June 23, 1931. H. L. MILLS 1,810,922

CENTRIFUGAL SEPARATING APPARATUS

Filed May 28, 1928

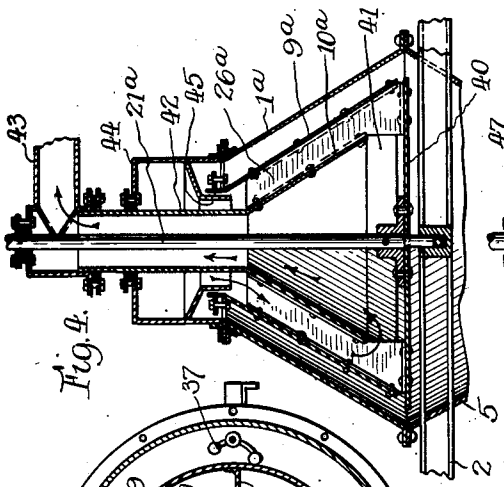


Fig. 4.

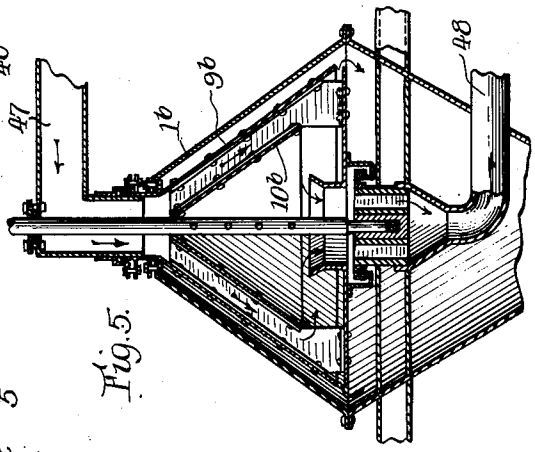


Fig. 5.

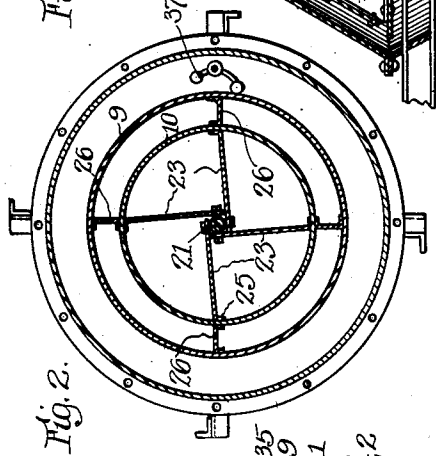


Fig. 2.

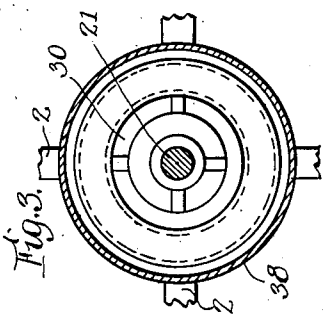


Fig. 3.

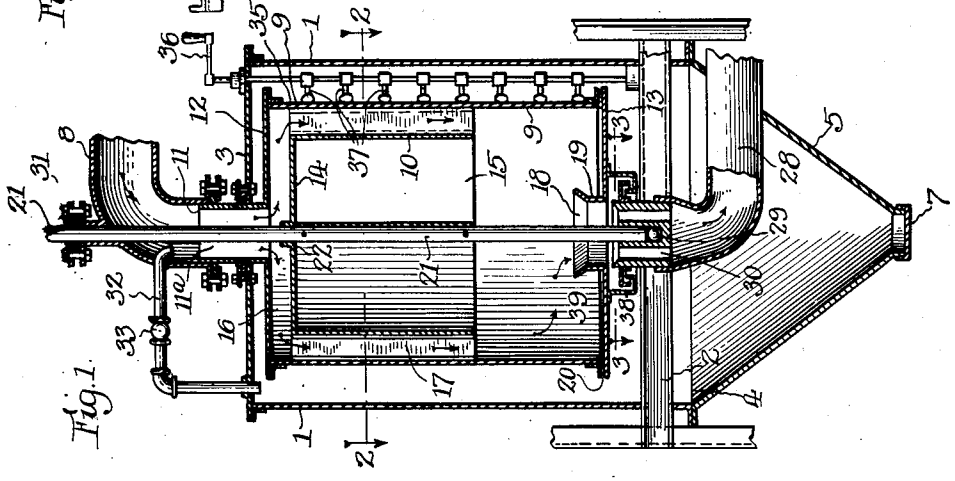


Fig. 1.

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UNITED STATES PATENT OFFICE

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CENTRIFUGAL SEPARATING APPARATUS

Application filed May 28, 1928. Serial No. 281,073.

My invention relates to centrifugal separating apparatus and processes, and particularly to an apparatus and process of this kind especially adapted for the separation of solid particles from air or gas.

One of the objects of the invention is to provide a simple, practical and efficient apparatus and process of the class specified.

Another object of the invention is to secure a high degree of effectiveness in the separating action.

Another object of the invention is to simplify the apparatus and process and thereby reduce the expense of construction and operation.

Another object of the invention is to arrange for the effective feeding of the stream or current of fluid to be separated to the machine or apparatus, and also to provide for the effective and efficient withdrawal of the separated elements.

Another object of the invention is to reduce as much as possible, the friction of operation of the machine, and also to eliminate, or substantially eliminate, friction in the operation of the process itself.

Other objects of the invention will appear and be pointed out hereinafter.

In the accompanying drawings:

Fig. 1 is a vertical longitudinal section of a centrifugal apparatus embodying my invention and adapted to carry out the process of the invention;

Fig. 2 is a cross section taken on line 2—2 in Fig. 1;

Fig. 3 is a cross section taken on line 3—3 in Fig. 1;

Fig. 4 is a vertical longitudinal section of a modified form of apparatus;

Fig. 5 is a similar section of another modification.

Referring first to the apparatus shown in Figs. 1, 2 and 3, there is illustrated a casing or housing 1 which is understood to be suitably supported in any mechanical way, as by channel members 2. This housing 1 is preferably cylindrical in form and has a closed top 3 and open bottom 4. Preferably a hopper 5 is attached or secured to the lower end of housing 1 and made conical in form and provided with a closing cap 7.

A pipe 8 is shown extending to the device and this pipe 8 may be the inlet pipe for conveying the material to be separated, such for example, as a current or stream of air more or less laden with particles of dust or the like.

Within the housing 1 there is shown a rotary structure, in this case preferably consisting of an outer rotary member 9 and an inner rotary member 10. The outer rotary member 9 is preferably provided with a central tubular member or extension 11, and this may fit between the end of inlet pipe 8, so that the oncoming stream or current of air or other fluid may pass from pipe 8 into the interior of hollow rotary member 9, which latter is preferably provided with top and bottom members 12 and 13 respectively, making it a substantially closed member, except for the inlet opening by member 11 and certain outlet openings which will be hereafter referred to.

The inner rotary member 10 is also preferably cylindrical in form and provided with a closed top 14 and an open bottom 15, and this hollow rotary member 10 is preferably, arranged so that its closed upper end 14, is opposite inlet 11*a*, so that top 14 will serve as baffle to deflect the incoming stream or current of air or other fluid outwardly toward the periphery of the outer member 9. Between the top 12 of the outer member 9 and top 14 of inner member 10, there is formed a space or passage 16 for the outward flow or movement of the incoming stream, and between the side walls of outer member 9 and side walls of inner member 10, there is formed an annular passage 17 for the downward or axial movement or flow of the stream of material to be treated or acted upon.

The lower end of outer rotary member 9 is provided with an outlet opening 18, conveniently formed by a tubular flange 19, this outlet 18 being to permit the outward movement or escape of the lighter elements after the heavier elements have been separated from them, as will hereafter be more fully explained. Furthermore the outer member

9 is preferably provided with an annular slot or opening 20, conveniently formed between the bottom of the cylindric walls of member 9 and the bottom plate 13 of said member. This annular slot 20 is for the purpose of permitting the continuous escape of the heavier elements after separation has taken place, as will be more fully explained hereafter.

It is preferred that the outer member 9 and inner member 10 shall rotate with one another, and to such end arrangement is preferably made to this effect. For such purpose a rotary shaft 21 may be provided and to this shaft the inner rotary member 10 may be attached as by a flange or tubular portion 22, and by radial members 23 secured by bolts to said shaft 21 and by flange 25 to said member 10. The outer member 9 may be secured by radial members or vanes 26 extending between and connected with members 9 and 10. Thus the rotation of shaft 21 will cause the rotation of members 9 and 10 and furthermore the members or vanes 26 will have an effect in moving or rotating the material or fluid under treatment as will be explained.

A pipe 28 is shown extending from the lower portion of the apparatus and this pipe may be used as an outlet pipe for the lighter elements of the material after separation. This pipe 28 may be connected centrally of the apparatus, below the center of the rotary member 9. The bearing 29 may be provided, which will serve as the lower bearing for rotary shaft 21 and may also be provided with ducts or passages 30 through which the lighter separated elements may pass from outlet opening 18 to outlet pipe 28. The upper end of shaft 21 may be arranged in a seal 31, conveniently arranged in connection with inlet pipe 8. Shaft 21 is understood to be turned or rotated in any convenient manner, as by a driving motor, belt or other agency.

A by-pass arrangement is preferably provided between inlet pipe 8 and the interior of outer casing or housing 1, as by providing a pipe 32 one end of which communicates with interior of pipe 8 and the other end of which communicates with interior of housing 1. A valve 33 is preferably arranged in this pipe 32.

An arrangement for striking against the interior of outer rotary member 9 is also preferably provided, in order to loosen and dislodge particles of heavy matter such as dust or the like, which may become lodged on the inner wall of said member 9. One arrangement as shown comprises a rotary shaft or rod 35 extending substantially from top to bottom of housing 1 and having its upper end projecting above the said housing and provided with a handle 36 which may be operated to turn said rod 35. Strikers 37 are shown mounted on rod 35 and adapted to strike the exterior of member 9, as said rod 35 is turned by handle 36.

The operation of this apparatus will be as follows:

A flow of movement of the material or fluid to be treated may be caused in any suitable or preferred manner, as by suction or forcing pressure. This movement will result in the flow of the current or stream of such material or fluid in pipe 8, so that such material or fluid will move through pipe 8 and into inlet 11*a* and into the interior of outer hollow rotary member 9. Within this member, the stream of material or fluid will be deflected outwardly through passage 16 and it will then descend or move axially through passage 17. When within member 9 said material or fluid will be rotated by the rotation of members 9 and 10 and the fluid or material will be held so as to move with said rotary members 9 and 10 by interposed members or vanes 26. Thus a flowing stream after entering the apparatus, soon is spread out so as to fill the elongated cylindric passage between members 9 and 10 and soon is, therefore, rapidly rotated by the rotation of these members and the vanes between them. This rotation causes centrifugal action in the fluid or material and results in separation of the relatively heavy parts or elements from the relatively light ones. In the case of a stream of dust or particle laden air, the dust or particles will be thrown outwardly so as to come more or less in contact with the interior of the walls of member 9 and these particles will, to some small extent, become attached to the interior of said wall, but will to a large extent, deseend or move axially with the main movement of the stream of air downwardly through the cylindric passage 17. Thus the desired centrifugal separating action takes place. The downwardly or axially moving lighter elements, as the air itself in a dust separating apparatus, will continue and such lighter elements or the cleansed air, will continue downwardly and outwardly through outlet 18 and outlet pipe 28, by which it will be conveyed to any desired place.

The separated heavier elements, as for example the dust from a dust-laden current of air, will move downwardly or axially until it reaches the slot 20, at which time it will be thrown or ejected outwardly through said slot or ejection orifice, into the outer casing or housing 1. At intervals as desired or found necessary, handle 36 may be actuated so as to cause a rapping or striking action on the outer separating member 9, thereby to cause the descent of the dust or heavy particles which may have attached themselves to the interior of member 9. Such dust or heavy particles will after ejection through slot or orifice 20, drop into hopper 5, from which it

may be taken at intervals as desired by removing cap 7.

A centrifugal separating action of this kind I have found to be extremely convenient, reaching a very high degree of efficiency in actual operation, since by causing the centrifugal action by rotary centrifugal members, a degree of efficiency and adaptability or applicability of the action to various conditions of service, large, small, and intermediate never before attained so far as I know by stationary separating members, is secured.

Some equalization of pressure will be secured by pipe 32 and adjusting valve 33 and furthermore should any of the heavier separated matter rise in casing 1, it may escape through pipe 32 and be returned into inlet pipe 8, through which it will be again introduced in the apparatus. Seal 38 is interposed between rotating member 9 and stationary outlet member 30.

Referring to construction shown in Fig. 4, an outer housing or casting 1A, similar in purpose to the housing 1 of the previously described construction, is shown. The housing 1A is preferably conical, however, instead of being cylindrical as is the housing 1.

Supporting members 2 are also shown and a hopper 5 secured to the bottom of housing 1A.

Within housing 1A are outer and inner rotary members 9A and 10A, and these members are preferably made conical to correspond with outer casing or housing 1A. These members 9A and 10A are preferably attached or secured to one another as by intermediate vanes 26A and a plate 40, which latter is also secured to a rotary shaft 21A. The inner member 10A has its lower end terminated above the bottom plate 40 so as to form an inlet passage 41, and said member preferably has an upwardly extending tubular portion or extension 42 whose upper end communicates with a pipe 43 which in this case may be used as an outlet pipe for the lighter separated material.

A hollow member 44 is shown arranged above the separating members 9A and 10A, being conveniently mounted on the outer housing or casing 1A. This hollow member 42 may serve as an inlet for the incoming material or fluid to be treated, and to such end, said member 44 is preferably provided with a downwardly extending tubular member 45 which has a telescopic relation with the upper end of rotary member 9A so as to introduce the incoming material or fluid into the rotary separating arrangement by way of the top of member 9A.

Thus, in the arrangement of Fig. 4, the general plan or method of construction and operation of the previously described apparatus is involved, but the incoming material or fluid is separated or deflected outwardly in a more gradual manner by reason of a conical shape of the rotary separating structure, and furthermore the light separated material arises and escapes through the upper end of the apparatus, instead of being withdrawn at the lower end of the same.

Referring next to Fig. 5, this apparatus is like the apparatus of Fig. 1 in some respects, and like the apparatus of Fig. 4 in other respects. In Fig. 5 the inflowing material is shown coming through a pipe 47, which is at the top of the apparatus similar to the arrangement of Fig. 1, but the rotary elements 9B and 10B are conical in form, similar to the arrangement of Fig. 4. Also the heavy separated material passes out the bottom of the apparatus through outlet pipe 48 similarly to Fig. 1, instead of passing out the top, as in Fig. 4.

It will be understood that changes and modifications may be made without departing from the spirit of the invention.

What I claim is:

1. An apparatus of the class specified having a rotary centrifucal separating member and rapping devices arranged outside of said member and extending the entire length thereof and adapted to strike against the same.

2. An apparatus of the class specified having a rotary centrifugal separating member rapping devices arranged outside of said member and adapted to strike against the same, an outer casing enclosing said member and also enclosing said rapping devices, and means outside of said outer casing for actuating said rapping devices.

3. An apparatus of the class described having a rotor provided with an axially extending passage with imperforate longitudinal walls and having an ejector outlet in the outer wall at the far end of said passage, said rotor being enclosed in a mechanically closed casing provided with means for collecting and permitting the removal of the separated material in a dry condition.

4. An apparatus of the class specified comprising a rotary member having an axially extending separating passage provided with a peripheral discharge outlet at the far end of said passage for the heavy separated material and an axially extending closed casing enclosing the rotary member and receiving the heavy material discharged therefrom and having a mechanically closed bottom arranged transversely to the axis of rotation and provided with an opening for the removal of said discharged heavy material.

5. An apparatus of the class specified comprising a rotary member having an axially extending separating passage closed between its ends, said member also having a peripheral outlet at the far end of said passage for the discharge of heavy material separated in said passage and also having a light material discharge passage extending inward from

the discharge end of said separating passage and an outer casing enclosing said rotary member and receiving the heavy material discharged from the rotary member, said casing having a mechanically closed floor or bottom below the rotary member to receive the heavy material discharged therefrom.

6. An apparatus of the class specified comprising an inner rotary member and an outer mechanically closed casing enclosing the rotary member said rotary member having an axially extending separating passage and a peripheral discharge outlet at the far end of said passage for the discharge of heavy material separated in said passage and inlet and outlet pipes extending to the same end of the rotary member.

7. A dust collector of the centrifugal type having a rotor provided with an axially extending passage and having an ejector outlet in the outer wall of said rotor at its greatest diameter, said rotor being enclosed in a mechanically closed casing provided with means for collecting and permitting the removal of the separated material.

In witness whereof I hereunto subscribe my name this 24th day of April, A. D., 1928.

HARRY L. MILLS.