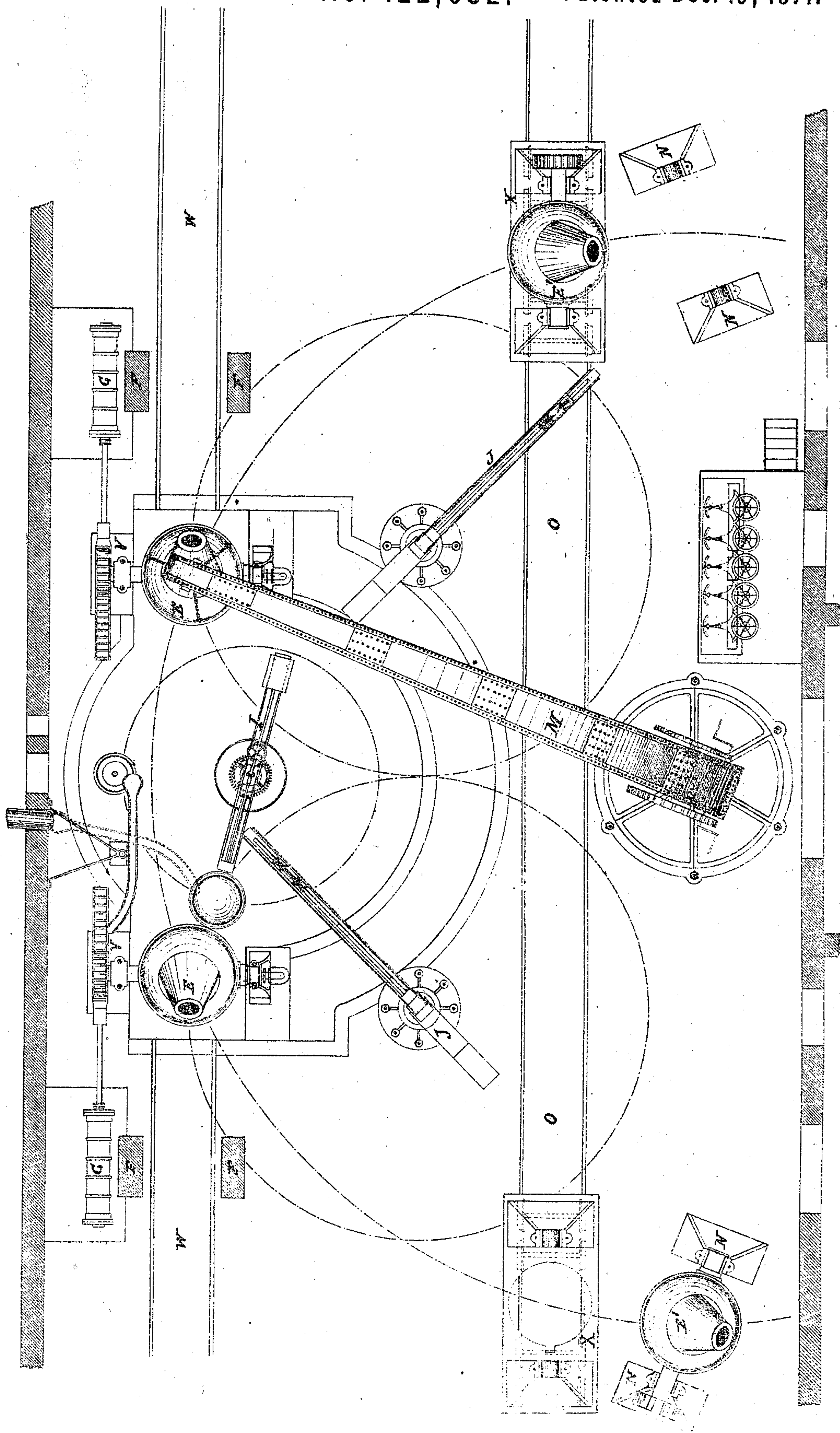


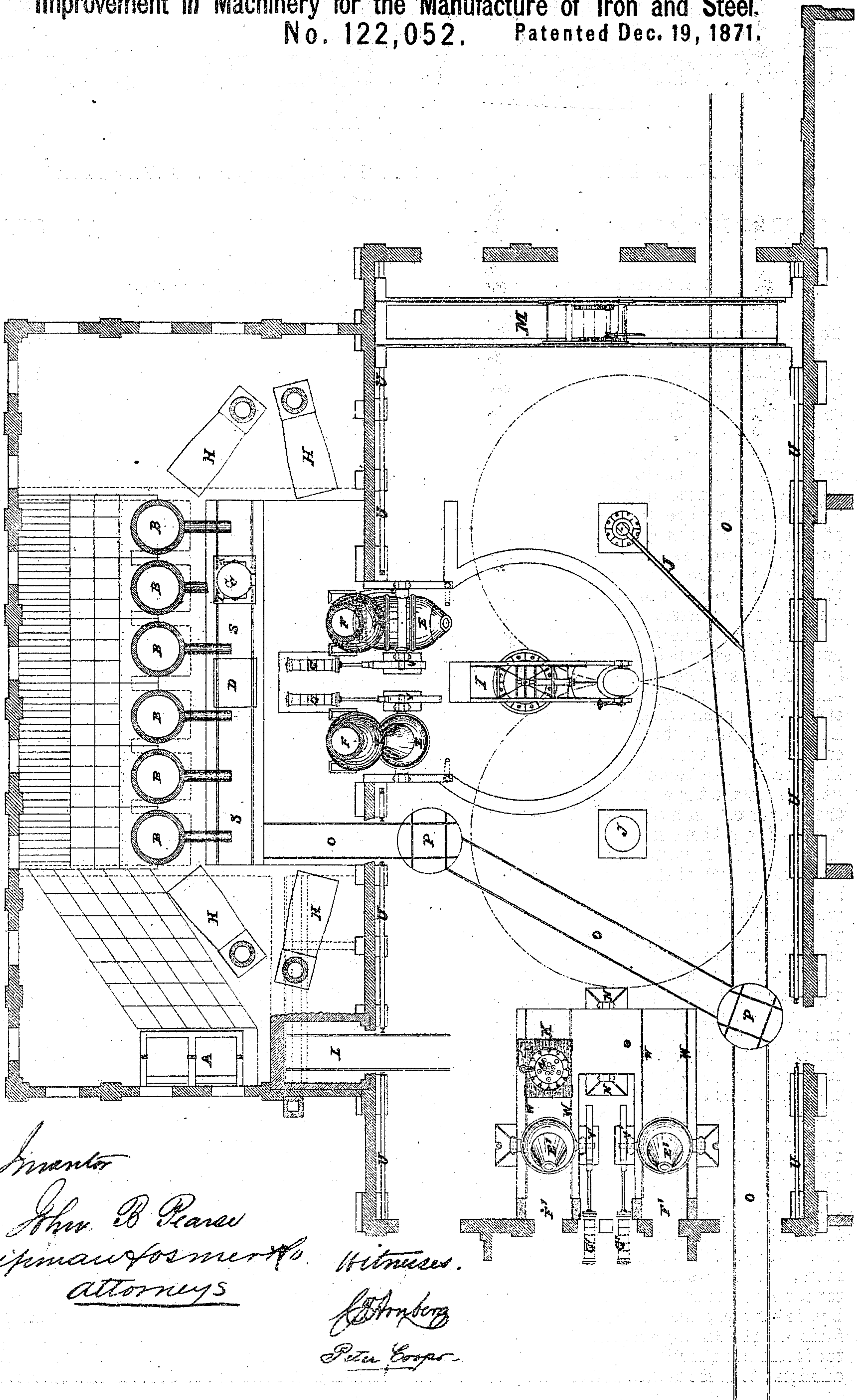
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Improvement in Machinery for the Manufacture of Iron and Steel.
No. 122,052. Patented Dec. 19, 1871.



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IMPROVEMENT IN PLANT FOR THE MANUFACTURE OF BESSEMER STEEL.

Specification forming part of Letters Patent No. 122,052, dated December 19, 1871.

To all whom it may concern:

Be it known that I, JOHN B. PEARSE, of Swatara Township, in the county of Dauphin and State of Pennsylvania, have invented certain new and useful Improvements in Plant and Machinery for the Manufacture of Iron and Steel; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawing.

These improvements relate to the manufacture of steel by what is known as the Bessemer or pneumatic process for the conversion of fluid, crude, or pig-iron into iron or steel by means of a blast of air forced into and among the fluid pig iron to be converted.

The apparatus heretofore employed in carrying out this process has been constructed substantially as follows: Two converters, movable on their axes by means of hydraulic cylinders, are placed either on opposite sides of a casting-pit, as in the English plants, or both together on one and the same side, as in the American and German plants. The hood of a detached chimney behind each converter receives the gaseous products issuing from the converter. A hydraulic crane in the center of the casting-pit carries a ladle, into which the metal from either converter may be poured by turning down the mouth of the converter, and from which ladle the metal is run out by means of a suitable valve into ingot molds ranged around the casting-pit and within the radius of the ladle-crane. Two or more hydraulic cranes standing outside of the casting-pit and collectively capable of swinging over the whole space occupied by the molds are used for putting the molds into the pit, and to lift the ingots out, and to place fresh ladles in the ladle-crane and remove them again after use. These cranes are generally called ingot-cranes, and are used, also, for handling the changeable lowest sections or bottoms of the converters when these bottoms are to be either put into a suitable drying-oven, or brought into a proper position for being connected with the vessel, or are to be removed after their ganister lining or coating has been worn away. These hydraulic cranes are further used for keeping spare crane-ladles and ingot-molds in their proper places on the floor of the converting-room. They are usually constructed to lift five tons, and sometimes are made to lift eight tons, but never more than that, as their function is to facilitate the casting and handling of the steel after it has been made. Water, under pressure, is admitted to these cranes and to the cylinders that

turn the converters by a workman standing on a raised platform, from which all the operations can be overlooked. The iron to be converted into steel is melted in cupolas or air-furnaces. The cupolas are emptied into a suitable loam-lined ladle fixed before them, or they may be emptied direct into the converter. The air-furnaces are, of course, always tapped direct into the converters. The melted iron is run into the converters by means of iron spouts or runners lined with loam. The converter is an egg-shaped vessel, having at one end a mouth or opening for the free escape of gases, and so arranged that it can be divided into three or more sections, as may be desired, with the exception that the lowest section or bottom must be one single and separate section. The shell is usually made of boiler-plate, and the trunnions may be made either of wrought-iron and be welded to a hoop that encircles the converter, or may be made of cast-iron, and be riveted to the converter. The converter is lined with quartz or fire-stone and fire-clay mixed with water into a plastic mass, and rammed into an annular space between a mold and the inside of the shell of the converter. The mold is then withdrawn and the lining glazed. Air is admitted to the converter through a hollow trunnion and a pipe leading into a compartment at the bottom of the converter opposite the mouth, called a tuyere-box, whence it is conducted up through the fire-stone lining into the liquid metal by means of perforated cylindrical blocks of fire-brick called tuyeres. This tuyere-box, in connection with the necessary bowl-shaped flange or straight arms (as the case may be) for fastening it onto the rest of the vessel, is known as the vessel-bottom, being the lowest section of the vessel. When, after six or eight charges or conversions, the tuyeres become burnt off or worn too short for further use, they are now generally all removed at once, together with the vessel-bottom and another bottom containing tuyeres, around which the refractory material has been already rammed and dried, is bolted or keyed onto the vessel in the proper place. In order to lift this bottom conveniently into place a hydraulic lift is placed perpendicularly under the vessel, the centers of each being in the same line. A car is so arranged as to run under the vessel, and its wheels and axles are placed so far apart that the lift can be raised up between the axles. A fresh bottom having been swung out of the oven onto the car the latter is run over the hydraulic lift, which is then raised and catches the bottom and raises it up to

its proper place against the rest of the vessel, where it is bolted or keyed on.

The chief defects of the said arrangement of machinery as heretofore used, and especially of the above-described arrangement of the converters and apparatus connected with them are that all repairs must be made in the same place or casting-pit, where the manufacture of steel is going on, and that there is no provision against accidents to the converters or the apparatus connected therewith. The consequences of this lack of provision against accidents is that a great deal of time is unnecessarily lost.

The objects of my improvement are to facilitate the manufacture of steel, and to provide against accidents to any part of the converting machinery, thereby preventing any loss of time.

For this purpose I so arrange the converting apparatus that the operations of the conversion of the fluid pig-iron into steel may be carried on in a separate place, and entirely independent of the repair of the bottoms of the converters and of the linings of the same. For this purpose I remove the hydraulic lifts and the cars above-described from beneath those converters in which steel is made, and place them under other and spare converters, which are so arranged that they may be repaired in any way without interfering with the operations of manufacture. In order to facilitate the said repairs to the spare converters I provide the latter with hydraulic cylinders to move them upon and around their axes into any required position, and with air-pipes and chimneys, in order that the linings may be dried by fire as required, and with a railway running out under any suitable crane, by means of which the above-described movable bottom may be taken out of an oven and placed on a car upon this railway, as above described.

In order to remove the converters from the place in which steel is made, or, in other words, from the casting-pit to the place in which they are repaired after use, I provide a very powerful crane, preferably a traveling crane, which shall command the whole floor of the converting room, and which shall be able to lift an entire converter, that has been either already used or freshly prepared for use, bodily from its place and set it down wherever it may be desired. I also provide a pair of spare supports for a converter. Upon these latter, either converter may be set on its way to or from the casting-pit.

By these means, properly worked, I can make from thirty to thirty-six or more blows daily, and can entirely prevent any time from being lost. In case of any accident whatever to a converter I can, in half an hour, replace it with another which is sound and ready for work.

To enable the cupolas to conveniently provide molten pig-iron for so many conversions daily, I prefer to mount the loam-lined ladle into which they are preferably emptied on a car to move both forward and backward, so that it may be run upon the scales and before any cupola that may be desired. This ladle has heretofore been permanently fixed before one or more cupolas, as above described, and could not be moved except around

its own axis, and could not be lifted out of its position on account of the spouts or runners leading into it, necessarily overlapping it in order that the molten iron might not drip down outside of the ladle.

The cupolas have heretofore been obliged to wait on the ladle and on the runners leading to the same. When two cupolas poured their metal successively into the same ladle, one has to be kept back for one or more hours because its runner was crossed by the runner from the other cupola, which runner could not be interfered with.

By mounting the ladle, as above described, upon a car I can provide each cupola, up to any desired number, with a separate and independent runner, which can be lined with loam independent of the rest, and, consequently, can be used at any time without waiting for the other cupola to finish its work. Further, if anything happens to an iron ladle while in use I can run it to one side with any molten iron it may contain after the accident and run another fresh ladle on another car before the cupola that is working. I can thus save one hour in twelve that would otherwise be lost, and can provide against any accident or detention that may arise.

To enable others to construct and use my invention I shall describe the same by reference to the annexed drawing, which forms a part of this specification, and in which the same letters refer to the same parts.

Figure 1 is a horizontal section of a converting-building or room, and of a cupola-room or building appertaining thereto. Some of the apparatus is shown as on a section, while the rest appears as on a plan. Fig. 2 is a horizontal section of a converting-building or room, the machinery therein being shown as on a plan.

The iron to be melted is raised, by means of the hoist or lift A, up to the charging-doors of the cupola-furnaces B, Fig. 1. In order to be able to use any cupola as may be desired, independent of any accident to the other cupolas or to the runners thereof, I place a railroad track, S S, Fig. 1, of any suitable gauge, in front of all the cupolas and at a proper distance from the same. On this track I place a car, T, which may be moved back and forth by any suitable means, such as a wire rope in connection with a hydraulic cylinder, or as a chain wound round a revolving drum, or by means of a hand-gearing attached to one of its axles. On this car I place, on proper supports, a large loam-lined ladle, C, Fig. 1, which may be tipped over by gearing in the usual way. The top of this ladle is placed at such a height that it may run freely underneath the loam-lined runners attached to the cupolas, and generally the ladle itself is preferably to be so placed on the car that the said runners may project over the side of the ladle about one-third of the diameter of the top. When I wish to use any desired cupola I run the car and ladle in front of said cupola and under the runner thereof, and tap the molten metal out directly into the ladle.

In order to know how much iron is in the ladle it is usual to use a scale under the fixed ladle

heretofore used. I place these scales, as at D, Fig. 1, in any suitable position, so that the track may run directly over them and the car and ladle run upon them, when desired.

A movable ladle mounted on a car may also be placed on a track in front of the cupola-furnaces sometimes used to melt the speigeleisen used to recarbonize the molten Bessemer metal into steel whenever said cupola-furnaces are used to melt the speigeleisen in preference to the reverberatory furnaces H, Fig. 1.

The arrangement of the converting-vessel before referred to is shown in Fig. 1. The converters E E are placed side by side in the usual way, but the chimneys F F appertaining to the same are placed on the other side of the wall from that on which the converters stand, only the hood Y being allowed to come through the wall. This I do to allow the girder that carries the traveling crane, I employ, by preference, to pass over the converters at such a distance behind the centers of the same that the carriage carrying the hoisting-gear may be run so far in on the crane that the hook of the hoisting-gear may be over the center of the converters. The converters are provided in the usual manner with hydraulic cylinders G G and rack-and-pinion arrangement V V. Under the converters E E there is no machinery for repairing them, such as an hydraulic lift and a car, as hereinbefore described. All this I remove to a place not liable to the accidents of manufacture—namely, under the converters E' E', Fig. 1, which I keep as spare converters to be repaired in the place represented and to replace the converters E E when these latter are worn out or disabled. Under the converters E' E', Fig. 1, I place a track, W W, and on this track a car, K, as above described. A vessel-bottom, Z, is shown in the drawing in position on the car ready to be run under the converter. These converters are likewise furnished with hydraulic cylinders G' G' and rack-and-pinion arrangements V' V'. I also place before the spare converters E' E', at a suitable distance from and centrally between them, the spare standards N N, upon which a converter may be set down before it is put into its proper place.

In order to remove the converters E E from their place, when they are worn out by use, and set them down again for repair in the places of the spare converters E' E', I provide, by preference, a heavy traveling crane, M, which spans the whole building and is of ample strength to lift the converters, no matter what their weight may be. This crane is arranged to be worked by steam in any suitable way and to have three motions—a traversing motion in direction of length of building, a traversing motion of the crane-carriage in the direction of the breadth of the building, and a hoisting or lowering motion. The crane M travels on a pair of heavy girders, U U, one of which is placed on each side of the building and each of which runs the whole length of the building. On these girders the crane traverses freely over the converters E E and the converters E' E'.

The operation of moving a converter, E, from

its place in the casting-pit to the place of E' may be concisely described as follows: The crane M is run over the converter E; the latter is then raised out of its place and carried to the spare standards N N, on which it is to be set down and left awhile. Then the crane M is run over the converter E', and the latter is to be lifted and carried directly to the place made vacant by the removal of the converter E. The crane M is then run back for the converter E, and the latter is to be taken up and deposited in the place vacated by the removal of E'. At the conclusion of these operations, which should not jointly occupy more than twenty minutes, we have a fresh converter, E', in place of the converter E, which is disabled from further use till a new bottom is put on, and we have this disabled converter in a place where it can be immediately repaired without disturbing the operations of manufacture.

In Fig. 1, J J are the ingot-cranes and I is the ladle-crane, both of which perform their usual functions, as hereinbefore described. Railway tracks O O lead to all desired points in the building, and turn-tables P P are placed where required. The oven L for drying vessel-bottoms is placed so that it is convenient to the spare converters E' E' and so that the track leading from it may be commanded by the crane M.

In Fig. 1 I have, by preference, so arranged the plant that the place in which the converters are repaired, as above described, is placed in the same building wherein are contained the converters in which steel is made. But my invention can easily be adapted to the improvement of many existing plants for the manufacture of steel in which there is no room to carry out the precise plan above described. I therefore show, in Fig. 2, a horizontal section of a converting-room so arranged that the converters may be repaired outside of it in any suitable and separate building. To this end I arrange, by preference, a Fairbairn's wrought-iron goose-neck crane, M, Fig. 2, so placed and of such radius that it conveniently sweeps over each of the converters as they stand in the place in which they are to be placed to make steel, and also sweeps over the railroad track O, Fig. 2, and the spare standards or supports N N N N, Fig. 2.

In order to remove the converters to a suitable place for repairing them as above described I place upon the railroad track O, Fig. 2, two large and heavily-built cars, X X, Fig. 2, resting on a suitable number of wheels, and so provided with suitable standards or supports that the converter when placed on them may sit securely and so as to be transported without risk.

The arrangement shown in Fig. 2 is that generally known as the English plant or arrangement, in which the converters E E, Fig. 2, are placed on opposite sides of the casting-pit and facing away from each other. I is the ladle-crane and J J are the ingot-cranes, all of which perform their work as hereinbefore described. F F are the sides of the chimney in front of the converters, and W W are the tracks on which any desired material or piece of apparatus may be taken in under the converter or taken from

underneath the same. G G are the hydraulic cylinders, connected with the converters by means of the rack-and-pinion arrangement, marked V V.

The operation of exchanging a fresh for a damaged converter is substantially the same as hereinbefore described, and may be briefly described as follows: The crane M, Fig. 2, is placed over a converter, E, Fig. 2, the bottom or the lining of which has been worn out in making steel, and the crane-hook is attached by chains to the converter. The converter E is then lifted, carried off, and placed upon the spare standards or supports N N conveniently placed for the purpose. Meanwhile a fresh converter, E', Fig. 2, which has been previously got ready, is run into the converting-room on the car X, which moves on the track O. This fresh converter is then raised by the crane M, Fig. 2, and placed in the position made vacant by the removal of the damaged converter E. The converter E' is then ready to use for making steel, and may be immediately so used, if desired. The converter E is then placed, by means of the crane M, on the car X, and is taken to the place provided for the repair of converters. This said repair place should be preferably provided with a traveling crane, and may be used to repair the bottoms and the linings of the converters, two or more Bessemer plants, each consisting of two converters, with the necessary apparatus.

I claim as my invention—

1. The combination, with a Bessemer plant as heretofore constructed, of the apparatus herein described or its equivalents, arranged in a separate place or places designed for their reception beyond the vicinity of the converters in use, and used solely for the repairing of damaged converters which are conveyed to and taken from such place or places, substantially in the manner specified.

2. The combination, with a Bessemer plant as heretofore constructed, of a crane so arranged as to command the whole plant and all the machinery therein contained, and so placed as to easily transfer the converters from the repair place to that in which steel is made, substantially as and for the purposes set forth.

3. The combination, with a Bessemer plant as heretofore constructed, of a crane and a heavy car so arranged that the crane may set the damaged converters on said car, which shall transport them to a suitable repair place separate from the main building, substantially as and for the purposes set forth.

4. The combination of a railroad track, a car, and a ladle with the cupolas of a Bessemer plant as heretofore constructed, substantially as and for the purposes set forth.

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