United States Patent [19]
Mark

[11] 3,755,914
[45] Sept. 4, 1973

[54] **PNEUMATIC DRIER SUPPORT STRUCTURE**

[76] Inventor: **Andre Mark**, 54 Cours Lafayette, Lyon, France

[22] Filed: **Aug. 26, 1971**

[21] Appl. No.: **175,216**

[52] **U.S. Cl.** ..... **34/57 A**, 432/58
[51] **Int. Cl.** ..... **F26b 17/10**
[58] **Field of Search** ..... 34/10, 22, 57 A, 34/57 R, 87; 248/13; 137/373

[56] **References Cited**

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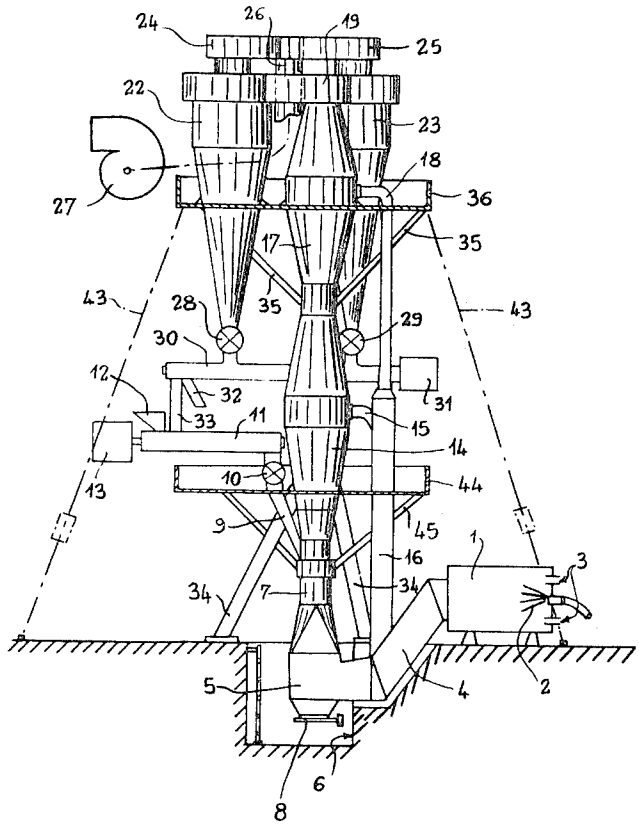
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*Primary Examiner*—William F. O'Dea
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*Attorney*—Arthur E. Dowell, Jr. et al.

[57] **ABSTRACT**

In a pneumatic drier including a drying conduit formed with one or more drying chambers, preferably of the biconical type with tangential hot air inlet, this conduit constitutes the main supporting element for one at least of the separators into which the said conduit opens, thus dispensing from any separate main supporting framework. The separator or separators is or are carried by a platform which is in turn supported by the drying conduit through devices allowing substantially free expansion of the conduit under the action of temperature changes.

**9 Claims, 14 Drawing Figures**



Patented Sept. 4, 1973 3,755,914



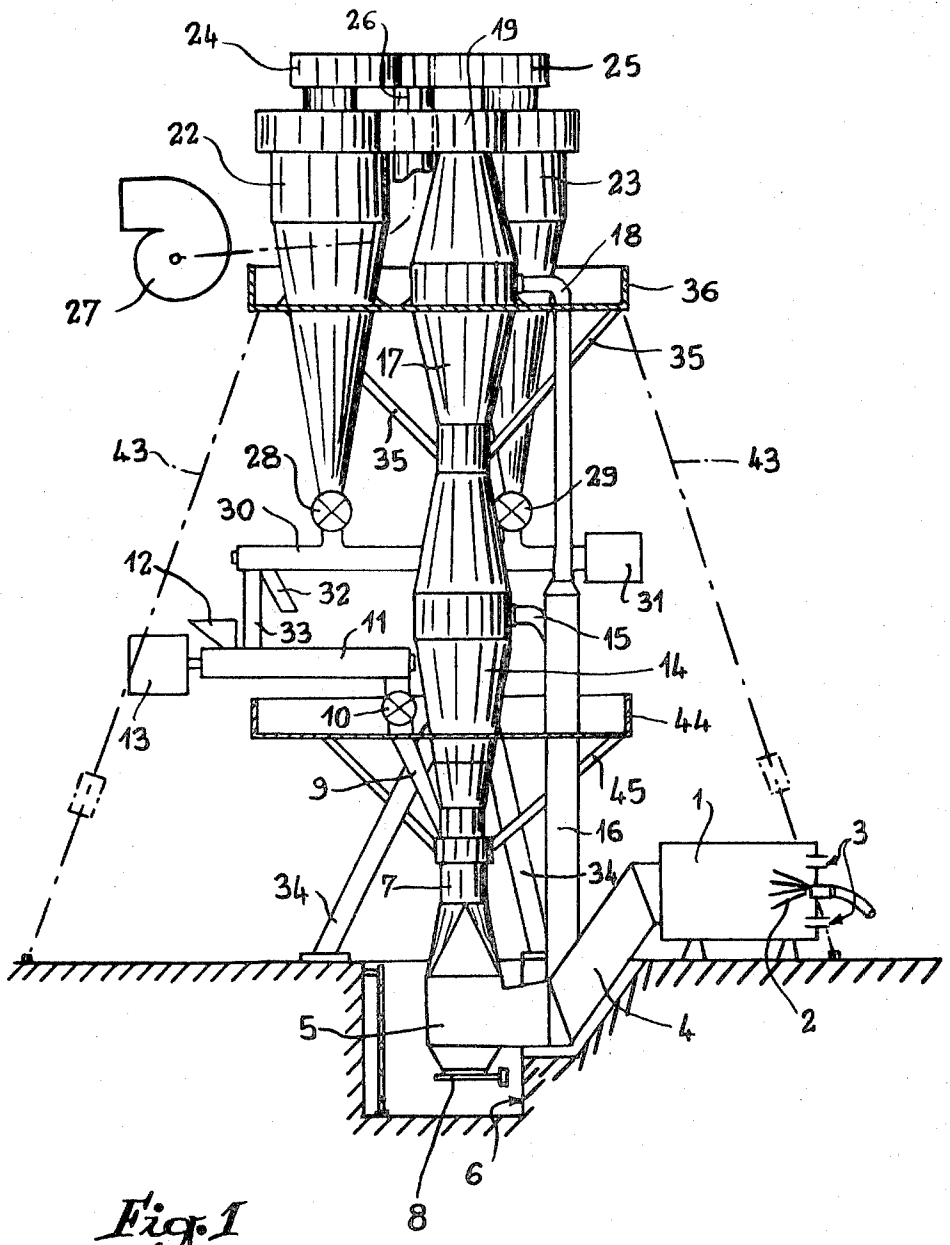



Fig. 1

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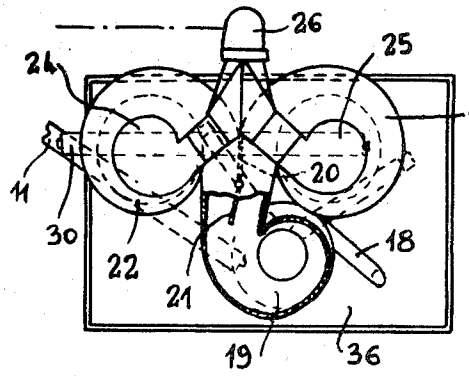



Fig. 2

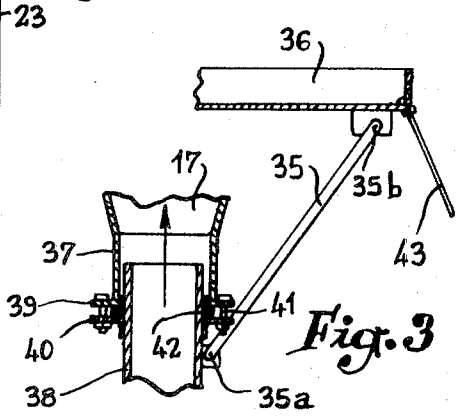



Fig. 3

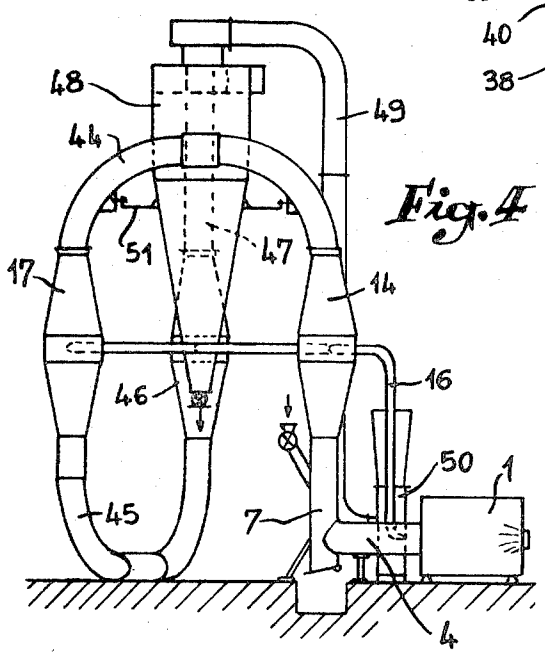



Fig. 4

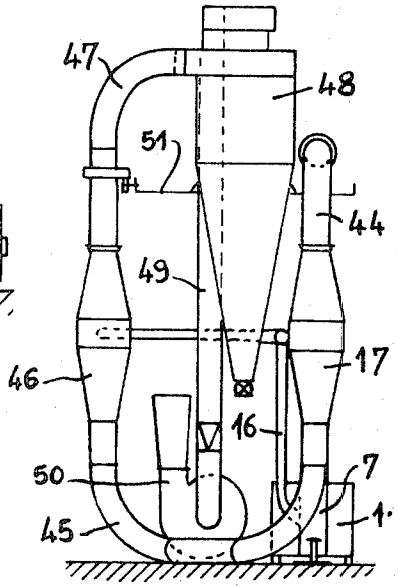



Fig. 6

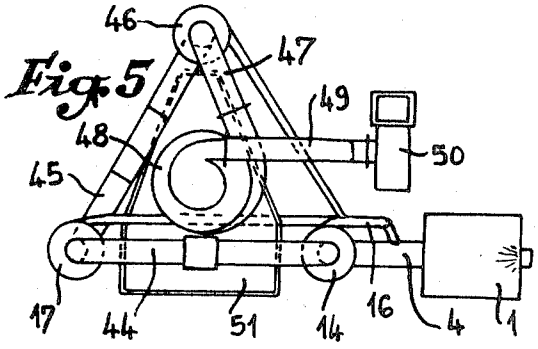



Fig. 5

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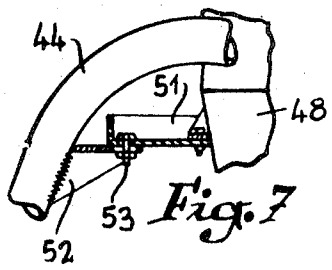



Fig. 7

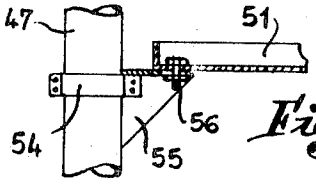



Fig. 8

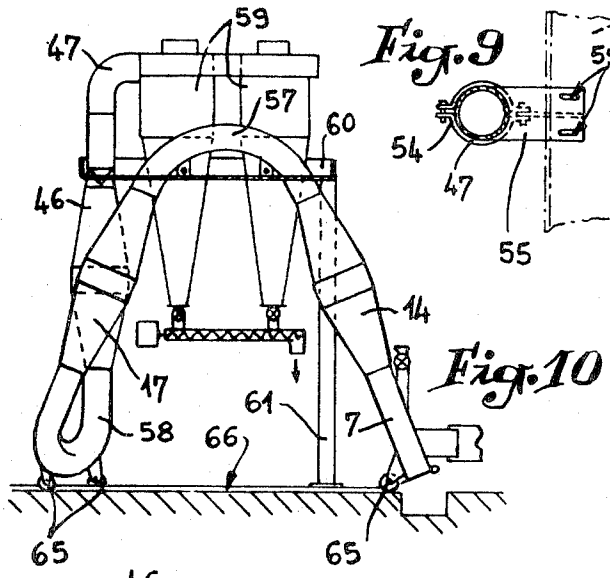



Fig. 10




Fig. 9

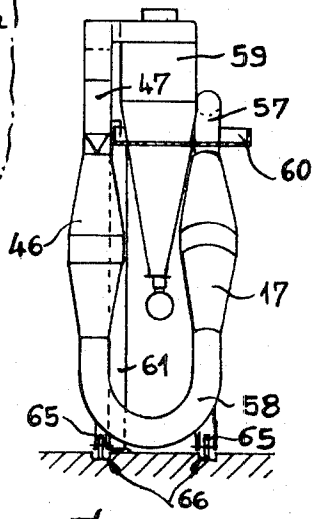



Fig. 12

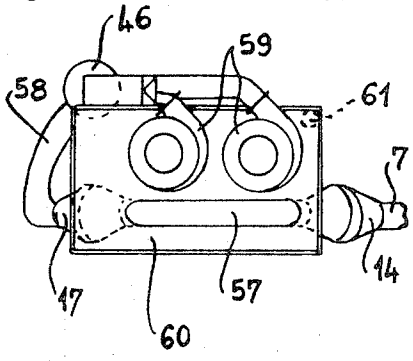



Fig. 11

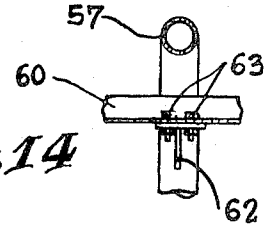
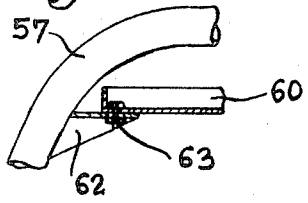



Fig. 14

Fig. 13




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# PNEUMATIC DRIER SUPPORT STRUCTURE

This invention relates to pneumatic driers, i. e. to drying apparatus wherein the material to be dried is introduced in the particulated state into a drying conduit through which a hot and dry gas (generally air) is caused to flow at such a velocity that it entrains the particles while absorbing their moisture. The treated material is collected in an appropriate separator, as for instance of the cyclone type and the gas issuing from the separator may be in part recycled, if desired, in order that its drying capacity may be more fully used and to reduce the heating costs. It is also possible to recycle a fraction of the treated material if on the average each particle should be submitted to more than one passage through the drying conduit in order to be dried to the required degree.

It is obvious that to be fully effective such driers should comprise a drying conduit of great length in order that the residence time of the particles, i. e. the average time during which they remain within this conduit, or in other words their travelling time between their inlet and the separator, be sufficiently long, being noted that it is impossible to reduce the flowing velocity of the drying gas below a safe limit, since otherwise the bigger particles would no more be entrained. Also in order to prevent the still wet particles from settling against the wall of the drying conduit the latter should be substantially vertical at least in its first portion in which the moisture content of the particles is still high. Designers have thus been led to establish driers of considerable height which require quite heavy and extricate supporting frameworks the cost of which may be higher than that of the conduit itself.

A number of solutions have been proposed to reduce the dimensions of pneumatic driers. For this purpose some driers are comprised of chambers in which the particles follow non-longitudinal paths which permits of considerably increasing their residence time without having to increase the length of the drying conduit. Such chambers may be of biconical shape with a tangential injection of dry gas midway of their height in order to induce within the chamber a whirling motion due to which the particles follow an ascending helical path the pitch of which is smaller for the heavier particles which normally require a longer residence time. But in spite of these arrangements the total height of these apparatus is still rather important and therefore their supporting frame remains relatively expensive.

It is an object of the present invention to avoid the above described disadvantages and to reduce to a considerable extent the supporting members required for driers of the kind in question.

In accordance with the present invention a portion at least of the drying conduit with some at least of the drying chambers which it may comprise, constitute the main supporting element for one at least of the separators into which the said conduit opens.

In the annexed drawings :

FIG. 1 is a view in elevation illustrating a first embodiment of a pneumatic drier with biconical drying chambers according to the invention.

FIG. 2 is a plan view thereof with parts in section.

FIG. 3 is an enlarged fragmental section showing the sliding seal provided between the first and the second drying chamber and illustrating how the upper platform of the drier is supported by the drying conduit.



FIG. 4 is a view in elevation of another embodiment wherein the drier comprises three biconical drying chambers.

FIG. 5 is a plan view thereof.

FIG. 6 is a side view thereof.

FIGS. 7 to 9 are fragmental detail sections illustrating the devices which support the separator in the drier of FIG. 4.

FIGS. 10 to 12 are views respectively similar to those of FIGS. 4 to 6, but corresponding to a modified embodiment.

FIGS. 13 and 14 are detail sections illustrating the devices which support the platform in the drier of FIGS. 10 to 12.

With reference to FIG. 1 a drier according to this invention comprises a hot gas generator 1, which may be formed of a furnace equipped with a burner 2, this furnace operating with a considerable air excess in such manner as to practically produce hot air mixed with some gaseous combustion products. In the diagrammatical representation of FIG. 1 this has been illustrated by large additional air inlets 3. The gas issuing from generator 1, and which may be termed hot air, is led by a conduit 4 into an inlet chest 5 located within a pit 6 below ground level. The upper end of chest 5 is connected with a vertical drying conduit 7, while its lower end is provided with a valve 8 through which foreign bodies, bigger particles, etc— which may have not been entrained upwardly by the air stream may be extracted.

The drier further comprises a material inlet conduit 9 which opens downwardly into the drying conduit 7 somewhat above chest 5. In the example illustrated this inlet conduit 9 is connected through a rotating valve 10 with a feed conveyor 11 which may be formed of a tube enclosing a rotating conveying screw (Archimedes screw), the material to be dried being supplied to this conveyor through an inlet hopper 12. Reference numeral 13 designates the motor (with speed reducing gearing) which drives the rotating screw.

The drying conduit opens into the lower end of a first biconical chamber 14 of the type described in my prior U.S. Pat. No. 3,178,830. Reference numeral 15 designates the tangential hot air inlet associated to this chamber, this inlet being connected with the hot air conduit 4 by a vertical tube 16. Chamber 15 is followed by a second biconical drying chamber 17, of somewhat larger diameter, also provided with a tangential hot air inlet 18 connected with tube 16. The upper end of this second chamber 17 opens into the center of a volute or spiral-shaped chamber 19 (see FIG. 2) the outlet of which has a dividing partition 20 provided with an adjustable flap, so as to determine two passages, each of which is connected with the tangential inlet of a cyclone separator, respectively 22 and 23. Each separator comprises an upper axial outlet, respectively 24 and 25 which is connected with a common outlet conduit 26. The latter is in turn connected with the low pressure side of a fan diagrammatically indicated at 27 in FIG. 1.

Each cyclone comprises an outlet rotating valve 28, respectively 29, through which it is connected with a screw conveyor 30 driven by a motor and speed-reducing set 31. The dried material issuing from conveyor 30 is divided into two fractions, a first one passing through an outlet nozzle 32 and being collected as the dried product, while the other one is led by a chute

33 into the feed conveyor 11 in order to be recycled.

The general operation remains as described in my aforesaid prior Patent : the particles of the material fed into conduit 7 are entrained by the ascending hot air stream, they whirl successively within chambers 14 and 17, and reach separators 22 and 23 from which they are in part collected and in part recycled.

The lower biconical chamber 14, which is situated at a relatively reduced height above ground level owing to the provision of pit 6, is supported by three legs 34 so as to constitute with conduit 7 a quite rigid tubular unit which is used according to the invention as the main supporting element of the drier. Diverging legs 35 extend upwardly from the sleeve which connects with each other chambers 14 and 17, these legs supporting in turn an upper platform 36 which carries cyclones 22 and 23.

In order to take into account the vertical expansion of the apparatus, in the example illustrated the connection between chambers 14 and 17 has been realized under slidable form. As shown in FIG. 3, chamber 17 has an inlet nozzle 37 which is slidably mounted within the outlet nozzle 38 of chamber 14. Nozzles 37 and 38 are assembled by means of end flanges, respectively 39, 40, and of bolts 41 which are left somewhat loose. A compressible packing or seal 42 is interposed between both flanges and it is so arranged as to extend somewhat into the annular clearance provided between the nozzles.

For the same reason the ends of legs 35 are preferably hinged to the corresponding parts, as indicated at 35*a* and 35*b*.

Furthermore, in order to improve the lateral stability of the construction bracing cables 43 are disposed between platform 36 and the ground, springs being preferably interposed on these cables to take into account expansion effects.

It will be noted that the drier illustrated further comprises a lower platform 44 supported by legs 45 the lower ends of which are secured to the periphery of conduit 7. Such a platform facilitates access to the feeding and recycling devices.

In the drier thus realized the drying conduit may be considered as including conduit 7, chamber 14, chamber 17 and volute 19. It may therefore be said that the upper platform 36, together with separators 22 and 23, is supported by a portion 7-14 of this drying conduit, thus dispensing from any separate framework.

In the embodiment of FIGS. 4 to 6 the drier also comprises a hot air generator 1, a hot air conduit 4 and a vertical drying conduit 7 which opens into the lower end of a first vertical biconical drying chamber 14. But here the connection between the upper end of this first chamber 14 and the lower end of the second one 17 is realized by means of a semi-circular connecting tube 44 having a relatively great radius of curvature. The outlet of the second chamber is connected by another semi-circular connecting tube 45 with the lower end of a third vertical biconical chamber 46. Finally the upper outlet of this third chamber is connected by a right-angled tube 47 with the tangential inlet of a cyclone separator 48, the upper axial outlet 49 of which is in turn connected with the low-pressure side of a fan 50.

As in the case of FIGS. 1 to 3, each biconical chamber has a tangential hot air inlet to which a common tube 16 supplies hot air from conduit 4.

As indicated in FIG. 5, the three biconical chambers 14, 17 and 46 are disposed in plan view at the apices of a substantially equilateral triangle, separator 48 being located at the center of this triangle. This separator is supported by a platform 51 which is itself supported at three points, namely two which correspond to the first and to the second end of connecting tube 44, and a third one which corresponds to the tubular outlet of chamber 46.

In order to take into account expansion effects, the fixation of the platform is so arranged as to allow minor displacements. FIG. 7 shows the details of the point of fixation situated at the left-hand end of connecting tube 44 in FIG. 4. A small bracket 52 is welded to tube 44. This bracket slidably supports the edge of platform 51 with which it is further connected by means of bolts 53 passed through appropriately elongated openings provided in these parts, these bolts being rather loosely tightened. In the embodiment illustrated in FIG. 9 tube 44 is provided with a collar 54 integral with a lateral bracket 55 which supports platform 51, the connecting bolts 56 here again passing through elongated apertures, such as 55*a* (see FIG. 9 wherein platform 51 is only shown in phantom lines).

FIGS. 10 to 12 illustrate another embodiment also comprising three biconical drying chambers 14, 17 and 46. A first difference between this embodiment and the preceding one is that the first connecting tube, here referenced 57, only extends through less than 180°, the axes of chambers 14 and 17 being oblique and converging upwardly. The second connecting tube has been referenced 58 and it is so shaped that the third drying chamber 46 remains vertical as in FIGS. 4 to 6. The drier of FIGS. 10–12 comprises two cyclone separators 59. Furthermore in plan view the three drying chambers are disposed at the apices of a right-angled triangle. Separators 59 are here again supported by a platform 60 which is in turn supported by the drying conduit, namely by the first connecting tube 57 and the third chamber 46, but owing to the rectangular shape of this platform, there is provided an auxiliary supporting column or upright 61 for its fourth corner.

FIGS. 13 and 14 show the details of the fixation of the platform to one of the ends of the first connecting tube 57. A bracket 62 welded to the latter slidably supports the edge of platform 60, the connection being completed by loose bolts 63 passed through elongated openings.

In this embodiment conduit 7 and the lower or second connecting tube 58 are mounted on wheels 65 which rest on rails 66, while the auxiliary column is rigidly fixed to the ground. Such an arrangement avoids any stress in the connecting tubes as a result of the thermal expansion of the parts in operation, while retaining the drier in position on the floor.

I claim :

1. In a pneumatic drier comprising a drying conduit having a first and a second end, means to supply a stream of hot and dry gas to the first end of said conduit, means to introduce into said conduit downstream of the first end thereof a particulated material to be dried in order that same be entrained by said gas stream, separator means connected with the second end of said dry-ing conduit to separate said particulated material from said gas stream, and means to support said conduit and said separator means on the floor, the improvement which consists in that said support-ing

means comprise at least a portion of said drying conduit; said drying conduit including a first substantially vertical ascending portion starting from said first end, said first portion of the conduit having an upper end; a first substantially vertical chamber having a lower end and an upper end with said first portion of said conduit opening into said lower end; the upper end of said first portion being connected with the lower end of said chamber; saud drying conduit also including a second portion starting from said upper end of said first chamber; said second portion including said chamber; and said supporting means including means to support on the floor said first chamber together with said first portion of said conduit, and a platform supported by said first chamber, said platform in turn supporting said second portion of said conduit together with said separator means.

2. In a pneumatic drier as claimed in claim 1, said second portion of said drying conduit including a second chamber situated downstream of said first chamber and also supported by said platform.

3. In a pneumatic drier as claimed in claim 2, sealing means interposed in the second portion of said drying conduit, between said first and second chambers to permit small relative vertical displacements of said second chamber with respect to said first chamber due to thermal expansion.

4. In a pneumatic drier comprising a drying conduit having a first end and a second end, means to supply a stream of hot and dry gas to the first end of said conduit, means to introduce into said conduit downstream of the first end thereof a particulated material to be dried in order that same be entrained by said gas stream, separator means connected with the second end of said drying conduit to separate said particulated material from said gas stream, and means to support said conduit and said separator means on the floor, the improvement which consists in that said supporting means comprise at least a portion of said drying conduit; said drying conduit including a number of substantially vertical successive chambers each having an upper end and a lower end; said drying conduit further including a number of substantially semi-circular successive portions to connect with each other alternatively the upper ends and the lower ends of the succeeding chambers in such manner that the gas may alternatively flow upwardly and downwardly through said chambers; and said supporting means including the substantially semi-circular portions of said drying conduit which connect the lower ends of said chambers.

5. In a pneumatic drier as claimed in claim 4 :

said drying conduit including three sccessive chambers disposed in plan view at the apices of a triangle;

the substantially semi-circular portion of said conduit which connects the lower ends of said second and third chambers resting on the floor to form part of said supporting means ;

and said supporting means further comprising means to support on the floor the first one of said chambers and a platform supported by said conduit, said platform in turn supporting said separator means.

6. In a pneumatic drier as claimed in claim 5, said triangle being substantially equilateral and said separator means being substantially disposed at the center of said triangle.

7. In a pneumatic drier as claimed in claim 5, said triangle being substantially right-angled, said platform being substantially rectangular with three of its four corners being supported by said drying conduit, and said supporting means further including an auxiliary vertical member to support on the floor the fourth corner of said platform.

8. In a drier as claimed in claim 7, said first chamber and said portion of said drying conduit which connects the lower ends of said second and third chambers being supported on the floor by wheels to permit free thermal expansion of said conduit.

9. In a pneumatic drier comprising a drying conduit having a first end and a second end, means to supply a stream of hot and dry gas to the first end of said conduit, means to introduce into said conduit downstream of the first end thereof a particulated material to be dried in order that same be entrained by said gas stream, separator means connected with the second end of said drying conduit to separate said particulated material from said gas stream, and means to support said conduit and said sep-arator means on the floor, the improvement which consists in that said supporting means comprise at least a portion of said drying conduit; said drying conduit including three successive chambers, each having an axis, a lower end and an upper end; said first and second chambers having their axes substantially in the same vertical plane and converging upwardly substantially as the sides of an isosceles triangle, and the axis of said third chamber being substatially vertical; said drying conduit further including a first arcuate portion to connect with each other the upper ends of said first and second chambers, and a second arcuate portion to connect with each other the lower ends of said second and third chamber; said supporting means including wheels to support on the floor said first chamber and wheels to support on the floor said second arcuate portion of said drying conduit; said supporting means also including a platform to support said separator means, said platform being rectangular in plan view with three of its four corners being in turn supported by said drying conduit; and said upporting means further including an auxiliary supporting member secured to the floor to support the fourth corner of said platform.

* * * * *

# UNITED STATES PATENT OFFICE
# CERTIFICATE OF CORRECTION

Patent No. 3,755,914 Dated September 4, 1973

Inventor(s) ANDRE MARK

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading of the patent (first column between lines 5 and 6 insert:

[30] Foreign Application Priority Date:

January 20, 1971 - France - No. 71.02564

Signed and sealed this 6th day of August 1974.

(SEAL)
Attest:

McCOY M. GIBSON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334