No. 668,665. Patented Feb. 26, 1901.

C. H. VEEDER.

FORGING MACHINE.

(Application filed May 15, 1900.)

(No Model.) 2 Sheets—Sheet 1

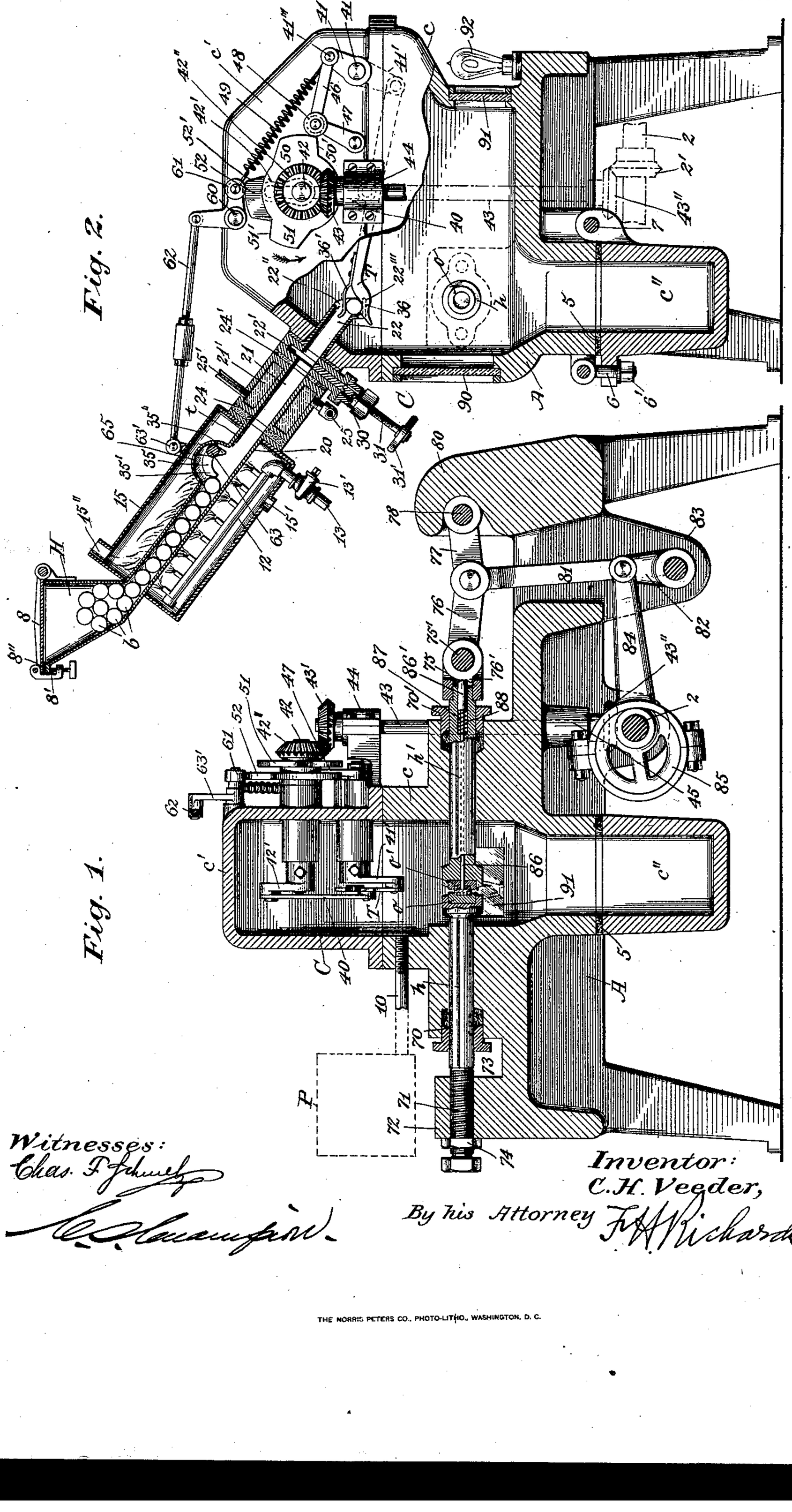

Fig. 1.

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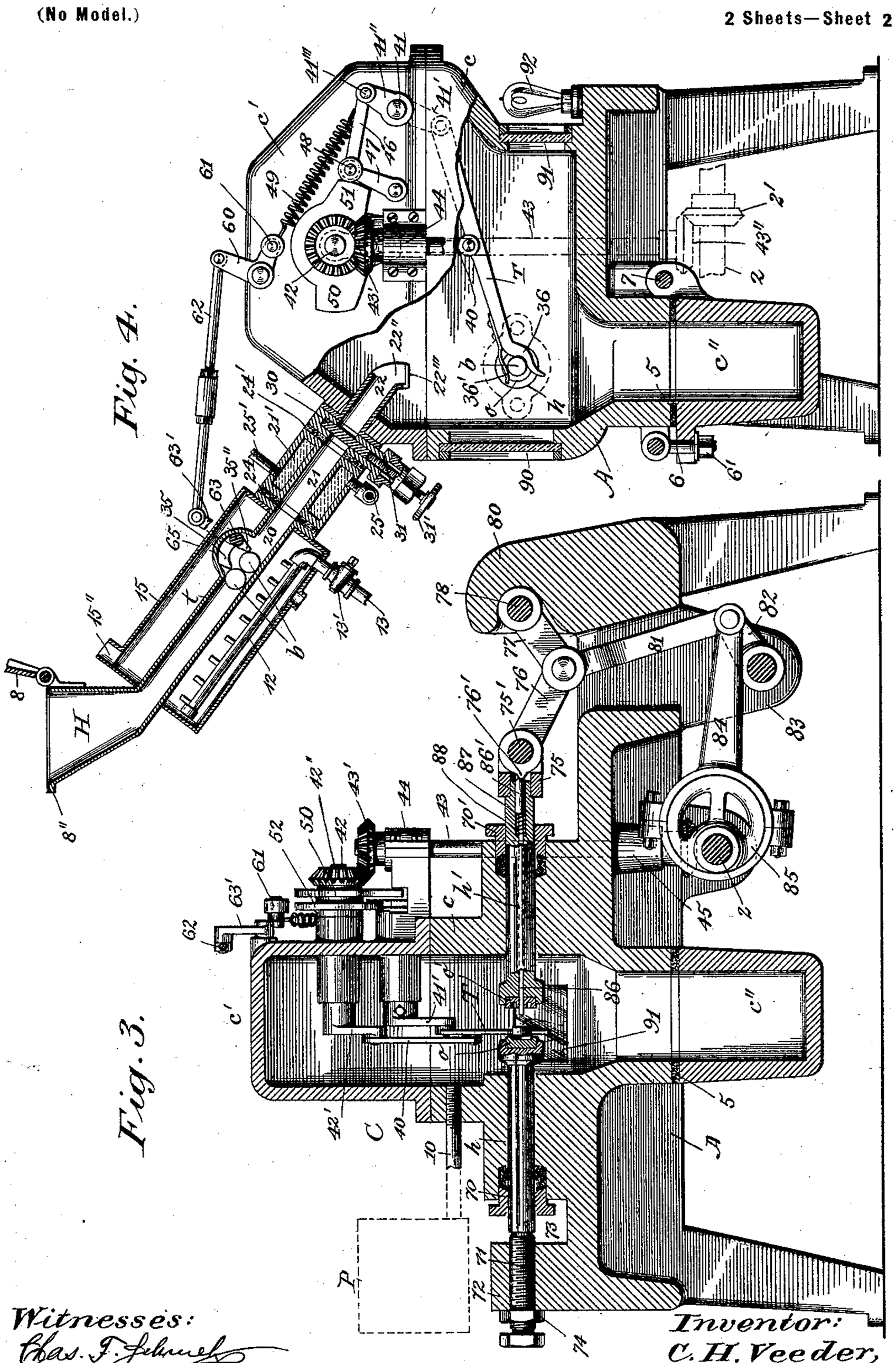

Fig. 3.

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UNITED STATES PATENT OFFICE.

CURTIS H. VEEDER, OF HARTFORD, CONNECTICUT.

FORGING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 668,665, dated February 26, 1901.

Application filed May 15, 1900. Serial No. 16,707. (No model.)

To all whom it may concern:

Be it known that I, CURTIS H. VEEDER, a citizen of the United States, residing in Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Forging-Machines, of which the following is a specification.

This invention relates to forging-machines; and it has for its main object the provision of a machine of this type in which articles may be formed by hot-forging from a suitable blank or blanks in an atmosphere in which the hot metal will be protected from oxidation. The inert atmosphere in which the blank operated upon will be forged into shape will usually be a vacuum, and I prefer to mount most of the principal operating parts of the mechanism which accomplish the forging of the blank in a suitable vacuum-chamber, and, moreover, the blank or blanks will preferably be heated while contained within an exhausted receiver. If desired, this inert atmosphere may in some cases be an inert gas—such as nitrogen or carbon dioxid—or it may be a reducing-gas—such as hydrogen or a proper hydrocarbon—which owing to the low temperature in the inclosing chamber will not exert a reducing action. Ordinarily the forging means proper will be contained within one vacuum-chamber and the blank or blanks will be heated in another vacuum-chamber communicating with the first in such a manner that the heat of the blank-holding vacuum-chamber will be very greatly reduced before it reaches the main vacuum-chamber in which the blank is to be forged, suitable heat-insulating means being employed to prevent the transmission of an excessive amount of heat to such main vacuum-chamber.

In the drawings accompanying this specification and forming part of the present application, Figure 1 is a vertical longitudinal section of a forging-machine embodying my invention and illustrating the positions of the parts when a blank is being forged. Fig. 2 is a vertical transverse section of the same, partly in elevation, showing the parts in the same positions. Fig. 3 is a section similar to Fig. 1 and illustrates the parts in the positions which they assume after a blank has been forged and the dies opened. Fig. 4 is a sectional elevation similar to Fig. 2 and illustrates the parts in the same positions in which they are shown in Fig. 3.

Similar characters designate like parts in the different figures of the drawings.

I have shown herein a complete automatic forging-machine by means of which forgings may be formed and ejected from the machine regularly and at a high rate of speed without requiring any considerable amount of attention from an operator.

The several operative parts of my improved machine may be mounted on a suitable framework, which in the present case embodies a bed, such as A, supported on legs in the usual manner and having a main shaft 2, which may be driven from any suitable source of power and from which the movements of all of the automatically-operating parts of the machine may be derived.

In the present construction the forging operation is intended to be carried on within a vacuum-chamber in order that the blanks may not become coated with scale as a result of oxidation, which takes place when the heated metal to be forged is exposed to the action of the air. A portion of this vacuum-chamber is preferably integral with and constitutes a part of the main frame of the machine, and in this case said main chamber (which is designated herein in a general way by C) is divided into three principal parts, the central one of which is open at the top and at the bottom and constitutes an integral portion of the main-frame structure, said central portion of the vacuum-chamber being designated herein by *c*. The other principal portion of the vacuum-chamber is designated herein by *c'* and constitutes a cover for the part *c*, while a third member of the vacuum-chamber may be a forging-receiver, such as *c''*, said receiver being in this case a swinging one, pivoted to the central portion *c* at the under side thereof in such a position as to be directly below the point at which the forgings are formed. For the purpose of forming an air-tight joint between said receiver and the part *c* I may make use of a suitable packing-ring 5, and a swinging clamping device 6, having a clamping-nut 6', may be employed for tightening the joint between these two parts of the vacuum-chamber. The pivot of the

forging-receiver is designated herein by 7, and it will be apparent that said clamping device may be loosened and the receiver dropped by swinging it on its pivot into a position in which the finished forgings may be removed therefrom from time to time.

Any suitable means may be employed for holding and heating a blank and for feeding the same to the forging means. In this case, however, I prefer to make use of a combined blank-heating and blank-feeding member, such as a feed-tube, through which the blank or blanks may be passed and in which such blank or blanks may be heated to the proper temperature before being subjected to the action of the forging means. This tube may be an inclined one, as shown at *t*, and will preferably be supplied with individual blanks from a hopper, such as H. The receiving end of this hopper will usually be closed by a swinging cover, such as 8, which may be held in place by a clamping device, such as 8′, a suitable packing-ring, such as 8″, being interposed between the cover and the hopper. The feed-tube constitutes an exhaustible blank-supplying and blank-heating chamber which communicates with the vacuum-chamber C, and when the communicating chambers have been exhausted the blanks will be heated, fed, and forged in a vacuum and will not be exposed to the air at all during or after heating until after the articles to be formed from the blanks have been finished. The inclosed space just described may be exhausted through a pipe 10, controlled by an exhaust-pump, which is indicated by P.

That portion of the feed-tube *t* in which the blanks (which are indicated herein by *b*) are intended to be heated should be formed from some material which will withstand a high degree of heat and which will heat the blanks quickly to the proper temperature, and I have found that a heating-tube of manganese steel fulfils all the requirements. The portion of the tube which is to be heated is preferably subjected to the direct action of gas-jets, as shown herein, these being so placed that the flames will impinge upon the tube throughout the length of the heating portion or blank-receiving section thereof, a distributing-pipe 12 being shown herein which receives gas from a supply-pipe, such as 13, controlled by a suitable valve, such as 13′.

For the purpose of confining the heat and utilizing the same most perfectly I prefer to make use of a hood, such as 15, which surrounds the heated portion of the feed-tube *t* and has air inlet and outlet openings, such as 15′ and 15″, the latter of which permits the escape of heated air and gases.

It is desirable to insulate the heating devices from the main vacuum-chamber C, and for this reason I have shown herein heat-insulating means between said main chamber and that portion of the feed-tube which is heated directly by the gas-jets. Said feed-tube itself is preferably a composite one, and in the construction shown it consists of several sections. One of the sections which is not heated directly by the flames may have the temperature thereof reduced in any suitable manner, as by a non-conducting medium interposed between it and the heated section of the tube or by circulating a cooling medium in contact with such unheated tube-section, or by both, the latter being the preferable mode and being the one illustrated herein. The tube shown embodies three sections, such as 20, 21, and 22, and packing-rings, preferably of asbestos or some similar material, are interposed in this case at 24 and 24′ between each pair of adjacent tube-sections, so that that section which communicates directly with the main vacuum-chamber C is kept comparatively cool, as the heat of the tube-section 20 cannot be transmitted to the section 22 by conduction, but only by convection.

The central tube-section 21 is preferably cooled by circulating water in contact therewith and in the construction shown is in the form of a water-jacket, the central opening in which forms the bore of the tube. Said section has a water-space 21′, through which a stream may be circulated by means of pipes, such as 25 and 25′, and thus the heat conveyed to the main vacuum-chamber may be still further decreased.

From time to time it will of course be necessary to raise the cover and refill the supply-hopper H, and when this is to be done it will be found desirable to cut off communication between the blank-heating vacuum-chamber and the main vacuum-chamber C in order that time may not be wasted afterward in exhausting the large space of said main vacuum-chamber. For this reason I have shown herein a cut-off valve between said chambers, this valve being preferably a sliding gate, such as 30, working in a transverse guideway intersecting the bore of the feed-tube and in this case formed in a member practically constituting a part of the tube-section 22, this guideway being designated herein by 22′. The position of the gate 30 may be controlled by a screw 31, having a hand-wheel 31′ for turning the same.

The blank-supplying means employed may be any suitable for the purpose of intermittently feeding a blank or blanks; but when it embodies an inclined feed-tube, as in the construction shown herein, said tube will preferably be divided at its discharge end, this end of the tube being in the present case bifurcated and having blank-frictioning retaining-walls, such as 22″ and 22‴, which will serve to prevent premature discharge of a blank from the tube. The walls 22″ are blank-retaining side walls, while the wall 22‴ is a substantially horizontal blank-supporting end wall, and when a blank rolls down the incline of the supply spout or tube *t* it will be evident that it will not only be stopped by the frictioning action of the side walls 22″,

but that it will be located in a vertical position by the end wall 22‴, on which it will rest, and hence the blank when it reaches the end of the supply spout or tube is accurately positioned.

In connection with blank-holding means for supplying separate blanks successively to the forging members means should be employed for intermittently feeding these blanks, and in the present case I have illustrated intermittently-effective blank-feeding means preferably in the form of an escapement-feed blank-releasing device, such as the escapement 35, having a pair of pallets, one of which is designated by 35′ and serves to stop the blanks *b*, while the other is designated by 35″ and serves to release said blanks successively, this escapement being oscillatory and operated in a manner which will be hereinafter described, it being evident that each time a blank is released by the pallet 35″ said blank will travel down the inclined feed-tube to the discharge end thereof, where it may be received by another member and transferred to the forging means.

I prefer to employ in connection with the blank-feeding means just described a blank-transferring carrier for shifting the blanks successively into position to be operated upon by the forging means, and in this case I have shown a carrier which moves between the discharge end of the supply-spout or feed-tube *t* and the forging members or dies between which the blank is to be compressed. Said carrier is preferably an oscillatory one and may be so constructed as to withdraw the blank which lies at the discharge end of the feed-tube and transfer said blank to a point between the forging members or dies. In this case said carrier (which is designated in a general way by T) constitutes a blank-gripping device and preferably has a pair of separated gripping-fingers so constructed as to exert considerable force and obtain a firm hold upon the blank to be withdrawn from the feed-tube, this being necessary in the present case, owing to the fact that the walls at the end of said feed-tube exert sufficient pressure upon a blank to prevent the rolling out of the same. Here the carrier or transfer device T has a rigid gripping-finger 36 and a yielding finger 36′, preferably in the form of a spring-arm, the two fingers being so shaped as to be capable of receiving the blank properly between them and holding the same firmly. The carrier T should be so constructed as to be movable into and out of the opening in the divided discharge end of the spout or feed-tube *t*, and hence the fingers 36 and 36′ will be relatively thin and considerably thinner than the blanks to be gripped thereby. In order that this blank-transferring carrier T may coöperate properly with the other parts, it is desirable to actuate it in a path transverse to the direction in which the forging action is exerted, as when it moves in this manner it will withdraw most readily from the dies after delivering the blank at the point where it is to be compressed. In this case said carrier not only oscillates between the discharge end of the feed-tube *t* and the forging means, but it may also withdraw quickly from said end of the feed-tube to assure the disengagement of the blank from the retaining-walls 22″ and 22‴. It is also intended to withdraw quickly from its delivering position between the dies in order that its operation may not be interfered with by said dies. In the present case the carrier T is in the form of a lever having a shiftable pivot, it being operated here in one path by a link, such as 40, pivoted thereto at a point between the ends thereof and in another path by a suitable device, such as a rock-arm 41′, which is connected to the lever at the center of movement thereof and serves to shift the pivot of said lever. In this case the link 40 is connected to a crank-arm 42′, secured to a crank-shaft 42, journaled in a bearing extending through one wall of the cover *c*′ of the main vacuum-chamber C, the journal being suitably packed to prevent admission of air to said chamber. This crank-shaft carries in the present construction a bevel-gear 42″, which meshes with and is driven by a bevel-gear 43′, carried at the upper end of a spindle 43, journaled at its upper end in a suitable bearing, such as the divided bearing 44, on the outside of the cover *c*′, and at its lower end in a bearing, such as the fixed bearing 45, on the under side of the main frame A, said spindle carrying in this case at its lower end another bevel-gear, such as 43″, which meshes with and is driven by a bevel-gear, such as 2′, on the main shaft 2. From these operating connections the oscillatory movement of the blank-transferring carrier is derived, as will be evident, and this movement thereof serves to effect the transfer of blanks successively from the discharge end of the feed-tube *t* to a point between the forging-dies and also the return of the carrier each time to a position for receiving another blank.

For the purpose of shifting the pivot of the oscillatory carrier T, I may mount said carrier on the rock-arm 41′, hereinbefore referred to, which rock-arm is secured to a rock-shaft 41, carrying another rock-arm 41″, to which is pivoted in this case one member 46 of a linkage, the other member 47 being pivoted to a fixed point on the framework, one of said members carrying in this case an anti-friction-roll 48, adapted to coöperate with a cam or cams for permitting a rapid shifting of the pivot of the carrier T at the proper times, this movement being effected in this case by a spring, such as 49, connected here to a pin 41‴ on the rock-arm 41″ and having its other end connected to a suitable point, which in this case is one end of an angle-lever, such as 60, for operating the escapement 35.

In order that the carrier T may have its

pivot shifted rapidly, and therefore be moved bodily in a different path, also preferably curvilinear, from the path of oscillation hereinbefore described, the antifriction-roll 48 is intended in this case to coöperate with one or more quick-let-off cams, which may be carried by the crank-shaft 42, and as it is preferable to shift the pivot of the carrier at both ends of its stroke, and thus withdraw said carrier quickly from the discharge end of the feed-tube, as well as from a point between the forging-dies, I have shown herein a pair of cams on said shaft 42, these cams being designated herein by 50 and 51, the former having a quick-let-off face 50′ and the latter a corresponding face 51′, said faces being so positioned as to permit the spring 49 to shift the carrier quickly just after it has gripped a blank in the end of the tube *t* and also just after the blank transferred thereby has been gripped between the members of the forging means.

The same shaft 42 on which the cams 50 and 51 are mounted may carry another cam, such as 52, for the purpose of operating the angle-lever 60 and imparting movement to the escapement 35, one arm of said angle-lever 60 carrying in this case an antifriction-roll 61, coöperative with the cam 52, while to the other arm of said angle-lever is pivoted a connecting-rod, such as 62, preferably adjustable and pivoted in turn at its opposite end to a rock-arm 63′, carried by a short rock-shaft 63, which passes in this case through the feed-tube *t* and has secured to the inner end thereof the escapement 35, the journal being suitably packed to prevent leakage of air and the feed-tube being preferably enlarged somewhat at this point, as shown at 65, in order to permit the proper operation of said escapement. The cam 52 has a quick-let-off face 52′ in order to permit the spring 49 to shift the pallet 35″ quickly to the position shown in Fig. 4 to prevent the release of more than one blank at a time.

The blanks delivered from the blank-holding means may be supplied to any suitable blank-shaping means for operating upon the blanks; but the blank-supplying means and the transferring device hereinbefore described will preferably be employed in connection with blank-forging means, which will usually embody a pair of complementary dies, one of which, such as that shown at *o*, may be fixed, while the other, such as *o′*, may be movable toward and from the fixed die. In this case the fixed die is supported by a carrier, such as *h*, which is passed through an opening in one wall of the central chamber *c* of the main vacuum-chamber C, a suitable stuffing-box, such as 70, being employed, through which said carrier *h* is passed to prevent leakage of air into the vacuum-chamber. This carrier *h*, with its die *o*, may be adjusted in position by a screw, such as 71, passed through an abutment, such as 72, formed in this case by cutting away a portion of the main frame at 73 to permit access to the stuffing-box 70, a check-nut, such as 74, being employed in connection with said screw 71 to locate the latter positively.

The movable die of the forging means may be supported by a carrier, such as *h′*, mounted in an opening in the opposite wall of the central portion *c* of the main vacuum-chamber C, said carrier also being preferably passed through a stuffing-box, such as 70′, in order to prevent leakage of air into said vacuum-chamber. Said carrier *h′* is intended to reciprocate toward and from the carrier *h* and its die *o* and may be actuated by any suitable mechanism, it having in this case at its outer end an open frame or swivel 75, carrying a pin 75′, on which is pivoted one member 76 of a toggle, the other member 77 of which is carried by a pin 78 and exerts its thrust directly against a strong abutment 80, forming part of the main frame, said toggle being preferably operated by a second toggle pivoted thereto at the knuckle thereof, said second toggle consisting in this case of a link 81 and a rock-arm 82, pivoted to a depending portion 83 of the main frame A. This second toggle may be operated in turn by an eccentric-rod 84, the strap of which is carried by an eccentric 85 on the main shaft 2, and the two toggles are so placed relatively to each other as to be straightened simultaneously, and thus secure a most effective thrust for forging the blank.

In connection with the blank-forging means I may employ a suitable stripper for separating the forging therefrom. In this case the carrier *h′* has a central longitudinal bore, in which is mounted for reciprocation a stripper-rod 86, which may have at its outer end an enlarged head 86′, working in a corresponding enlargement of the bore in the carrier *h′*, a suitable spring, such as 87, being interposed between the inner end of the head 86′ and the inner wall of such opening 88 for the purpose of normally retracting the stripper to the position shown in Fig. 1. Said stripper may be operated in any suitable manner, but preferably by means of a cam or wiper, which in this case is in the form of a nose 76′ on the toggle member 76.

For the purpose of observing the operation of the parts within the vacuum-chamber C, I prefer to employ one or more sight-openings, which in this case are in the central portion *c* of said vacuum-chamber, two of them being shown herein at opposite points in the chamber, they being designated, respectively, by 90 and 91 and having transparent air-tight closures. I deem it advantageous to place an electric lamp, such as 92, in alinement with and just outside of one of said sight-openings for the purpose of illuminating the interior of the main vacuum-chamber.

The operation of a forging-machine constructed in accordance with my present invention, as hereinbefore described, is as follows: It being understood that the parts are

in the positions shown in Figs. 1 and 2, that the vacuum-chambers have been exhausted, and that the blanks in the receiving and heating sections of the feed-tube have been brought to the proper forging temperature, the machine will be started, whereupon movement will be transmitted from the main shaft 2 through the operating connections to the driven parts. At the beginning of the operation of forging a blank the antifriction-roll 48 will be forced down the cam-face 50′ by the spring 49 and the pivot of the carrier T will be quickly shifted to the rear, and hence the gripping-fingers of said carrier will be withdrawn quickly from the divided end of the delivering-section 22 of the feed-tube *t* and will carry with them the blank, which, it should be understood, will have been permitted to travel down the tube to the discharge end thereof. As said carrier T is shifted to the rear in one curvilinear path by the turning of the rock-arm 41′ it is also actuated in another curvilinear path by its oscillation about its own pivot due to the turning of the crank-arm 42′ in the direction of the arrow, as seen in Fig. 2. Immediately after said carrier begins to descend the antifriction-roll 61 will be forced down the let-off face 52′ of the cam 52 by the spring 49 and the pallet 35″ will be shifted quickly into position to receive another blank *b* and prevent the further descent thereof, said antifriction-roll withdrawing entirely from the cam when it reaches the bottom of said cam-face, as will be seen by referring to Fig. 4. In the meantime the eccentric-rod 84 will strike the toggles and the carrier *h′* will be shifted to the right, as shown in Fig. 3, and at the same time the nose 76′ on the toggle member 76 will force the stripper inward to strip from the die *o′* any previously-made forging, after which said toggles will be gradually straightened again and the carrier *h′* forced inward, while the nose 76′ will withdraw from the stripper, and the spring 87 will return the latter to the position shown in Fig. 1. Just before the die *o′* reaches its working position the carrier T will reach the limit of its downward movement and the gripping-fingers 36 and 36′ will hold the blank carried thereby in position to be properly engaged between the dies. As soon as said blank is engaged by the continued inward movement of the carrier *h′* and its die *o′* the antifriction-roll, which, it will be understood, had just previously ridden up the rise of the cam 51, will ride down the let-off face 51′ of said cam and withdraw said carrier T and its gripping-fingers from its position between the dies before the latter can engage said carrier, whereupon the blank will be forged by the dies and the latter will afterward open, while the carrier will rise to the limit of its upward movement and riding up the rise of the cam 50 will move forward into the opening in the divided end of the delivering-section 22 of the feed-tube to receive another blank. At about the same time that the antifriction-roll 48 rides up the rise of the cam 50 the antifriction-roll 61 rides up the rise of the cam 52, and hence oscillates the escapement to the position shown in Fig. 2 and permits the pallet 35″ to release the blank in engagement therewith, whereupon said blank will travel down the incline to the discharge end of the feed-tube, when the pallet 35′ will form a stop for all of the other blanks, whereupon all of the parts may go through a new cycle of operations. Blanks which are subjected to hot forging in an inert or exhausted atmosphere in this manner do not become oxidized and coated with scale, and therefore the dies are filled much more perfectly and the finished articles have much smoother surfaces, finer lines, and sharper corners than it is possible to obtain by forging heated blanks in the ordinary manner, it being practically impossible to prevent the formation of an injurious amount of scale when blanks are hot-forged in the open air.

Having described my invention, I claim—

1. The combination, with a chamber having an inert atmosphere, of blank heating and feeding means, and blank-forging means effective for forging a blank within said chamber.

2. The combination, with a vacuum-chamber, of blank heating and feeding means, and blank-forging means effective for forging a blank within said chamber.

3. The combination, with a vacuum-chamber, of blank heating and holding means; a blank-transferring carrier; and blank-forging means effective for forging a blank within said chamber.

4. The combination, with a vacuum-chamber, of blank heating and holding means; an oscillatory blank-transferring carrier; and blank-forging means effective for forging a blank within said chamber.

5. The combination, with a vacuum-chamber, of blank heating and feeding means; blank-forging means effective for forging a blank within said chamber; and a stripper cooperative with said blank-forging means.

6. The combination, with a vacuum-chamber, of blank heating and feeding means; blank-forging means effective for forging a blank within said chamber and embodying a movable die; and a stripper coöperative with said die.

7. The combination, with a vacuum-chamber, of blank heating and feeding means; blank-forging means effective for forging a blank within said chamber and embodying a movable die; and a stripper carried by said die.

8. The combination, with blank-heating means, of a vacuum-chamber; an inclined blank-supplying device; a blank-transferring carrier; and blank-forging means coöperative with said carrier and effective for inclosing and forging a blank.

9. The combination, with blank-heating means, of a vacuum-chamber; an inclined

blank-supplying device; blank-forging means effective on the withdrawal of the carrier therefrom for inclosing and forging a blank within said chamber; and a blank-transferring carrier shiftable from the discharge end of the blank-supplying device to the blank-forging means.

10. The combination, with blank-heating means, of a vacuum-chamber; intermittently-effective blank-feeding means; a blank-transferring carrier; and blank-forging means coöperative with said carrier and effective for inclosing and forging a blank within said chamber.

11. The combination, with blank-heating means, of a vacuum-chamber; blank-holding means; a blank-feeding escapement having blank-engaging and blank-releasing pallets for releasing a series of blanks successively; and blank-forging means effective for inclosing and forging a blank within said chamber.

12. The combination, with blank-heating means, of a vacuum-chamber; escapement-feed blank-supplying means; a blank-transferring carrier; and blank-shaping means coöperative with said carrier and effective for shaping a blank within said chamber.

13. The combination, with blank-heating means, of a vacuum-chamber; escapement-feed blank-supplying means; a blank-transferring carrier; and blank-forging means coöperative with said carrier and effective for inclosing and forging a blank within said chamber.

14. The combination, with blank-heating means, of a vacuum-chamber; blank-holding means; a blank-transferring carrier; and blank-forging means coöperative with said carrier and effective for inclosing and forging a blank within said chamber.

15. The combination, with blank-heating means, of a vacuum-chamber; blank-holding means; blank-forging means embodying a die movable toward and from a working position and effective for inclosing and forging a blank within said chamber; and a blank-transferring carrier coöperative with said blank-forging means and movable transversely to said die.

16. The combination, with blank-heating means, of a vacuum-chamber; blank-holding means; blank-forging means embodying a die movable toward and from a working position and effective for inclosing and forging a blank within said chamber; and an oscillatory blank-transferring carrier movable between the blank-holding means and said die in a path transverse to the forging-stroke of the latter.

17. The combination, with blank-heating means, of a vacuum-chamber; a blank-supplying spout having a divided discharge end; a blank-transferring carrier movable into and out of the opening in the divided end of said spout and blank-forging means coöperative with said carrier and effective for inclosing and forging a blank within said chamber.

18. The combination, with blank-heating means, of a vacuum-chamber; a blank-supplying spout having a divided discharge end; a blank-transferring gripper movable into and out of the opening in the divided end of said spout; and blank-forging means coöperative with said gripper and effective for inclosing and forging a blank within said chamber.

19. The combination, with blank-heating means, of a vacuum-chamber; a blank-supplying tube having a divided discharge end with blank-frictioning retaining-walls; a blank-transferring carrier movable into and out of the opening in the divided end of said tube; and blank-forging means coöperative with said carrier and effective for inclosing and forging a blank within said chamber.

20. The combination, with blank-heating means, of a vacuum-chamber; an inclined blank-supplying tube having a divided discharge end with blank-frictioning retaining side walls and substantially horizontal blank-supporting end walls; a blank-transferring carrier movable into and out of the opening in the divided end of said tube; and blank-forging means coöperative with said carrier and effective for inclosing and forging a blank within said chamber.

21. The combination, with blank-holding means, of blank-forging means constructed and operative to inclose a blank and also to forge the same on the withdrawal of the carrier therefrom; a blank-transferring carrier movable between the blank-holding means and the blank-forging means; and means for accelerating the movement of said carrier as it withdraws from the blank-forging means.

22. The combination, with blank-holding means, of blank-forging means constructed and operative to inclose a blank and also to forge the same on the withdrawal of the carrier therefrom; a blank-transferring carrier movable between the blank-holding means and the blank-forging means; and means for accelerating the movements of said carrier as it withdraws from the blank-holding means and the blank-forging means.

23. The combination, with blank-holding means, of blank-forging means constructed and operative to inclose a blank and also to forge the same on the withdrawal of the carrier therefrom and embodying a die movable toward and from a working position; a blank-transferring carrier movable between the blank-holding means and the blank-forging means; and means for accelerating the movement of said carrier as it withdraws from the blank-forging means.

24. The combination, with blank-holding means, of blank-forging means embodying a pair of complementary blank-engaging dies operative to inclose a blank and also to forge the same on the withdrawal of the carrier therefrom and one of which is movable toward and from the other; die-actuating means; a blank-transferring carrier movable between the blank-holding means and said dies; and means for accelerating the movement of said

carrier as it withdraws from the dies on the engagement of the blank by the latter.

25. The combination, with blank-holding means, of blank-forging means constructed and operative to inclose a blank and also to forge the same on the withdrawal of the carrier therefrom; a rotary quick-let-off cam; and a spring-pressed blank-transferring carrier movable between the blank-holding means and the blank-forging means and controlled by said cam and adapted to be released by the latter as it withdraws from the blank-shaping means.

26. The combination, with blank-holding means, of blank-forging means constructed and operative to inclose a blank and also to forge the same on the withdrawal of the carrier therefrom; a pair of rotary quick-let-off cams; and a spring-pressed blank-transferring carrier movable between the blank-holding means and the blank-forging means and controlled by said cam and adapted to be released by said cams respectively as it withdraws from the blank-holding means and from the blank-forging means.

27. The combination, with blank-holding means, of blank-shaping means; a pair of rotary quick-let-off cams; an oscillatory spring-pressed blank-transferring carrier movable between the blank-holding means and the blank-shaping means and adapted to be released by said cams respectively as it withdraws from the blank-holding means and from the blank-shaping means, and having a shiftable pivot the position of which is controlled by said cams; and carrier-oscillating means coöperative with said cams.

28. The combination, with a main chamber for containing an inert atmosphere, of blank-supplying means embodying a blank-heating chamber communicating with said main chamber, and blank-forging means coöperative with said blank-supplying means and effective for forging a blank within said main chamber.

29. The combination, with a main vacuum-chamber, of blank-supplying means embodying a blank-heating chamber communicating with said main vacuum-chamber, and blank-forging means coöperative with said blank-supplying means and effective for forging a blank within said main vacuum-chamber.

30. The combination, with a main chamber for containing an inert atmosphere, of blank-supplying means embodying a blank-heating feed-tube communicating with said main chamber and also adapted to contain an inert atmosphere, and blank-forging means coöperative with said blank-supplying means and effective for forging a blank within said main chamber.

31. The combination, with a main chamber for containing an inert atmosphere, of blank-supplying means embodying an inclined blank-heating feed-tube communicating with said main chamber and also adapted to contain an inert atmosphere, and blank-forging means coöperative with said tube and effective for forging a blank within said main chamber.

32. The combination, with a main chamber for containing an inert atmosphere, of blank-supplying means embodying a blank-heating chamber communicating with said main chamber and also adapted to contain an inert atmosphere; blank-forging means coöperative with said blank-supplying means and effective for forging a blank within said main chamber; and heat-insulating means between said chambers.

33. The combination, with a main chamber for containing an inert atmosphere, of blank-supplying means embodying a blank-heating chamber communicating with said main chamber and also adapted to contain an inert atmosphere; blank-forging means coöperative with said blank-supplying means and effective for forging a blank within said main chamber; and means for circulating a cooling medium in contact with the blank-heating chamber adjacent to its point of connection with the main chamber.

34. The combination, with a main chamber for containing an inert atmosphere, of blank-supplying means embodying a blank-heating feed-tube communicating with said main chamber and also adapted to contain an inert atmosphere; blank-forging means coöperative with said tube and effective for forging a blank within said main chamber; and means for circulating a cooling medium in contact with said tube adjacent to its point of connection with the main chamber.

35. The combination, with a main chamber for containing an inert atmosphere, of blank-supplying means embodying a feed-tube communicating with said main chamber and also adapted to contain an inert atmosphere; means for heating said feed-tube; blank-forging means coöperative with said tube and effective for forging a blank within said main chamber; and means for circulating a cooling medium in contact with said tube at a point between the tube-heating means and the main chamber.

36. The combination, with a main chamber for containing an inert atmosphere, of blank-supplying means embodying a sectional feed-tube communicating with said main chamber and also adapted to contain an inert atmosphere, and having heat-insulating material between its sections; means for heating said feed-tube; and blank-forging means coöperative with said tube and effective for forging a blank within said main chamber.

37. The combination, with a main chamber for containing an inert atmosphere, of blank-supplying means embodying a sectional feed-tube communicating with said main chamber and also adapted to contain an inert atmosphere, and having heat-insulating material between its sections; means for heating a receiving-section of the feed-tube; means for cooling a delivering-section of said feed-tube;

and blank-forging means coöperative with said tube and effective for forging a blank within said main chamber.

38. The combination, with a main chamber for containing an inert atmosphere, of blank-supplying means embodying a feed-tube communicating with said main chamber and also adapted to contain an inert atmosphere, and comprising a plurality of sections separated by heat-insulating material, one of said sections constituting a water-jacket; means for heating said feed-tube; and blank-forging means coöperative with said tube and effective for forging a blank within said main chamber.

39. The combination, with a main chamber for containing an inert atmosphere, of blank-supplying means embodying a blank-heating chamber communicating with said main chamber and also adapted to contain an inert atmosphere; a cut-off valve controlling communication between said chambers; and blank-forging means coöperative with said blank-supplying means and effective for forging a blank within said main chamber.

40. The combination, with a main chamber for containing an inert atmosphere, of blank-supplying means embodying a feed-tube communicating with said main chamber and also adapted to contain an inert atmosphere; a cut-off valve controlling communication between said chamber and the feed-tube; and blank-forging means coöperative with said feed-tube and effective for forging a blank within said chamber.

41. The combination, with a chamber for containing an inert atmosphere, of blank heating and feeding means; a die located within said chamber; and die-actuating means.

42. The combination, with a chamber for containing an inert atmosphere, of blank heating and feeding means; a die located within said chamber; and die-actuating toggle mechanism.

43. The combination, with a chamber for containing an inert atmosphere, of blank heating and feeding means; a die located within said chamber; and die-actuating toggle mechanism located without said chamber.

44. The combination, with a chamber for containing an inert atmosphere and having an opening therein, of blank heating and feeding means; a die located within said chamber; a die-operating member passing through said opening; an air-tight packing between said die-operating member and the walls of said opening; and means for actuating said die-operating member.

45. The combination, with a chamber for containing an inert atmosphere, of blank heating and feeding means; a die located within said chamber; a die-carrier; toggle mechanism for actuating said die-carrier; and a stripper on said die-carrier and controlled by said toggle mechanism.

CURTIS H. VEEDER.

Witnesses:
H. W. LESTER,
HENRY BISSELL.