(No Model.)

W. R. HINSDALE.

APPARATUS FOR PRESSING FLUID METAL.

No. 332,656. Patented Dec. 15, 1885.

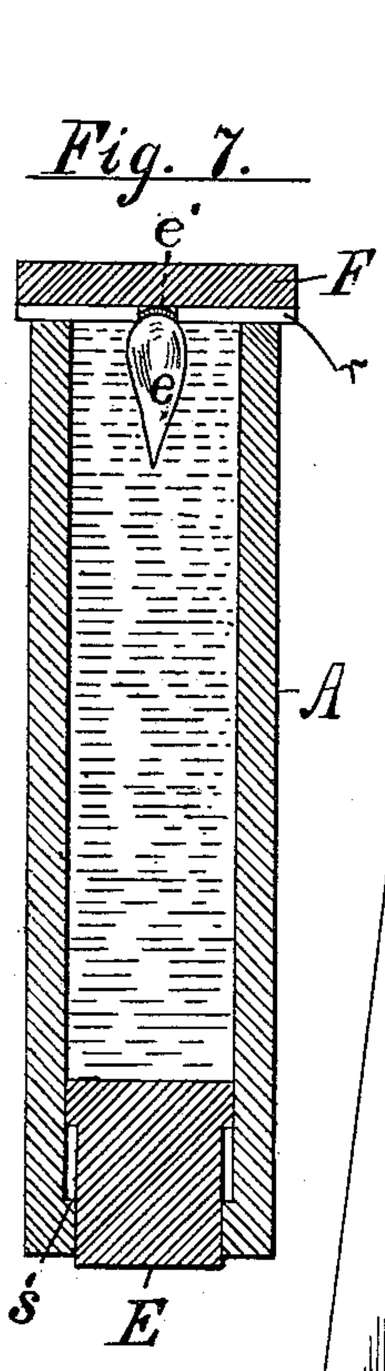

Fig. 7.

Fig. 1.

Fig. 3

Fig. 2.

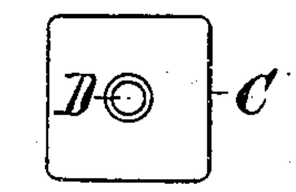

Fig. 5.

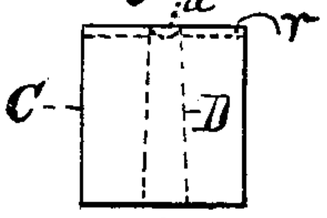

Fig. 4

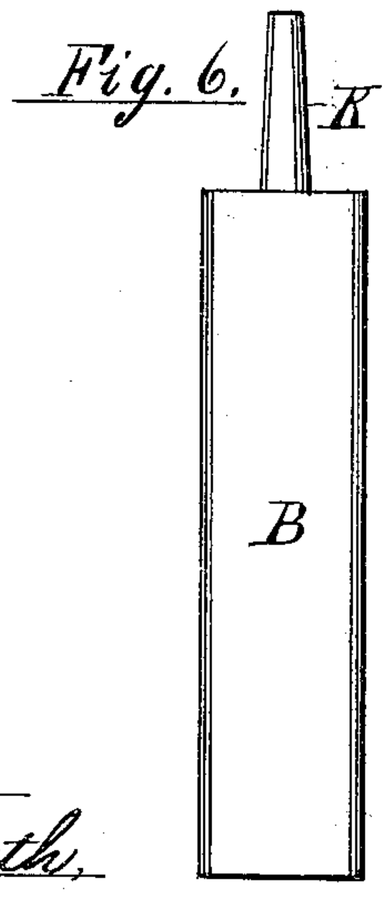

Fig. 6.

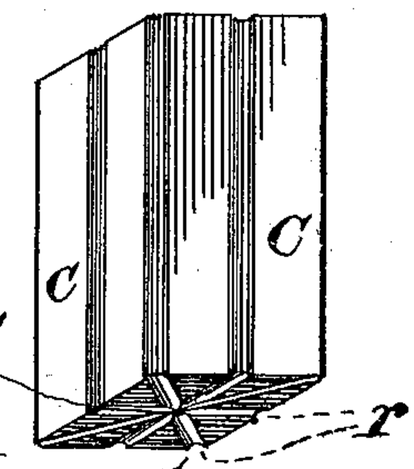

Fig. 8.

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR PRESSING FLUID METAL.

SPECIFICATION forming part of Letters Patent No. 332,656, dated December 15, 1885.

Application filed September 10, 1884. Serial No. 142,617. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM R. HINSDALE, a citizen of the United States, residing in the city of Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Apparatus for Pressing Fluid Metal, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

My invention relates to a means for insuring the discharge of the gases contained in the molten metal when poured in the mold, and also for collecting the impurities which rise to the top after pouring in a central stud, which may afterward be broken off the body of the ingot.

It consists, essentially, in providing a central recess in the lower end of a stopper applied to the mouth of a filled ingot-mold, and in maintaining an outlet or outlets from such recess to the external atmosphere during the compression of the metal, until the gases are discharged from their point of accumulation at the center of the ingot-head.

It also consists in certain modifications, which are fully described herein.

In the forming of steel ingots by surface-pouring, to which my invention is particularly adapted, the metal obviously fills the bottom of the mold first, and is liable to chill at such point sooner than at the top, where the metal is last supplied, and is not as readily moved within the mold from the bottom in its chilled condition as by pressure applied at the top. If no opening is provided at the center of the top during the application of pressure at the bottom, the slag, impure metal, and the gases which exist in the mold, and which naturally move toward the top when the mold is filled, are all confined in the product, and seriously affect the upper end of the ingot. To obviate this defect, I apply the pressure preferably at the top of the mold by inserting a movable plunger therein, that I may act upon the most fluid part of the ingot; and I form such plunger with a recess and outlet extending from the center of the top to the outside of the mold, that I may furnish an outlet for the gases. Although I prefer to use the plunger in connection with my invention at the top of the mold, in some cases I use my invention in connection with a plate at the top of the mold, and apply the pressure at the bottom. My experience has shown that it is preferable to permit the overflow or waste of a small amount of fluid metal in order to produce a movement of the metal upward in the interior of the ingot and the discharge of the gases from the center of the top. The recess shown herein is formed in the center of the stopper or cover of the mold, as the metal in the center of the mold is obviously more fluid than that in contact with its sides, and thus yields more readily to pressure, while the rising gases naturally move upward chiefly in the center, where they meet the least resistance. I also in some cases apply pressure to movable plungers in both ends of the mold, that I may operate through but one-half of the metal and its frictional resistance in pressing upon the middle part of the mold's contents.

In the drawings, Figure 1 is a side view of a mold under a power, steam, or air hammer, the mold and anvil being shown in section. Fig. 2 is a longitudinal section of the mold and its attachments on a larger scale. Fig. 4 is a side view of a perforated plunger. Fig. 3 is a view of the under side of the cap-plate. Fig. 5 is a view of the inner end of the perforated plunger. Fig. 6 is a side view of an ingot with the waste-stud attached. Fig. 7 is a section of the mold with a cap applied to its upper end; and Fig. 8 is a perspective view of the plunger, showing radial outlets at the bottom end.

A is the mold, which may be divided lengthwise and clamped together with straps in the usual way. B is the ingot; C, the top movable plunger, (shown as a prismatic plug with a central conical perforation, D, in Figs. 1, 2, 3, and 4, and with radial outlets extending from the central recess, *d'*, to its edges, in Fig. 8.) E is the bottom plunger, formed, as well as the mold, with a shoulder, *s*, to sustain it in the mold and movable inward only. F is a cap, formed with a central depression or recess, *d'*, and shown provided with radial grooves *r*, to allow the escape of fluids from the depression *d'*. G is the frame of the hammer. H is the anvil. I is a guide thereon to surround the base of the mold when applied thereto, and *t* is a pin therein to press upon the lower plunger, E; and J is the head or

ram of the hammer for pressing or striking upon the head of the top plunger, C. L is a tongs for supporting the mold by chains or rope M upon a trolley, N, which is shown in Fig. 1, fitted to a rail, O, overhead for shifting the mold from the furnace to the press or hammer.

With this apparatus the mold, with the plunger E in place to close its bottom, is filled adjacent to the furnace and is then transported to the hammer and sustained in an upright position thereon beneath the ram J, with the plunger C inserted in its mouth upon the fluid metal, and the bottom plunger, E, in contact with the pin *t*. The hammer is then operated to press or strike upon the plunger C, the reaction of the anvil pressing the lower plunger into the mold with nearly the same degree of force, and the blows or pressures are repeated until the operator perceives that the compression has ceased.

I find in practice that the friction of the metal keeps the mold from sliding downward over its contents, so that the metal will sustain the mold and its contents upon the lower plug during such pressing operation, and that the mold therefore does not come in contact with the anvil at all, and that a succession of blows, gradually increased in force, materially facilitates the expulsion of the contained gases from the metal, by shaking the viscid fluid and moving the particles about.

As the valves of the steam-hammer are preferably actuated by hand to produce the required blows, it is very easy to gradually increase their intensity in the same manner as is common when hammering a cooling forging by admitting the steam to the hammer-piston at an earlier point in each descending stroke.

As the gases rise to the top of the mold, they tend to form a bubble at the central part, as at *e* in Fig. 2, and as the pressure upon the fluid metal is increased the surface material is forced upward into the conical aperture D, carrying with it such bubble and leaving the remainder of the contents solid and absolutely free from defects. The stud K, formed by the chilling of the surface material within the aperture D, is found to consist partly of impurities and generally shows, upon fracture, the presence of a large compressed bubble formed of the discharged gases, as shown at *e* in Figs. 2 and 7. As it is requisite that each ingot should be broken to test its quality, the breaking off of the stud affords a very convenient means of thus showing a fracture and determining the character of the metal at the top end of the ingot.

To apply pressure to the plunger C without obstructing the hole D, I may use the cap or cover F, provided with the radial grooves *r* upon the top of the plunger, or may form the grooves in the top of the plunger itself, as shown in Figs. 1 and 3, thus affording an escape for the air or gases from the hole D, while it furnishes an additional cold surface beyond the hole to chill the escaping material and prevent too great a loss of metal from the mold. The chilling of this stud finally closes the gas-outlet, and the blows then effect a final pressure upon the mold's contents at the central point, and thus secure the compression of such part and avoid the formation of a spongy spot at the center of the end.

In practice, the discharge may be regulated to exactly fill the hole D, which is preferably made conical to secure an easy separation of the plunger from the stud when cold. The hole D may, if preferred, be so formed in the plunger as to slope from the center of the bottom end outward in a straight line through one of its sides, thus making the stud shorter and at an angle with the head of the ingot. A central recess, *d'*, may also be formed in the bottom of the plunger and the escape of the gas be secured with a very limited discharge of the metal by making grooves or channels *r* at its lower end as well as at the sides and corners, as shown in Fig. 8, in which case the gas has no outlet at the center, but is conducted by the radial grooves *r* to the sides of the mold before it escapes by the side grooves. The central recess, *d'*, and apertures for the escape of the gas may also be secured without the use of the movable plug, by applying the grooved cap F directly to the top of the mold with the grooves *r* toward the fluid metal, as in Fig. 7. In these constructions (shown in Figs. 7 and 8) the skin or chilled crust upon the surface metal is cut by the margin of the recess and the gas is deflected by the radial grooves to the side of the mold before escaping, and in addition the center of the ingot is pressed harder and rendered a little more solid than with the perforated plug.

To prevent injury to the operators from the flying of the fluid metal from the hole D or any of the grooves *r*, the ram J may be provided with metal guards *g*, depended from its sides sufficiently to inclose the plunger on one or all sides. If no central vent in the top of the mold is made, no pressure would be great enough to rupture the bubble of gases accumulated there, for the fluid-pressure is equal in all parts of the mold and compresses the chilled metal over the bubble with the same force as the fluid metal beneath and around it.

By making the central recess at the top of the mold, the downward pressure on the metal directly under it is removed, and the upward pressure being the same as that in other parts of the mold, the equilibrium is destroyed and the crust of chilled metal above the bubble is broken, as shown at *e'* in Figs. 2 and 7, thus allowing the confined gases and the impurities which have risen to the top to pass into the recess from the mold. This effect is analogous to that of a punch and die, the superficial metal sustaining the pressure from below at all points except under the recess, where the pressure operates as a punch

and ruptures the surface so as sometimes to discharge the gas at first, and sometimes to cause a discharge of the gas and fluid metal mingled together. The same effect is produced by the use of a plate having a central recess or depression formed by the intersections of the radial grooves *r* when in direct contact with the metal in the mouth of the mold, as shown in Fig. 7. Such recess relieves the pressure upon the fluid metal sufficiently to effect the rupture of the chilled surface, and after such rupture is effected the discharge of the gas and the fluid steel is naturally confined to the opening thus formed in the surface of the metal, the free escape of the gas being secured by the radial channels. The pressure in the mold during the first part of such discharge has obviously no tendency to press the actual chilled metal (upon the top of the ingot) up into the radial outlets or channels *r r*, as the flow of gas or more fluid metal under pressure out through such channels serves to balance any pressure beneath the chilled surface metal, and to keep the outlets open as long as such flow is maintained. The function of the central recess is thus seen to be that of a shear or cutter by which a rupture is produced in the chilled surface at the desired point, while the function of the channel or outlet leading from such recess outward is to destroy the equilibrium of pressure existing in the head of the ingot at the central point, and to thus make the pressure toward the recess effective. The action of each of these agencies is the same, whether the outlet be in the same line and continuous with the recess, as in the hole D in the perforated plunger C, or at right angles thereto, as in the plate F, with the radial channels *r*.

I am aware that the gases have with other devices been partially expelled from the mold through the opening existing between a movable plunger and the mold, or between a hollow plunger and a central core; but in such cases the opening for the escape of the gases is not at that central point in the top of the mold to which the bubble of gas rises, and in such cases no means of rupturing the chilled metal above the bubble is presented. Molds have also been constructed having porous linings or covers, and others with a lining of cast-iron in segments, having the surfaces in contact with each other fluted or grooved both transversely and longitudinally to form passages for the escape of the gas, but as the tendency of the gas is to rise to the top and not to move toward the sides of the mold, no such means can effect the same object as my invention.

I am also aware that a vent has been used in the top of the mold when pouring the metal in by a bottom runner; but such vent cannot perform any function analogous to my invention, as it is applied to an empty mold instead of to a full one, as in my construction, and the metal which comes in contact with it is not that in which the gas has been accumulated at the top by the gradual operation of gravity, but is the agitated metal which is pushed up by the flow beneath it, and which stops up the vent by chilling therein before any effective pressure is applied to the contents of the mold.

I therefore disclaim all mere vents and provisions for discharging the gas at other points in the mold than the center of the top, as my invention is intended only for use in casting steel ingots under compression, and only where metallic molds are used, and in such cases as when the metal is poured into the open mouth of the mold.

In the method employed with my apparatus the mold is first filled, the top closed by a suitable stopper, and the gases permitted to rise before the compression is induced to consolidate the ingot.

I am aware that a central runner has been formed in a movable mouth-piece inserted in the top of a mold, as in United States Patent No. 152,040, dated June 16, 1874, but in such construction the central aperture is used only as an in-gate to introduce the metal, and is stopped up when the mold is filled by forcing a plug against its external opening. The only air-vents specified or shown in the said patent are formed at the upper corners of the mold, and do not connect with the central aperture at all, so that there is no discharge for either gas or metal at such point. My invention differs from this construction in having no runner whatever at the top of the mold, in the application of the stopper to the mouth of the mold only after it is filled, in the provision of a permanent outlet from the central point of the stopper in contact with the metal, and in the actuation of the device in such manner that the gas is discharged from the central part of the ingot's head with a small quantity of the fluid metal.

As I do not consider it possible to entirely discharge the gases from an ingot-head, except by an outlet or outlets connected with the central point where the gases spontaneously collect, I hereby disclaim any constructions which are not adapted to effect the discharge from such point, and do not, therefore, claim a central aperture, except the same be kept open during the application of the pressure until the gases are discharged to the fullest extent attainable.

Having thus distinguished my invention from others, what I claim herein is—

1. The combination, with the mouth of a filled ingot-mold, of the stopper herein described, and provided with a central recess communicating with the external atmosphere and adapted to rupture the surface-metal at the head of the ingot while under pressure, the said recess being connected with the external atmosphere by means of an outlet or outlets by which the gas is conducted from such recess with a portion of the fluid metal, substantially as and for the purpose set forth.

2. The combination, with a filled ingot-mold, of means applied to the top of the mold for forming a central stud upon the surface of the metal, and means applied to the bottom of the mold for forcing the metal upward and discharging the confined gases from the center of the mold with such stud, substantially as and for the purpose set forth.

3. The combination, with an ingot-mold, of the stopper herein described, and provided with a central recess having edges or corners adapted and operated to rupture the surface metal at the head of the ingot while under pressure, and having one or more outlets connecting said central recess with the external atmosphere to discharge the gas from such central recess with a portion of the fluid metal, and of means for compressing the fluid metal within the mold with said central recess in communication with the atmosphere, substantially as and for the purpose set forth.

4. The combination, with the mouth of an ingot-mold, of a movable plunger provided with a central perforation, and having radial grooves in its upper end for the escape of the gas between the plunger and the abutment against which it presses, substantially as and for the purpose set forth.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

WILLIAM R. HINSDALE.

Witnesses:
C. C. HERRICK,
THOS. S. CRANE.