This invention relates to smelting hearths, and more particularly to the type described in Patents No. 1,263,695, October 24, 1916; No. 1,263,695, April 23, 1918; and No. 1,388,144, August 16, 1921.

An ore hearth designed more particularly for the smelting of lead, comprises, a comparatively deep basin of cast iron, a water back having tuyers at the lower end thereof positioned just above the basin, an apron which extends forwardly from the basin and a hood which extends over the hearth. In the operation of such a hearth, the basin is filled nearly full of lead, which is brought to a molten condition and the ore and fuel are then placed so as to float on top of this bed of molten metal in the basin, and banked up against the water back. If a blast is now applied to the tuyers a part of the ore is reduced to a molten state and settles in the basin while the unmolten clinker rises to the top. In the operation of such a hearth, more particularly of the character described in the above patents, the charge of ore and fuel banked against the water back is rabbed so as to turn over and work up the material on the hearth and bring the grey clinker to the surface; this rabbling proceeds from one end to the other of the hearth, and is succeeded by a backing operation which pushes back the rabbled charge against the water back. The clinker is picked off and removed from the hearth for subsequent reduction on a blast furnace. Small quantities of ore and fuel in a ground condition are scattered over the hearth after the charge has been rabbed and pushed back. The operations of rabbling, pushing back the rabbled charge, and distribution of fuel are then again proceeded with. The molten metal will overflow and discharge into molds to form pig lead; and grey clinker is extracted for smelting and the fumes given off during the smelting operation pass upwardly and are caught by the hood whence they pass to the bag house where they are collected, sintered and smelted.

The length of a hearth of the type described in the above patents is limited from a metallurgical standpoint, for a long continuous structure is not sufficiently elastic to permit right control of the temperature, exhaust, rabbling, backing and addition of fuel. Accordingly, the length of the hearth should be proportioned to correspond to the movement of the rabbling and backing devices, and to the period of smelting of the ore to the hearth. As a practical proportion, therefore, a hearth eight feet in length is found to secure the best results.

In Patent No. 1,263,695, rabbling and backing devices are arranged in cooperative relation on a carriage moving along the hearth so as to successively rabble the charge and push back the rabbled charge against the apron; the backing device being arranged alongside of the rabbling device. It is desirable, however, that the charge on the hearth be completely rabbled as well as pushed back from one end of the hearth to the other, for otherwise the material near the ends of the hearth may not receive proper treatment, thereby resulting in loss of efficiency. In a hearth of this type, however, and of limited length, as shown and described in Patent No. 1,388,144, the water back extends forwardly at the ends to provide water jackets at the ends of the hearth. If the backing device is arranged alongside of the rabbling device, so as to follow the same from one end of the hearth to the other, the water back end will interfere with the operation of the backing device, unless the carriage is stopped when the backing device reaches the end; this, however, prevents efficient rabbling of the material charge near that end.

One of the objects of this invention, therefore, is to provide a smelting hearth of the character referred to, whereby the charge of material on the hearth may be rabbed from end to end while still permitting the rabbled charge to be pushed back.

Another object is to provide a smelting hearth having a rabbling device as well as a backing device, operating mechanically and adapted to rabble as well as push back the rabbled charge from end to end of the hearth and without interference with the hearth.

Another object is to provide a hearth of the character described having a backing device which is simple in construction, effective in its action and economical to manufacture.

Further objects will appear from the detail description in which

Figure 1 is a front elevation of a hearth embodying this invention; and

Figure 2 is an end view.

In accordance with one embodiment of this invention the operation of the backing device is controlled so that this backing device remains inactive and even retarded until after the rabbling device has started. This is accomplished in the particular embodiment disclosed by operating the backing device by a separate train of mechanism controlled by a clutch which does not throw the backing device into operation until after the carriage has moved a predetermined...
distance along the hearth. In this way the rabbling device can start at the extreme end of the hearth close up to the forward extension of the water back while the backing device does not come into operation until it passes that forward extension. Means are also provided whereby the operation of the backing device can be at any time interrupted so as to permit pushing back the ruddled charge by hand and independent of the operation of the backing device. A yielding connection is provided between the backing device and its operating mechanism so that the backing device is protected from damage should it strike an obstruction.

The drawings, to the accompanying drawings, the hearth 1 is shown as provided with a basin 2, an apron 3 and a water back 4 having forward extensions 400, 405, 410 and a hoist 10. Standards 20, carry-rails 21 supporting a carriage 22 having wheels 23 and 24 running on the rails which hold the carriage is suspended for movement along the hearth. The wheels 23 are fixed to a shaft 25 having a ratchet 26 engaged by a pawl 27 moving over a shield 82, this pawl being actuated by a link 35 from an eccentric 36 on the shaft 38. This shaft has a gear 39 arranged to be clutched thereon by a clutch 330, and this gear is driven from the motor 45 through a train of gears 40, 43, and 44. The shield 82 is connected with a rock shaft 85 which has an arm 193 provided with a cam roll engaging a cam 105 on one of the rails 21. The rock shaft 86 is further connected by a link 88 with an arm 135 controlling the clutch 930, which is held by a latch 105. A chain 66 connects a sprocket attached to the gear 39 with a sprocket on a shaft 66 connected by bevelled gears with a shaft 73 fixed to the wheels 24; a clutch 96 connects the sprocket with the shaft 86 and is controlled by an operating device 80. A crank disk 50 fixed to the shaft 35 has a crank pin 57 through which passes a rabbling device supported by a fork 60 on the carriage 22.

The parts so far described are substantially as shown and described in Patent No. 1,395,144, to which reference is had for details. Assuming the carriage to be in the position shown in Figure 1, the operator throws the clutch 59 by pulling on 80 thereby causing the carriage to move to the left, the clutch being disengaged, when the rabbling device 58 reaches the end 400 of the water back, by the lug 81; during this return movement the rabbling device is retracted. The operator will then disengage the latch 100 there by engaging the clutch 930 and shifting the shield 82 to permit the pawl 27 to operate on the ratchet 26. The carriage will now be fed step by step to the right (Figure 1) while the rabbling device is operated to rabble the charge on the hearth, the rabbling device being retracted while the carriage is being fed a step. When the rabbling device reaches the other end of the hearth the arm 123 strikes the cam 135 to again shift the shield 82 and disengage the clutch 930.

Attached to the side of the carriage 22 is a carriage 122 for the backing device. Extending along the carriage 22—122 is a shaft 123 having loose thereon a sprocket 124 connected by a chain 125 with a sprocket 126 on the shaft 38, this chain passing over an idler 127. A clutch 128 splined on the shaft 123 is normally held by a spring 129 into engagement. A clutch actuator 130 pivoted on the carriage has a cam roll 131 arranged to ride on a cam 132 on one of the rails 21 when the backing device reaches the forward extension 400 of the water back. The shaft 123 drives a shaft 133 through bevel gears 134 while the shaft 133 in turn drives a shaft 135 through bevel gears 136.

The shaft 123 has fixed thereon a crank disk 137 having a crank pin 138 between the forks of which is pivoted a guide 139 to allding engage the end 140 of the lever pivoted at 141 on the carriage 122. The other end 142 of this lever has pivoted thereon at 143, the backing device carrier 144 which is pivoted at 145 to a link 146 which has pivoted thereon a slide 147 moving in a guide 148 on the carriage 122. The link 146 is forked as shown at 149 to embrace a cam 150 on the shaft 135 which cam is engaged by a cam roll 151 on the slide 147. The backing device proper has a head 152 whose shank 153 slides in the carrier 144 while interposed between the two is a spring 154. This spring bears against a key 155 attached to the shank 153 and moving in a closed slot in the carrier 144 so as to limit the forward movement of the rabbling device while providing a yielding connection.

Assuming that the carriage 22—122 is moved to the left, before the rabbling device reaches the left forward extension 400 of the water back, the cam roll 131 will ride on the cam 132 in order to disengage the clutch 128 while the carriage is permitted to move on until the rabbling device is near that extension. When now the latch 100 is disengaged the carriage will move step by step to the right while the rabbling device operates to rabble the charge on the hearth. As soon as the backing device clears the extension 400 the roll 131 will drop off of the cam 132 so as to throw the backing device into operation. It will be noted however, that the clutch 128 is a simple tooth jaw clutch so as to come into action in one position of the clutch which is driven directly from the same shaft 38 that the rabbling device is driven from. When the backing device, therefore, starts into operation it will start in step with the rabbling device and the transmitting mechanism is so constructed that the backing device follows closely upon the rabbling device; in other words, the backing device moves forward shortly after the rabbling device moves forward. This backing device moves in the path shown in dotted lines in Figure 2 so as to move along the apron and in inclined upward direction in order to push the material against the water back, while the return path is higher so as to clear the bed of material. When the carriage 22—122 reaches the right hand position the clutch 930 is again disengaged while the shield 82 is again shifted to a position to stop the feeding. The cycle can then be repeated.

It will, therefore, be seen that the invention accomplishes its object. By means of the mechanism described the rabbling as well as the backing can be performed in an efficient manner. As the rabbling device moves into and out of the material the grey slag is brought to the surface. The backing device follows closely upon the rabbler and immediately thereafter so as to cover up the charge as the surface will be pushed up towards the water back, but as the backing device returns this slag will roll back upon the apron where it can be removed by the operator. The operator will follow up the backing device picking out the slag and distributing additional ore and fuel over the hearth. Due to the control of the backing device the rabbling can be carried out the full length.
of the hearth and from end to end, while the backing device is not interfered with by the forwardly projecting end of the water back.

While the invention is particularly applicable to the particular type of smelting hearth shown and described, it will be understood that certain features of the invention may be employed without reference to other features and sub-combinations; that is contemplated by it within the scope of the appended claims. It is further obvious that various changes may be made in the structure of construction within the scope of the appended claims, without departing from the spirit of this invention. It is, therefore, to be understood that this invention is not to be limited to the specific details shown and/or described.

Having thus described the invention what is claimed is:

1. A smelting furnace comprising, a hearth adapted to receive molten metal upon which floats the material to be smelted, a carriage mounted for movement along said hearth, a rabling device mounted on said carriage and adapted to rabble the charge on said hearth, a backing device mounted on said carriage and adapted to push back the rabbled charge, means for operating said rabling and backing devices in cooperative relation and means for interrupting the operation of said backing device while said rabling device remains in operation.

2. A smelting furnace comprising, a hearth adapted to receive molten metal upon which floats the material to be smelted, a carriage mounted for movement along said hearth, a rabling device mounted on said carriage and adapted to rabble the charge on said hearth, a backing device mounted on said carriage and adapted to push back the rabbled charge, means for operating said rabling and backing devices in cooperative relation, and means for starting the operation of said backing device after said rabling device has started.

3. A smelting furnace comprising, a hearth adapted to receive molten metal upon which floats the material to be smelted, a carriage mounted for movement along said hearth, a rabling device mounted on said carriage and adapted to rabble the charge on said hearth, a backing device mounted on said carriage and adapted to push back the rabbled charge, means for operating said rabling and backing devices in cooperative relation, and means for interrupting the operation of said backing device while said rabling device remains in operation.

4. A smelting furnace comprising, a hearth adapted to receive molten metal upon which floats the material to be smelted, a carriage mounted for movement along said hearth, a rabling device mounted on said carriage and adapted to rabble the charge on said hearth, a backing device mounted on said carriage and adapted to push back the rabbled charge, means for operating said rabling and backing devices in cooperative relation, and means for interrupting the operation of said backing device while said rabling device remains in operation.

5. A smelting furnace comprising, a hearth adapted to receive molten metal upon which floats the material to be smelted, a carriage mounted for movement along said hearth, a rabling device mounted on said carriage and adapted to rabble the charge on said hearth, a backing device mounted on said carriage and adapted to push back the rabbled charge, means for operating said rabling and backing devices in cooperative relation, and means for interrupting the operation of said backing device while said rabling device remains in operation.

6. A smelting furnace comprising, a hearth adapted to receive molten metal upon which floats the material to be smelted, a carriage mounted for movement along said hearth, a rabling device mounted on said carriage and adapted to rabble the charge on said hearth, a backing device mounted on said carriage and adapted to push back the rabbled charge, means for operating said rabling and backing devices in cooperative relation, and means for interrupting the operation of said backing device while said rabling device remains in operation.

7. A smelting furnace comprising, a hearth adapted to receive molten metal upon which floats the material to be smelted, a carriage mounted for movement along said hearth, a rabling device mounted on said carriage and adapted to rabble the charge on said hearth, a backing device mounted on said carriage and adapted to push back the rabbled charge, means for operating said rabling and backing devices in cooperative relation, and means for interrupting the operation of said backing device while said rabling device remains in operation.

8. A smelting furnace comprising, a hearth adapted to receive molten metal upon which floats the material to be smelted, a carriage mounted for movement along said hearth, a rabling device mounted on said carriage and adapted to rabble the charge on said hearth, a backing device mounted on said carriage and adapted to push back the rabbled charge, means for operating said rabling and backing devices in cooperative relation, and means for interrupting the operation of said backing device while said rabling device remains in operation.

9. A smelting furnace comprising, a hearth adapted to receive molten metal upon which floats the material to be smelted, a carriage mounted for movement along said hearth, a rabling device mounted on said carriage and adapted to rabble the charge on said hearth, a backing device mounted on said carriage and adapted to push back the rabbled charge, means for operating said rabling and backing devices in cooperative relation, and means for interrupting the operation of said backing device while said rabling device remains in operation.

10. A smelting furnace comprising, a hearth adapted to receive molten metal upon which floats the material to be smelted, a carriage mounted for movement along said hearth, a rabling device mounted on said carriage and adapted to rabble the charge on said hearth, a backing device mounted on said carriage and adapted to push back the rabbled charge, means for operating said rabling and backing devices in cooperative relation, and means for interrupting the operation of said backing device while said rabling device remains in operation.
ing said carriage along said hearth, means for operating said backing and rabbling devices in cooperative relation and with said feeding means, and means for suspending the operation of said backing device while said carriage moves a predetermined distance with said rabbling device in operation.

11. A smelting furnace comprising, a hearth adapted to receive molten metal upon which floats the material to be smelted, a carriage mounted for movement along said hearth, a rabbling device mounted on said carriage and adapted to rabble the charge on said hearth, a backing device mounted on said carriage and adapted to push back the rabbled charge, means for feeding said carriage along said hearth, means for operating said backing and rabbling devices in cooperative relation and with said feeding means, and means for holding said backing device retracted while said carriage moves a predetermined distance with said rabbling device in operation.

12. A smelting furnace comprising, a hearth adapted to receive molten metal upon which floats the material to be smelted, a carriage mounted for movement along said hearth, a backing device mounted on said carriage and adapted to push back the charge on said hearth, means for operating said backing device and for feeding said carriage in cooperative relation, and means for starting the operation of said backing device after said carriage has started.

13. A smelting furnace comprising, a hearth adapted to receive molten metal upon which floats the material to be smelted, a water back extending forwardly at the end of said hearth, a carriage mounted for movement along said hearth, a rabbling device mounted on said carriage and adapted to rabble the charge on said hearth, a backing device mounted on said carriage alongside of said rabbling device and adapted to follow said rabbling device to push back the rabbled charge, and means for operating said rabbling and backing devices in cooperative relation to rabble the charge on said hearth from end to end without interfering with the ends of said water back.

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