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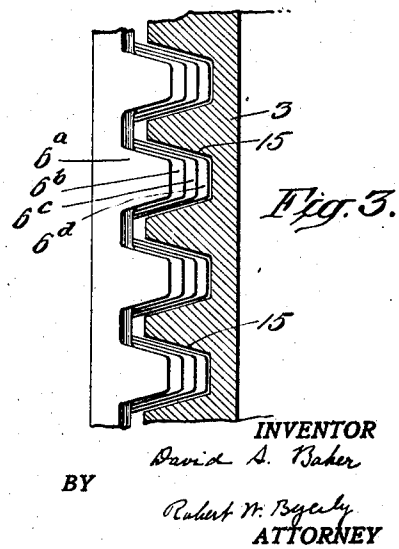
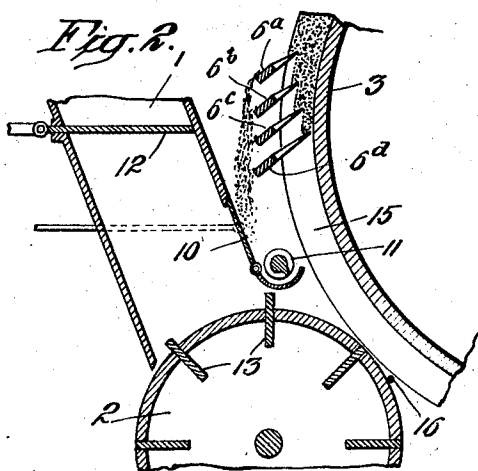
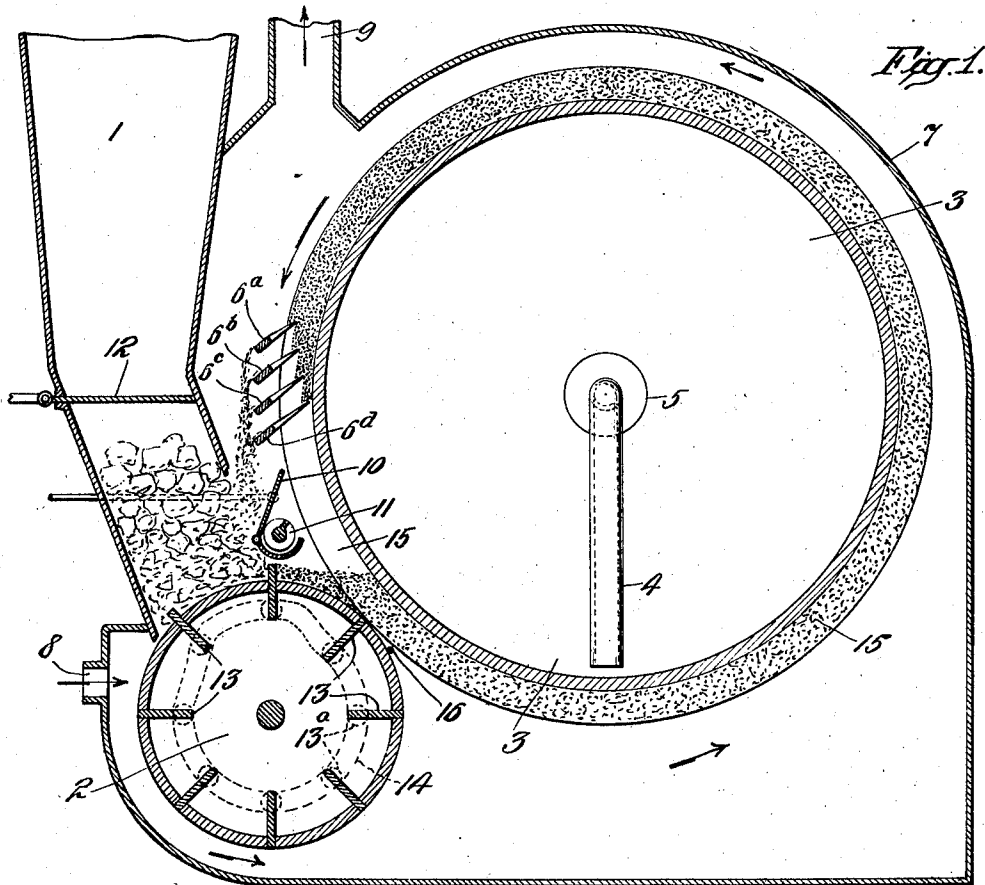
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2,102,607

METHOD AND APPARATUS FOR TREATING MATERIALS

Filed April 17, 1934

3 Sheets-Sheet 1



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Dec. 21, 1937.

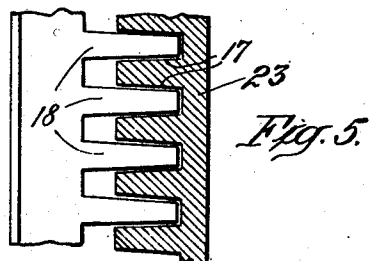
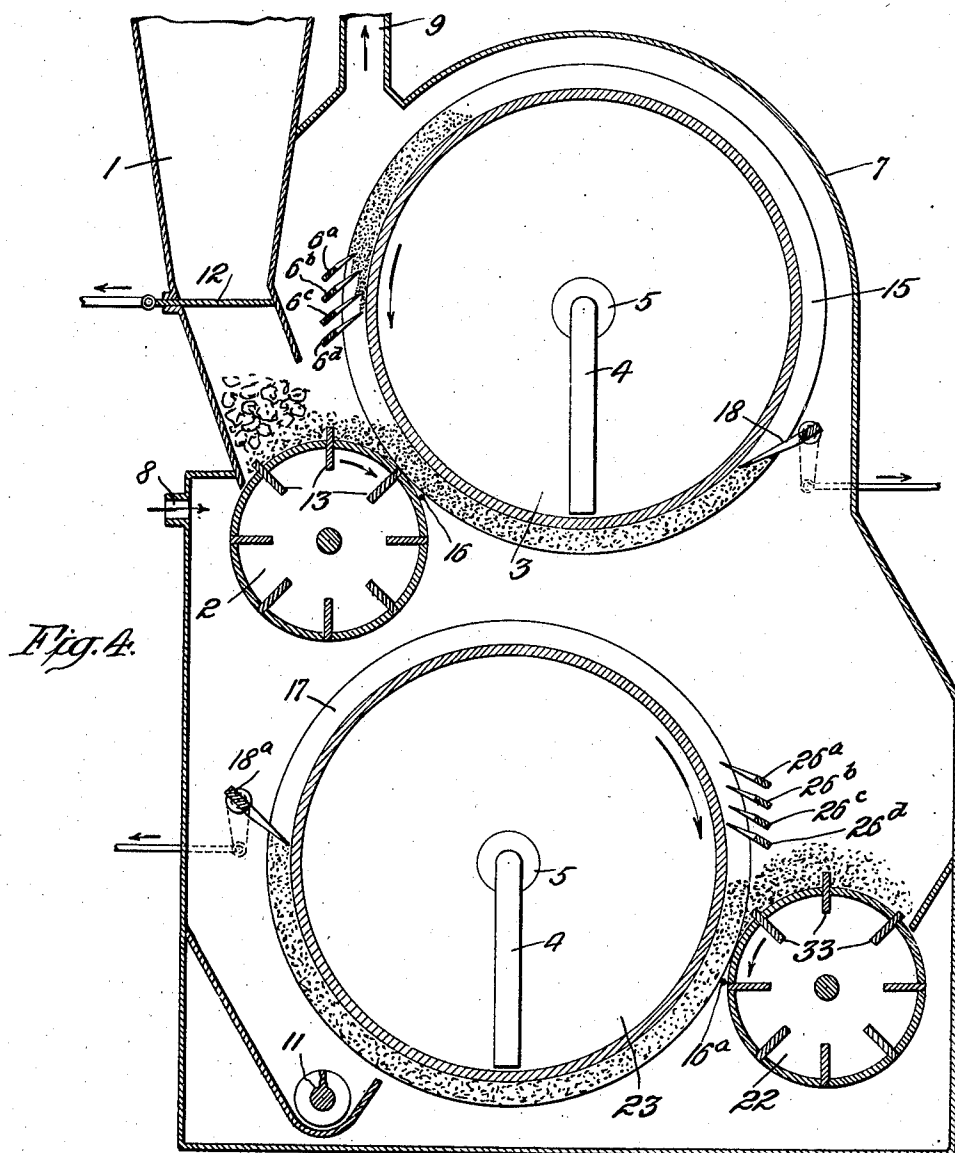
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METHOD AND APPARATUS FOR TREATING MATERIALS

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3 Sheets-Sheet 2



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Fig. 6.

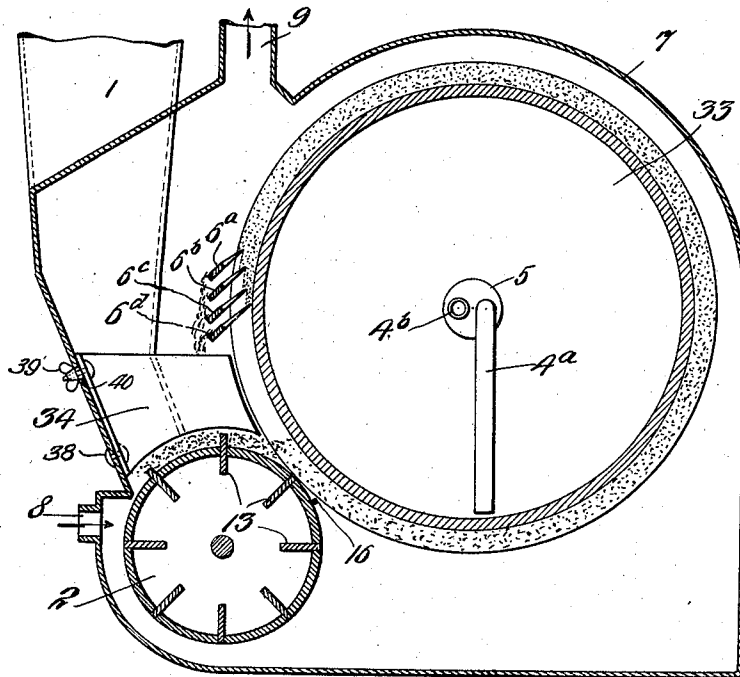


Fig. 7.

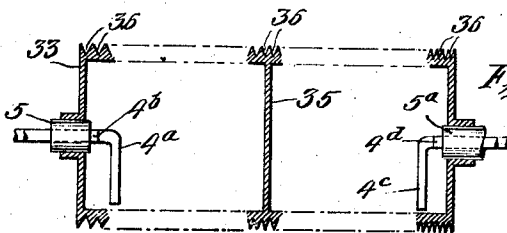
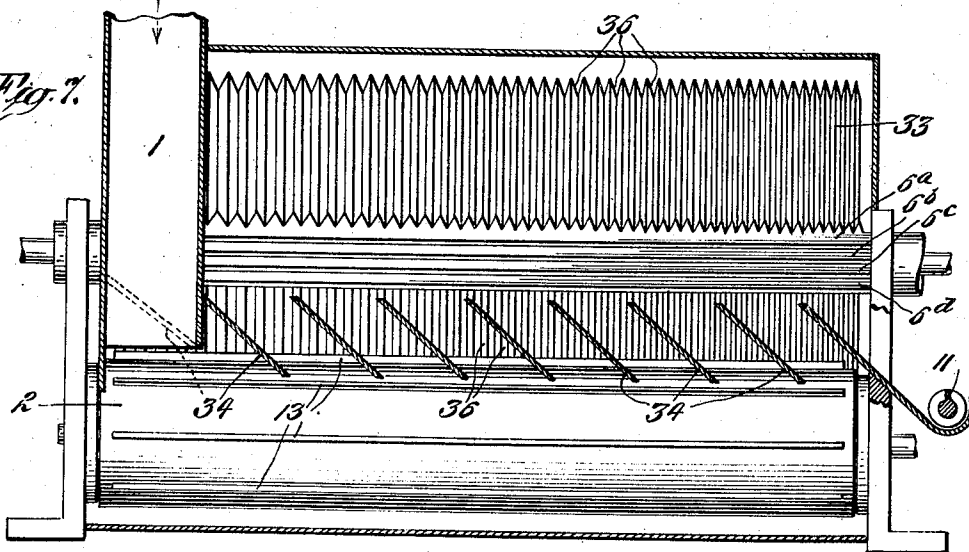


Fig. 8.

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2,102,607

METHOD AND APPARATUS FOR TREATING MATERIALS

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Application April 17, 1934, Serial No. 720,944

27 Claims. (Cl. 34-4)

This invention relates to a method and apparatus for treating materials, one of its applications, in connection with which I have described my invention herein, being to modify either or both of the conditions of temperature and moisture content of the materials treated. While my invention is particularly adapted for treatment of plastic materials of all kinds, including gypsum, aluminum hydrate, zinc stearate, lithopone and paint pigments generally it is also applicable to a great variety of other materials and may be used to advantage, for example, in heat treating finely divided materials such as grains and the like.

Heretofore devices have been used in which the material to be treated is rotated within a hollow drum. This method is subject to several disadvantages. The material in the drum tends to form into balls, the outside of which become hardened, preventing the drying of the material within the balls. Where the treatment consists in drying the material, difficulty is experienced due to the dusting of the material after it becomes partially dry.

My invention makes it possible to overcome the difficulties heretofore experienced, and, at the same time materially decreases the time required for treating the material, and otherwise effects a substantial economy.

In accordance with my invention, the material to be treated is repeatedly and alternately (1) formed into a layer adapted to be efficiently heated or cooled, and (2) broken up and disintegrated so that it may be acted on by the atmosphere or other gas. These operations are repeated until the desired conditions of temperature of moisture content, or both, have been attained.

The term "drum" dryer is used herein to indicate the class of drying apparatus in which the drying operation takes place on the external surface of a revolving drum. Such dryers are distinct from rotating kilns in which the material is introduced inside of the cylinder. The latter class of dryers are commonly referred to as "rotary" dryers.

In the case of a "drum" dryer the heat is applied to the internal surface of the drum and the material to the outside surface of the drum. In the internal or "rotary" dryer the heat and the material are both applied to the same surface. Moisture is free to escape from the "drum" dryer along lines perpendicular to the axis of rotation of the drum. In the internal or "rotary" dryer the moisture cannot escape directly but must pass

along the surface of the rest of the material on a line substantially parallel to the axis of rotation of the kiln.

While the exact mechanical arrangement of the parts of my device is subject to wide variation, I have, for the sake of illustration, shown in the accompanying drawings specific embodiments of my invention whereby the material to be treated may be supplied either intermittently in separate measured batches or continuously. Other objects and advantages of my invention will be apparent if the following detailed description and the claims appended thereto are read in connection with the drawings in which:

Fig. 1 is a vertical cross-section of my apparatus;

Fig. 2 is a detail view of the measuring, applying, and removing means illustrated in Fig. 1;

Fig. 3 is a fragmentary view illustrating the action of the material removing means;

Fig. 4 is a vertical sectional view of a modification of my device employing a plurality of material receiving surfaces;

Fig. 5 is a fragmentary view, showing a modification of the surface illustrated in Fig. 3;

Fig. 6 is a vertical cross-section of another form of my apparatus;

Fig. 7 is a front plan view, partly in cross-section of the form of my apparatus shown in Fig. 6; and

Fig. 8 is a vertical cross-section of the cylindrical receiving member forming part of the embodiment of my invention illustrated in Figs. 6 and 7.

Referring now to the drawings, the numeral 1 refers to a hopper from which material to be treated is supplied to the rotary cylinder 2 and transferred thereby to the surface of the rotary cylinder 3, the temperature of which, if desired, may be controlled by any suitable means such as the steam connection 4 admitted to the interior of the cylinder through the trunnion 5. The rotary cylinders 2 and 3 are adapted to rotate inwardly with respect to one another and are so positioned relatively that the scrapers 6a, 6b, 6c, and 6d may be positioned adjacent the surface of the member 3 and in the pathway of material thereon, and, at the same time, be positioned directly above the member 2. Material separated from the member 3 by the scrapers 6a, 6b, 6c and 6d is, therefore, returned by gravity to the surface of the member 2 and re-applied to the surface of the member 3. In this way the material is continually broken up and exposed to the action of the atmosphere or other gas which

is supplied to the casing 7, through the inlet port 8, and exhausted therefrom through the port 9.

If desired, for accelerating the treatment of the material, air or other gas under pressure may be applied to the material, preferably just after it is broken up and removed from the retaining surface.

It will be noted that the scrapers 6a, 6b, 6c, and 6d are arranged at different distances from the surface of the member 3, thereby more effectively breaking up the material on the surface of the member 3 by removing it in successive layers as illustrated in Figs. 1 and 3.

When the material being treated has attained a predetermined condition, or for any reason it is desired to terminate the successive operations of applying the material to the surface of the member 3 and removing it therefrom the member 10 is interposed between the member 2 and the scrapers 6a, 6b, 6c, and 6d and the separated material is diverted thereby to the screw conveyor 11 by which it is evacuated from the casing 7.

Within the hopper 1 a valve member 12 is provided which is opened to admit material to the surface of the member 2, but which is closed when the space between it and the surface of the member 2 has become filled, thereby permitting only a predetermined or measured amount of material to be supplied to the surface of the member 3.

Any suitable means of feeding, spreading, depositing or otherwise applying material to the surface of the member 3 may be used, but I have found it particularly desirable to use the feeding means fully set forth and claimed in my co-pending application for Letters Patent of the United States, Serial No. 713,117, filed February 27, 1934. Since the feeding means per se forms no part of my present invention, I will describe it only briefly herein. The hollow rotatable member 2 is provided with a number of radial vanes 13 adapted to be projected through apertures in its periphery, and each of said vanes is provided with a cam roller 13a mounted in a cam race 14 whereby the vanes are projected during the portion of each revolution of the member 2 when they are travelling through the space enclosed by the hopper 1, but are withdrawn before reaching the point of closest approach between the members 2 and 3. The vanes 3 serve to engage the material in the hopper and force it against the surface of the member 3 and into the grooves 15 provided thereon. The wire 16 is positioned adjacent to and extending longitudinally across the surface of the member 2 below the point of closest approach to the member 3, to separate material adhering to the surface of the member 2, this means having been found to be particularly desirable as is explained more fully in my said co-pending application.

As illustrated herein the grooves 15 provided on the surface of the member 3 are substantially V-shaped. This structure has the advantage of bringing a maximum surface in contact with the material being treated, which is of obvious advantage in any operation involving the transfer of heat. Since in the operation of my invention, the material receiving surface is heated internally and the material to be treated is applied externally, the material itself serves to insulate the heated surface, thereby greatly reducing the amount of heat consumed.

In practicing my invention, it may be desirable under certain conditions to successively

apply the material being treated to two or more different surfaces. I have found that, in reducing the moisture content of some materials, it is desirable to use a surface having comparatively wide material receiving grooves, such for example as those numbered 15 in Fig. 3, until a portion of the moisture content has been removed, and to complete the operation on a second surface having grooves which are deeper and narrower in cross-section, such, for example, as those numbered 17 in Fig. 5.

It may also be desirable in some instances to modify either the heat applied to the material or the frequency with which the material is removed from the surface. Thus, for example, it may be desirable to apply the material to a surface heated to a high degree and moving at a low rate of speed, while said material retains a high percentage of moisture, but, when the moisture content has been reduced, it may be found that under these conditions the material is becoming overheated. Overheating may be avoided either by increasing the frequency with which the material is removed from the surface, or by reducing the temperature of the surface, and one way of accomplishing this is to transfer the material from one surface to another having a different temperature or speed.

A modified form of my device employing a plurality of surfaces is illustrated in Fig. 4. The material is supplied through the valve 12 in the hopper 1 to the feeding member 2 by which it is applied to the external surface of the member 3, which is supplied with a heating medium through the tube 4 entering the member 3 through the trunnion 5. The material is received in the grooves 15 on the surface of the member 3 and carried through a portion of the rotation of the member 3 until it is removed therefrom by the scrapers 6a, 6b, 6c, and 6d arranged at spaced intervals from the surface of the member 3, for the reasons set forth above. The material, after being removed from the member 3, is returned by gravity to the member 2 and re-applied to the surface of the member 3, and these operations are successively repeated until the material has attained the desired conditions of temperature and moisture content or until it is, for any reason, desired to transfer the material to another surface.

The transfer is accomplished by projecting the movable scraper 18 into the path of the material on the member 3 intermediate the member 2 and the scrapers 6a, 6b, 6c, and 6d, thereby removing the material from the member 3. The separated material is transferred by gravity to the feeding member 22 by which it is applied to the surface of the member 23. The material is carried on the surface of the member 23 until it is removed therefrom by the scrapers 26a, 26b, 26c, and 26d, and returned by force of gravity to the feeding member 22 to be re-applied to the surface of the member 23. These operations are repeated until the treatment of the material is completed or it is desired for any reason to remove the material when the movable separating means 18a is projected into the path of the material on the member 23 intermediate the member 22 and the separating means 26a, 26b, 26c, and 26d, and the separated material is directed to the conveyor 11 by which it is evacuated from the casing 27.

All of the operations described herein may be performed by automatic means as will be readily understood by those skilled in the art. Thus, for example, automatic timing means may be pro-

vided so that the member 10 will be automatically closed at a predetermined time, thereby diverting the material to the conveyor 11 to be evacuated from the casing, and it is to be understood that either automatic or hand-operating means are within the scope of my invention.

In the embodiments of my invention described above, the material to be treated is supplied intermittently in measured batches. In the form of my invention illustrated in Figs. 6, 7, and 8, the material to be treated is continuously supplied to one portion of the receiving surface and is progressively advanced across said surface.

The material is supplied from the hopper 1 to a portion of the surface of the material-applying member 2 adjacent one end, and is transferred thereby to a corresponding portion of the surface of the rotary cylinder 33 and is rotated thereon until it is brought into contact with the scrapers 6a, 6b, 6c, and 6d, by which it is separated from the said surface and broken up. Instead of dropping back onto the portion of the member 2 to which it was first supplied, the separated material falls upon the first of a series of deflectors 34, by which it is advanced to the portion of the member 2 adjacent to the portion to which it was originally supplied, and is applied to the corresponding portion of the surface of the rotary cylinder 33. The steps of separating, advancing and applying the material are repeated until the material has been advanced across the entire length of the receiving surface, and the treated material is then discharged into the conveyor 11.

In order to eliminate the necessity for transferring the material from one receiving surface to another to vary the condition of temperature, the interior of the cylindrical member 33 is divided into a plurality of chambers by the partition 35, and differentially heated mediums are supplied to and removed from said chambers by the conduits 4a and 4b, and 4c and 4d, admitted to the interior of the respective chambers through the trunnions 5 and 5a.

As illustrated in Fig. 8, the material retaining grooves 36 are made progressively narrower from the point where the material is first applied to the receiving surface to the point where the treated material is discharged. This structure corresponds in a general way with the diminishing moisture content of the material being treated and enables the progressively dried material to be retained on the same receiving surface.

It is desirable that the deflectors 34 be mounted in any suitable way permitting the angle of deflection and the number of deflectors employed to be varied so that the number of times that the material is separated from the receiving surface and the time required for traversing the surface may be adjusted to the character and condition of the material being treated. As shown in Fig. 6, the deflectors 34 are mounted on the casing 7. By mounting each of the deflectors at its lower end on a pivot 38 and providing it at its upper end with a thumb screw 39 engageable in a slot 40, the inclination of the deflectors may be controlled.

What I claim is:

1. The method of drying material which comprises repeatedly applying, and re-applying it to the same attempering surface in such a manner that while it is disposed on said surface it is divided into a number of spaced units, and disintegrating said units and redistributing the material comprising the units between applications to said surface.

2. A drum dryer, comprising a rotary cylinder,

means for repeatedly applying the material to the surface of the cylinder at one point of its periphery, means for attempering said surface, means for scraping the material from the surface of the cylinder and disintegrating it located at another point of the periphery of the cylinder, and means for directing the disintegrated material from the scraping means to the applying means.

3. A drum dryer comprising a grooved receiving surface, means for attempering said surface, means for applying material to said surface, means for breaking up and removing the material from said surface, and means for returning and re-applying the separated material to the same surface.

4. A drum dryer comprising, a grooved material receiving surface, means for attempering said surface, means for applying material to said surface, material removing and disintegrating means positioned adjacent to said receiving surface, means for causing relative movement between said surface and said removing means to separate the material from said surface, and means including said applying means for returning the separated material to the same surface.

5. Apparatus for attempering plastic material, comprising two adjacent cylinders rotated in opposite directions to transfer the material from the external surface of the first cylinder to the external surface of the second cylinder, means for attempering the surface of said second cylinder, scrapers positioned within the path of the material on said second cylinder, and means for returning to said first cylinder material separated from the second cylinder by said scrapers.

6. In apparatus for treating material, the combination of a receiving surface, a material applying member positioned adjacent said surface, a hopper enclosing a part of the peripheral surface of said member, vanes projectible from the peripheral surface of said member, means for projecting each vane while it is within said hopper and for withdrawing it before it reaches the closest point between said member and said surface, and means for separating the material from said surface and returning it to said member.

7. In apparatus for treating material, the combination of a receiving surface, a rotary material applying member positioned adjacent said surface, means for supplying material to said member, means on said member for pressing material onto said surface, a wire positioned adjacent the surface of said member just below the point of closest approach between said member and said surface to remove material adhering to said member, and means for separating material from said surface and returning it to said member.

8. In apparatus for attempering material, a material receiving surface, means for applying material to the external side of said surface, means for applying a temperature modifying medium to the inner side of said surface, material removing means positioned above said applying means and adjacent to said receiving surface, means for causing relative movement between said surface and said material removing means to separate the material from said surface, and means for returning the separated material to said applying means.

9. A drum dryer comprising in combination of a grooved attempering surface, means for supplying a temperature controlling medium to one side of said surface, means for applying material to the other side of said surface, and means in-

cluding said applying means for removing the material from said surface, disintegrating it and returning it to said surface.

10. A drum dryer comprising in combination
5 a rotary cylindrical member having an external
tempering surface, means for tempering said
surface, means for applying material to said sur-
face, means for breaking up and removing the
material from said surface, and means for re-
10 turning the separated material to said surface.

11. Apparatus for treating material, compris-
ing a rotary cylinder, means for applying the ma-
terial to the surface of said cylinder, means for
scraping the material from the surface of said
15 cylinder, disintegrating it and returning it to the
applying means, a second rotary cylinder, means
for applying material thereto, means for scrap-
ing the material therefrom, disintegrating it and
returning it to said applying means, and trans-
20 ferring means normally out of the path of the
material on the first cylinder and movable into
said path to transfer the material to the apply-
ing means associated with the second cylinder.

12. In apparatus for treating material, the
25 combination of a plurality of differentially heated
receiving surfaces, means for alternately apply-
ing the material to and removing it from one of
said surfaces, means for transferring the mate-
rial to the other of said surfaces, and means for
30 alternately applying the material to and remov-
ing it from said other surface.

13. In apparatus for treating material, the
combination of a plurality of differentially scored
35 receiving surfaces, means for alternately apply-
ing material to and removing it from one of
said surfaces, means for transferring the mate-
rial to the other of said surfaces, and means for
alternately applying the material to and remov-
ing it from said other surface.

14. In a drum dryer, the combination of a re-
40 ceiving surface, means for tempering said sur-
face, means for continuously supplying material
to one portion of said surface, means for sepa-
rating the material from said surface, means for
changing the position of said material relatively
45 to said receiving surface, and means for re-ap-
plying the material to another portion of said
surface.

15. In a drum dryer, the combination of an
50 tempering surface, means for differentially at-
tempering different portions of said drum, means
for continuously applying material to one por-
tion of said surface, and means for progressively
advancing the material parallel to the axis of
55 rotation of said surface in a series of steps, each
of which includes separating material from said
surface and reapplying it to said surface.

16. In a drum dryer, the combination of an
60 tempering surface having differentially scored
portions, means for continuously applying ma-
terial to one portion of said surface, and means
for progressively advancing the material upon
said surface.

17. In a drum dryer, the combination of an
65 tempering surface, means for tempering said
surface, means for applying material to said sur-
face, means for separating the material from
said surface, and means interposed between said
separating means and said applying means for
70 intercepting the separated material, advancing
it laterally of said surface, and returning it to
said applying means to be re-applied to said sur-
face.

18. The method of tempering material which
75 comprises repeatedly removing the material

from an tempering surface onto a second sur-
face adapted to receive material separated from
said tempering surface and to transfer it onto
said tempering surface, including an interme-
5 diate step of separating the material and return-
ing it to the second surface.

19. The method of tempering plastic mate-
rial which comprises repeatedly molding the
material in some of a series of molds contained
in an tempering surface, tempering said sur-
10 face, removing the material from said molds,
disintegrating it and advancing it along the said
surface and remolding it in some of the molds
contained in said tempering surface.

20. A drum dryer comprising a grooved at-
15 tempering surface, means for tempering the
said surface, means for pressing material to be
treated into the grooves of said surface, means
for separating the material from said grooves,
means for advancing the material along the face
20 of said dryer and for returning it to said means
for pressing material into the grooves of said
surface to be retreated upon said surface.

21. The method of tempering material which
comprises molding it in a number of molds in
25 the periphery of a drum dryer, supplying an
tempering medium to the under faces of said
molds, removing the material from the molds,
disintegrating it, and automatically returning it
to the same drum dryer and remolding and re-
30 tempering it.

22. The method of drying materials which
comprises applying the material to the outer
periphery of a cylindrical surface in units of
substantially equal width, disintegrating the
35 material and re-applying it as before to the
same surface in a continuous operation.

23. The method of tempering plastic mate-
rial which comprises applying the material to
the external surface of a revolving drum, attem-
40 pering the said surface, separating the material
from said surface and disintegrating it, advanc-
ing the material along the axis of rotation of
said drum and re-applying it to the external
surface of the same cylinder.

24. The method of tempering plastic mate-
45 rial which comprises applying the material to
the external surface of a rotary cylinder and
confining it in concavities in said surface, at-
tempering the material on a plurality of sides,
50 removing the material from said concavities and
disintegrating it, advancing the material along
the axis of rotation of said cylinder and re-ap-
plying it to the external surface of the same
cylinder and re-confining it in concavities in
55 the surface of the same cylinder.

25. A drum dryer having means for enmesh-
ing material on its surface, means for temper-
ing said surface, means for molding material
upon said surface into units of predetermined
60 shape, means for intermittently removing and
disintegrating the material, adjustable means
for advancing said material a predetermined dis-
tance along the surface of said drum in a direc-
tion substantially parallel to the axis of rotation
65 of said drum, and means for returning the dis-
integrated material to the same drum and re-
forming the material thereon into units of pre-
determined shape.

26. A drum dryer having means for enmesh-
70 ing material on its surface, means for temper-
ing said surface, means for molding material
upon said surface into units of predetermined
shape, means for intermittently removing and
disintegrating the material, means for advanc-
75

ing the disintegrated material along the surface of the drum in a direction substantially parallel to the axis of rotation of said drum, and means for returning the disintegrated material to the same drum and re-forming the material there-
5 on into units of predetermined shape.

27. Apparatus for attempering material having an externally grooved attempering surface,

and means for applying material to said attempering surface arranged so that material separated from said surface is returned to said applying means by gravity, means for separating material from said cylinder at a predetermined point and means for attempering said cylinder.

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