

April 11, 1944.

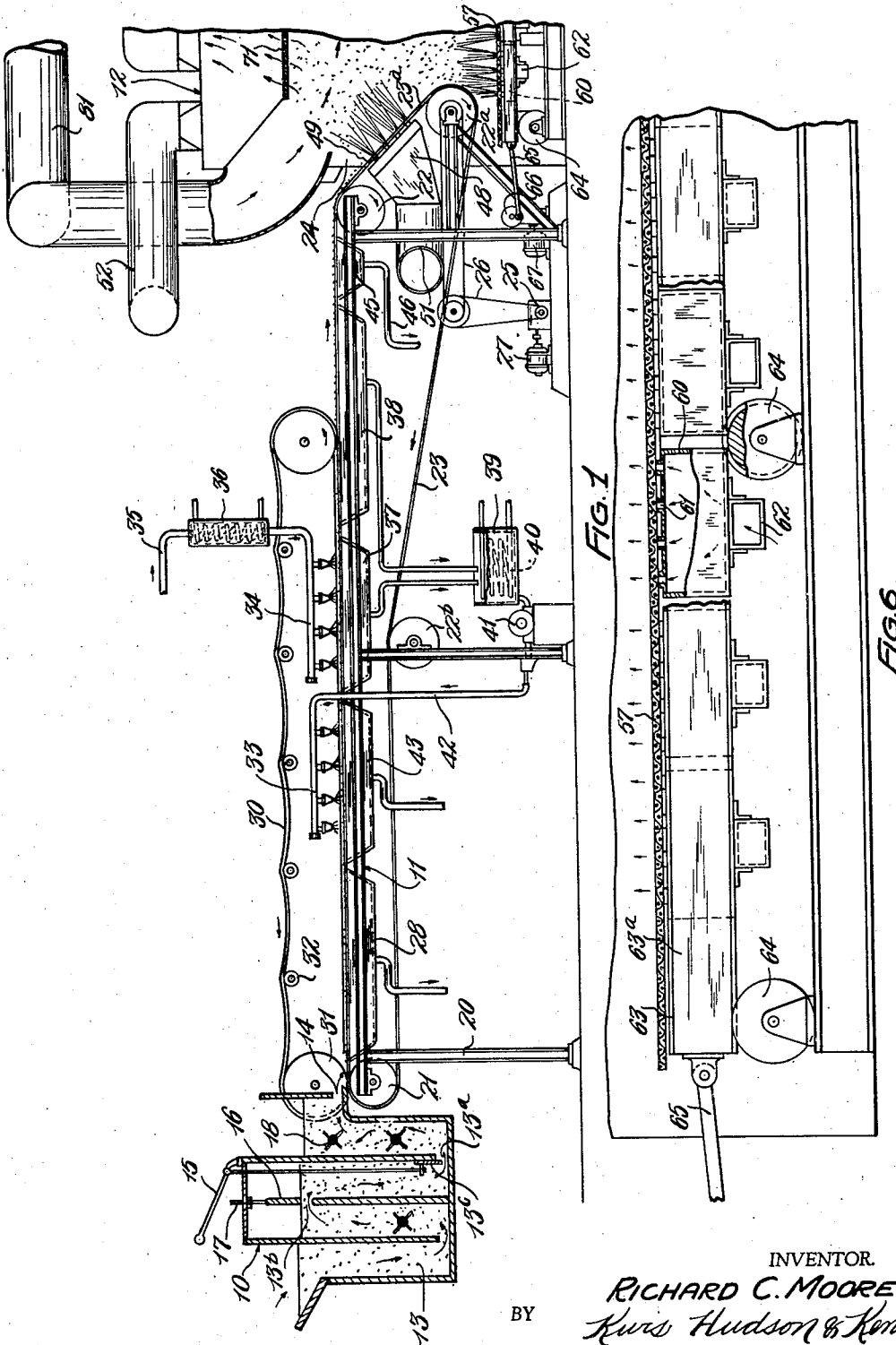
R. C. MOORE

2,346,500

DRYING METHOD AND APPARATUS

Filed Jan. 20, 1942

4 Sheets-Sheet 1



INVENTOR.

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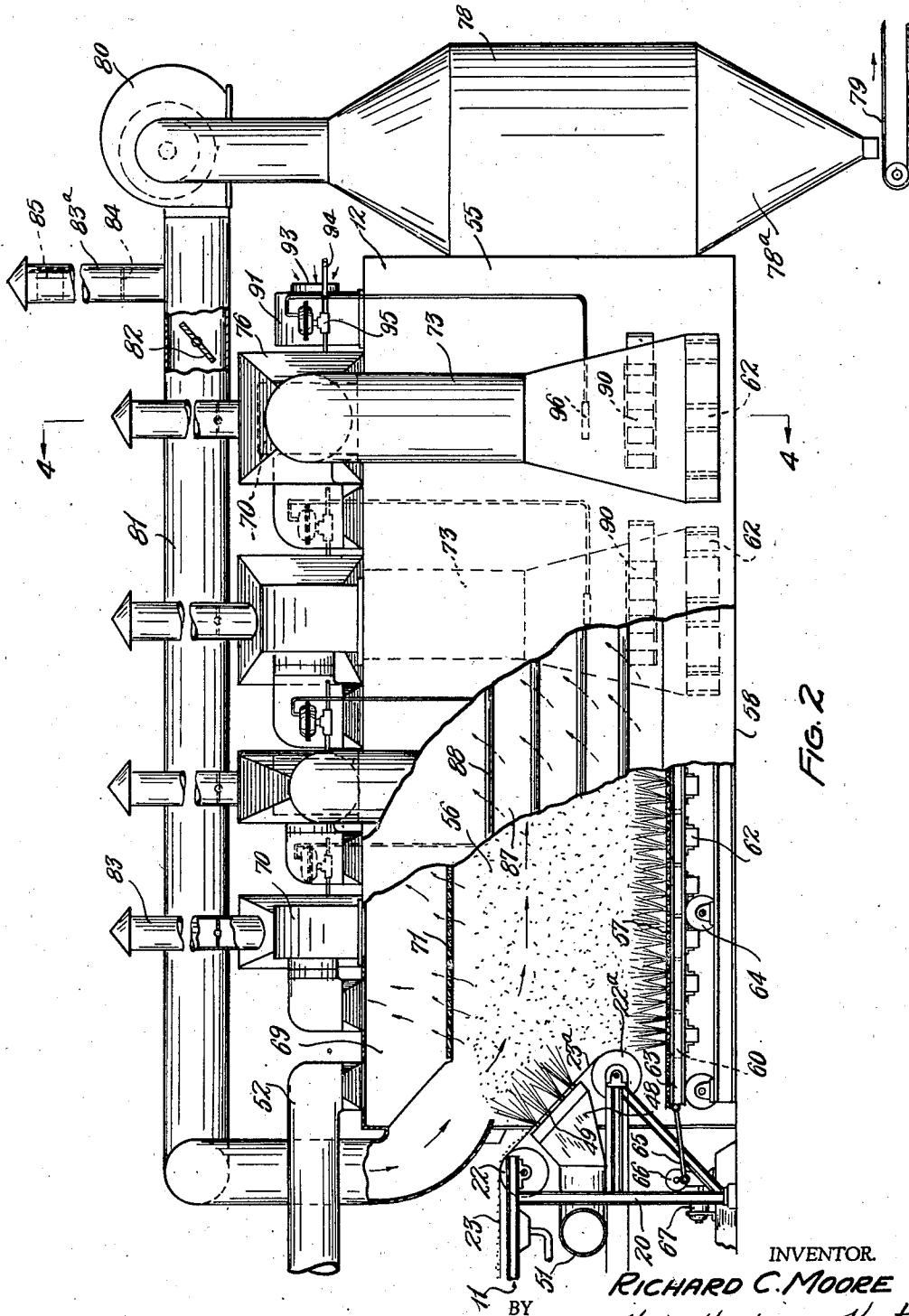
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DRYING METHOD AND APPARATUS

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4 Sheets-Sheet 2



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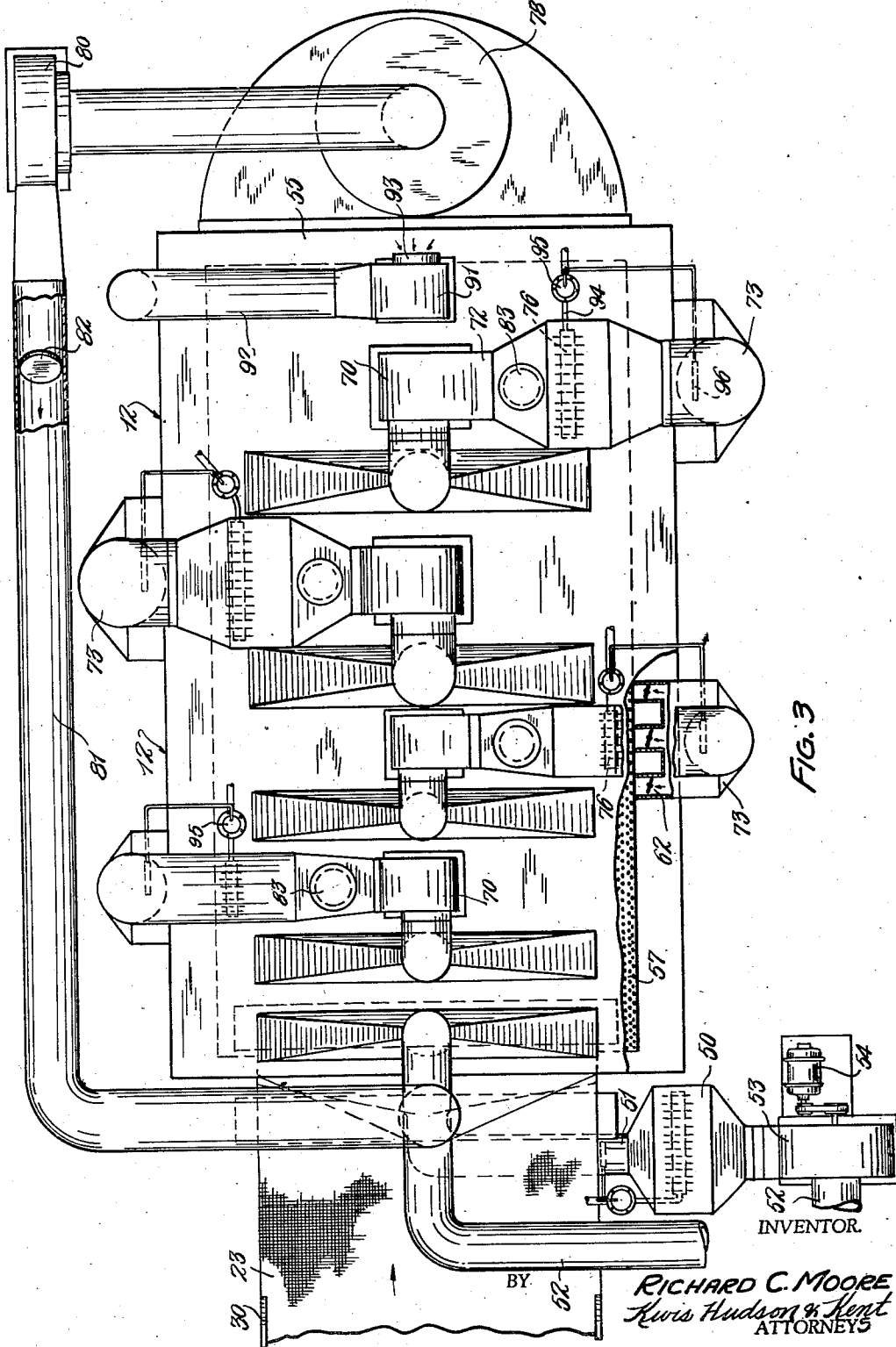
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DRYING METHOD AND APPARATUS

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4 Sheets-Sheet 4

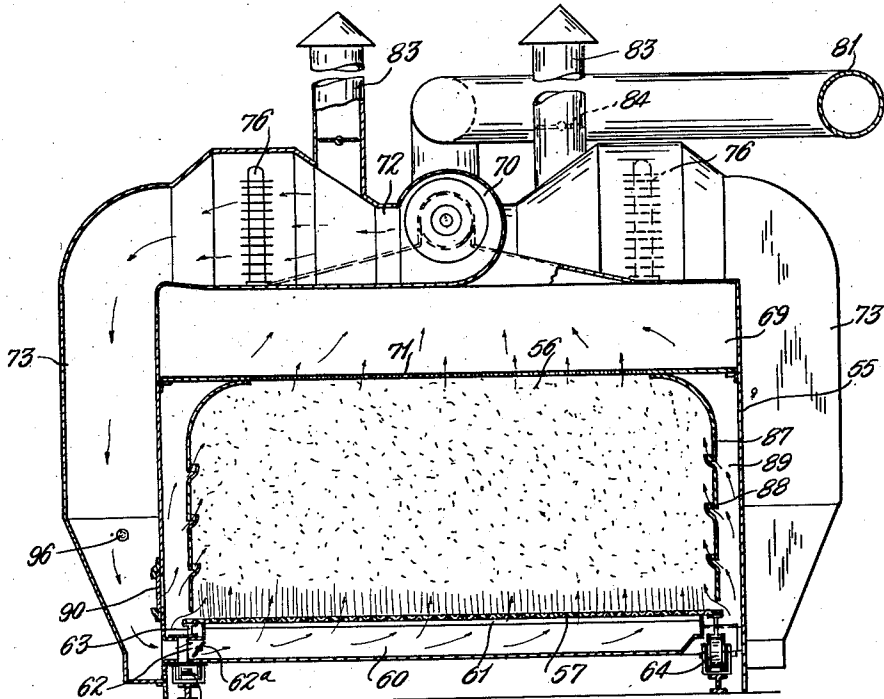


FIG. 4

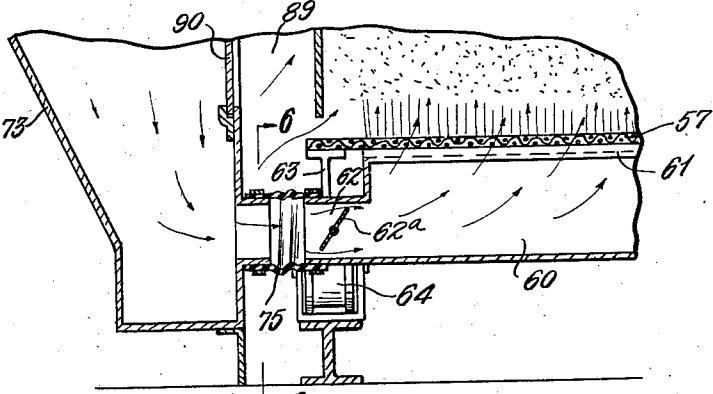


FIG. 5

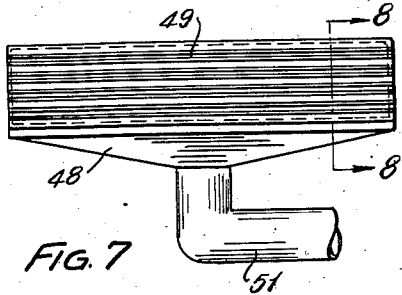


FIG. 7

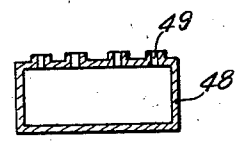


FIG. 8

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2,346,500

DRYING METHOD AND APPARATUS

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Application January 20, 1942, Serial No. 427,482

21 Claims. (Cl. 134—30)

This invention relates to an improved method and apparatus for handling and drying various materials and especially suitable for handling and drying materials in the form of tacky particles such as crumbs, curds or grains of synthetic rubber.

An object of my invention is to provide an improved method and apparatus for handling and drying synthetic rubber crumbs or various other tacky materials in which the crumbs are prevented from sticking together or coalescing while they are being advanced to the drier and also during their passage through the drier.

Another object of my invention is to provide a novel method and apparatus for advancing crumbs of tacky material to a drier and starting the crumbs through the drier.

Still another object of this invention is to provide a novel method and apparatus for handling and drying tacky crumbs or the like involving the use of a foraminous or screen belt onto which the crumbs are deposited in a soapy liquid and wherein air discharged through the belt removes and dries the crumbs.

A further object of my invention is the provision of a novel method and apparatus for drying crumbs of tacky material in which jets or streams of air are employed to agitate, dry and advance the crumbs in a manner such as to prevent the crumbs from sticking to each other and to the bottom and walls of the drier.

My invention also aims to provide an improved method and apparatus for drying crumbs of tacky material in which the drier has a foraminous or screen floor through which jets of heated air are discharged by reciprocating nozzles to maintain the crumbs substantially in suspension and to dry the same, and wherein air is caused to flow longitudinally through the heater for advancing the crumbs therealong.

Other objects and advantages of the invention will be apparent from the following description of the accompanying drawings, in which

Fig. 1 is an elevational view with parts in section showing the supply end of my improved material handling and drying apparatus.

Fig. 2 is an elevational view with parts in section showing the drying unit or section of my improved apparatus.

Fig. 3 is a plan view of the drying unit.

Fig. 4 is a transverse sectional view taken through the drying unit as indicated by line 4—4 of Fig. 2.

Fig. 5 is a partial transverse sectional view on a larger scale taken through the drying unit to

illustrate the connection of the air supply piping with the reciprocating nozzle boxes.

Fig. 6 is a partial longitudinal sectional elevation further illustrating the reciprocating nozzle boxes.

Fig. 7 is a detached plan view of the nozzle box at the delivery end of the feed conveyor, and

Fig. 8 is a transverse sectional view taken through this nozzle box on the line 8—8 of Fig. 7.

More detailed reference will now be made to the drawings for the purpose of describing my novel method and apparatus for handling and drying tacky crumbs and other materials, but it will be understood, of course, that the invention is not limited to the particular method and apparatus disclosed but includes all variations and modifications thereof coming within the scope of the appended claims.

In Fig. 1 I show a head box 10 and a conveyor 11 extending between the head box and the receiving end of the drying unit 12. The head box contains a circuitous passage 13 leading to a discharge chute or nozzle 14 which extends over the receiving end of the conveyor. The material to be dried is contained in a slurry which is supplied to the head box and is fed therefrom onto the conveyor 11 through the chute or nozzle 14.

The material to be dried may be particles of synthetic rubber which may be in the form of crumbs, curds or grains of approximately one-eighth of an inch in diameter and which are sticky or tacky in character after they have been removed from the slurry and washed. These tacky crumbs tend to adhere to any surface which they touch and also tend to adhere to each other or coalesce if the particles are piled up or otherwise come into contact with each other after they have been washed and before they have been dried. My method and apparatus is hereinafter described in connection with the drying of such synthetic rubber crumbs but the invention is not limited in this respect and is applicable to various other materials.

The slurry which is brought to the head box 10 is in the form of a soapy solution, or any equivalent liquid, containing the crumbs of synthetic rubber. The flow of the slurry through the circuitous passage 13 of the head box and through the nozzle 14 to the conveyor may be controlled by varying the width of, or closing, the passages 13a and 13b. These passages are controlled by the gates 13c and 13d which may be closed by downward swinging of the lever 15. Agitators 18 may be provided in the head box

and may be suitably driven for agitating the slurry to prevent settling of the crumbs.

The conveyor 11 comprises a suitable frame 20 having rollers mounted thereon for supporting an endless belt 23 formed of wire screen or other foraminous material. The rollers may include a roller 21 at the receiving end of the conveyor, rollers 22 and 22a at the discharge end, and a guide roller 22b for supporting the return section of the belt at an intermediate point of the conveyor. The discharge end of the conveyor is located at or adjacent the inlet opening 24 of the receiving end of the drying unit 12. For a purpose to be presently explained the discharge end of the conveyor is so arranged that the portion 23a of the belt passing from the roller 22 to the roller 22a extends in a forwardly and downwardly direction adjacent such opening of the drying unit. If desired the roller 22 may actually be located a short distance inside the receiving end of the drying unit 12. The belt 23 may be propelled by suitable driving means connected with one of the rollers such as the roller 22a which, in this instance, is connected with a speed reducing gear 25 by means of belts 26 and the speed reducing gear is driven by an electric motor 27.

When the slurry containing the crumbs of synthetic rubber is discharged through the nozzle 14 onto the moving belt 23 the soapy solution passes through the belt leaving the crumbs on top at a fair density of coverage but preferably such that the individual crumbs are not in contact with each other. A pan or tray 28 may be located beneath the section of the belt nearest the nozzle 14 so as to collect the soapy solution for further use. The slurry may be prevented from flowing over the side edges of the belt 23 by providing the conveyor with endless deckle strips 30 which extend over the rollers 31 and 32 and travel with the belt to form retaining sides thereon.

It is desirable to wash the synthetic rubber crumbs to free them of the soapy solution before the crumbs are dried. For this purpose I provide a plurality of spray units 33 and 34 located over the conveyor and spaced therealong in the direction of travel of the belt 23. Clean soft rinse water is supplied to the second spray unit 34 through piping 35 and through a heater 36 containing a steam coil or provided with other appropriate heating means. The clean rinse water which is discharged by the unit 34 washes the synthetic rubber crumbs and after passing through the conveyor belt is collected by the pan 37. The rinse water may continue to drain from the belt and the rubber crumbs thereon as the belt travels away from the spray unit 34 and such additional drainage of rinse water may be collected by the pan 38. The used rinse water collected by the pans 37 and 38 may be returned to a tank 39 in which it is heated by a steam coil 40 or other suitable heating means. The used and reheated rinse water in the tank 39 is supplied to a pump 41 which delivers the water to the first spray unit 33 through a pipe 42. At this point the rinse water is used a second time and washes the crumbs on the conveyor belt at a point in advance of the point at which they are washed by the spray unit 34. After passing through the layer of crumbs and the belt 23 the rinse water is collected in a pan 43 and can be disposed of in any desired manner.

As the belt passes beyond the pan 38 some of the rinse water will still be clinging to the crumbs

of synthetic rubber, and for the purpose of removing some of this remaining water I may provide a suction box 45 beneath the belt 23 at a point between the pan 38 and the roller 22. A discharge pipe 46 leading from the suction box 45 may be connected with a suction fan or other vacuum producing device so that air and water will be removed from the suction box and a flow of air downwardly through the belt will be produced to remove additional rinse water from the rubber crumbs.

For removing the crumbs from the belt 23 and starting them through the drying unit 12 I provide means for discharging air through the belt with sufficient velocity and volume to lift or blow the crumbs therefrom and carry or propel them forwardly and upwardly into the receiving end of the drying unit in a separated or scattered condition. This air discharging means may be in the form of a nozzle box 48 extending transversely of the conveyor beneath the forwardly and downwardly extending section 23a and having a plurality of laterally elongated nozzles 49 located relatively close to the underside of the belt for discharging blasts of air there-through.

In removing the rubber crumbs from the belt 23 and starting them through the drying unit 12, the use of an air blast for this purpose which will also cause a rapid surface drying of the crumbs is highly important because this surface drying reduces the degree of stickiness of the surface of the crumbs to a sufficient extent to prevent them from adhering to each other or to portions and surfaces with which they may come in contact in the drying unit. I prefer to use heated air for this blast because the surface drying is accomplished more effectively. At this stage the crumbs are in a relatively wet condition and since this drying and conveyor-unloading blast is in contact with the crumbs for only a very short time, it can be of a relatively high temperature without causing heat damage to the crumbs. For heating the air for this blast I provide a heater 50 in the pipe 51 leading to the nozzle box 48. The air to be discharged through the nozzles 49 is drawn through a supply pipe 52 by a blower 53 which forces the air through the heater 50 and the pipe 51 to the nozzle box 48. The blower may be driven by suitable power means such as the electric motor 54.

The drying unit 12 comprises an elongated housing 55 having a drying tunnel 56 extending longitudinally therethrough. The bottom of the tunnel is formed by a stationary screen or perforated plate 57 which is suitably supported in the housing at a point above the floor line 58. It is desirable to keep the crumbs of synthetic rubber in an agitated condition and more or less in suspension from the time that they have been blown off the belt 23 until they arrive at the delivery end of the tunnel. For this purpose I provide a plurality of air boxes or plenum chambers 60 which are spaced apart longitudinally of the tunnel and extend transversely thereof beneath the screen floor 57. As shown in Fig. 6 these boxes have a plurality of air discharge slots or nozzles 61 formed in the top thereof so as to lie adjacent the underside of the screen bottom or tunnel floor 57. Each of the boxes 60 has an inlet pipe or connection 62 through which the heated air may be supplied to the box with sufficient pressure to cause blasts or streams of air to pass upwardly through the screen 57 and lift the rubber crumbs therefrom. When the rubber crumbs are blown from the belt 23 into the receiv-

ing end of the drying tunnel 56 they are separated and partially dried by the air blast from the box 48, as mentioned above, and then fall toward the screen. The crumbs may or may not actually fall on the screen 57 because as they approach the screen they are acted upon by the blasts of heated air being discharged upwardly by the slots or nozzles 61 and these blasts of air lift and agitate the crumbs in the drying tunnel and maintain them substantially in suspension.

To prevent any substantial amount of the crumbs from remaining at rest on the screen 57 for more than a very brief interval, it may be desirable to reciprocate the boxes 60 longitudinally of the drying tunnel 56 so that the blasts of air discharged by the nozzles 61 will intermittently pass through all portions of the screen. To this end I may support the air boxes 60 on a suitable frame 63 having side rails 63a which are supported at spaced points therealong by rollers 64 and reciprocate the frame 63 by means of a rod or link 65 connecting the frame with a crankshaft or eccentric 66 of a motor driven unit 67. The stroke of the connecting rod or link should be such that the nozzle travel will be slightly greater than the spacing between adjacent nozzles so that there will be no dead spots on the screen 57. The rate of reciprocation of the air boxes may be relatively rapid so that any rest period of the crumbs on the screen will be very brief.

To provide for the removal of air from the drying tunnel 56 I employ a longitudinally extending plenum chamber 69 in the upper portion of the housing 55 and from which air can be rapidly withdrawn by a plurality of blowers 70 spaced along the top of the drying unit 12. The plenum chamber 69 is separated from the drying tunnel 56 by a perforated plate or screen 71 which permits the air to pass upwardly into the plenum chamber and causes the air to enter the plenum chamber at a substantially uniform face velocity over the entire area of the screen. The air discharged through the nozzles 61 of the boxes 60 should have sufficient velocity and volume to prevent the crumbs from settling on the screen bottom or floor 57 and to maintain them more or less in suspension in the tunnel 56. Likewise the flow of air through the screen 71 into the plenum chamber 69 should be such that its velocity will not be so great as to hold the crumbs against the screen but will permit them to fall back into the tunnel. To obtain the desired air velocity and volume through the screens 57 and 71 I may provide suitable control dampers at appropriate points such as the dampers 62a in the inlet connections 62 of the air boxes 60. When streams of heated air satisfying the above requirements are supplied by the nozzles 61 and traverse the drying tunnel 56 they will impart a more or less dancing movement to the crumbs during which the crumbs are kept more or less in suspension between the screens 57 and 71 and are subjected to an effective drying action.

The air which is supplied to the boxes 60 may be recirculated air and therefore the discharge nozzles 72 of the blowers 70 may be connected to the inlet openings 62 of the boxes by means of the relatively large pipes 73. The lower ends of the pipes 73 may be flattened and flared out laterally in the longitudinal direction of the drying tunnel 56 so that each of the pipes 73 may supply air to two or more of the longitudinally spaced air boxes 60. Since the air boxes are arranged to be moved back and forth in the

drying tunnel 56 it is necessary to provide the air supply connections 62 with a flexible sleeve 75, or equivalent means, which will permit these boxes to move relative to the pipes 73 while the air supply is being maintained.

The drying action of the air delivered by the nozzle 61 will be much more rapid if the air is heated and I, therefore, provide a heating unit 76 in each of the air supply pipes 73. A more balanced and satisfactory arrangement is obtained for the piping and the heaters 76 if the discharge pipes 73 are arranged alternately on opposite sides of the housing of the drying unit as shown in Fig. 3. I also find that a more uniform and satisfactory flow of air across the drying tunnel 56 from the nozzle 61 is obtained when approximately one-half of the boxes 60 are supplied with air from one side of the drying unit and the remaining boxes are supplied with air from the opposite side of the unit.

The air which is supplied to the box 48 by the blower 53 for use in blowing the crumbs off the belt 23 may also be recirculated air and, accordingly, the inlet pipe 52 leading to the blower 53 may be connected with the plenum chamber 69 as shown in Figs. 1 and 2.

In order to produce a movement of the crumbs along the tunnel 56 while they are being subjected to the drying action of the air discharged by the nozzles 61, I cause a flow of air longitudinally through the tunnel which gradually moves the dancing crumbs to the discharge end of the tunnel and into the collecting device 78. This collecting device may be a separator of the kind known as a cyclone separator and may have a hopper bottom 78a from which the collection of dried crumbs may be discharged onto a conveyor 79 for moving the crumbs to a desired point of use or storage. The upper end of the separator may be connected with the intake of a blower 80 which returns the air to the receiving end of the drying tunnel 56 through the pipe 81. The rate of advance movement of the crumbs in the drying tunnel 56 may be controlled by varying the flow of air longitudinally in the tunnel and this may be accomplished by regulating the flow of air in the pipe 81 by suitable adjustment of the damper 82 and the damper 84 of the exhaust stack 83a to be referred to hereinafter.

In controlling the operation of the drying unit 12 it may be desirable to permit a sufficient quantity of the air discharged by the fans 70 to escape to atmosphere to carry off the water vapor removed from the material and, for this purpose, I provide the exhaust stacks 83 which are provided with adjustable dampers 84. A similar exhaust stack 83a may be provided on the pipe 81 adjacent the discharge connection of the fan 80. The loss of fine particles or crumbs of synthetic rubber through the exhaust stack 83a may be prevented by providing a filter bag or other suitable filtering means 85 in this exhaust outlet which will separate out and retain the fine particles.

The rate of movement of the crumbs along the drying tunnel 56 is also regulated more or less automatically by reason of the fact that the larger or heavier crumbs will be lifted only a relatively small distance by the air blasts from the nozzles 61, whereas the smaller or lighter crumbs will be lifted a considerably higher distance by these blasts. The particles which are lifted for such higher distance will be moved longitudinally of the drying tunnel more readily

by the longitudinal air flow produced by the blower 80, whereas the particles which remain closer to the screen 57 will not be acted on to the same extent by the longitudinal air flow and will therefore travel through the tunnel more slowly. These different rates of movement are desirable because the larger particles usually require a longer drying period.

To prevent the crumbs from sticking to the side walls 87 of the drying tunnel I may provide these side walls with vertically spaced longitudinally extending slots or louvers 88 so that scouring jets or streams of air will flow upwardly in the drying tunnel along the side walls. The walls 87 of the drying tunnel may be spaced inwardly from the side walls of the housing 55 to provide air spaces or plenum chambers 89 therebetween. The air to be discharged through the slots or louvers 88 may be heated air supplied to the plenum chambers 89 from the pipes 73. The amount of air supplied to the plenum chambers 89 for this purpose may be controlled by suitable dampers or valves 90.

When the crumbs approach the discharge end of the drying tunnel they will be relatively dry and since they may be at a relatively high temperature it may be desirable to subject them to a cooling action. For this purpose I may supply relatively cool air to one or more of the air boxes 60 located nearest the discharge end of the drying unit 12. Cool air may be supplied to these boxes by means of a blower 91 and a pipe 92 connecting the boxes with such blower. The intake opening 93 of this blower may be open to atmosphere so that relatively cool atmospheric air will be supplied to the boxes through the pipe 92.

The temperature of the heated air which is supplied to the boxes 48 and 60 and to the plenum chambers 89 should be such that it will be high enough to cause a rapid drying of the synthetic rubber crumbs but must not be so high as to cause damage to the crumbs. The air may be at a temperature of approximately 350° F. although it may be at a considerably higher temperature if such higher temperature can be used without damage to the material being dried. In heating the air to the desired temperature steam or other heating medium may be supplied to the radiators or heat-exchangers 50 and 76 by pipe connections 94. The supply of heating medium to the heaters may be regulated in accordance with the temperature to which it is desired to heat the air and such regulation may be accomplished by providing automatic valves 95 in the supply pipes 94 and which valves are operated in response to the control functions exercised by thermostats 96 appropriately located in the air pipes 51 and 73.

From the foregoing description and the accompanying drawings it will now be readily understood that I have provided a novel method and apparatus for drying various materials in the form of crumbs, curds, grains or other particles and which is especially suitable for handling and drying crumbs of synthetic rubber or other tacky particles.

While I have illustrated and described my method and apparatus in more or less detail it will be understood, of course, that I do not wish to be limited to the particular method steps and structural details herein disclosed but regard my invention as including all variations

and modifications coming within the scope of the appended claims.

Having thus described my invention, I claim:

1. In a method of drying, the steps of advancing particles of the material to be dried on a foraminous belt to the receiving end of a drying tunnel, and discharging a blast of air through the belt from the under side thereof and with a direction and velocity such that it removes the particles from the belt and carries them into said receiving end of the tunnel.

2. In a method of drying, the steps of advancing particles of the material to be dried on a foraminous belt to the receiving end of a drying tunnel, and discharging a blast of heated air through the belt from the under side thereof and with a direction and velocity to lift and separate the particles and carry them into said receiving end of the tunnel.

3. In a method of drying, the steps of advancing particles of the material to be dried on a foraminous belt and causing the belt to travel forwardly and downwardly at the receiving end of a drying tunnel, and discharging a blast of heated air through the forwardly and downwardly extending portion of the belt in a direction to remove the particles from the belt and carry them upwardly and forwardly into said receiving end of the tunnel.

4. The method of treating crumbs of tacky material which comprises advancing the material while in contact with a soapy liquid, depositing the material on a screen belt so as to separate it from the liquid, washing the material while on the belt to remove the soapy liquid, advancing the material by movement of the belt to a point adjacent a drier, and discharging air through said screen belt from the under side thereof and with sufficient velocity to remove the crumbs from the belt and carry them into the drier.

5. The method of drying which comprises advancing the material to be dried on a foraminous belt to the receiving end of a drying tunnel, discharging a blast of heated air through the belt to lift, separate, and partially dry the particles of material and to carry the particles into said receiving end, discharging blasts of heated air upwardly in the tunnel at spaced points therealong to further dry the particles and maintain them substantially in suspension, and causing a flow of air longitudinally through the tunnel to advance the particles therealong.

6. The method of treating crumbs of tacky material which comprises discharging soapy liquid containing such crumbs onto a foraminous belt so as to separate the crumbs from the liquid, washing the crumbs while on said belt, advancing the material to a drier, discharging air through the belt from the under side thereof and with a direction and velocity such as to blow the crumbs from the belt and into the drier, discharging streams of heated air upwardly in the drier to dry the crumbs and maintain them substantially in suspension, and causing a flow of air in the drier for advancing the crumbs therein.

7. The method of treating crumbs of tacky material which comprises discharging soapy liquid containing such crumbs onto a foraminous belt so as to separate the crumbs from the liquid, washing the crumbs while on said belt, advancing the material to a drier, discharging air through the belt from the under side thereof and with a direction and velocity such as to blow the crumbs from the belt and into the drier,

discharging streams of heated air upwardly in the drier through nozzles spaced therealong to dry the crumbs and maintain them substantially in suspension, reciprocating said nozzles while said air streams are being discharged, and causing a flow of air in the drier for advancing the material therein.

8. The method of treating crumbs of tacky material which comprises discharging soapy liquid containing such crumbs onto a foraminous belt so as to separate the crumbs from the liquid, washing the crumbs while on said belt, advancing the crumbs to a drier, discharging air through the belt from the under side thereof and with a direction and velocity such as to blow the crumbs from the belt and into the drier, discharging streams of heated air upwardly in the drier to dry the crumbs and maintain them substantially in suspension, causing a flow of air in the drier for advancing the crumbs therein, and cooling and collecting the dried crumbs.

9. In drying apparatus, a drying tunnel, a movable foraminous belt arranged to carry the material to be dried to a point adjacent one end of said tunnel, and means for discharging air through said belt from the under side thereof and with a direction and velocity such as to lift the material from the belt and carry it into said tunnel.

10. In drying apparatus, a drying chamber, a movable foraminous belt arranged to carry the material to be dried to a point adjacent an opening into said chamber, and means for discharging heated air through said belt from the under side thereof and with a direction and velocity such as to blow the material from the belt and into said chamber and cause separation and drying of the individual particles of said material.

11. In drying apparatus, a drying tunnel, a movable foraminous belt arranged to carry the material to be dried to a point adjacent one end of said tunnel, and means for discharging air through said belt so as to lift the material therefrom and carry it into said tunnel, means for discharging heated air upwardly in said tunnel at spaced points therealong for agitating and drying said material and maintaining it substantially in suspension, and means for causing a flow of air longitudinally of the tunnel for advancing the material therealong.

12. In drying apparatus, a drying tunnel having receiving and discharge ends and a continuous longitudinally extending substantially flat screen bottom therebetween, means for delivering material to be dried into the receiving end of said tunnel, means at the discharge end adapted to receive the dried material, a plurality of nozzles beneath said screen bottom and spaced longitudinally of the tunnel, means for supplying heated air to said nozzles to be discharged thereby through said screen bottom for drying the material and substantially maintaining the same in suspension above said bottom, and means for causing the circulation of an additional supply of air longitudinally through the tunnel above said bottom and from said receiving end toward said discharge end for advancing the material in suspension along the tunnel.

13. In drying apparatus, a drying tunnel having a foraminous bottom, a plurality of nozzles beneath said foraminous bottom and spaced longitudinally of the tunnel, means for supplying heated air to said nozzles to be discharged thereby through said foraminous bottom for agitating

and drying said material, means for reciprocating said nozzles longitudinally of the tunnel, and means for causing a flow of air longitudinally through the tunnel above said bottom for advancing the material along the tunnel.

14. In combination with a drier having an opening at one end thereof, a foraminous belt arranged so that a portion thereof extends downwardly and forwardly in front of said opening, and means for forcing air through said downwardly and forwardly extending portion of the belt so as to blow material to be dried from the belt and into the drier.

15. In drying apparatus, a drying tunnel having side walls and a continuous longitudinally extending substantially flat screen bottom, means for supplying material to be dried to said tunnel at one end thereof, means at the other end of the tunnel adapted to receive the dried material, means for discharging heated air upwardly through said screen bottom for drying the material and substantially maintaining the same in suspension above said bottom, the side walls of said tunnel having louvers therein arranged to direct air over the surfaces of said walls to prevent the material from sticking to said walls, means providing plenum chambers at the sides of said tunnel for supplying air to said louvers, and means for causing the circulation of an additional supply of air longitudinally through the tunnel above said screen bottom and in a direction from said one end towards said other end for advancing the material in suspension along the tunnel.

16. In drying apparatus of the character described, an elongated housing having a drying tunnel therein, means at one end of the housing for blowing the material to be dried into the receiving end of the tunnel, means for blowing air upwardly in the tunnel at spaced points therealong for agitating and drying the material, the side walls of said housing being spaced from the side walls of the drying tunnel to provide plenum chambers therebetween and the side walls of the tunnel having longitudinally extending louvers for discharging air upwardly in the tunnel to prevent the material from sticking to the tunnel side walls, and means for forcing air into said plenum chambers.

17. In drying apparatus, a housing having an elongated drying tunnel provided with a foraminous bottom, a plenum chamber extending longitudinally in the housing and communicating with the drying tunnel along the top of the latter, means for blowing particles of the material to be dried into the tunnel at the receiving end thereof, a plurality of nozzles spaced along the tunnel beneath said bottom and arranged to blow air upwardly through said bottom for agitating and drying the material, a blower operable to withdraw air from said plenum chamber and to supply air under pressure to said nozzles, and means for heating the air supply to said nozzles.

18. In drying apparatus, a housing having an elongated drying tunnel provided with a foraminous bottom, a plenum chamber extending longitudinally in the housing and communicating with the drying tunnel along the top of the latter, means for blowing particles of the material to be dried into the tunnel at the receiving end thereof, a plurality of nozzles spaced along the tunnel beneath said bottom and arranged to blow air upwardly through said bottom for agitating and drying the material, a blower operable to withdraw air from said plenum chamber and to sup-

ply air under pressure to said nozzles, means for heating the air supply to the nozzles, air discharge means at the receiving end of the tunnel arranged to discharge air longitudinally through the tunnel for advancing the material therealong, a separator at the delivery end of the tunnel adapted to receive the dried material, and a blower operable to withdraw air from the separator and to supply air under pressure to said air discharge means.

19. In drying apparatus, a housing having an elongated drying tunnel provided with a foraminous bottom, a plenum chamber extending longitudinally in the housing and communicating with the drying tunnel along the top of the latter, a wire belt movable to convey the material to be dried to a point adjacent the receiving end of said tunnel, a nozzle arranged to discharge air through said belt for blowing the material into the receiving end of the tunnel, a plurality of nozzles spaced along the tunnel beneath said foraminous bottom and arranged to blow air upwardly through said bottom for agitating and drying the material, means for withdrawing air from said plenum chamber and supplying air under pressure to the nozzles, means for heating the air supply to the nozzles, air discharge means at the receiving end of the tunnel arranged to discharge air longitudinally through the tunnel for advancing the material therealong, a separator at the delivery end of the tunnel adapted to receive the dried material, and a blower operable to withdraw air from the separator and to supply air under pressure to said air discharge means.

20. In drying apparatus, a housing having an elongated drying tunnel provided with a forami-

nous bottom, a plenum chamber extending longitudinally in the housing and communicating with the drying tunnel along the top of the latter, a wire belt movable to convey the material to be dried to a point adjacent the receiving end of said tunnel, a nozzle arranged to discharge air through said belt for blowing the material into the receiving end of the tunnel, a plurality of nozzles spaced along the tunnel beneath said foraminous bottom and arranged to blow air upwardly through said bottom for agitating and drying the material, means for withdrawing air from said plenum chamber and supplying air under pressure to the nozzles, means for heating the air supply to the nozzles, means for thermostatically controlling said heating means to maintain said air supply at a desired temperature, air discharge means at the receiving end of the tunnel arranged to discharge air longitudinally through the tunnel for advancing the material therealong, a separator at the delivery end of the tunnel adapted to receive the dried material, and a blower operable to withdraw air from the separator and to supply air under pressure to said air discharge means.

21. The method of drying crumbs of tacky material which comprises advancing the crumbs on a foraminous belt to the receiving end of a drier in a relatively wet condition, discharging a blast of drying air through the belt from the under side thereof with a velocity, direction and volume to remove the crumbs from the belt and to reduce their surface tackiness sufficiently to prevent the crumbs from adhering and to carry the crumbs into said receiving end of the drier.

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