No. 810,865.

PATENTED JAN. 23, 1906.

F. K. HOOVER & A. J. MASON.

METHOD OF CHILLING CINDER OR SLAG.

APPLICATION FILED AUG. 31, 1903.

4 SHEETS—SHEET 1.

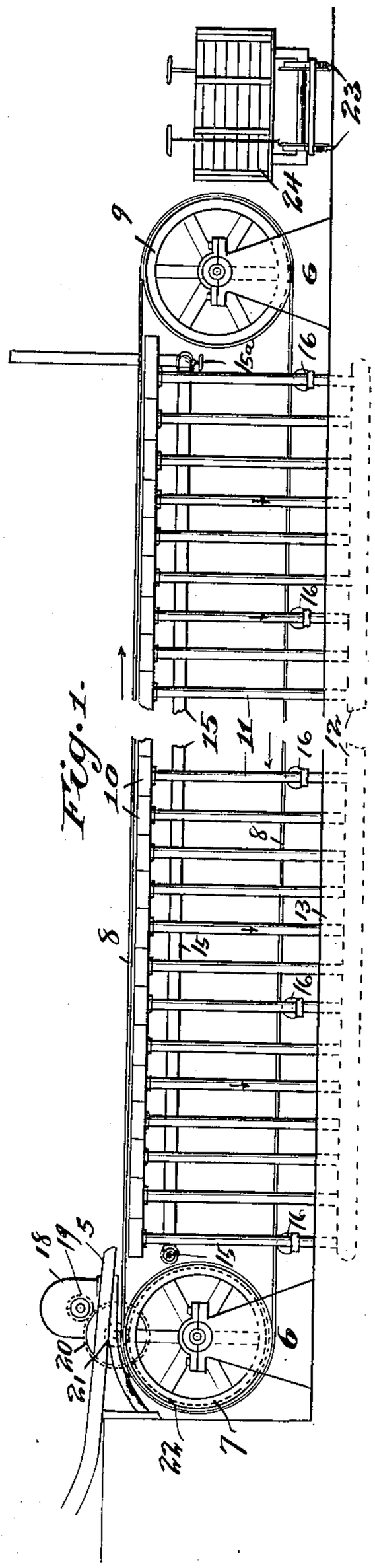

Fig. 1.

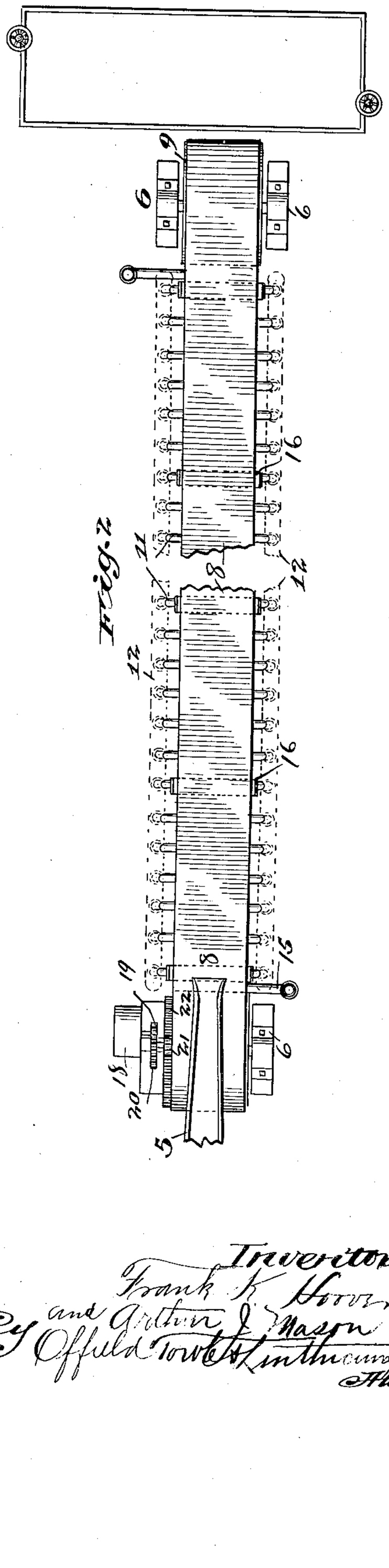

Fig. 2.

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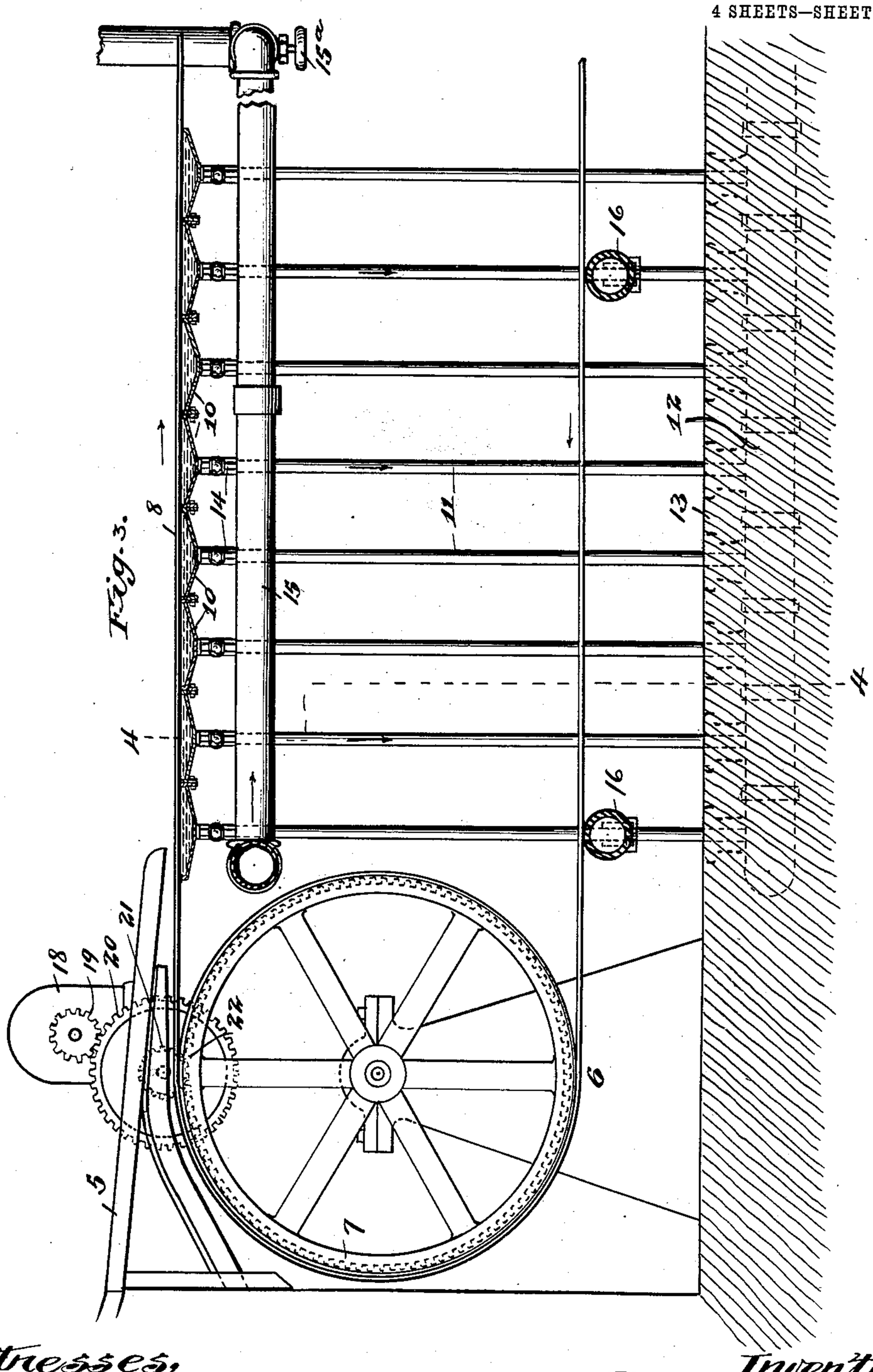
4 SHEETS—SHEET 2.

Fig. 3.



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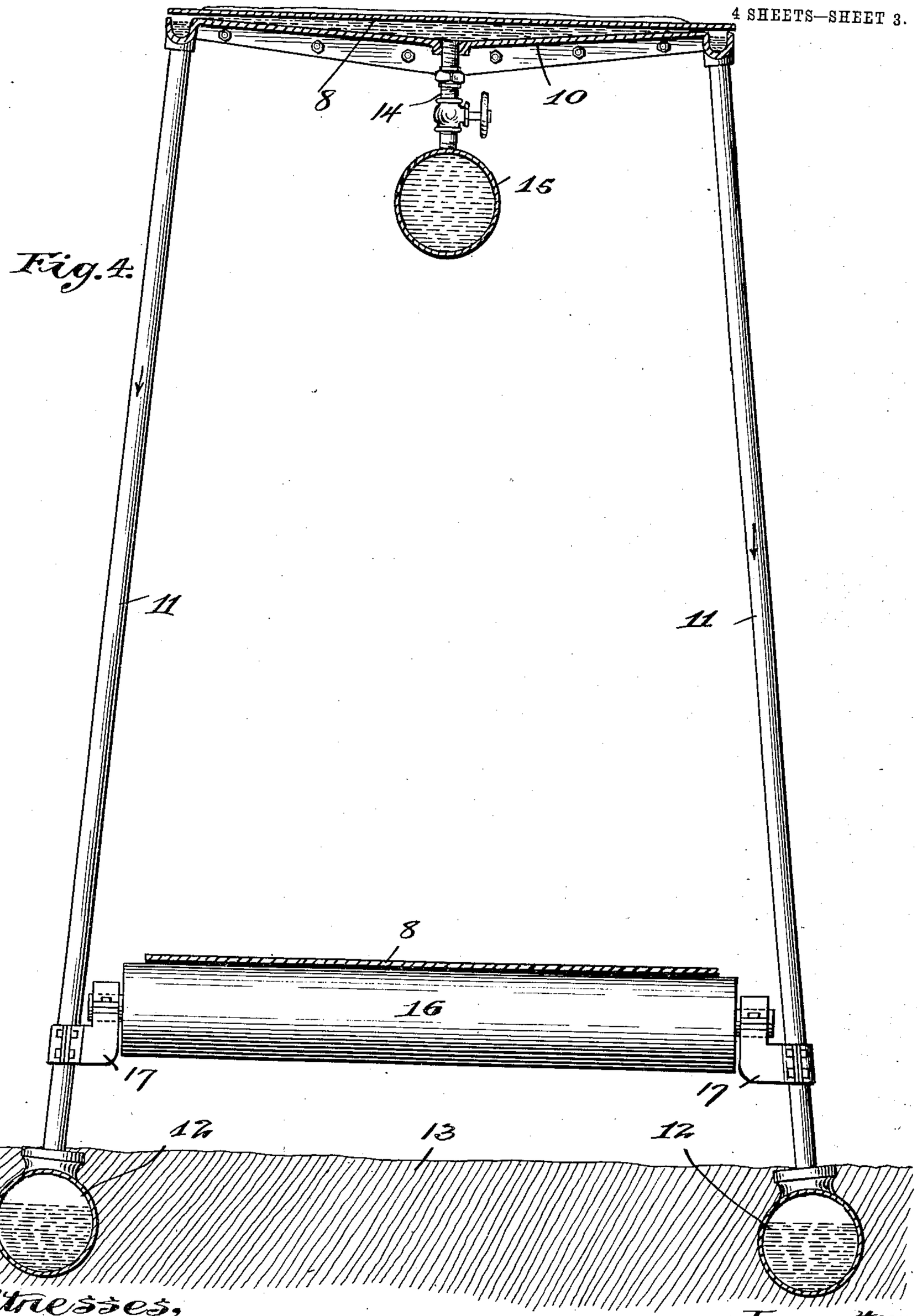
4 SHEETS—SHEET 3.

Fig. 4.



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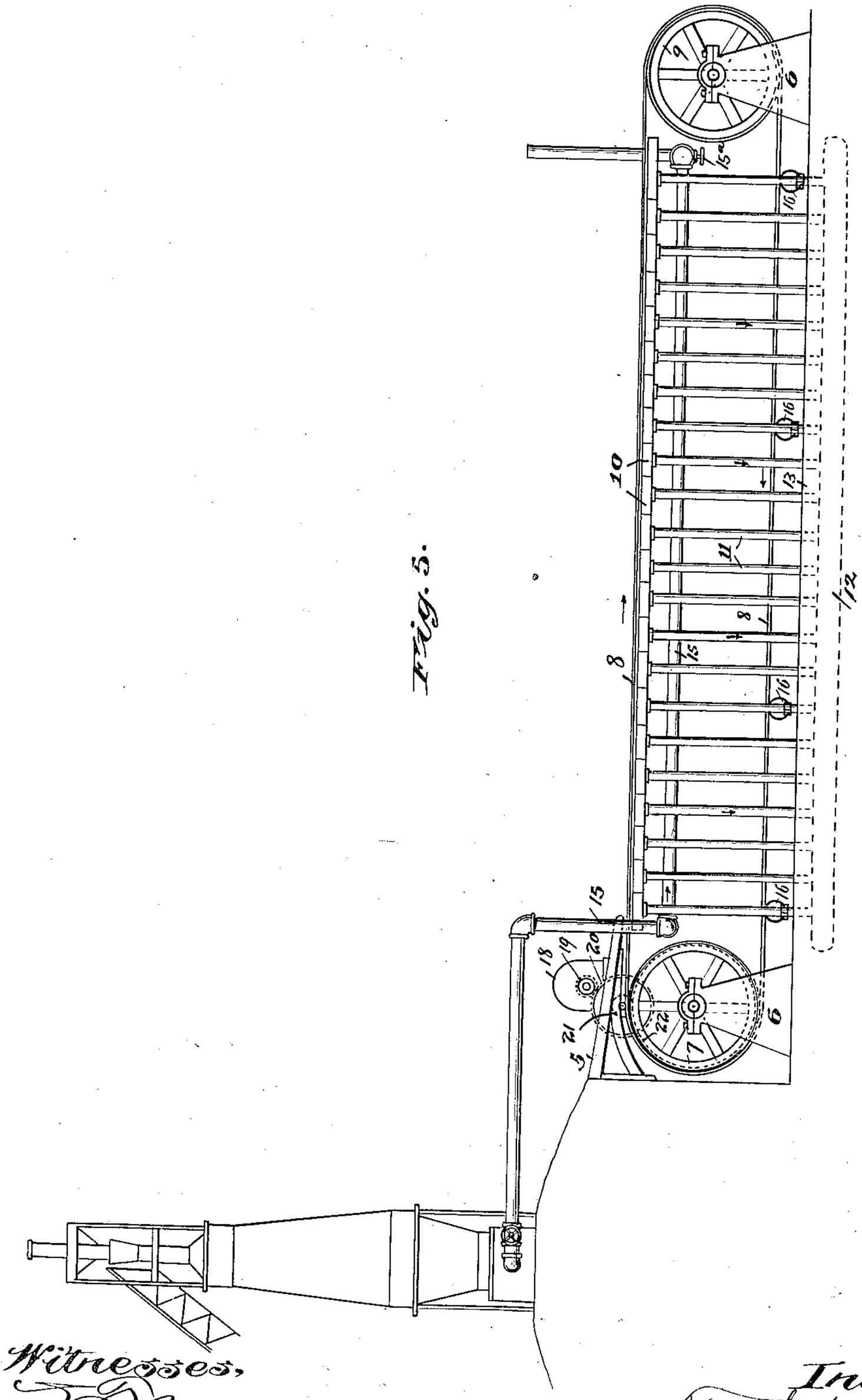
4 SHEETS—SHEET 4.

Fig. 5.



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UNITED STATES PATENT OFFICE.

FRANK K. HOOVER AND ARTHUR J. MASON, OF CHICAGO, ILLINOIS.

METHOD OF CHILLING CINDER OR SLAG.

No. 810,865. Specification of Letters Patent. Patented Jan. 23, 1906.

Application filed August 31, 1903. Serial No. 171,409.

To all whom it may concern:

Be it known that we, FRANK K. HOOVER and ARTHUR J. MASON, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Method of Chilling Cinder or Slag for Use in Connection with Blast-Furnaces, of which the following is a specification.

Our invention relates to a novel method or process of chilling and disposing of the cinder or slag discharged as waste from iron-furnaces and for rendering the same suitable for various subsequent uses, such as for railroad-ballast.

The cinder or slag discharged from iron-furnaces and disposed of under the method at present in vogue requires a long time for cooling, and in the case of the method of cooling by the direct application of streams of cold water thereagainst the cinder or slag is given a peculiar spongy character, which produces such a ratio between its volume and specific gravity as destroys its usefulness for the purpose of railroad and other ballast, and hence under present methods this cinder or slag becomes worse than waste material by reason of the large amount of space of more or less valuable land required for its final disposition. Our present invention contemplates a new and improved method of treating and disposing of this by-product of blast-furnaces, which not only obviates the objections last referred to with reference to the transportation and final disposition of the material, but also produces therefrom a material excellently adapted for use as ballast by reason of its increased density and specific gravity.

Briefly described, our novel method of treating this material consists, essentially, in pouring the same in the form of a comparatively thin sheet upon a flat impervious heat-conducting surface, to the under side of which latter is applied under hydrostatic pressure a continuously-renewed cooling agent, which rapidly abstracts the heat from the thin sheet of slag through the intermediate heat-conducting support of the latter. Preferably our present invention also contemplates the imparting of a traveling movement to the slag away from its point of discharge, the primary object of which is to introduce a sufficient time element into the process to insure a sufficient cooling of the slag to enable it to be safely loaded into railway-cars or other carriers.

Our novel method is capable of being carried out by a variety of devices; but in order to enable the same to be more readily understood we have illustrated in the accompanying drawings a form of apparatus which we have devised and found excellently adapted for the performance of our improved chilling process and wherein we may advantageously and economically utilize the waste cooling-water discharged from the jacket of the furnace, and referring thereto—

Figure 1 is a side elevation of the complete mechanism, showing at the discharging end thereof a railway-car adapted to receive the discharge from the belt. Fig. 2 is a top plan view of the mechanism shown in Fig. 1. Fig. 3 is a side elevational view, on an enlarged scale, of the inner or receiving end of the belt and its driving, supporting, and other coöperating devices; and Fig. 4 is a cross-sectional view, still further enlarged, on the line 4 4 of Fig. 3. Fig. 5 shows connection of chilling apparatus with furnace.

In the drawings, 5 designates the lower or discharging end of the usual trough or runner through which the liquid slag is allowed to run off from the discharge-ports of the furnace. Directly beneath the overhanging end of this runner is rotatably mounted on suitable standards 6 a large broad pulley 7, carrying the inner end of an endless thin sheet-steel belt 8, the opposite end of which is carried by a similar pulley 9, similarly supported at the outer or discharging end of the apparatus. Directly beneath the upper section of this endless belt are arranged a series of shallow pans 10, supported at their outer edges upon the upper ends of a corresponding series of downwardly-divergent tubes or pipes 11, the lower ends of which latter are tapped into a pair of sewer-pipes 12, Fig. 4, disposed longitudinally of the belt and preferably embedded in the groundwork or foundation 13 of the apparatus. The pans 10 are deepest at their central points, and at such points are respectively tapped by short valve-controlled pipes 14, leading upwardly

from a large longitudinally-extending water-inlet pipe or main 15, the inner end of which communicates freely with the discharge of the cooling-water of the furnace, while its opposite end, beyond the series of pans served thereby, may be permanently closed or provided with a stop-cock 15ª. The connection of the opposite side margins of the pans to their respective supporting-tubes 11 is such as to provide a direct overflow from said lateral margins of the pans into the upper open ends of said tubes, as most clearly illustrated in Fig. 4. Beneath the lower section of the belt are rotatably mounted at suitably-spaced intervals a series of supporting-rolls 16. These rolls may be supported and journaled by any suitable means, but preferably and conveniently are carried by brackets 17, mounted on the tubular supports 11 at suitable points on the latter to sustain the rollers at the proper height to support the belt. The belt may be driven by any suitable or convenient mechanism, the present illustration showing for this purpose an electric motor, (indicated at 18,) the armature-shaft of which carries a pinion 19, which, through an intermediate speed-reducing gear 20 and pinion 21, drives a gear 22, fast on one face of the pulley 7. At the opposite end of the apparatus and transversely thereof is a railroad-track 23, so located with reference to the pulley 9 as to permit a railroad-car 24 to be brought into a position favorable to directly receiving the cooled cinder or slag discharged from the belt, all as plainly indicated in Figs. 1 and 2.

The operation is as follows: The steel belt being driven in the direction indicated by the arrows in Figs. 1 and 3 and the outer end of the main 15 being closed, the cooling-water from the furnace flows under hydrostatic pressure into the main 15, rising therefrom through the pipes 14, filling and flooding the pans, which may overflow into each other, overflowing the margins of the pans into the tubular supports 11, and being discharged by the latter into the sewers 12. By reason of the described relative arrangement of the pans, their means of overflow, and the superposed upper section of the belt the latter virtually floats on the surface of the water in the pans, being in constant and complete contact with said water, which, it should be observed, constitutes a continuous stream flowing in a direction transversely of the belt. The belt and water flow having thus been started up, the slag-discharge port of the furnace is opened and the molten slag runs in a continuous stream down the runner 5, pouring and distributing itself in a thin continuous layer upon the upper surface of the floating section of the belt, very much in the manner in which batter is poured upon a griddle. The cooling effect of the water is instantly transmitted through the thin belt to the thin body of slag, and so great is this cooling effect by reason of the large volume of cooling-water passed in contact with the belt and the large radiating-surface of the slag that by the time a given quantity of slag has traveled from the discharging end of the runner to the discharging end of the belt it has cooled sufficiently to permit it to be safely received by the car 24. During its travel upon the belt and by reason of the rapid cooling to which it is subjected the sheet of slag automatically breaks and splinters into comparatively small fragments or cubes of sizes well adapted for its use as ballast, while the rapid cooling effect at the same time chills and reduces the slag to the form of a dense glassy substance having a comparatively high specific gravity and by virtue of this characteristic also being well adapted for use as ballast.

We have thus illustrated and described with some particularity the best form of apparatus which we have as yet devised for carrying out our present invention; but it is obvious that so far as the novel method of chilling involved in the pouring of the slag in the form of a thin sheet and the application of a cooling agent thereto through a cold-conductor and out of direct contact therewith is concerned a large variety of means or agents might be employed. The apparatus herein shown and described for this purpose is not claimed in the present application, but is made the subject-matter of a companion application filed concurrently herewith, Serial No. 171,408.

We claim—

1. The herein-described method of chilling and solidifying blast-furnace cinder or slag which consists in pouring it in the form of a thin sheet upon a thin heat-conducting surface, floating said heat-conducting surface upon a stream of constantly-flowing cooling-water maintained out of contact with said cinder or slag, and imparting to said heat-conducting surface containing said cinder or slag a traveling movement on said stream of cooling-water for a period of time sufficient to enable said cinder or slag to chill and solidify thereon, substantially as described.

2. The herein-described method of chilling blast-furnace slag which consists in pouring it in a thin sheet upon a thin heat-conducting surface and applying to the other side of said heat-conducting surface in intimate contact therewith a rapidly and continuously flowing stream of cooling-water, and maintaining said cooling-water out of direct contact with said slag, substantially as described.

3. The herein-described method of chilling

blast-furnace slag which consists in pouring it in a thin sheet upon a thin heat-conducting surface, and simultaneously applying to the other side of said heat-conducting surface in intimate contact therewith a rapidly and continuously flowing stream of cooling-water, and maintaining said cooling-water out of direct contact with said slag, substantially as described.

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