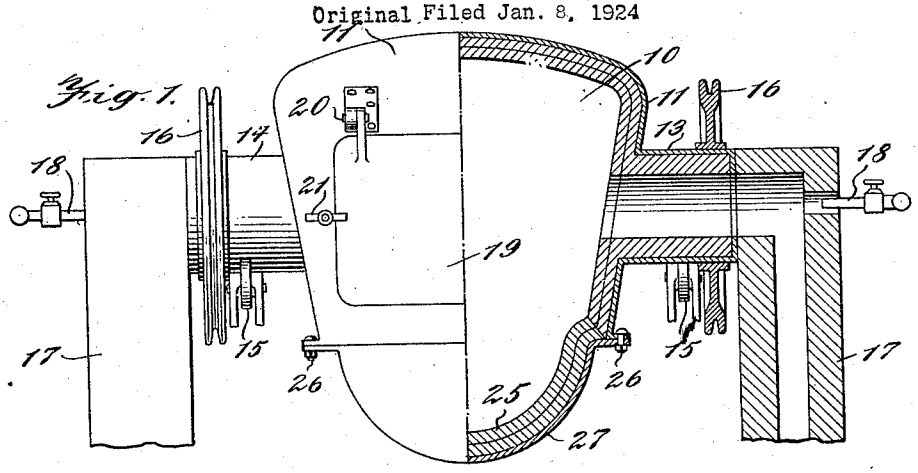
July 21, 1925. 1,546,965

E. F. BLESSING

PROCESS FOR PRODUCING WROUGHT METAL

Original Filed Jan. 8, 1924

Fig. 1.



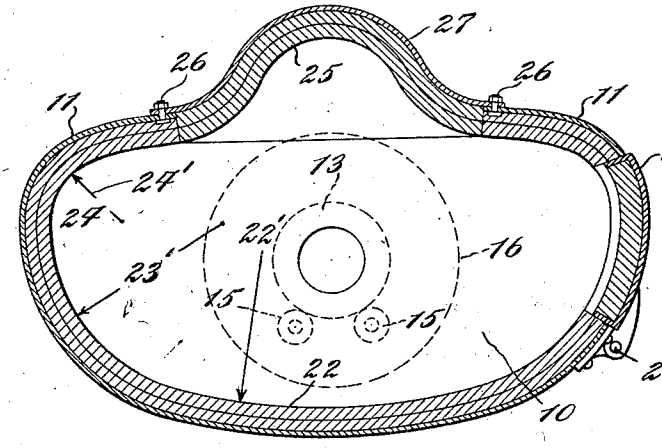


Fig. 2.

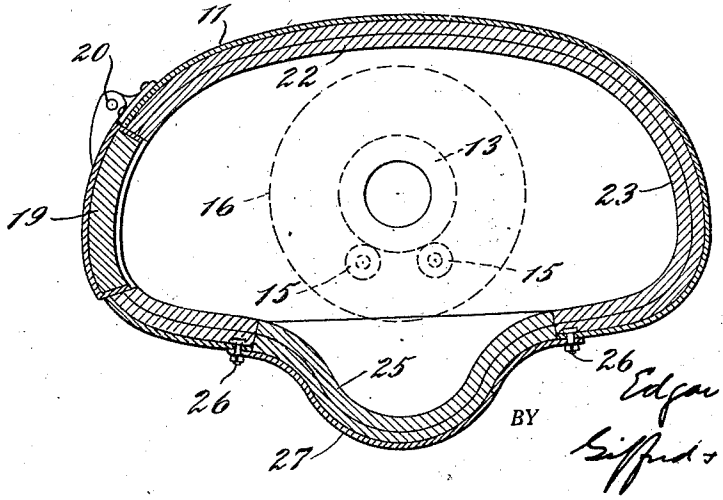


Fig. 3.

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UNITED STATES PATENT OFFICE.

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PROCESS FOR PRODUCING WROUGHT METAL.

Original application filed January 8, 1924, Serial No. 684,923. Divided and this application filed July 5, 1924. Serial No. 724,253.

To all whom it may concern:

Be it known that I, EDGAR F. BLESSING, a citizen of the United States, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Processes for Producing Wrought Metal, of which the following is a specification.

My present invention relates to processes particularly adapted for the production of wrought iron, and will be best understood from the following description and the annexed drawings showing an illustrative form of apparatus by which my novel process may be practised.

My present application is a division of my copending application Serial No. 684,923, filed January 8, 1924.

In the drawings, Fig. 1 is a side elevation, partly in section, of my illustrative form of apparatus; Fig. 2 is a vertical middle section of the furnace shown in Fig. 1 in reversed position, and Fig. 3 is the same furnace as shown in Figs. 1 and 2, but in the original position of Fig. 1.

Like reference characters indicate like parts in the different views.

In the illustrative apparatus shown in the drawings, 10 is a furnace having a metal shell 11 and lined with the usual refractory lining. The furnace is provided with trunnions 13 and 14, mounted on supporting rollers 15, and provided with means for oscillating the furnace, such as the pulleys 16, by which the furnace may be turned on the rollers 15. The trunnions 13 and 14 are hollow and may be made to communicate with the ducts or flues in stacks 17 at either end of the furnace. The fuel burners 18 may also be provided as shown more or less diagrammatically in Fig. 1, or any other suitable means for heating the furnace may be used.

A door 19, pivoted at 20, and held in position by any suitable fasteners, such as 21, is located in the side of the furnace.

In the illustrative embodiment, the refractory surface or lining constitutes what are, in fact, a series of hearths or receptacles, each constructed so that a different step of the cycle can be effectively carried out in each of these portions of the furnace.

Referring to the section shown in Fig. 2, the part 22, struck on the relatively long radius 22′, is used as a refining hearth while the metal is principally in the liquid state. By reason of its long radius of curvature, this portion is relatively flat, so that when the charge is resting on this portion 22, as it would be when the furnace is in the position shown in Fig. 2, the charge is spread over a larger area with a relatively shallow depth. Consequently, the oxidizing slag, which tends to float on the surface of the bath, will be brought into more intimate relation with the iron of the bath than if the portion 22 were relatively deep and of small area.

At the left-hand end of Fig. 2, a portion 23 of the refractory surface is shaped so as to be effective in the second operation, that of turning the metal. Preferably, I arrange this portion of the hearth so that it has a relatively abrupt termination, as at 24, with a part on a radius 23′ arranged to connect the relatively flat portion 22 with the abrupt portion 24, the latter being struck on the radius 24′. Preferably, for the sake of uniformity, I make the right-hand end of the furnace, as shown in Fig. 2, of the same shape as the left-hand end of Fig. 2, though this will not be essential, and in some cases may not be desirable.

In the illustrative embodiment, opposite the relatively flat portion 22, I provide a balling section which, preferably, is a more or less semi-spherical recess or pocket 25, with its surface connecting with the surface 24, preferably so as to avoid any abrupt curves, but also preferably arranged so that there will be sufficient curvature to provide an arch for locking in the refractory lining.

In my preferred form, I make the sides of the furnace as shown best in Fig. 1 tapering toward each other from the flat section 22 to the balling section 25 for reasons to be pointed out more fully hereinafter. In the illustrative form the balling section 25 is removably connected to the shell 11 by means of stud bolts 26 passing through the removable shell 27 supporting the lining of the balling section 25. If desired, the removable shell 27 may be hinged to be removable instead of being bodily removable, as illustrated. I preferably make this balling section removable so that the lining thereof may be readily replaced and, moreover, so that in the event that the iron has not been worked so as to produce a proper ball which may be discharged through the door 19 in

the usual manner, the balling section 25 may be dropped to remove the charge from the furnace.

With the furnace just described, the molten iron and the oxidizing slag or reagent are charged in the furnace when it is in the position shown in Fig. 2, and the charge melted and the furnace rocked back and forth to cause the thorough mixture of the slag and the iron. The door 19 is preferably positioned so that the charge or bath will be carried across the door during this refining operation. In order to seal the door, I preferably wash the cinder around the door before the furnace is charged with iron.

After the refining process is substantially completed and the iron begins to drop, due to the elimination of the major part of its carbon or shortly thereafter but before it is welded into a mass, the furnace is rolled to a position approximately 90° from that shown in Fig. 2, with the charge on the portions 23 and 24. The iron is now "coming to nature" and should be turned to bring the particles which have been on the bottom to the top, so that the remaining portion of the carbon and other impurities can be contacted by the flame and the slag. With the furnace in this position, it is rocked back and forth, so that the charge passes up the abrupt portion 24, which obviously will cause it to turn over, this operation being assisted by the narrowing of the portions 23 and 24 because of the angle of the side walls of the furnace. During this turning operation, additional heat is supplied, as is usual, and when the iron is ready to "ball," the furnace is turned quickly into the position shown in Fig. 3, which causes the charge to slide into the balling section 25 and, because the iron is now plastic and the particles will cohere by mere contact and weight, the entire mass will be turned into a spongy ball, which can then be discharged through the door 19 by turning the furnace through 90°. It will be noted that the balling section 25 is also narrower than the portion 24, and this, of course, crowds the ends of the charge inward to tend to make a more or less rounded form or ball. Preferably, I make this balling section 25 more or less hemispherical, as shown in Figs. 1 and 2, but somewhat the same results will be obtained by merely continuing the angle of the side walls to the furnace downward in Fig. 1, with a more or less flat bottom to the balling section in the direction of the axis of rotation of the furnace.

If desired, the ball may be further compacted by turning the furnace so that the ball will pass from the balling section 25 back over the surface 23 and the surface 22 to the door 19, instead of directly from the balling section 25 to the door 19.

It will also be obvious that many of the advantages of my invention could be obtained by modifying one or more of the sections. For instance, the advantages of the lateral narrowing of the furnace from the part which is used as a refining section to the part which is used as the balling section would be obtained regardless of the shape which the furnace may have in a plane at right-angles to the axis of rotation. For instance, the balling section 25 may be applied to a furnace which is otherwise cylindrical in outline, although preferably I use the form illustrated in order to get a relatively shallow bath during the refining operation to accelerate that operation. Furthermore, it would be advantageous in a furnace which is entirely cylindrical and without any pocket or recess for the balling if the lateral walls were angled so as to produce a furnace which would be wide at one part and narrower at another, because in such a furnace, the relatively wide part could be used for the refining operation and the relatively narrow part for the turning and balling steps. It will also be understood that while the particular shape which I have given is my preferred form, the relative dimensions of the several sections of the furnace and the degree of curvature may be widely varied without departing from my invention.

While I have described my preferred form of furnace for carrying out my process, it will be understood that other forms may be used, if desired.

I claim:

1. An improvement in the art of puddling iron consisting in first agitating a broad shallow body of molten metal and slag by imparting frictional supporting action, then deepening and laterally reducing the body and continuing such action.

2. An improvement in the art of puddling iron consisting in first agitating a broad shallow body of molten metal and slag by imparting alternating frictional supporting action, then deepening and laterally reducing the body and continuing such action.

3. An improvement in the art of puddling iron consisting in first agitating a broad shallow body of molten metal and slag by imparting alternating frictional supporting action, then deepening and laterally reducing the body and continuing such action, with alternating variable resistance whereby to effect turning over of the mass.

4. An improvement in the art of puddling iron consisting in first agitating a broad shallow body of molten metal and slag by imparting alternating frictional movement while supporting the mass, then changing the form of the body by increasing its depth and reducing its width, and continuing the movement to effect turning.

5. An improvement in the art of puddling iron consisting in first agitating a broad

shallow body of molten metal and slag by imparting alternating frictional movement while supporting the mass to bring the oxidizing slag into intimate relation with the iron of the bath, and then increasing the depth while reducing the width of the mass during continuance of said movement.

6. An improvement in the art of puddling iron consisting in first agitating a broad shallow body of molten metal and slag by imparting alternating frictional movement while supporting the mass to bring the oxidizing slag into intimate relation with the iron of the bath, and then increasing the depth while reducing the width of the mass during continuance of said movement, and effecting alternating opposing resistance in different degrees whereby to effect turning of the mass.

7. An improvement in the art of puddling iron consisting in first agitating a broad shallow body of molten metal and slag by imparting alternating frictional movement while supporting the mass to bring the oxidizing slag into intimate relation with the iron of the bath, and then increasing the depth while reducing the width of the mass during continuance of said movement, and effecting alternating opposing resistance in different degrees whereby to effect turning of the mass with final balling.

8. The method of puddling iron consisting in alternately agitating a broad shallow mass of molten metal and slag, then deepening and laterally reducing the mass while continuing the agitation, and simultaneously effecting its turning.

9. The method of puddling iron consisting in alternately agitating a broad shallow mass of molten metal and slag, then deepening and laterally reducing the mass while continuing the agitation, and simultaneously effecting its turning, and then further compacting the mass and continuing its agitation to effect balling.

10. The steps in the process of producing wrought metal consisting in agitating a shallow batch of molten metal and oxidizing slag within a suitable chamber until the metalloids and other impurities in the metal become substantially freely oxidized, then turning the metal until the mass becomes plastic, with final balling, while successively compacting the mass.

11. The steps in the process of producing wrought metal consisting in agitating a shallow batch of molten metal and oxidizing slag within a suitable chamber until the metalloids and other impurities in the metal become substantially freely oxidized, then turning the metal by shifting its supporting bottom and continuing agitation by alternating movement with varying opposing resistance until the mass becomes plastic, with final balling.

12. The steps in the process of producing wrought metal consisting in agitating a shallow batch of molten metal and oxidizing slag within a suitable chamber until the metalloids and other impurities in the metal become substantially freely oxidized, then turning the metal by shifting its supporting bottom and continuing agitation by alternating movement with varying opposing resistance until the mass becomes plastic, and then further compacting the mass in ball form by continued agitation and accompanying increase in depth and lateral restriction.

EDGAR F. BLESSING.