

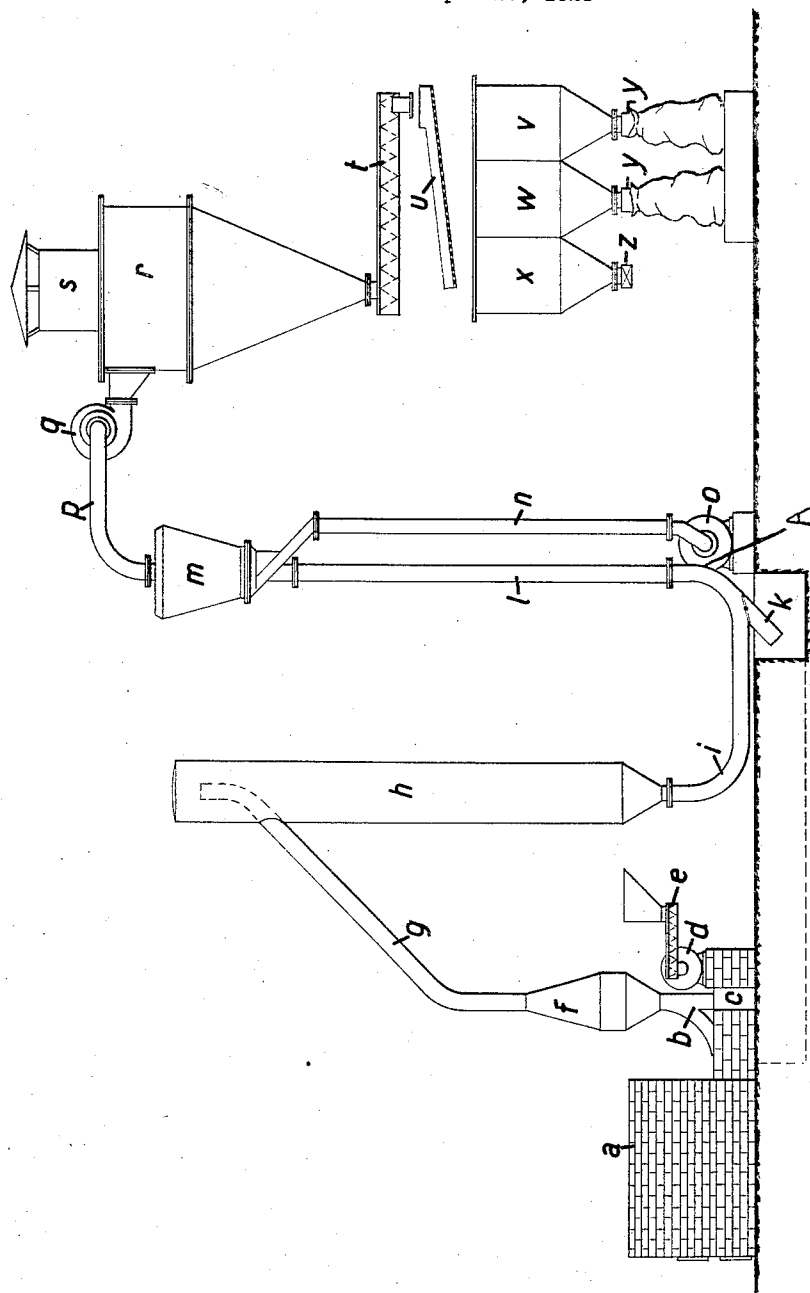
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PNEUMATIC DRYING OF MATERIALS

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PNEUMATIC DRYING OF MATERIALS

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It is well known that in pneumatic grinding installations the drying of the material can be effected at the same time as the grinding process. The sifting and circulation of the material proceed simultaneously, the drying media (combustible gases or hot air) affecting the finished ground material only on its way between the delivery of the material and the separation of the finished goods, whilst a mill is arranged in such a manner that the combustible gases are not drawn through the mill itself. The drying medium is used simultaneously for transporting and sifting the material.

The subject matter of the present invention is a pneumatic drying process, which forms an extension of the above mentioned process, more particularly in instances in which the disintegration of the material is subsidiary to the drying thereof, that is to say, the disintegration is merely used as a contributory factor in the acceleration of the drying process.

According to the present invention, the moist material is only dried superficially, after which it is distributed and led back again by mechanical means, so that a fresh moist surface is always exposed to the heating gas. The speed of each drying operation depends upon two factors, the difference in temperature and the exposed moist surface. So long as any material has a moist surface, it can be unhesitatingly submitted to high temperatures. As soon, however, as the surface has become dry, the necessary heat for drying the core can only penetrate into the interior by conduction. Since the coefficients of heat conduction of a very large number of substances (more particularly organic substances) are low, the surface which has once been dried must only be allowed to come into contact with fairly low temperatures, in order to prevent any concentration of heat on the surface, which would otherwise overheat the surface or damage it. The decisive factors governing the speed of the drying have thus become very small, the exposed, moist surface has disappeared and the difference in temperature must be kept low. For this reason, the known drying process is more

and more retarded, and large apparatus and heavy installation costs are inevitable.

In accordance with the present process, the dry surface is removed from time to time. Since, in the case of disintegration, the sum of the moist surfaces newly formed from time to time increases in proportion to the volume of the material to be dried, and since on the other hand, the surface, which thus remains moist, can be brought into contact with high temperatures, the drying process can be carried out in an extraordinarily brief space of time and with the aid of inexpensive apparatus.

The present process is more particularly suitable for drying sensitive organic substances, such, for instance as potatoes and turnips, which have a high water content of something like 80% and 90%. It can also be used, for example, with lignite, irrespective of its moisture content, thus replacing the known expensive process of drying by means of steam or furnace gases.

Apparatus whereby the present process may be put into practical execution is shown, by way of example, on the accompanying drawing.

The heating gases, which are produced in an oven *a* enter the apparatus through a pipe *b*, being mixed, if and as necessary, with fresh air which is drawn through a fresh air valve *c*. The wet material is fed by means of a worm conveyor *e* to a centrifugal machine *d* which is a sort of a small fan or sling which throws or flings the wet material upwards into the centre-line of the current of the hot gases. An enlarged space *f* is provided for all substances which, when in a moist condition, have a tendency to adhere to the hot walls of the pipes. The material is carried upward by means of the stream of heating gases flowing in a pipe *g* and thereafter descends in a pipe *h*, which is of larger cross section, in order to retard the speed of movement of the material and thus afford time for the drying of the latter. After passing the bend *i* the gas can be either cooled or heated by means of air or hot gases entering through a pipe *k*. After ascending in a further pipe *l*, the material enters a separating

funnel *m* which in the construction illustrated is formed as an air sifter. The dry, fine material and the coarse undried material are separated in said sifter, the product being then drawn up, through a pipe *p* by an ex-
 5 hauster *q*, which furnishes the necessary kinetic energy for the whole system. The exhaust gases from the exhauster are separated from the product in a cyclone fan *r* and pass out through a pipe *s*. The material
 10 which is only superficially but not internally dried is separated from the dried material in the separating (sifting) device and drops through a return pipe *n* into a disintegrating device *o* which is designed as a centrifugal
 15 mill. The latter removes the dry surfaces, creates fresh moist surfaces and flings the material through the slot A back again into the rising pipe *l*, in which the fresh moist
 20 surfaces again come into contact with the hot gases and are dried. The dried material is again separated from the undried material in the separating device *m*, and the undried product is returned for further circulation,
 25 and so on. After leaving the cyclone, the finished product is cooled in a worm *t*, separated by means of an oscillating sieve *u* into a bin *v* where the fine material is collected, a bin *w* where the coarse material is col-
 30 lected and a bin *x* where the husks are collected. These materials are subsequently drawn off into sacks through the valves *y* and *z*.

The above described process is capable of
 35 a number of modifications to suit any particular requirements. Some materials, for instance, potatoes, have a great tendency to pasting up or adhering to the walls, especially if they are thrown against these walls
 40 at a high speed. This pasting up also takes place if sharp bends are used to connect the ascending and descending pipes. This drawback can be avoided if, instead of narrow
 45 bends, enlarged chambers are used to connect the ascending and descending pipes. In these enlarged chambers, the reversing of the current takes place at a reduced speed so
 50 that the pasting up is avoided. Substances of high specific gravity, which, therefore, are not easily carried by the current, may be fed above a diffuser-like constriction of the
 ascending pipe, cool air being added, if necessary.

The point at which the disintegration and
 55 the re-introduction of the return flow of the material into the current of gas takes place, varies according to the nature of the material. In the appended drawing it is shown arranged at the point A behind the preliminary
 60 drying column. In the case of substances which are not sensitive, it can be arranged at the beginning of the whole system and thus allow of the disintegrating device being used simultaneously as a delivery de-
 65 vice. The slot A, through which the material

is returned from the disintegrating device into the pipe *l* may be arranged at a point at which the temperature has fallen so low that an injurious effect of the hot gases on the predried material is avoided. It is also possible to feed the returned material, together
 70 with the fresh material, into the current of hot gases, by introducing it into a machine which is used simultaneously as a disintegrating and delivery device. Further, the work can be carried out in such a way that
 75 the fine product taken from the cyclone can be regarded as the finished product, whilst the coarse parts are again drawn by the pneumatic system at any desired point and dried.
 80 Tests which have been carried out up to the present time have shown that the process according to this invention can be very successfully applied to the most diverse materials, and that it is possible, in the space of a
 85 few seconds, to completely dry substances such as for instance, potatoes, beets and raw lignite. The process can also replace the very expensive and slowly working drying apparatus hitherto in use and, consequently,
 90 constitutes an important progress in the drying technology.

I claim:

1. In apparatus for pneumatic drying of materials, the combination of an oven, a conduit in communication with the oven and with
 95 the outside air, means for supplying material to be dried to the conduit, a relatively large chamber into the upper end of which the conduit opens for the discharge of the material and its further drying while falling,
 100 a conduit opening out of the bottom of said chamber, and a second drying chamber to which said conduit leads, a hot air passage opening into said conduit, means for the return of moist material from the drying chamber
 105 to the last mentioned conduit for further drying, and means for exhausting dry material from said drying chamber.

2. In apparatus for pneumatic drying of materials, the combination of an oven, a conduit in communication with the oven and
 110 with the outside air, means for supplying material to be dried to the conduit, a relatively large chamber into the upper end of which the conduit opens for the discharge of the material and its further drying while falling,
 115 a conduit opening out of the bottom of said chamber, and a second drying chamber to which said conduit leads, a hot air passage opening into said conduit, means for the return of moist material from the drying chamber to the last mentioned conduit for
 120 further drying, and means for exhausting dry material from said drying chamber, a cyclone fan for further drying of the material, a vibratory sieve for separating the material according to size and a plurality of
 125 chambers into which the material is received and graded according to size.

3. In apparatus for pneumatic drying of materials, the combination of an oven for providing hot gases, a deviation chamber in communication with said oven and of conical shape to prevent the moist material from adhering to its walls, a pipe connecting said oven to said chamber, a feeding device for delivering material to be dried to said pipe, a chamber into which the feeding conduit opens for separating the fine dried from the coarse undried material while falling through said chamber, a disintegrator for removing the dry surfaces of the material and for returning the dry material into the conduit for further drying, an exhauster for drawing hot gases through the system, a pipe connecting the exhauster to the separating device, and a cyclone fan for separating the exhaust gases from the finished material.

4. In apparatus for pneumatic drying of materials, the combination of a source for furnishing hot gases, a rising conduit in communication with said source, means for supplying material to be dried to the conduit, a relatively large chamber, into the upper end of which the conduit opens for the discharge of the material and its further drying while falling, a conduit opening out of the bottom of said chamber, a further drying chamber to which said conduit leads, a separating device for separating the dried particles from the moist, means for the return of the moist particles from said separating device to the last mentioned conduit for further drying, an exhauster for drawing hot gases through the system and exhausting the dried particles from the separating device, and a cyclone for separating the finished material from the gas current.

5. In apparatus for pneumatic drying of materials, the combination of an oven for providing hot gases, a deviation chamber of conical shape to prevent the moist material from adhering to its walls, a pipe connecting said oven to said chamber, a feeding device for delivering material to be dried to said pipe, a relatively large chamber for the further drying of the material while falling, a conduit connecting the upper end of said drying chamber with the deviation chamber, a conduit opening out of the bottom of the drying chamber, a further drying chamber to which said conduit leads, a passage opening into the conduit between the two drying chambers for introducing cold air or fresh gases, a separating device for separating the dried particles from the moist, means for the return of the moist particles from said separating device to the last mentioned conduit for further drying, an exhauster for drawing hot gases through the system and exhausting the dried particles from the separating device, and a cyclone for separating the finished material from the gas current.

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