P. T. LINDHARD.

TUBE MILL.

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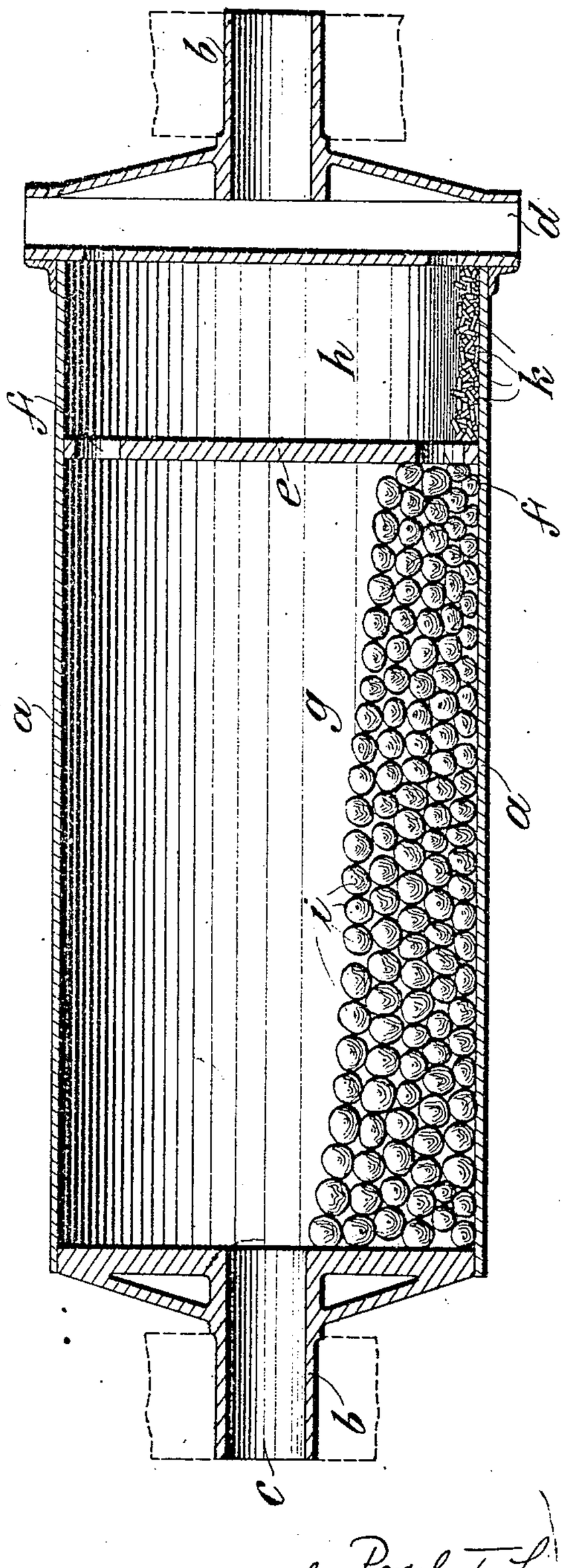
983,068. Patented Jan. 31, 1911.



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UNITED STATES PATENT OFFICE.

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TUBE-MILL.

983,068. Specification of Letters Patent. Patented Jan. 31, 1911.

Application filed November 30, 1908. Serial No. 465,180.

To all whom it may concern:

Be it known that I, POVL T. LINDHARD, a subject of the King of Denmark, residing in the borough of Manhattan of the city of New York, in the State of New York, have invented certain new and useful Improvements in Tube-Mills, of which the following is a specification, reference being had to the accompanying drawing, forming a part hereof.

In the operation of tubemills, in which coal, ores, etc., are reduced to a finely divided condition, the work is accomplished in a slowly rotating cylinder with grinding bodies which are usually either flint pebbles or small metallic bodies. The flint pebbles have the advantage of being very hard and cheap, so that the expense of wear and tear is low, and the disadvantage of necessitating the employment of comparatively large machines and of requiring considerable power to drive the machines. Moreover, near the discharge end of the mill the material fills the interstices between the grinding bodies and the cylinder to a much less degree than at the feed end, with the result that the grinding bodies are frequently broken in that part of the mill. Furthermore, in the grinding of certain materials, such as coal, for example, the flint pebbles often cause the finely divided particles of the material being ground to cohere and form flakes which are discharged from the mill and are more or less harmful, as, for instance, when they are blown into a cement kiln along with the finely divided particles. On the other hand when relatively small grinding bodies of metal are used, the power consumption in the operation of the mill is much less than when flint pebbles are used and the flaking of the material being ground, above referred to, is wholly prevented, but the small grinding bodies of metal are more expensive and less durable than the flint pebbles, so that the expense of wear and tear is higher than when flint pebbles are used.

In the present invention it is proposed to combine the use of the flint pebbles or similar large grinding bodies with the small metallic grinding bodies of relatively high specific gravity and of cylindrical shape in such a manner as to secure results which cannot be secured with either class of grinding bodies alone, and in accordance therewith the grinding space in the mill is divided into two compartments, the first compartment, at the feed end of the mill, usually taking up the greater portion of the space in the mill and being charged with the flint pebbles or other large grinding bodies, and the second compartment, usually being relatively short, located at the discharge end of the mill, and charged with the relatively small metallic grinding bodies. A suitable partition between the two compartments separates the two classes of grinding bodies, but permits the discharge of the material being ground from the first compartment to the second compartment.

The invention will be more fully explained hereinafter with reference to the accompanying drawing, which represents, in longitudinal central section, so much of a grinding mill as is necessary to enable the invention to be understood.

In the embodiment of the invention represented in the drawing there is provided the usual cylindrical shell *a*, having trunnions *b* upon which it is adapted to be rotated by any suitable means in suitable bearings, and having a feed inlet *c* at one end and a discharge outlet *d* at the other end. At a suitable point in the shell, preferably quite near the discharge end of the shell, is a partition *e*, having suitable openings *f* through which the pulverized material may pass from the large compartment *g* to the small compartment *h*. The compartment *g* is charged with the usual flint pebbles *i* or other grinding bodies, the same being more or less spherical in form and comparatively large, while the compartment or chamber *h* is charged with comparatively small metallic grinding bodies *k*.

In the operation of the mill, the material to be ground is introduced at the feed inlet into the compartment *g* and, the shell being rotated slowly, such material is ground by the relatively large flint pebbles or other grinding bodies. As the material to be ground, while in a relatively coarse condition, occasions more wear and tear upon the grinding bodies as well as upon the lining of the mill, and as such wear falls upon the flint pebbles which are relatively cheap, it is evident that the expense of wear and tear will be at its minimum when the flint pebbles are used for the preliminary grinding. Furthermore, since it is not nec-

essary to carry the grinding of the material with the flint pebbles to the ultimate degree of fineness required, there is less breakage of the flint pebbles at the remote end of the larger compartment than would be the case if it were attempted to complete the grinding with the flint pebbles. From the first or larger compartment the partly pulverized material passes through the openings in the partition into the second or smaller compartment where the grinding is completed with the small metallic grinding bodies. Not only do these small grinding bodies effectually break up all flakes which may have been formed by the action of the flint pebbles, thereby permitting the discharge of the material from the mill in a uniformly pulverized condition, but this work is accomplished with less consumption of power than would be possible with the flint pebbles and moreover, since the greater part of the wear and tear falls upon the cheaper flint pebbles, as already pointed out, the expense of wear and tear on the more expensive small metallic grinding bodies is reduced to a minimum.

It will be understood, of course, that the relative sizes of the compartments or chambers in which the grinding is carried on with the two classes of grinding bodies may be varied more or less according to the nature of the material to be ground and the character of the results to be accomplished.

It will be understood that the employment of flint pebbles for the larger grinding bodies for the preliminary grinding is most economical in respect to wear and tear while the employment of small cylindrical bodies of relatively high specific gravity for the final grinding secures as advantages a more compact mass of grinding bodies, a greater aggregate surface for grinding and a greater impact for a given size to grinding bodies.

I claim as my invention:

A tube-mill comprising a horizontally arranged rotatable shell having passages leading thereto and therefrom through which material may be introduced into and discharged from said shell; a vertical partition within said shell and located adjacent the discharge end thereof whereby the interior of said shell is divided into a relatively large preliminary grinding chamber and a relatively small final grinding chamber, said partition having an opening through which material may pass from the preliminary to the final grinding chamber; a mass of relatively large flint pebbles within the larger or preliminary grinding chamber; and a mass of relatively small metallic grinding bodies each cylindrical in form within the smaller or final grinding chamber.

This specification signed and witnessed this 25th day of November A. D., 1908.

POVL T. LINDHARD.

Signed in the presence of—
ARCHIBALD C. WEEKS,
ARCHIE B. ZAHN.