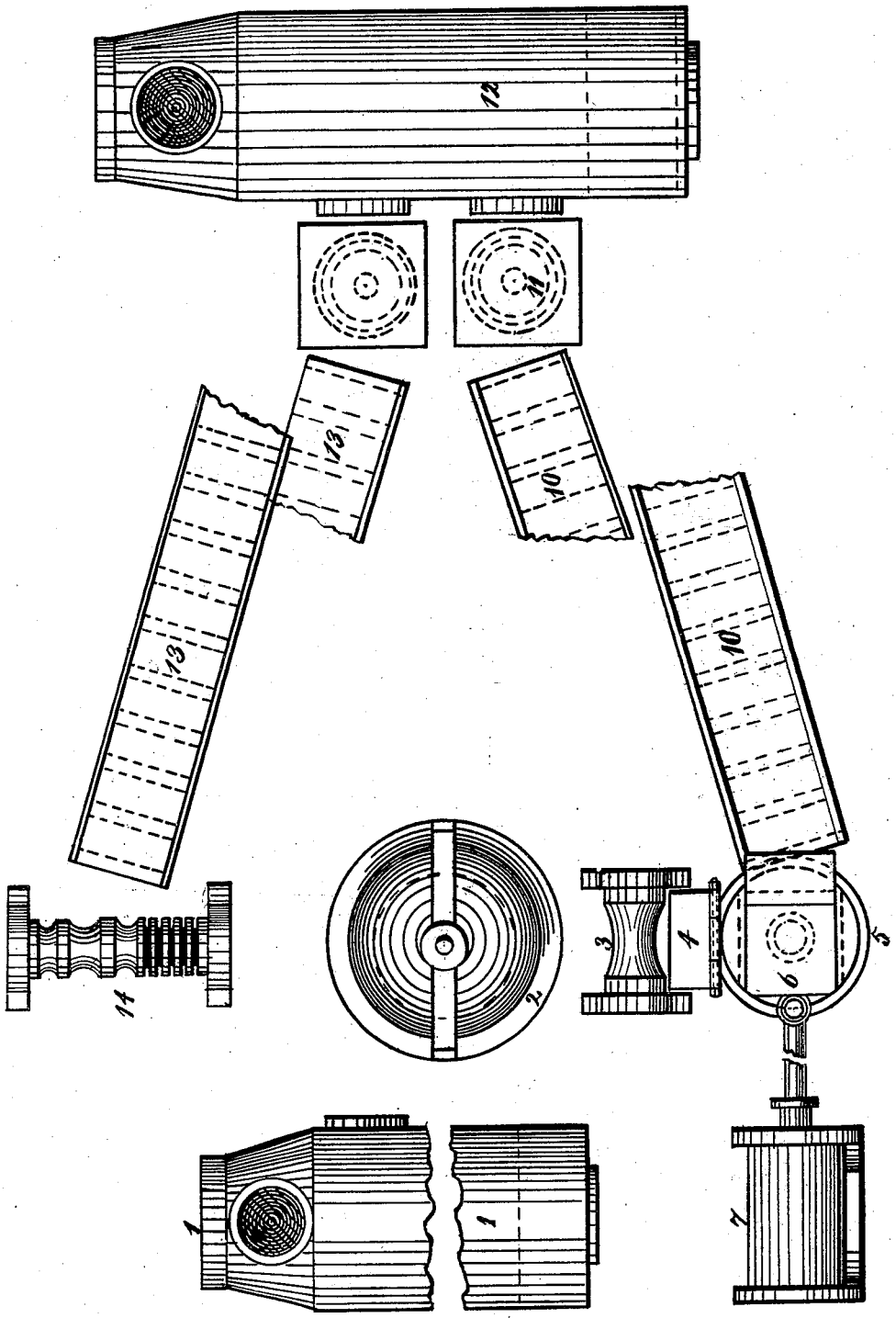
2 Sheets—Sheet 1

A. J. MOXHAM.

Manufacture of Iron.

No. 210,049. Patented Nov. 19, 1878.



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2 Sheets—Sheet 2.

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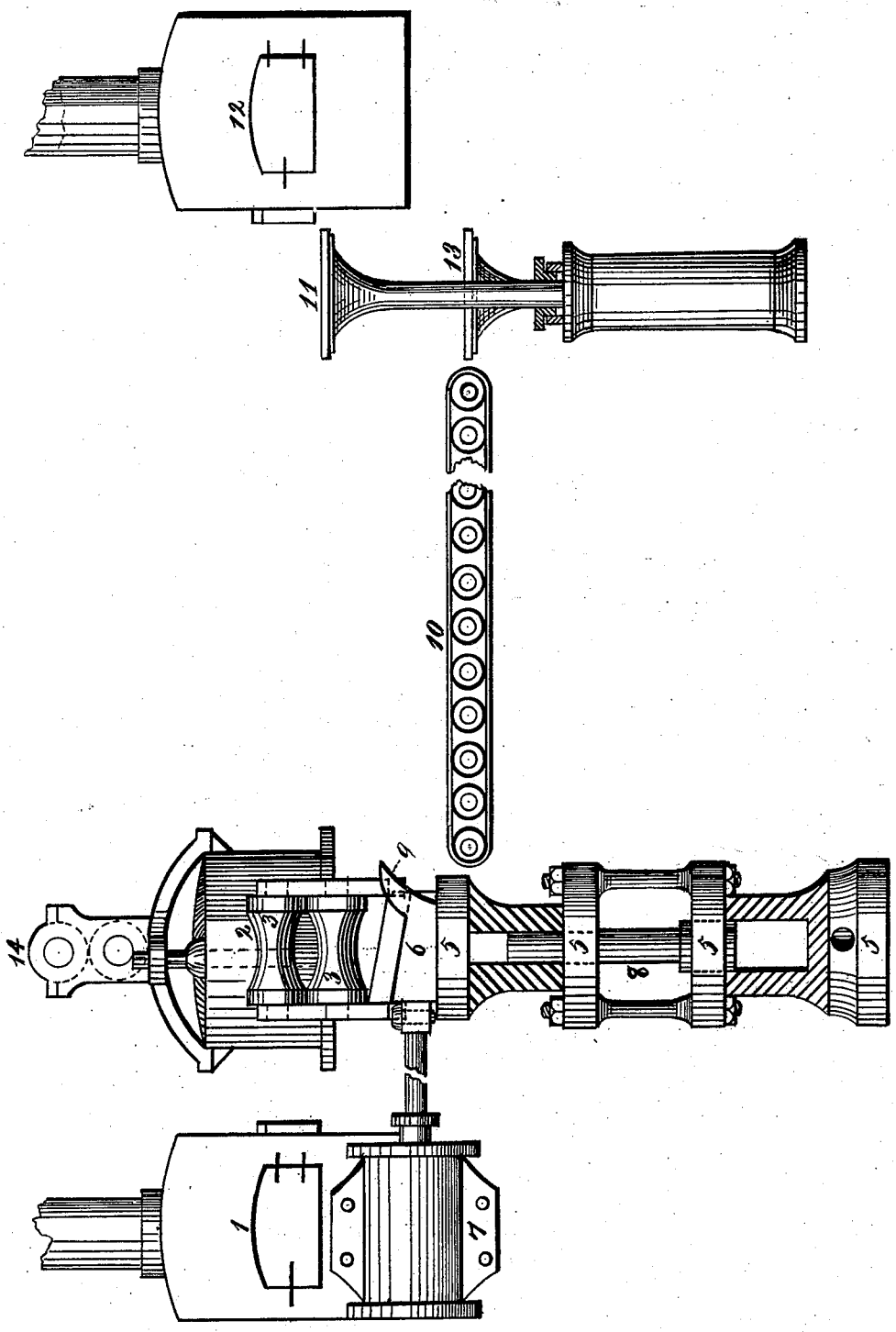

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UNITED STATES PATENT OFFICE.

ARTHUR J. MOXHAM, OF LOUISVILLE, KENTUCKY.

IMPROVEMENT IN THE MANUFACTURE OF IRON.

Specification forming part of Letters Patent No. **210,049**, dated November 19, 1878; application filed May 24, 1878.

To all whom it may concern:

Be it known that I, ARTHUR J. MOXHAM, of Louisville, in the county of Jefferson and State of Kentucky, have invented a new and useful process or improvement in the art of converting cast-iron into merchantable finished wrought-iron, which process is fully set forth in the following specification, and illustrated in the accompanying drawing, forming part of the same.

The object of the invention is to produce merchantable wrought-iron of superior quality from cast-iron of even ordinary quality at a cheaper cost than by the ordinary methods of conversion practiced, the distinguishing features in the quality of the iron thus produced being greater specific gravity and homogeneity and greater tensile strength than is found to exist in the wrought-iron of commerce obtained by the methods of conversion heretofore practiced.

The plant illustrated in the accompanying drawing, and the treatment of the metal constituting the process of conversion, will now be described and explained.

In the said drawing is illustrated a puddling-furnace, 1, which first receives the pig or other mass of cast-iron, which, after being puddled in the ordinary manner, either by hand or by machinery, is taken from the furnace in the form of a hot puddled ball, and then transported, in traveling tongs or otherwise, to the squeezer 2, wherein the ball is subjected to the ordinary action of the squeezer, for the purpose, however, of only expressing the desired amount of cinder from the ball, the external form or shape of the ball, as it emerges from the squeezer, being immaterial or of but little importance. As the ball is passed out from the squeezer, purified from cinder, it is received between the transferring or shipping rolls 3, which are so formed as to give, while in transit, the necessary shape to the hot mass of iron for its succeeding receptacles.

The rolls 3 are properly not a roll-train, and perform no function of "working" the iron by lateral compression. The shaping of the squeezed ball effected by the said rolls consists in merely smoothing down or reclosing the edges of any flaws in the exterior of the hot ball due to the tearing action of the squeezer, so that the ball, after leaving the squeezer in proper mass, may be easily and closely fitted, by means of the rolls 3, into the bore of the hydraulic press, hereinafter described.

From the rolls 3 the iron is deposited upon the hinged plate or table 4, whence it is tripped and discharged downwardly into the hydraulic press 5. As soon as the iron is deposited in the said press, the gate 6, having an inclined or wedge-shaped back, is closed by the hydraulic pump 7, and simultaneously the ram 8 within the press 5 is brought up, and the whole power of the press, amounting to many tons, is concentrated upon the iron within the press.

When the iron is sufficiently condensed, the gate 6 is withdrawn by means of the pump 7, and, the pressure of the ram 8 still continuing, the iron is ejected from the press as a highly-compressed finished bloom, and, meeting the angle-piece 9, upon the end of the gate 6, the bloom is tripped and thrown over upon the carrier or apron 10, by which it is carried to the hydraulic table 11, upon which it is raised to the level of the door of the reheating-furnace 12. From this table an operator removes the bloom and places it within the furnace 12. Subjected to a short reheating or "wash-heat" in this furnace, the bloom is thence removed through another door and placed upon another carrier or apron, 13, which conveys it to the finishing-rolls 14, through which the bloom is passed and reduced to any desired shape of commercial finished iron.

In the conversion of cast-iron or the manufacture of merchantable finished wrought-iron by mechanical means—that is, by other than direct processes—there are four necessary steps or stages: first, purification; second, expulsion of cinder; third, welding of the mass; and, fourth, finishing. In the ordinary mechanical processes of conversion, these operations are jointly and severally accomplished by the following-enumerated means: The first, purification, by puddling; the second, expulsion of the cinder, by squeezing (the squeezer also forming the bloom) and muck-rolling; the third, welding, is partially accomplished by muck-rolling; and the fourth, the finishing, in which is completed the welding by piling the

muck-bars, reheating the piles, and then rolling down the piled bars in forming-rolls to the desired shape of commercial wrought-iron. It is thus seen that most of these steps do not complete any one desired result, but only partially accomplish some one result, which is completed in a succeeding operation or operations, one operation thus overlapping, as it were, another. There is also a certain unavoidable waste of material, due to the necessity of cutting off the unwelded ends of the piled muck-bars.

In the process constituting the invention herein described and claimed, the purification of the iron is accomplished by the puddling; the expulsion of the cinder is effected and completed by the squeezer, without regard to the formation of the bloom; the welding is effected and completed by the hydraulic press; and the finishing is completely effected without any piling, but by the rolling of a highly-compressed bloom of great density, just as it comes from the hydraulic press. This highly-condensed bloom thus formed in the hydraulic press, having its interior yet of a very high temperature, is merely subjected to a wash-heat, or short reheating of its exterior within a reheating-furnace, as already described, whence it is taken and reduced in the finishing-rolls to commercial iron. This reheating is usually preferable, but is not vital to the process, and may be omitted.

It is a fact well known to those conversant with the qualities of iron that the higher its specific gravity the greater its strength. Increased density and consequent higher specific gravity are by the ordinary mechanical methods imparted to the iron by successive reworkings or rerollings, rendering repeated reheatings necessary; but in such reworkings, notwithstanding such reheatings, the iron loses heat externally very rapidly, and, while thus having a surface cooler and harder than its interior, it is subjected to pressure in but one direction, and is thus always free to flow in one or more directions while under compression. It is also true that as the iron becomes externally cooler, so does the difference between outside and inside temperatures become greater, and thus the increased specific gravity is ordinarily obtained under the disadvantage of a different tension in the particles of the iron (due to the different temperatures in the mass) in given parts of the same bar. To the iron thus rolled is therefore imparted an increase of density and specific gravity nearly in proportion only as the inertia of its unequally heated and softened mass is in opposition to the flow of its particles while under unequal tension and compression. A slight gain only in density is thus obtained at each successive rolling, and time and fuel are consumed in proportion to the number of the reworking operations required.

The hydraulic treatment in the process constituting this invention not only reduces to a minimum the disadvantages above enumerated inseparable from rerolling and numerous operations, but said treatment also gives great celerity to the operation of producing a finished condensed bloom and its derivative products; and the exact amount of pressure required to produce an iron of known and predetermined specific gravity can be regulated at will, without any perceptible additional expenditure of time or fuel, by simply regulating the degree of condensation within the press. The iron, moreover, when thus treated is at its first or mellow heat, in which state, as is well known to those skilled in the iron manufacture, it will receive a condensation under pressure which it is impossible to impart to it by any mechanical means at any subsequent reheating after passing from the virgin or nascent condition of a first or mellow heat. While in the press, therefore—the requisite amount of cinder having been previously removed—the whole mass of the iron becomes perfectly welded and is rendered perfectly homogeneous, as not even the smallest remaining trace of cinder need be allowed to escape out of the press. A most marked feature, also, of this process, due to the hydraulic compression, is the great evolution of gas expelled from the whole interior of the mass of iron, which, escaping through its tightest joints, inflames and burns upon the outside of the press. This thorough illumination of the gas, generated within the mass of iron either in its previous or existent stages of treatment, is an additional cause of the great density or specific gravity and homogeneity of the finished bloom and of the finished iron rolled therefrom. Neither internal flaw nor superficial blister due to gaseous action can occur in the iron thus produced.

Every blow-hole and ragged surface in the ball must be thoroughly closed and their edges perfectly welded, thus forming the entire mass into a homogeneous highly-condensed bloom, leaving no flaws or blisters for future discovery, and no causes for producing such in the future treatment of the iron. For boiler-plate alone, an absolute certainty of the non-existence of blisters can be well appreciated, to say nothing of internal flaws or cavities within large shafts.

The operation of this plant is as continuous and rapid as the supply of puddled balls will permit, for no sooner is one bloom expelled from the hydraulic press than another takes its place, which, as soon as duly condensed, is ejected by the simple opening of the gate 6, for, the ram of the press still exerting its pressure, the bloom is thus ejected from the press. Upon the reversal of the ram another ball is automatically dropped into the press, the gate closes, the ram again rises, and thus accomplishes its round of operations.

Instead of hydraulic, screw or other power may be used, if preferred.

It is also obvious that the special or relative arrangement of plant herein described may be varied without departing from the principle

underlying this invention. I do not therefore confine myself to such special arrangement shown, nor to the special machines shown for accomplishing either the several desired results or the general result of the process as a whole. I do not herein claim any of the special devices herein shown and described, reserving all such as may be new for the subject-matter of other applications for Letters Patent. I do not herein claim any one of the several operations herein described, but only the process as a whole, as herein described.

Having thus fully described my said process, as of my invention I claim—

The process for the conversion of cast-iron hereinbefore described, consisting of first puddling said iron, and, by means of a squeezer, expelling cinder therefrom; then, without reheating the mass thus purified of cinder, closely fitting the same into a cinder-tight press, and therein rapidly welding and condensing the iron by reducing its mass in length only without altering its transverse sectional area, as described; and, finally, finishing the bloom thus formed and condensed by rolling it into desired shapes of bar or other merchantable iron.

ARTHUR J. MOXHAM.

Witnesses:
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T. C. COLEMAN.