May 4, 1954 K. J. MENNING 2,677,195

APPARATUS FOR TREATING GRANULAR MATERIALS

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FIG. 3.

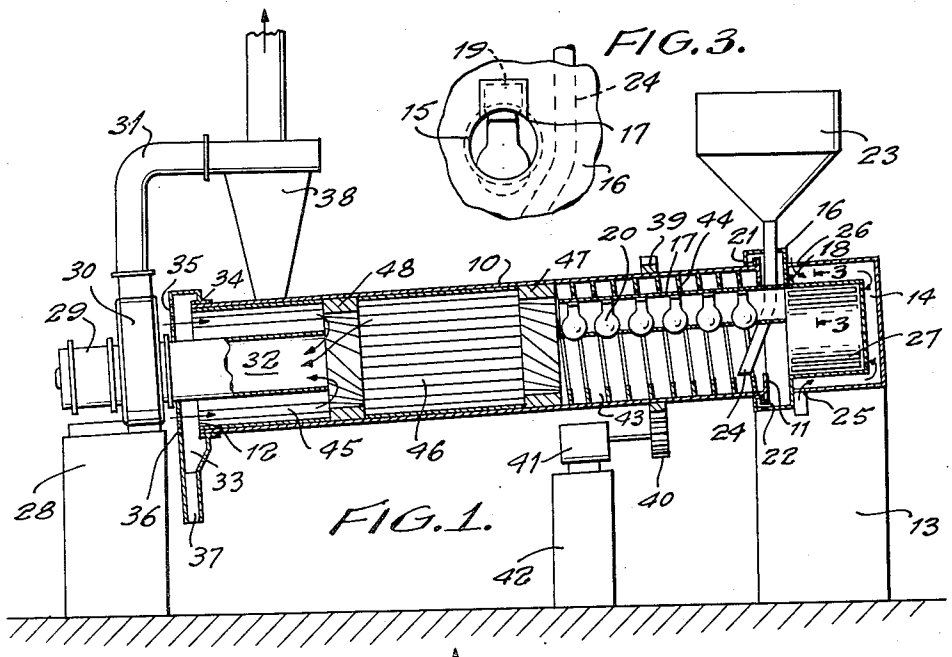


FIG. 1.

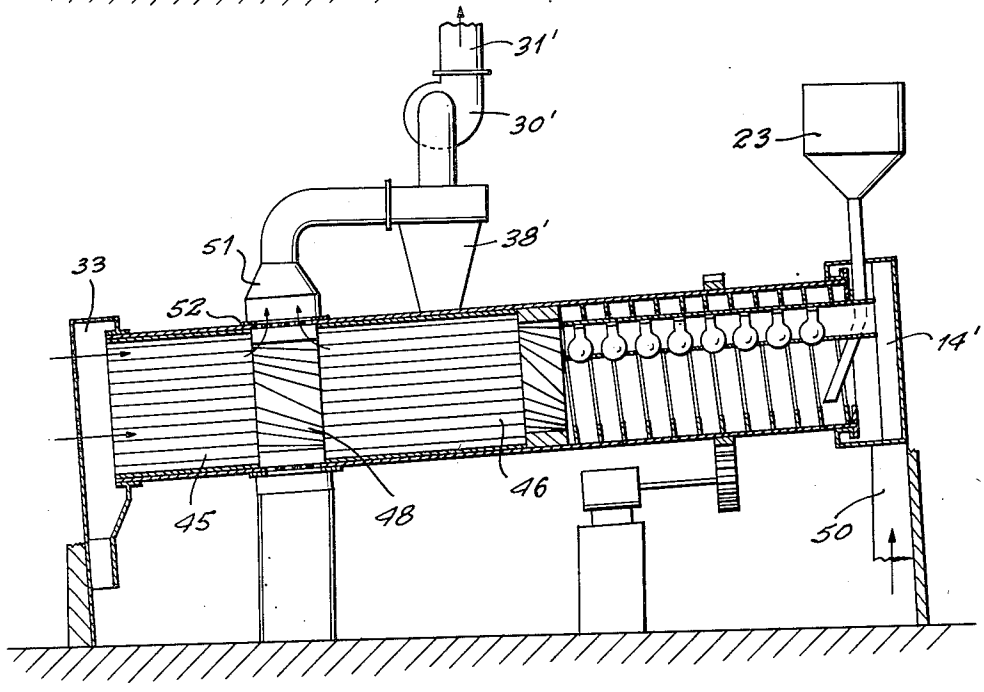


FIG. 2.

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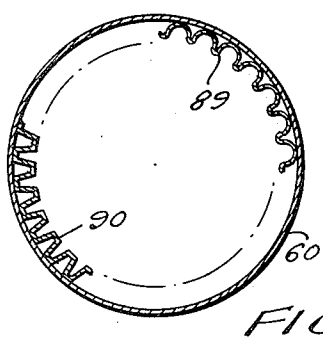
APPARATUS FOR TREATING GRANULAR MATERIALS

Filed June 26, 1951 2 Sheets-Sheet 2

FIG. 5.



FIG. 4.



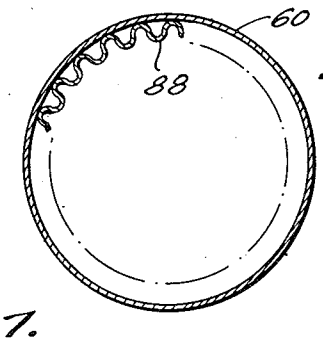


FIG. 6

FIG. 7.

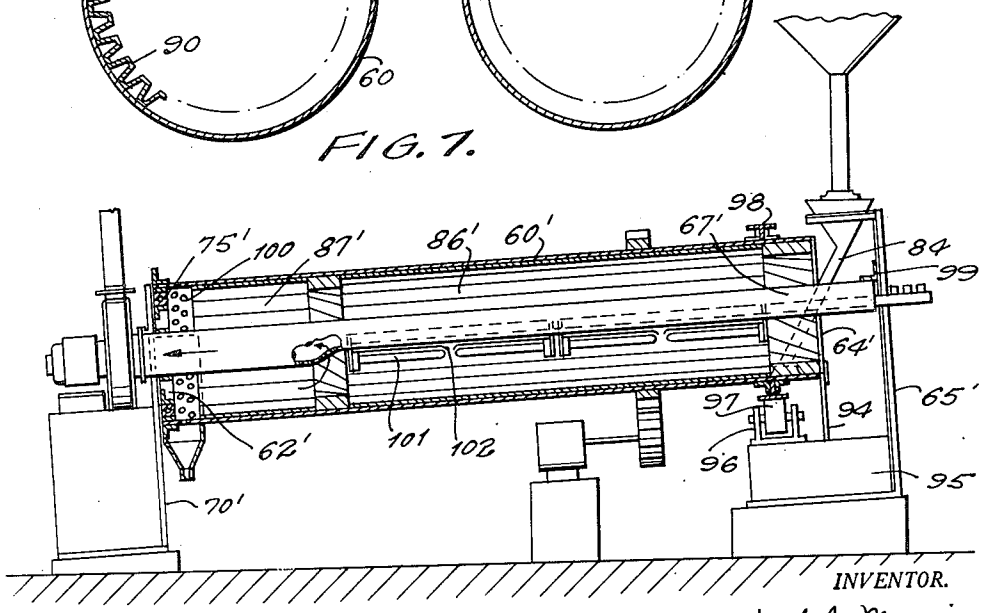


FIG. 8.

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2,677,195

APPARATUS FOR TREATING GRANULAR MATERIALS

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Application June 26, 1951, Serial No. 233,550

Claims priority, application Germany June 26, 1950

17 Claims. (Cl. 34—63)

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The present invention relates to a process and apparatus for treating granular materials such as coffee, grain, barley, pharmaceutical products and vegetable foodstuffs. More particularly, the present invention relates to a process and apparatus for drying and/or roasting, as well as cleaning such granular materials.

One of the objects of the present invention is to provide a process and apparatus for treating granular materials in a continuous, rapid and effective manner.

Another object of the present invention is to provide a process and apparatus for subjecting the granular material only to the influence of infra-red rays during a part of the treatment thereof.

Still another object of the present invention is to fully utilize all of the energy of the infra-red rays.

A further object of the present invention is to provide a means for automatically removing overdried or over-roasted materials.

A still further object of the present invention is to provide a simple mounting structure for the parts of the device of the present invention.

Yet another object of the present invention is to provide a means for observing and regulating the rate of flow of material to the apparatus of the present invention.

With the above objects in view, the present invention mainly consists of a process and apparatus for subjecting the granular material to be treated only to the influence of infra-red rays during one part of its treatment and subsequently cooling the thus treated materials. The material may be dried between the cooling stage and the stage where it is treated with infra-red rays, and the latter may be concentrated by reflectors. The drying of the material is brought about by air which is heated by the infra-red rays, and this air may be preheated before it is further heated by the infra-red rays.

The apparatus for carrying out the invention comprises an elongated rotatably mounted drum which has a closed entrance end and an open exit end. The closed entrance end is mounted at a higher elevation than the open exit end of the drum so that the axis of rotation of the drum is downwardly inclined towards the exit end thereof. The interior of the drum may be provided with two or three portions in which the granular material is processed, and these portions may have inner fluted surfaces so as to guide the granular material in small streams

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along the interior of the rotating drum. A source of infra-red rays is mounted adjacent the entrance end of the drum to subject the material supplied to the entrance end of the drum only to the influence of infra-red rays, and at this portion of the drum, where the material is treated with infra-red rays, the drum may be provided with spiral blading to conduct the material along the drum, rather than a fluted inner surface. The source of infra-red rays is removably mounted in a hollow support. Air conducting means may be located either at the exit end of the drum or before the last treating portion of the drum to conduct fresh air into this last portion through the open exit end of the drum so as to cool and clean the material. This air conducting means may draw air through the hollow support means for the source of infra-red rays so that this air is heated by the source of infra-red rays and dries the material at an intermediate treating portion of the drum. Between the intermediate and last treating portions of the drum, the drum may be perforated and have the air conducting means located around its perforated portion so that any over-roasted or overdried grains of the material will pass through the perforations of the drum and outwardly with the air drawn therethrough.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

Fig. 1 is an elevational, partially diagrammatic and partially sectional view of one embodiment of the apparatus of the present invention;

Fig. 2 is a partially sectional and partially diagrammatic view of another embodiment of the apparatus of the present invention;

Fig. 3 is a view of a detail of the present invention taken along line 3—3 of Fig. 1 in the direction of the arrows;

Fig. 4 is a partially sectional and partially diagrammatic elevational view of still another embodiment of the present invention;

Fig. 5 is a view of a detail of the present invention taken along line 5—5 of Fig. 4 in the direction of the arrows;

Fig. 6 is a transverse sectional view of a part of the drum;

Fig. 7 is a view similar to Fig. 6 diagram-

matically showing two different embodiments of the inner drum surface; and

Fig. 8 is a partially sectional and partially diagrammatic elevational view of still another embodiment of the present invention.

Referring to the drawings, there is shown in Fig. 1 the drum 10 having an entrance end 11 and an exit end 12. The entrance end 11 is at a higher elevation than the exit end 12 so that the axis of rotation of the drum is downwardly inclined towards the exit end thereof.

Located adjacent the entrance end 11 of the drum 10 is the supporting structure 13 upon which is fixedly mounted the chamber 14 and the hollow support 15 which is provided at one end thereof with a rearwardly bent circular flange portion 16. As is apparent from Fig. 3, the hollow support 15 is slotted along its top portion and the opposite sides of the slot are beveled. Mounted in this slot so as to fill the same is the elongated support member 17 which has an upwardly bent end 18 located in overlapping relation over a cut away portion 19 of the flange 16 which communicates with the slot in the upper part of hollow support member 15. The elongated support member 17 also has opposite beveled sides which mate with the sides of the above-mentioned slot. The hollow support member 15 is provided with a plurality of spaced apertures in its lowermost part, and the support member 17 is provided with sockets along the length thereof respectively located over these apertures. In these sockets are mounted infra-red ray lamps 20 which fill and seal the apertures in the lower part of hollow support 15. These lamps 20 may be connected in any suitable manner with a source of current, such as by passing electrical wires through the upwardly bent portion 18 of support member 17 and out through the chamber 14. The flange 16 is provided with an annular bearing surface portion 21 which has a right-angled bend therein, and the entrance end 11 of the drum is provided with an outer annular flange 22 which cooperates with the bearing means 21 to support the drum for rotation.

Supply hopper 23 for the material to be treated is mounted over the drum in any suitable manner, and the conduit 24 extends from the hopper 23 through the flange 16 and into the interior of the drum. As is apparent from Fig. 3, conduit 24 is located to one side of the hollow support 15.

The chamber 14 is apertured at parts 25 and 26 thereof so that air may be admitted into the same, and an electrical heating means 27 is fixedly mounted in the chamber 14 so as to heat such air.

Adjacent the exit end of the drum there is located the support member 28 which has mounted thereon the motor 29 and the fan 30 which communicates at its outlet side with the air discharge conduit 31. The inlet side of fan 30 communicates with the tube 32 which is fixedly connected to the fan and extends into the drum. Mounted about the tube 32 is the collection chamber 33 which is provided with a bearing ring 34 for rotatably supporting the exit end of the drum. The collection chamber 33 is apertured at 35 and 36, for example, and is provided with a discharge spout 37 from which the processed material is discharged. Air discharge conduit 31 communicates with a centrifugal separator device 38 of any known construction for separating dust and any other foreign matter from the discharged air.

The drum 10 may be rotated in any suitable manner, and in the particular example shown a gear 39 is fixedly mounted about the drum and meshes with a pinion 40 driven by the motor 41 which is fixedly mounted on the support 42.

The drum 10 is divided into three portions. The first portion 43 is located adjacent the entrance end of the drum and is provided with the spiral blade means 44 which is fixedly connected to the inner surface of the drum for rotation therewith. The second portion 45 of the drum is located adjacent the exit end 12 thereof and is provided with an inner fluted surface. The third portion 46 of the drum is located between the first and second portions thereof and is also provided with an inner fluted surface. Respectively located between the third portion 46 and the first and second portions 43 and 45 of the drum are the pair of blade means 47 and 48 which simply consist of plate members fixedly connected by welding, for example, at one edge thereof to the interior surface of the drum and extending into the interior of the drum at an angle to the axis of rotation of the drum, as is illustrated in Fig. 1.

The operation of the above-described embodiment of the invention is as follows:

Granular material is supplied from hopper 23 in a continuous manner through the conduit 24 to the entrance end of the drum which is sealed by the flange 16 of the hollow support member 15. The spiral blading 44 in the first portion 43 of the drum rotates with the drum, which is rotated by motor 41 and gears 39 and 40, so as to convey the granular material to the blade means 47, which receives the granular material from the first portion 43 from the drum and delivers it to the third portion 46 thereof. In this third portion 46 of the drum, the granular material flows in the flutings in small rivulets toward the exit end of the drum due to the inclined axis of the drum. Blade means 48 receives the granular material from the third portion 46 and delivers it to the second portion 45 of the drum, where it also flows in small rivulets to the exit end of the drum where it is collected in the collection chamber 33 and passes to the discharge spout 37.

The fan 30, driven by the motor 29, draws air from the second portion 45 of the drum into the tube 32 and outwardly through the air discharge conduit 31. Fresh air is thereby drawn into the second portion 45 of the drum through the apertures 35 and 36 of the collection chamber 33 so as to cool and clean granular material in the second portion 45 of the drum. The suction of air into the tube 32 through the open right hand end thereof, as viewed in Fig. 1, draws air through the apertures 25 and 26 into the chamber 14 and through the hollow support means 15 into the third portion 46 of the drum.

The hollow support means prevents any of this air from communicating with the granular material in the first portion of the drum 43 so that the material in this first portion is subjected only to the influence of infra-red rays from the lamps 20 which seal the apertures in the hollow support 15. The electrical heating means 27 preheats the air which passes through the hollow support 15, and this air is further heated by the lamps 20 so that none of the energy of the lamps 20 is wasted. This air, as it passes to the tube 32, dries the material passing through the third portion 46 of the drum. The blade means 47 and 48 respectively receive material from the

first and third portions of the drum and distribute it over the third and second portions of the drum.

The embodiment of the invention which is illustrated in Fig. 2 is substantially the same as that illustrated in Fig. 1, except that air is supplied in an already preheated state to the chamber 14' through the conduit 50 so that the embodiment of Fig. 2 does not include the electrical heating means 27. The air delivered to chamber 14' in this manner may be preheated in any suitable manner by apparatus independent of the processing apparatus. The embodiment of Fig. 2 also differs from the embodiment of Fig. 1 in that the drum is perforated about the blade means 48 and communicates with the hollow housing 51 which has a pair of bearing rings 52 for rotatably supporting the drum. The fan means 30' draws air from the interior of the drum through the housing 51 and delivers it to the discharge conduit 31'. The centrifugal separator means 33' is operatively connected to the fan 30' for separating dust and other foreign matter from the air drawn from the drum. Air is drawn into the third portion 45 of the drum through perforated collection chamber 33 in the same way as the embodiment of Fig. 1.

The purpose of the apertures in the drum about blade means 48 is to provide a means for automatically removing from the granual material particles thereof which have been overdried or over-roasted and so have become smaller than the remaining grains of the granular material and will pass through the perforations of the drum with the air drawn therethrough, since these perforations are smaller than the grains of the material which are not overdried or over-roasted. Thus, the embodiment of Fig. 2 is capable of automatically producing food products which will not have the quality and aroma thereof spoiled by over-processed particles of the material.

Referring now to Fig. 4 of the drawings, there is shown a drum 60 which has an entrance end 61 and an exit end 62. The entrance end of the drum is fixedly connected to the outer race ring of the ball bearing 63 which has its inner race ring supported by the annular, right-angled ring 64 on the frame member 65. Removably mounted over the space included by the ring 64 is the stationary cover means 66 which fills this space and which is provided with an aperture through which the hollow support 67 extends so as to fill this aperture. The hollow support 67 extends from the stationary tube 68 which is apertured at 69 and which is supported on the frame 70 and connected to the inlet side of the fan 71 operatively connected to the motor 72 mounted on the support 73. Fan 71 has its outlet side connected to the air discharge conduit 74. The exit end 62 of the drum 60 is apertured and fixedly connected to the outer race ring of the ball bearing 75 which has its inner race ring supported on the tube 68.

The elongated hollow support 67 has a slot extending along its lower portion, and over this slot in overlapping relation thereto, is mounted the bar 76 which is provided with sockets to support the pear-shaped lamps 77 which provide a source of infra-red rays. The necks of these lamps 77 pass through the slot in the lower part of support 67 and are connected to the sockets in bar 76. Electrical wiring may be mounted in any suitable manner in the bar 76 and connected to a source of current, and switches 78 are mounted on the outwardly extending right hand end of bar 76 and interconnected with the lamps in any suitable manner so as to enable individual lamps or individual groups of lamps to be energized at will. Collection chamber 79 is located at the exit end 62 of drum 60 to receive granular material therefrom and is provided with a discharge spout 80.

Hopper 81 is located above the drum adjacent the entrance end thereof and is provided with the material to be treated which is delivered to the telescoped conduit means 82 which is provided with a lower slidable conduit member that delivers the granular material to the funnel-shaped chamber 83. From chamber 83 material is delivered by conduit 84 to the entrance end 61 of the drum 60. The conduit 84 passes through the cover 66 and is located to one side of the elongated support 67. The conduit means 82 is provided with a butterfly valve 85 adjacent the lower end of hopper 81 for controlling the rate of flow of the granular material, and the rate of flow may be observed by raising the movable conduit of the telescoped conduit means 82.

The drum 60 is driven by a motor and gear means similar to that described in connection with the embodiments of Figs. 1 and 2. The interior of the drum 60 is provided with a first treating portion 86 adjacent the entrance end 61 therof and with a second treating portion 87 adjacent the exit end 62 thereof. These treating portions each have inner fluted surfaces formed by corrugated sheet material, as is illustrated in Figs. 6 and 7. As is shown in Fig. 6 the corrugated sheet material 88 may have equal curved depressions and projections and may be mounted against the inner surface of the shell of drum 60 so as to provide an insulating air space between the material 88 and the outer shell of drum 60 to insulate the interior of the drum from the exterior thereof. Instead of the corrugated sheet material 88, the interior of the drum may be provided with corrugated sheet material 89 which has curved projections and depressions, and in which the curved depressions are wider than the curved projections so that larger rivulets of material may flow along the drum. Instead of providing the sheet material with curved projections and depressions, a corrugated sheet material 90 which has straight inclined sides and substantially equal projections and depressions may be used. Between the portions 86 and 87 of the drum 60 where the corrugated sheet material 88, 89 or 90 is located, the drum 60 is provided with an annular blade means 91 of substantially the same construction as the blade means 47 and 48 described above, and drum 60 is also provided with annular blade means 92 before the portion 86 at the entrance end 61 thereof. This blade means 92 is also of the same construction as the above-described blade means 47 and 48.

It is apparent that the embodiment of Fig. 4 differs from the embodiments described above in that a spiral blade means and a third drying portion are omitted. No heated air is drawn into the apparatus of Fig. 4, and the material simply flows along the fluted portion 86 where it is subjected only to the influence of the infra-red rays emanating from the pear-shaped lamps 77. The granular material flows in rivulets along the fluted portion 86 and is transferred by the blade means 91 to the portion 87 of the drum where it also flows in rivulets along the flutes thereof to the collection chamber 79. The air in the

portion 87 of the drum is drawn into the tube 68 through the perforations 69 and discharged from the drum through the conduit 74. Fresh air is thereby drawn into the drum 60 through the apertured end 62 thereof, and this fresh air cools and cleans the granular material in portion 87 of the drum.

The right hand edge of support 67, as viewed in Fig. 4, is provided with a hinged door 93 which has a cut-out portion closely fitting over the bar 76 so that the right hand end of the hollow support 67 is sealed. The hinged door 93 may be turned upwardly away from the bar 76 so that the latter may be slidably removed from the hollow support 67 with the pear-shaped lamps 77. The cover 66 may be made of overlapping pieces which are removably connected to the frame 65 so that the lamps 77 may be withdrawn after the cover 66 is disconnected from the support 65.

The embodiment of the invention which is illustrated in Fig. 8 is similar to that illustrated in Fig. 4 except that cover 64' which may be made of overlapping pieces, bears against the entrance end of the drum to seal the same and is located about the support 67' and conduit 84. The cover 64' is removably connected to support 94 extending upwardly from the support 95 upon which is provided the frame 96 which rotatably supports the roller 97. Instead of roller bearing 63, the drum 60' of Fig. 8 is provided with an annular bearing ring 98 which rests on the roller 97 so as to rotatably support the drum. The hollow support 67' is of substantially the same construction as support 67 but extends to the frame 65' to which it is connected by the angle bar 99. The embodiment of Fig. 8 also differs from the embodiment of Fig. 4 in that the roller bearing 75' is directly supported on the frame 76' and the exit end 62' of drum 60' is located inwardly of the roller bearing 75'. Exit end 62' of drum 60' is provided with a plurality of apertures 100 through which fresh air is drawn into portion 87' of drum 60' by substantially the same structure as described above.

The embodiment of Fig. 8 further differs from the embodiment of Fig. 4 in that elongated lamps 101 are provided to produce a source of infra-red rays, and these lamps 101 have reflectors 102 connected to the same so as to direct the infra-red rays downwardly directly onto the granular material located in the lower part of drum 60 in the portion 86'.

It is believed apparent that the above-described embodiments of the invention provide a process and means for treating granular materials in a continuous, rapid manner so as to dry and/or roast the same. Also the above process and apparatus provides a means for subjecting material only to the influence of infra-red rays which has the result of uniformly treating the material through its entire thickness. Also, the process and apparatus for conveying the material in the drum in narrow, flowing rivulets has been found to be a very efficient manner of transporting the granular material. By the adjustable flow means illustrated in Fig. 4 it is possible to regulate the flow of the material through the drum so that the best possible treatment is produced in a continuous manner.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of process and apparatus for treating granular material differing from the types described above.

While the invention has been illustrated and described as embodied in a process and apparatus for treating granular material by first subjecting the same only to the influence of infra-red rays and then cooling and cleaning the same, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. Apparatus for treating granular material, comprising in combination, a rotatably mounted hollow drum having a closed entrance end and an open exit end, said entrance end of said drum being located at a higher elevation than said exit end thereof so that the axis of rotation of said drum is downwardly inclined towards the exit end thereof, said drum having a first portion located adjacent said entrance end thereof and a second portion located adjacent said exit end thereof, and said second portion of said drum having an inner fluted surface; supply means communicating with said first portion of said drum for continually supplying granular material thereto; a stationary source of infra-red rays mounted in said first portion of said drum; and air conducting means mounted in said second portion of said drum for conducting fresh air thereto, said air conducting means comprising a stationary tube mounted in said second portion of said drum and communicating with the interior of said second portion of said drum, and suction means communicating with the interior of said tube for drawing air from said second portion through said tube so as to thereby draw fresh air into said second portion of said drum through said open exit end thereof.

2. Apparatus for treating granular materials, comprising in combination, a rotatably mounted hollow drum having a closed entrance end and an open exit end, said entrance end of said drum being located at a higher elevation than said exit end thereof so that the axis of rotation of said drum is downwardly inclined towards the exit end thereof, said drum having a first portion located adjacent said entrance end thereof and a second portion located adjacent said exit end thereof, and said portions of said drum each having an inner fluted surface; supply means communicating with said first portion of said drum for continually supplying granular material thereto; a stationary source of infra-red rays removably mounted in said first portion of said drum; and air conducting means mounted in said second portion of said drum for conducting fresh air thereto, said air conducting means comprising a stationary tube mounted in said second portion of said drum and communicating with the interior of said second portion of said drum, and suction means communicating with the interior of said tube for drawing air from said second portion through said tube so as to thereby draw

fresh air into said second portion of said drum through said open exit end thereof.

3. Apparatus for treating granular materials, comprising in combination, a rotatably mounted hollow drum having a closed entrance end and an open exit end, said entrance end of said drum being located at a higher elevation than said exit end thereof so that the axis of rotation of said drum is downwardly inclined towards the exit end thereof, said drum having a first portion located adjacent said entrance end thereof and a second portion located adjacent said exit end thereof, and said portions of said drum each having an inner fluted surface; supply means communicating with said first portion of said drum for continually supplying granular material thereto; a stationary source of infra-red rays removably mounted in said first portion of said drum; air conducting means mounted in said second portion of said drum for conducting fresh air thereto, said air conducting means comprising a stationary tube mounted in said second portion of said drum and communicating with the interior of said second portion of said drum, and suction means communicating with the interior of said tube for drawing air from said second portion through said tube so as to thereby draw fresh air into said second portion of said drum through said open exit end thereof; and annular blade means fixedly mounted in said drum between said first and second portions thereof for conveying material from said first portion to said second portion of said drum.

4. Apparatus for treating granular materials, comprising in combination, a rotatably mounted hollow drum having a closed entrance end and an open exit end, said entrance end of said drum being located at a higher elevation than said exit end thereof so that the axis of rotation of said drum is downwardly inclined towards the exit end thereof, said drum having a first portion located adjacent said entrance end thereof and a second portion located adjacent said exit end thereof, and said portions of said drum each having an inner fluted surface; supply means communicating with said first portion of said drum for continually supplying granular material thereto; a stationary source of infra-red rays removably mounted in said first portion of said drum; air conducting means mounted in said second portion of said drum for conducting fresh air thereto, said air conducting means comprising a stationary tube mounted in said second portion of said drum and communicating with the interior of said second portion of said drum, and suction means communicating with the interior of said tube for drawing air from said second portion through said tube so as to thereby draw fresh air into said second portion of said drum through said open exit end thereof; first annular blade means fixedly mounted in said drum between said first and second portions thereof for conveying material from said first portion to said second portion of said drum; and second annular blade means mounted in said drum at said entrance end thereof for receiving material from said supply means and delivering the same to said first portion of said drum.

5. Apparatus for treating granular materials, comprising in combination, a rotatably mounted hollow drum having a closed entrance end and an open exit end, said entrance end of said drum being located at a higher elevation than said exit end thereof so that the axis of rotation of said drum is downwardly inclined towards the exit end thereof, said drum having a first portion located adjacent said entrance end thereof and a second portion located adjacent said exit end thereof, and said portions of said drum each having an inner fluted surface portion made of a corrugated sheet material mounted in said drum against the outer shell thereof; supply means communicating with said first portion of said drum for continually supplying granular material thereto; a stationary source of infra-red rays removably mounted in said first portion of said drum; air conducting means mounted in said second portion of said drum for conducting fresh air thereto, said air conducting means comprising a stationary tube mounted in said second portion of said drum and communicating with the interior of said second portion of said drum, and suction means communicating with the interior of said tube for drawing air from said second portion through said tube so as to thereby draw fresh air into said second portion of said drum through said open exit end thereof; first annular blade means fixedly mounted in said drum between said first and second portions thereof for conveying material from said first portion to said second portion of said drum; and second annular blade means mounted in said drum at said entrance end thereof for receiving material from said supply means and delivering the same to said first portion of said drum.

6. Apparatus for treating granular materials, comprising in combination, a rotatably mounted hollow drum having a closed entrance end and an open exit end, said entrance end of said drum being located at a higher elevation than said exit end thereof so that the axis of rotation of said drum is downwardly inclined towards the exit end thereof, said drum having a first portion located adjacent said entrance end thereof and a second portion located adjacent said exit end thereof, and said portions of said drum each having an inner fluted surface portion made of a corrugated sheet metal mounted in said drum against the outer shell thereof, said corrugated sheet material having substantially equal curved projections and depressions; supply means communicating with said first portion of said drum for continually supplying granular material thereto; a stationary source of infra-red rays removably mounted in said first portion of said drum; air conducting means mounted in said second portion of said drum for conducting fresh air thereto, said air conducting means comprising a stationary tube mounted in said second portion of said drum and communicating with the interior of said second portion of said drum, and suction means communicating with the interior of said tube for drawing air from said second portion through said tube so as to thereby draw fresh air into said second portion of said drum through said open exit end thereof; first annular blade means fixedly mounted in said drum between said first and second portions thereof for conveying material from said first portion to said second portion of said drum; and second annular blade means mounted in said drum at said entrance end thereof for receiving material from said supply means and delivering the same to said first portion of said drum.

7. Apparatus for treating granular materials, comprising in combination, a rotatably mounted hollow drum having a closed entrance end and an open exit end, said entrance end of said drum being located at a higher elevation than said exit end thereof so that the axis of rotation of said

drum is downwardly inclined towards the exit end thereof, said drum having a first portion located adjacent said entrance end thereof and a second portion located adjacent said exit end thereof, and said portions of said drum each having an inner fluted surface portion made of a corrugated sheet material mounted in said drum against the outer shell thereof, said corrugated material having curved projections and depressions and said curved depressions being wider than said curved projections; supply means communicating with said first portion of said drum for continually supplying granular material thereto; a stationary source of infra-red rays removably mounted in said first portion of said drum; air conducting means mounted in said second portion of said drum for conducting fresh air thereto, said air conducting means comprising a stationary tube mounted in said second portion of said drum and communicating with the interior of said second portion of said drum, and suction means communicating with the interior of said tube for drawing air from said second portion through said tube so as to thereby draw fresh air into said second portion of said drum through said open exit end thereof; first annular blade means fixedly mounted in said drum between said first and second portions thereof for conveying material from said first portion to said second portion of said drum; and second annular blade means mounted in said drum at said entrance end thereof for receiving material from said supply means and delivering the same to said first portion of said drum.

8. Apparatus for treating granular materials, comprising in combination, a rotatably mounted hollow drum having a closed entrance end and an open exit end, said entrance end of said drum being located at a higher elevation than said exit end thereof so that the axis of rotation of said drum is downwardly inclined towards the exit end thereof, said drum having a first portion located adjacent said entrance end thereof and a second portion located adjacent said exit end thereof, and said portions of said drum each having an inner fluted surface portion made of a corrugated sheet material mounted in said drum against the outer shell thereof, said corrugated material having equal projections and depressions, and said projections and depressions all having straight inclined sides; supply means communicating with said first portion of said drum for continually supplying granular material thereto; a stationary source of infra-red rays removably mounted in said first portion of said drum; air conducting means mounted in said second portion of said drum for conducting fresh air thereto, said air conducting means comprising a stationary tube mounted in said second portion of said drum and communicating with the interior of said second portion of said drum, and suction means communicating with the interior of said tube for drawing air from said second portion through said tube so as to thereby draw fresh air into said second portion of said drum through said open exit end thereof; first annular blade means fixedly mounted in said drum between said first and second portions thereof for conveying material from said first portion to said second portion of said drum; and second annular blade means mounted in said drum at said entrance end thereof for receiving material from said supply means and delivering the same to said first portion of said drum.

9. Apparatus for treating granular material, comprising in combination, a rotatably mounted hollow drum having a closed entrance end and an open exit end, said entrance end of said drum being located at a higher elevation than said exit end thereof so that the axis of rotation of said drum is downwardly inclined towards the exit end thereof, said drum having a first portion located adjacent said entrance end thereof and a second portion located adjacent said exit end thereof, and said second portion of said drum having an inner fluted surface; supply means communicating with said first portion of said drum for continually supplying granular material thereto; a stationary source of infra-red rays mounted in said first portion of said drum; air conducting means mounted in said second portion of said drum for conducting fresh air thereto, said air conducting means comprising a stationary tube mounted in said second portion of said drum and communicating with the interior of said second portion of said drum, and suction means communicating with the interior of said tube for drawing air from said second portion through said tube so as to thereby draw fresh air into said second portion of said drum through said open exit end thereof; and hollow support means extending from said stationary tube through said first portion of said drum and supporting said source of infra-red rays in the same.

10. Apparatus for treating granular material, comprising in combination, a rotatably mounted hollow drum having a closed entrance end and an open exit end, said entrance end of said drum being located at a higher elevation than said exit end thereof so that the axis of rotation of said drum is downwardly inclined towards the exit end thereof, said drum having a first portion located adjacent said entrance end thereof and a second portion located adjacent said exit end thereof, and said second portion of said drum having an inner fluted surface; supply means communicating with said first portion of said drum for continually supplying granular material thereto; a stationary source of infra-red rays mounted in said first portion of said drum; air conducting means mounted in said second portion of said drum for conducting fresh air thereto, said air conducting means comprising a stationary tube mounted in said second portion of said drum and communicating with the interior of said second portion of said drum, and suction means communicating with the interior of said tube for drawing air from said second portion through said tube so as to thereby draw fresh air into said second portion of said drum through said open exit end thereof; hollow support means extending from said stationary tube through said first portion of said drum and supporting said source of infra-red rays in the same; and reflector means mounted about said source of infra-red rays for concentrating the same.

11. Apparatus for treating granular material, comprising in combination, a rotatably mounted hollow drum having a closed entrance end and an open exit end, said entrance end of said drum being located at a higher elevation than said exit end thereof so that the axis of rotation of said drum is downwardly inclined towards the exit end thereof, said drum having a first portion located adjacent said entrance end thereof and a second portion located adjacent said exit end thereof, and said second portion of said drum having an inner fluted surface; supply means communicating with said first portion of said drum for continually supplying granular material thereto; a

stationary source of infra-red rays mounted in said first portion of said drum; air conducting means mounted in said second portion of said drum for conducting fresh air thereto, said air conducting means comprising a stationary tube mounted in said second portion of said drum and communicating with the interior of said second portion of said drum, and suction means communicating with the interior of said tube for drawing air from said second portion through said tube so as to thereby draw fresh air into said second portion of said drum through said open exit end thereof; hollow support means extending from said stationary tube through said first portion of said drum and supporting said source of infra-red rays in the same; reflector means mounted about said source of infra-red rays for concentrating the same; first bearing means operatively connected to said drum adjacent said entrance end thereof for supporting the same for rotation; and second bearing means operatively connected to said exit end of said drum for supporting the same for rotation, said second bearing means being located about and supported by said stationary tube.

12. Apparatus for treating granular material, comprising in combination, a rotatably mounted hollow drum having a closed entrance end and an open exit end, said entrance end of said drum being located at a higher elevation than said exit end thereof so that the axis of rotation of said drum is downwardly inclined toward the exit end thereof, said drum having a first portion located adjacent said entrance end thereof, a second portion located adjacent said exit end thereof and a third portion located between said first and second portions, said second and third portions of said drum each having an inner fluted surface; hollow stationary support means mounted in said first portion of said drum and communicating with the exterior of said drum through said closed entrance end thereof, said hollow support means being formed with a plurality of apertures; a source of infra-red rays mounted in said hollow support means, said source of infra-red rays filling said apertures of said support means so as to close the same and communicating with the interior of said first portion of said drum through said apertures; and air conducting means mounted in said second portion of said drum for conducting fresh air thereto, said air conducting means comprising a stationary tube mounted in said second portion of said drum and communicating with the interior of said second portion of said drum and suction means communicating with the interior of said tube for drawing air from said second portion of said drum through said tube so as to thereby draw fresh air into said second portion of said drum through said open exit end thereof, said suction means also drawing air through said hollow support means and said third portion of said drum to said tube, whereby the air passing through said hollow support means is heated by said source of infra-red rays and dries granular material located in said third portion of said drum.

13. Apparatus for treating granular material, comprising in combination, a rotatably mounted hollow drum having a closed entrance end and an open exit end, said entrance end of said drum being located at a higher elevation than said exit end thereof so that the axis of rotation of said drum is downwardly inclined towards the exit end thereof, said drum having a first portion located adjacent said entrance end thereof and a second portion located adjacent said exit end thereof, and said second portion of said drum having an inner fluted surface; supply means communicating with said first portion of said drum for continually supplying granular material thereto, said supply means comprising a movably mounted conduit and a hopper to which material is delivered from said conduit, whereby, when said movably mounted conduit is moved away from said hopper, the rate of flow of granular material may be observed; a stationary source of infra-red rays mounted in said first portion of said drum; air conducting means mounted in said second portion of said drum for conducting fresh air thereto, said air conducting means comprising a stationary tube mounted in said second portion of said drum and communicating with the interior of said second portion of said drum, and suction means communicating with the interior of said tube for drawing air from said second portion through said tube so as to thereby draw fresh air into said second portion of said drum through said open exit end thereof; hollow support means extending from said stationary tube through said first portion of said drum and supporting said source of infra-red rays in the same; and reflector means mounted about said source of infra-red rays for concentrating the same.

14. Apparatus for treating granular material, comprising in combination, a rotatably mounted hollow drum having a closed entrance end and an open exit end, said entrance end of said drum being located at a higher elevation than said exit end thereof so that the axis of rotation of said drum is downwardly inclined toward the exit end thereof, said drum having a first portion located adjacent said entrance end thereof, a second portion located adjacent said exit end thereof and a third portion located between said first and second portions, said second and third portions of said drum each having an inner fluted surface; hollow stationary support means mounted in said first portion of said drum and communicating with the exterior of said drum through said closed entrance end thereof, said hollow support means being formed with a plurality of apertures; a source of infra-red rays mounted in said hollow support means, said source of infra-red rays filling said apertures of said support means so as to close the same and communicating with the interior of said first portion of said drum through said apertures; air conducting means mounted in said second portion of said drum for conducting fresh air thereto, said air conducting means comprising a stationary tube mounted in said second portion of said drum and communicating with the interior of said second portion of said drum and suction means communicating with the interior of said tube for drawing air from said second portion of said drum through said tube so as to thereby draw fresh air into said second portion of said drum through said open exit end thereof, said suction means also drawing air through said hollow support means and said third portion of said drum to said tube, whereby the air passing through said hollow support means is heated by said source of infra-red rays and dries granular material located in said third portion of said drum; spiral blade means fixedly mounted in said first portion of said drum for rotation therewith and for conveying material along said first portion of said drum; and a pair of annular blade

means respectively mounted between said third portion of said drum and said first and second portions thereof for conveying material from said first portion to said third portion of said drum and from said third portion of said drum to said second portion thereof.

15. Apparatus for treating granular material, comprising in combination, a rotatably mounted hollow drum having a closed entrance end and an open exit end, said entrance end of said drum being located at a higher elevation than said exit end thereof so that the axis of rotation of said drum is downwardly inclined toward the exit end thereof, said drum having a first portion located adjacent said entrance end thereof, a second portion located adjacent said exit end thereof and a third portion located between said first and second portions, said second and third portions of said drum each having an inner fluted surface; hollow stationary support means mounted in said first portion of said drum and communicating with the exterior of said drum through said closed entrance end thereof, said hollow support means being formed with a plurality of apertures; a source of infra-red rays mounted in said hollow support means, said source of infra-red rays filling said apertures of said support means so as to close the same and communicating with the interior of said first portion of said drum through said apertures; air conducting means mounted in said second portion of said drum for conducting fresh air thereto, said air conducting means comprising a stationary tube mounted in said second portion of said drum and communicating with the interior of said second portion of said drum and suction means communicating with the interior of said tube for drawing air from said second portion of said drum through said tube so as to thereby draw fresh air into said second portion of said drum through said open exit end thereof, said suction means also drawing air through said hollow support means and said third portion of said drum to said tube, whereby the air passing through said hollow support means is heated by said source of infra-red rays and dries granular material located in said third portion of said drum; spiral blade means fixedly mounted in said first portion of said drum for rotation therewith and for conveying material along said first portion of said drum; a pair of annular blade means respectively mounted between said third portion of said drum and said first and second portions thereof for conveying material from said first portion to said third portion of said drum and from said third portion of said drum to said second portion thereof; and heating means mounted adjacent said hollow support for preheating air passing through the same.

16. Apparatus for treating granular material, comprising in combination, a rotatably mounted hollow drum having a closed entrance end and an open exit end, said entrance end of said drum being located at a higher elevation than said exit end thereof so that the axis of rotation of said drum is downwardly inclined toward the exit end thereof, said drum having a first portion located adjacent said entrance end thereof, a second portion located adjacent said exit end thereof and a third portion located between said first and second portions, said second and third portions of said drum each having an inner fluted surface, and said drum being formed with perforations between said second and third portions thereof; hollow stationary support means mounted in said first portion of said drum and communicating with the exterior of said drum through said closed entrance end thereof, said hollow support means being formed with a plurality of apertures; a source of infra-red rays mounted in said hollow support means, said source of infra-red rays filling said apertures of said support means so as to close the same and communicating with the interior of said first portion of said drum through said apertures; and air conducting means mounted about said drum between said second and third portions thereof so as to communicate with the interior of said drum through said perforations, said air conducting means comprising a suction means for drawing fresh air into said second portion of said drum through said open exit end thereof and for drawing air through said hollow support means and said third portion of said drum, whereby said air passing through said hollow support means is heated by said source of infra-red rays so as to dry material in said third portion of said drum.

17. Apparatus for treating granular material, comprising, in combination, a rotatably mounted hollow drum having an entrance end and an open exit end; supply means communicating with said entrance end of said drum for supplying granular material thereto; guide means located in said drum for guiding granular material supplied thereto from said entrance end thereof to said exit end thereof; heating means located in said drum distant from said exit end thereof for heating granular material in said drum moving toward said exit end thereof so as to dry the granular material; a conduit extending into said drum substantially along the axis thereof through said exit end thereof and being formed with an inlet opening in the interior of said drum adjacent said exit end thereof; and fluid moving means operatively connected to said conduit for drawing fluid into the same through said inlet openng thereof so as to thereby draw cooling air into the drum through said exit end thereof in counterflow to the granular material adjacent said exit end of said drum and so as to draw the cooling air out of said drum through said conduit in the same direction that the granular material moves in said drum.

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