C. L. MOWRY AND C. L. DUDLEY.

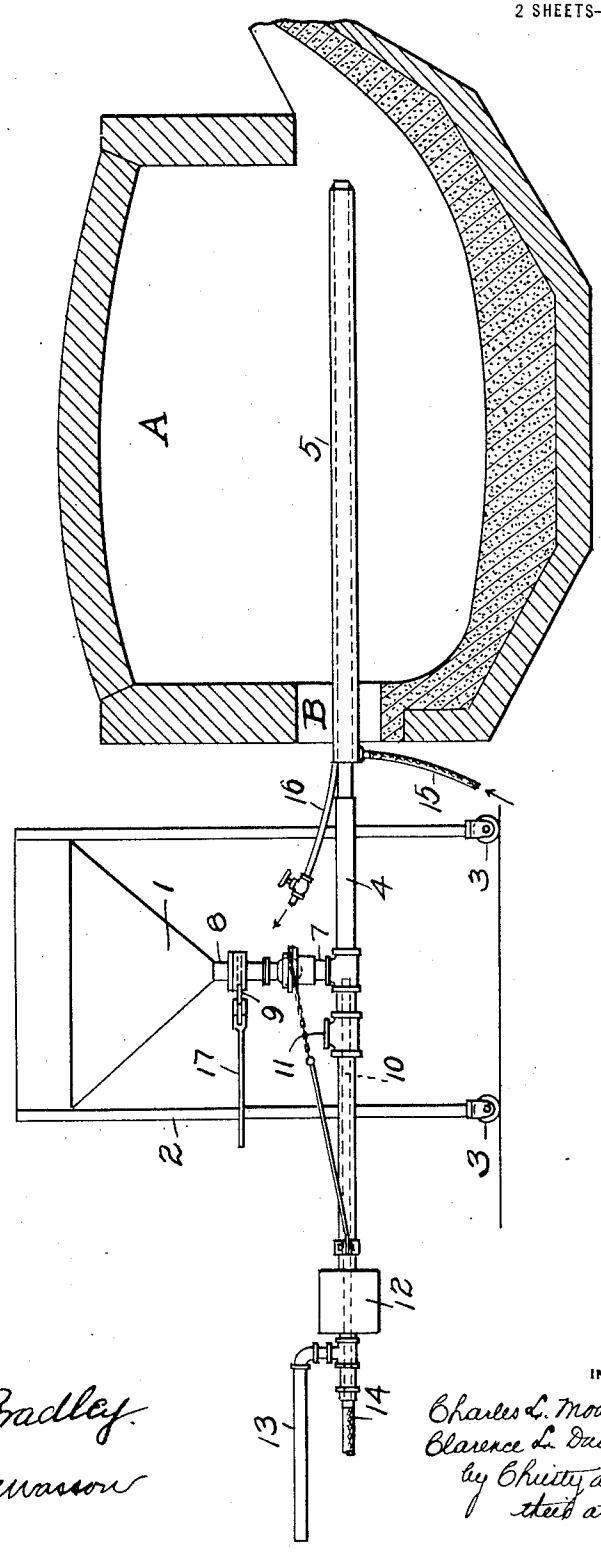
APPARATUS FOR REPAIRING FURNACE LININGS.

APPLICATION FILED APR. 6, 1920.

1,363,610. Patented Dec. 28, 1920.

2 SHEETS—SHEET 1.

FIG. 1.



WITNESSES

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2 SHEETS—SHEET 2.

FIG. II.

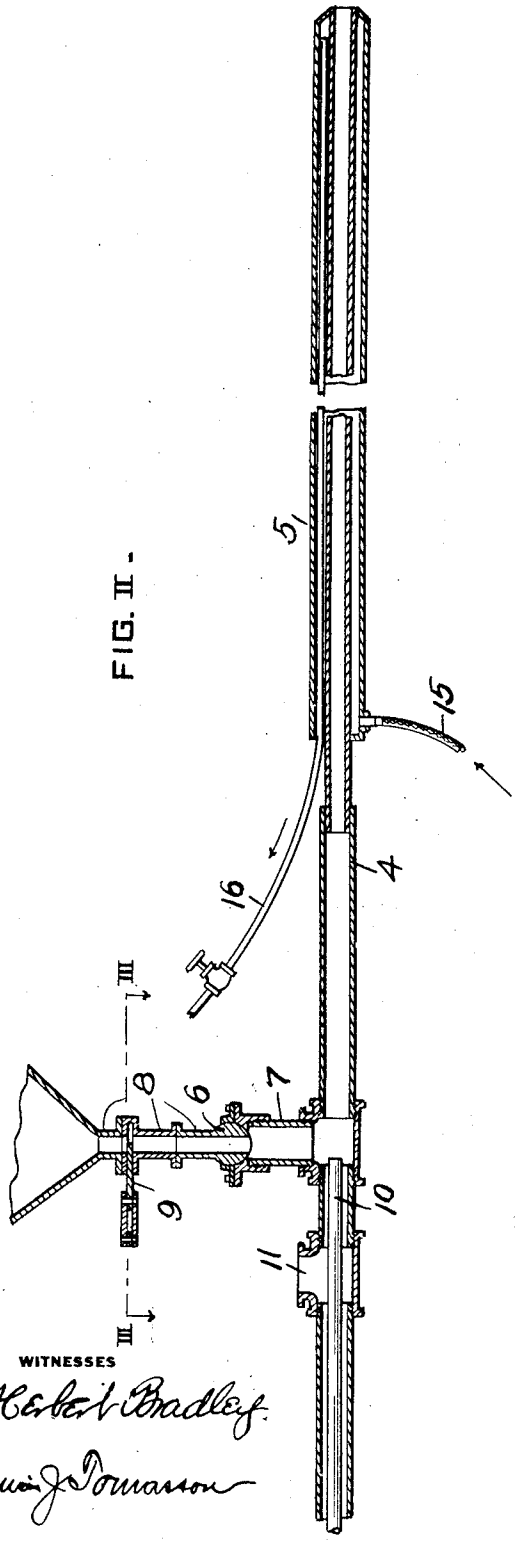
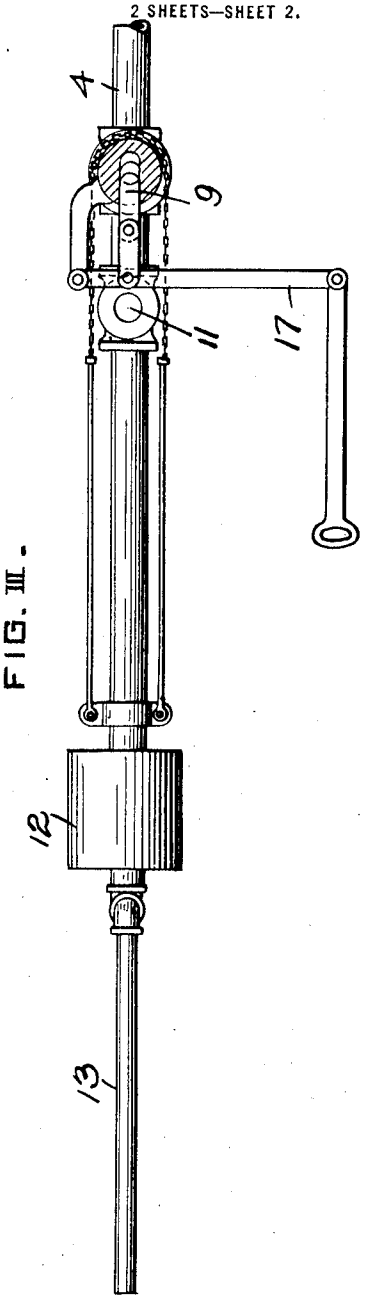


FIG. III.



WITNESSES

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR REPAIRING FURNACE-LININGS.

1,363,610. Specification of Letters Patent. Patented Dec. 28, 1920.

Application filed April 6, 1920. Serial No. 371,687.

To all whom it may concern:

Be it known that we, CHARLES L. MOWRY and CLARENCE L. DUDLEY, residing at Woodlawn, in the county of Beaver and State of Pennsylvania, both citizens of the United States, have invented or discovered certain new and useful Improvements in Apparatus for Repairing Furnace-Linings, of which improvements the following is a specification.

Our invention has to do with means for impelling broken material in bulk; we have developed the invention as an adjunct to an open-hearth furnace for smelting steel, but manifestly it is not limited to such specific use.

In the operation of open-hearth furnaces, and particularly those of basic type, the reactions which occur involve the gradual eating away of the furnace lining. Although the lining or hearth material of the furnace is carefully measured and spread before the furnace is charged and heated, still this initial body of material is often, in the progress of the operation, so far eaten away as to threaten destruction of the more permanent portions of the furnace structure, and impairment of the quality of the metal under treatment. The chemical attack of the molten charge upon the material which composes the lining is most violent along the margin of the bath or pool of molten metal. In the course of operation as commonly practised it is requisite for men to be at all times ready, and, when the consumption of the basic material has at any point advanced too far, to apply new quantities of material at the danger point. Such application is made by throwing the material from a shovel through the furnace door to the proper point along the margin of the pool of molten metal which forms the bath or furnace charge. And, since furnaces of this sort measure as much as fourteen feet across, there is required of the men tending the furnace not only a considerable degree of strength and skill, but also, in view of the extremely high temperature of the furnace, great physical endurance as well.

Mechanical conveyers of one sort and another have heretofore been proposed, to take the place of these skilled workmen; but, so far as we know, none of them has met with any enduring or extended success.

We have devised a mechanical conveyer and carried it to the point of success, and in its novel features of structure our present invention resides.

In the accompanying drawings Figure I is a view in vertical and transverse section through an open-hearth furnace, in the line of door and spout, showing in side elevation conveyer apparatus of our invention; Fig. II is a view in longitudinal and vertical section and to larger scale of a portion of the conveyer apparatus shown in Fig. I; and Fig. III is a view in horizontal section, on the plane indicated by the line III—III, Fig. II.

Our conveyer is a "gun," in the sense that it shoots the material through a tube or barrel to the point where application is desired. The motive power is fluid under pressure; it might for example be steam, but is preferably compressed air.

An open-hearth furnace is indicated at A. A hopper 1 is suitably mounted to be conveyed to position opposite the furnace door B. Any convenient method of support may be resorted to; we show the hopper carried in a frame 2 which is movable upon rollers 3 across the floor adjacent the furnace.

The gun itself consists in a long tube or barrel 4, water-jacketed as indicated at 5 in well-known manner through so much of its extent as in operation is exposed to the intense heat of the furnace. It is of sufficient length to extend through the furnace door and across the furnace chamber to a point so related to the margin of the pool of metal which within the chamber constitutes the furnace charge that the stream of material ejected from the muzzle of the gun will fall upon the bank of the pool at or just above the margin of metal, where erosion is greatest.

This gun is carried by the hopper 1, and is through a lateral pipe-connection 7 pivoted or swiveled, preferably by the universal joint indicated at 6 to the pipe 8 which constitutes a spout, or prolongation of the throat of the hopper. The support constitutes an open passageway, through which material from the hopper descends by gravity and enters the bore of the gun. This is fully and clearly indicated in Fig. II. A shutter 9 may be provided, to cut off at will or to control the effective area of the passageway (*cf.* Fig. III).

Into the bore of the gun, and in the direction toward its delivery end or muzzle, and preferably at a point adjacent the en-

trance of material from hopper 1, is projected through a nozzle 10 a jet of fluid, conveniently air under relatively high pressure—100 pounds to the square inch, or thereabout. This nozzle is fed through a pipe which enters the bore of the gun axially from the rear, as indicated in Fig. I.

Rearward of nozzle 10, and of the point in the length of the gun barrel where the material enters from hopper 1, is arranged a breach or opening 11, of relatively large size, through which there is free flow of air to the bore of the gun.

The rear end of the gun, rearward of the point of support, is of convenient length; it may be counterweighted, as indicated at 12, so that the whole structure is well balanced in its support from joint 6, and a handle 13 may be provided, for convenience in turning and tipping. The air connection 14, and the water connections 15 and 16 for the water jacket, are flexible, as indicated. A lever 17 is provided, with a handle, for manipulating shutter 9.

Operation is simple. The apparatus is brought to position, with the muzzle of the gun extending through the door of a furnace a sufficient distance (to be determined by experience), as is indicated in Fig. I. It will be understood that under service conditions a pool of molten metal will be resting on the hearth of the furnace, and at the time of introduction water will be circulating in the water jacket of the gun. The passageway from the hopper 1 being then open, the compressed air supply is, by a control valve (not shown) admitted through connection 14 to blow in a strong jet from nozzle 10. This inblown jet of air sucks additional quantities of air through opening 11, and the result is a strong-flowing stream of air sweeping through the bore of the gun and across the point of entrance of material from hopper 1—which material, as has been said, descends by gravity through passageway 8, 7 into the gun bore. The stream of air sweeping forward carries with it this solid material and delivers it in a stream from the muzzle of the gun. It will be understood that in a proper control of the air supply, the slide or shutter 9, the ball-and-socket joint 6 with the provision for manual swinging found in handle 13, there are all the factors necessary to direct a stream of material and deliver it to the desired point through a considerable range. In addition, the movement of the frame upon its rollers 3 across the floor will afford further means for accurately directing the stream of material to the desired point of delivery. But ordinarily, the movement of the frame is resorted to, only to carry the gun from one furnace door to another; there is, in the remaining adjustments mentioned, sufficient flexibility to bring the stream to the point desired on the farther shore of the pool of metal, and shoveling will suffice for the repair of the proximate shore. However, it will be understood that the possibilities are there, and the apparatus may be made as easy of movement over as wide ranges as may be desired.

The showing afforded in the drawings is exemplary: in the ensuing claims we define what is of the essence of our invention; for the rest, variation within the knowledge of the engineer is permissible, and expected.

We claim as our invention:

1. A gun for impelling broken material in bulk, consisting of a barrel, a passageway for material opening transversely into said barrel, a fluid jet directed longitudinally of said barrel from a point adjacent the opening of said passageway, and an air induction port opening to said barrel rearward of the opening of said passageway, substantially as described.

2. In apparatus for impelling broken material in bulk, the combination of a frame, a hopper carried in said frame, and a gun pivotally carried by said hopper, into which gun said hopper opens, substantially as described.

3. In apparatus for impelling broken material in bulk, the combination of a frame, a hopper carried in said frame, a gun carried by said hopper by a universal joint, a passageway from said hopper to the barrel of said gun, a forwardly directed fluid nozzle arranged in the barrel of said gun, and an air port in the barrel of said gun rearward of the point where said passageway enters said gun barrel, substantially as described.

In testimony whereof we have hereunto set our hands.

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Witnesses:
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