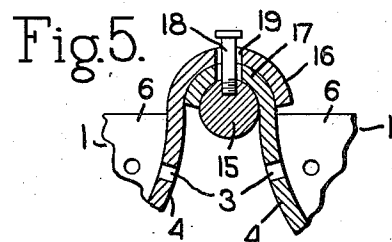
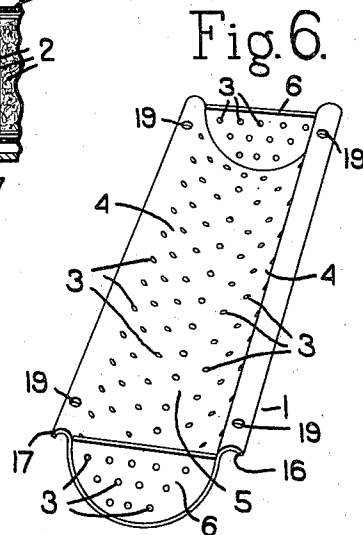
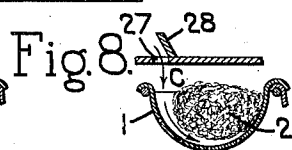
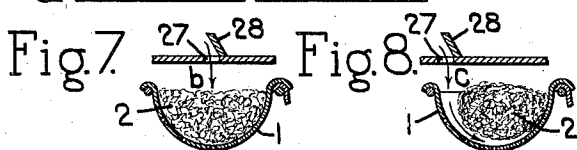
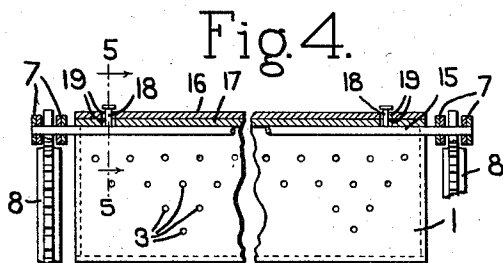
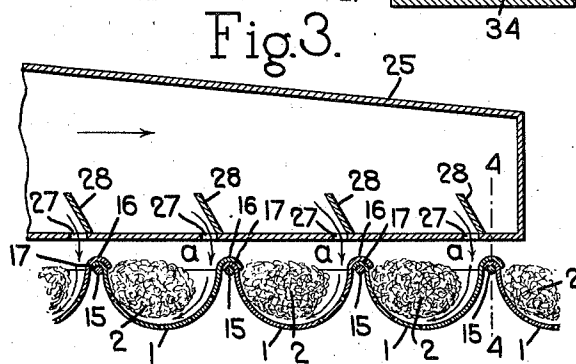
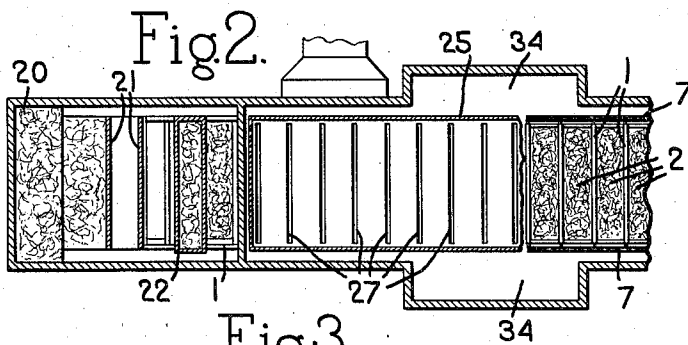
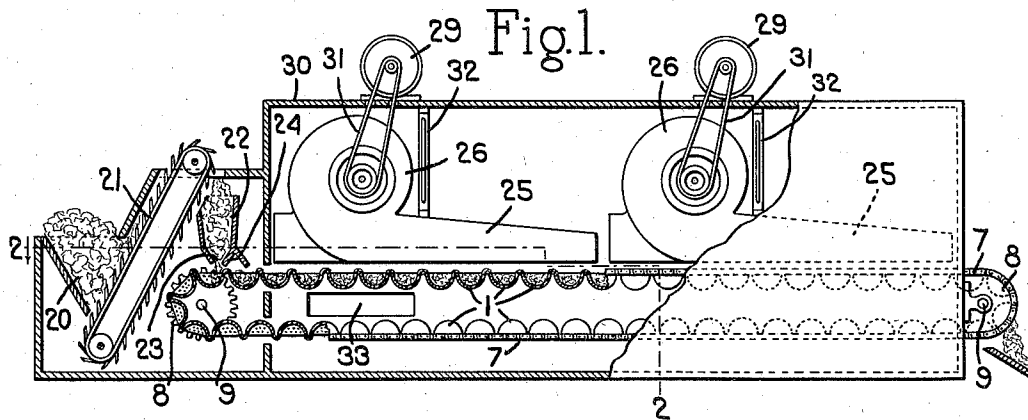


June 16, 1936.

E. H. HANSEN
METHOD OF AND APPARATUS FOR TREATING FIBROUS,
GRANULAR, OR OTHER MATERIAL IN LOOSE FORM
Filed April 17, 1934

2,044,744



Inventor.
Edwin H. Hansen
by *Heard Smith & Tennant*
Attys.

UNITED STATES PATENT OFFICE

2,044,744

METHOD OF AND APPARATUS FOR TREATING FIBROUS, GRANULAR OR OTHER MATERIAL IN LOOSE FORM

Edwin H. Hansen, Braintree, Mass., assignor to
Andrews & Goodrich, Inc., Dorchester, Mass.,
a corporation of Massachusetts

Application April 17, 1934, Serial No. 720,972

16 Claims. (Cl. 34—12)

This invention relates to the treating of fibrous, granular or other loose material with a jet of gaseous medium, which may be done for the purpose of drying the material, or humidifying it, or incorporating therein an ingredient which is carried by the gaseous medium.

An object of the invention is to provide an improved method of and apparatus for treating material with the jet of gaseous medium by which the desired treatment of the material can be quickly and efficaciously achieved.

In carrying out my invention the mass of material to be treated is subjected to the action of the jet of gaseous material in such a way as to produce a rolling or tumbling action of the mass first in one direction and then in another, as a result of which rolling or tumbling tendency the gaseous medium finds access to all parts of the mass whereby the mass is uniformly subjected to the action of the gaseous medium.

One way of practising the invention is to place the mass of material to be treated in an open trough-like receptacle, which preferably is provided with perforated walls, and then to direct the jet of gaseous medium along first one side wall of the trough and then along the other side wall and also against the top of the material contained in the trough. When the jet is directed against or along either side wall of the trough-like receptacle, said jet tends to follow the wall and pass under the mass of material in the receptacle, while at the same time some of the gaseous medium is flowing through the perforations in the wall with the result that said mass will be slightly lifted from the bottom of the receptacle and will also be given a sort of rolling or tumbling movement in the trough-like receptacle. The delivery of the jet along first one side wall and then the other of said receptacle thus produces a turbulent tumbling or rolling tendency of the mass of material first in one direction and then in the other, and hence the portions of the mass which are normally least accessible for treatment by a jet of gaseous material will be subjected to such jet and thus receive the desired treatment.

Where the desired treatment is carried out by placing the material to be treated in a trough-like receptacle a convenient way of carrying out the process is to give the receptacle and the jet a relative movement so that the jet will first engage or pass down along one side wall of the trough, thereby giving said mass of material a turbulent rolling tendency in the trough in one direction, and then impinge against the top of

the mass of material and then be directed against or along the opposite side wall of the receptacle, thereby giving the mass a turbulent rolling tendency in the other direction.

As stated above the invention is adapted for subjecting the material to the action of gaseous medium to produce various effects. For instance, the invention may be used for drying a mass of material by treating such mass with drying gaseous medium, or the invention may be used for humidifying a mass of material by using a gaseous material which will produce a humidifying effect, or the invention may be used for incorporating in the mass of material some ingredient for which the gaseous medium is a vehicle.

The ingredient to be incorporated in the material may be carried by the gaseous medium vehicle either as a liquid or as a vapor or in finely-divided solid form.

Merely as illustrating the manner in which the invention operates I will describe it as it might be used in drying wool or similar fibrous material, but, as stated above, it will be understood that the invention can be used in various other ways than in drying fibrous material.

In the accompanying drawing:

Fig. 1 is a side view, with part broken out, of an apparatus embodying my invention and by which the improved method may be practised;

Fig. 2 is a fragmentary section on the line 2—2, Fig. 1;

Fig. 3 represents a fragmentary longitudinal section through the manifold from which the gaseous medium is delivered;

Fig. 4 is a section on the line 4—4, Fig. 3;

Fig. 5 is an enlarged section on the line 5—5, Fig. 4;

Fig. 6 is a perspective view of one of the trough-like receptacles;

Figs. 7 and 8, together with Fig. 3, illustrate the action of the jet of gaseous material in giving the mass of fibrous material a rolling or tumbling tendency.

As applied to the drying of wool the invention is of special advantage in drying wool preparatory to combing or otherwise treating it after it has been washed to remove grease, dirt and other impurities and has also been dewatered by being passed between squeeze rolls or the like. Wool which has been thus treated may contain up to 100% of water based on the bone dry weight of the fibre, but even with such water content the wool is quite light and fluffy.

The apparatus which I have herein illustrated for carrying out my improved process comprises

a plurality of trough-like receptacles 1, each of which is adapted to contain a mass or batch 2 of wool or other material to be treated. These trough-like receptacles 1 can conveniently be arranged in endless formation and each is preferably concavely curved in cross section. I will also preferably make the curved portion of each receptacle of perforated sheet metal, although any other suitable foraminous material may be used. As shown in Fig. 6 the receptacle 1 has perforations 3 in its side walls 4 and bottom 5 and the end walls 6 are also shown as being provided with similar perforations although it is relatively unimportant whether the end walls are perforated or not. These trough-like receptacles are shown as linked together in any suitable way and are fixed to chains 7 which are mounted on and pass around sprocket wheels 8. These sprocket wheels are carried by shafts 9 which are suitably mounted in a supporting frame. One convenient way of mounting the trough-like receptacles 1 on this endless chain carrier is to provide the chains with the cross rods 15 and to form the receptacles with hook portions 16, 17 at their opposite edges, which hook portions hook over the rods 15.

18 indicate pins secured to the rods and extending through openings 19 formed in the hook portions 16 and 17 of each receptacle. The openings 19 are larger than the pins so as to allow for the angular movement between the troughs as they make their turns around the sprocket wheels 8. This endless chain structure can be driven by any suitable source of power which may be delivered to either of the shafts 9.

Means may conveniently be provided for delivering the wool or other material to the trough-like receptacles during the movement of the endless chain device. As herein shown this material is delivered through a sluice or opening 20 onto an endless conveyor 21, the receiving surface of which travels upwardly at an inclination. The material is delivered from this conveyor into a hopper 22 having a delivery opening 23 in its bottom through which the material is deposited into the various receptacles 1 as they pass beneath the hopper. Any excess of material which is deposited in any trough will be removed by a doctor or scraper 24, such excess being scraped into the next succeeding receptacle.

After the receptacles have thus been loaded, the material in each receptacle is then subjected to the action of one or more jets of gaseous medium in such a way that each jet of gaseous medium will be delivered first down along and over one side wall 4 of each receptacle, then against the top of the material in the receptacle and then against and along the other side wall of said receptacle, thereby to produce the above-mentioned rolling or tumbling tendency of the mass of material in the receptacle first in one direction and then in the other.

Various ways of delivering such jet of gaseous material may be employed without departing from the invention. In the construction shown there is provided a manifold 25 into which the gaseous medium is delivered under pressure through the agency of a blower 26. The manifold 25 is provided in its bottom with a plurality of discharge openings 27, each opening being shown as in the form of a slot extending from one side to the other of the manifold. The manifold will preferably have a width equal to the length of each receptacle 1 so that the slots 27

are of substantially the same length as the receptacle.

The manifold is further provided with a deflecting vane 28 adjacent each slot 27, said vanes serving to direct the gaseous medium supplied to the manifold downwardly through said slots.

The blower 26 may be driven in any suitable way as by means of a motor 29 mounted on the casing 30 within which the blower and manifold are received, said motor being connected to the blower through a suitable belt 31. In Fig. 1 two such manifolds 25 and blowers 26 are shown, but for some purposes a single blower and manifold might be sufficient while for other purposes it might be desirable to have more than two blowers and manifolds. The spacing between the slots 27 in either manifold is preferably the same as that between the receptacles 1.

As each receptacle passes underneath a slot or jet aperture 27, the jet of gaseous medium, which has a sheet-like shape, passes down along the right hand wall of the receptacle 1 and across the bottom of the receptacle and tends to move upwardly along the left hand wall as shown by the arrows *a* in Fig. 3. This action of the sheet-like jet will tend to lift the mass 2 slightly from the bottom of the trough-like receptacle and will also tend to give said mass a more or less turbulent rolling or tumbling tendency within the trough as shown in Fig. 3. During this operation the gaseous material is, of course, leaking or passing out through the apertures 3 in the walls of the trough-like receptacle, but nevertheless it reaches the fibres or particles on the under side of the mass or batch of material in the trough. As the endless carrier moves into a position relative to the jet aperture 27 which is shown in Fig. 7 the sheet-like jet will be directed against the top of the mass of material in the receptacle and will pass downwardly through said mass as shown by the arrow *b*. As the trough advances still further it will arrive at the position relative to the jet aperture 27 shown in Fig. 8, in which position the sheet-like jet of gaseous material is being delivered downwardly along the left hand wall 4 of the trough as shown by the arrow *c*, and will tend to move not only downwardly along said wall but across the bottom of the trough and to a certain extent upwardly along the right hand wall. This will serve to again lift the mass of material slightly from the trough and at the same time give it a rolling or tumbling tendency in the opposite direction from that which it received when the jet of gaseous material was passing down along the right hand wall 4.

As each trough-like receptacle passes any jet aperture 27 there will be a somewhat longer period of turbulent rolling or tumbling movement in the mass 2 of material while the trough is moving from the position relative to the jet aperture shown in Fig. 3 to that shown in Fig. 7 than there will be during the movement of the trough from the position shown in Fig. 7 to that shown in Fig. 8.

Just as soon as the advancing edge of any trough passes under a jet aperture 27 the jet or stream of gaseous medium will be forced down the right hand wall of the trough as shown in Fig. 3 and the turbulent tumbling motion of the mass of material 2 will be initiated and this will continue as the trough-like receptacle moves to the right until the receptacle is nearly in the position shown in Fig. 7. The reverse turbulent rolling or tumbling motion of the material 2 will not begin until the trough-like receptacle is nearly

in the position shown in Fig. 8 and consequently there would be a shorter period of time in which the mass is being turbulently tumbled or rolled in a counter-clockwise direction, viewing Fig. 8.

5 With the construction shown the mass of material in each receptacle 1 will have this turbulent rolling or tumbling movement as said receptacle passes underneath each jet aperture 27 and hence as the receptacles pass under the successive jet apertures 27 the mass or batch of material in each receptacle will be given repeated turbulent rolling or tumbling movements, first in one direction and then in another, and by this means the fibres of each mass of fibrous material, 15 (assuming fibrous material is being treated) or the grains of each mass of granular or other loose material (assuming granular or other loose material is being treated), will be uniformly treated by the jets of gaseous medium. Where this treatment is being used for drying material the manifolds 25 and the blowers 26 will preferably be placed within a drying chamber, such as shown at 30, through which the connected receptacles 1 pass, and the gaseous material which is used 20 will be a drying medium, such for instance as heated air, in which case any suitable means may be employed for heating the air.

In the construction shown the blowers 26 are arranged to take air from the interior of the chamber 30 and this air may be preheated before delivery to the inlet of each blower by passing through a steam heated coil 32. The chamber 30 is shown as provided with a vent opening 33 through which the moisture-laden air may escape, this vent opening being placed at the inlet end of the chamber 30 where the air will become most heavily laden with moisture.

The air at the intermediate portion of the chamber 30 and near the outlet end thereof may be advantageously re-used so as to utilize such residual heat as it may carry. The intermediate portion of the chamber 30 is shown as being widened at each side as indicated at 34 to form unobstructed spaces through which the air or other drying medium delivered from the right hand manifold 25 may rise to the upper part of the chamber and thence pass through the heater to the left hand blower.

50 The pressure of the air jets may be varied but a pressure corresponding to at least about one to two inches of water is usually preferred.

The capacity of the receptacles 1 may also be varied, although for drying wool and similar material it is convenient to use receptacles which have a capacity of about one pound of bone-dry wool.

In order to avoid dissipation of the jets issuing from the apertures 27 I prefer to arrange the manifolds so that the apertures are not more than an inch above the top of the receptacles 1.

60 The degree of turbulence which the fibrous material receives as it passes under each jet aperture depends somewhat upon the relation between the total area of the perforations and the total area of the solid portions of the receptacles. The larger the perforations in size and number the less will be the turbulence as the gaseous material will more readily flow through the perforations. The smaller the total area of the perforations the greater will be the turbulence since a smaller amount of the gaseous fluid will escape through the apertures and a larger portion will be flowing over the curved side walls and bottom of the receptacles.

75 This invention provides a method and appara-

tus by which wool can be rapidly and thoroughly dried and it has the further advantage that the drying may be quickly done at temperatures less than 150° F., above which temperatures the wool fibre is apt to lose some of its optimum qualities. 5

While I have referred above to the drying of wool, yet as previously stated the principle of the invention may be applied to drying other fibrous material such as cotton, jute, etc., and also to drying granular material or any other material 10 in loose form. The invention is also equally applicable for giving the fibrous material, granular material or any material in loose form a treatment for humidifying it, which would be done by using a gaseous material adapted to give 15 the desired humidification, or a treatment for incorporating into the material an ingredient for which the gaseous medium acts as a vehicle. For instance, if it is desired to apply oil or some other liquid to fibrous or granular material this 20 could be done by using a gaseous medium which carried oil in atomized form; or if it is desired to treat the material, whether fibrous or granular or in other loose form, with some vapor, then the gaseous medium may be used as a vehicle to 25 carry the desired vapor, or if it is desired to incorporate in a mass of fibrous or granular or other loose material an ingredient in finely-divided form, then the gaseous medium may be used as a vehicle for carrying such solid matter. 30

The turbulent rolling or tumbling movement given to the material in each trough-like receptacle results in giving the gaseous medium access to all parts of the mass so that the mass will be uniformly treated. 35

When the invention is used for drying fibrous or granular material, the drying operation can be carried out more expeditiously than with other drying apparatus with which I am familiar. The term "trough-like" receptacle as used herein is 40 intended to include any suitable receptacle adapted to hold a batch of material being dried and to retain said batch while it is being given the rolling or tumbling motion above-described.

I claim:

1. The process of treating a batch of material which consists in delivering a jet of gaseous material-treating medium against said batch first on one side thereof and then on the other side thereof, thereby causing said batch as a unit to 50 have a turbulent rolling or tumbling tendency first in one direction and then in the other.

2. The process of treating a batch of material in a trough-like receptacle which consists in directing a jet of gaseous medium along first one 55 side of the trough-like receptacle from the top toward the bottom and subsequently along the other side in a similar manner, whereby said batch of material is given a rolling or tumbling tendency in said trough first in one direction and 60 then in the other.

3. The process of treating a batch of material in a trough-like receptacle, which consists in repeatedly directing a jet of gaseous medium along first one side of said receptacle from the top 65 toward the bottom and then similarly along the other side thereof, whereby said batch of material is repeatedly given a rolling or tumbling tendency in the trough first in one direction and then in the other. 70

4. The method of treating a batch of material in a trough-like receptacle which consists in directing a jet of gaseous medium first along one side of said receptacle from the top toward the bottom with sufficient force to cause the batch 75

as a unit to have a rolling or tumbling motion in the trough, then downwardly against the material in the receptacle, thence along the other side of the receptacle also from the top toward the bottom and also with sufficient force to again cause said batch as a unit to have a rolling or tumbling motion in the trough.

5. The method of treating a batch of material which consists in directing a jet of gaseous material-treating medium past the under surface of the batch of material with sufficient force to cause said batch as a unit to have a rolling motion and then directing said jet against the upper surface of said batch while such material is maintained intact in batch form.

6. The method of treating material which comprises depositing a batch of such material in a foraminous trough and directing a jet of gaseous medium into the trough past the under surface of said batch with sufficient force to cause the batch as a unit to have a rolling motion and then against the upper surface thereof while such medium is escaping through the perforations of said trough.

7. The method of treating material which consists in depositing a batch of such material in a foraminous trough of curved cross section and producing a relative movement between such trough and a jet of gaseous medium to cause said jet to be directed into the trough and sequentially past the under surface, against the upper surface, and again past the under surface of such batch of material while said medium is escaping through the perforations in the trough.

8. The method of treating material which consists in progressively forming a succession of small batches of such material, giving the batches of such material and jets of gaseous medium a relative motion in such a direction that each jet is directed sequentially past the under surface with sufficient force to cause the batch to have a rolling movement, against the upper surface, and again past the under surface of each batch also with sufficient force to cause the batch to have a rolling movement, and accumulating the resulting batches of treated material.

9. In the drying of wet material, those steps which comprise progressively depositing a succession of batches of such material in a series of foraminous troughs of curved cross section, progressively moving said troughs and contents past jets of gaseous drying medium each directed sequentially past the under surface with sufficient force to cause the batch to have a rolling or tumbling tendency in the trough, against the upper surface, and again past the under surface of each batch while escaping through the perforations of the corresponding trough, and progressively discharging the batches of dried material from said troughs.

10. The method of treating material which consists in depositing a batch of such material in a foraminous trough of curved cross section and producing a rolling or tumbling motion of the batch as a unit in said trough by directing a jet of gaseous material downwardly along the inner

face of one side wall of the trough and across the curved bottom thereof.

11. The method of treating material which consists in depositing a batch of such material in a foraminous trough of curved cross section and giving such batch as a unit a rolling or tumbling tendency in the trough by directing a sheet-like jet of gaseous medium into the trough between the inner wall thereof and said batch of material.

12. The method of treating material which comprises subjecting a mass of the material to the action of a jet of gaseous material-treating medium while said material is confined in a trough-like receptacle and so directing said jet against said mass as to give the mass as a unit a rolling or tumbling tendency in the receptacle first in one direction and then in another direction.

13. The method of treating a batch of material which consists in directing a jet of gaseous material-treating medium between said batch and its support first in one direction and then in another direction thereby causing the batch to have a rolling or tumbling tendency on its support first in one direction and then in another direction.

14. Apparatus for treating material comprising a trough of concavely curved cross section, means to deposit a batch of material in such trough, means to produce a jet of gaseous material, and means to give said jet and said trough a relative movement transversely of the trough, whereby the jet of material is directed into the trough first along one side wall thereof so as to impinge against the material in the trough and subsequently along the other side wall thereof.

15. Apparatus for treating material comprising an endlessly moving succession of foraminous troughs of curved cross section, means for progressively depositing a succession of batches of such material in said troughs, a series of jets of gaseous medium each directed to sweep the internal wall of each trough, the upper surface of its contents, and again to sweep its internal wall as it moves past, and means for causing the discharge of said troughs after they have moved past said jets.

16. Apparatus for treating material comprising a succession of foraminous troughs of curved cross section linked together as a circuitously moving carrier, means for guiding both stretches of said carrier substantially horizontally, means for progressively depositing a succession of batches of such material in said troughs at their upper stretch immediately after they have made the turn to become the upper stretch, and a series of jets of gaseous medium arranged above said upper stretch each directed to sweep the internal wall of each trough, impinge against the upper surface of its contents, and again to sweep its internal wall as it moves past, said troughs discharging their contents as they make the turn to become the lower stretch.

EDWIN H. HANSEN.