

Jan. 26, 1937.

C. NIELSEN

**2,069,174**

# AIR SWEEP GRINDING MILL

Filed July 11, 1933

2 Sheets-Sheet 1

Fig. 1.

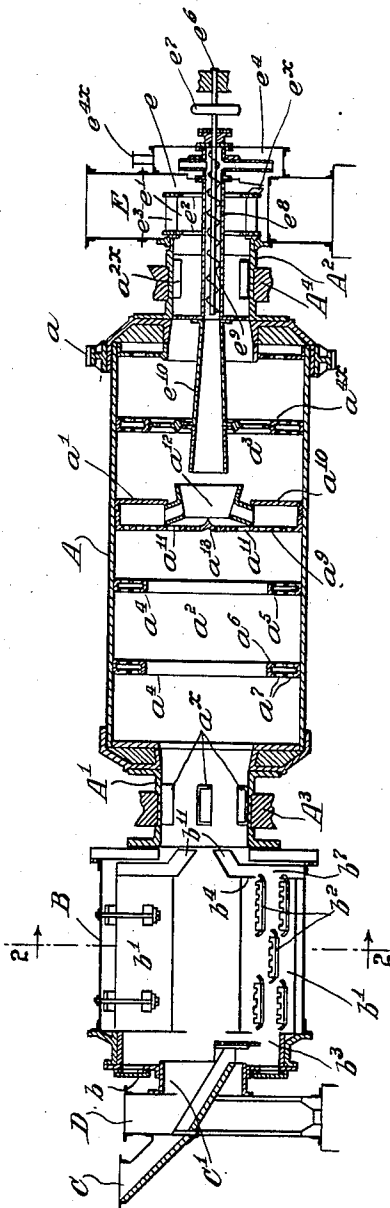
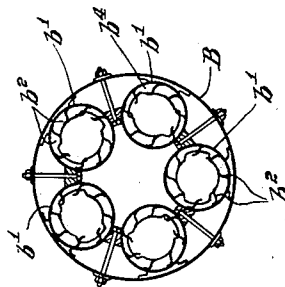


Fig. 2.



INVENTOR

Christian Nielsen  
BY

BY

Redding, Greeley, O'Shea & Campbell  
ATTORNEYS

**ATTORNEYS**

Jan. 26, 1937.

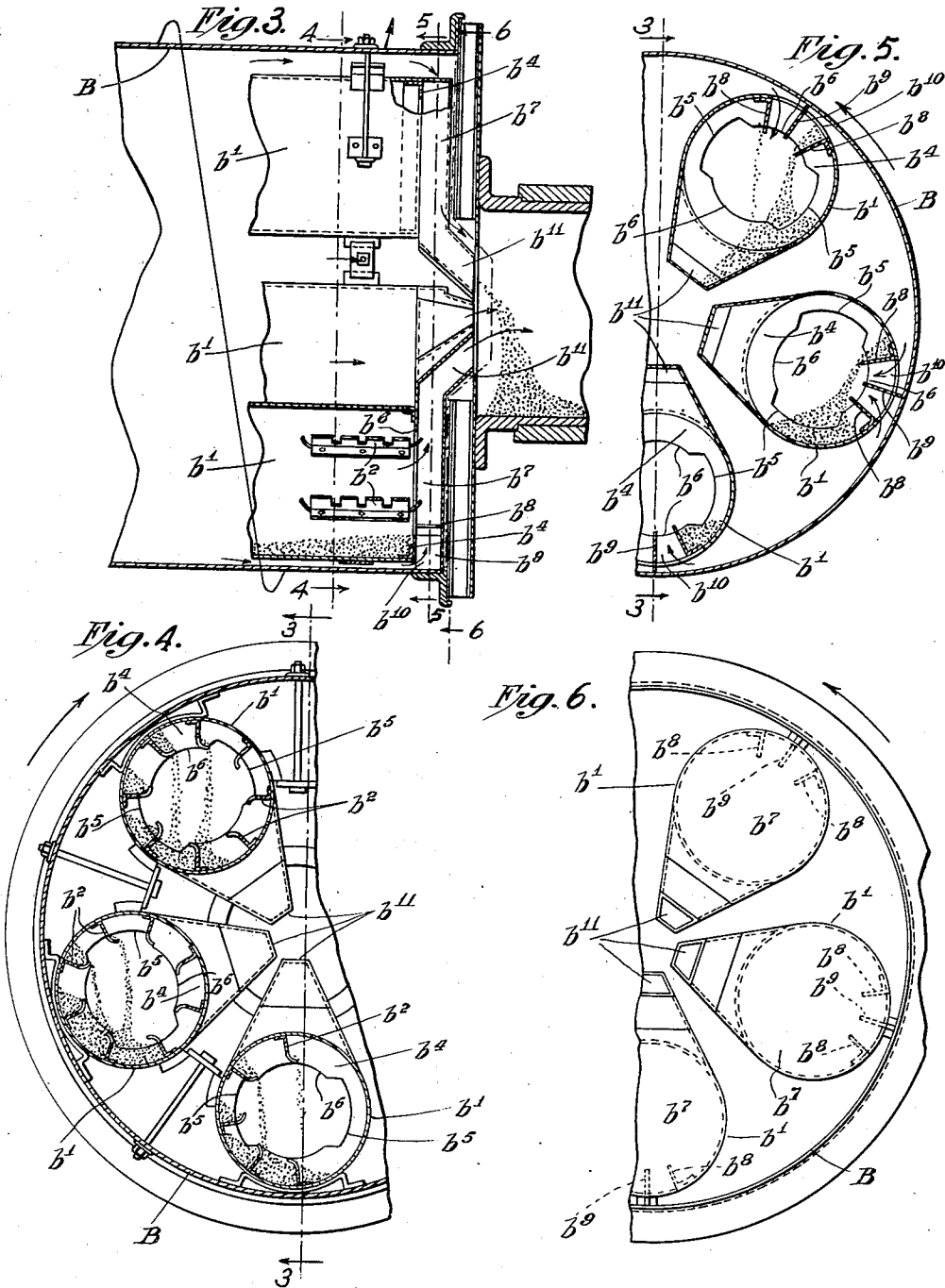
C. NIELSEN

2,069,174

AIR SWEEP GRINDING MILL

Filed July 11, 1933

2 Sheets-Sheet 2



INVENTOR  
*Christian Nielsen*  
BY  
*Redding, Greer, & Campbell*  
ATTORNEYS

## UNITED STATES PATENT OFFICE

2,069,174

## AIR-SWEPT GRINDING MILL

Christian Nielsen, Klampenborg, near Copenhagen, Denmark, assignor to F. L. Smidth & Co., New York, N. Y., a corporation of New Jersey

Application July 11, 1933, Serial No. 679,833  
In Great Britain July 14, 1932

## 1 Claim. (Cl. 34—5)

This invention relates to grinding mills such as those used in the fine grinding of cement raw materials and of coal for fuel and other similar purposes and has been developed with particular relation to so-called tube mills in which the cement raw material, the coal, or whatever material is to be ground, is fed into one end of a cylinder which is rotated on a horizontal or nearly horizontal axis and is charged with grinding bodies by which, in the rotation of the cylinder, the material, as it passes through the cylinder from one end to the other, is reduced to the desired degree of fineness. In order that the maximum efficiency of such mills may be secured it is desirable that the material to be ground and being ground shall be as dry as possible and therefore capable of being discharged from the mill on a current of air or other aeriform fluid. The drying of the material has been accomplished in some degree heretofore by the passage through the mill, while the grinding is going on, of a current of heated aeriform fluid, such as heated air from a suitable source or the hot waste gases from a rotary kiln or other source and it has been the object of the present invention to improve the construction of such mills in such respects that the drying of the material to be ground and being ground shall be carried on more efficiently than has been possible heretofore. In accordance with the invention not only have various improvements been introduced in the main cylinder in which the grinding is carried on but there has been combined with such cylinder, at its feeding end, a pre-heater in which the material to be ground is heated and dried before it is introduced into the grinding cylinder and devices at the discharge end of the grinding cylinder by which the material which has been reduced to the desired degree of fineness is separated from larger particles which are returned to the grinding cylinder to be further subjected to the grinding action therein, the current of heated air or gas entering the pre-heater and sweeping through the same and through the grinding cylinder and finally carrying away the finely ground material. In the pre-heater and in the grinding cylinder the material to be ground and being ground is by devices to be described raised at various points in its progress and permitted to fall through the current of heated air or gas as it sweeps through the mill.

The invention will be more fully described hereinafter with reference to the accompanying drawings in which is illustrated a mill in which are incorporated the features of improvement to be described, in which drawings:

Figure 1 is a view in longitudinal section, partly in outline, of a mill constructed and arranged to operate in accordance with the invention.

Figure 2 is a view in transverse section through the pre-heater on the plane indicated by the broken line 2—2 of Figure 1.

Figure 3 is a view in longitudinal, sectional elevation and on a larger scale of the delivery end of the pre-heater, the plane of section being indicated by the broken line 3—3 of Figure 4.

Figures 4, 5 and 6 are views of the pre-heater in transverse section on the planes indicated, respectively, by the broken lines 4—4, 5—5 and 6—6 of Figure 3.

In the embodiment of the invention illustrated in the drawings the grinding cylinder A is supported at its end by trunnions A<sup>1</sup> and A<sup>2</sup> which rotate in suitable bearings A<sup>3</sup> and A<sup>4</sup>. The pre-heater is an overhung cylinder B secured to and supported by the trunnion A<sup>1</sup> of the grinding cylinder A of which it forms a part and with which it rotates. The material to be ground is supplied through a chute C which delivers the material to the pre-heater through a fixed sleeve C<sup>1</sup> which projects inwardly through the head b of the pre-heater B. The heated air or gas from any suitable source is supplied under some degree of pressure through a conduit D which delivers the air or gas into the pre-heater through the sleeve C<sup>1</sup>. The trunnion A<sup>2</sup> at the discharge end of the grinding cylinder A communicates with a conduit E by which the air-borne, finely ground material is delivered under the influence of the pressure at the feeding end of the mill or, it may be also, under the influence of suction created by a suitable fan, not necessary to be shown, connected to conduit E. It will be understood that both the material to be ground and the air current pass longitudinally through the mill, including the pre-heater and the grinding cylinder, and are discharged together (the air and the finely ground material) through the trunnion A<sup>2</sup> into the conduit E.

The grinding cylinder rotated in the usual manner through a gear a may be divided by a partition a<sup>1</sup> into a preliminary grinding chamber a<sup>2</sup> and a secondary grinding chamber a<sup>3</sup>. The preliminary grinding chamber a<sup>2</sup> is further provided with annular partitions having or formed with a large central opening to permit the free passage of air through the mill, each of which, as clearly shown, is formed by walls a<sup>5</sup>, a<sup>6</sup>, which are so narrowly spaced apart that the material treated is engaged frictionally and is raised, in the rotation of the partition with the cylinder,

so far toward the high point that when it falls it falls through the current of air sweeping through the mill and passing through the opposite slotted openings  $a^7$  in the walls and the central opening, the fines being carried on with the current of air while the coarser particles drop into the chambers between the partitions for further grinding. The fines which may be carried nearly to the high point are permitted to fall into the central air current through the outlets formed in the inner peripheral wall and in the side walls adjacent thereto. The material being ground passes through the perforations  $a^7$  of the leading plate  $a^5$  into the chamber formed between the plates, in the lower arc of movement, and in the rotation of the cylinder is raised to or toward the highest arc of movement and is then discharged through the perforations  $a^7$  and through the perforations  $a^8$  and falls through the current of heated air which sweeps through the central opening of the annular partition and is thereby heated and dried. The perforated plates of the annular partitions  $a^4$  also serve to carry the grinding bodies further up in the rotation of the mill and therefore promote the cascading of the grinding bodies and increase their effective grinding action.

Within the cylinder of the pre-heater there are mounted axially parallel drums  $b^1$  each of which is armed interiorly with lifters  $b^2$ . Each of the drums  $b^1$  is open at its ends to admit and permit the passage of material and heated air and at and near the lowest point of its revolution each drum receives material from the pocket  $b^3$  into which it falls from the chute C and in the continued rotation of the pre-heater the material is lifted by the lifters  $b^2$  and is permitted to fall therefrom at and near the highest point of revolution through the current of heated air which is continuously passing through each of the drums. The discharge end of each drum  $b^1$  is partially closed by an annular plate  $b^4$  which has two low portions  $b^5$  and two high portions  $b^6$ , the purpose of this construction being to permit the material to enter the discharge pocket  $b^7$  only at certain points during the rotation of the pre-heater. The high portions  $b^6$  in cooperation with the deflector plates  $b^8$  and baffle plate  $b^9$  prevent spilling of the material from the drums through the gas passages  $b^{10}$  into the chamber of the pre-heater in which the drums are mounted. The construction further serves the purpose of recovering such material as might be discharged into the main chamber of the pre-heater and delivering it into the pocket  $b^7$  and thence, through spout  $b^{11}$ , into the trunnion  $A^1$  and so into the grinding cylinder A.

It will be seen that with the construction of the pre-heater as described the material which is delivered to it is continually being lifted and permitted to fall through the continually onward moving current of heated air or gas and is being thereby continually and effectively subjected to the drying action of such current so that it is in a proper condition for effective and rapid grinding in the grinding chamber without liability to caking or clogging, whatever moisture is released in the grinding operation from the larger particles of material being effectively dried out by the continued lifting and falling of the material through the current of heated air at several points in the grinding chamber.

It will be understood that the heated air or gas sweeps around and in contact with the exterior of the drums as well as through them, and thereby promotes the heating and drying of the material in contact with the walls of the drums.

When the material is discharged from the grinding chamber of the mill it is practically free from moisture, but it may be that while the greater part of the material is reduced to the desired degree of fineness, when it reaches the discharge end of the grinding cylinder, there may be some relatively coarse particles which should be returned to the mill for further grinding. Accordingly provision is made for the return for further grinding of such relatively coarse particles, as will now be described.

The material delivered through the trunnion  $A^2$  is discharged therefrom into a chamber  $e$  in which rotates a lifter  $e^1$  formed of end plates  $e^2$  and lifter blades  $e^3$ , the lifter being secured to the trunnion  $A^2$  to rotate with the grinding cylinder. By this means the material is raised and allowed to fall through the current of heated air, not only being subjected thereby to a continued drying operation (if that be necessary) but also being subjected to a separating operation by which the fine particles are released from the relatively coarser particles and are carried on with the current of air while the relatively coarser particles fall to the bottom of the chamber  $e$ , and are urged on by a scraper  $e^4$  into a chamber  $e^5$ , vented as at  $e^{4x}$ , and are picked up by scoops  $e^5$  mounted on a shaft  $e^6$  to which a drive is applied, as at  $e^7$ , the material so raised by each scoop passing from it into a pipe  $e^8$  which rotates with the cylinder A and in which is a worm conveyor  $e^9$  mounted on the shaft  $e^6$ . The pipe  $e^8$  is provided with a funnel-shaped extension  $e^{10}$  by which the relatively coarser particles of material gathered by the scoops  $e^5$  are returned to the grinding cylinder well in advance of the discharge end so that they may be subjected to a further grinding action.

It is noted that lifters  $a^x$  and  $a^{2x}$  may be provided in the trunnions  $A^1$  and  $A^2$  for the purpose of lifting the material at these points also and letting it fall through the air current.

It will be understood that various changes in details of construction and arrangement may be made to suit different conditions of use and that, except as pointed out in the accompanying claim, the invention is not limited to the particular construction shown and described herein.

I claim as my invention:

A pre-heater for an air-swept tube mill comprising a rotatable shell, a plurality of axially parallel drums mounted in the shell, each drum being open at its ends to receive and permit the passage of material and aeriform fluid, means to deliver material to the receiving ends of the drums, and devices to discharge from the pre-heater material discharged from the drums, a conduit being provided through which may be introduced a current of heated aeriform fluid, each of said drums being provided at its discharge end with an annular plate having a high portion and a low portion to permit discharge of the material at a predetermined point in the rotation of the pre-heater and to prevent spilling of the material at other points.

CHRISTIAN NIELSEN. 70