No. 610,302. Patented Sept. 6, 1898.

J. M. HARTMAN.

NOTCH GUN FOR BLAST FURNACES.

(Application filed May 12, 1896.)

(No Model.)

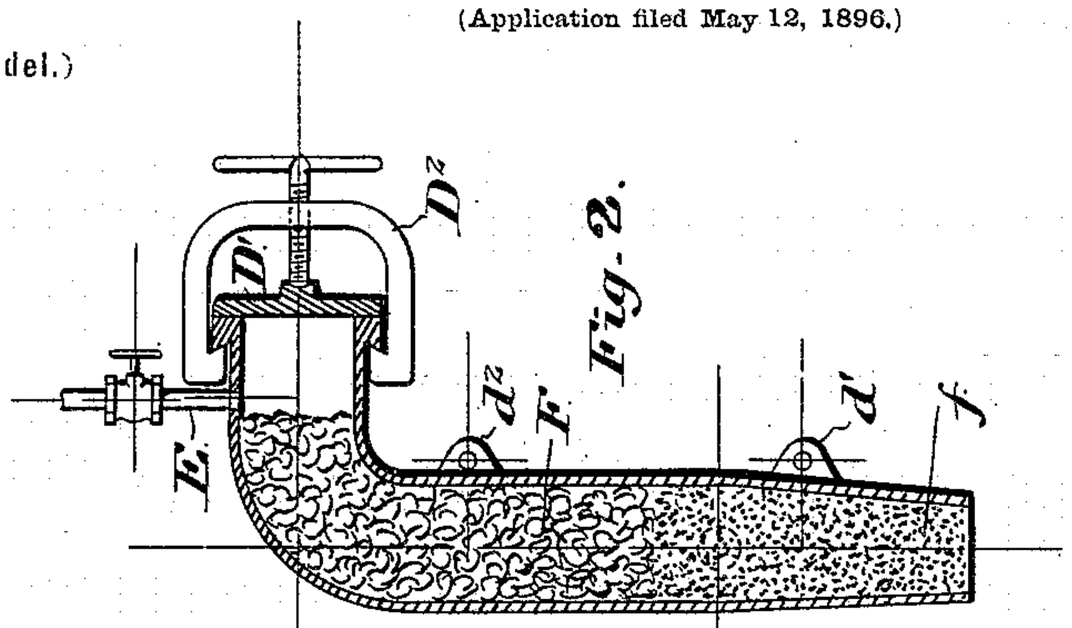

Fig. 2.

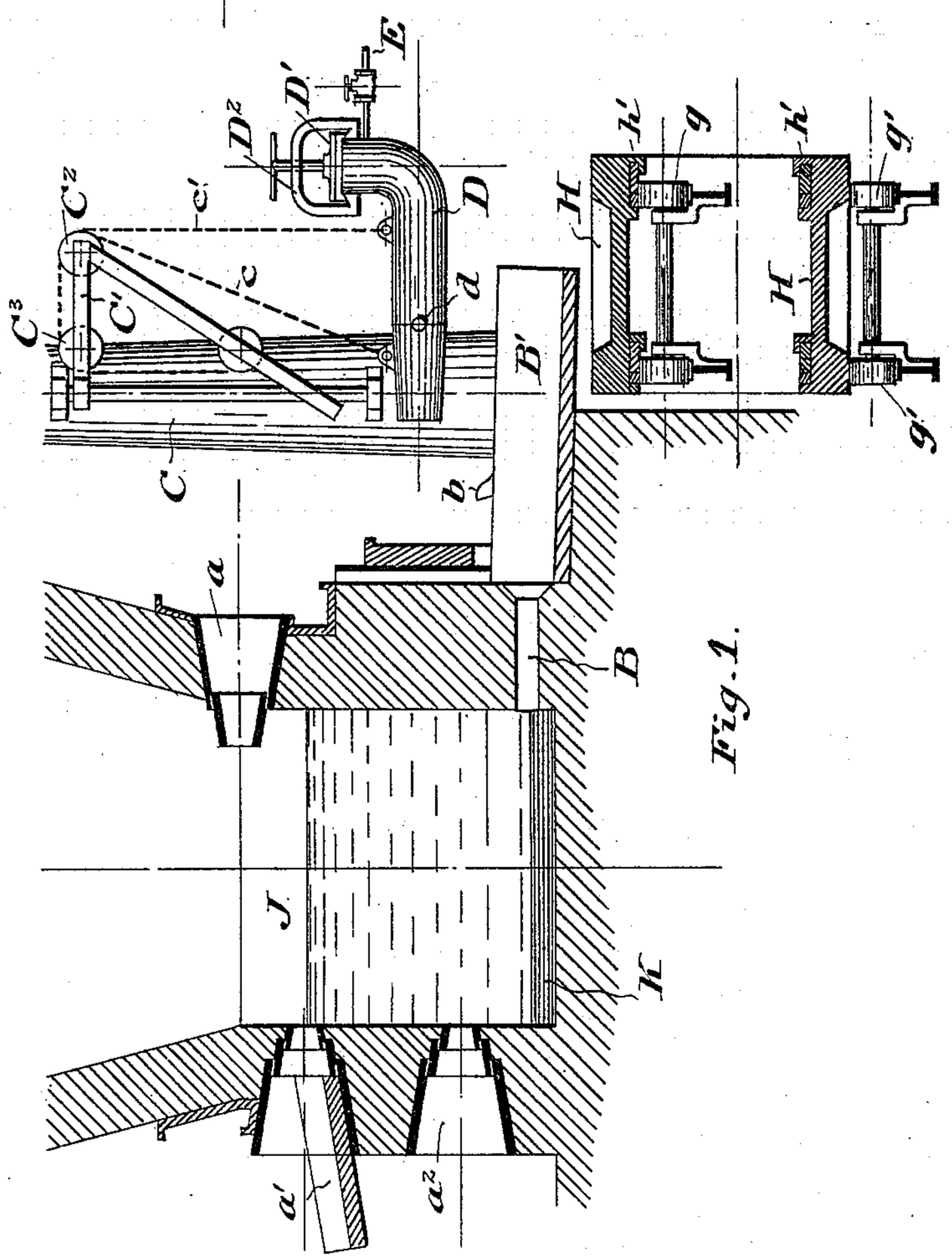

Fig. 1.

Witnesses
James H. Bell.
R. Herbert Jenkins

Inventor
John M. Hartman

By his Attorney
W. B. Fraley

UNITED STATES PATENT OFFICE.

JOHN M. HARTMAN, OF PHILADELPHIA, PENNSYLVANIA.

NOTCH-GUN FOR BLAST-FURNACES.

SPECIFICATION forming part of Letters Patent No. 610,302, dated September 6, 1898.

Application filed May 12, 1896. Serial No. 591,221. (No model.)

To all whom it may concern:

Be it known that I, JOHN M. HARTMAN, of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Iron-Notch Guns for Blast-Furnaces, of which the following is a specification, reference being had to the accompanying drawings.

In said drawings, Figure 1 represents a view, partially in elevation and partially in vertical section, of the lower portion of the furnace and its adjuncts, including my improved iron-notch gun. Fig. 2 is a longitudinal section, on an enlarged scale, of the iron-notch gun.

Iron-notch guns as heretofore made are large and somewhat cumbrous pieces of machinery, which are used for the purpose of ramming a charge of plastic material, usually clay, into the iron-notch of a blast-furnace when the proper time comes to stop the discharge of metal from the furnace. They consist, usually, of a nozzle by which the charge of the gun is fed into the notch, a magazine for containing the charge, a piston working in said magazine, the forward motion of which drives the charge through the nozzle into the iron-notch, and the requisite mechanism, usually a steam cylinder and piston, for driving the first-mentioned piston forward to effectuate the discharge of the contents of the gun. The piston may, however, be driven by hand. Such guns, except those driven by hand, as heretofore constructed have weighed about two thousand pounds and required to be swung into position by a large derrick. Among other difficulties which are involved in this operation is the fact that the trough into which the molten metal discharges must have sides which rise somewhat above the height of the iron-notch, protecting it on all sides except the top, thereby limiting access to the notch for the purpose in hand to an almost vertical swing. Furthermore, in order to handle and discharge such a large gun it is necessary for one or more workmen to stand in its immediate proximity, entailing considerable danger in case of the failure of the apparatus to work with exactness.

The object of my invention is to reduce the size and weight of iron-notch guns, so as to make them more easy to handle, and at the same time to increase the capacity of the charge which they hold, so that the stopping of the iron-notch may be invariably and properly performed by one discharge of the gun. At the same time I accomplish this I also afford a simple and direct means of operating the gun which avoids the necessity of the workmen being too near the notch.

a, Fig. 1, represents a twyer of the blast-furnace, the lower part of which is shown in section in the drawings.

B is the iron-notch, and at the flared outer orifice thereof is a trough B′, secured in position and provided with upwardly-projecting lugs *b* on its opposite edges a short distance from the wall of the furnace.

C is one of the columns which support the mantel of the furnace. Upon this or any other convenient fixed support I mount a swinging crane C′, which carries the iron-notch gun D. On the top of the gun are lugs d' d^2, to which are fastened chains *c* *c*′, by means of which it is suspended. These chains pass to any convenient actuating-point over pulleys C^2 C^3, which are mounted upon the swinging crane C′.

The gun is shown with more detail in the section Fig. 2. It consists of a pipe or hollow cylinder tapered toward the discharge end. This end is of the proper diameter to fit into the iron-notch B, keeping in mind the fact that this notch through use soon becomes considerably enlarged. Near the front end of the gun D are mounted two horizontal trunnions *d*, one on either side and in such relation to its extremity that when the gun is fitted into position against the outer orifice of the iron-notch D the trunnions *d* shall engage with the upwardly-projecting lugs *b* upon the trough B′, which has been spoken of. The rear end of the gun D is closed by a removable cap D′, secured in position by a clamp and screw D^2. Adjacent to this rear end is an inlet-pipe E, through which steam or other fluid or gas under pressure may be admitted into the rear of the gun.

In operation the gun is filled with a packing of plastic material. This is usually properly-moistened clay and loam. If desired, the front

portion—*i.e.*, that nearest the discharge end—may consist of dry sand *f*. When the proper moment arrives in the operation of the blast-furnace to stop the flow of the molten metal through the iron-notch, (either when the notch has worn too large, causing an unduly rapid flow of the metal, or when the appearance of cinder flowing from the notch shows that the level of the molten metal in the furnace has fallen to the top of the notch,) the gun D is swung into position, its front end tipped down, so as to fit into the external orifice of the iron-notch, and the trunnions *d* dropped upon the lugs *b*. By the engagement of these parts the cylinder is held firmly into contact with the face of the iron-notch against the reactive effect which the discharge of the contents of the gun will of course produce. The gun being in position, steam, air, or other fluid under pressure is quickly admitted behind the packing, forcing the contents of the cylinder forward through the tapering nozzle into the iron-notch. As the plastic material is driven by the fluid-pressure through the tapering nozzle of the gun it is compressed laterally, as well as longitudinally, and thereby rendered sufficiently compact to prevent the steam escaping through and in front of it. As soon as the contents of the gun have been discharged the cylinder may be swung away and, if necessary, a shovel of hot cinders held against the clay in order that it may set more quickly. When the packing is sufficiently dry, if the entire contents of the furnace have not yet been cast a bar may be forced through it and withdrawn, thus forming a new iron-notch of sufficiently small diameter to properly control the flow of the molten metal.

I am aware that iron-notch guns are not broadly new. They have, however, either been actuated entirely by hand—that is to say, the forcing forward of the plastic material has been accomplished by a piston driven or hammered forward by the workmen—or else they have been operated by a steam-actuated piston. There are many objections to the former method of operation, among which it is only necessary to refer to the danger to which the workmen are exposed. The latter variety of iron-notch guns—that is, those in which the plastic material is pushed forward by a piston which itself is operated from a steam-cylinder attached to the gun—are objectionable by reason of the great size and weight of the gun.

By the use of my apparatus I am able to reduce the weight by more than one-half as compared with the steam-piston-actuated gun, and along with this reduction of weight I obtain a very much larger receptacle or magazine for the plastic material, whereby the quantity of the discharge is greatly increased. It is obvious that in the piston-actuated gun the clay remaining in the tapering end of the gun cannot be discharged. In addition to this nearly half of the length of the gun is used for the piston-actuating cylinder. By my invention practically the entire gun is available as a magazine, and its entire contents can be discharged. This is of the highest importance. If the quantity of plastic material discharged is not large enough, it is necessary either to repeat the operation, often a number of times in succession, or else it is necessary to keep the gun in position against the orifice for a considerable length of time until the plug of plastic material which has been discharged has hardened. This is attended with many disadvantages. The notch is on a level with the trough filled with molten metal and cinder, and to maintain the gun for any length of time in this hot cinder ultimately destroys it.

By my apparatus I am able notwithstanding the reduced size of the gun of which I have spoken to eject a large enough quantity of the material to not only fill the notch, but to pass in some distance to the interior of the furnace. It must be understood that by the flow of the molten metal and its intense heat the notch tends to enlarge very considerably both at its inner and outer extremity, the point of greatest constriction usually being about its middle. The plug should therefore be sufficiently large to pass this point of greatest constriction and correspondingly enlarge on the inside of it. As soon as this has been accomplished the discharge will immediately bake on both sides, effectually sealing the notch, so that the gun may be instantly removed after discharge. Another advantage which results from my improved gun is that the point of actuation by the workmen may be removed some distance out of the way of the notch, so that in case of any accident no danger need be experienced by the operator of the gun.

In the drawings a valve is shown immediately in the rear of the gun. This is merely a secondary valve to check the flow of drip-water while the gun is swung out of place. The main actuating-valve may be placed behind one of the columns of the furnace and connected with the pipe E by a flexibly-jointed pipe.

Having thus described my invention, I claim—

1. An iron-notch gun for blast-furnaces, having a tapered nozzle and of sufficient length and size to hold enough plastic material to effectually plug the notch in a single discharge; in combination with means substantially as set forth for admitting fluid-pressure into the rear of said gun behind said plastic material and directly in contact therewith without the intervention of any piston, substantially as described.

2. An iron-notch gun for blast-furnaces, having a tapered nozzle and of sufficient

length and size to hold enough plastic material to effectually plug the notch in a single discharge; in combination with means substantially as set forth for admitting fluid-pressure into the rear of said gun behind said plastic material and directly in contact therewith without the intervention of any piston; a removable door arranged at the rear end of said gun, substantially as described.

JOHN M. HARTMAN.

Witnesses:
JAMES H. BELL,
HENRY N. PAUL, Jr.