

(No Model.)

J. ILLINGWORTH.
APPARATUS FOR CASTING INGOTS.

No. 403,755.

Patented May 21 1889.

Fig. 1.

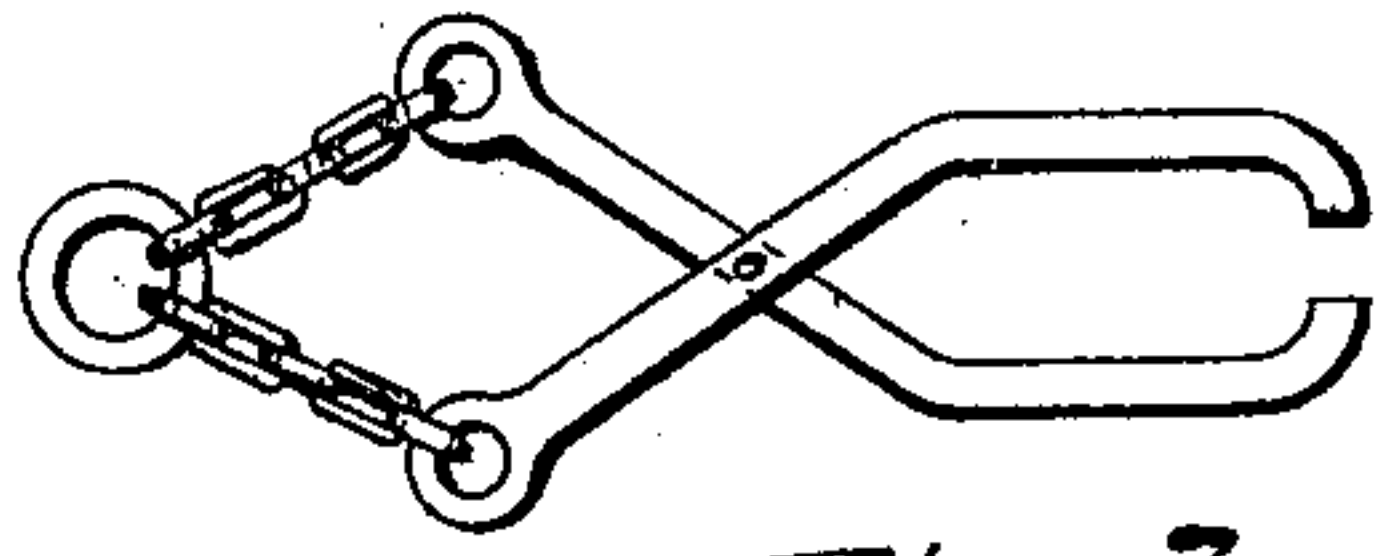
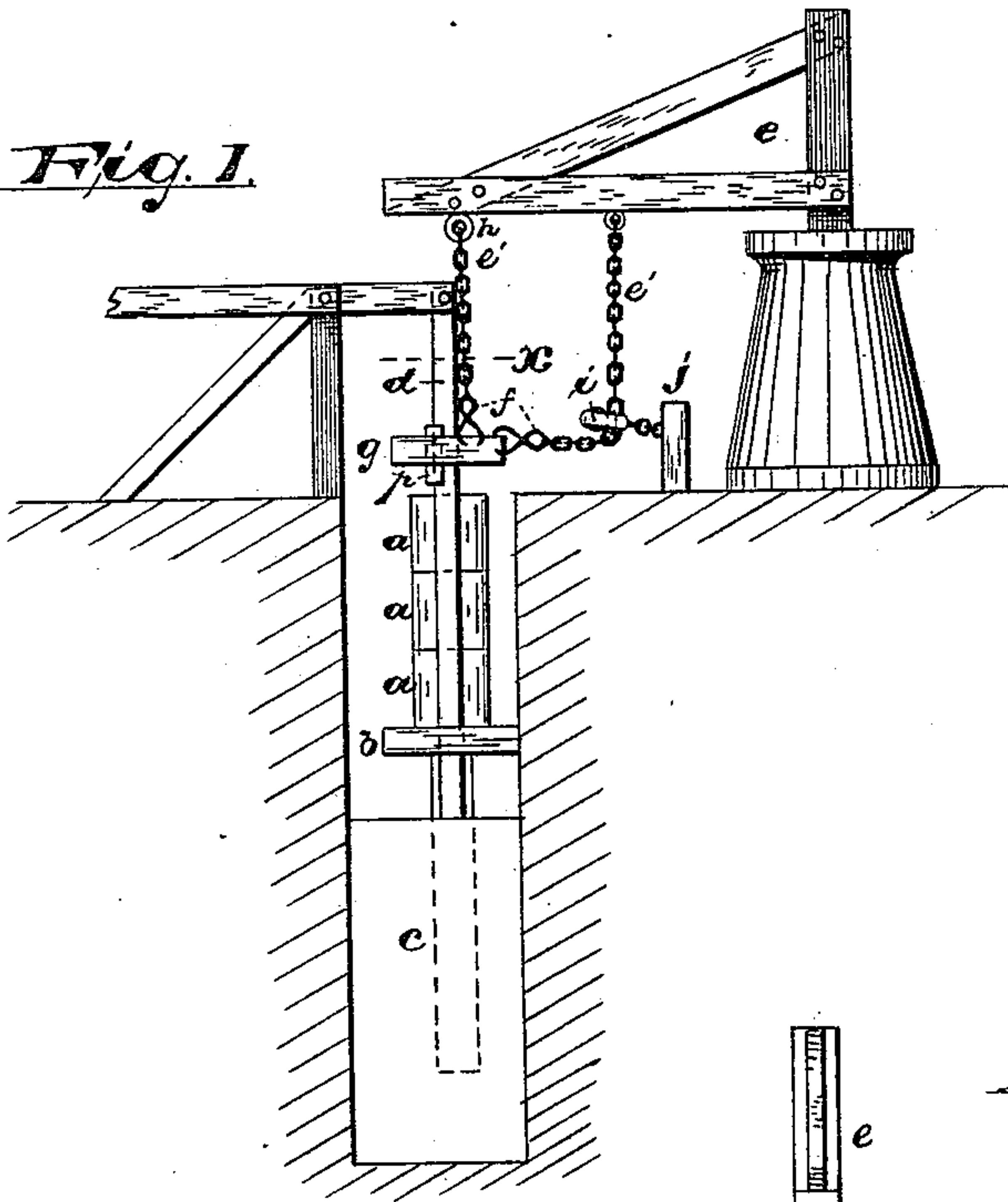


Fig. 3.

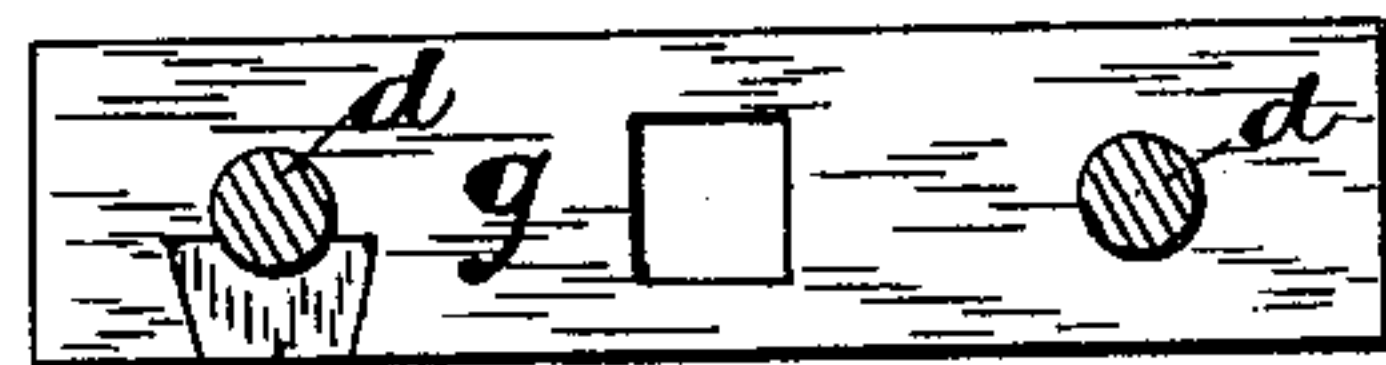


Fig. 6.

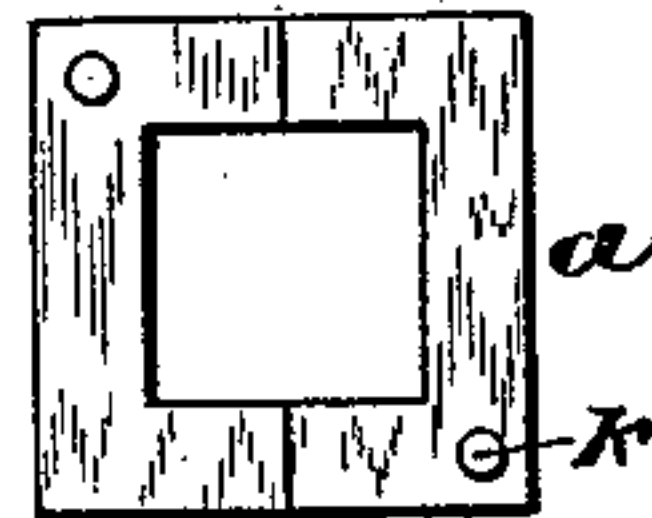


Fig. 4.

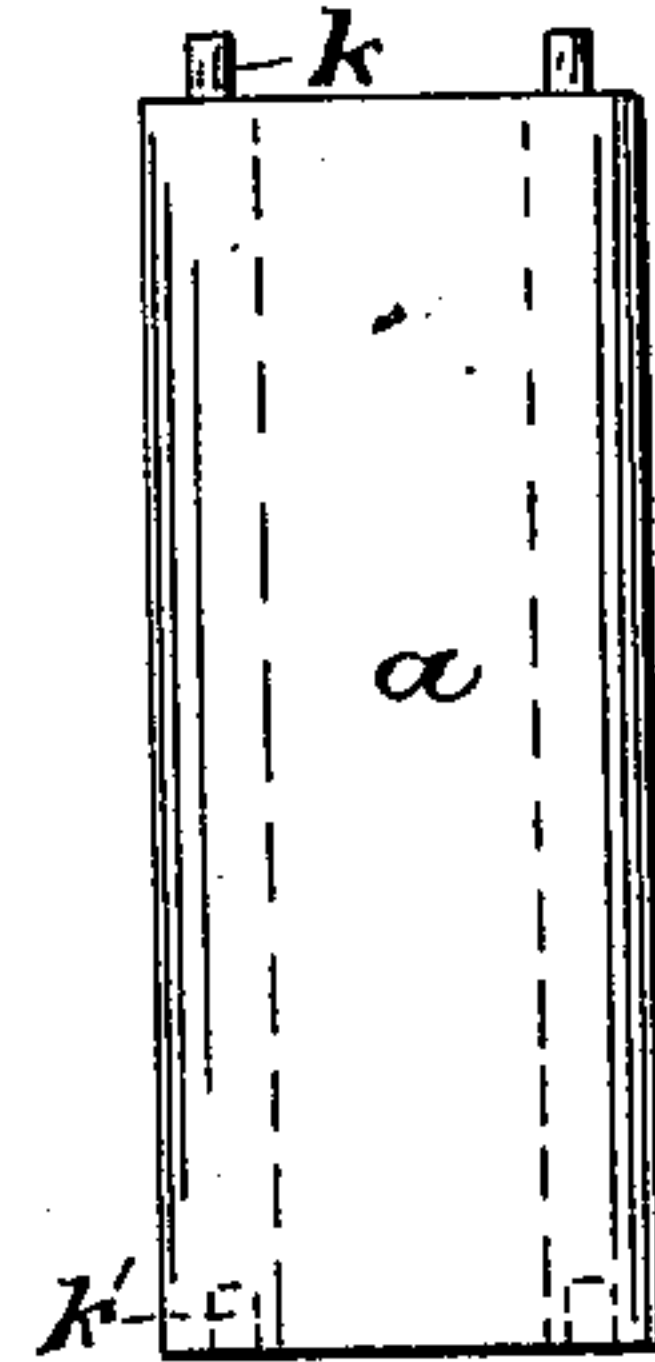


Fig. 5.

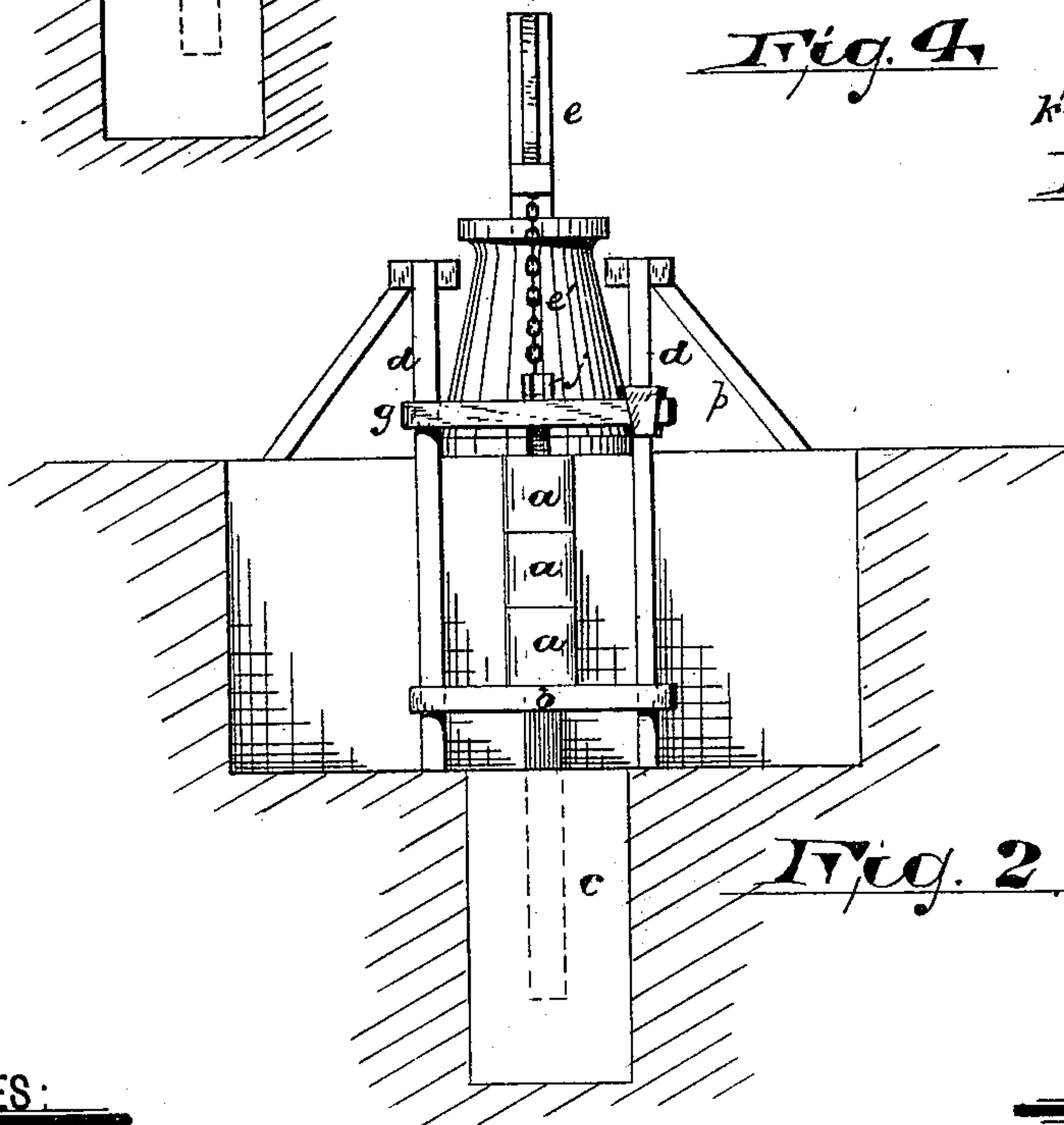


Fig. 2.

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UNITED STATES PATENT OFFICE.

JOHN ILLINGWORTH, OF NEWARK, NEW JERSEY.

APPARATUS FOR CASTING INGOTS.

SPECIFICATION forming part of Letters Patent No. 403,755, dated May 21, 1889.

Application filed December 20, 1887. Serial No. 258,440. (No model.)

To all whom it may concern:

Be it known that I, JOHN ILLINGWORTH, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Ingot-Molds; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

The object of this invention is, primarily, to prevent the wastage incident to the present method of casting ingots, in which a large percentage of loss is occasioned in steel of high carbon because of the piping of the ingot when the same is cooling or passing from the liquid to the solid state.

A further object is to facilitate the operation, and thus reduce the cost of forming ingots.

The invention consists in an apparatus or means whereby several ingots, or a plurality of ingots, may be cast by vertically running or pouring the metal in one body-casting, and when cool, or in a condition to be separated, said ingots may be individually severed from the said body-casting.

Other devices for preventing the piping in the process of casting ingots of steel of high carbon—such, for example, as the one shown in cotemporaneous applications filed August 26, 1886, and June 10, 1887—have been provided prior to the date of filing this specification, and certain claims covering in part the invention herein described have been reserved and incorporated in said prior applications and in another filed June 13, 1887. To secure the desired result, I provide a mold or series of molds through which the ingot may project, so as to be bare to receive severing mechanism, the mold being arranged to stand vertically, so that in the successive pourings the slight seams, joints, or places of union, hereinafter referred to, formed in the casting by the intermitting pouring or flowing of liquid metal into the mold, may be formed at right angles to the longitudinal axis of the body-casting, to produce in the ingots, when the same are broken from the casting, end faces fairly at right angles to the side faces of said ingots, as will be understood.

A further object in having the mold vertically disposed is to enable the metal to be poured into said mold without its striking or impinging upon the sides thereof and eating out the said sides, and thus producing recesses into which the hardened metal of the ingots will lodge and prevent the latter from being withdrawn from said mold when such action is attempted. I also provide means for separating the ingot from the hardened casting after said casting has been freed or stripped from the mold, or laid bare so as to receive severing mechanism or to allow the same to be grasped. I also provide means for baring the ingot, or separating it from its surrounding mold or jacket, so that it may be in a condition to receive the severing devices or to be grasped, as above stated. The specific means shown in this case which may be employed, but to which I do not wish to be understood as limiting myself, are tongs or grasping-arms, which are connected or may be connected, by means of a suitable chain, to a crane or hydraulic elevating device, said grasping-arms or tongs being adapted to take hold of the ingot, and when power is exerted by the hydraulic device to move the ingot longitudinally out of the mold.

The ingot may be bared or stripped from the mold, so as to be presented to the means for breaking the same into smaller ingots, by making the mold in sections, as *a a a* in the drawings, which may be removed from the ingot one section at a time, the bared portion of the ingot being broken off immediately into smaller ingots as the sections are removed before the metal is allowed to become too cool and hard for breaking. After the ingot is laid bare, it is presented to the means for severing it into ingots. This may be accomplished by moving the casting to said means or by moving the said means to the casting, either of said methods being a mere variation of the other. Said severing means where they engage the ingot are vertically in line with said mold, so as to grasp or otherwise engage the ingot issuing vertically therefrom. The severing means preferably provide a holding device or devices capable of receiving the bared ingot and steadying the same or holding it firmly while it is being severed, co-operating means being provided independent of the holding means for exerting the force by which the vertically-disposed

casting is divided into ingots. Said holding device is a fulcrumal bearing, over or on which the ingot may be bent or forced by a sudden exertion of power, causing the ingot to separate from the casting.

In the steel-manufacturing concerns with which I am familiar it has been and is the practice to melt a given amount of metal at a time, the amount being varied in accordance with the capacity of the plant. The operation of melting this amount is technically termed a "heat." The ordinary practice has been to take the metal of a heat and cast it separately in independent molds and produce independent ingots. The result has been that each ingot has in cooling shrunk at the central upper part, so as to produce a longitudinal axial hole or "pipe," which extends more or less deeply into the ingot, vitiating the same, so that the piped portion is necessarily removed at a loss to the manufacturer. It is true that attempts have been made to cast the metal of a heat in one continuous casting and subsequently to sever them into ingots, but by means and processes different from those herein described.

In the improved process the molten metal of a heat is cast in a continuous casting, the process of pouring or running the molten metal into the mold being carried on intermittently, so that the portions of the casting last cast may be given time to set in part before the subsequent casting is made or to allow parts of the device for effecting the process or the ingot to be manipulated. After the casting has cooled to a degree where it may be readily broken or severed—a degree of heat technically termed "red short"—the ingot is brought into engagement with the severing devices, which are preferably arranged at a distance from the mold, so that the strain on the ingot will not be brought to bear on the mold. Said devices break or otherwise divide or sever the casting into ingots one after another in regular succession. Said device for breaking the ingots from the casting may be a hammer in the hands of a workman or may be a clutch or other device otherwise actuated. By this process the axial holes or pipes at the top of the ingots are obviated, except at the top of the body-casting or the portion last formed. In presenting the ingot to the severing devices the ingot is caused to move the length of the desired ingot and then to stop. The severing apparatuses are then caused to act upon the ingot or upon the body-casting as a whole in such a manner as to sever or separate the ingot from the said body-casting. The said casting is then caused to move longitudinally again another length and to stop as before and allow another ingot to be severed from the body portion, and this operation is repeated until all the metal of the heat is consumed, or as long as desirable.

The accompanying drawings, in which like letters of reference indicate corresponding

parts in each of the several figures, illustrate an ingot-forming machine, device, or mold of the improved construction, Figure 1 being a side view of the ingot-forming apparatus, a pit being shown by illustrating a section of the ground adjacent to said apparatus. Fig. 2 is a front view of the same. Fig. 3 is a plan of a pair of tongs which may be employed to grasp the ingot in elevating or severing the same. Figs. 4 and 5 are respectively a plan and an elevation of a section of a mold in detail; and Fig. 6 is a plan of a certain fulcrumal bearing which is employed in severing a portion of the casting from the body thereof, the said bearing being shown in connection with certain bars which are in section on line *x*, Fig. 1.

In said drawings, *a a a* indicate a sectional mold in which the body-casting is formed. Said mold is arranged separably or permanently upon an elevator or vertically-movable table, bed, or support, *b*, said elevator being adapted to raise or lower the mold arranged thereon and the ingot formed therein. Said elevator may be actuated by water-power or other active force, but preferably by a hydraulic cylinder and piston, *c*, working beneath or at the side of said elevator. Said elevator is guided in its vertically-upward and downward movements by vertical guide-bars *d d*, disposed at the sides of the elevator or at any other position. The elevator is preferably lowered into a pit, or below the level at which the metal is poured. *e* is a hydraulic crane either for breaking or severing the ingots or for raising or drawing the body-casting from the mold. The crane has suitable chains, *e'*, for connecting with the casting, and tongs *f* for grasping the ingot.

In operating the peculiar device shown in the drawings a section *a* of the mold is arranged in place on the elevator, and the latter is lowered until the mouth thereof arrives at a point convenient to receive the metal. The metal is then poured into said mold until it is full or approximately full, when another section of the mold is placed on the first, vertically in line therewith, and the elevator is again lowered, bringing the mouth of the second section to a convenient filling-point. In the meantime the liquid metal which was poured or cast into the first section has cooled sufficiently to receive the metal for the second section, or next section of the series. The second casting having been imposed onto the first, a slight seam, joint, or place of union is formed where the two castings unite, at which the two may be broken apart subsequently. It will be understood, however, that this seam is not of such a nature as to be detrimental to the value of the ingot should I desire to use it as a whole. The third section of the mold is now arranged in place and the elevator again lowered, the metal again poured in, and a third accretion thus secured in the casting, and

other accretions may be secured as often as is desirable. The action of placing the mold, filling, and lowering will consume ordinarily about three-quarters of a minute, less time than will be required to wait for the metal to cool to a degree where it is desired to make the succeeding casting.

It may be observed here that should all the metal of a casting be poured into the mold at one time instead of intermittingly, as herein described, the pipe will extend downward in the casting a distance proportionate to the whole length of said casting; but by casting and cooling intermittingly the pipe in the final cast portion of the body-casting extends a distance in proportion to the length of said final cast portion. It will be thus apparent that a great saving is effected by the method of pouring intermittingly. After the casting has hardened, as described, the same is laid bare by removing from the casting one or more of the mold-sections *a a a*, so that said casting can be moved longitudinally and presented to the die and be broken; or this may be done by means of the grip, tongs, or grasping device *f*, which, being connected with the eyebolt *h* of the crane by means of the chain, or to another crane or hydraulic motor, draws the ingot or casting from the mold, suitable means being provided whereby the said tongs or grip may enter into holding relation to the ingot, such as an eyebolt cast into the upper end of the ingot. After said ingot or casting has been thus drawn from the mold, it may be again lowered through the die and broken into sections, the ingot being first lowered so that its lower extremity projects through the die or bearing *g*, and after being held or fastened therein by wedges or in any other manner and releasing the lowering tongs, then grasped by breaking tongs on the under side of the die and forced laterally, and thus said ingot is broken or severed into smaller ones; or instead of thus operating the device the ingot may be bared and held on the elevator by simply standing thereon in the bottom mold-section or in any other manner in a line with the opening in the die or fulcrum *g*. By raising the ingot through the said die or fulcrum the said ingot may be grasped and broken off above said die, as will be understood.

The lateral draft by which the ingot is severed from the body-casting is or may be accomplished by means of tackling, (shown in Figs. 1 and 2,) in which the chain *e'* is passed through a block, *i*, secured to a fixture, *j*, laterally adjacent to the casting. When the casting is made bare and brought into contact with the fulcrumal die-plate, the tongs or grip is brought into holding or grasping contact with the bare ingot, the crane is set in motion, and by lateral draft the ingot is severed from the body-casting. The die-plate *g* is or may be fixed to the guide bars or posts *d d*, and is preferably made adjust-

able, so as to be removed from the vertical path of the mold, so that when the ingots are cast it will not be in the way. To this end it may be pivoted upon one of said bars *d* and locked to the other by a wedge or other device, *p*, which may be dovetailed in the fulcrum or die-plate, as indicated in Figs. 2 and 6, or held in any other manner, so that it locks the fulcrum upon the guide-bars.

The molds are preferably provided with dowels *k* and holes *k'*, or other means for guiding the sections into line. The sections may be in part sections, as in Fig. 4, by which construction they may be stripped laterally from the ingot. When thus formed, suitable clamps are provided to hold said part sections together. When the mold is stripped from the ingot, the same is effected by means of the crane, the clamps being loosened up to readily allow the same.

The process herein described is reserved for a cotemporaneous application, Serial No. 241,163.

Having described the invention, what I claim as new is—

1. In combination, a sectional mold, an elevator, a die or fulcrumal bearing, and means co-operating therewith to sever an ingot from the casting, substantially as set forth.

2. In combination, an elevator, a sectional mold, a die, a grip, and means for operating the same, substantially as set forth.

3. In combination, a vertically-disposed mold, a die arranged in a vertical line therewith, through which the casting may be caused to pass, means for presenting said casting to said die, and a grip actuated by a crane to sever the ingot from the body-casting, substantially as set forth.

4. In combination, a vertically-disposed mold, a clutch or tongs for stripping or barring an ingot cast therein, a power crane or hoist to separate an ingot from the body-casting, and a fulcrumal bearing or die to hold the body-casting while the ingot is being separated therefrom, substantially as and for the purposes set forth.

5. The combination of a series of mold-sections arranged vertically in line, means for lowering the said sections, a fulcrumal bearing and means for presenting the ingot to said bearing, and severing means, substantially as set forth.

6. In combination, a mold, a fulcrum, die, or bearing arranged at the open end of said mold, means for presenting the ingot to said fulcrum, and means for forcing the ingot against said fulcrum, substantially as and for the purposes set forth.

In testimony that I claim the foregoing I have hereunto set my hand this 14th day of December, 1887.

JOHN ILLINGWORTH.

Witnesses:

CHARLES H. PELL,
OSCAR A. MICHEL.