No. 872,046. PATENTED NOV. 26, 1907.

T. S. BLAIR, Jr.

STEEL PLANT.

APPLICATION FILED JULY 20, 1907.

2 SHEETS—SHEET 1.

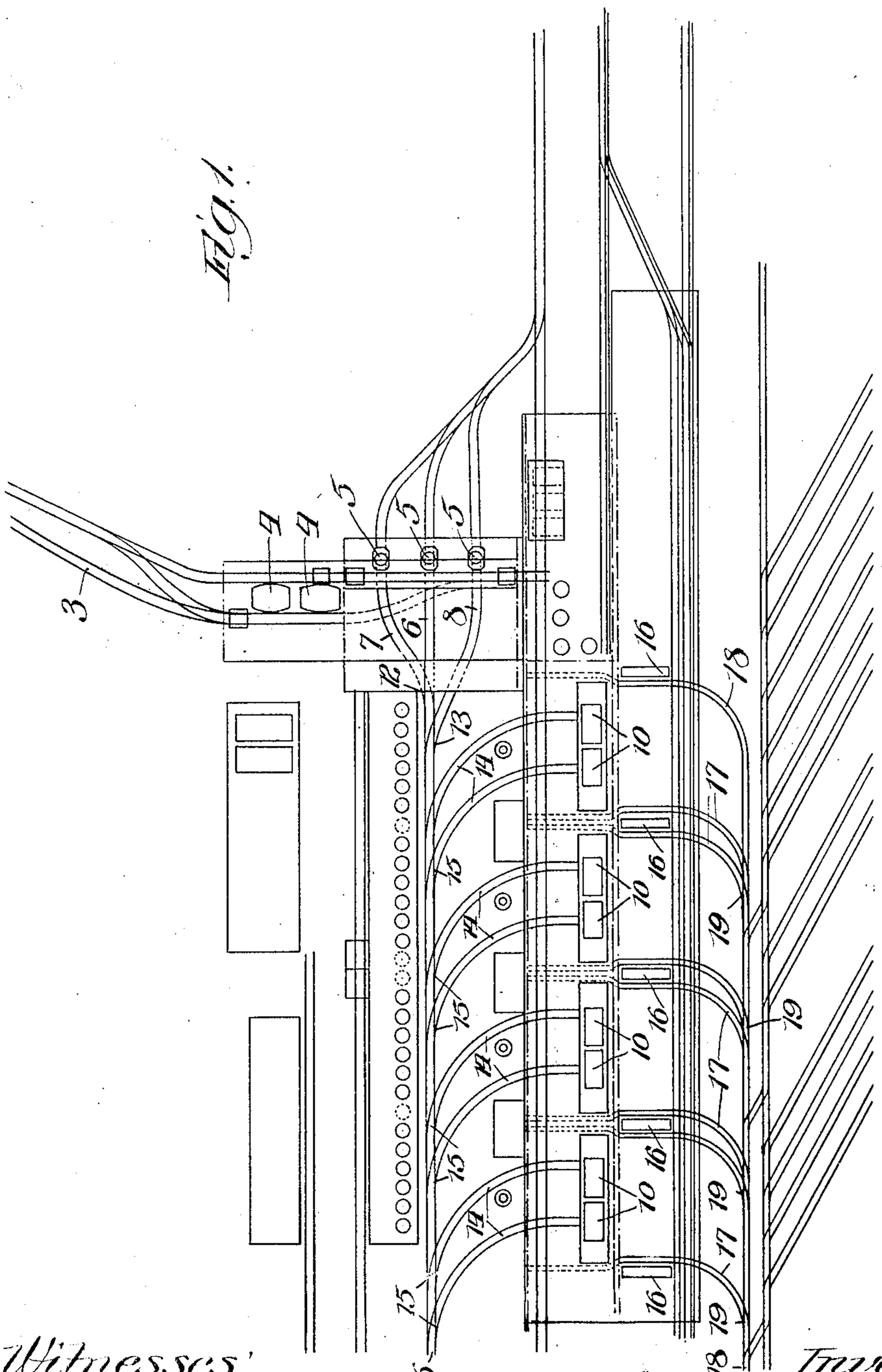

Fig. 1.

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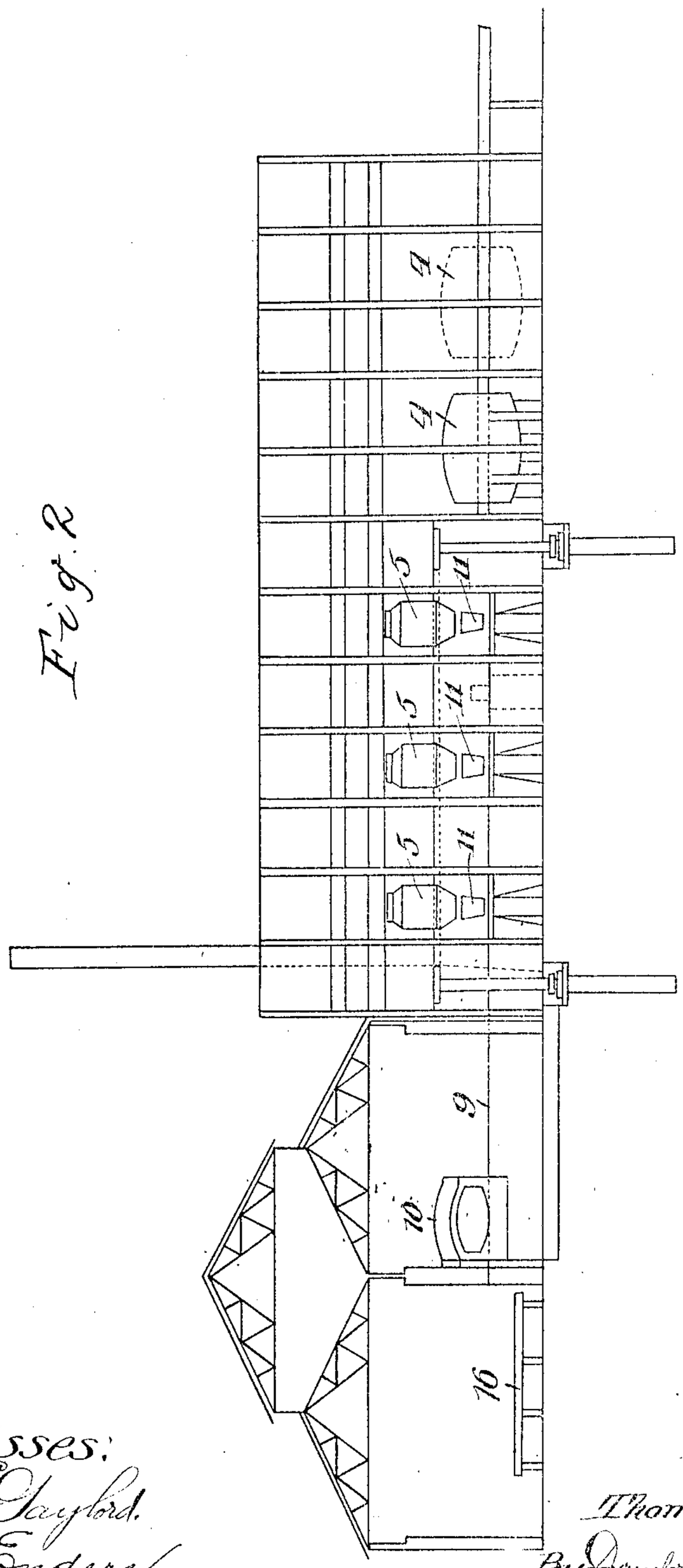
2 SHEETS—SHEET 2.

Fig. 2.



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UNITED STATES PATENT OFFICE.

THOMAS S. BLAIR, JR., OF ELMHURST, ILLINOIS

STEEL PLANT

No. 872,046 Specification of Letters Patent. Patented Nov. 26, 1907

Application filed July 20, 1907. Serial No. 384,730.

To all whom it may concern:

Be it known that I, THOMAS S. BLAIR, Jr., a citizen of the United States, residing at Elmhurst, in the county of Dupage and State of Illinois, have invented a new and useful Improvement in Steel Plants, of which the following is a specification.

This invention relates to an improvement in the so-called "duplex" plant, which consists, generally stated, of a combined Bessemer plant and open-hearth plant. This type of plant has been adopted over the Bessemer method, as employed by itself, which developed on the lines of large tonnage, because the quality of the steel produced by the latter is not equal to the demands upon rails made of the steel by the modern heavy type of locomotive; and it has been adopted over the open-hearth method, as employed by itself, in which the quality of the steel produced is considered rather than the tonnage, because it necessitates for a plant on a scale commensurate with the requirements of the rail-mill supplied from it, one that is cumbersome and unwieldy and which renders the cost of production of rail-steel much greater than the cost thereof by the Bessemer method.

The more important advantages, over either the Bessemer or the open-hearth method, of the existing duplex plant are that it enables a blast-furnace to be run to suit the mineral conditions that are encountered, without regard to the succeeding steps in the operation, whereas in the Bessemer method, the blast-furnace must be so operated as to produce pig iron which will produce steel not over 0.10 per cent. in phosphorus and sulfur, and in the open-hearth method, not over 1.00 per cent. in silicon; that it enables the Bessemer element of the plant to be operated to the best advantage because it has only to blow down the silicon and part of the carbon, and does not have to contend with the phosphorus or sulfur, nor with the finishing of the steel; that the open-hearth-furnace element of the plant is thus permitted to operate under the most favorable conditions, because of the removal by the Bessemer converter, from the metal before it is introduced into the open-hearth, of the silicon and thus of the cause of all the difficulty in the basic open-hearth, and of the preparation for the open-hearth of the metal to the desired carbon point and its introduction thereat at a very high temperature.

The principal objections to a duplex plant, as hitherto constructed, are the great cost of installation and the uneconomical manner in which it is required to be operated because of the construction.

The primary purpose of my invention is to avoid these objections; and to show the extent and nature of the improvement in this behalf which my invention accomplishes, the comparison may best be made (neglecting the Bessemer method, because the question of quality is driving it out of use) with an open-hearth plant of usual construction having a daily capacity of, say, three thousand tons of ingots. Such a plant costs to install, in round numbers, about five million dollars, while a duplex plant of the same capacity, constructed in accordance with my invention, will cost about one and one-half million dollars; and the operating cost, computed on the same basis in each method, will be about one dollar and seventy cents per ton of ingots in my improved duplex plant, as against three dollars and fifteen cents per ton in the open-hearth. These and other advantages are due to the improved means I have devised for enabling the handling of the blown metal from the Bessemer converters to the open-hearth furnaces, and of the cast product of these furnaces away from them to the rolling-mills, in a manner to permit each "unit"—consisting of a furnace and its appliances—to work to its own full capacity, by working it quite independently of, and without interfering with, any other unit.

In the existing duplex plant the supply of blown metal is brought from the converters to the row of open-hearth furnaces on tracks running longitudinally of the furnaces along their front side, whereby the delivery of the material to any one furnace in the row, except the first, inevitably interrupts, and therefore interferes with the operation of all the other furnaces. Where, in the regular open-hearth practice, each furnace makes only about two heats per day, this interruption is not so serious a factor; but to enable a duplex plant to be run to its full capacity of about eight heats per day requires that the material shall be delivered to each furnace and that the furnace be operated without interruption from the delivery of the material to the other

furnaces This my invention accomplishes by bringing the material to the furnaces on tracks running in lateral direction to them, so that each unit of the row of furnaces may be supplied without hindrance to the operation of any other unit.

Precisely the same conditions apply to the "pit", so-called, or side of the shop back of the furnaces, where the steel from them is poured into ingot-molds on cars to be transported on the latter to the rolling-mills. An example of this is the ordinary open-hearth plant, of twelve furnaces in a row twelve hundred feet long, which can handle about sixteen to eighteen hundred tons of ingots per day, while four furnaces, in one duplex plant, are capable of producing daily about three thousand tons of ingots, required to be handled within a space only one-third that length, or four hundred feet, which, however, under the present system, is but sufficient for handling about one-fifth that amount of product. My improvement in this behalf, which involves running the ingot-delivery tracks in lateral direction from the furnaces, avoids hindrance, from the operation of any furnace in the row, to the operation of the other furnaces, and permits the handling of any tonnage of product which the furnaces are capable of turning out. Thus running the metal-supply and ingot-delivery tracks respectively to and from the furnaces enables the duplex system of plant to be operated to its full capacity and with the utmost economy.

Referring to the accompanying drawings—Figure 1 is a plan view, in the nature of a diagram, of a duplex steel-plant involving my improvements, and Fig. 2 is an end view of the same.

The molten metal is brought in ladles from blast-furnaces (not shown) on an elevated track 3 to ordinary mixers, indicated at 4, whence it is delivered, as required, in ladles as usual, to Bessemer converters, indicated at 5, wherein it is desilicized and decarburized, by the customary procedure, to the desired carbon content. The converters are placed in elevated position with relation to ladles on cars upon the track 6 and branches or leads 7 and 8 therefrom on approximately a level with the usual charging platform 9 of the row of open-hearth furnaces 10, to permit the converters to be conveniently emptied into these ladles. After the metal has been blown in the converters, it is poured from them into the ladles, indicated at 11, on cars (not shown) movable on the tracks 6, 7 and 8, and delivered to the open-hearth furnaces to be refined, by dephosphorizing and desulfurizing it and bringing it to the desired carbon and manganese contents, by the usual procedure in the open-hearth practice. The track 6, with which the branches 7 and 8 connect by switches, indicated at 12 and 13, extends along the platform-side of the row of furnaces, which are preferably of the double-hearth construction shown and described in my pending application, Serial Number 382,487 filed on the 6th day of July, 1907.

The novelty in the system thus far explained lies in placing the converters at a level sufficiently high to adapt them to deliver the blown metal to the ladles at approximately the level of the charging-platform, which is desirable for the sake of economy in handling the metal.

Similar branch-tracks 14 have switch-connections, indicated at 15, with the track 6, each branch-track leading across the charging-platform 9 and thus laterally to a different furnace, or furnace-section as indicated. This construction in the plant enables the cars carrying the ladles from the converters to be switched laterally, to approach the furnaces in the direction transverse of the line thereof, for charging them with the ladle-contents, whereby the route to each furnace is rendered independent of that to any other furnace in the row, so that a supply-car may be directed to any one without its interfering with, or interrupting, the operation of any of the others; thus enabling each furnace to be worked up to its full capacity by rendering the operation of each unit absolutely independent of every other unit.

When the metal has been refined and finished in the open-hearth furnaces, it is tapped into ladles, in the usual manner, to be poured from them into ingot-molds on cars movable on tracks in the so-called "pit".

In the customary arrangement of pit the pouring-platforms and tracks extend lengthwise along the rear side of the furnace-row, thereby limiting the capacity of the plant to the amount of steel that can be handled in the pit, since each furnace has to await its turn for molds inasmuch as the pit serves all the furnaces; and it is demonstrated by common practice that a pit, say, twelve hundred feet in length will handle about sixteen hundred to eighteen hundred tons of ingots per day. My improvement in this behalf consists in providing pouring-platforms 16 to extend, coincidently with the spaces between furnaces 10, transversely of the pit, with branch-tracks, or turn-outs, 17, for the mold-carrying cars, leading from the pouring-platforms to a track 18 extending lengthwise of and parallel with the rear or pit side of the row of furnaces, the turn-outs connecting with the track by switches, indicated at 19. By thus providing the pouring-platforms and tracks 17 the product of each furnace may be handled without regard to the work of any other furnace, thus enabling unhampered disposition to be made of the product of all the furnaces, however great it may be. The great advantage of this improvement may best be explained by the following

comparative example: By the open-hearth method, a pit for twelve open-hearth furnaces in a row, say, twelve hundred feet long, is capable of disposing of about eighteen hundred tons per day, while a pit for four furnaces, one-third that length, is capable of disposing of about six hundred tons per day; but four furnaces in one duplex-system, as aforesaid, are capable of producing about three thousand tons per day. Therefore the great advantage of the duplex plant is lost, without my improvement, which enables easy disposition of this three thousand tons, or more, daily product of the four furnaces.

It may be suggested that the switches 15, 19 should be spring-switches of any suitable type, so that the through-tracks 6 and 18 shall be closed automatically, and when it is desired to enter one of the turn-outs at a switch, the latter may be closed and held closed against the spring until the locomotive and its train have passed into the turn-out; and coming out of a turn-out the switch acts automatically to allow the train to enter the through-track and to close when the train has cleared it.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a duplex steel-plant, the combination with the Bessemer-converters and the row of open-hearth furnaces, of a track for ladle-carrying cars extending lengthwise along the front side of said row with leads to it from the converters; and turn-outs having switch-connections with said track and leading laterally therefrom to extend transversely of the charging-platform to the different furnaces, for the purpose set forth.

2. In a duplex steel-plant, the combination with the row of open-hearth furnaces, of Bessemer-converters disposed at a level sufficiently high to adapt them to deliver the blown metal to ladles at or near the level of the charging-platform, a track for the ladle-carrying cars extending along the front side of said row with leads from it to the converters, and turn-outs leading laterally from said track to extend across the charging-platform to the different furnaces, for the purpose set forth.

3. In a duplex steel-plant, the combination with the row of open-hearth furnaces, of a pit at the rear side of said row, a track extending lengthwise along said side, pouring platforms extending across said pit, and turn-outs extending from said platforms to said track, for the purpose set forth.

4. In a duplex steel-plant, the combination with the row of open-hearth furnaces, of a pit at the rear side of said row, a track extending lengthwise along said side, pouring-platforms extending across said pit, and turn-outs extending from said platforms to and having switch-connections with said track, for the purpose set forth.

5. In a duplex steel-plant, the combination with the Bessemer-converters and the row of open-hearth furnaces, of a track for the ladle-carrying cars extending lengthwise along the front side of said row, with leads to it from the converters, turn-outs leading laterally from said track to the different furnaces across the charging-platform, a pit at the rear side of said row, pouring-platforms extending across said pit, and turn-outs extending from said platforms to said rear track, for the purpose set forth.

6. In a duplex steel-plant, the combination with the row of open-hearth furnaces, of Bessemer-converters disposed at a level sufficiently high to adapt them to deliver the blown metal to ladles at or near the level of the charging-platform, a track for the ladle-carrying cars extending along the front side of said row with leads from it to the converters, turn-outs leading laterally from said track to extend across the charging-platform to the different furnaces, a pit at the rear side of said row, pouring-platforms extending across said pit, and turn-outs extending from said platforms to said rear track, for the purpose set forth.

THOMAS S. BLAIR, Jr.

In presence of—
Wm. Niellward,
R. T. Harris.