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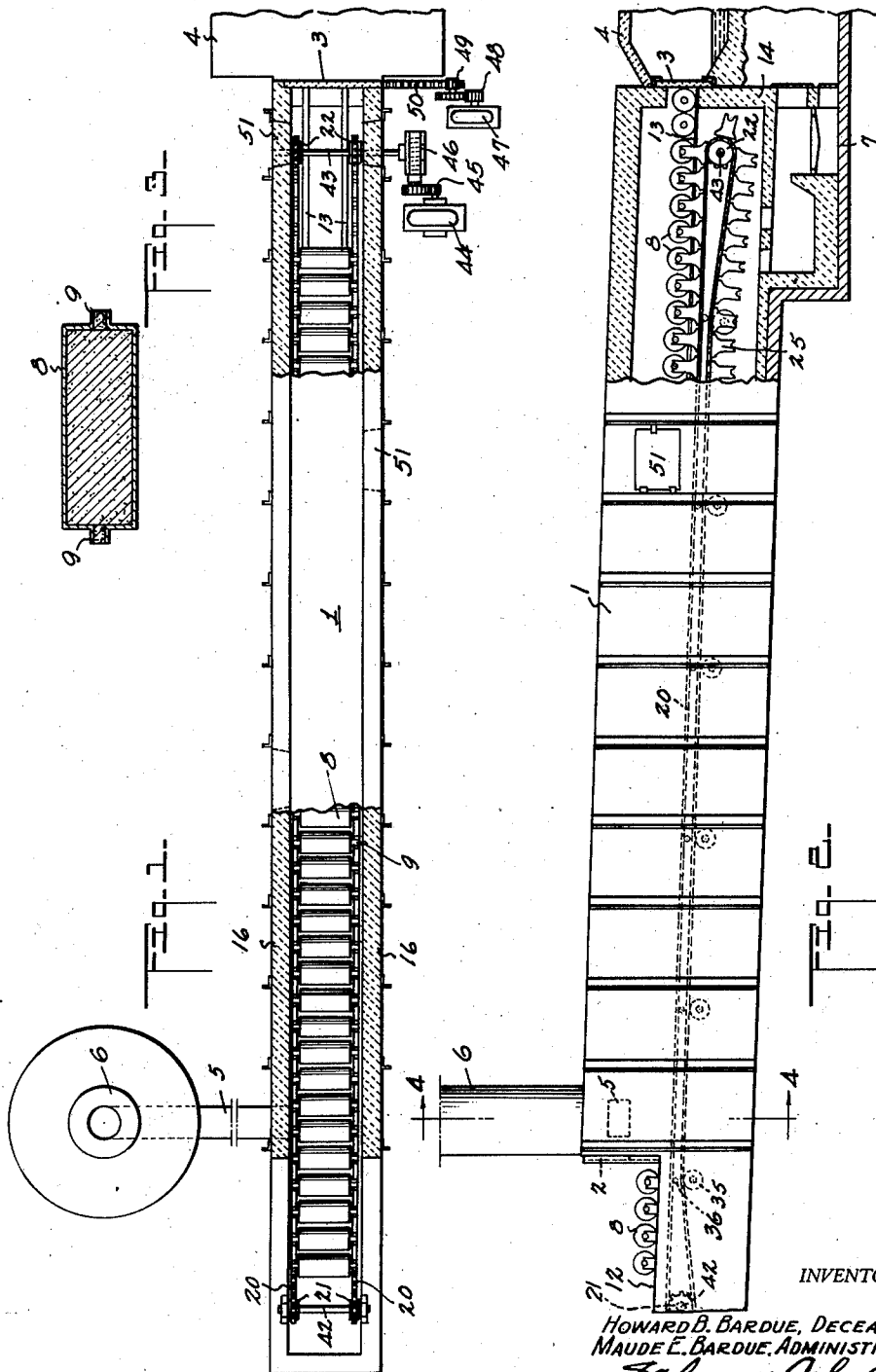
H. B. BARDUE

2,116,554

REDUCING FURNACES

Filed May 10, 1937

2 Sheets-Sheet 1



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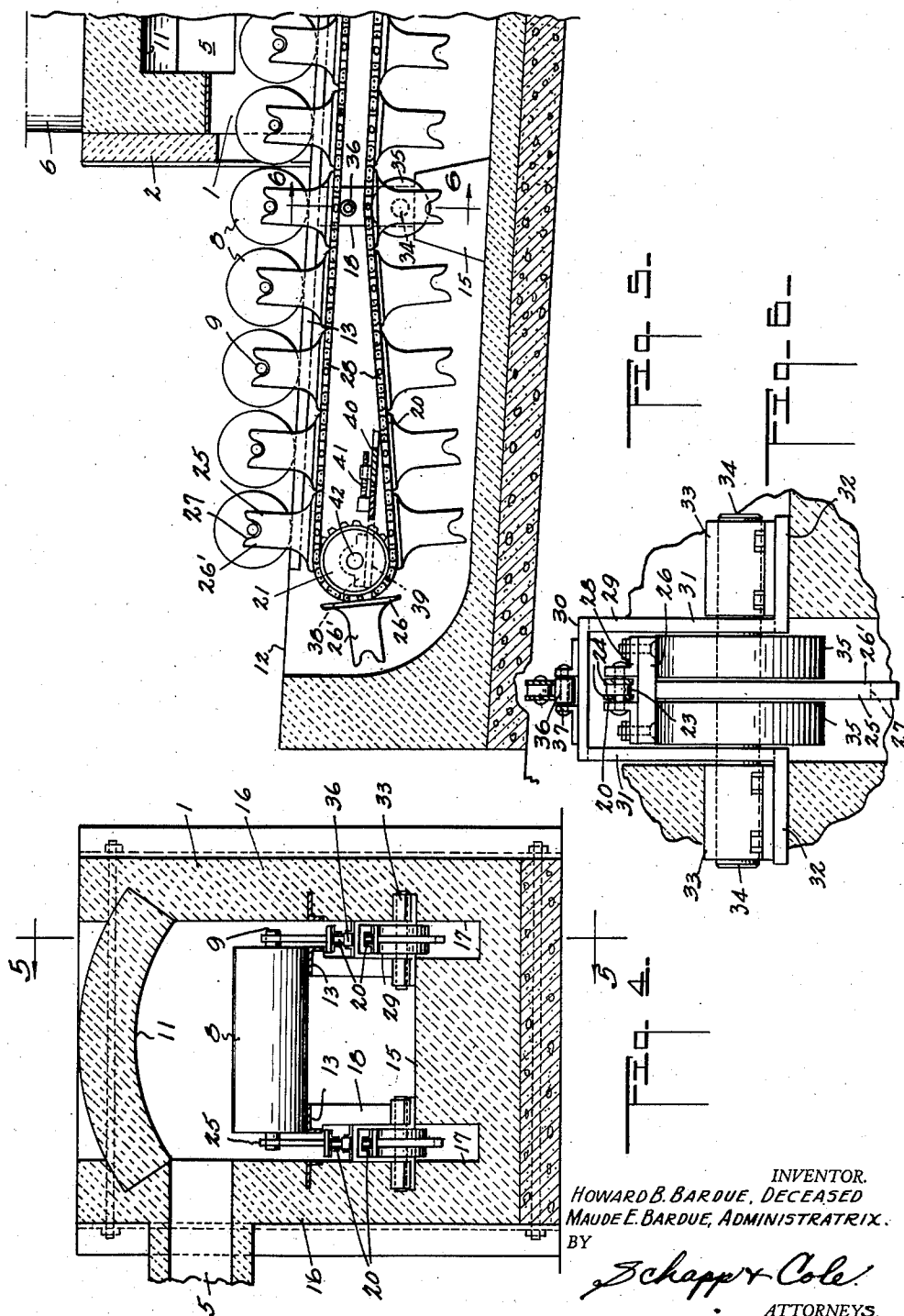
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UNITED STATES PATENT OFFICE

2,116,554

REDUCING FURNACE

Howard B. Bardue, deceased, late of San Francisco, Calif., by Maude E. Bardue, administratrix, San Francisco, Calif.

Application May 10, 1937, Serial No. 141,587

5 Claims. (Cl. 266—24)

The present invention relates to improvements in reducing furnaces and constitutes a further development of the furnace described in his United States Patent No. 1,340,548 issued on May 11, 1920 on a Process for the manufacture of iron and steel.

This patent discloses a process of and apparatus for reducing and melting iron ore in the presence of carbonaceous material and a flux in a single and continuous operation, without permitting an oxidizing agent, such as atmosphere, to come into contact with the material under treatment.

The patent further discloses a special method of arranging the material, for the purposes of the invention, in metallic containers of cylindrical form, the containers being adapted to roll through a reducing furnace for final discharge into a melting furnace, where the containers melt along with the reduced metal inside of the container.

The patent further provides for a special reducing furnace in the form of a long inclined tunnel having an entrance for the containers at its upper end and connecting with the melting furnace at its lower end, the containers rolling by gravity from the upper end to the lower end while the products of combustion from the melting furnace travel in the opposite direction for heating the containers, which latter release carbon monoxide during the process and thus add fuel to the heating means.

The present invention follows substantially the same process but provides certain improvements in the reducing furnace which make the latter easier to operate and subject its operation to better and more positive control.

It is particularly proposed in the present invention to provide a positive feed or travel of the containers through the furnace and to arrange the feed in such a manner that the containers remain in spaced relation to one another and thus allow the heated gases to more freely move between and around the containers.

It is further proposed to provide an improved charging means for the furnace arranged in such a manner that the containers may be positioned in proper relation outside of the furnace and in front of the entrance gate and then be advanced into the furnace by the same agency which takes care of the advance of the containers within the furnace.

It is further proposed in the present invention to provide an improved operating means for the

discharge gate and to provide improvements in the general arrangement of the reducing furnace.

And finally it is proposed to make certain changes in the container itself to facilitate the manipulation thereof.

Further objects and advantages of his invention will appear as the specification proceeds.

The preferred form of his invention is illustrated in the accompanying drawings, in which

Figure 1 shows a plan view of his furnace, parts being shown in horizontal section,

Figure 2 a side elevation of the furnace with portions shown in section,

Figure 3 an axial section through one of his containers charged with material to be reduced,

Figure 4 a transverse section through the furnace taken along line 4—4 of Figure 2,

Figure 5 a longitudinal vertical section through the charging end of the furnace, taken along line 5—5 of Figure 4, and

Figure 6 a detail view taken substantially along line 6—6 of Figure 5.

While only the preferred form of his invention has been shown it is understood that various changes or modifications may be made within the scope of the claims hereto attached without departing from the spirit of the invention.

Referring to the drawings in detail, the general arrangement shows a reducing furnace 1 in the form of an elongated tunnel, with an entrance gate at 2 and an exit gate at 3, which latter communicates with a melting furnace 4 of substantially the same construction as shown in the patent. The products of combustion pass from the melting furnace lengthwise through the reducing furnace and are discharged at the front end of the latter through the conduit 5 and the chimney 6 arranged near the furnace.

Additional heat may be provided for the tunnel by means of an auxiliary furnace indicated at 7 and the products of combustion from this furnace follow the same path.

While passing through the reducing furnace the containers 8 liberate combustible gas, the combustion of which adds further heat units.

The containers 8 are cylindrical in form and are charged with iron ore, carbonaceous material such as powdered coal or crude oil, lime stone serving as a flux and, if desired, some alloy metal to produce as final product a desired alloy. These ingredients are arranged to form a pasty mass, as described in the patent.

The container may itself be made of iron or of other fusible metal which enters into the final product as a permanently united part thereof and

is formed with two axial hubs 9 which are hollow and filled with a porous mixture, preferably of tar and limestone, the tar burning away at the beginning of the process and the remaining limestone permitting of the escape of gases from the container.

The furnace itself is preferably made of brick or other suitable fire-resisting material and forms a long, tunnel-like chamber, preferably rectangular in cross-section, with an arched roof shown at 11. The entire tunnel is preferably built on a slight incline as shown in Figure 2, and a portion of the tunnel extends beyond the gate 2 to form a loading platform 12. Two spaced rails 13 extend throughout the length of the tunnel, substantially midway of the height thereof, and are supported at the rear end on the rear wall 14 and at the front end on the platform 12.

A number of blocks 15 are arranged throughout the length of the tunnel in spaced relation to one another and to the side walls 16 of the tunnel to form channels 17 along the side walls, and these blocks may be used as foundations for braces 18 supporting intermediate portions of the rails.

The spacing between the rails is such that the container may freely ride thereon and the ends of the containers come flush with the outer faces of the rails, while the ends are spaced from the side walls of the tunnel and the hubs of the containers project beyond the rails.

For advancing the containers on the rails two endless chains 20 are provided, each being supported by two sprockets 21 and 22, the former being mounted underneath the front platform and the latter near the discharge end of the tunnel. The chains may be of any suitable construction and are here shown as consisting of single links 23 alternating with double links 24 pivoted to opposite faces of the single links. Each chain has a plurality of brackets 25 projecting therefrom, the brackets including a base plate 26 and a vertical plate 26' rising from the center of the former and terminating, at its outer end, in a saddle 27. The base plate is secured to the double links of the chains by means of short angles 28.

The brackets are proportioned so that the saddles of the upper reach of each chain receive the projecting hubs of the containers riding on the rails and are adapted to advance the containers when the chains are advanced.

For supporting the chains at points between the two sprockets the means illustrated in detail in Figure 6 are provided comprising a metal plate formed in the shape of a yoke 29 with a top 30, sides 31 and lateral bottom flanges 32, the latter being supported on the blocks 15 and the side walls respectively so that the yoke overlies the channel 17 formed therebetween.

The flanges 32 have bearings 33 resting thereon and two short shafts 34 are journaled in the bearings in aligned relation, the shafts carrying spaced and confronting rollers 35 inside the yoke on opposite sides of the vertical plates 26' of the brackets and in supporting relation to the base plates 26 thereof.

The rollers 35 thus give support to the lower reach of each chain at spaced points and the yoke, in which the rollers are supported, has additional rollers 36 mounted on top thereof, between bearing members 37, for supporting the upper reach of the chain.

One of the sprockets of each chain, the front one for instance, is preferably mounted with freedom of positional adjustment for taking up

any slack developing in the chain. For this purpose the bearings 38 for the sprockets are mounted on slidable plates 39 which may be pushed forward relative to a stationary plate 40 by means of a screw 41, in a conventional manner.

The two sprockets at each end of the furnace are mounted coaxially on shafts 42 and 43, and the latter shaft receives rotary motion from a motor 44 through the reduction gears 45 and the worm drive 46.

The front gate 2 may be raised and lowered by any suitable means, and the rear gate 3 is preferably power-operated, by means of a motor 47 which, through a reduction gear 48 and a pinion 49, drives a rack 50 fixed relative to the door.

Suitable doors 51 may be provided in the sides of the furnace for inspection and service.

The operation of the furnace is as follows:

The containers are placed on the front platform so as to ride on the rails 13 and the hubs projecting from the containers are engaged with the saddles 27 of the brackets 25. When they are thus arranged they are slightly spaced from one another as shown in the drawings. With the front and rear gates open, the containers may be continuously advanced, through the entire furnace, a new one being added in front for each container discharged at the rear end.

While each container thus travels from front to rear, heated gases travel in the opposite direction, thus causing each container to grow hotter as it travels and to reduce the ingredients until the latter are ready for discharge into the melting furnace.

It will be noted that the rails for supporting the containers are continuous from front to rear and that the last containers which lose contact with the saddles of the brackets, as shown in Figure 2 will roll toward the exit due to the slight grade in the rails and additionally through the pushing action of the other containers.

What is claimed is:

1. A furnace for reducing material, comprising an elongated tunnel having spaced rails extending lengthwise therethrough, cylindrical containers for material adapted to be supported on the rails, the containers having axial hubs, and means engaging the hubs for advancing the containers.

2. A furnace for reducing material, comprising an elongated tunnel having spaced rails extending lengthwise therethrough, cylindrical containers for material adapted to be supported on the rails, the containers having axial hubs, and a pair of endless chains arranged on opposite sides of the rails and having means engaging the hubs for positively advancing the containers when the chains are moved.

3. A material container for use in connection with a reducing furnace, the container comprising a cylindrical body for receiving the material and axial hubs whereby the container may be advanced in the furnace.

4. In a furnace of the character described, an endless drive chain having two sprockets supporting the same so as to form an upper and a lower reach, brackets projecting outwardly from the chain, each bracket having a horizontal base and a vertical plate, and supporting means for an intermediate portion of the chain comprising a yoke straddling the lower reach, and a pair of rollers supported within the yoke on opposite sides of the vertical plates of the brackets and in supporting relation to the base members of the brackets.

5 5. In a furnace of the character described, an endless drive chain having two sprockets supporting the same so as to form an upper and a lower reach, brackets projecting from the chain, each bracket having a horizontal base and a vertical plate, and supporting means for an intermediate portion of the chain comprising a yoke straddling the lower reach, and a pair of rollers supported within the yoke on opposite

sides of the vertical plates of the brackets and in supporting relation to the base members of the brackets, the yoke having means on the top thereof for supporting the upper reach of the chain.

MAUDE E. BARDUE,
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