

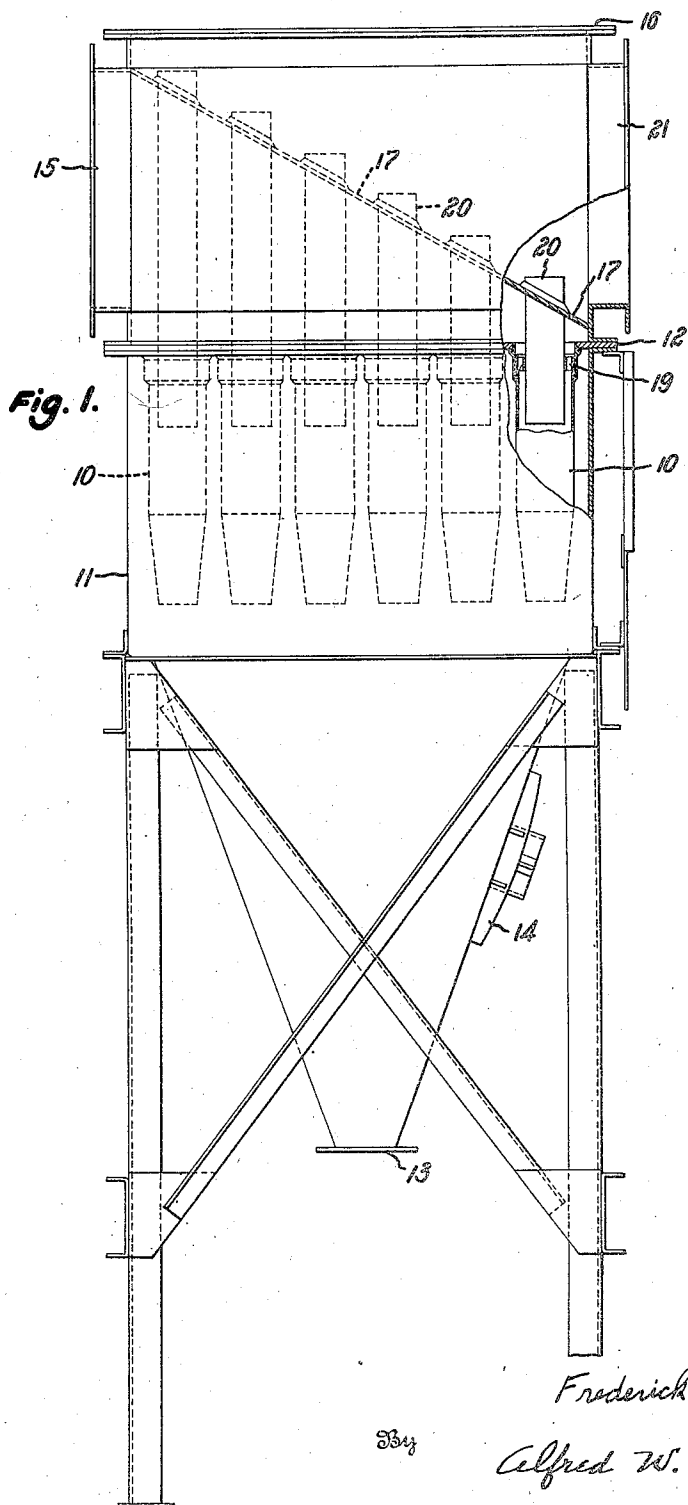
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CENTRIFUGAL SEPARATOR

2,433,774

Filed May 18, 1944

2 Sheets-Sheet 1



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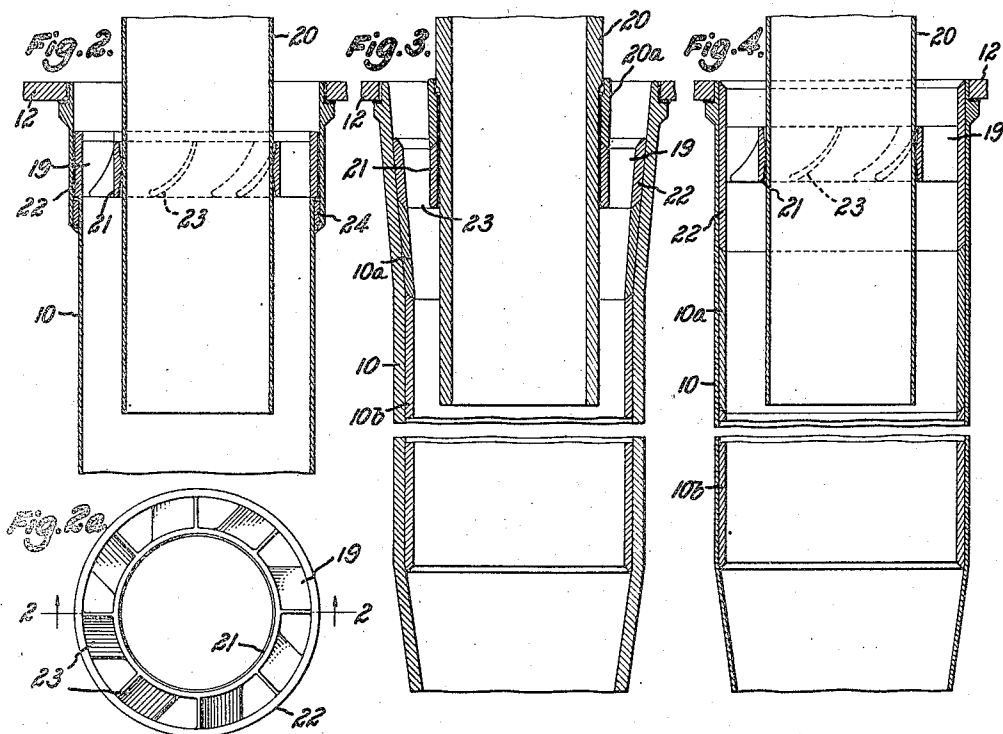
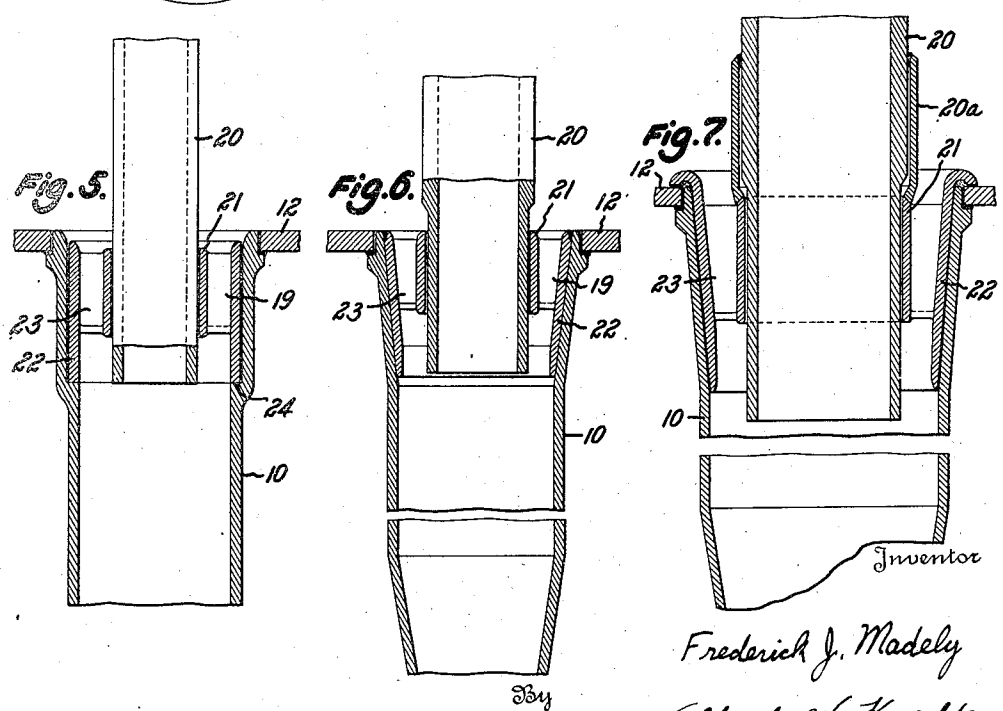
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CENTRIFUGAL SEPARATOR

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1

This invention relates to apparatus for separating suspended matter from a stream of gas by centrifugal action, and particularly to separators of the centrifugal type commonly known as "cyclone separators," wherein a stream of gas is subjected to a vortical motion, whereby suspended material is separated from the gas.

The invention is particularly concerned with centrifugal separating apparatus wherein suspended matter is separated from a stream of gas by passing the gas through one or more vertical tubular separating units, each having a vertical tubular outlet member concentrically positioned within the upper portion of the separating unit, and a directing vane assembly positioned between the separating unit and the outlet member whereby a whirling motion is imparted to a stream of gas passing through the separating unit. Under the centrifugal force of the whirling motion suspended particles in the gas stream are segregated adjacent the peripheral wall of the separating unit and pass downward to the lower end thereof where they may be removed while the gas stream substantially freed of suspended particles flows out through the concentrically positioned outlet tube.

In the operation of cyclone separators of this type, difficulties have been encountered arising from the abrasive action of the suspended particles concentrated by centrifugal force at the outer ends of the directing vanes. This abrasive action frequently results in wearing away the outer ends of the vanes as well as the wall of the unit adjacent and below the outer ends of the vanes, so that the vanes lose their effectiveness and creepage around the outer ends of the vanes is permitted which tends to increase and localize the abrasive action so that the wall of the separating unit may be worn through.

A principal purpose of the present invention is to provide a centrifugal separator of the type described wherein abrasive action adjacent and below the ends of the directing vanes is substantially reduced or eliminated.

A further purpose of the invention is to provide a centrifugal separator including a directing vane assembly which protects the separator unit from excessive abrasive action.

Another object of the invention is to provide an effective and convenient support for the directing vane assembly within the separating unit.

2

These and other purposes of the invention are attained by the apparatus of the invention which comprises a vertical tubular separating unit, a vertical tubular outlet member concentrically positioned within the upper portion of the separating unit, and a directing vane assembly positioned between the separating unit and the outlet member and comprising an outer ring supported by the separating unit, an inner ring, preferably slidable along the outlet member, and helical vanes extending between the inner and outer rings and integral therewith. The outer ring may advantageously extend a substantial distance below the vanes to provide a protective liner for the separating unit in the zone of greatest abrasive action thereon.

The invention will be more particularly described with reference to the accompanying drawings showing illustrative embodiments of the invention.

In the drawings:

Fig. 1 is a diagrammatic elevation in partial section of a centrifugal separator embodying the principles of the invention;

Fig. 2 is a fragmentary sectional elevation on an enlarged scale of a separating unit of the separator of Fig. 1;

Fig. 2a is a plan view of the directing vane assembly of Fig. 2; and

Figs. 3-7 are fragmentary sectional elevations of separating units embodying various modified forms of the invention.

Fig. 1 shows an apparatus for separating suspended matter from a stream of gas by centrifugal action, the construction being of the multiple-tube form comprising a plurality of open-ended tubular separating units 10 of generally circular cross section and small diameter arranged vertically in a housing 11 having a top header plate 12 to which the separating units are removably secured, the axes of the separating units being substantially perpendicular to the header plate. An outlet 13 at the lower end of the housing provides for removal of the separated material discharged through the open lower ends of the separating units 10. The inclined side wall of the lower hopper-shaped portion of the housing has an opening normally closed by a removable door 14 affording access to the interior of

3

the housing for removing the separating units for the purpose of cleaning or repair.

The gas with suspended matter is supplied to the separating units through an inlet opening 15 and a header 16. This header is separated into lower and upper chambers by an inclined partition wall 17 which cuts off communication between the chambers, said chambers constituting common inlet and outlet chambers respectively for the several units 10. The header plate 12 is provided with openings in which the separating units 10 are removably secured and through which the separating units receive the gas and suspended matter from the inlet chamber formed below the inclined partition 17. The gas and suspended matter are whirled, to subject them to centrifugal action, by a suitable directing element 19 disposed adjacent the inlet end of each unit 10, as shown in Fig. 2, and the suspended matter is separated from the gas. The separated material falls downwardly into the bottom of the housing 11. The gas is withdrawn by flowing upwardly through outlet members or tubes 20 extending into the upper ends of the separating units 10 and slidably engaging the directing elements 19. The outlet members 20 are secured to and extend through the inclined partition 17 so as to communicate with the outlet chamber formed above the inclined partition 17, the chamber having an outlet opening 21 through which the gas is discharged.

As shown more particularly in Figs. 2 and 2a the directing element 19 comprises an inner ring 21, and outer ring 22 and helical vanes 23 extending between the two rings and preferably cast integrally with the rings. The outer ring rests on a shoulder 24 on the inner surface of the separating unit, the inner face of the outer ring being substantially flush with the inner surface of the unit 10 below the shoulder 24. The inner ring is dimensioned to slide along the outer surface of outlet tube 20. The provision of the outer ring 22 effectively prevents creeping of abrasive particles around the outer edges of the vanes 23 and protects the separating unit 10 from abrasion and erosion adjacent the vanes. The method of support makes the removal and replacement of the directing element 19 simple and easy. The unit 10 may be dropped down from its position of engagement with header 12 or the outlet tube 20 may be lifted upwardly. In either case, the directing element 19 may be simply lifted out of the separator unit and equally readily replaced.

In the embodiment of the invention shown in Fig. 3, the directing element 19 is supported in part by engagement with the conical upper end of separator unit 10 and in part by engagement with the uppermost of liner members 18a, 18b, which are supported by engagement of lower liner 18b with the conical lower end of unit 10. Liners 18a, 18b provide a downwardly extending continuation of the protection against erosion provided by ring 22 of the directing element and liner 20a extends upwardly from inner ring 21.

In the embodiment of Fig. 4, the outer ring 22 of directing element 19 is extended both upwardly and downwardly from the vanes 23, thereby affording protection against erosion of the separating unit both above and below the vanes. The element is supported upon liner members 18a, 18b which are, in turn, supported by the lower conical end of separator unit 10.

In the embodiment of Fig. 5, the outer ring 22 of element 19 extends downwardly below the

4

vanes 23 and the lower edge of the ring 22 rests upon ledge 24 provided by an inward projection of separator unit 10.

In the form of the invention shown in Fig. 6, the directing element 19 is supported entirely by the conical upper portion of separator unit 10. The outer ring 22 of element 19 in this form likewise extends downward to provide additional protection against erosion of the separator element below the vanes 23.

In the form of the invention shown in Fig. 7, the outer ring 22 of the directing element 19 extends upwardly from the vanes 23 and outwardly to protect the upper end of separating unit 10 and the joint between unit 10 and header 12 from erosion as well as downwardly to protect unit 10 from erosion below the vanes. In this form the directing element is supported both by the conical upper end of unit 10 and by header 12.

It will be seen from the foregoing description that a wide variation in form and arrangement of the elements of the invention is possible without departing from the principles of the invention.

I claim:

1. In apparatus for separating suspended matter from a stream of gas by centrifugal action, a vertical tubular separating unit, a vertical tubular outlet member concentrically positioned within the upper portion of the separating unit, and a directing vane assembly positioned between said separating unit and said outlet member comprising an outer ring supported by said separating unit, an inner ring slidable along said outlet member, and helical vanes extending between said inner and outer rings and integral therewith, said outer ring extending a substantial distance below said vanes to provide a liner element for said separating unit through the zone of greatest wear thereof.

2. In apparatus for separating suspended matter from a stream of gas by centrifugal action, a vertical tubular separating unit, a vertical tubular outlet member concentrically positioned within the upper portion of the separating unit, and a directing vane assembly positioned between said separating unit and said outlet member comprising an outer ring supported by said separating unit, an inner ring slidable along said outlet member, and helical vanes extending between said inner and outer rings and integral therewith, said outer ring extending a substantial distance above and below said vanes to provide a liner element for said separating unit through the zone of greatest wear thereof.

3. In apparatus for separating suspended matter from a stream of gas by centrifugal action, a vertical tubular separating unit, a vertical tubular outlet member concentrically positioned within the upper portion of the separating unit, and a directing vane assembly positioned between said separating unit and said outlet member and slidable along said outlet member and comprising an outer ring supported by said separating unit and helical vanes extending inwardly from said outer ring and integral therewith, said outer ring extending a substantial distance below said vanes to provide a liner element for said separating unit through the zone of greatest wear thereof.

4. In apparatus for separating suspended matter from a stream of gas by centrifugal action, a vertical tubular separating unit, a vertical tubular outlet member concentrically positioned within the upper portion of the separating unit, and

2,483,774

5

a directing vane assembly positioned between said separating unit and said outlet member and slidable along said outlet member and comprising an outer ring supported by said separating unit and helical vanes extending inwardly from said outer ring and integral therewith, said outer ring extending a substantial distance above and below said vanes to provide a liner element for said separating unit through the zone of greatest wear thereof.

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6

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