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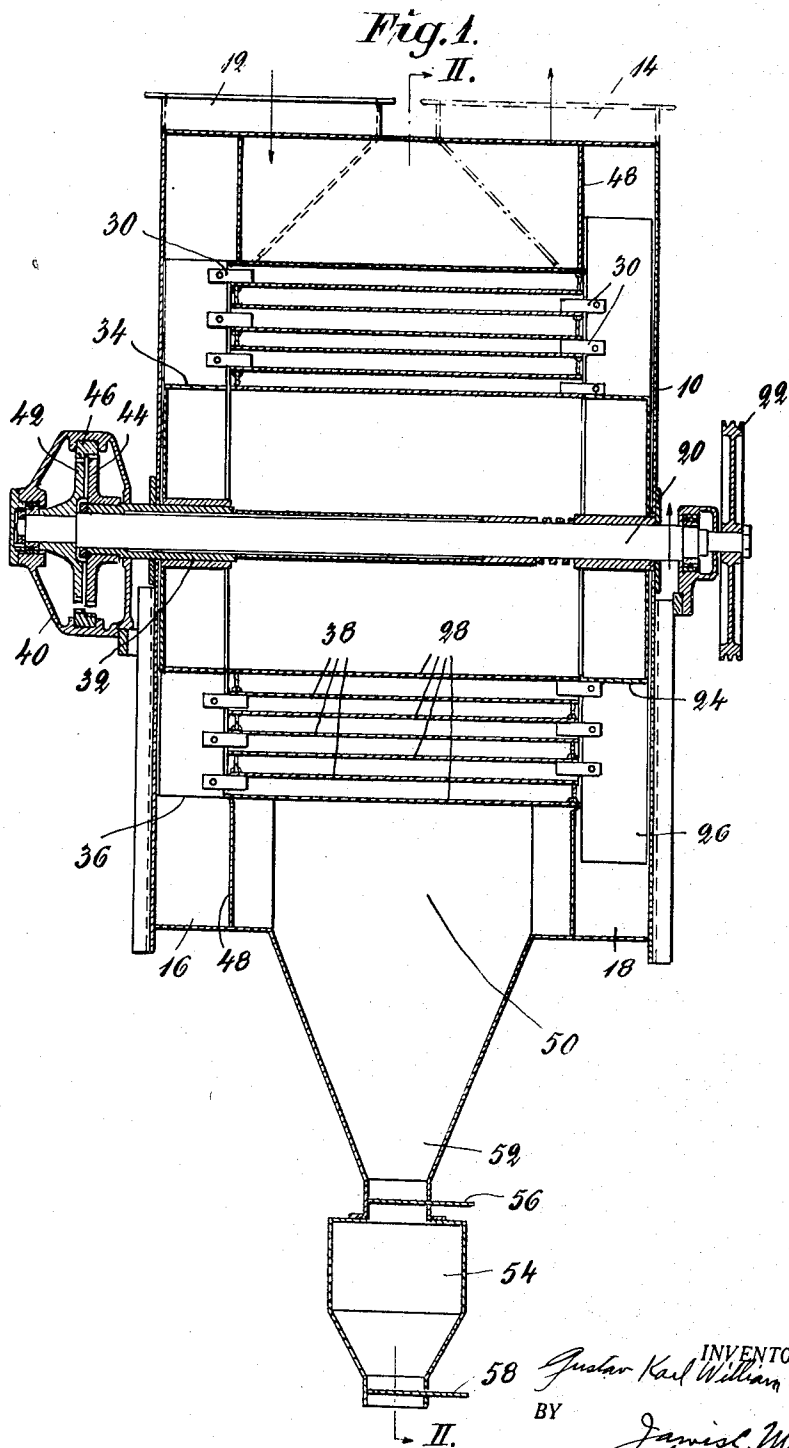
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2,459,145

MULTIPLE SEPARATOR CENTRIFUGE

Filed Sept. 29, 1944

4 Sheets-Sheet 1



Jan. 18, 1949.

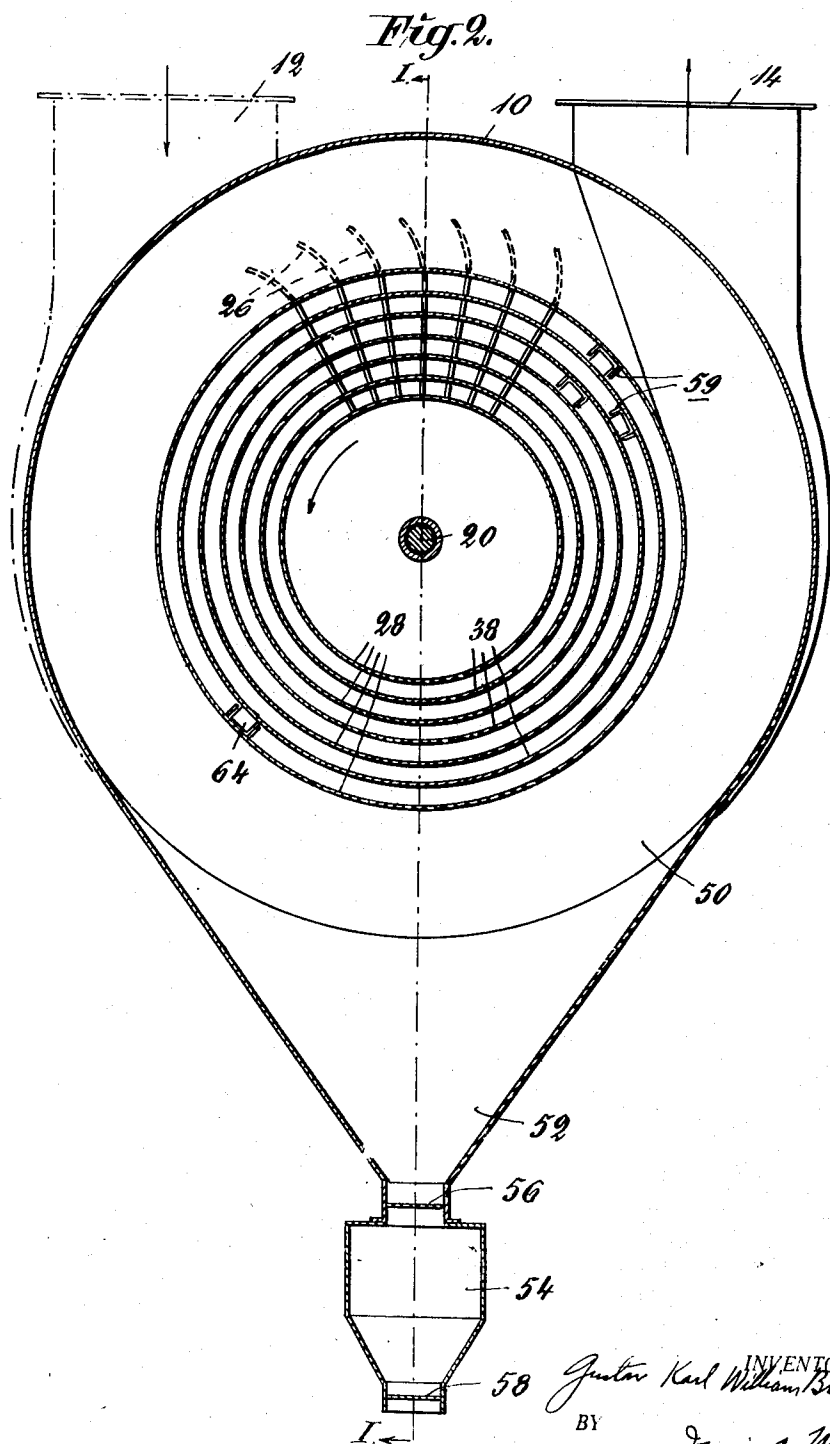
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MULTIPLE SEPARATOR CENTRIFUGE

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4 Sheets-Sheet 2



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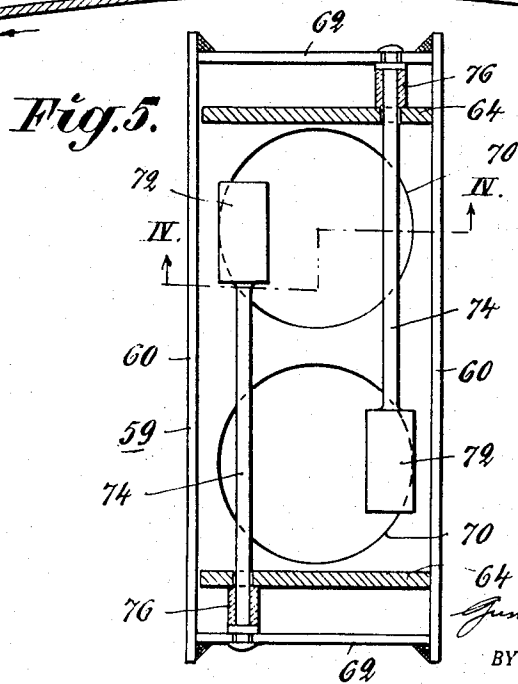
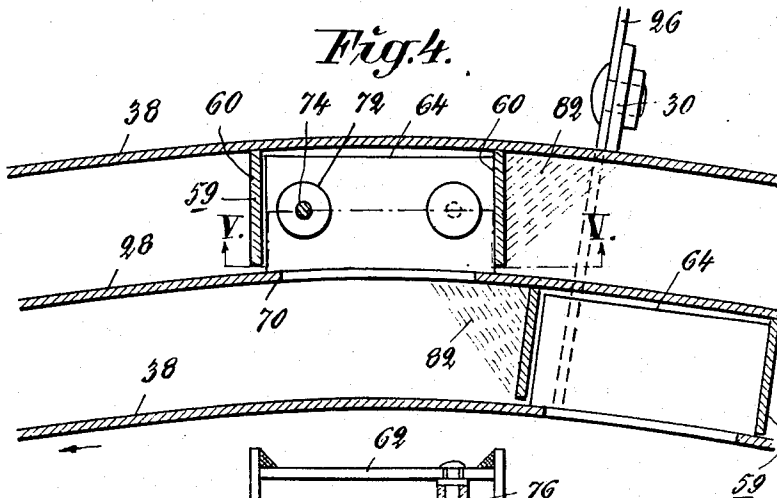
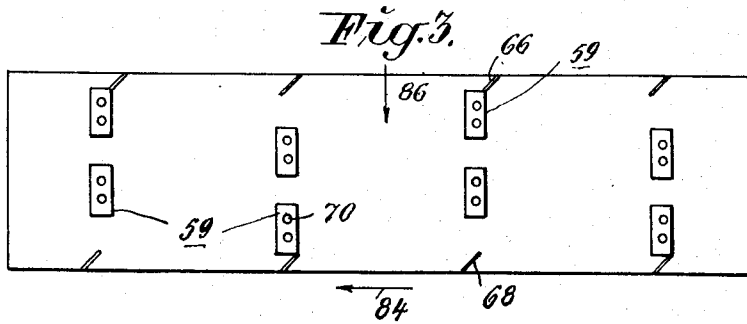
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MULTIPLE SEPARATOR CENTRIFUGE

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4 Sheets-Sheet 3



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MULTIPLE SEPARATOR CENTRIFUGE

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Fig. 6.

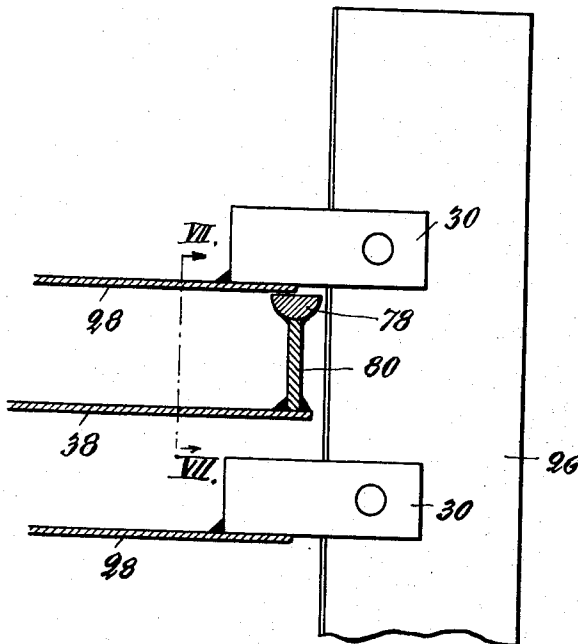
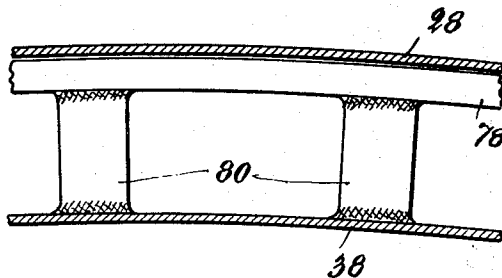


Fig. 7.



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2,459,145

MULTIPLE SEPARATOR CENTRIFUGE

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Application September 29, 1944, Serial No. 556,457
 In Sweden April 28, 1944

10 Claims. (Cl. 233-18)

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The present invention relates to gas centrifuges, which are provided with a rotor comprising a number of concentric, cylindrical or substantially cylindrical jackets with intermediate spaces therebetween, the gas to be purified flowing through said spaces in an axial direction while performing a rotary movement at the same time. By imparting to the gas a rotational velocity which is of the same order as the rotational speed of the rotor, favourable conditions will be obtained for purification of the gas to a high degree.

In the patent application Ser. No. 448,768, a centrifuge is described having scraping members between the jackets to remove the material depositing on the inside of the jackets. These scrapers are secured to the inner jacket bounding a jacket space and carry along the outer jacket on account of the friction exerted by the scrapers on this jacket under the influence of the centrifugal force. A certain small relative movement between the two jackets is obtained by means of a ratchet mechanism, which under the influence of a reciprocating member rotates the outer jacket relatively to the inner one in a step-wise movement.

The objects of the present invention are to improve devices of this kind, among other things with respect to the purifying effect and to safety in operation.

Further objects and advantages of the invention will be apparent from the following description considered in connection with the accompanying drawings which form a part of this specification, and of which:

Figs. 1 and 2 are sectional views on the lines I—I and II—II, respectively, of the two figures.

Fig. 3 shows a jacket with its scraping members developed in a plane.

Fig. 4 shows portions of three jackets with their scrapers in the same section as in Fig. 2 but on an enlarged scale; this figure also is a part section on the line IV—IV of Fig. 5.

Fig. 5 is a sectional view on the line V—V of Fig. 4.

Fig. 6 shows a portion of the rotor in the same section as in Fig. 1 but on an enlarged scale.

Fig. 7 is a sectional view on the line VII—VII of Fig. 6.

In the drawings, 10 designates the stationary casing of the centrifuge, said casing being preferably provided with a gas inlet 12 and a gas outlet 14 at the top, each merging into a helical passage 16 and 18, respectively, at the side portions of the casing. Rotatably mounted in the casing is a shaft 20 which is driven by a pulley 22,

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for example. Rigidly connected with the shaft 20 on the outlet side of the centrifuge is a carrier member in the form of a drum 24 or the like, which in the present instance carries vanes in the form of plates 26 on its outer peripheral portion, said plates being spaced in a relatively close relation about the whole circumference of the drum. A few of these plates are illustrated in Fig. 2. The plates 26 serve as carriers for a plurality of cylindrical jackets 28, which in the present instance are four in number and which provide a plurality of radially spaced walls. The connection between the plates 26 and the jackets 28 may be effected by means of straps 30, which are welded to the respective jackets and secured to the plates 26 by means of rivets. The radially outermost jacket 28, however, is welded directly to the plates 26.

Arranged on the shaft 20 is a hollow shaft sleeve 32 which is rigidly connected with a drum 34 serving as a carrier member for a number of radially disposed plates 36 in the manner above described with reference to the plates 26. The vanes in the form of plates 36 carry a plurality of cylindrical jackets 38, which in the present instance are three in number. The connection between said jackets is likewise effected by means of straps 30 and which also provide a plurality of radially spaced walls. The concentrically arranged jackets 28, 38 are alternately connected with the radial plates 26 and 36, and as will be observed from Fig. 1, provide between them a plurality of radially nested annular passages for flow of gas through the separating portion of the apparatus.

The shaft 20 drives the sleeve 32 through a gearing 42 having such a ratio that the jackets 28, 38 will rotate with a small differential relative speed. This gearing may advantageously consist of a wheel 42 provided with external teeth and rigidly connected to the shaft 20, and of a wheel 44 which is likewise provided with external teeth and rigidly connected with the sleeve 32. The two gear wheels each engage an internal toothed rim on a ring 46, which rotates in a fixed path within the gear box, said path being eccentrically disposed relative to the axis of the shaft 20. The axis of the two internal toothed rims of the ring 46 are consequently also eccentrically disposed relative to the said axis. The pitch circle of the inner teeth of the ring 46 is by a certain amount larger than the pitch circle of the gear wheels 42, 44. By suitably varying this eccentricity and the difference between the diameters of said internal toothed rims gear ratios of, for instance, 3000:

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3001 may be obtained between the gear wheels 42 and 44. It will thus be seen that a divided rotor structure is provided, one part of which, carrying the walls 28, rotates at a speed different from that of the part carrying walls 38. The difference in rotational speed between the drums 28 and 38 thus becomes very small.

The plates 26 are preferably of a greater length than the plates 36 and consequently extend radially outwardly further than the latter plates. The end portions of the plates 26 may be bent forwardly in the direction of rotation. The plates 26, 36 are of a comparatively large width and in an axial direction fill the respective annular spaces 16, 18. The latter are, radially outside the plates provided therein, separated by means of partitions 48 from a central annular chamber which may merge at the bottom into a funnel 52 and a collecting receptacle 54 connected thereto, said receptacle having an upper and a lower cut-off valve, said valves being indicated as dampers 56, 58 in Figs. 1 and 2.

The scraper devices, generally designated by 59, appear particularly from Figs. 3-5. They consist of a rectangular box-like frame composed of walls 60 paralleling the lines generating the wall surfaces of the jackets or slightly inclined thereto, and of two connecting walls 62. The height of the walls 60, 62 is less than the intermediate space between two jackets 28, 38 (see Fig. 4). They are maintained in a fixed peripheral and axial position relative to the inner one of the two jackets bounding a jacket space. This inner jacket is for this purpose provided with two projections 64 over which the scraper 59 is placed. Preferably, a plurality of scraper devices 59 are provided in each jacket space, the axial extent of said members being less than that of the jacket plate, as will appear from Fig. 3. Furthermore, the scraper boxes 59 are evenly distributed in a peripheral direction about the circumference of the jacket while being positioned in such manner as to cover together the whole of the width of the jacket, save perhaps for the edges, where obliquely positioned scraper plates 66, 68 may be provided. Such plates may also be arranged on the intermediate scrapers. The jacket plate has one or more spaced apertures 70 between two projections 64, and as will be observed from Fig. 3 the aggregate area of the apertures in any one wall constitutes only a minor portion of the area of the wall. The weight of the projections 64 may preferably equal the weight of the jacket material removed by the provision of the apertures 70. The projections, which may constitute plates welded to the jacket, have a stiffening effect on the jacket. The boxes 59 and the apertures 70 are preferably distributed uniformly in the various jackets, that is to say so that the box carried along by a jacket upon rotation of the latter passes right above apertures in the jacket on the outside, and so forth.

The scraper boxes 59 not being fixed to inner jacket plate 28 are movable in a radial direction relative to the inner jacket plate of a jacket space, whereby they will, under the influence of centrifugal force, bear against the outer jacket plate of the same space. To reduce the effect of the centrifugal force it may be found suitable to provide one or more counter-weights 72 carried by one end of arms 74 pivotally arranged in the projections 64. The opposite ends of the arms 74 are secured in the transverse walls 62 of the scraper boxes, bushings 76 being provided between these walls and the projections 64. By a

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lever effect the counterweights reduce the pressure by which the scraper boxes 59 press against the outside jacket plate. In this embodiment, the projections 64 should preferably be made lighter than the jacket material corresponding to the apertures 70, inasmuch as the centrifugal force from the scraper itself is also supported by the inner jacket plate.

Reinforcing members may be provided at the free ends of the jackets 28, 38, which are not connected with or guided by the straps 30. According to Figs. 6 and 7, these members consist of rings 78 which are connected with the outside of the jacket plate 38 by means of spaced transverse braces 80. The rings 78 reach as far as to the proximity of the outside jacket 28. These reinforcing members are arranged as far off laterally as possible in order not to interfere with the scrapers. The jacket plate carrying the same (38 according to Fig. 6) may to this end be longer than the adjacent jackets.

The apparatus operates in the following manner: The impure gas or air enters the inlet 12 and will have a rotary motion imparted thereto within the space 16. After that, the gas flows radially inwardly between the plates 36 which impart to the gas a peripheral velocity corresponding to the peripheral speed of the jacket located thereat. The gas now flows axially between the jackets 28, 38, the entrained particles then depositing on the inside of the jackets. The purified gas escapes over the plates 26 and the space 18 to the outlet 14. By the fact that the plates 26 extend to a greater radius than the plates 36, the fan effect required for the flow of the gas through the purifier is obtained.

The above-described relative movement between the jackets 28 and 38 gives the result that the scraper devices 59 will move relative to the adjacent outside jacket plate so as to entrain the separated dust, as indicated at 82 in Fig. 4. In this figure, the direction of rotation is as indicated by the arrow, and at the same time the jackets 38 rotate somewhat faster than the jackets 28. When a scraper box approaches the apertures 70 having the same axial position in the jacket on which it scrapes, the dust will be thrown out into the scraper box 59 which is located over these apertures in the adjacent outside jacket space. This dust is then entrained by the latter box so as to be emptied, when the latter is in due order brought opposite the apertures of the outside jacket, into the next scraper box, and so forth, until the dust is thrown into the chamber 50 and is finally collected in the receptacle 54, which is emptied at suitable intervals. The front edges of the scraper boxes consequently carry the separated dust to the respective apertures in the jacket scraped off by the boxes, while their interior takes care of the material coming from the jacket space on the inside. By the combination of box-like scraper members and apertures opposite the interior thereof, the result will be attained that the separated material may be carried radially outwardly through the rotor, without coming into contact with and without being disturbed by the air flowing in the channels through which the material is transported.

The direction of rotation of a jacket plate is that shown by an arrow 84 in Fig. 3, while the gas flows axially according to the arrow 86. From this it will be seen that such dust which is separated at the inlet edge of the jacket plate will be carried by the scrapers 59 back into the gas. At the outlet edges, on the other hand, the scrapers

68 carry particles, if such would happen to be separated in this place, to the adjacent boxes 59, which then convey the dust to the apertures 70 cooperating therewith.

In place of counterweights there may be provided springs to reduce the contact pressure of the scraping members against the respective jackets.

While one more or less specific embodiment of the invention has been shown, it is to be understood that this is for purpose of illustration only, and that the invention is not to be limited thereby, but its scope is to be determined by the appended claims.

What I claim is:

1. Apparatus for separating solid particles from an impure gas comprising rotor structure providing a plurality of concentric radially spaced walls forming between them a plurality of radially nested annular passages, means for causing the gas to flow through the respective passages in helical paths for separation of the solid particles by centrifugal force and collection thereof on the inner surfaces of the outer walls of the respective passages, said walls having spaced apertures therein the aggregate area of which constitutes only a minor portion of the areas of the walls, means for causing adjacent walls to rotate at different angular speeds, and a plurality of scraper devices moving with the inner walls of the respective channels for causing removal of the solid material collected on the outer walls thereof through said apertures, said devices being formed to provide passages for receiving and conducting radially through the channel in which the device is located solid material removed from an inner channel.

2. Apparatus as set forth in claim 1 in which said scraper devices are carried rotationally by the inner wall of the passage in which they are located and are disposed radially outside of the apertures in said wall.

3. Apparatus as set forth in claim 1 in which said devices are carried by and positioned radially outside of the apertures in the inner wall of the passage in which they are located and are mounted to have freedom of radial movement whereby to bear against the outer wall of the passage.

4. Apparatus as set forth in claim 1 in which said devices are mounted to have freedom of radial movement in the passage in which they are located, whereby to bear against the outer wall of the passage due to centrifugal force, and means are provided for counteracting a portion of the centrifugal force acting on the devices to limit the pressure with which the devices bear on the outer walls.

5. Apparatus as set forth in claim 1 in which said devices are peripherally spaced and axially staggered in axially overlapping relation.

6. Apparatus as set forth in claim 1 in which

said devices comprise box-like frames positioned radially outside the apertures in the inner wall of the passage in which they are located.

7. Apparatus for separating solid particles from an impure gas comprising a divided rotor structure providing a plurality of concentric radially spaced walls forming between them a plurality of annular passages, a first carrier member at one end of said walls to which alternate walls are connected, a second carrier member at the opposite end of said walls to which the remaining walls are connected, means for causing said members to rotate at slightly different speeds whereby to produce a slow relative rotational movement between adjacent walls, means for causing the gas to flow through said passages in a helical path for separation of the solid particles by centrifugal force and collection thereof on the inner surface of the outer wall of each passage, said walls having spaced apertures therein the aggregate area of which constitutes only a minor portion of the areas of the walls, and scraper means located in said passages and cooperating with said apertures for removing the accumulated solid material from the walls of the respective passages and conducting the material removed from an inner passage in a confined path through the next adjacent outer passage.

8. Apparatus as set forth in claim 7 in which the means for causing the rotation of the gas in said passages comprises vanes constituting a part of said first carrier member.

9. Apparatus as set forth in claim 7 in which said carrier members include vanes for introducing into and withdrawing the gas from said passages.

10. Apparatus as set forth in claim 7 in which said first carrier member is provided with generally radially extending vanes for introducing gas into said passages with rotary motion and said second carrier member is provided with generally radially extending vanes having greater radial extent than the vanes on said first carrier member, whereby to induce flow of gas through said passages.

GUSTAV KARL WILLIAM BOESTAD.

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The following references are of record in the file of this patent:

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Certificate of Correction**Patent No. 2,459,145.****January 18, 1949.****GUSTAV KARL WILLIAM BOESTAD**

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows:

Column 2, line 24, strike out the words "vanes in the form of" and insert the same after "disposed" in line 22, same column; lines 28 and 29, strike out "and which also provide a plurality of radially spaced walls" and insert the same after "number" and before the period in line 26, same column;

and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 4th day of October, A. D. 1949.

THOMAS F. MURPHY,
Assistant Commissioner of Patents.