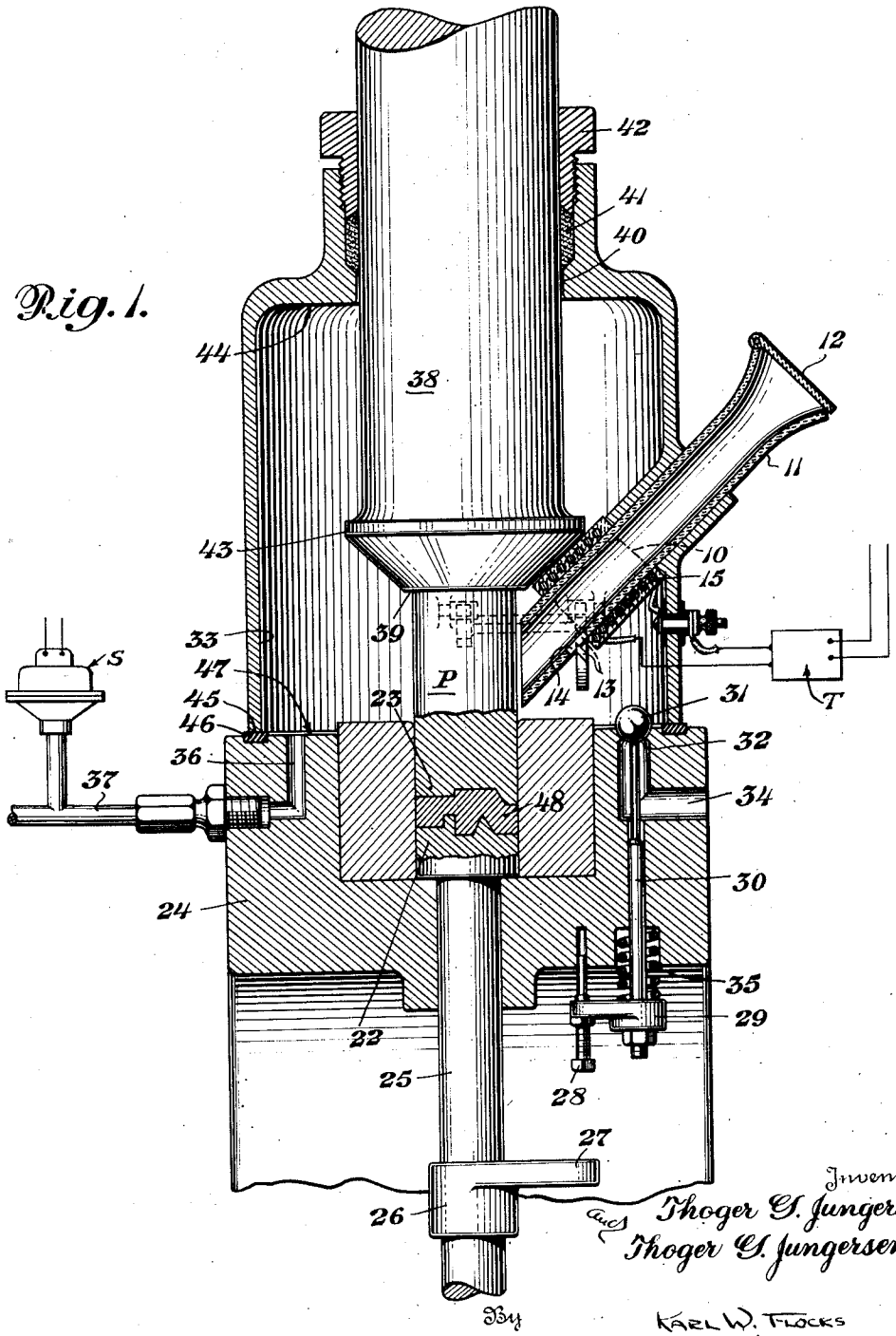
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PRECISION FORMING OF METAL

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Fig. 1.



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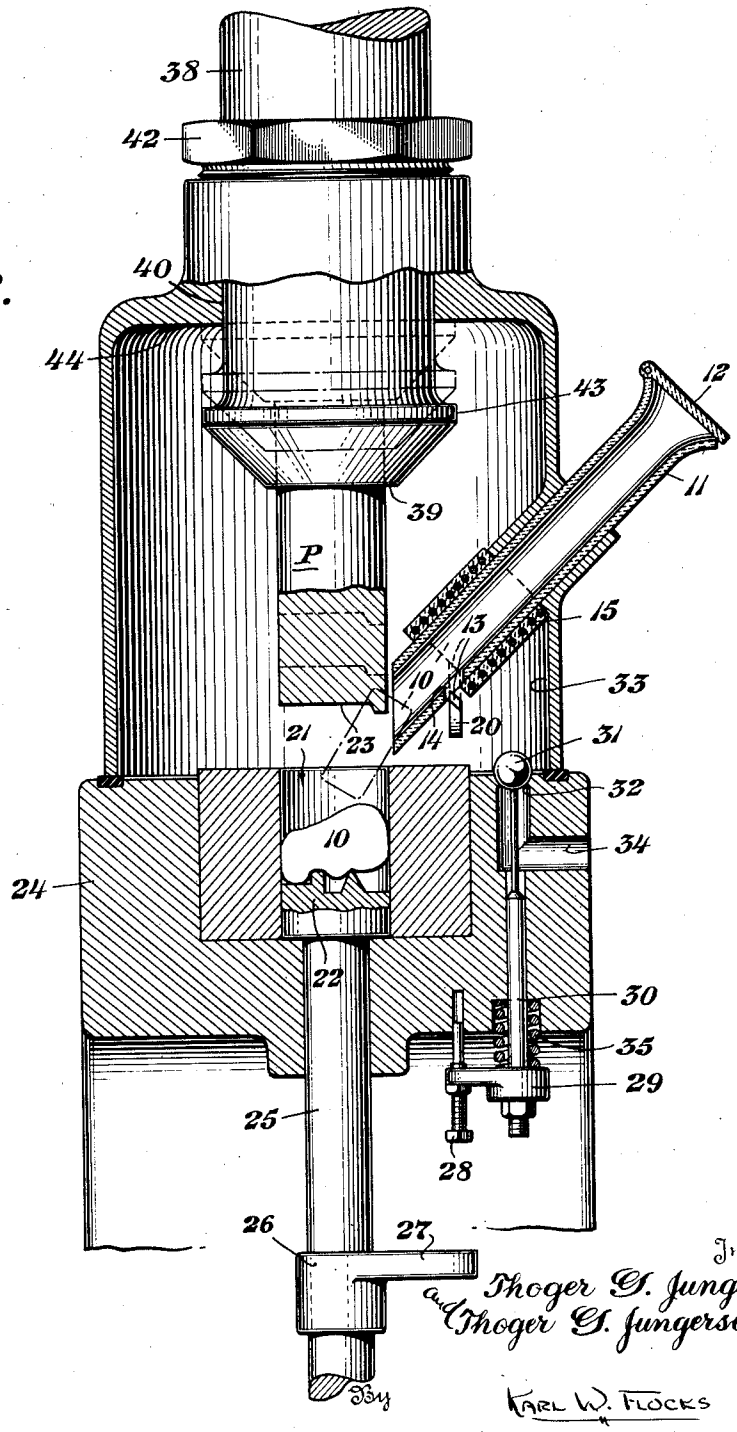
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Fig. 2.



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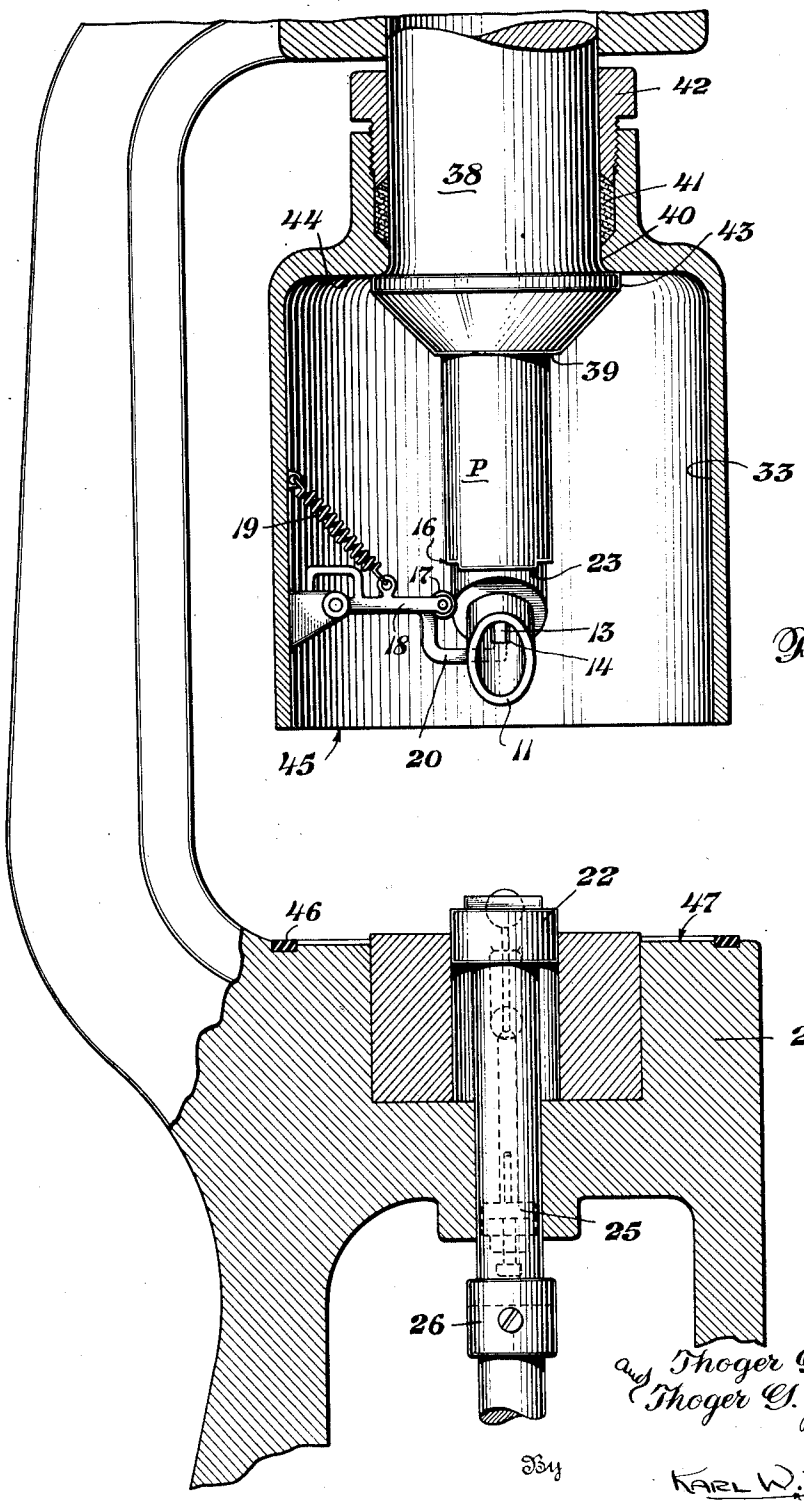


Fig. 3.

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PRECISION FORMING OF METAL

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3 Claims. (Cl. 219—3)

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This invention relates to the precision forming of metal and more particularly to the precision forming of metal while it is in a hot plastic state and in a non-oxidizing atmosphere under the influence of pressure.

Prior to the instant invention relatively crude metal forming has been accomplished by machine forging, but forgings produced by prior processes have required considerable machining and finishing.

It is an object of the instant invention to teach a novel process of precision metal forming.

It is another object of the invention to provide a novel apparatus for the forming of metal with precision.

Other objects and the nature and advantages of the instant invention will be apparent from the following description taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a fragmentary vertical sectional view with parts shown in elevation of an apparatus in accordance with the invention.

Fig. 2 is a view similar to Fig. 1 showing relative positions of parts of the apparatus during various stages of operation thereof.

Fig. 3 is a view similar to Figs. 1 and 2 taken along line 3—3 of Fig. 2 and looking in the direction of the arrows, portions of the apparatus being in different operating positions from that shown in Fig. 2.

Referring to the drawings, a pellet of metal 10 is introduced into the ceramic loading tube 11 through the hatch 12 and comes to rest against the stop 13 which protrudes upwardly through the hole 14 formed in the underside of the ceramic tube 11. In this position the pellet 10 is raised to a temperature sufficiently high to cause it to become plastic by the induction heating coils 15. When this temperature has been induced into the pellet 10, the stop 13 is caused to move downwardly by engagement of the bottom corner 16 of the plunger P with the roller 17 on the lever 18 which is normally held in a horizontal position by the tension spring 19, the stop element 13 being connected to the lever 18 by the U-shaped link 20. With the stop element 13 in its depressed position, the hot plastic pellet 10 then falls into the die cavity 21 as shown in Figure 2.

Within the die cavity 21 is the die section 22 which cooperates with a die section 23 in the bottom of the plunger P to form an accurate die corresponding to the shape of the finished metal piece desired.

The base element 24 is incorporated into the frame of the machine and the rod 25 is adapted

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to slide therethrough; the element 26 is secured to the rod 25 and has portion 27 adapted to contact the head of the adjustment screw 28 which is secured to the element 29 which in turn is fixed to the valve stem 30 which in turn is secured to the ball valve 31 so that when the valve 31 is unseated from the valve seat 32 the space within the bell jar 33 is communicated to the atmosphere through the passageway 34. The compression spring 35 holds the valve 31 in its closed position when the head of the adjustment screw 28 is not in engagement with the portion 27 of the fixed element 26.

The base element 24 is also provided with a passageway 36 leading from the space beneath the bell jar 33 to the conduit 37 which is connected to a vacuum pump, not shown.

The rod 38 is connected at its bottom 39 to the plunger P and the upper portion thereof is arranged in sealed relation with the opening 40 through the top of the bell jar 33 and is further arranged so as to be capable of sliding through the opening 40 while the seal therethrough is maintained by the packing 41 and the packing nut 42. Above the bottom 39 of the rod 38 is the annular projection 43 which is adapted to engage the under side 44 of the top of the bell jar 33 when the rod 38 is in fully raised position.

In the operation of the device described above, with the rod 38 in its uppermost position as shown in Fig. 3 and with the bell jar 33 in raised position, the operator has access to the mold cavity between the mold section 22 and the mold section 23 for the removal of any already formed metal piece. A pellet 10 may then be inserted through the hatch 12 in the ceramic tube 11 and it will come to rest against the stop element 13. The operator then causes the lowering of the rod 38 until it takes the position shown in dotted lines in Fig. 2 and in this position the bottom 45 is in sealing relation with the annular gasket 46 arranged on the top 47 of the element 24. Movement of the rod 38 to this position automatically cuts in the vacuum pump and when a sufficient vacuum has been produced beneath the bell jar 33, a vacuum responsive switch S associated with the suction line 37 closes the circuit to the induction coil 13 and when the pellet 10 has been heated to a sufficiently high temperature to cause it to become plastic which, for a given size pellet of a given material, requires a predetermined fixed time, a timing element T then permits the rod 38 to be further lowered until it takes the position shown in broken lines in Fig. 2 whereupon the

corner 16 of the plunger P will engage the roller 17 and depress the stop element 13 to permit the pellet 10 in plastic state to fall into the cavity 21. At this time the plunger is still moving downwardly and continues to move downwardly until it takes the position shown in Fig. 1 and forms the pellet 10 into the finished metal piece 48. The rod 38 is then caused to rise and the rod 25 is caused to rise until element 26 fixed to the rod 25 engages the adjusting screw 28 and against the action of the spring 35 the valve 31 is opened permitting the atmosphere to enter the space beneath the bell jar 33. Thereupon the operator effects the continued raising of the rod 38 and the stop element 13 again enters through the opening 14 in the ceramic tube 11 and takes the position shown in dotted lines in Fig. 1. Further movement of the rod 38 in an upward direction then causes the bell jar 33 to raise as shown in Fig. 3 and the operator may remove from the raised die section 22 the finished metal piece 48 which will have been precision formed.

Instead of the operator removing the finished metal piece 48 as described, conventional knock-out pins may be provided.

If desired, the atmosphere beneath the bell jar when it is in sealed relation with the top 47 of the element 24 may be filled with a non-oxidizing atmosphere such as nitrogen gas through the line 37 after the atmosphere has been removed from beneath the bell jar 33 by the vacuum pump.

Movement of the rod 38 may be hydraulically controlled and operated. With the utilization of the device in the process above described, the finished metal pieces will be accurate in dimension and precision parts may be thus formed to close tolerances without the necessity of further machining of surfaces or removal of flashings and gates or the like. The metals of which the final precision piece is to be made may be selected from either the softer metals or harder metals such as the tougher steels.

It will be obvious to those skilled in the art that various changes may be made without departing from the spirit of the invention and

therefore the invention is not limited to what is shown in the drawings and described in the specification but only as indicated in the appended claims.

What is claimed is:

1. In an apparatus for precision forming metal pieces, means for holding a metal pellet of predetermined size while it is being heated, a die having a die cavity, means for creating a non-oxidizing ambient about said pellet while it is being held and in said die cavity, means for heating said metal pellet until it reaches a plastic state, means for causing the introduction of said metal pellet in a plastic state into said die cavity, means for squeezing said metal pellet into said die cavity until it takes the shape of said die cavity, said last two means being interconnected so that said pellet is introduced into the die cavity prior to the operation of said means for squeezing said pellet.

2. The structure recited in claim 1, said means for creating a non-oxidizing ambient including a vacuum pump and bell jar, said holding means including a ceramic tube passing through in sealed relation to said bell jar, said heating means including an induction heating coil.

3. The structure recited in claim 1, and means responsive to the creation of said non-oxidizing ambient for rendering effective said heating means.

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