

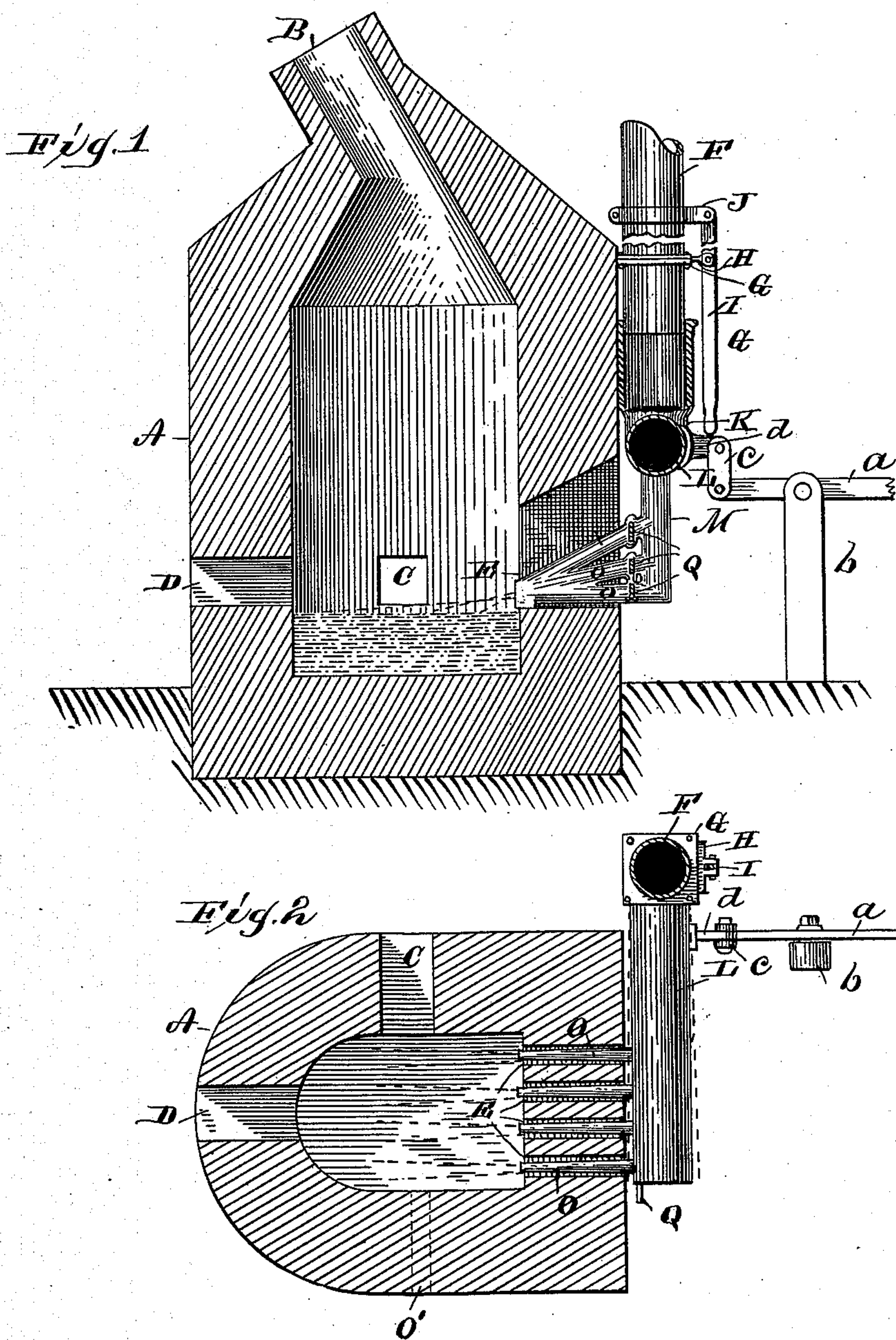
(No Model.)

2 Sheets—Sheet 1.

R. F. LUDLOW.
CONVERTER.

No. 412,767.

Patented Oct. 15, 1889.



WITNESSES

Charles Hull
J. E. Fenwick

INVENTOR

Rodney F. Ludlow,
By H. A. Toulmin
Attorney.

(No Model.)

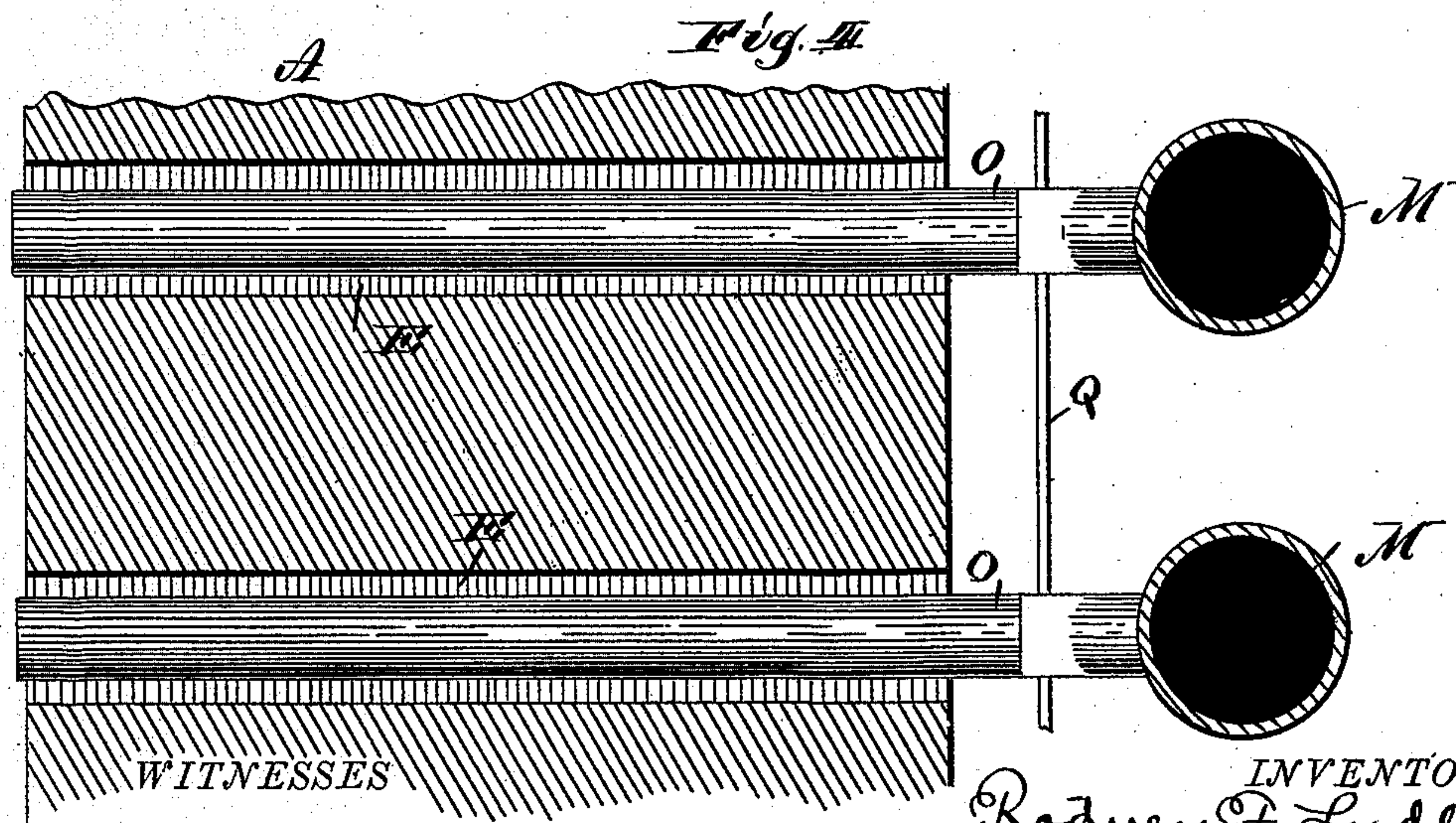
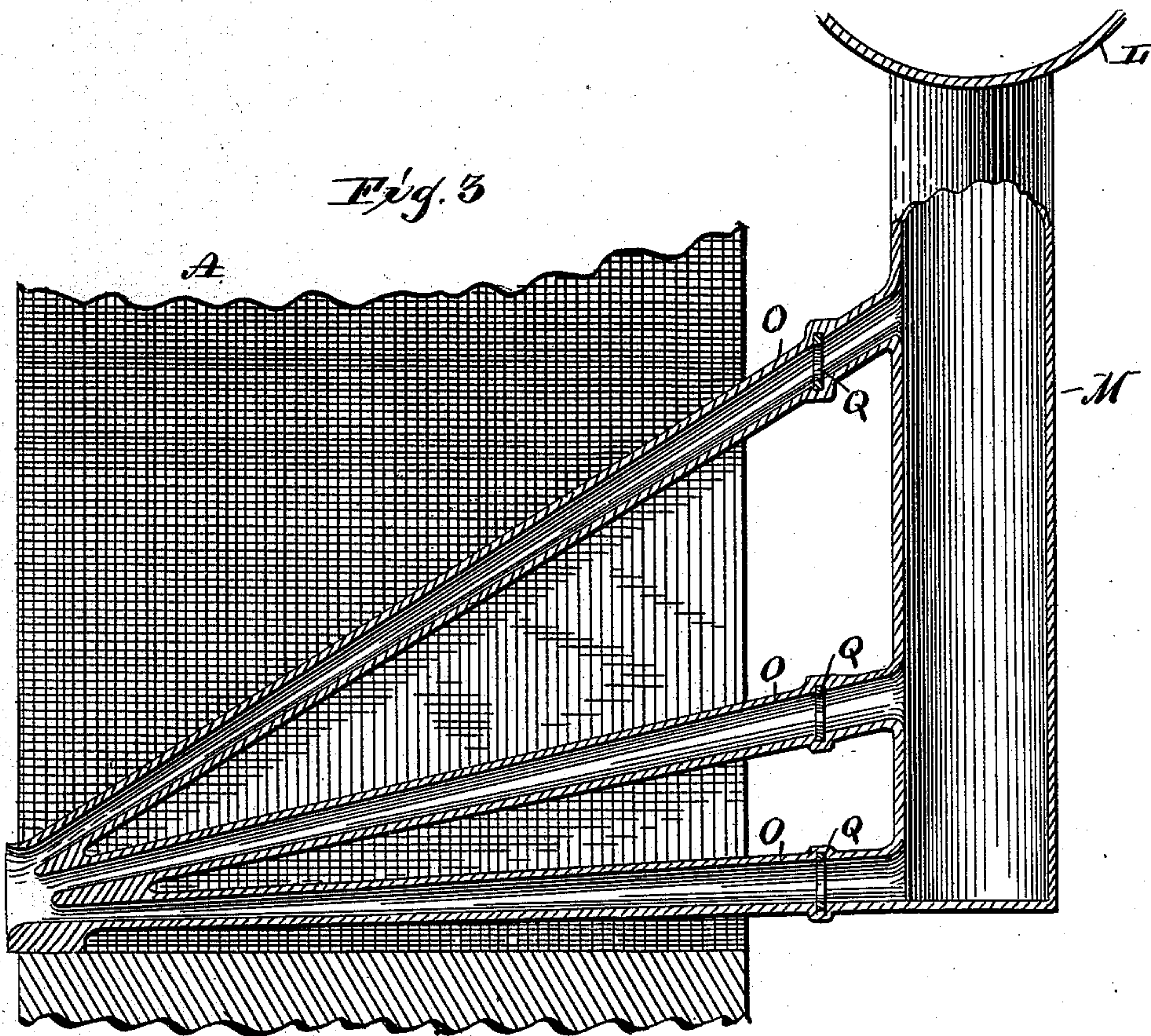
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Patented Oct. 15, 1889.



Warren Bull.
J. E. Fenwick

INVENTOR
Rodney F. Ludlow,
By H. A. Toulmin
Attorney

UNITED STATES PATENT OFFICE.

RODNEY F. LUDLOW, OF SPRINGFIELD, OHIO.

CONVERTER.

SPECIFICATION forming part of Letters Patent No. 412,767, dated October 15, 1889.

Application filed December 18, 1888. Serial No. 293,981. (No model.)

To all whom it may concern:

Be it known that I, RODNEY F. LUDLOW, a citizen of the United States, residing at Springfield, in the county of Clark and State of Ohio, have invented certain new and useful Improvements in Converters, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to the decarbonization of iron and the removal or liberation of the impurities contained therein, while in a molten state, by the action of atmospheric air blasts or currents, for the purpose of converting the same into higher and different grades of iron and into different grades of steel, as may be desired.

The invention consists, first, of a converter-vessel and air-blast tuyeres, the tuyeres and the converter being capable of relative adjustment or change of position, this change also changing the relative position between the tuyeres and the molten mass of metal contained in the converter, so as to extend the places of contact of the air with the metal to different places over essentially the whole surface; and, secondly, of a converter-vessel combined with tuyeres assembled in groups, the several tuyeres of a group running at different angles to each other, provided with suitable cut-offs to admit the air through all of the tuyeres of a group at a time, or less than all, or any one, whereby the mass of molten metal contained in the converter-vessel is impinged upon its surface at different places and at varying angles by the air-currents, they having the ability to so disturb the mass as to cause it to expose, practically, its entire body to the currents, whereby essentially every part of the mass is exposed to the effect or combustion which this action creates, to the end that the contained impurities may be consumed or liberated and decarbonization effected, rendering the mass in condition to be recarbonized by fluxing therewith some carbonizing agent to convert it into any desired high grades of iron or to convert it into steel.

In the accompanying drawings, forming a part of this specification, and on which like reference-letters indicate corresponding parts, Figure 1 represents a vertical sectional view of a converter-vessel and a partial sectional

view and elevation of the air-pipes and groups of tuyeres; Fig. 2, a horizontal section of the same parts on the line of the openings C D; Fig. 3, a vertical sectional view, on a large scale, of a portion of one wall of the converter-vessel and of a group of tuyeres; and Fig. 4, a horizontal section of the converter-wall, showing the two groups of tuyeres in plan.

Letter A designates a vessel, which I term the "converter," built or lined with refractory material and conveniently located with respect to the surface of the ground or floor about the apparatus on which the workmen stand. It is by preference of the type illustrated in the several views, being rectangular in three sides, substantially semicircular in the fourth side, and terminating in an inclined neck or exit B, and provided with openings C and D for the introduction of the molten metal for inspecting the same after the blast is cut off and for introducing the carbonizing agent, concerning which more will hereinafter be stated. The openings C and D may be interchangeably used for these purposes. One of the vertical walls of the converter is constructed with a series of slots or passages E, for the reception of the groups of tuyeres, and of such shape as to substantially agree with the outer contour of the respective groups and to permit the groups to be adjusted vertically and to different lateral directions.

Letter F refers to a blast-pipe provided with a cut-off G—preferably in the form of a slide H—operated by a lever I and fulcrumed to the pipe through a band and pin J. This pipe has slidingly and rotatably fitted over its lower end an elbow K, and forming a part of or secured to this elbow is a pipe L, constituting the tuyere-section. I connect to the tuyere-section at suitable intervals the groups of tuyeres composed of the head-pipe M and the branches or tuyeres proper O. These are provided with lateral cut-offs Q, and by preference the cut-offs of the several tuyeres occupying the same horizontal plane are connected, as suggested in Fig. 4, so that when the air is to be admitted through any one tuyere of a group it may be admitted through the corresponding tuyeres of the several groups. I do not confine myself, however,

to this arrangement, as the cut-offs may be entirely independent to admit projecting the air through any one or more corresponding tuyeres of the several groups at the same time. It will be observed that each tuyere of a group runs at a different angle from the other tuyeres in that group, and these angles may vary relatively to suit the exigencies of any particular case, and the number of tuyeres in a group may also vary. It is preferred to cast the head and the several tuyeres integrally, as shown in Fig. 3. They may be separately made, however, and connected together in any convenient manner. Each group occupies a slot or opening E, with sufficient play to admit of adjusting the groups vertically and laterally to change the place of contact with and the course of the air-currents over the surface of the molten mass, as suggested by the dotted lines in Fig. 2, whereby essentially every part of the surface is reached. These adjustments of the tuyeres are permitted by the sliding and rotatable connection between the elbow K and the pipe F, the latter allowing of moving the tuyere-section to and from the converter, as suggested by the dotted lines in Fig. 2.

It will be observed from Fig. 1 that the upper tuyeres of the groups direct the air against the metal near the tuyeres; that the intermediate or middle tuyeres direct it farther toward the middle of the metal, and the lower tuyeres direct it to the extreme opposite or far side of the metal. This contemplates using the group of tuyeres without changing them vertically. The same thing is accomplished by adjusting the tuyeres vertically and using either of the group. When the latter mode is depended upon, the tuyeres not used are cut off, making practically but one tuyere undergoing vertical adjustment during the operation of converting. This changing of the air-currents relatively to the converter and to the surface of the molten mass is of vital importance in performing the process, so as to reach, as above suggested, all of the parts of the surface of the metal, and yet to at no time create opposing currents, which might interfere with the regular, constant, and reliable tumbling motion given the metal, and which results in the exposure to the air-currents of the entire mass. The high degree of heat of the mass of metal and the violent projection of the air-blasts at varying parts of the surface by said relative change of position of the air-currents and the converter and metal produces the combustion or effect which takes up or consumes the contained carbon and impurities, effecting decarbonization and the liberation of foreign substances. When these results have been secured, an indication of which is the withdrawal or absence of escaping flames from the neck or exit B of the converter, I recarbonize the molten mass of pure iron by any of the well-known carbons—as spiegel-eisen—in varying quantities, according to the

grade of commercial iron or grade or hardness of steel desired. After a lapse of about three minutes the molten mass will be found to have thoroughly fused with the introduced carbon and to be ready for withdrawal. The converter is then tapped, as by removing an obstruction from an opening designated at O' in Fig. 2. The converting process occupies from eight to eleven minutes when a ton is contained in the converter.

Various instrumentalities may be employed for the up and down adjustment of the tuyere-section L. I have illustrated one form, the same consisting of a lever *a*, fulcrumed in a post *b*, and connected by a link *c* to an arm *d*, rigidly secured to the tuyere-section. The link-connection admits of the adjustment of the tuyere-section to and from the converter.

I desire to have it understood that I am aware that prior to my invention it was well known to introduce air-currents upon the surface of molten iron; but in such instance the direction of the currents was not varied and the place of contact of the air with the metal was essentially in one place. This failed of the result attained by me in the practice of this invention, as I have ascertained by repeated trials on a large and practical scale.

I am also aware that prior to my invention it was proposed to manipulate the converter on trunnions, practically in this regard after the fashion of the well-known tipping of the Bessemer converter during the introduction of air-currents through tuyeres fixed in the wall of this tipping converter; but this involved a manipulation of the converter itself—a structure necessarily heavy and correspondingly unwieldy—and also involved, as is apparent, a mode of operation differing from mine and opposed to the change of relative position between the tuyeres and the converter, which change leads to the change of the place of contact between the air and the metal. I have shown one manner of changing this relative position, consisting in adjusting the tuyere or tuyeres; but my invention includes this relative change, broadly considered.

It will of course be understood in referring hereinbefore to the use of the openings C and D for the admission of the molten metal that it is drawn from a furnace or other melting apparatus. A cupola—that is to say, a vessel constructed after the manner of a cupola—when provided with my improvements, will be understood as included within the term “converter” or “converter-vessel.”

While I have referred to air as being forced into the cupola, I wish to be understood as contemplating the use of any vapor or gaseous substance capable of desired results.

The openings C and D may also be used, besides for the purposes hereinbefore mentioned, for skimming the dross or other impurities which accumulate on the surface of the iron. I also take out of the converter

through either of these openings some of the metal, to more closely inspect its condition, should occasion require. The openings C and D are closed with clay or other suitable material during the operation of effecting the conversion of the metal.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

10 1. In an apparatus for decarbonizing iron and liberating the impurities contained therein, the combination, with a converter-vessel, of groups of tuyeres in vertical series, the individual tuyeres thereof running at an angle to one another, and a common mouth for all the tuyeres of the group terminating in close proximity to their confluence and including in its circumference the said ends of the whole group, whereby each tuyere directs its air-current to different places across the surface of the bath in the converter.

2. In an apparatus for decarbonizing iron and liberating the impurities contained therein, the combination, with a converter-vessel, of groups of tuyeres in vertical series, the tuyeres of each group running at an angle to one another, and the groups adjustable upon a vertical axis to change their lateral direction.

30 3. In an apparatus for decarbonizing iron and liberating the impurities contained therein, the combination, with a converter-vessel having a series of openings in one wall thereof, of a series of groups of tuyeres, the tuyeres of each group running at an angle to each other and connecting with a common head-pipe, a tuyere-section to which said heads are connected, and the air-blast pipe to which the tuyere-section is rotatably connected, and suitable cut-offs for the tuyeres.

4. In an apparatus for decarbonizing iron and liberating the impurities contained therein, the combination, with a stationary converter-vessel having a series of openings in one wall thereof, of a corresponding series of groups of tuyeres, the tuyeres of each group running at an angle to each other and connecting with a common head-pipe, a cut-off for each tuyere, the cut-offs of all the tuyeres on the same horizontal plane being connected

together, a tuyere-section to which the heads are secured, and a blast-pipe with which said section is rotatably connected.

5. In an apparatus for decarbonizing iron and liberating the impurities contained therein, a group of tuyeres in vertical series, the individual tuyeres thereof running at an angle to one another, and a common mouth for all the tuyeres of the group terminating in close proximity to their confluence and including in its circumference the said ends of the whole group, whereby each tuyere directs its air-current to a different place across the surface of the bath in the converter, and a common head-pipe to which the tuyeres connect at their free ends, and a suitable cut-off in each tuyere.

6. In an apparatus for decarbonizing iron and liberating the impurities contained therein, the combination, with a converter-vessel, of tuyeres in vertical series, each tuyere running at an angle to the other and one or more of them at an angle to the vessel, and means to adjust the whole series vertically with respect to the vessel, the said angle to the vessel and the said adjustability changing the place of contact of the air with the surface of the molten metal contained in the vessel from side to side of the vessel.

7. In an apparatus for decarbonizing iron and liberating the impurities contained therein, the combination, with a converter-vessel, of vertically-adjustable air-tuyeres running at an angle to the vessel and pointing toward the surface of the contained bath at an angle thereto and with their points above the same, and means to adjust the tuyeres vertically with respect to the vessel, the said angle of the tuyeres to the vessel and the said adjustability operating to change the place of contact of the air with the surface of the bath contained in the vessel from side to side thereof.

In testimony whereof I affix my signature in presence of two witnesses.

RODNEY F. LUDLOW.

Witnesses:

E. S. WALLACE,
WARREN HULL.