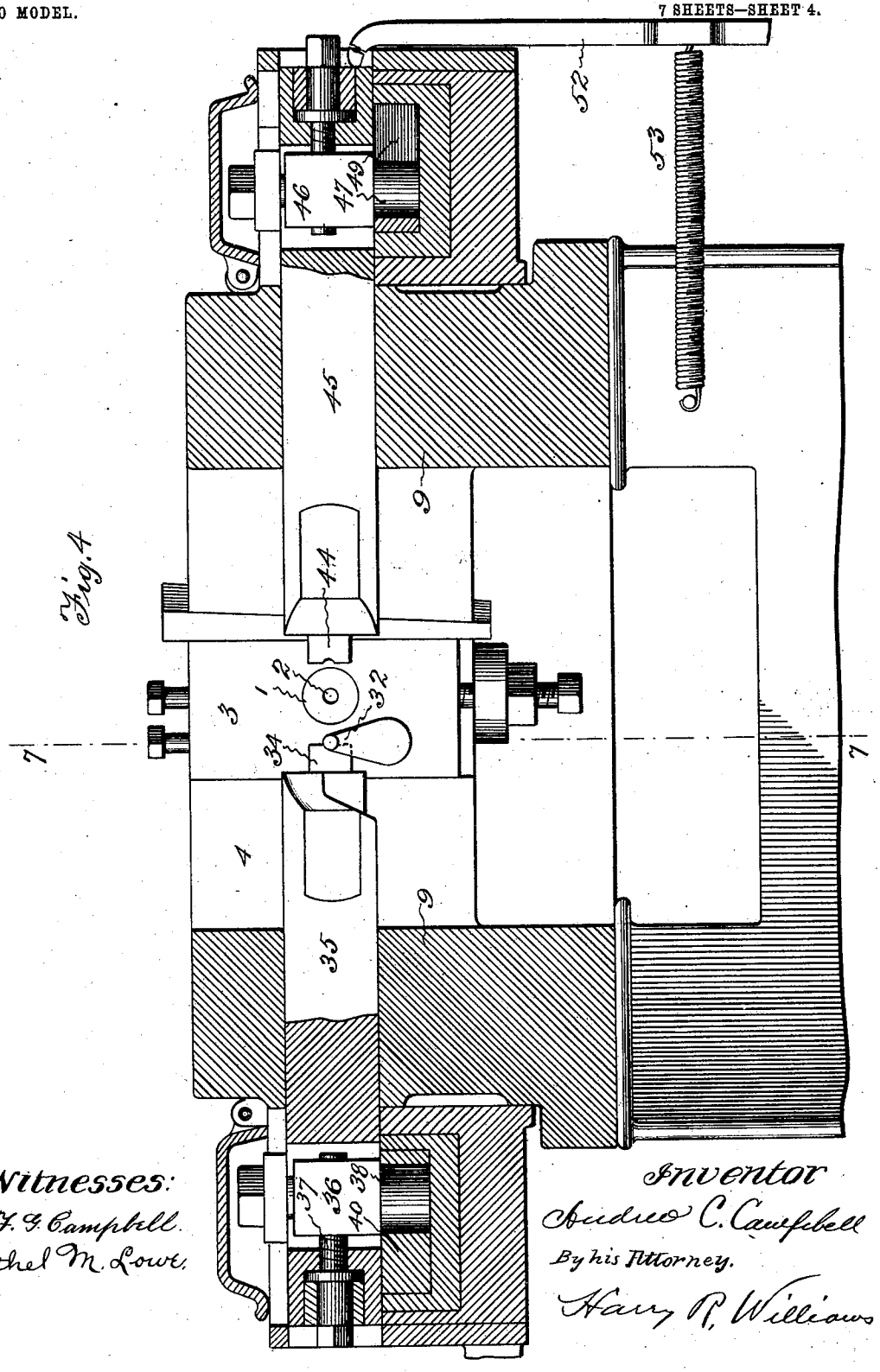
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MACHINE FOR FORMING BALLS.

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NO MODEL. 7 SHEETS—SHEET 4.

Fig. 4



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NO MODEL. 7 SHEETS—SHEET 5.

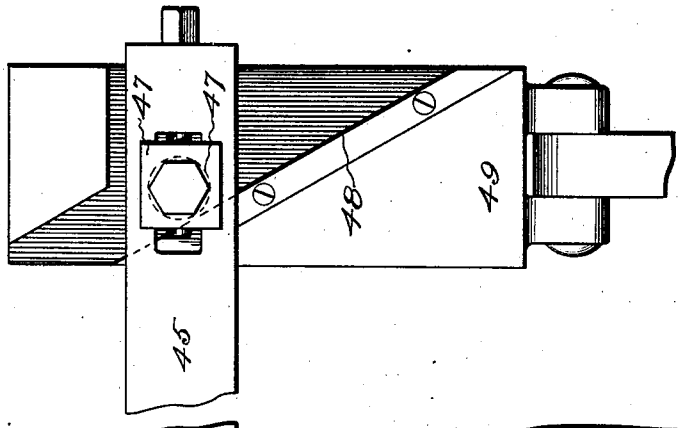


Fig. 5

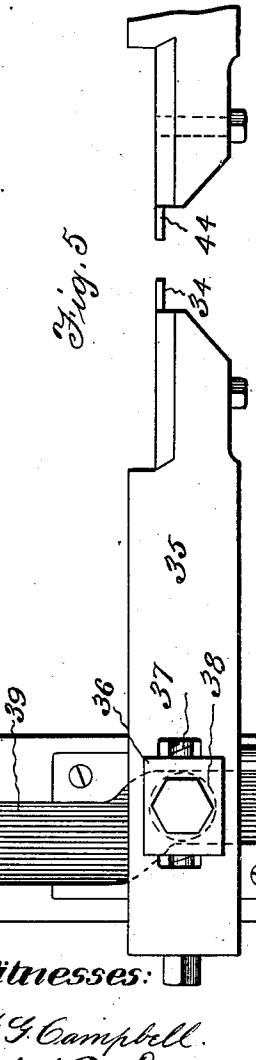
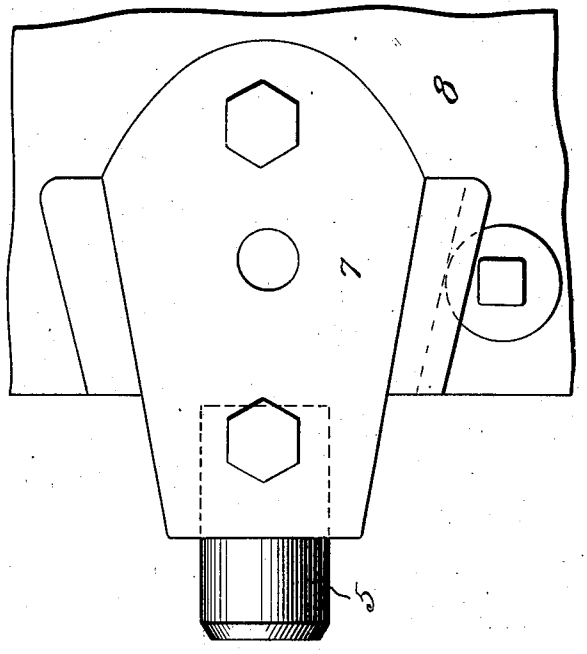


Fig. 6



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APPLICATION FILED MAY 9, 1903.

NO MODEL. 7 SHEETS—SHEET 6.

Fig. 7

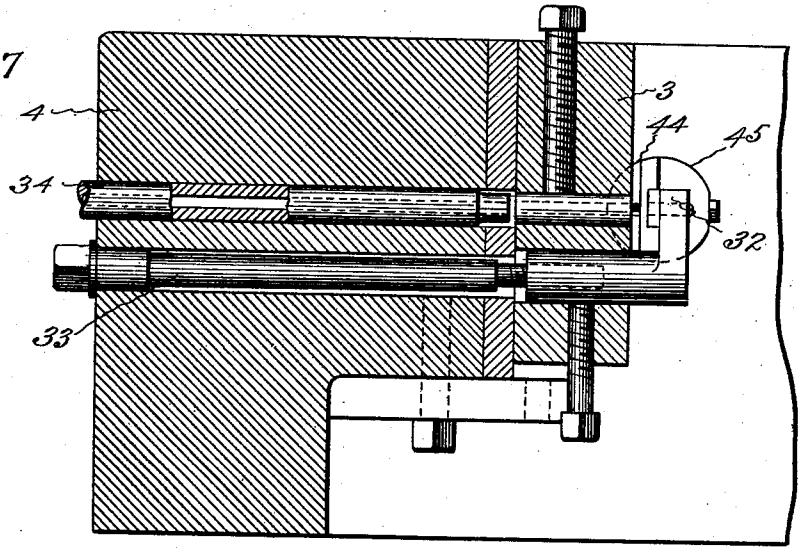
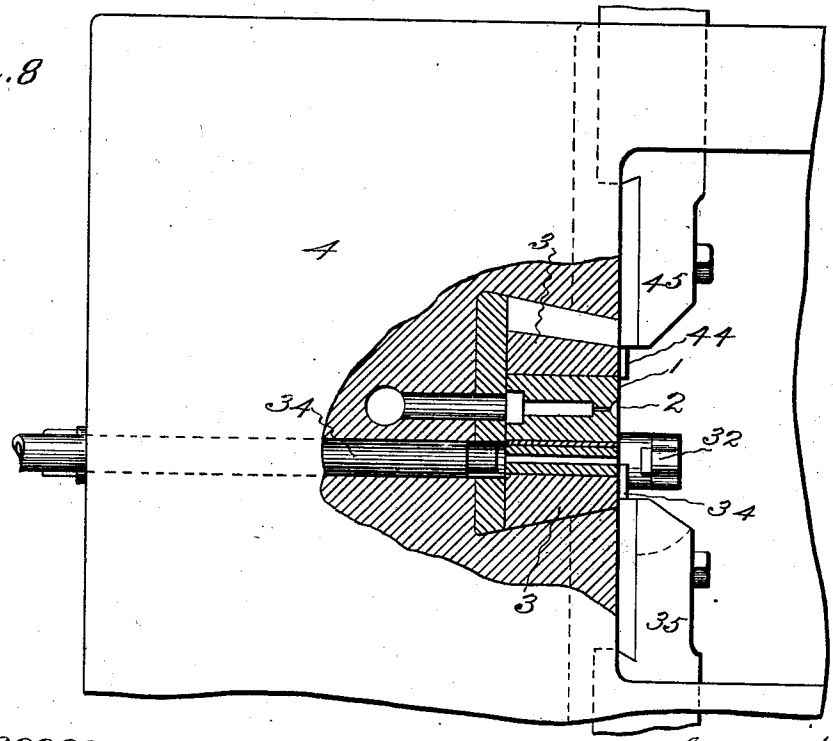


Fig. 8



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MACHINE FOR FORMING BALLS.

APPLICATION FILED MAY 9. 1903.

NO MODEL. 7 SHEETS—SHEET 7.

Fig. 9

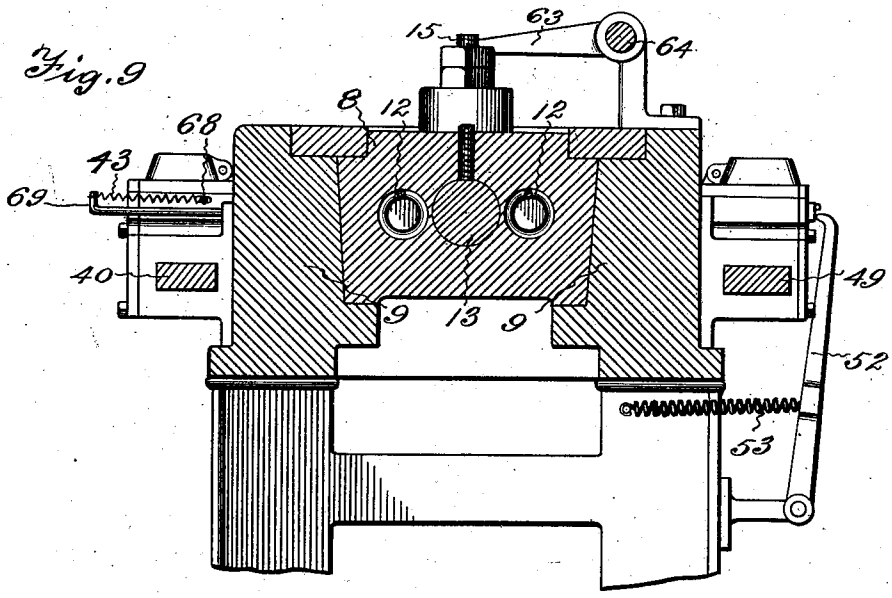


Fig. 10

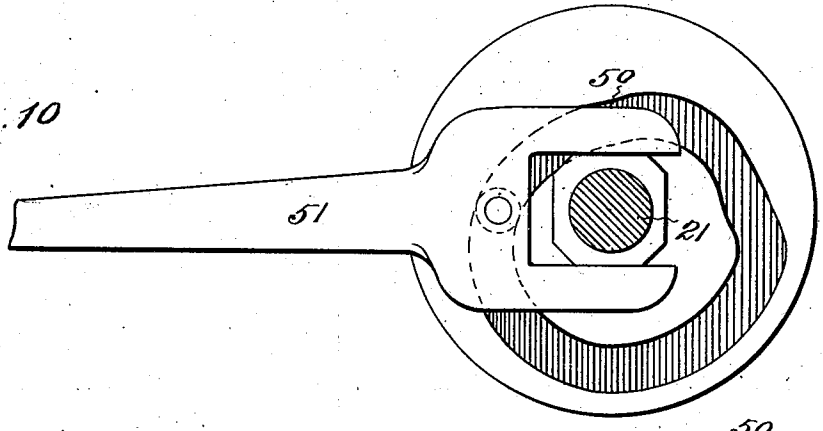
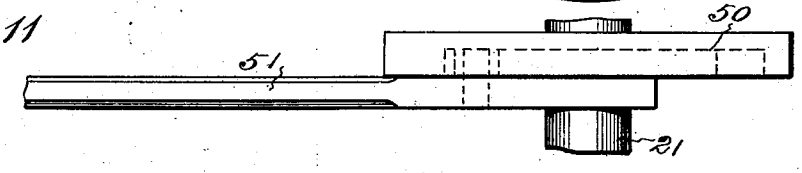


Fig. 11



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No. 756,212. Patented April 5, 1904.

UNITED STATES PATENT OFFICE.

ANDREW C. CAMPBELL, OF WATERBURY, CONNECTICUT, ASSIGNOR TO THE E. J. MANVILLE MACHINE COMPANY, OF WATERBURY, CONNECTICUT, A CORPORATION OF CONNECTICUT.

MACHINE FOR FORMING BALLS.

SPECIFICATION forming part of Letters Patent No. 756,212, dated April 5, 1904.

Application filed May 9, 1903. Serial No. 156,347. (No model.)

To all whom it may concern:

Be it known that I, ANDREW C. CAMPBELL, a citizen of the United States, residing at Waterbury, in the county of New Haven and State of Connecticut, have invented certain new and useful Improvements in Machines for Forming Balls, of which the following is a specification.

This invention relates to a machine which automatically forms a continuous length of wire into metal balls.

The object of the invention is the production of a machine which will form accurate balls very rapidly from a continuous length of wire.

In the machine illustrated as embodying the invention wire is intermittently fed rearwardly by rolls through the front of the frame against an adjustable stop. The end of the wire that is back of the frame is then cut off by a cutter which is positively moved transversely from one side. At the same time that the cutter is moved from one side a coöperating holder is moved by a spring transversely from the other side, so that the cut piece of wire will be held between the cutter and the holder. The cutter and the holder are then moved together and carry the blank sidewise into line with a fixed front die having a semispherical cavity and a movable back die having a semispherical cavity. When the blank is alined with the dies, the back die is moved forwardly by a cam until the blank is held at one end at the center of the cavity in the fixed die and held at the other end at the center of the cavity in the movable die. Then while the movable die dwells the cutter and holder are drawn apart from between the dies, after which the back die is forced forwardly farther and squeezes the blank until it fills the spherical cavity between the dies. The back die is then drawn rearwardly, and a pin is caused to move into the cavity in the face of each die to knock out the ball.

Figure 1 of the accompanying drawings is a perspective view of the machine. Fig. 2 is a side elevation of the machine, showing the feed-operating mechanism. Fig. 3 is a longitudinal section on the vertical plane that passes through the center of the dies, showing the movable die-operating mechanism and the knock-out mechanisms. Fig. 4 is a transverse section taken on the vertical plane indicated by the dotted line 4 4 of Fig. 2 and looking forwardly toward the cutter, holder, and fixed die. Fig. 5 is a plan of the cutter and holder mechanisms. Fig. 6 is a plan of the movable die and die-block. Fig. 7 is a longitudinal section through the front part of the frame on the vertical plane that passes through the feed-quill and wire-stop. Fig. 8 is a plan with a portion of the front part of the frame and the fixed die cut away. Fig. 9 is a transverse section taken on the vertical plane indicated by the dotted line 9 9 of Fig. 2 looking toward the front. Fig. 10 is a detail side view of the holder-operating cam, and Fig. 11 is an edge view of the same.

The fixed die 1, with a semispherical cavity 2, is secured in a die-block 3, that is held in a mortise in the back edge of the front part of the frame 4.

The movable die 5, with a semispherical cavity 6, is secured in a die-block 7, that is adjustably held in a mortise in the front end of a gate 8. This gate is movable toward the front and back in the opening between the sides 9 of the frame. In a recess in the rear end of the gate is a block 10 with a roll 11, that projects beyond the rear edge of the block. In two sockets in the rear end of the gate are springs 12, that thrust against the front edge of the block and tend to force the block and roll rearwardly. Adjustably held in a longitudinal opening in the gate in front of the block is a cylindrical stud 13. The forward end of this stud is beveled and engaged with the inclined rear edge of a wedge 14, that is vertically movable in the gate. This wedge has a screw-threaded stud 15 at its upper end, which is provided with a set-nut and a lock-nut, by means of which it can be adjusted and secured. The adjustment of this wedge determines the amount of rearward projection of the stud, Fig. 3. A rod 16 connects the ear 17, secured on the top at the

rear end of the gate, with the upper end of a cross-head 18, and a rod 19 connects the lug projecting from the bottom of the gate with the lower end of the cross-head. This cross-head carries a roll 20, which projects forwardly from the front edge of the cross-head, Fig. 3.

The main shaft 21 extends transversely and is held by bearings on each side near the rear end of the frame. On this shaft near the middle of the frame is a cam 22, that engages the roll in the block, which is thrust rearwardly from the back end of the gate carrying the movable die, and that engages the roll in the cross-head that is connected with the gate by the upper and lower rods, Fig. 3. When the shaft is rotated, the cam by engagement with the roll in the block forces the gate forwardly and by engagement with the roll in the cross-head draws the gate backwardly. The springs between the gate and the block thrust the former forwardly, and when the movable die engages the end of a blank the springs yield until the block engages the stud. Then the gate is forced forward positively.

The wire is intermittently fed by the friction of rolls 23 through a quill 24, inserted into an opening through the front part of the frame at one side of the fixed die. The feed-roll spindles are mounted in the case 25, that is attached to the front of the machine, and on the ends opposite the feed-rolls have intermeshing gears 26. On the lower spindle is a ratchet-wheel 27 and a ratchet-arm 28, that has a pawl 29 engaging the ratchet-teeth, Figs. 1 and 2. A rod 30 connects the ratchet-arm with a crank 31 on the main shaft. The rotation of this crank reciprocates the ratchet at the proper time and causes the wheels to feed the wire, Fig. 2.

Inside of the front of the frame, with its upper end in line with the opening through the feed-quill, is a stop 32. The hub of this stop is connected with a spindle 33, that extends through the front part of the frame below the feed-quill and is threaded, so that by the rotation of the spindle the stop can be adjusted with relation to the end of the opening through the feed-quill, Figs. 7 and 8. The wire is fed through the quill against this stop, so that the adjustment of the stop determines the exact length of wire fed into the machine. It is desirable to have the rolls feed slightly more than is necessary and butt the wire firmly against the stop, thus insuring a feed of the full amount of wire required to form a ball. (The rolls slip after the wire has come in contact with the stop.)

The cutter 34 has a semicircular recess in its operative edge, which approximately fits the wire and is mounted on a bar 35, that is movable transversely through one side of the machine. The outer end of the cutter-bar has a block 36, mounted on an adjusting-screw 37. Attached to the under side of this block is a roller 38, which projects into a cam-groove 39 in the slide 40, that is movable forwardly and backwardly on the side of the machine, Figs. 4 and 5. This slide is connected by a rod 41 with a crank 42 on one end of the main shaft, Fig. 1. When the crank moves this slide forwardly, the cam-groove and the roll on the block attached to the outer end of cutter-bar drive the cutter inwardly toward the wire, and when the slide is drawn back the cutter is drawn outwardly. A spring 43, which is connected between a pin 68, projecting from the cutter-bar, and a post 69, secured to the frame, tends to hold the roll attached to the cutter-bar against the outer wall of the cam-groove, Figs. 1, 5, and 9.

The holder 44 has a semicircular recess in its operative edge which approximately fits the wire and is attached to a bar 45, which is movable transversely through the side of the frame opposite the cutter. The holder-bar has an adjustable block 46 with a roll 47, that extends into a mortise, having an inclined wall 48 in a slide 49, Figs. 4 and 5. This slide is moved forwardly and backwardly on the outside of the frame by means of a cam 50 and a connecting-rod 51.

The inclined wall is so arranged that the forward movement of the slide causes the withdrawal of the holder from the dies and cutter at the proper time. The holder-bar is pushed inwardly by a lever 52, pivoted to the side of the frame, and a spring 53, connected between the lever and the frame, Figs. 2 and 9.

The cutter-slide crank and the holder-slide cam are so timed that the holder is allowed to move over against the wire as the cutter begins to cut. Then the cutter mechanism moves the cutter and the holder together and causes them to carry the blank into line with the dies. After the back die has been moved forward and the blank is held between the dies the cutter by its slide and the holder by its slide are while the springs between the gate and block are yielding and the gate and back die are dwelling drawn apart from between the dies.

A pin 54 lies in an opening in the fixed die in line with the center of the cavity. This pin is fixed to a rod 55, that has a beveled end. Engaging this beveled end is a wedge on the vertical spindle 56, that is normally raised by a spring 57.

Lying in an opening through the movable die in line with the cavity is a pin 58, that is fixed to a rod 59, that has a beveled end. The beveled end of this rod is engaged by a wedge on a vertical spindle 60, that is normally held raised by a spring 61, Fig. 3. Above the upper ends of these spindles are screw-studs 62 in the ends of arms 63, that are attached to a shaft 64, that at the rear end has an arm 65 with a roll 66, adapted to engage the peripheral cam 67. This cam is so timed that after a ball has been formed by compressing the wire blank between the dies and the movable die is retracted the shaft is

rocked so that the arms cause the studs to depress the spindles and drive the pins into the cavities, so as to insure the removal of the ball which has been formed.

As a result of the employment of a cam which can be timed to give a variable movement to the gate which carries the back die, the cutter and holder can carry the blank into line with the center of the semispherical cavities in the dies and hold the blank in such position until the back die has been moved forwardly enough to firmly pinch the blank between the dies before the cutter and holder are withdrawn and loosen their grasp upon the blank, the gate with the movable die dwelling after the blank has been pinched until the cutter and holder are withdrawn and then moving forwardly for expanding the metal into spherical form. As the blanks are always held in exact alinement, perfectly-shaped balls can be rapidly formed. This cannot be accomplished where the gate is moved forwardly by a crank. The employment of springs for forcing the gate forwardly permits the dies to hold blanks which vary somewhat in length and also allows the use of different lengths of wire for forming balls of different size without changing the cam on the main shaft.

I claim as my invention—

1. A machine for forming balls having a frame, a cutter, a holder, means for moving the holder and cutter toward each other and against opposite sides of the piece to be cut, means for moving the cutter and holder together and causing a piece to be cut and carried between them into line with a die fixed with relation to the frame and a die movable with relation to the frame, means for reciprocating the movable die and causing that die to first hold, then dwell, and afterward compress into spherical form the cut piece, and means for drawing the holder and cutter apart from between the dies while the movable die dwells, substantially as specified.

2. A machine for forming balls having a frame, a wire-feed mechanism, a cutter, a holder, means for moving the holder and cutter toward each other and against opposite sides of the piece to be cut, means for moving the cutter and holder together and causing a piece to be cut and carried between them into line with a die fixed with relation to the frame and a die movable with relation to the frame, means for reciprocating the movable die and causing that die to first hold, then dwell, and afterward compress into spherical form the cut piece, and means for drawing the folder and cutter apart from between the dies while the movable die dwells, substantially as specified.

3. A machine for forming balls having a frame, a wire-feed mechanism, a stop for limiting the amount of wire fed, a cutter, a holder, means for moving the holder and cutter toward each other and against opposite sides of the piece to be cut, means for moving the cutter and holder together and causing a piece to be cut and carried between them into line with a die fixed with relation to the frame and a die movable with relation to the frame, means for reciprocating the movable die and causing that die to first hold, then dwell, and afterward compress into spherical form the cut piece, and means for drawing the holder and cutter apart from between the dies while the movable die dwells, substantially as specified.

4. A machine for forming balls having a frame, a die with a semispherical recess fixed with relation to the frame, a gate movable with relation to the frame, a die with a semispherical recess carried by the gate, a block movable in a recess in the gate, springs tending to thrust the block rearwardly from the gate, a cam adapted to force the block and gate forwardly as they are held apart by the springs, then force the block forwardly independently of the gate and afterward force the block and gate forwardly as one piece, a cutter, a holder, means for moving the cutter and holder together and causing a piece to be cut and carried between them in line with the dies, and means for drawing the holder and cutter apart from between the dies while the movable die dwells, substantially as specified.

5. A machine for forming balls having a frame, a die with a semispherical recess fixed with relation to the frame, a gate movable with relation to the frame, a die with a semispherical recess carried by the gate, a block movable in a recess in the gate, a roll with a portion projecting from the rear edge of the block, springs tending to thrust the block rearwardly from the gate, a cam adapted to engage the roll and thrust the block and gate forwardly as separated by the springs, then force the block forwardly independently of the gate and afterward force the block and gate forwardly as one piece, a cutter for cutting off the blanks, a holder, means for moving the holder and cutter toward each other and against opposite sides of the piece to be cut, means for moving the cutter and holder together and causing a piece to be cut and carried between them into line with the dies, and means for drawing the cutter and holder apart from between the dies while the movable die dwells, substantially as specified.

6. A machine for forming balls having a frame, a die with a semispherical recess fixed with relation to the frame, a gate movable with relation to the frame, a die with a semispherical recess carried by the gate, a block movable in a recess in the gate, a roll with a portion projecting from the rear edge of the block, springs tending to thrust the block rearwardly from the gate, a cross-head connected with the gate, a roll with a portion projecting forwardly from the cross-head, a cam adapted to engage the front roll and thrust the

block and gate forwardly as separated by the springs, then force the block forwardly independently of the gate and afterward force the block and gate forwardly as one piece and adapted to engage the rear roll and force the cross-head backwardly, a cutter, a holder, means for moving the cutter and holder toward each other and against opposite sides of the piece to be cut, means for moving the cutter and holder together and causing a piece to be cut and carried between them into line with the dies, and means for moving the cutter and holder apart from between the dies while the movable die dwells, substantially as specified.

7. A machine for forming balls having a frame, a die with a semispherical recess fixed with relation to the frame, a gate movable with relation to the frame, a die with a semispherical recess carried by the gate, a block movable in a recess in the gate, springs tending to thrust the block rearwardly from the gate, an adjustable stud carried by the gate in front of the block, a cam adapted to force the block and gate forwardly as they are held apart by the springs, then force the block forwardly independently of the gate and afterward force the block and gate forwardly as one piece, a cutter, a holder, means for moving the cutter and holder toward each and against opposite sides of the piece to be cut, means for moving the cutter and holder together and causing a piece to be cut and carried between them in line with the dies, and means for drawing the holder and cutter apart from between the dies while the movable die dwells, substantially as specified.

8. A machine for forming balls having a frame, a wire-feed mechanism, a stop for limiting the amount of wire fed, a die with a semispherical recess fixed with relation to the frame, a gate movable with relation to the frame, a die with a semispherical recess carried by the gate, a block movable in a recess in the gate, springs tending to thrust the block rearwardly from the gate, a cam adapted to force the block and the gate forwardly as separated by the springs, then force the block forwardly independently of the gate and afterward force the block and gate forwardly as one piece, a cutter for cutting off blanks, a holder, means for moving the cutter and holder toward each other and against opposite sides of the piece to be cut, means for moving the cutter and holder together and causing a piece to be cut and carried between them in line with the dies, and means for drawing the cutter and holder apart from between the dies while the movable die dwells, substantially as specified.

9. A machine for forming balls having a frame, a fixed die, a movable die, mechanism for moving the latter die forwardly, causing it to dwell, moving it still farther forwardly and then moving it backwardly, a cutter adapted to cut a length of wire, a holder adapted to cooperate with the cutter for holding the cut piece, and mechanisms for moving the cutter and the holder together with the cut piece between them into line with the dies and moving the cutter and holder from each other while the movable die dwells during its forward movement, substantially as specified.

10. A machine for forming balls having a frame, a wire-feed mechanism, a stop for limiting the amount of wire fed, a fixed die, a movable die, mechanism for moving the latter die forwardly, causing it to dwell, moving it still farther forwardly and then moving it backwardly, a cutter adapted to cut a length of wire, a holder adapted to coöperate with the cutter, and mechanisms for moving the cutter and the holder together with the cut piece between them into line with dies and moving the cutter and holder from each other while the movable die dwells during its forward movement, substantially as specified.

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