July 12, 1938. M. VOGEL-JORGENSEN 2,123,593

TREATMENT OF SOLID MATERIAL WITH GASEOUS MEDIA

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Fig. 1.

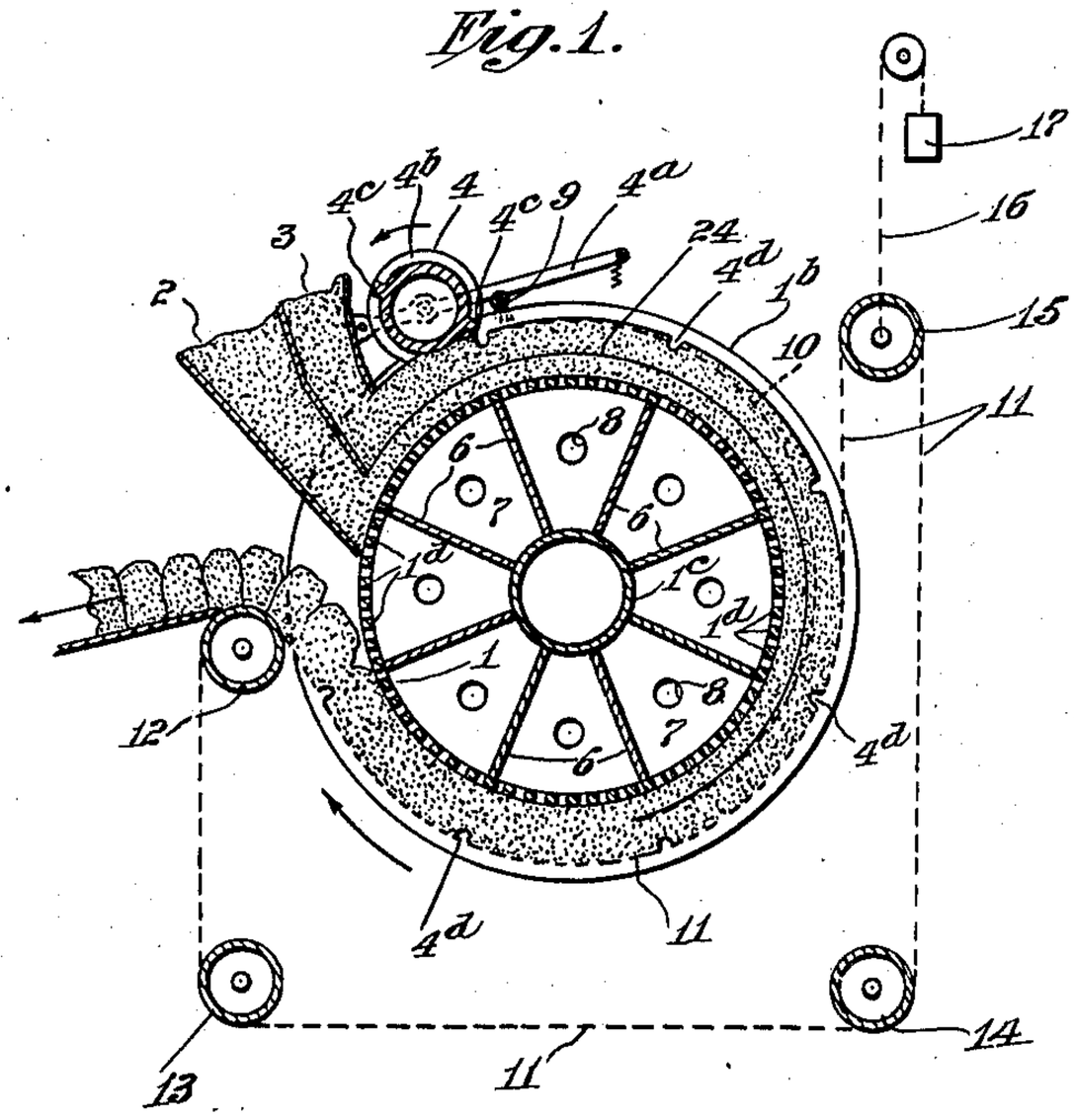

Fig. 2.

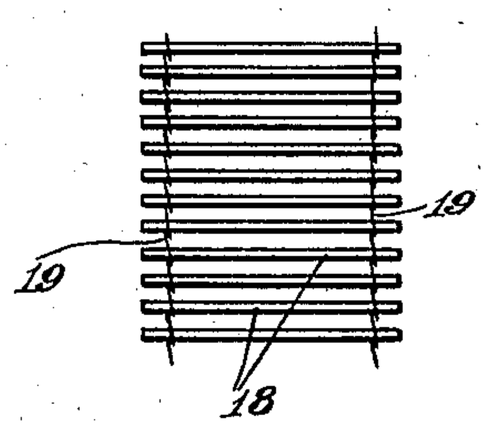

Fig. 3.

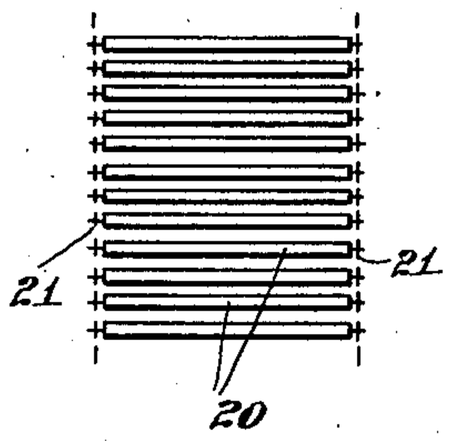

Fig. 4.

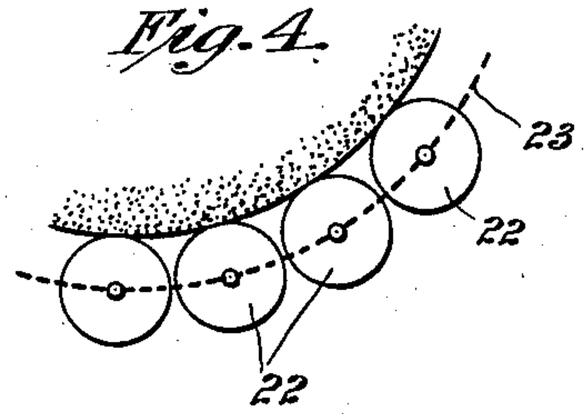

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Fig. 5.

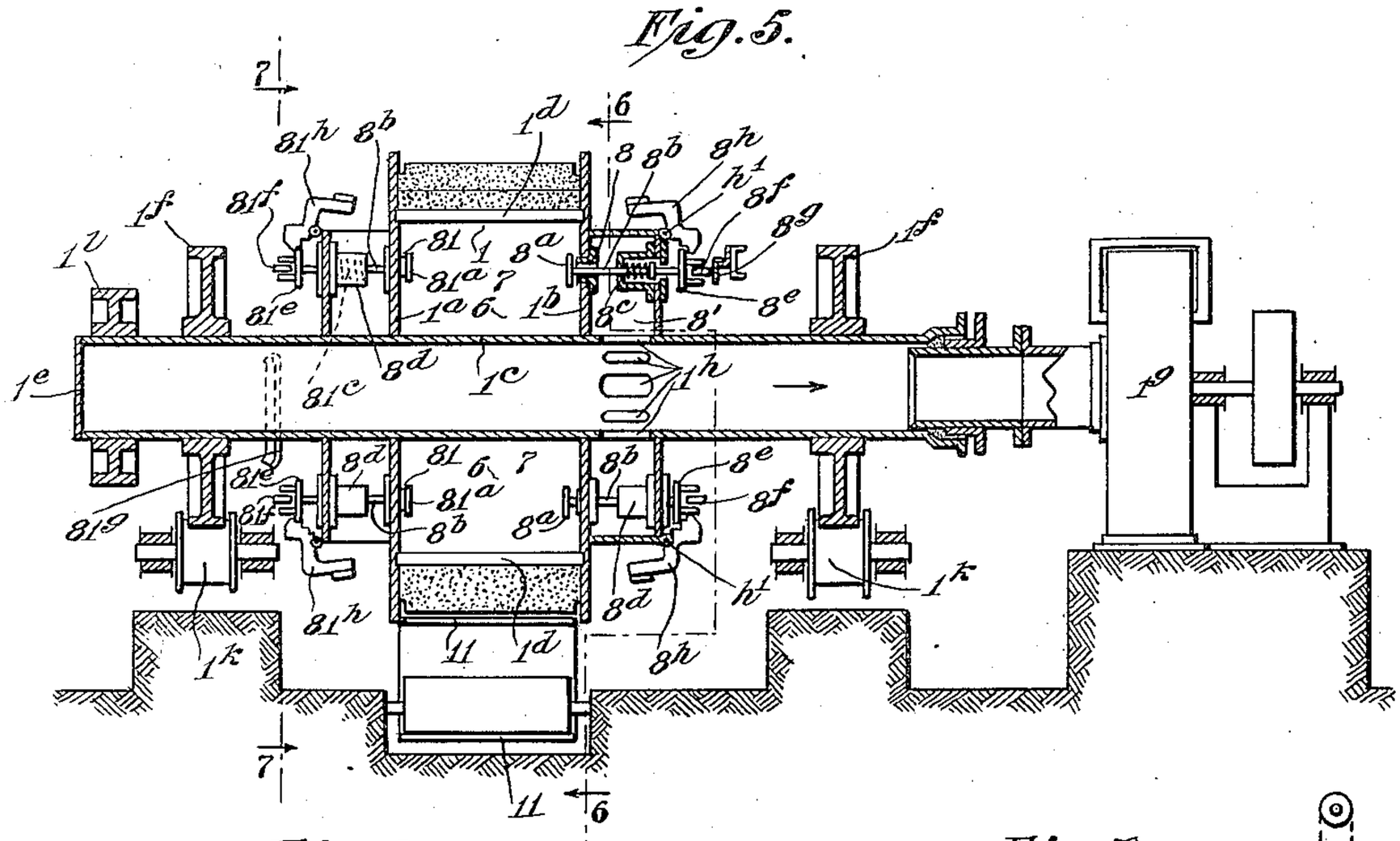


Fig. 6.

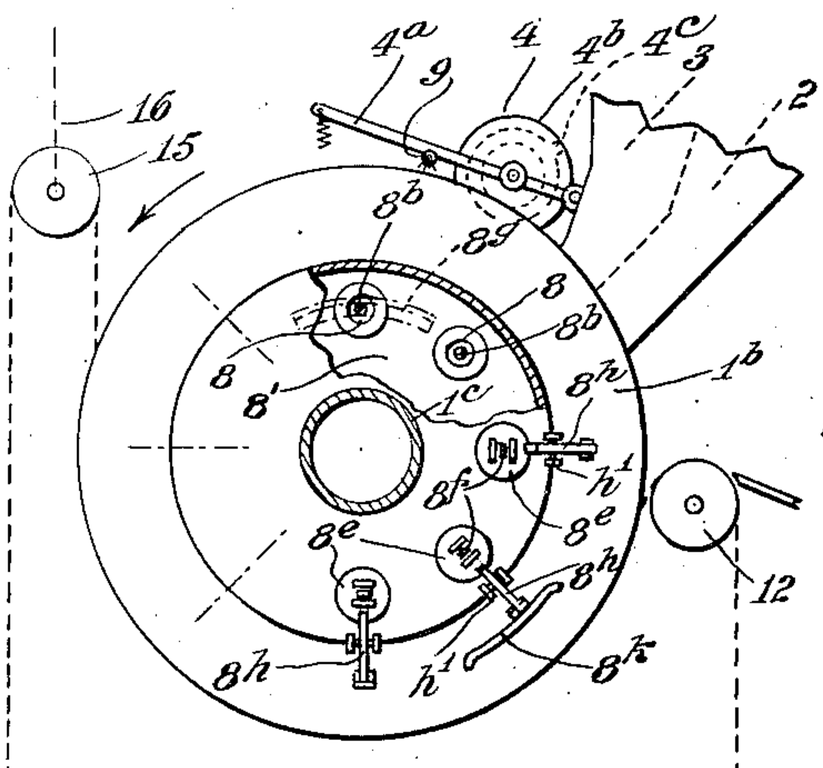


Fig. 7.

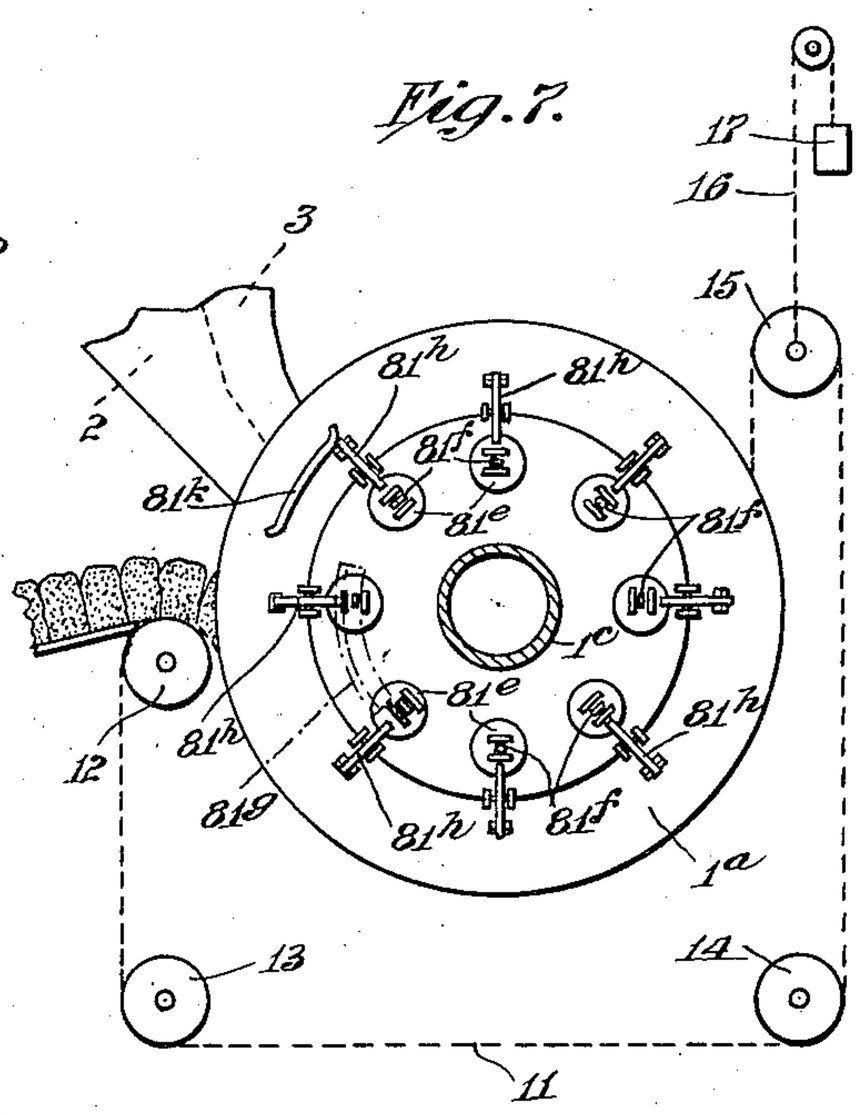
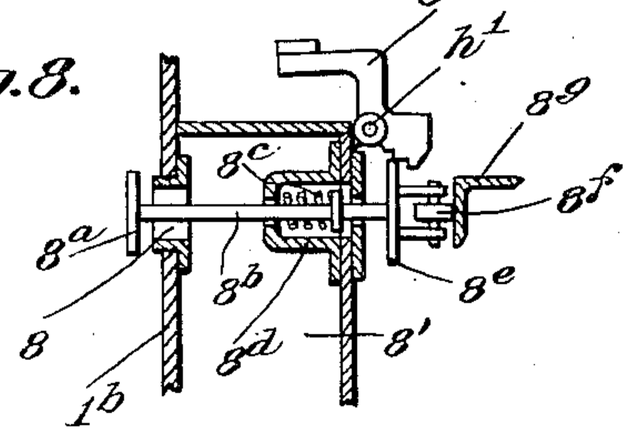


Fig. 8.



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Patented July 12, 1938 2,123,593

UNITED STATES PATENT OFFICE

2,123,593

TREATMENT OF SOLID MATERIAL WITH GASEOUS MEDIA

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Application February 6, 1937, Serial No. 124,512
In Great Britain February 6, 1936

7 Claims. (Cl. 263—33)

In Letters Patent of the United States No. 2,024,453 dated December 17, 1935 and granted to F. L. Smidth & Co. of New York, N. Y., the present assignee, as the assignee of Mikael Vogel-Jorgensen, the present applicant, there is shown and described an apparatus comprising a drum-like carrier upon the gas permeable periphery of which the material to be treated, such as finely divided cement material, or other raw material which may be treated with gases, is deposited at one point in the rotation of the drum, is held thereon in part by the differential of air pressures at the surface of the mass on the drum and on the other surface of the drum and is discharged therefrom at another point in the rotation of the drum where the pressures are equalized, the mass of material being then discharged from the drum by the action of gravity. In the continued use of such apparatus and in its adaptation to diverse uses in industry and particularly in the metallurgical and cement industries it has been found that while retaining the general principle of operation disclosed in said Letters Patent some modifications in structure have been found desirable and it has been the object of the present invention to provide an apparatus of the same general type which is more efficient in operation.

The development of the present invention has been particularly concerned with the attempering or sintering of ores, but it will be obvious as this description proceeds that the invention is capable of application to other specific uses also with improved results, as for example, the burning of cement or drying of materials. In the particular embodiment of the invention shown and described herein the construction is such that a layer of sintered ore is applied directly to the gas permeable surface of the carrier and there is then superimposed on the layer another layer of finely divided ore or other material and by the application of flame to the outer surface of the second layer the mass of the second layer is ignited and attempering or sintering of the material is effected, the sintering being carried on in the continued movement of the carrier until the entire mass is homogenized and formed into a cake whereafter the mass is discharged from the carrier and is broken into small masses capable of being handled readily in the further treatment of the mass, the outer surface of the mass when formed on the carrier being impressed with transverse indentations or grooves which make it easier for the mass to break as it passes at an angle over a discharge roller or lip or bar. In accordance with the invention provision is also made for preventing the falling of the mass from the carrier under the influence of gravity until the treatment of the mass has been completed and also for the maintenance of a negative pressure or partial vacuum within the carrier to hold the mass against the surface of the carrier and to break such partial vacuum in order to permit the discharge of the broken mass from the carrier at the predetermined point of discharge.

The invention will be more fully explained hereinafter with reference to the accompanying drawings in which it is illustrated, and in which:

Figure 1 is a partly diagrammatic view in sectional elevation of a simplified form of the apparatus, from which are omitted details of construction which will be referred to.

Figures 2, 3 and 4 are detail views of different types of auxiliary supporting devices.

Figure 5 is a view in longitudinal section of a form of apparatus which embodies the invention, including such appurtenances as are to be described.

Figure 6 is a view of the apparatus in partly sectional elevation as seen from the right hand in Figure 5, the lower right hand quadrant being shown in elevation, the upper right hand quadrant being shown in section on the broken line 6—6 of Figure 5, and the remainder of the apparatus being shown in outline.

Figure 7 is a view in end elevation as seen from the left hand on the line 7—7 of Figure 5.

Figure 8 is a detail view, in sectional elevation and on a larger scale than Figure 5, of one of the valve actuating mechanisms.

The embodiment of the invention illustrated in the drawings is intended primarily for attempering or sintering ore. It comprises a grated rotary drum 1 having end plates 1^a and 1^b, mounted on a tubular shaft 1^c and supporting grate bars 1^d (affording perforations to permit the passage of air or other gaseous medium) which are parallel with the axis of the drum. The tubular shaft is shown as closed at one end, as at 1^e, and as receiving tires 1^f, resting on supporting rollers 1^k, and a pulley 1^l through which the drum may be rotated. At its other end the tubular shaft 1^c is connected to an exhaust fan 1^g, the tubular shaft being provided with openings, as at 1^h, through which the exhaust fan is connected with the interior of the drum. Radial partitions 6 divide the interior of the drum into chambers 7 and each chamber is

connected through a port 8 with a chamber 8' which communicates with the interior of the shaft 1c through the openings 1h. The interior of each chamber of the drum may thus be placed in communication with the tubular shaft 1c and the exhaust fan 1g.

Each port 8 is controlled by a disc valve 8a mounted on a stem 8b and normally closed by a spring 8c in a spring housing 8d. Outside of the housing the stem of the valve, which may be squared to be held from rotation, is armed with a flange 8e and a roller 8f which coacts in the rotation of the drum with a cam rail 8g, whereby at the proper time in the rotation of the drum the valve 8a is forced from its seat and the interior of the chamber is placed in communication with the tubular shaft 1c and the exhaust fan 1g.

A stepped bell crank lever 8h, pivoted at h1, coacts with the flange 8e to hold the valve 8a from its seat after the roller 8f has left the cam rail 8g until the upper arm of the bell crank detent 8h coacts with a cam rail 8k, thereby disengaging the detent from the flange 8e and permitting the valve 8a to be closed by the spring 8c.

In the opposite end wall of each chamber 7 is a port 81 for the admission of air to the chamber for the purpose of breaking at the proper time the partial vacuum which has been created in the chamber by the action of the exhaust fan 1g. This port 81 is controlled in the same manner as already described with respect to the port 8 by a valve 81a, held normally closed by a spring 81c and opened under control of a detent 81h by the coaction of a roller 81f and a cam rail 81g and closed again when detent 81h is disengaged from flange 81e by coaction with a cam rail 81k. Each valve controlling mechanism, for the admission of air to each chamber 7, may be in all respects precisely similar to the valve controlling mechanism for the port 8 and therefore need not be described more in detail herein.

Pre-sintered material is supplied through a chute 2 to the gas permeable surface of the grated carrier drum and forms on the peripheral surface of the carrier drum a layer which protects the drum from the destructive action of the heat developed in the attempering or sintering of the material which is delivered through a chute 3 and is superimposed as a layer on the protective layer above referred to. Line 24 of Figure 1 indicates the line of demarcation between the protecting layer of sintered ore and that to be sintered. This line has been indicated as extending somewhat more than half way around the drum and at the point indicated by its end the process of attempering or sintering is presumed to have been completed and the two layers of material amalgamated as a homogeneous cake of thoroughly sintered material.

The raw material itself containing a combustible element or being mixed with fuel and superimposed on the protective layer of pre-sintered material is subjected to the action of flame from a burner 9, the combustible element being thereby ignited and burning with sufficient intensity to effect a complete sintering of the raw material and an amalgamation of the same with the pre-sintered material of the inner layer. The progress of the sintering of the material is indicated by the broken line 10 of Figure 1.

For the purpose of compressing somewhat the layer of raw material mixed with fuel there is provided a roller 4 which is carried by spring-pressed arms 4a and thereby pressed firmly against the material on the drum to compact the same. The roller 4 is provided at its ends with flanges 4b which separate the material on the drum, at least at its surface, from the end walls 1a and 1b of the drum. The roller 4 is also provided with blades 4c which, as the roller rotates through frictional contact with the material on the drum, are pressed into the material on the drum and mark it with transverse grooves, as at 4d, which facilitate the breaking of the cake of material as it is discharged from the drum.

It will be understood that when the material is first placed upon the drum and passes beyond the pressure roller 4 and approaches the vertical axis of the drum in the upper arc of its movement it will be held to the drum throughout the upper arc by its own weight as well as by the suction which is applied to the interior of the drum through the opening of the ports 8. When the material has passed in the clockwise rotation of the drum beyond the upper arc the influence of gravity in holding the material on the drum is diminished and lost and it might be that in the drying out and heating of the material the material might fall away from the drum during its movement through the lower arc of rotation. Accordingly there is provided an auxiliary or supplemental support for nullifying the effect of gravity on the material during the lower arc of movement of the drum and preventing such undesirable action. As shown in Figures 1, 2 and 3 such supplemental support consists of an endless gas permeable belt 11 carried on rollers 12, 13, 14 and 15, the roller 15 being connected by a chain 16 to a counter-weight 17 for the purpose of maintaining the chain belt 11 in contact with the material. Such chain belt may consist of bars 18 flexibly connected by wires or chains 19, as shown in Figure 2, or by rollers 20, connected by chains 21, as shown in Figure 3. This auxiliary support might also be formed of rollers 22 linked together by chains 23, so that each roller may rotate on its own axis while held in contact with the material on the drum.

As the cake of sintered material passes from the drum over the belt supporting roller 12 and is made thereby to change direction it will break into small pieces facilitated by the indentations.

In the operation of the apparatus the perforated surface of each chamber 7 of the drum, as the drum rotates in a clockwise direction, receives from the chute 2 a relatively thin protective layer of the pre-sintered material and immediately thereafter receives superimposed on the protective layer, from the chute 3, the layer of raw material containing a combustible element or admixed with a fuel, both layers being compressed by the roller 4 and marked by the flanges and blades of that roller. In the continued movement of the drum each chamber 7, as it passes beyond the vertical plane, is subjected to suction through the described connection to the exhaust fan, the valve 8a of the chamber being opened by the described mechanism and held open until the chamber has passed through the lowermost position, whereby the cake of material is held to the surface of the chamber by suction or partial vacuum within the chamber against the action of gravity, accidental separation of the cake from the surface of the chamber being further guarded against by the auxiliary support 11. As each chamber passes toward the point of discharge beyond the vertical axis of the drum in the lower arc of its movement the valve 8a is closed by its spring (the detent 8h having been disengaged by

coaction with cam rail 8k), and at that time the valve 81e is opened by the described mechanism and air is admitted to the chamber to destroy the partial vacuum within the chamber. The cake being thus released separates from the surface of the drum and breaks as it moves through the angle over the roller 12. This described action takes place for each chamber of the drum carrier and the cake of attempered or sintered homogenized material passes continuously from the discharge point to be received in a receptacle preparatory to further treatment in another apparatus if desired.

While the invention has been described herein with particular reference to the use of apparatus in sintering ores, it will be understood that the invention is not restricted to use for attempering or sintering ores and that the apparatus illustrated may be used for burning cement material, or for drying cement materials, or other materials, or for any other process in which solid materials are treated with gases. It will be understood that various changes may be made in details of construction and arrangement to suit different conditions of use and that, except as pointed out in the accompanying claims, the invention is not restricted to the particular construction shown and described.

I claim as my invention:

1. An apparatus for the attempering of solid material comprising a rotary drum provided with a plurality of radial chambers, each chamber having a gas permeable peripheral surface and closed at its end except for an air suction port, means to supply material to be treated to the peripheral surface of each chamber as the drum rotates, means to subject each chamber to suction as it approaches the vertical axis of the drum in the upper arc of its movement and passes through the upper arc of movement, means to terminate the suction as the chamber passes beyond the vertical axis of the drum in the lower arc of movement and approaches the point of discharge of the material, each chamber being provided at one end with an air suction port and at the other end with an air inlet port, and means to admit air through the inlet port as the chamber approaches the point of discharge of the material.

2. An apparatus as described in claim 1, and in which each chamber is provided at one end with an air suction port and at the other end with an air inlet port, a valve to control the air suction port, a valve to control the air inlet port, and means to actuate the valves.

3. An apparatus as described in claim 1, and in which each chamber is provided at one end with an air suction port and at the other end with an air inlet port, a valve to control the air suction port, a valve to control the air inlet port, springs coacting with the valve to close the ports, and means acting on both valves to move them to open the ports.

4. An apparatus as described in claim 1, and in which each chamber is provided at one end with an air suction port and at the other end with an air inlet port, a valve to control the air suction port, a valve to control the air inlet port, springs coacting with the valves to close the ports, means acting on both valves to move them to open the ports, a detent for each valve to hold the valve from its seat, and means to release both detents.

5. An apparatus as described in claim 1, and in which there is provided an auxiliary gas permeable support to hold the material against the drum and to nullify the effect of gravity on the material during the lower arc of movement of the drum.

6. An apparatus as described in claim 1, and in which there is provided an auxiliary gas permeable support to hold the material against the drum and nullify the effect of gravity on the material during the lower arc of movement of the drum, the auxiliary support consisting of an endless gas permeable chain belt, comprising bars flexibly connected by wires or chains.

7. An apparatus as described in claim 1, and in which there is provided an auxiliary gas permeable support to hold the material against the drum and nullify the effect of gravity on the material during the lower arc of movement of the drum, the auxiliary support consisting of interlinked rollers, said rollers rotating on their own axes while held in contact with the material on the drum.

MIKAEL VOGEL-JORGENSEN.