

April 9, 1963

E. LAU
CYCLONE

3,084,798

Filed Jan. 28, 1960

2 Sheets-Sheet 1

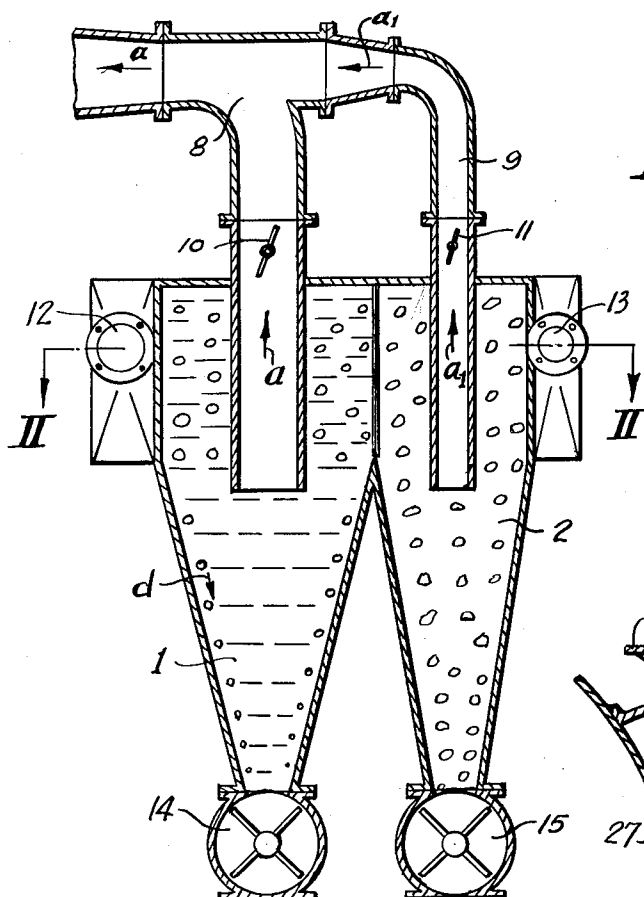


Fig. 1

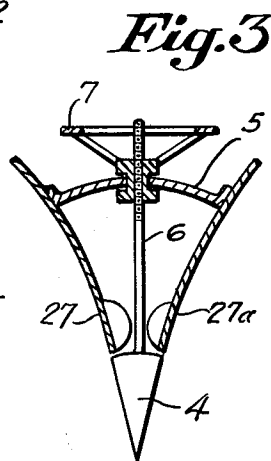
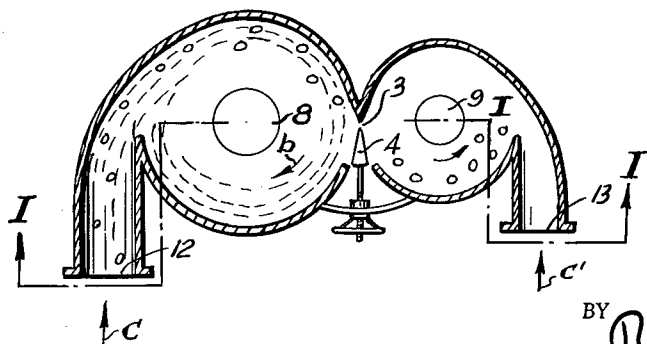


Fig. 3

Fig. 2



INVENTOR
ERICH LAU

BY *Richard & Geier*

ATTORNEYS

April 9, 1963

E. LAU
CYCLONE

3,084,798

Filed Jan. 28, 1960

2 Sheets-Sheet 2

Fig. 4

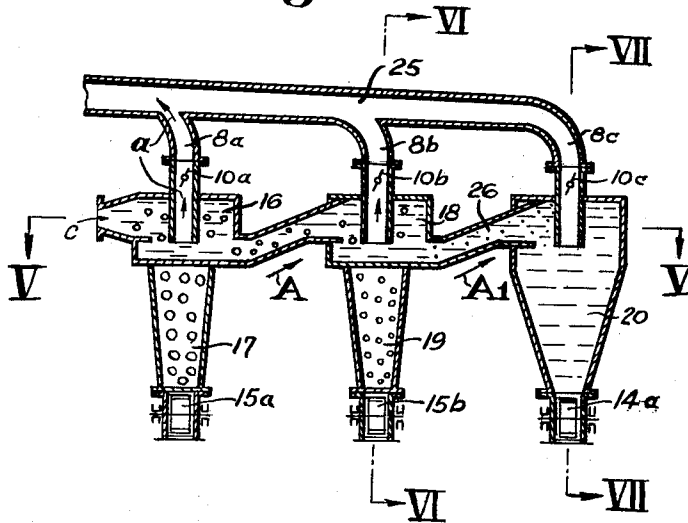


Fig. 6

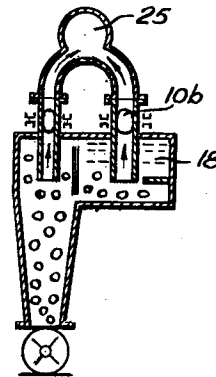


Fig. 5

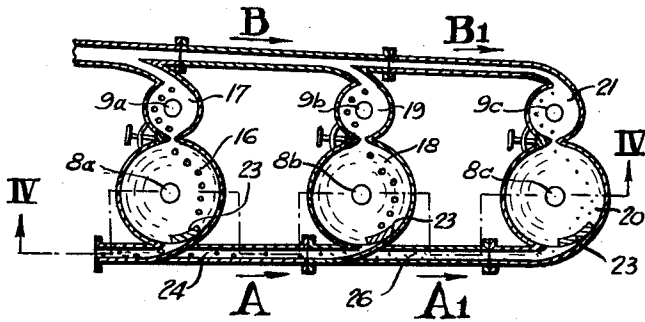
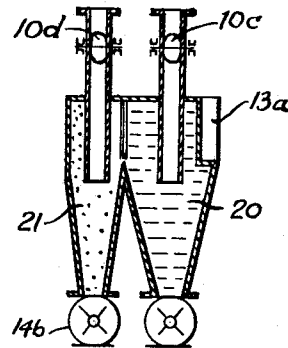


Fig. 7



INVENTOR
ERICH LAU
BY *Richards & Geier*
ATTORNEYS

1

3,084,798
CYCLONE

Erich Lau, Hamm, Westphalia, Germany, assignor to
Altenburger Maschinen G.m.b.H., Altenburg, Kreis
Melsungen, Bezirk Kassel, Germany, a limited liability
firm of Germany

Filed Jan. 28, 1960, Ser. No. 5,303

Claims priority, application Germany Jan. 28, 1959

1 Claim. (Cl. 209-144)

This invention relates to a cyclone and refers more particularly to a twin cyclone with pneumatic and mechanical closure means.

Cyclones are used in prior art for the dry or wet separation of granules of various sizes or of mixtures of gases and solid particles. The action of such cyclones in separating particles of various sizes is not particularly precise. The operation of such cyclones consists usually in that a mixture of solid particles and gas is introduced into a cylindrical portion of the cyclone. The speed with which this mixture is injected is so great that particles having a greater weight or mass are deposited upon the walls of the cyclone due to the action of the centrifugal force and by gravity slide down into a conical container. The lighter particles, however, are collected in a tube which projects into the cylindrical portion of the cyclone and are carried upwardly along with the gas. The separation or the dividing line between the particles of various sizes is primarily determined by the ratio of the diameters of the above-mentioned projecting tube and nozzles which are located at the bottom of the cyclone and are used for the withdrawal of the collected particles. The extent to which the particles are separated and sorted is reduced by the fact that eddy currents are superposed over centrifugal forces, so that particles within a comparatively wide range of sizes and weights are partly subjected to the centrifugal forces and partly subjected to the forces which remove the particles along with the gases.

An object of the present invention is to provide a twin cyclone consisting of two separate cyclones and to shape it and to operate it in such manner that a better and more precise separation and sorting of particles of various sizes can be attained in an operationally secure manner than was possible in any of prior art devices.

Other objects of the present invention will become apparent in the course of the following specification.

In accomplishing the objects of the present invention, it was found advisable to provide double chambers which are so connected with each other at their periphery that a slot is formed between the chambers. This slot, the size of which can be suitably regulated from the outside, serves for the passage of specifically heavy or larger solid particles. However, the separation of the particles provided by such slot is incomplete without the use of pneumatic means which support and further the operation produced by the slot. For that purpose, fresh air or exhaust air is sucked into the second cyclone. Thus, by introducing additional air into the second cyclone, a small sub-atmospheric pressure is created therein with the result that a pneumatic lock is provided at the slot. By changing the size of the slot and by varying the differences in pressure, and also by changing the direction of flow of the air currents or the currents of the mixture of solids and gases, it is possible to provide a very precise separation of the individual particles and to sort the particles even within the range of less than 50 microns.

The invention will appear more clearly from the following detailed description when taken in connection with

2

the accompanying drawings, showing by way of example preferred embodiments of the inventive idea.

In the drawings:

FIGURE 1 is partly a section through and partly a side view of a twin cyclone constructed in accordance with the principles of the present invention.

FIGURE 2 is a section along the line II—II of the apparatus shown in FIGURE 1.

FIGURE 3 illustrates in section and on an enlarged scale a device for mechanically varying the size of the slot between the two cyclone chambers.

FIGURE 4 shows in section along the line IV—IV of FIG. 5 a somewhat different construction consisting of a group of three twin cyclones, whereby the first cyclone is essentially devoid of the conical portion.

FIGURE 5 is a section along the line V—V of FIGURE 4.

FIGURE 6 is a section along the line VI—VI of FIGURE 4.

FIGURE 7 is a section along the line VII—VII of FIGURE 4.

Throughout the drawings, fine solid particles are illustrated by small horizontal lines while larger and heavier particles are shown as round bodies of irregular size.

The twin cyclone shown in FIGURES 1 and 2 has two cyclone chambers 1 and 2, the casings of which are so joined that the chambers are interconnected by a slot 3, the height of which corresponds approximately to the cylindrical portion of the cyclone chambers.

As shown in FIGURE 3, the operative width of the slot can be changed by means of a wedge-like supporting blade 4 which is carried by a rod 6 and is supported upon a metal sheet 5. The rod 6 is threaded and can be operated from the outside by a screw which is turned by means of a handle 7. Bodies 27 and 27a are located opposite each other and are used as seals and for the purpose of guiding the blade 4.

Tubes 8 and 9 project into the interior of the chambers 1 and 2, respectively. These tubes lead to an exhausting device, not shown in the drawings. Flaps 10 and 11 are located within the tubes 8 and 9, respectively, and are used to provide sub-atmospheric pressure which facilitates the operation of the apparatus.

This operation is as follows:

The mixture of solid particles and gases which is to be sorted is introduced tangentially through the pipe 12 into the chamber 1. The centrifugal force acts upon the particles so that the specifically heavier or larger particles are pressed against the walls. Since the particles are subjected to a rotary action, they move past the slot 3. If no lock were available at the slot 3, the mixture would move practically in its entirety from the chamber 1 into the chamber 2. However, such lock is created by the fact that fresh air is introduced into the chamber 2 through the pipe 13. This additional amount of air produces a small sub-atmospheric pressure. The difference in pressure in the two chambers which can be regulated by the pipe 13 and the flaps 10 and 11 produces a type of pneumatic lock in the slot 3. Thus, two currents of air will be subjected to rotary movement at different pressures in the chambers 1 and 2. At the slot 3 wherein the two air currents engage each other, the extent of the difference in potential of the two air currents permits a certain amount of the heaviest solid particles, which has been already sorted out by the centrifugal force and the rotational movement, to break through the pneumatic lock and to pass through the slot 3 into the chamber 2. The lighter and smaller particles remain in the chamber 1 and are divided into very light particles which float upwardly through the pipe 8 and

medium-sized particles which are collected at the bottom of the chamber 1. The heaviest particles are collected at the bottom of the chamber 2. The medium-sized particles in the chamber 1 are withdrawn through the usual collecting and transmitting device 14, while a similar device 15 is used for assembling and withdrawing the heavy particles in the chamber 2.

FIGURES 4 and 5 show further combinations of the elements of the present invention. They illustrate a combination of three twin cyclones which are so constructed that there is no removal of particles in the chambers 16 and 18. The solid-gas mixture which continues in rotation in the chamber 16 is withdrawn through a connecting pipe 24 to an adjacent twin cyclone 18, 19 for further treatment. As indicated in FIGURES 4, 5 and 6, the chambers 16 and 18 of the two twin cyclones do not have a conical portion for all practical purposes while the chambers 17, 19, 20 and 21 do have such a conical portion. Guide plates 23 are located within the chambers 16, 18 and 20 so as to vary the direction of flow. By way of example, these plates can cause the solid-gas mixture to remain during a predetermined length of its path at the same height in the first chamber 16, whereby the deposits of the particles will be avoided.

The operation is as follows:

The mixture of solid particles and gases which is to be sorted is introduced tangentially into the chamber 16 (as indicated by the arrow *c* in FIG. 4) where it is subjected to centrifugal action. Thence a part of the mixture goes to the chamber 17 while another part of the mixture flows through the pipe 24 in the direction of the arrow *A* into the chamber 18 of the second cyclone. In the chamber 17 the mixture is separated and the solid particles drop into the collecting device 15*a*. The gases flow from the chamber 16 through the pipe 3*a* and from the chamber 17 through the pipe 9*a*. Both pipes lead into the pipe or conduit 25. The part of the mixture which reaches the chamber 18 of the second cyclone is subjected to centrifugal action therein. Gases escape through the pipe 8*b* into the conduit 25, while a part of the mixture flows into the chamber 19 and another part of the mixture flows through the pipe 26 in the direction of the arrow *A*₁ into the chamber 20 of the third cyclone. In the chamber 19 the mixture is separated and the solid particles drop into the collecting device 15*b* while gases escape through the pipe 9*b* into the conduit 25. The part of the mixture reaching the chamber 20 is again separated therein and some of the solid particles drop into the collecting device 14*a*, while some of the gases flow through the pipe 8*c* into the conduit 25. The remaining mixture flows into the chamber 21 where it is finally separated into solid particles dropping into the collecting device 14*b* and gases flowing through the pipe 9*c* into the conduit 25.

Thus it is apparent that four different types of particles can be collected at the collecting devices 15*a*, 15*b*, 14*a* and 14*b*.

Practical experience has shown that in this manner it is possible to separate different types of flour particles within the range of 15 and 20 microns. Thus, it was shown that by means of the described devices, a fine and precise separation of particles can be attained which heretofore was not considered operationally possible in corn grinding and flour milling industries. Thus, the apparatus of the present invention makes it possible to increase to an extraordinary extent the quality of expensive and perishable merchandise.

It is apparent that the examples shown above have been given solely by way of illustration and not by way of limitation and that they are subject to many variations and modifications within the scope of the present invention. All such variations and modifications are to be included within the scope of the present invention.

What is claimed is:

A multi-stage cyclone station for separating mixtures of solids and gases, comprising two larger casings and two smaller casings, each of said casings having a cylindrical portion and enclosing a cyclone chamber, each larger casing being in communication with a separate smaller casing through a common slot extending along the entire height of a cylindrical portion of at least one of the two casings, a pipe extending tangentially to and connected with one of said larger casings for introducing a solids-gas mixture into the cyclone chamber of said one larger casing, another pipe extending tangentially to and connected with the two larger casings for transmitting a solids-gas mixture from said one larger casing to the other larger casing in the direction of the feed inlet of the mixture, a third pipe extending tangentially to and connected with said smaller casings for introducing air into the cyclone chambers of said smaller casings tangentially and in a direction opposite to the direction of said solids-gas mixture, the inlet openings of the third pipe extending over the entire cylindrical portions of said smaller casings, said cyclone chambers having top discharge openings, and means regulating the size of said slots.

References Cited in the file of this patent

UNITED STATES PATENTS

2,039,692	Van Tongeren	May 5, 1936
2,219,711	Marston	Oct. 29, 1940
2,701,056	Morton	Feb. 1, 1955

FOREIGN PATENTS

529,387	Great Britain	Nov. 20, 1940
---------	---------------	---------------