No. 810,864. PATENTED JAN. 23, 1906.

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

APPARATUS FOR CHILLING CINDER OR SLAG.

APPLICATION FILED AUG. 31, 1903.

4 SHEETS—SHEET 1.

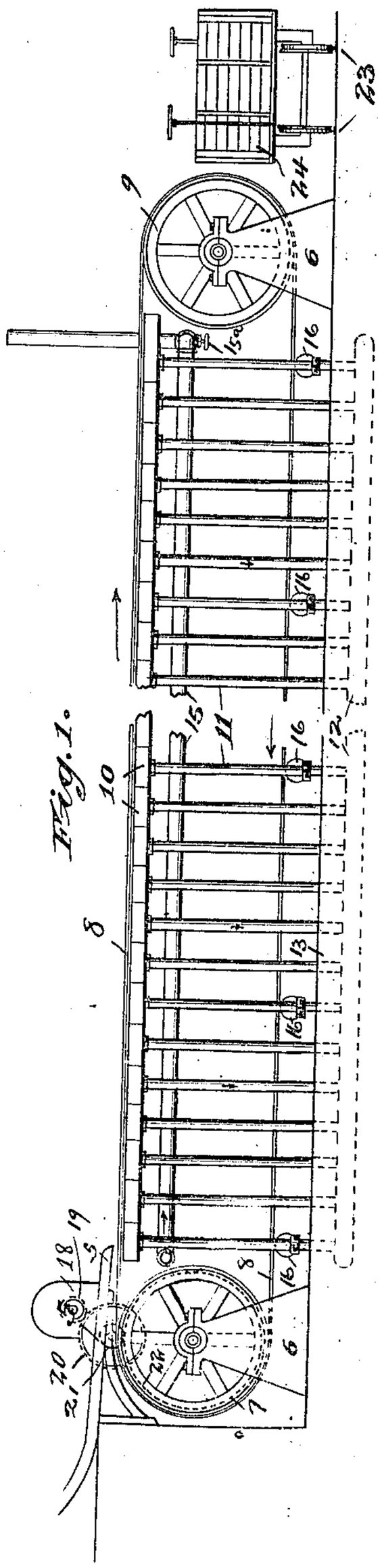

Fig. 1.

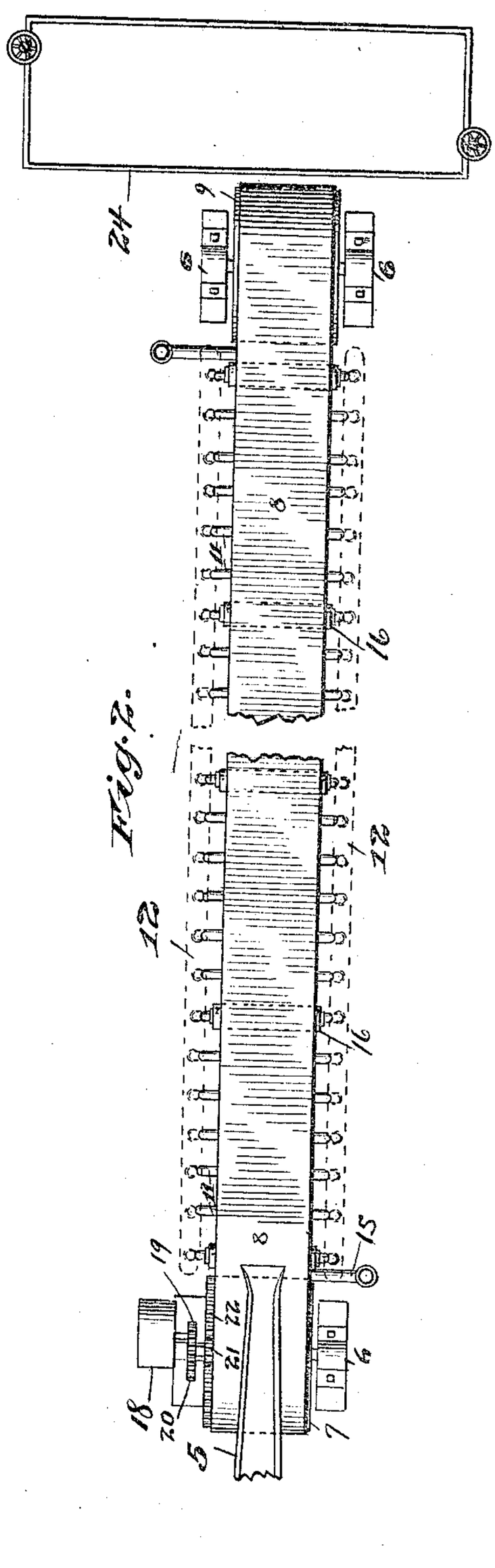

Fig. 2.

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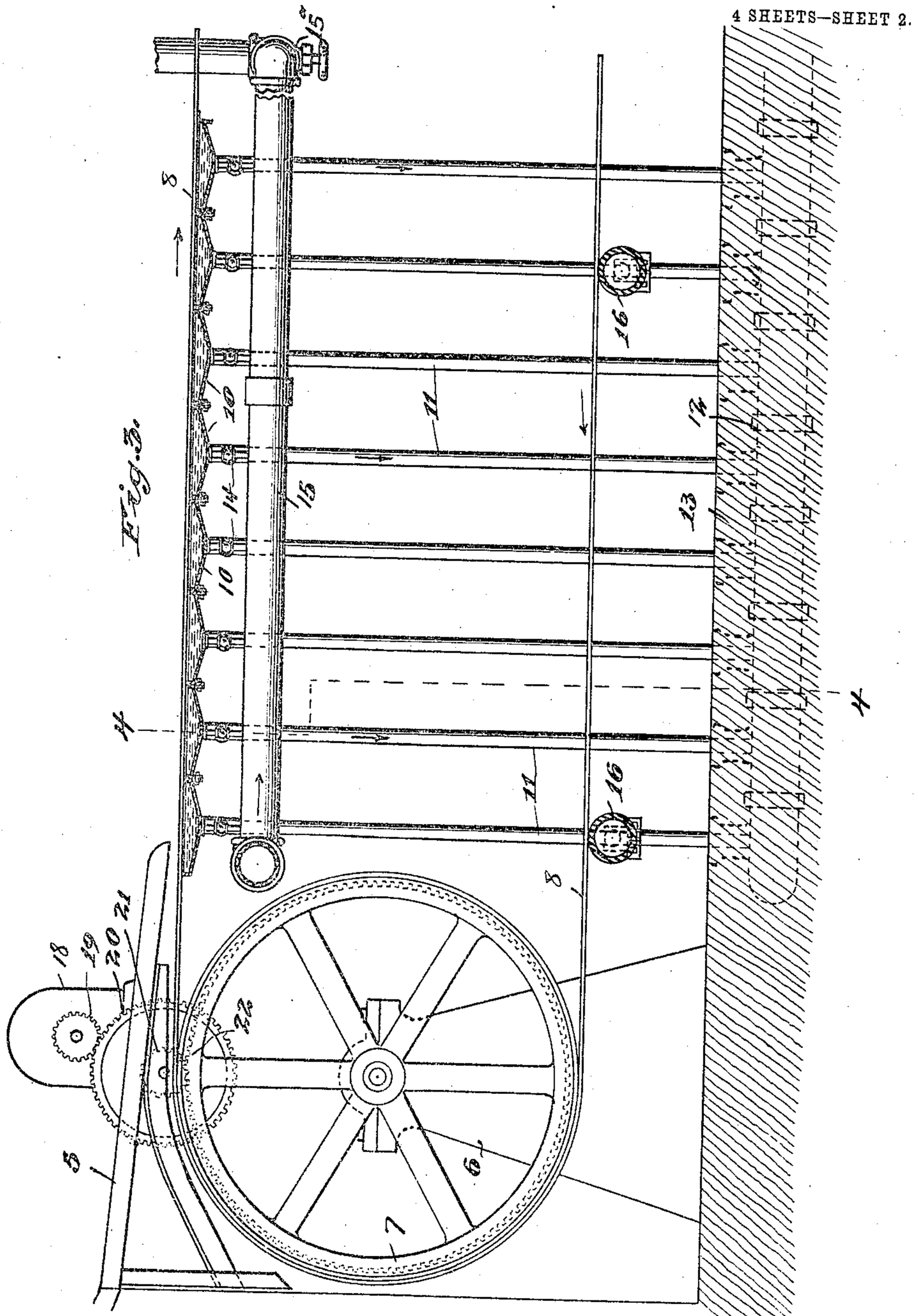
4 SHEETS—SHEET 2.

Fig. 3.



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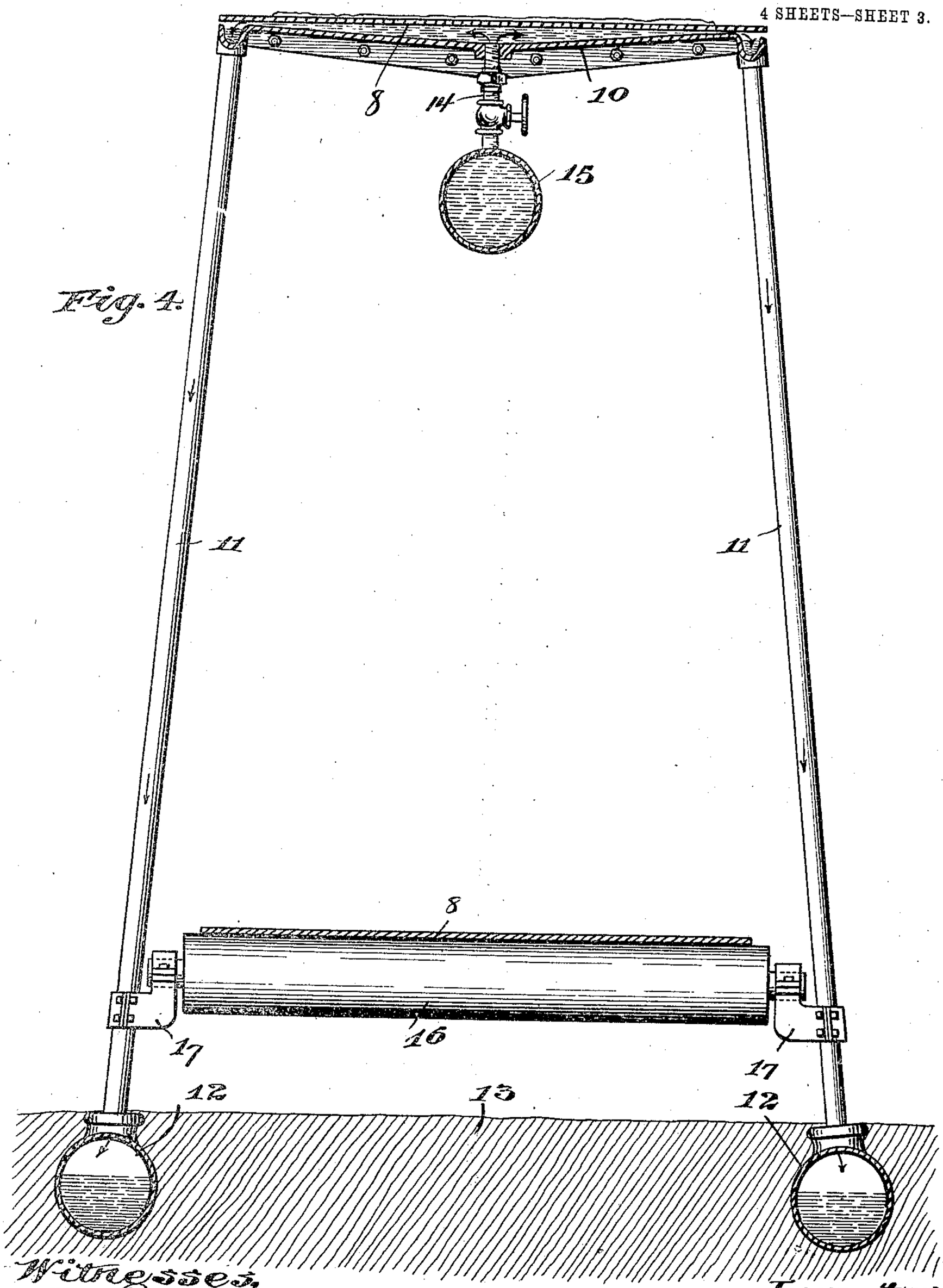
4 SHEETS—SHEET 3.

Fig. 4.



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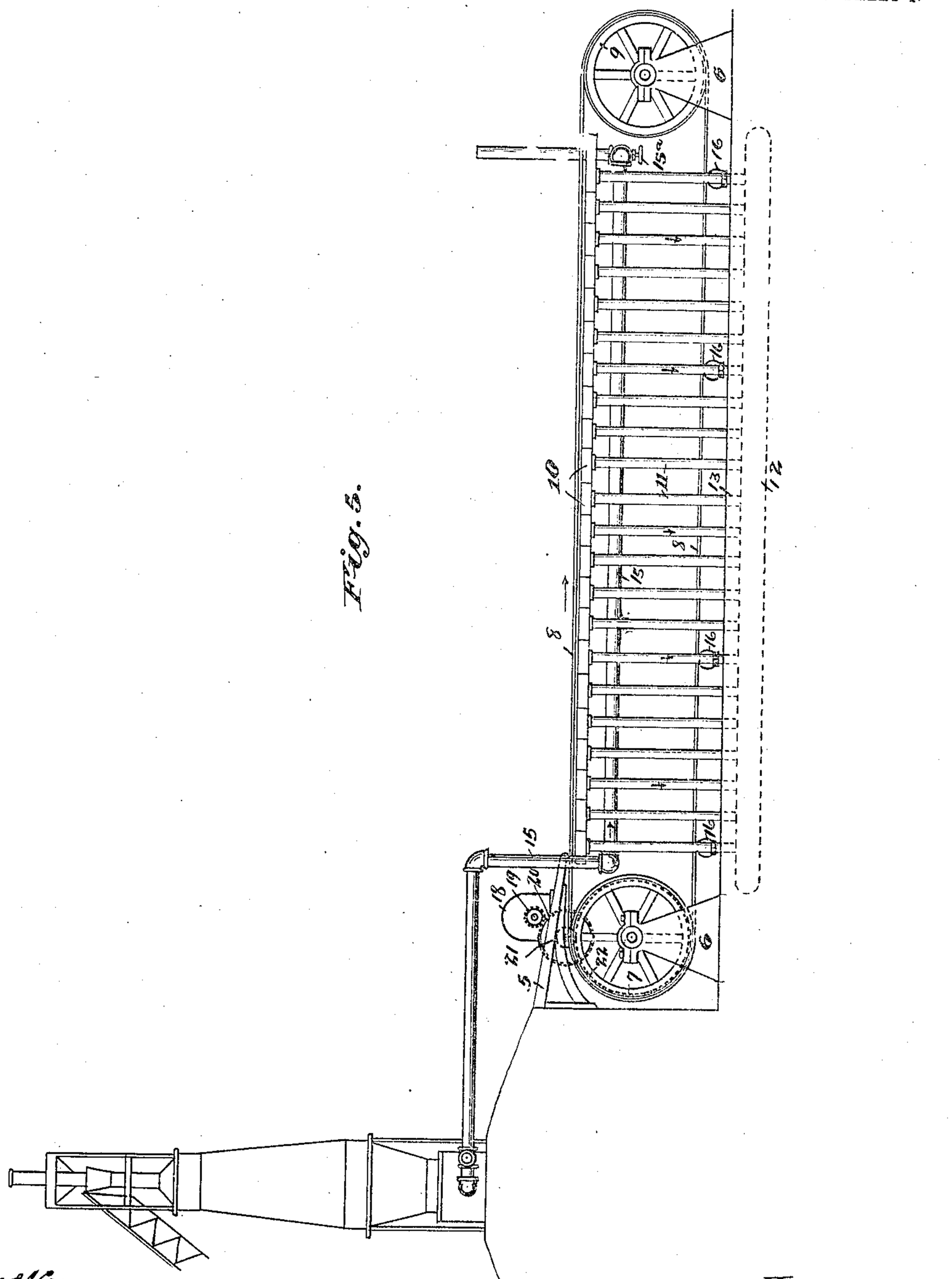
4 SHEETS—SHEET 4.

Fig. 5.



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR CHILLING CINDER OR SLAG.

No. 810,864. Specification of Letters Patent. Patented Jan. 23, 1906.

Application filed August 31, 1903. Serial No. 171,408.

To all whom it may concern:

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

Our invention relates to a device for chilling 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 an improvement in the means for 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, the mechanism constituting our improvement consists of an impervious endless conveyer, preferably in the form of a flexible steel belt maintained in continuous motion and supported on the under side of its upper section by a body of cooling-water led into a series of pans forming a continuous stream of transversely-moving water, upon which this upper section of the belt floats, and the cinder or slag is let through the runner in the ordinary manner and delivered onto the top surface of this upper section of the belt in much the manner that batter is poured upon a griddle to make batter-cakes. The plate being exceedingly thin, the cinder at once chills and forms a dense glassy substance varying in thickness from one-quarter to one-half of an inch, while the carrying-section of the belt is made of such length that the cinder will be sufficiently chilled during its travel thereon from the receiving to the discharging end, from which latter it may be discharged directly into railway-cars, whence it may be transported to any desired locality.

In order to enable the invention to be more clearly understood, we have illustrated such an apparatus in the accompanying drawings.

Referring to the drawings, 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, parts being drawn in section; and Fig. 4 is a cross-sectional view, still further enlarged, on the line 4 4 of Fig. 3. Fig. 5 shows connection of cooling apparatus with furnace.

In the drawings, 5 indicates 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-metal 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 is disposed a trough, herein shown as consisting of 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 metal 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 chilled 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 or chilling 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 chilling effect at the same time 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.

The novel method of chilling slag or cinder hereinabove disclosed, and which may be carried out by means of the apparatus herein described and claimed, is not claimed in the present application, but is made the subject-matter of a companion application, filed concurrently herewith, Serial No. 176,409.

We claim—

1. In an apparatus for chilling blast-furnace slag, the combination with an impervious endless belt on which the slag is adapted to be poured and carried away, of means located beneath the upper carrying-section of the belt adapted to support a running body of cooling-water contacting under hydrostatic pressure with the under surface of said upper belt-section, substantially as described.

2. In an apparatus for chilling blast-furnace slag, the combination with an impervious endless belt on which the slag is adapted to be poured and carried away, of a series of pans located directly beneath the upper carrying-section of the belt, and means for continuously flooding said pans with a stream of cooling-water on which said carrying-section of the belt floats, substantially as described.

3. In an apparatus for chilling blast-furnace slag, the combination with an impervious endless belt on which the slag is adapted to be poured and carried away, of a trough consisting of a series of shallow pans located directly beneath the upper carrying-section of the belt, a water-inlet pipe having branches tapping the bottoms of said pans, and water-overflow pipes freely communicating with the opposite side margins of said pans, substantially as described.

4. In an apparatus for chilling blast-furnace slag, the combination with an impervious thin endless metal conveyer-belt on which the slag is adapted to be poured, of a trough consisting of a series of shallow pans coextensive with the width of the belt and lying directly beneath the upper carrying-section thereof, a water-inlet pipe disposed beneath said series of pans and having branches tapping the respective bottoms thereof, and water-overflow pipes freely communicating with the opposite side margins of the pans and supporting the latter, substantially as described.

5. In an apparatus for chilling blast-furnace slag, the combination with an impervi-

ous thin endless metal conveyer-belt having its receiving end located beneath a furnace-runner to receive the slag, of a trough consisting of a continuous series of shallow pans coextensive with the width of the belt and lying directly beneath the upper carrying-section thereof, a water-inlet pipe disposed beneath and longitudinally of said series of pans and having branches tapping the respective bottoms thereof, and water-overflow pipes freely communicating with the opposite side margins of the pans at a height which effects a flooding of the pans and the floating of the belt on the water passed therethrough, substantially as described.

6. In an apparatus for chilling blast-furnace slag, the combination with an impervious endless conveyer-belt and means for supporting and driving the same, of means for pouring melted slag in a thin sheet onto the receiving end of said belt, means for receiving the discharge from the opposite end of said belt, and means located beneath the upper carrying-section of the belt adapted to spread a running body of cooling-water into supporting contact with substantially the entire under surface of said upper belt-section, substantially as described.

7. In an apparatus for chilling blast-furnace slag, the combination with an impervious endless thin conveyer-belt and a pair of large pulleys or drums supporting and driving the same at its opposite ends, of means for pouring liquid slag onto the upper surface of said belt, a trough consisting of a series of shallow pans located directly beneath the upper section of said belt, means for flooding said pans by a continuously-flowing stream of cooling-water which contacts and floats said upper section of the belt, overflow-pipes communicating with the side margins of said pans, and means for suitably supporting the lower or return section of the belt, substantially as described.

8. In an apparatus for chilling blast-furnace slag, the combination with the slag-runner and the cooling-water apparatus of a smelting-furnace, of means for cooling and conveying away the slag comprising an impervious traveling metal conveyer adapted to receive and transport the slag, a water-receptacle arranged in juxtaposition to the conveyer and through which the cooling-water may be circulated in contact with the conveyer, and means for conveying the water from the cooling-water apparatus of the furnace to said receptacle, as and for the purpose set forth.

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