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

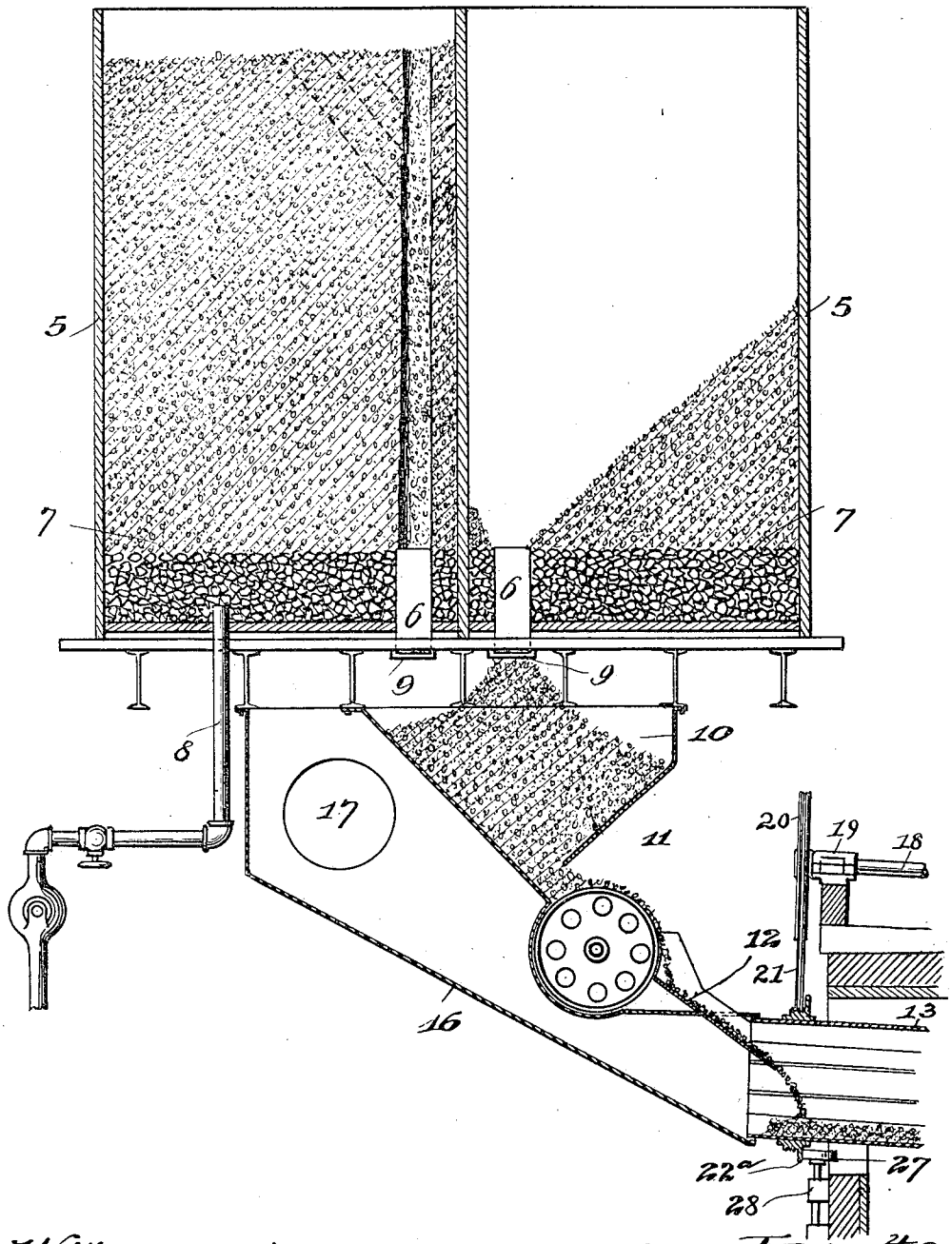
DRIER.

APPLICATION FILED JUNE 9, 1911.

1,085,126. Patented Jan. 27, 1914.

2 SHEETS—SHEET 1.

Fig. 1.



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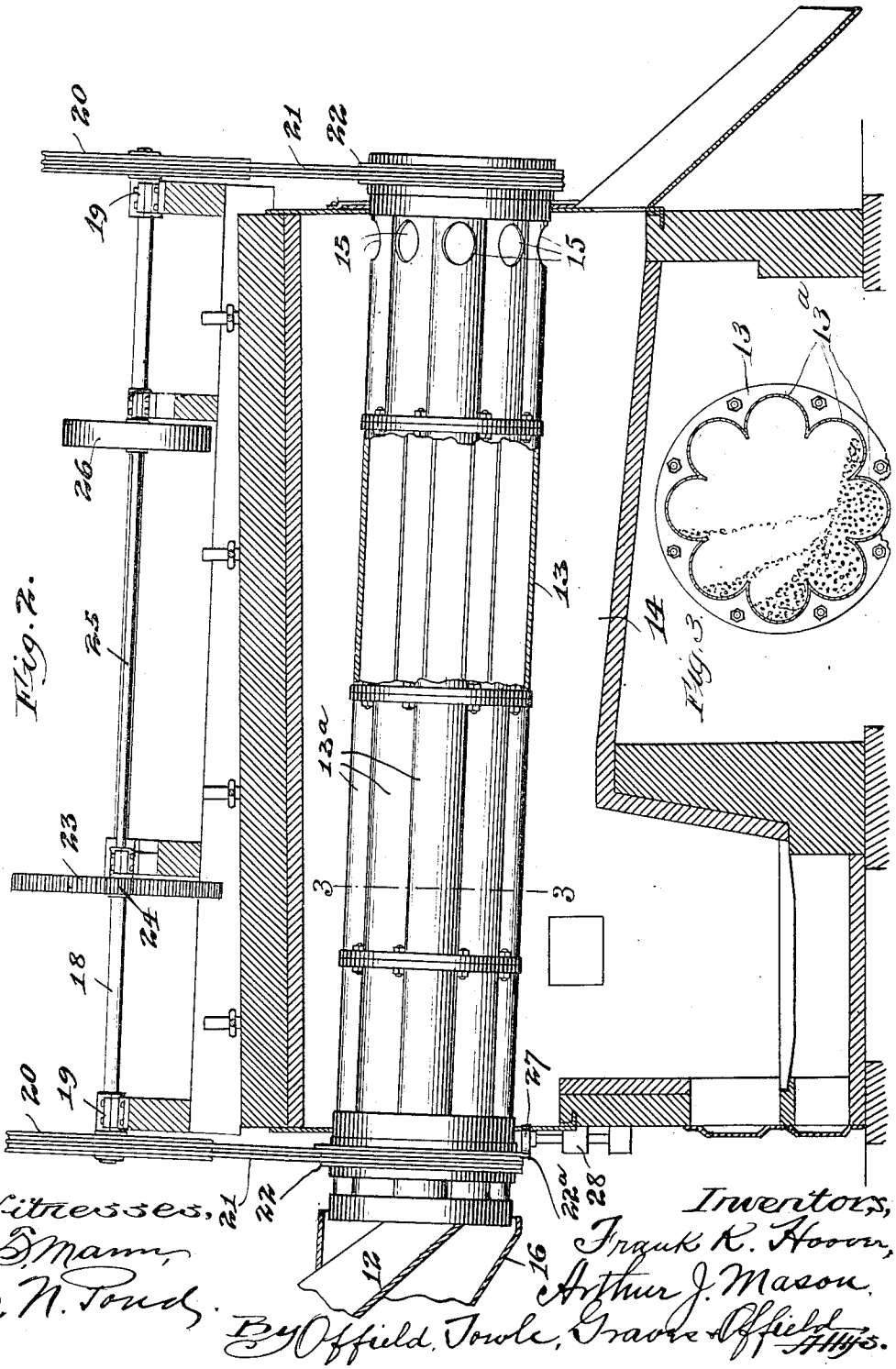


Fig. 2.

Fig. 3.

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UNITED STATES PATENT OFFICE.

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

DRIER.

1,085,126. Specification of Letters Patent. Patented Jan. 27, 1914.

Application filed June 9, 1911. Serial No. 632,239.

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 certain new and useful Improvements in Driers, of which the following is a specification.

This invention relates to the general art of driers, and has reference more particularly to a new and improved apparatus for effecting the final drying of mineral matter that has previously been subjected to a washing operation to cleanse it from foreign matter and impurities.

The device of our present invention has been designed more especially for use in connection with, and to effect the final step of, a new process of treating a natural mineral product commonly known as "phosphate rock," which is essentially a phosphate of lime that is extensively mined and marketed as a fertilizing agent. This natural product exists to a considerable extent with a greater or less admixture of clay, iron, sand and other foreign matter or impurities; and in an application filed by us June 9, 1911, Serial No. 632,234, we have set forth and claimed the novel process of treatment above referred to, which consists essentially in the loosening, dissolving and final rinsing out of the clay and other impurities from the particles of phosphate rock. These operations, of course, involve the thorough wetting of the material treated; and the final step in the said process consists in drying by artificial means the purified product. The subject matter of the present application relates to an improved apparatus for effecting this final drying operation.

In its main features the present apparatus comprises a rotary tube or drum that is disposed lengthwise of the firebox and smoke chamber of a furnace, and is disposed at a slight angle to the horizontal, so that the material fed in at one end will automatically flow slowly toward the other or discharge end; and this drum or tube is so constructed and mounted as to be subject both exteriorly and interiorly to the hot gases and products of combustion of the furnace, and, furthermore, the cylindrical shell thereof is corrugated or scalloped longitudinally, which has the double function of increasing the area of its heating surface, and also providing a simple means for effecting a thorough agitation and tumbling of the material during its passage through the drum which facilitates the passage of the hot gases therethrough. The drum is preferably hung by wire cables at its ends from an overhead rotating shaft to which power is applied; but, obviously, the manner and means of driving the drum may be varied as desired. In association with this device for applying furnace heat, we preferably employ a device for effecting a preliminary draining of the material by which a considerable percentage of the total moisture is extracted before the material is subjected to the artificial heat.

Our invention, its principle and mode of operation, and the benefits and advantages secured thereby will be readily understood when considered in connection with the accompanying drawings, which illustrate one practical form in which the invention may be embodied and wherein—

Figure 1 is a central vertical section through the drainer and the feed devices leading therefrom into the rotary drum of the drier. Fig. 2 is a vertical longitudinal section through the furnace, showing the drum of the drier mounted therein and partly broken out to show its internal construction, and also showing the drum supporting and driving means. Fig. 3 is a cross-section on the line 3—3 of Fig. 2.

Referring to the drawings, and first briefly describing the draining mechanism, which is preferably, though not necessarily, employed as a part of the complete drier, 5 designates each of a pair of tanks having in their bottoms discharge openings 6, formed by tubes set in the bottoms of the tanks and extended up through a body 7 of filtering material. The drainage water escapes through a drain pipe 8, while tubes 6 are equipped with controlling valves 9, that are opened from time to time to permit the drained material to pass into an underlying hopper 10. When the drainage tank has been filled with the washed phosphate rock and given time for drainage, and is ready for the drying operation, we find that it has assumed a condition so water-packed that it will not flow even when a very large opening as large as three feet in diameter is made in the floor of the tank or receptacle. In order to cause it to flow out of the tank, we first bore a hole through the exit opening 6 from below upwardly to the full

height of the material in the tank, as shown in Fig. 1, using for this purpose an earth-boring auger of sufficient size (actually about nine inches in diameter). The material is then shoveled from the top into this hole and passes thence into the hopper 10. While it is true that this material packs in the manner above described, yet after it has been drained and once loosened it remains in the loose condition, like ordinary building sand, and flows freely in any desired manner. The expeditious removal of the drained phosphate rock from these draining-tanks has heretofore presented quite a serious problem; but operating in the manner above described the material is easily removed and the capacity of a single operator becomes very great, as high as ten tons per hour. The hopper 10 is equipped with a delivery roller 11, adapted to effect a regulable feed of the material through a discharge chute 12 into the receiving end of the drier tube or drum 13. This latter, as will be seen by reference to Fig. 2, is located within and longitudinally of a well known type of boiler heating furnace designated as an entirety by 14. This heating tube or drum is made up of a plurality of cast-iron sections united end to end; and it will be noted as a special feature of construction that the cylindrical surface of this drum is not a plain circle in cross-section, but is made in the form of a plurality of scallops, 13^a, as best shown in Fig. 3. This construction very considerably increases the total area of the heating surface; and, further, the scallops constitute local chambers or pockets, which, as the drum revolves, serve to pick the material up and tumble it upon itself, thus producing a continuous state of agitation, most favorable to the thorough penetration of the entire body of material by the conducted heat and the hot gases, and the release of the steam particles generated therein.

The discharge end of the tube is blanked, and near said end the cylindrical surface is provided with an annular row of apertures 15, which serve the double function of effecting the discharge of the dried material and permitting the entrance of the hot gases and products of combustion, which flow back through the interior of the drum, and are led thence through a casing 16 underlying the feed devices and a flue 17 to the chimney. It will thus be seen that the drum is subjected to the heat of the gases and products of combustion both externally and internally. The greater part of the drying is accomplished merely by the contact of the material with the heated metal which receives its heat largely from the external exposure. The hot gases flow from the fire-box externally of the drum to its discharge end, and thence pass into the drum through the same holes 15, which afford exit to the dry material.

For supporting and slowly rotating the drum we have shown an overhead shaft 18, journaled in suitable bearings 19, and carrying at its ends pulleys 20, over which are trained wire slings 21 that engage similar pulleys 22 on the ends of the drum 13. The shaft 18 is driven by a gear 23 thereon engaged by a pinion 24 on a counter shaft 25, this latter being belted to a source of power through pulley 26. To support the drum 13 at a slight incline and in proper driving relation to its overhead driving devices, we provide an anti-friction stop or abutment in the form of a roller 27, journaled in a vertical bearing 28, secured to the front wall of the furnace and engaging a flange 22^a on the front pulley 22.

As above stated the apparatus is complete for many practical purposes without the preliminary draining device; but when it is borne in mind that a great preponderance of the heat required to dry a material, such as phosphate rock, is necessary merely to evaporate the water, it will be seen that the employment of the drainer effects a substantial reduction in the fuel necessary to complete the drying operation. The customary process now in use for drying phosphate rock consists in passing hot gases from a furnace simply through a constantly rotating metal tube or drum, the contact of the material with the hot gases being relied on to effect the drying. In the device of our invention this tube or drum is heated both externally and internally by the hot gases, and the drying of the material is principally effected simply by contact of the wet material with the highly heated metal of the drum. Each section of the drum is a single integral piece of cast iron, by reason of which the heat conduction is more perfect than in the case of a built-up structure. In addition, it is well known that cast-iron will withstand the effect of high temperatures and variations in temperature below 1800 F. much better than wrought iron.

We claim:

1. In a drier of the character described, the combination with a furnace, of a drier tube the cylindrical wall of which is of scalloped form in cross section mounted therein and extending longitudinally thereof at an angle to the horizontal, said tube being closed at, and formed in the bottoms of the scallops with a row of apertures adjacent to, its rear end; said apertures serving both to discharge the material passing through the tube and to admit the hot products of combustion from the furnace chamber to the interior thereof, means for rotating said tube, and means to supply the material to be dried to the front end of said tube, substantially as described.

2. In a drier of the character described, the combination of a draining device, a hopper into which the drained material is discharged, a furnace, a drier tube rotatably mounted in said furnace, and means for effecting a regulable feed of the material from said hopper into one end of said drier tube, substantially as described.

3. In a drier of the character described, the combination of a draining device, a hopper into which the drained material is discharged, a furnace, a rotary drier tube extending through the fire-box of said furnace and formed near the discharge end with an annular row of openings for the discharge of the material and the ingress of the hot gases of combustion, means for effecting a regulable feed of the material from said hopper into the receiving end of said drier tube, a casing underlying said hopper and feeding means and communicating with the receiving end of said drier tube, and a smoke flue communicating with the upper portion of said casing, substantially as described.

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