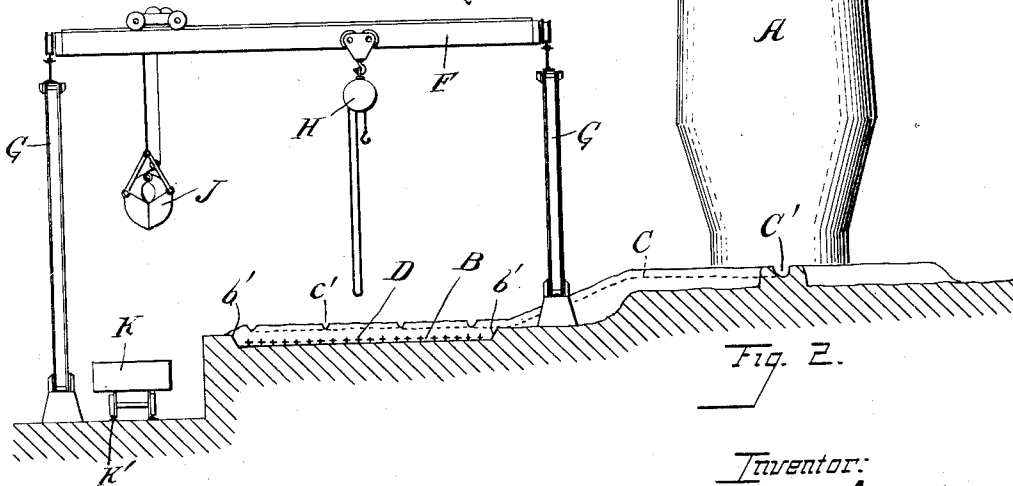
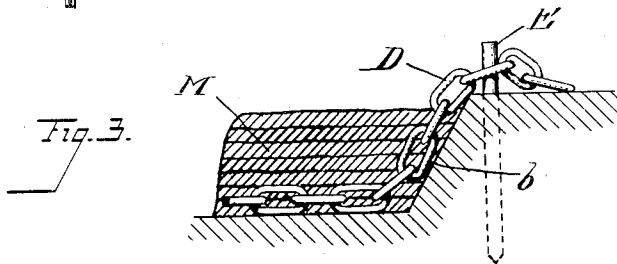
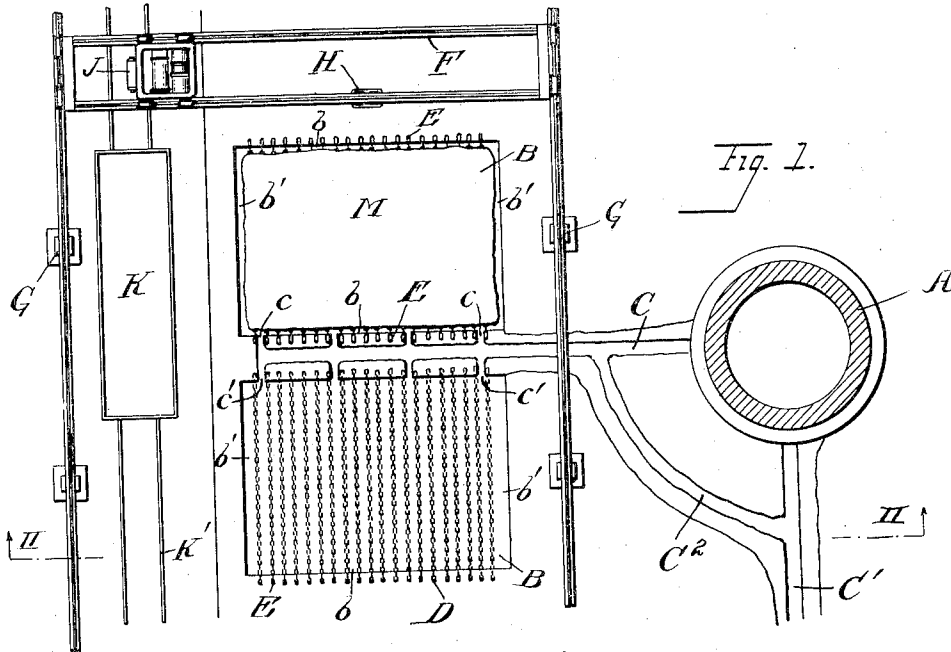


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METHOD OF AND APPARATUS FOR HANDLING SLAG AND SIMILAR FRIABLE MATERIAL.
APPLICATION FILED JUNE 23, 1911

1,056,632.

Patented Mar. 18, 1913.

2 SHEETS—SHEET 1.



Witnesses:
Herman Esch
Winifred Fleming

Inventor:
David T. Croxton
by *W. Merkel*
his Attorney.

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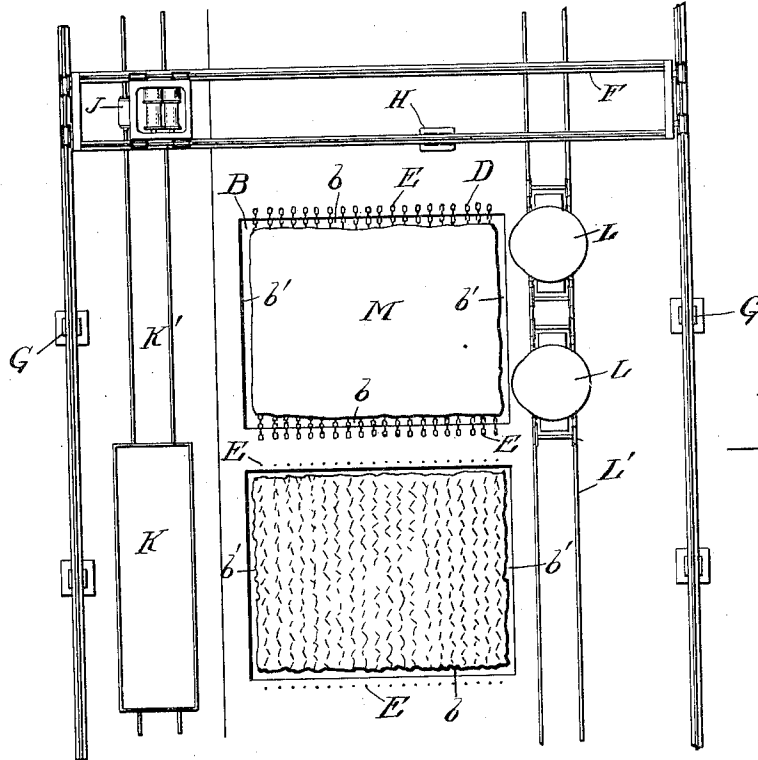


Fig. 4.

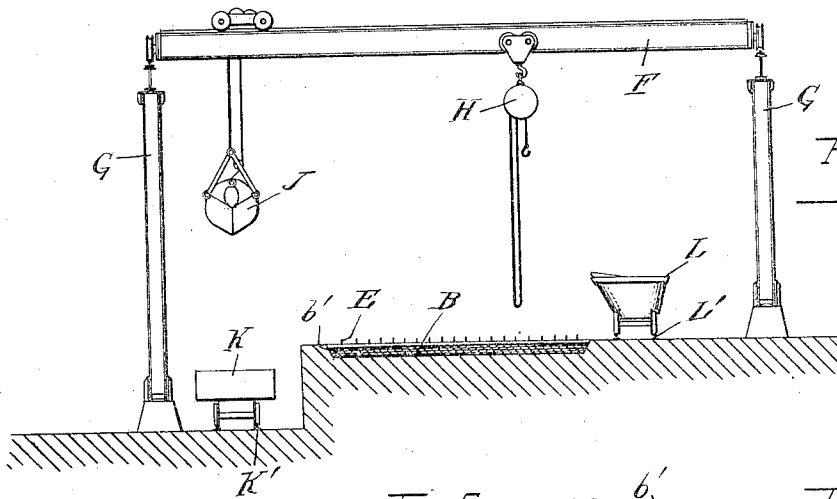
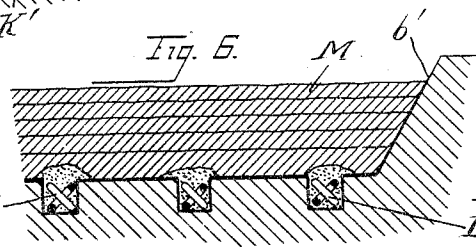


Fig. 5.

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UNITED STATES PATENT OFFICE.

DAVID T. CROXTON, OF CLEVELAND, OHIO.

METHOD OF AND APPARATUS FOR HANDLING SLAG AND SIMILAR FRIABLE MATERIAL.

1,056,632.

Specification of Letters Patent.

Patented Mar. 18, 1913.

Application filed June 23, 1911. Serial No. 635,003.

To all whom it may concern:

Be it known that I, DAVID T. CROXTON, a citizen of the United States, resident of Cleveland, county of Cuyahoga, and State of Ohio, have invented a new and useful Improvement in Methods of and Apparatus for Handling Slag and Similar Friable Material, of which the following is a specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle, so as to distinguish it from other inventions.

My invention relates to methods of and apparatus for handling blast furnace slag and similar friable material, its object being to effect such handling in an efficient and economical manner.

The said invention consists of a method and apparatus hereinafter fully described and particularly pointed out in the claims.

It is customary at the present time to dispose of blast furnace slag in any one of the following three ways: The first of such ways is to run the molten slag directly from the furnace into ladle-cars on suitable tracks, pull these cars by means of locomotives or other suitable means, out to a dump, and pour the slag out upon the latter. The second method is to run the molten slag directly from the furnace into a well of water, whereby such slag is turned into a granular form, after which it is removed by means of a grab-bucket, loaded on to cars, and hauled out and dumped at a suitable location. The third method is to run the molten slag out from the furnace into long, narrow and shallow individual runs or runways, in which such slag is allowed to cool, after which it is broken up by hand and loaded by hand into cars and hauled away. It is nearly always desirable to save this slag and convert it into a form in which it may be, after crushing and screening, advantageously used as railroad ballast, road ballast, or as an aggregate for concrete. To make the slag available for these purposes, it is necessary to handle same at a certain minimum cost, and also to have the slag retain certain qualities of hardness to make it suitable for use for these purposes.

When the slag is handled in the first above-described manner, it forms a hard mass on the dump which cannot be removed except by blasting or by means of a steam shovel. This process is so expensive that the

cost thereof renders it impractical in some locations to use this slag for ballast or concrete aggregate, and it is therefore in such cases allowed to remain on the dump and become absolute waste. The second of the above-named methods of handling slag produces a soft granular substance, which has no value as concrete aggregate, or as road or railroad ballast, and is also therefore converted into absolute waste. The third of the above-described methods also, in addition to involving a comparatively high cost of handling, produces a soft material unsuitable for any one of the above-named purposes.

The specific objects of my invention are, to handle the slag in a manner such that the expense involved therein will not be such as to preclude the practicability of the use of the slag as ballast or concrete aggregate, and at the same time to retain in the slag the physical qualification of hardness which is required to make it practical for use as such ballast or aggregate.

Incidentally to the above-named object of reduction of cost, a further specific object is to do away with the use of slag-ladles, thereby eliminating the expense incident to the wear and tear upon such ladles primarily due to the expansion and contraction of the metal parts owing to the excessive variations of temperature incident to their use; and to eliminate a further part of the expense of such handling by cheapening the method of disintegrating the slag after it has been formed upon cooling into an integral hardened mass.

The annexed drawings and the following description set forth in detail certain means for carrying out my invention, the disclosed means, however, constituting but one of various forms in which the principle of my invention may be employed.

In said annexed drawings:—Figure 1 is a plan of a blast furnace plant arranged in accordance with my invention, one slag bed being shown filled and the other unfilled. Fig. 2 is a vertical section, taken upon line II—II of Fig. 1. Fig. 3 is a fragmentary detail section, upon an enlarged scale, of a slag bed and tension-member therein, arranged in accordance with my invention. Fig. 4 is a plan of a modified arrangement of plant embodying my invention. Fig. 5 is a vertical section of the modification shown in Fig. 4. Fig. 6 is a fragmentary detail section upon an enlarged scale, of a modified

arrangement of slag bed embodying my invention.

Referring first to the embodiment of my invention as illustrated in Figs. 1 and 2, A represents a blast furnace of the ordinary, accepted type. Adjacent to this furnace are formed one or more slag beds B, two being shown in the drawing. These beds are usually made by forming depressions in the soil, as shown in Fig. 2, the soil at the sides *b b* and ends *b' b'* forming the walls of the bed, as will be readily understood. A suitable flushing runner C leads from the furnace, and by means of a plurality of branches *c c c' c'* permits the slag to be discharged into these beds, it being customary to dam up the set of branches leading into one bed while the other branches are open, so as to divert the slag into one or the other of the beds, as may be required. This flushing runner C is ordinarily connected also with the iron runner C' by means of the roughing runner C², whereby the slag skimmed off the top of the iron may also be diverted into the slag beds, as will be readily understood by those skilled in the art. Placed in these beds are a plurality of tension-members D, flexible, and preferably consisting of chains of suitable strength, as shown in Fig. 1. These chains extend from one side to the other of the bed, lie upon the bottom, and are of a length sufficient to project upwardly and out over the ends of the beds, as shown in Fig. 3. These ends are held in place by slipping one of the links of such ends over pins E E, driven into the earth adjacent to the walls of the bed, a suitable number of pins being provided so that the two ends of each tension-member may be so secured. These pins are preferably placed equi-distant from each other, so that the chains may lie parallel with each other and impart to said chains a fixed relationship longitudinally with reference thereto of a character such as will suffice to hold such chains within the bed in the proper manner during the pouring operation whereby said chains may, as will hereafter be described, become embedded in the mass of slag. The bed having been so prepared, and the chains placed as above described, slag may now be run into same from the furnace, by which action the tension-members or chains, held in place by the pins E E, become covered with the mass M of slag or embedded therein, as shown in Fig. 3, it being preferable to have the tension-members of sufficient length to permit them to lie flat upon the bottom of the bed, as shown, so that they will become embedded in the bottom of the slag mass. The size of the bed, both as to horizontal dimensions and as to depth, is preferably such that it may contain the slag produced by the furnace in twenty-four hours. These runs of slag are made at the usual intervals,

as will be readily understood by those skilled in the art, and the slag would, therefore, incidentally exist in the slag bed in the form of layers, as indicated in Fig. 3 of the drawing.

After the slag bed has received its quota of slag, that is, the product of a twenty-four run, it is permitted to cool sufficiently, that is, for a period of about two hours, whereupon it becomes friable, and may be handled as hereinafter described. After this cooling operation, one end of each chain in succession is grasped by means of a suitable lifting device, lifted off its detaining pin E, and raised upwardly so as to become detached from the slag mass. This lifting of one end of the chain causes the latter to rip through such mass, and all the slag adjacent thereto to be broken up and detached therefrom. This breaking action is facilitated by the fact that the tension-member or chain is flexible in its character. This flexibility permits the power to always be applied entirely to that portion of the slag mass from which the chain projects, permitting the great bulk of the slag mass to resist any tendency which it might have to lift up completely with the chain. This being the case, that portion of the slag mass from which the chain projects, receives the entire strain effected by the pulling operation, and therefore readily breaks off and disintegrates. After each chain has been so raised and separated from the slag, the entire mass of the latter will rest in the bed in a broken or disintegrated state, after which it is removed by any suitable hoisting and conveying apparatus.

As illustrative of one form of device for lifting the tension-members and removing the slag, I have shown an overhead crane F supported upon suitable pillars G placed laterally of the beds. This crane is provided with a hoist H traveling upon the girder of the crane, and a grab-bucket J of suitable dimensions, also traveling upon the latter. By means of the hoist H, it will be seen that the ends of the chains may be attached to the hoist's hook and lifted as above described. After this lifting operation has been completed, the grab-bucket J is operated to scoop up the broken slag and deposit it in the cars K running upon a suitable track K' placed adjacent to the bed and below the crane, as will be readily understood.

In Figs. 4 and 5, I have illustrated an arrangement wherein the slag, instead of being run directly from the furnace into the beds, is first run into ladle-cars L running along a track L' placed adjacent to the beds upon the side opposite that upon which is placed the track K'. In this modified arrangement of plant, it will be, of course, understood that the principal economy of

operation resides in the method of breaking up the slag after it has hardened, the use of the ladles being similar to that heretofore employed, and would only be used in such plants as would not provide sufficient room for placing the beds adjacent to the furnace, as first above described.

A further modification may be resorted to, as illustrated in Fig. 6, in which the bottom of the bed is provided with parallel grooves in which the chains are caused to lie, and covered with sand, as indicated in such drawing, to protect them from any deteriorating action of the heat of the molten mass. Where the chains are covered with sand, they would of course, not become embedded in the slag, but in operating the device they would be pulled up through the mass of slag in the same manner as hereinbefore described.

Having fully described my invention, what I claim and desire to secure by Letters Patent is:—

1. The method of handling slag or other similar friable material, which consists in pouring molten slag over a flexible tension member, and then pulling such member up through such slag, whereby the latter is disintegrated.
2. The method of handling slag or other similar friable material, which consists in pouring molten slag over a plurality of flexible tension-members, and then pulling the latter up through said slag, whereby the latter is disintegrated.
3. The method of handling slag or other similar friable material, which consists in embedding a flexible tension-member in the molten slag while such member is stationary, and then separating such member and slag, whereby the latter is disintegrated.
4. The method of handling slag or other similar friable material, which consists in embedding a flexible tension-member in the molten slag while such member is stationary, allowing the slag to cool, and then withdrawing such member from such slag, whereby the latter is disintegrated.
5. The method of handling slag or other similar friable material, which consists in placing a tension-device on a bed adapted to receive molten slag; pouring such molten slag upon such member and leaving the ends of same exposed; allowing such slag to cool; and then lifting such tension member from the slag by means of a lifting device attached to one of such exposed ends.
6. The method of handling slag or other similar friable material, which consists in placing a tension-member on a bed adapted to receive molten slag; fixing the ends of such tension device; pouring the molten slag upon such members and leaving such ends exposed; allowing such slag to cool; and then lifting the tension member from the

slag by means of a lifting device attached to one of such exposed ends.

7. The method of handling slag or other similar friable material, which consists in placing a plurality of tension members on a bed adapted to receive molten slag; fixing the ends of such tension members; pouring molten slag over such members and leaving such fixed ends exposed; allowing such slag to cool; and then lifting each of such members from the slag by means of a lifting device attached to one of its exposed ends.

8. The method of handling slag or other similar friable material, which consists in placing a flexible tension-member on a bed adapted to receive molten slag; pouring such molten slag onto such bed; allowing such slag to cool; then lifting said member from the slag, whereby the latter is disintegrated.

9. The method of handling slag or other similar friable material, which consists in placing a plurality of flexible tension-members on a bed adapted to receive molten slag; pouring such molten slag upon portions of such tension-members; allowing such slag to cool; and then lifting the latter from such slag by means of a lifting device attached to the exposed portions of such members.

10. The method of handling slag or other similar friable material, which consists in laying a flexible tension-member on the bottom of a bed adapted to receive molten slag; pouring such molten slag upon such member, leaving one of its ends exposed; allowing the slag to cool; and then lifting such member from the slag by means of a lifting device attached to such exposed end.

11. In apparatus for handling slag or other similar friable material, the combination of a receptacle or bed for receiving the molten slag; a tension member lying in such receptacle or bed; and means for holding such tension member in fixed relationship longitudinally with reference thereto.

12. In apparatus for handling slag or other similar friable material, the combination of a receptacle or bed for receiving the molten slag; a flexible tension member lying in such receptacle or bed; and means for holding such tension member in fixed relationship longitudinally with reference to said member.

13. In apparatus for handling slag or other similar friable material, a combination of a receptacle or bed adapted to receive the molten slag; a flexible tension member lying in such receptacle or bed, and having a portion thereof placed in such receptacle or bed, and a portion so placed as to be exposed after the molten metal is poured therein; and means for holding such tension member in fixed relationship longitudinally with reference to said member.

14. In apparatus for handling slag or other similar friable material, the combination of a bed adapted to receive molten slag; a tension-member placed in said bed and having one end projecting out of same; and means for fixing such projecting end.

15. In apparatus for handling slag or other similar friable material, the combination of a bed adapted to receive molten slag; a tension-member placed in said bed and having both its ends projecting therefrom; and means for fixing said ends.

16. In apparatus for handling slag or other similar friable material, the combination of a receptacle or bed adapted to receive the molten slag; a plurality of tension members lying in such receptacle or bed; and means for holding such tension members in fixed relationship longitudinally with reference thereto.

17. In apparatus for handling slag or other similar friable material, the combination of a receptacle or bed for receiving the molten slag; a plurality of flexible tension members lying in such receptacle or bed; and means for holding such tension members in fixed relationship longitudinally with reference thereto.

18. In apparatus for handling slag or other similar friable material, the combination of a receptacle or bed for receiving the molten slag; a plurality of tension members lying in said receptacle or bed, each having a portion thereof placed in the latter, and a portion thereof so placed as to be exposed after the molten metal is poured into same; and means for holding such tension members in fixed relationship longitudinally with reference thereto.

19. In apparatus for handling slag or other similar friable material; the combination

of a receptacle or bed for receiving the molten slag; a plurality of flexible tension members, each lying in said receptacle or bed, and placed so as to have one end projecting out of same; and means for holding such tension members in fixed relationship longitudinally with reference thereto.

20. In apparatus for handling slag or other similar friable material, the combination with a bed adapted to receive molten slag; of a plurality of tension members, each placed in said bed and having one end projecting out of same; and means for fixing such projecting end.

21. In apparatus for handling slag or other similar friable material, the combination with a bed adapted to receive molten slag; of a plurality of tension members each placed in said bed and having both its ends projecting therefrom; and means for fixing said ends.

22. In apparatus for handling slag or other similar friable material, the combination with a bed adapted to receive molten slag; of a plurality of flexible tension members, each placed in said bed and having one end projecting out of same; and means for fixing such projecting end.

23. In apparatus for handling slag or other similar friable material, the combination with a bed adapted to receive molten slag; of a plurality of flexible tension members, each placed in said bed and having both its ends projecting therefrom; and means for fixing said ends.

Signed by me, this 21st day of June, 1911.

DAVID T. CROXTON.

Attested by—
COURT B. MUELLER,
A. E. MERKEL.